Comfort Home Impact Evaluation: Delivered Fuels (January 2020-April 2023)

Final Report

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Introduction

As part of its effort to advance toward a carbon-neutral economy in New York, NYSERDA launched the Comfort Home Pilot (hereafter referred to as Comfort Home or Comfort Home Program). To assess the program's effectiveness, NYSERDA engaged Opinion Dynamics and 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 included 1,939 households that participated between January 2020 and April 2023 and comprised two components: an impact evaluation and a process evaluation.[1] The objective of the impact evaluation was to estimate electricity, natural gas, and delivered fuel (DF) savings (kWh/therm/MMBtu per household and as a percentage of baseline consumption) and realization rates.

The analysis and reporting covering the natural gas and electric impact evaluation and the process evaluation were completed in August 2025.[2] This report covers the impact evaluation for homes with delivered fuel (DF) heating systems (oil, propane, and kerosene[3]) and is divided into four sections: program description, data collection, methods, and results.

Program Description

The Comfort Home Program aims to facilitate the transition to heat pumps by providing incentives for installing building shell improvement packages designed to reduce heating and cooling loads in residential homes. The reduced load makes it more attractive for customers to install heat pumps. Three load reduction packages are incentivized: A ("Good"), B ("Better"), and C ("Best"). The program also provides information to customers about heat pump technologies and connects 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.

[1] https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={300EAF8E-0000-CE45-B11D-107C52F78677}&DocTitle=NYSERDA.ComfortHome.ImpactEvaluationPlan%20April%202024

[2] New York State Energy Research and Development Authority (NYSERDA). 2025. "Comfort Home Impact and Process Evaluation," prepared by Opinion Dynamics Corporation, Waltham, MA. https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/Program-Evaluation/2025-09-Comfort-Home-Impact-and-Process-Evaluation.pdf.

[3] Kerosene is used infrequently and none of the participants in the DF analysis used kerosene.

Data Collection

This section covers the development of the DF sample frame, description of the outreach strategies to collect DF bills and a discussion of the outcome of this data collection process.

Sample Frame

The sample frame for DF analysis was constructed from the program tracking data and consisted of participants who completed program-incentivized installation in 2020 or later and met at least one of the following criteria:

1. Primary heating fuel was either oil or propane, and the program reported oil or propane heating savings, or
2. A fuel supplier was identified.

The Comfort Home workflow process instructs participating contractors to collect participant consent forms, which identify the participants' energy suppliers (electricity, natural gas, and DF) and their consent for the suppliers to release their energy consumption data to NYSERDA or a third-party appointed by NYSERDA. Energy consumption data can only be requested for customers who have signed a consent form. The evaluators noted that some projects lacked a corresponding consent form.

Table 1 presents the sample frame for DF outreach. Overall, 512 participants were identified for the DF impact analysis: 465 with a primary delivered heating fuel and 47 with a secondary delivered heating fuel. For 191 of these participants (37%), a consent form was not available and was not able to be subsequently obtained. For an additional 24 participants (5%), the program tracking data did not identify a fuel supplier and follow-up requests yielded the same results. This resulted in an effective sample frame of 297 participants (58% of all DF participants).

Table 1. Sample Frame for DF Outreach

Category	Number of Participants	Remaining in the Sample Frame
All participants with DFs	512	512
Consent Form could not be located	191	321
Fuel supplier not identified in program tracking data	24	297

Outreach Strategies

The evaluation team provided multiple avenues as well as incentives for fuel suppliers and participants to submit DF bills. A key component was the development of a secure data share platform to allow electronic bills to be easily and securely uploaded. Additionally, bills could be provided by mail. These strategies are described in Table 2.

Table 2: Fuel Bill Collection Outreach Strategies

Outreach Target	Incentive	Outreach Method	Description
Participants	$25 for providing fuel bills covering the analysis period	Process evaluation survey	Offered an incentive of $25 to survey respondents who provided fuel bills. All participants with DFs were included in the survey solicitation.
		Letter	Offered an incentive of $25 to participants with DF and consent forms to provide fuel bills.
Fuel suppliers	$50 for the first participant and $5 for each additional participant	Email	Email outreach to all fuel suppliers, regardless of the number of participants
		Phone	Phone outreach to all fuel suppliers with two or more Comfort Home participants

Fuel Bills Received

The team received DF bills for 60 participants, 54 from fuel suppliers, and 6 directly from participants (see Table 3).

Table 3: Fuel Supplier Outreach Outcomes

Outreach Approach	Number of Bills Provided	Share of Bills Received
Bills received from fuel supplier	54	90%
Bills received from participant	6	10%
Total homes with bills	60	100%

This process was less successful than expected based on previous experience with similar efforts in New York. Complicating factors included the following:

- Large fuel suppliers were generally nonresponsive. One large fuel supplier explained that they have a corporate policy of providing data only when it is "required by the regulators".
- Some fuel suppliers use third-party call center services, making it more difficult to directly reach fuel supplier staff able to respond to the request.
- Some fuel suppliers stated that they were unwilling to use the secure online system and would rather provide the bills by fax or email, which presented a challenge due to data security concerns.

- Several fuel suppliers required the customer to call them directly in order to release records, despite offers to provide them with the participant-signed consent forms.
- At least three fuel suppliers switched their invoicing platforms in the recent past and no longer had access to previous records.
- "Cash on delivery" fuel suppliers often do not keep track of fuel deliveries.
- Timing of the outreach coincided with the start of the DF season, including preparation of pre-buy contracts leading to delays in responsiveness.
- Residential homeowners were substantially less responsive in providing consent and release of fuel data than in previous evaluations.
- Some homeowners with DFs changed fuel suppliers over the course of the three-year analysis period. However, the consent forms only include the fuel supplier that was used at the time of program enrollment. Thus, in some cases, the fuel bills from the identified fuel supplier did not cover the analysis period.

Alternative Fuel Data Collection strategies

As noted above, collecting fuel bills, particularly for the year following the installation, is complicated, can be expensive, and can leave the analysis short of usable data. Given (1) the prevalence of delivered fuel heating in New York, and (2) the importance of heating savings to overall Comfort Homes savings, we identified several alternative strategies for obtaining these bills. Possibilities include the following:

1. Requesting the New York Public Service Commission to establish a regulatory requirement for fuel suppliers to respond to requests for fuel bills from NYSERDA to improve cooperation from the fuel suppliers
2. Adding documentation on pre-install fuel bills to the program requirements for participating contractors
3. Providing an additional incentive to participants through the program after they provide the post-installation DF bills
4. Timing the evaluation activity, especially for DF homes, to take place sooner after project installations, with the understanding that one year of post-installation consumption is required.

Experience with collecting fuel bills has shown that it is a time-consuming and lengthy process, and improving this process is likely to require changes to both policy and program implementation.

Methods

The following subsections describe the analysis method, billing data preparation, weather normalization, validation of results, and savings estimation.

Analysis Method

The DF consumption analysis quantified the weather-normalized per-household savings for program participants using oil and propane as their primary source of heat. The savings were estimated using a combination of site-specific regressions and simplified heating degree days (HDD) analyses. This combined approach was used due to the granularity of the available billing data (long gaps between deliveries in many homes) and a low number of homes with data.

The regression analysis used a model with HDD as the predictor variable and the fuel consumption as the response variable, with separate models for the pre- and post-installation periods. The initial model assumed that the homes were using the fuel for both space and water heating, as shown in Equation 1.

$$\text{Equation 1: } y_i = \alpha + \beta x_i + \varepsilon_i$$

Where

- y_i is the response variable (fuel use in MMBtu) for period i,
- α is the intercept and captures the non-weather-dependent use (e.g. water heating),
- x_i is the HDD for period i,
- β is the heating slope (MMBtu/HDD), and
- i is the interval between the bills

The change in the heating slope (β) between the pre- and post-periods was multiplied by the normalized annual HDD to determine the savings. For sites where the regression showed no non-weather-dependent use, *e.g.*, the intercept (α) was close to zero or negative, an alternative regression was conducted assuming all fuel use was related to heating.[4]

To include additional sites with less available data, the team used a simplified HDD model comparing the pre- and post-period MMBtu per HDD. The MMBtu consumption was divided by the HDD for the period for the pre and post periods and the change in the MMBtu/HDD was calculated and multiplied by the normalized annual HDD to determine the savings. This approach allowed sites with insufficient records for the regression to be included if the bills covered winter months in both the pre- and post-period. The two different approaches showed similar consumption and percent reduction comparison to the baseline consumption across the two groups, increasing confidence in the simple approach used for the additional sites.

[4] The intercept was removed from the regression equation.

Billing Data Preparation

The team initiated the analysis by combining key fields from the program tracking database with the fuel bills, calculating the number of days between readings, and excluding the first reading in the pre- and post-periods. The data cleaning steps included:

- Checking for instances of duplicate records; none were found.
- Checking for records with overlapping bill periods; this only occurred in sites with multiple fuels or tanks.[5]
- Combining records with exactly 100/150/200 gallons with the next record as it was unlikely that the tank was filled and, thus, the fuel consumption may not match the period between bills.
- Combined short billing periods of 10 days or less with the next billing period.
- Flagged, examined, and removed negative consumption values. The record was removed, but sites were still included as the negative read was the last read (likely due to a tank removal).
- Removed fuel consumption that showed very low or no heating use preceding the intervention. This step resulted in removing the non-heating fuel (propane) for two homes from the analysis.
- Two homes classified as having natural gas primary heat were reclassified as having DF primary heat, given the fact that (1) it is very unlikely that a home with natural gas heating will also have propane heating, and (2) we received DF bills for these participants.

The resulting cleaned dataset was reviewed to identify which homes could be kept in the final analysis.

Ultimately, all homes included in DF models used DF as their primary heating per the program tracking data or evaluator judgment.

Table 4 summarizes the extent of drops during each billing data cleaning step. Most drops occurred due to insufficient consumption history. For the regression analysis, the team defined sufficient consumption data as 225 or more days of coverage preceding and following the intervention. For the HDD model analysis, sites with at least 45 days of winter (i.e., the months of December, January, and February) in both the pre- and post-periods were included. This approach enabled the inclusion of additional sites with winter fuel records and unreliable regression results.

Two homes were removed from DF models: One because the program tracking data identified the participant as using electricity as the primary heating source and the program

[5] For homes with multiple fuels or tanks, the savings were calculated separately for each fuel or tank and then added together to estimate the savings for the home.

records did not have an estimate of the DF fuel savings;[6] the other because the program tracking data indicated that the participant was interested in installing a heat pump, and the team observed a large drop in DF consumption consistent with a heat pump installation. After completing these steps, the final number of participants used in the DF analysis was 29 (or 48% of participants for whom DF bills were received).[7]

Ultimately, all homes included in DF models used DF as their primary heating per the program tracking data or evaluator judgment.

Table 4: Data Cleaning Drops Table

Drop Reason	Homes Dropped	Homes Remaining	
		Number	Percentage (%)
Homes with Bills Received		60	100%
Data Sufficiency Drops	29	31	52%
Other	2	29	48%
Total Homes in Analysis		**29**	**48%**
Homes in Regression Analysis		*17*	*28%*
Homes in HDD Model Analysis		*12*	*20%*

Weather Normalization

To account for the effect of weather patterns on DF consumption, 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 home's geographic location. Using multiple sites increases the accuracy of the weather data associated with each account. This data was obtained from the National Climatic Data Center (NCDC). The daily data are based on average hourly temperature readings for each day. The evaluation team calculated HDD for each day, then aggregated them to the period between the DF bills, and used the number of days between the bills to estimate average daily HDD.[8]

After the relationship between DF consumption and temperature was established using actual weather data, the evaluation team used TMYx "typical" weather data to estimate

[6] Comfort Homes only estimates savings for the primary heating fuel. All of the homes in the DF model were identified as using the fuel as their primary heat source.
[7] The overall attrition rate of 52% is fairly common for consumption analysis.
[8] A "heating degree-day" is a unit of measure for recording how cold it was over a 24-hour period. The number of HDDs for a given day is determined by comparing the mean temperature for that day to a base value of 60°F. (The "mean" temperature is the average of the high and low temperatures for the day.) For example, if the mean temperature was 55°F, then there were 5 HDDs (60 minus 55) for that day. National Weather Service, https://www.weather.gov/ffc/degdays.

weather-normalized savings. Both actual and TMYx data from the same weather stations were used. Moreover, the same approach was applied to calculate the HDD for each day.

Savings Estimation

This section covers the DF model results, validation of results and the approach to estimating the total program DF savings.

DF Model Results

The simple average first year savings per home for all homes in the model are 17.3 MMBtu. As discussed above, only 29 of the 512 participants with DF savings remained in the modeling dataset. Despite the small number of homes, the estimated heating consumption savings for the modeled participants is statistically significant ($t = 3.2$) at 99% confidence. As expected due to the limited number of participants, the relative precision is low at 44%. A practical threshold of 90/10 confidence/precision standard is typically used by NYSERDA to trigger formal reporting, which this research does not strictly meet. The confidence/precision numbers indicate that while there is evidence of savings, the model results are not definitive.

Consequently, the team reviewed the results for accuracy and contextualized the result as discussed below. Based on this review process, the team developed a strategy to adjust the model results and more accurately reflect the DF savings as a whole.

Validation of Results

The team validated the DF model results using two main approaches:

1. Compare all DF program participants to the homes in the DF model to assess the potential for bias
2. Compare the DF model results to the results from the natural gas impact analysis, as applying the natural gas results could be an alternative if the DF model is shown to be unreliable

Table 5 shows the comparison between homes in the DF model and all homes with DF heating, based on program tracking data.

Table 5. Comparison of All Homes with DF Heat to Homes in the DF Model

	All Homes with Primary DF Heat			DF Model		
	Number of Homes	Average Program-Estimated Savings (MMBtu/yr)	Percent of Homes in Package	Homes in the DF Model	Average Program-Estimated Savings (MMBtu/yr)	Percent of Homes in Package
Package A – Good	264	20.8	57%	15	17.3	52%
Package B – Better	173	39.9	37%	12	27.9	41%
Package C – Best	28	32.4	6%	2	16.7	7%
All Homes	**465**	**28.5**		**29**	**21.6**	

It is evident that homes in the DF model vary from all homes with DF heat in two critical ways:

1. The program-estimated savings for modeled homes are about 24% lower on average compared to program-estimated savings for all DF participants.
2. The distribution of homes in the packages is different, with modeled homes having a lower percentage of Package A and a higher percentage of Package B, compared to all DF homes.

However, comparing the percentage of program-estimated savings to the program-estimated baseline consumption shows that this ratio is consistent for all DF-heated homes (14%) and the homes in DF model (13%). This result indicates that applying the ratio of savings to baseline consumption will adjust for the difference in DF savings between the DF population and DF homes in the model identified in Item 1 and shown in Table 5 above.

The difference in the distribution of packages was addressed through stratifying the results by package, as discussed further below. See details in sub-section Approach to Estimating Per-Home DF MMBtu Savings.

The evaluation team also compared DF savings with results from the natural gas impact evaluation. This comparison is shown in Table 6.

Table 6. Comparison of Natural Gas and DF Evaluated Savings[9]

	Natural Gas Impact Evaluation			DF Model		
	Number of Homes	Average Evaluated Savings (MMBtu/yr)	Evaluated Savings as % of Evaluated Baseline Heating Consumption	Homes in the DF Model	Average Evaluated Savings (MMBtu/yr)	Evaluated Savings as % of Evaluated Baseline Heating Consumption
Package A – Good	211	13.4	14%	15	14.8	14.7%
Package B – Better	122	16.2	20%	12	22.9	20.3%
Package C – Best	78	5.5	8%	2	3.2	2.4%
All Homes	411	12.7	15%	29	17.3	16.1%

The key findings from this comparison are as follows:

1. The natural gas average evaluated savings are about 25% lower than the DF savings from the model. Higher savings for DF homes are not unexpected, as DF heating systems, particularly oil-fired ones, have substantially lower efficiencies than natural gas systems.
2. The evaluated savings as a percentage of the evaluated baseline heating consumption for the DF model are extremely close to the natural gas impact evaluation results for Packages A and B. The estimates diverge for Package C. However, there were only two participants in the DF model with Package C. Hence, the DF results may not be reliable for Package C participants.

In aggregate, these results suggest that applying the savings as a percentage of the baseline heating consumption is the most effective approach to developing an unbiased estimate of evaluated savings, given the data limitations.

Approach to Estimating Per-Home DF MMBtu Savings

Before estimating per-home MMBtu savings by applying the evaluated savings percentages to the baseline consumption of DF homes, one additional adjustment was necessary: The results of the DF analysis showed that program-estimated baseline DF consumption is systematically overstated compared to baseline consumption based on the primary data used in the DF model. This finding is consistent with results from the natural gas and electric analyses, which also showed higher program-estimated baseline consumption. As a result, the team developed an adjustment factor based on the ratio of modeled baseline

[9] New York State Energy Research and Development Authority (NYSERDA). 2025. “Comfort Home Impact and Process Evaluation,” Prepared by Opinion Dynamics Corporation, Waltham, MA. nyserda.ny.gov/publication

consumption to the program-estimated baseline consumption for the 29 homes included in the DF analysis (Equation 2):

Equation 2: $$\textit{Baseline Consumption Adjustment Factor} = \frac{MB_{DF\ Model}}{PB_{DF\ Model}}$$

This adjustment factor, estimated to be 63%, was applied to the program-estimated baseline consumption to develop the evaluated baseline consumption for each home with primary DF. The team then applied the evaluated package-specific savings as a percentage of baseline consumption from Table 6.

Table 6 (DF model results of 15% and 20%, respectively, for Packages A and B, and natural gas results of 8% for Package C) to the evaluated baseline consumption to derive the average per-home MMBtu savings for each package.

Results

Table 7 summarizes the per-home savings results, by package as well as the weighted average across all homes with primary delivered heating fuel.

Table 7. Calculating the DF Savings Per Household

	Program-Estimated Baseline (MMBtu)	Baseline Consumption Adjustment Factor	Evaluated Baseline (MMBtu)	Evaluated Savings as % of Evaluated Baseline Consumption	Average Evaluated Savings per Home (MMBtu)
Package A - Good	215.2	0.63	135.6	14.7%	19.9
Package B - Better	211.7		133.3	20.3%	27.0
Package C - Best	114.5		72.1	7.9%	5.7
All Homes	207.9		131.0	16.6%	21.7

Homes with DF heat saved an average of 21.7 MMBtu per home, reflecting a reduction of 16.6% from evaluated baseline consumption. As shown in Table 8, the realization rate is 76%, with a relative precision of 44% due to the low number of homes in the DF model. While the precision does not meet the 90/10 precision/confidence standard, the savings from the DF model are statistically significant, and the adjustments based on the validation process address the potential sources of bias. In aggregate, the total program delivered fuel savings are estimated to be 10,091 MMBtu.

Table 8: DF Average Program Estimated and Evaluated Savings per Home

	Number of Homes with DF Heating Savings	Average Program-Estimated Savings per Home (MMBtu)	Average Evaluated Savings per Home (MMBtu)	Realization Rate	Total DF Savings (MMBtu)
Package A - Good	264	20.8	19.9	96%	5,253
Package B - Better	173	39.9	27.0	68%	4,679
Package C - Best	28	32.4	5.7	18%	160
All Homes	465	28.5	21.7	76%	10,091

Conclusions and Recommendations

Key findings and associated recommendations from the evaluation of Comfort Home delivered fuel impacts include:

- **Finding 1:** The total delivered fuel savings per year were 10,091 MMBtu; giving a program realization rate of 76%. Delivered fuel savings per participant was 21.7 MMBtu/year, which represents 16.6% of evaluated baseline. The realization rate relative precision is 44%, due to the low number of homes in the DF model. While these results do not meet the 90/10 confidence/precision standard, the savings from the DF model are statistically significant. Package B produced the highest annual savings (27.0 MMBtu), followed by Package A (19.9 MMBtu) and Package C (5.7 MMBtu).

- **Recommendation 1:** NYSERDA should ensure delivered fuels incentives are aligned with energy savings potential of the measures.

- **NYSERDA Response to Recommendation:** Implemented. The available incentives have been aligned to associated delivered fuels savings.

Finding 2: Delivered fuel consumption data collection and analysis was significantly constrained by limited cooperation from fuel suppliers and homeowners. There is no clear path obliging delivered fuel dealers to comply with data requests, making it difficult to reach fuel dealer staff with decision-making authority. Furthermore, the current customer data consent approach that is built into the program to allow NYSERDA to request data proved insufficient as a few fuel suppliers required customers to request data directly. In addition, even when suppliers or homeowners were responsive, the evaluators found data gaps due to varied delivery windows, cash-on-delivery practices without associated invoicing statements, and changes in fuel suppliers during the analysis period.

- **Recommendation 2:** To improve the feasibility and quality of future delivered fuel analyses of its programs, NYSERDA should consider alternative strategies for obtaining delivered fuel bills. NYSERDA should consolidate data requests and simplify data-sharing strategies with large-scale delivered fuel providers.

- **NYSERDA Response to Recommendation:** Pending development of comprehensive delivered fuels data and evaluation strategy.