Eversource
Home Energy Report Program

Year One Persistence Savings and Decay Rate Study

Prepared for:

Eversource
Part of the Residential Evaluation Program Area

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Executive Summary

Guidehouse Inc. and ILLUME Advising (the evaluation team) developed this report for Eversource to provide insight into the persistence of savings and decay rates associated with their recently discontinued Home Energy Report (HER) program.

In the first year after program termination, the evaluation team found aggregate savings net of uplift for all waves to be 37,359 MWh and 857,253 Therms. Total electric savings across all waves decreased by 5.71 percent and total gas savings across all waves decreased by 1.91 percent from the final program year to the first year after reports ceased.

Percentage savings in both the final year and first year after program termination were higher and more likely to be statistically significant at the 90% level for earlier program waves. This led to lower, more stable decay rates for earlier waves. It is possible that length of program enrollment is correlated with the persistence of savings after program termination.

Due to the uncertainty surrounding the savings findings in later waves, the evaluation team recommends periodically updating this study to develop stronger knowledge of the trends in persistence, which will help with future planning cycles and filings.

1. Introduction

This report presents the results of the first year of research on persistence and decay of savings for Eversource's discontinued Home Energy Reports (HER) program. The primary objective of this research is to identify persistence savings realized between January and December 2020, and to determine the extent to which savings decayed once customers no longer received HERs.

This report provides aggregate and wave-specific persistence and final year savings net of uplift, savings decay rates, and persistence factors for the Massachusetts population that received HER treatment. Decay rates and persistence factors are intended to measure the extent to which savings persist following termination of program treatment. For calendar year 2020, the persistence factor is defined as the ratio of percentage savings realized in 2020 and the percentage savings realized in the final year of program treatment, and the decay rate is equal to one minus the persistence factor. For a program with savings declining after discontinuation of program treatment persistence factors and decay rates will be between zero and one.

The evaluation team nets uplift from our estimate of savings to ensure the evaluated savings only represent savings from the behavioral messaging, excluding any effect from increased participation in other energy efficiency programs (i.e., uplift). In the Uniform Methods Project Chapter 17, the authors describe uplift as the increased participation in other utility programs resulting from behavioral messaging.[1]

2. Research Description

The HER Program was designed to generate energy savings by providing residential customers with information about energy use and conservation. Program participants received this information in the form of regularly mailed and emailed HERs that gave customers insight into their energy use, including:

- An assessment of how the customer's recent energy use compares to past energy use
- Tips on how to reduce energy consumption, some of which were tailored to the customer's unique circumstances
- Information on how their energy use compares to that of neighbors with similar homes

This research sets out to determine how savings persist in the absence of mailed and emailed HERs. To evaluate this question, Guidehouse estimated final year and first year persistence savings, developed persistence factors, and calculated decay rates, which shed light on the persistence of savings in the absence of HERs.

[1] Stewart J and Todd A. 2015 "Chapter 17: Residential Behavior Protocol." National Renewable Energy Laboratory. https://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter17-residential-behavior.pdf

3. Research Results

3.1 Total Savings

Table 3-1 and Table 3-2 present total savings aggregated across all waves for both the final year of the HER program – corresponding with November 2018 through October 2019 – and the first year calendar year after reports ceased – corresponding with January through December 2020.[2] For both gas and electric waves, savings decayed slightly, but remained large in absolute terms. Total electric savings across all waves decreased by 5.71 percent and total gas savings across all waves decreased by 1.91 percent from the final program year to the first year after reports ceased. Results by wave, including percent program and net total savings are in Appendix B.

Table 3-1. Home Energy Reports Net Electric Savings – Final Year

Savings Category	Final Year Savings	First Persistence Year Savings
Verified Net Savings, Prior to Uplift Adjustment, kWh	40,317,429	37,412,265
Savings Uplift in Other EE Programs, kWh	697,768	53,015
Savings net of Uplift, kWh	**39,619,661**	**37,359,250**
Percent Decline in Savings, Final Year to First Persistence Year	**N/A**	**5.71%**

Source: Guidehouse and ILLUME analysis

Table 3-2. Home Energy Reports Net Gas Savings – Final Year

Savings Category	Final Year Savings	First Persistence Year Savings
Verified Net Savings, Prior to Uplift Adjustment, Therms	880,820	864,130
Savings Uplift in Other EE Programs, Therms	6,865	6,877
Savings net of Uplift, Therms	**873,955**	**857,253**
Percent Decline in Savings, Final Year to First Persistence Year	**N/A**	**1.91%**

Source: Guidehouse and ILLUME analysis

[2] Since 2020 billing data were extracted in January 2021, there is a chance that billing records for the month of December were not included within the 2020 billing data provided to the evaluation team. As such, the evaluation team, Eversource, and EEAC came to an agreement that the evaluation team should use billing data corresponding with the last bill of 2019 through the last bill of 2020 as an approximation of calendar year 2020.

3.2 Persistence Factors and Decay Rates

Table 3-3 and Table 3-4 present the decay rates and persistence factors for all HER waves[3] enrolled in the HER program. More detail surrounding these tables is provided below

Table 3-3. Home Energy Reports Electric Persistence Factors and Decay Rates by Wave

Wave	Final-Year Savings (percent)	First Year Persistence Savings (percent)	Persistence Factor	Decay Rate
201202_E	2.52%†	2.19%†	0.87	0.13
201205_E	1.34%†	1.40%†	1.05	-0.05
201304_E	1.56%†	1.00%†	0.64	0.36
201304_E_Drop	1.71%†	1.55%†	0.91	0.09
201402_E	1.33%†	1.21%†	0.91	0.09
201404_E	0.44%	0.44%	1.00	0
201501_E	0.81%	0.75%	0.92	0.08
201512_E	0.49%	2.05%	4.16	-3.16
201602_E	1.76%†	1.71%†	0.97	0.03
201604_E_NewMovers	0.42%	-0.16%	-0.38	1.38
201612_E_NewMovers	0.81%	0.74%	0.92	0.08
201701_D	-0.88%	-0.07%	0.08	0.92
201701_E	0.94%†	0.46%	0.49	0.51
201701_E_NewMovers	0.29%	0.17%	0.59	0.41
201901_E	0.75%†	0.54%	0.72	0.28
201906_D	4.94%†	1.52%	0.31	0.69
201906_E	-0.14%	1.10%	-8.09	9.09
201309_G	0.66%	0.08%	1.06	-0.06
201409_G	0.17%	1.17%	6.92	-5.92
201809_G	1.04%	0.87%	0.83	0.17

† Denotes percentage savings are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

Table 3-4. Home Energy Reports Gas Persistence Factors and Decay Rates by Wave

Wave	Final-Year Savings (percent)	First Year Persistence Savings (percent)	Persistence Factor	Decay Rate
201008_G	1.52%†	1.29%†	0.85	0.15
201101_G	1.44%†	1.30%†	0.90	0.10
201309_G	0.56%	1.02%†	1.81	-0.81

[3] In the Home Energy Reports program, waves are groups of Eversource customers randomized into program treatment. Waves are enrolled in the program with the purpose of encouraging customers to reduce gas or electric energy usage. Eversource rolled many customers into the HER program iteratively across 24 separate waves from 2010 through 2019.

Wave	Final-Year Savings (percent)	First Year Persistence Savings (percent)	Persistence Factor	Decay Rate
201309_G_Drop	1.46%†	0.96%	0.66	0.34
201409_G	1.69%†	1.67%†	0.98	0.02
201610_G	0.44%	0.47%	1.07	-0.07
201612_E_NewMovers	0.04%	0.72%	19.89	-18.89
201701_D	0.09%	-0.13%	-1.37	2.37
201809_G	0.34%	0.36%	1.07	-0.07
201906_D	-3.53%†	-0.30%	0.08	0.92

† Denotes results are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

Decay rates for electric savings range from -5.92 to 9.09; however, these extrema come from a gas wave with electric savings[4] and a 2019 wave with only half a year of HER program treatment, respectively. A similar pattern is present in the gas decay rates, which range from -18.89 for an electric wave with gas savings to 0.92 for a dual fuel wave with only half a year of treatment.

Persistence factors and decay rates are muddled slightly by the presence of extrema. However, it appears that earlier waves consistently have higher final-year and first-year persistence savings that are statistically significant at the 90% level. This leads to more stable, lower decay rates for the earlier waves and could point to length of treatment as a key indicator for the "stickiness" of program savings. Appendix Section 4.B.5 illustrates decay rates by wave.

3.3 Uplift

The uplift adjustment is relatively small compared to program savings, ranging from 0.14% to 1.76% of total program savings depending on the wave, which is a similar finding to previous studies in Massachusetts.

3.3.1 Magnitude of Uplift

Table 3-5 and Table 3-6 show the magnitude of uplift by fuel type and analysis period (i.e., final program year and first persistence year). These tables provide program savings net of uplift, the total uplift adjustment, and the percent of program savings adjusted for uplift. In summary, the percent of savings adjusted for uplift is relatively small.

Table 3-5. Magnitude of Uplift Adjustment Electric Savings

Savings Category	Final Year Savings	First Persistence Year Savings
Total Savings net of Uplift, kWh	39,619,661	37,359,250

[4] The wave 201409_G was a HER wave that was randomized into treatment and control groups to reduce gas usage. A large portion of customers within this wave also had electric accounts. Since reports sent in the HER program may cause treated customers to change behaviors that can affect both gas and electric usage, electric savings were estimated for this wave.

Savings Category	Final Year Savings	First Persistence Year Savings
Savings Uplift in Other EE Programs, kWh	697,768	53,015
Percent of Savings Adjusted for Uplift	**1.76%**	**0.14%**

Source: Guidehouse and ILLUME analysis

Table 3-6. Magnitude of Uplift Adjustment Gas Savings

Savings Category	Final Year Savings	First Persistence Year Savings
Total Savings net of Uplift, Therms	873,955	857,253
Savings Uplift in Other EE Programs, Therms	6,865	6,877
Percent of Savings Adjusted for Uplift	**0.79%**	**0.80%**

Source: Guidehouse and ILLUME analysis

For electric savings, the percent of savings adjusted for uplift is 1.76% for the final program year and 0.14% for the first persistence year. For gas savings, the percent of savings adjusted for uplift is about 0.8% for both the final program year and for the first persistence year.

Electric uplift from other EE programs declines between the final program year and the first persistence year. However, the cause of this shift is unclear. The list below presents possible hypothetical causes and additional considerations, which the evaluation team will revisit after estimating uplift for the second persistence year.

Ending the HER program: While the decline in electric uplift may be the result of ending the HER program, gas uplift remains stable across the final program year and the first persistence year.

Wave-level changes: The electric-only waves from April 2013 and February 2014 account for a large portion of the change in electric uplift during the study period. However, wave-level changes in uplift between the analysis periods are more variable for electric savings than gas savings and these are two of the largest waves. It is unclear whether there are underlying characteristics of these waves that are causing the shift in electric uplift or if the shift is simply due to the combination of variable results at the wave-level and the size of these waves.

COVID-19 Pandemic: While the pandemic does not appear to affect gas uplift, it could affect participation in gas and electric programs differently depending on the typical seasonal patterns of program participation and local policies and attitudes about the pandemic throughout 2020.

Changes in program design and implementation strategies: While the evaluation team is unaware of any substantial program design or implementation changes over this time period, changes in electric programs during the evaluation period could hypothetically affect electric uplift.

3.3.2 Benchmarking Uplift

For the 2016 Massachusetts behavioral program evaluation, the evaluation team used estimates of uplift as a percent of baseline usage from the 2013 evaluation.[5] [6] Table 3-7 compares uplift as a percent of baseline usage from the 2013 evaluation to the current estimates. The estimates of uplift vary to some degree between the studies, but each study indicates a relatively small impact from uplift. Similarly, the differences between the studies may be due to the underlying cohorts. Most of the cohorts included in the current study were launched after 2013 and any overlapping cohorts have been receiving messaging for several additional years since the previous uplift analysis.

Table 3-7. Benchmarking Uplift Adjustment

	2013 MA Study[1]	Final Year	First Persistence Year
Electric Uplift (percent of baseline usage)	0.075%	0.021%	0.002%
Gas Uplift (percent of baseline usage)	0.053%	0.005%	0.005%

1. Opinion Dynamics Corporation, Navigant Consulting, and Evergreen Economics (2013). Massachusetts Cross-Cutting Behavioral Program Evaluation Integrated Report.
Source: Guidehouse and ILLUME analysis

4. Findings and Recommendations

The evaluation team developed key findings and one recommendation following the evaluation of final year and first year persistence savings. These are provided below:

Finding 1. The evaluation team found persistence savings net of uplift for all waves to be 37,359 MWh and 857,253 Therms. Total electric savings across all waves decreased by 5.71 percent and total gas savings across all waves decreased by 1.91 percent from the final program year to the first year after reports ceased. At a wave-specific level, earlier waves have smaller, more stable decay rates resulting from higher, statistically significant savings in both the final program year and first year after program termination. Newer waves show higher levels of uncertainty based on larger confidence bounds.

Recommendation 1. While the savings from this study reflect reasonable statistical significance, the decay rate results indicate that forecasting future persistence based on this study may be unreliable. If Eversource claims persistence savings in the future, the evaluation team recommends periodically updating this study to learn how persistence savings are changing year-over-year, which will allow for more certainty during future planning cycles and filings.

[5] Navigant Consulting and ILLUME Advising (2016). Summary of the Massachusetts Behavioral Program Impact Evaluations. https://ma-eeac.org/wp-content/uploads/Massachusetts-Behavioral-Programs-Impact-Evaluation-2016-04-26-FINAL.pdf

[6] Opinion Dynamics Corporation, Navigant Consulting, and Evergreen Economics (2013). Massachusetts Cross-Cutting Behavioral Program Evaluation Integrated Report.

Appendix A. Impact Analysis Methodology

A.1 Detailed Data Cleaning

The evaluation team removed customers and data points from the analysis in several steps:

- Observations missing bill dates that could not be backed out from additional information
- Observations missing, or with zero, bill duration days
- Observations outside the final program year, first year after program termination, and each wave's relevant pre-program year
- Outliers, defined separately for gas and electric usage. For gas, outliers are any observation with negative average daily use or greater than one order of magnitude from the median usage. For electric, outliers are any observation greater or less than one order of magnitude from the median.

For each wave, these steps removed observations and customers evenly across participants and controls. This suggests that non-random biases were not introduced during data cleaning.

A.2 Handling Missing Pre-Period Data

The evaluation team found that numerous waves, including New Mover and non-New Mover waves, had less than a full year of pre-period data.[7] Incomplete (fewer than 12 months) pre-period data can introduce bias when modeling savings. This can occur particularly when pre-period data are missing entire seasons, as pre-period usage is no longer an accurate representation of usage that may be expected within a given calendar year. In addition, due to the nature of the lagged dependent variable (LDV) model, participants with incomplete pre-period data are dropped from the modeling process.[8]

For New Mover waves, we addressed this in two steps, (1) tracking down as much pre-period data as possible from premises that New Mover participants and controls currently reside in, then (2) imputing remaining missing pre-period data. For non-New Mover waves, many of which had participants and controls with incomplete pre-period data, missing pre-period data were imputed.

For New Mover waves, the evaluation team first worked to capture as much pre-period data from participants and controls as possible. New Mover participants and controls were randomized into the program in the HER program right when they moved into a premise. Participants and controls can consist of New Movers from outside the Eversource territory, for which the pre-period data will have never existed, or of New Movers from elsewhere within the Eversource territory. To capture all possible data for the New Mover waves group, controls' and

[7] The evaluation team has seen the problem of limited pre-period data arise when the program implementer does not require at least one year of pre-treatment billing history for randomized treatment and control customers.

[8] Since this model includes pre-period information as explanatory variables, if a customer is missing billing data for a certain pre-period month, then the model will drop this calendar month in the analysis period for the customer.

participants' Premise IDs were used to bring in as much data as possible from a customer's current premise prior to their enrollment in a New Mover wave.

After pulling as much pre-period data as possible for the New Mover waves, the evaluation team imputed any remaining missing pre-period data for all New Mover and non-New Mover waves. To account for the remaining missing pre-period observations, we replaced the missing data with substituted values (i.e., imputed data) representing average daily consumption for customers that have pre-period data. We performed imputations independently for each wave, pre-period month, and customer group (treatment vs. control).

A.3 Detailed Impact Evaluation

Lagged Dependent Variable (LDV) Model

To evaluate electric and gas savings during the final year and first persistence year, the evaluation team estimated a LDV model for each electric and gas wave independently. The LDV model combines both cross-sectional and time series data in a panel dataset. This model uses only the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the participant and control customers. In particular, energy use in calendar month *t* of the post-program period is a function of both program participation and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between participants and controls will be reflected in differences in their past energy use, which is highly correlated with their current energy use. The version we propose to estimate includes monthly fixed effects and interacts these monthly fixed effects with the pre-program energy use variable. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month. The model is detailed in Equation A-1 below.

Equation A-1. Lagged Dependent Variable Model

$$ADC_{kt} = \beta_1 Treatment_k + \sum_j \beta_{2j} Month_{jt} + \sum_j \beta_{3j} Month_{jt} \cdot ADClag_{kt} + \varepsilon_{kt}$$

where

ADC$_{kt}$ = The average daily usage in kWh or therms for customer k during billing cycle t. This is the dependent variable in the model;

Treatment$_k$ = A binary variable indicating whether customer k is in the treatment group (taking a value of 1) or in the control group (taking a value of 0);

ADClag$_{kt}$ = Customer k's energy use in the same calendar month of the pre-program year as the calendar month of month t;

Month$_{jt}$ = A binary variable taking a value of 1 when j = t and 0 otherwise;

$\boldsymbol{\varepsilon_{kt}}$ = The cluster-robust error term for customer *k* during billing cycle *t.* Cluster-robust errors account for heteroscedasticity and autocorrelation at the customer level.[9]

In this model, β_1 is the estimate of average daily energy savings due to the program. Total program savings are the product of the average daily savings estimate and the total number of participant-days in the analysis.

Persistence Factors and Decay Rates

Once savings net of cross-program savings were estimated, the evaluation team calculated first year persistence and decay rates for each HER wave. The first-year decay rate is equal to one minus the ratio of the percentage savings in the first year after the reports were discontinued to percentage savings in the last year before the reports were discontinued, as highlighted in Equation A-2 below:

Equation A-2. First-Year Decay Rate

$$\delta_G = 1 - \frac{\%\ Savings\ in\ first\ year\ after\ reports\ stop}{\%\ Savings\ in\ last\ year\ reports\ are\ sent}.$$

where *G* is the specific HER wave of interest. The persistence factor is equal to 1 - δ_G.

A.4 Accounting for Uplift in Other Energy Efficiency Programs

To conduct uplift analysis the evaluation team requested all energy efficiency program databases across all fuel sources, with the associated measures and deemed savings values. We received program tracking data for all waves between 2018 and 2020. These data did not include pre-period program participation for most treatment groups. Therefore, we estimated uplift due to suggested actions contained in this HER evaluation period through a post-only differences (POD) approach.[10]

The evaluation team calculated uplift savings through the following steps for each wave for each HER treatment year being estimated:

1) Calculate the average daily per-customer (over all wave customers) kWh or therm savings attained through participation in other energy efficiency programs for the treatment and control group;

2) Calculate the difference in average daily energy savings attributed to participation in other programs between treatment and control customers;

[9] Ordinary Least Squares (OLS) regression models assume that the data are homoscedastic and not autocorrelated. If either of these assumptions is violated, the resulting standard errors of the parameter estimates are incorrect (usually underestimated). A random variable is heteroscedastic when the variance is not constant. A random variable is autocorrelated when the error term in one period is correlated with the error terms in at least some of the previous periods.

[10] Note that the post-only differences approach is commonly used to estimate differences in participation between the treatment and control groups for programs that did not exist for an HER wave's pre-period.

3) Multiply that difference by the total number of days for which customers received treatment. This converts the average daily per-customer uplift savings to wave-level savings for the year. This value is the uplift savings attributed to differential participation of the treatment group in energy efficiency programs for that wave and year.

As shown in Appendix Section B.6, our team includes negative uplift in our analysis. We include negative uplift to ensure we are properly estimating the HER program savings. Treating the negative uplift values as zero could lead to an underestimate of the HER program's savings.[11]

The team included the programs listed in Table A-1 in our analysis for program years 2018, 2019 and 2020. The implementers changed tracking systems midyear in 2020 and, as such, we list the corresponding program names separately.

Table A-1. Program Names and Years Included in Uplift Analysis

Program Names 2018 – Mid-2020	Program Names Mid-2020 – End of 2020
ENERGY STAR Appliances Elec. Products	Res – Appliances
High Efficiency Water Heating Rebate	Res – Hot Water
ENERGY STAR HVAC High Efficiency Heating Rebate	Res – HVAC
ENERGY STAR Lighting	Res – Lighting
ENERGY STAR Thermostat Rebate Residential Conservation Services	Res – Products – Fuel Switching Res – Retrofit – Fuel Switching Res – Retrofit – Single-Family
Multi-Family Program	Res – Retrofit – Multi-Family
	Res – Major Renovations (0 HER participants)
	Res – New Homes (0 HER participants)

Source: Guidehouse and ILLUME analysis

We cannot directly calculate uplift savings for upstream programs. Upstream programs negotiate discounts at the manufacturer or retailer level and customers can make purchases at a lower price point without a need to complete rebate forms. As such, program databases do not contain information on individual customer activity. However, the team reports on findings from other studies that conducted surveys or onsite home inventories to address this issue and recommend any adjustments to savings accordingly in Appendix B.

[11] Navigant Consulting (2016). Home Energy Reports Program Evaluation Report. http://www.oracle.com/us/industries/utilities/home-energy-rp-prog-gpy4-eval-5225455.pdf

Appendix B. Impact Analysis Detail

This appendix presents savings by wave and aggregated uplift analysis results. Tables with the regression outputs and detailed uplift results by wave are available upon request

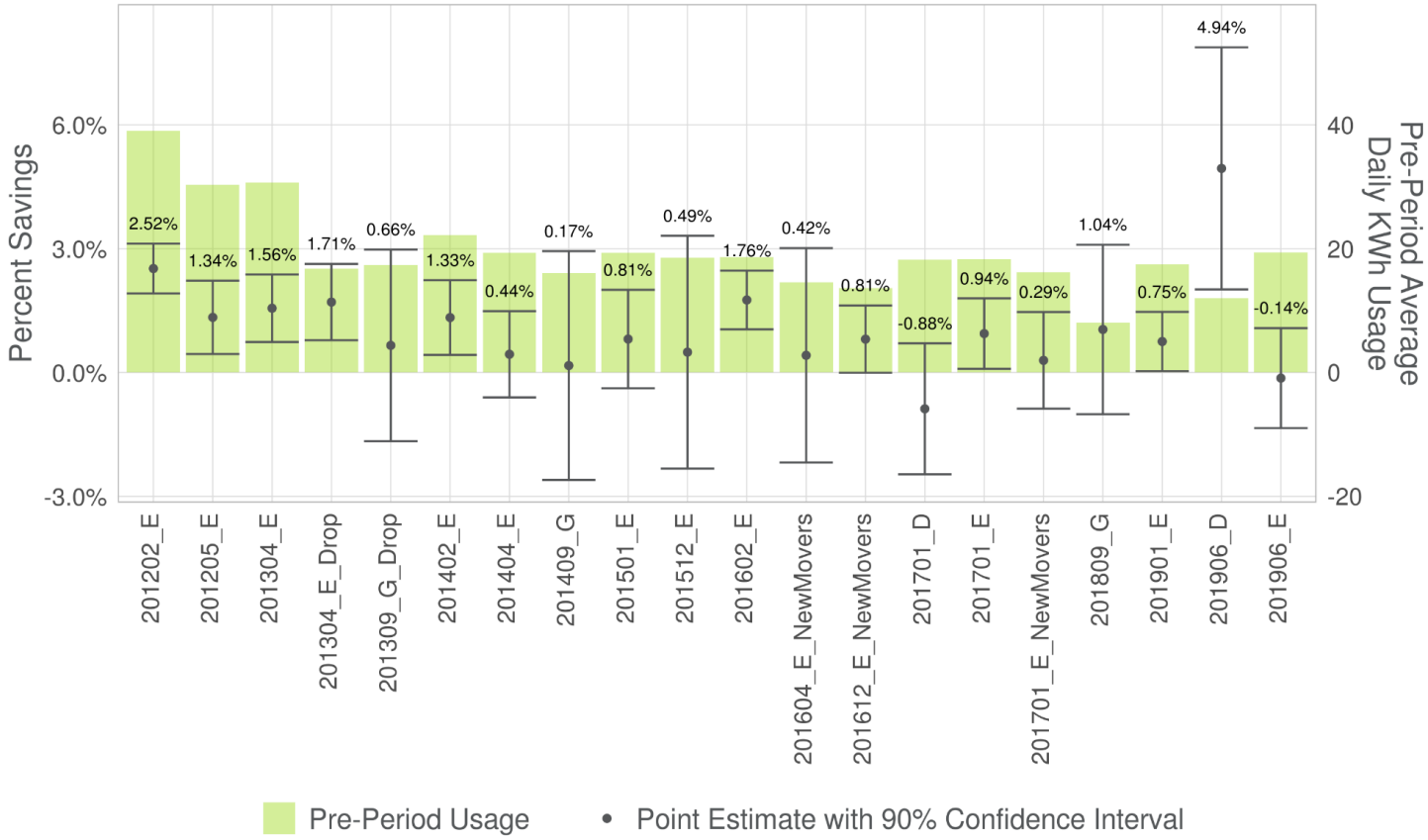
The figures in this section present the percentage savings for each wave and study period (final year and first persistence year) as well as the wave's corresponding pre-period average daily use. The tables provide a breakout for each wave that includes net savings and uplift results, treatment and control counts, and percent savings with standard errors.

You will see that electric savings were estimated for some gas waves, and vice versa for gas savings. This is because some customers in the gas (or electric) waves also have electric (or gas) usage data for any one of several reasons (i.e. they added the service after enrollment and weren't moved into the dual fuel group or they were added later on as a way to rebalance some waves). These customers' savings were included in the final aggregation as well since their savings could be tied to the HER program.

B.1 kWh Final Year Savings by Wave

Figure B-1 shows the average daily kWh usage for treatment customers in each wave during the pre-period as well as the percent final year savings. Each percentage savings estimates includes upper and lower bounds of its associated 90 percent confidence interval. Savings are statistically significant when confidence intervals do not cross zero on the y-axis. More detail is provided below.

Figure B-1. Electric Savings and Pre-Period Usage by Wave – Final Year



Source: Guidehouse and ILLUME analysis

Compared to later waves, earlier waves have greater percentage savings that are more often statistically significant at 90 percent. Earlier waves also have higher pre-period usage. Prior research conducted by Guidehouse has shown that higher usage is often associated with greater HER program savings.[12] The exception to this trend is the 201906_D wave, which began receiving HER treatment midway through the final year. As such, this wave had savings estimated for only June through October 2019, which may explain its high and volatile savings estimate.

Table B-1 presents wave-specific percent savings, total savings, and total savings net of uplift. Significance of savings estimates does not appear to correlate with sample size. Consistent with the figure above, the earlier waves account for a higher percent of total electric savings as a result of their larger percentage savings and greater baseline usage.

Table B-1. Home Energy Reports Program Electric Savings by Wave – Final Year

Wave	Treatment Customer Count*	Control Customer Count*	Percentage Savings	Standard Error (Percent)	Verified Net Savings, Prior to Uplift Adjustment (kWh)	Standard Error (kWh)	Savings Uplift in Other EE Programs (kWh)	Verified Net Savings (kWh)
201202_E	43,829	14,588	2.52%†	0.37%	12,017,180	1,748,969	6,945	12,010,235
201205_E	12,501	9,462	1.34%†	0.54%	1,556,804	629,434	-82,520	1,639,324
201304_E	24,495	9,170	1.56%†	0.50%	3,879,056	1,238,972	68,558	3,810,489
201304_E_Drop	41,363	5,883	1.71%†	0.56%	3,997,809	1,315,865	176,814	3,820,995
201309_G_Drop	2,134	1,620	0.66%	1.41%	82,025	176,233	-8,849	90,873
201402_E	83,103	7,370	1.33%†	0.55%	7,016,750	2,898,791	371,083	6,645,668
201404_E	41,304	5,418	0.44%	0.63%	1,170,275	1,681,979	-21,211	1,191,486
201409_G	2,507	1,136	0.17%	1.68%	23,973	239,611	6,810	17,163
201501_E	16,593	6,760	0.81%	0.72%	738,879	661,036	-23,428	762,306
201512_E	8,369	1,256	0.49%	1.71%	219,983	765,512	43,032	176,951
201602_E	36,047	11,193	1.76%†	0.43%	4,095,639	1,006,645	13,738	4,081,900
201604_E_NewMovers	5,329	2,356	0.42%	1.58%	119,525	453,452	-16,056	135,580
201612_E_NewMovers	59,791	19,942	0.81%†	0.50%	2,170,338	1,331,405	31,854	2,138,484

[12] Navigant. 2016. *ComEd Home Energy Report Program Evaluation Report.* Presented to Commonwealth Edison Company.

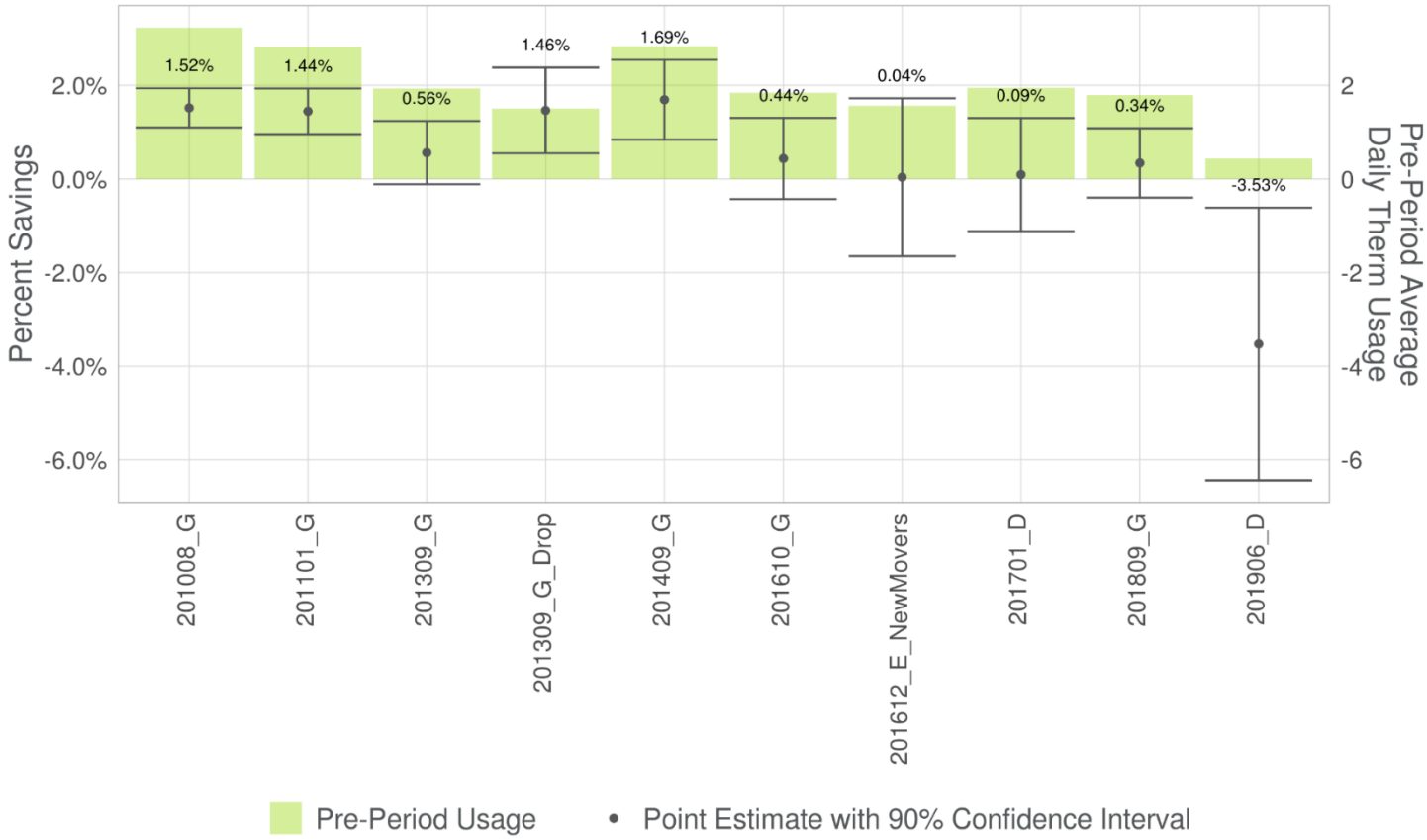
Wave	Treatment Customer Count*	Control Customer Count*	Percentage Savings	Standard Error (Percent)	Verified Net Savings, Prior to Uplift Adjustment (kWh)	Standard Error (kWh)	Savings Uplift in Other EE Programs (kWh)	Verified Net Savings (kWh)
201701_D	3,091	3,071	-0.88%	0.96%	-171,561	188,187	7,262	-178,823
201701_E	19,156	11,285	0.94%†	0.52%	1,202,886	661,982	-7,351	1,210,236
201701_E_NewMovers	18,292	18,307	0.29%	0.71%	309,215	747,185	10,589	298,626
201809_G	4,166	3,249	1.04%	1.25%	137,355	164,405	20,116	117,239
201901_E	39,656	14,822	0.75%†	0.44%	1,477,105	858,796	105,684	1,371,421
201906_D	3,190	2,277	4.94%†	1.78%	297,356	107,174	-1,133	298,490
201906_E	6,089	3,396	-0.14%	0.74%	-23,163	125,056	-4,170	-18,992

**These counts are the analysis sample size.*
† Denotes results are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

B.2 Therms Final Year Savings by Wave

Figure B-2 shows the average daily has usage for treatment customers in each wave during the pre-period as well as the final year percent savings. Similar to the electric waves, earlier gas waves have greater percentage savings that are more often statistically significant at 90 percent, and these earlier waves tended to have higher pre-period average daily usage compared to later waves. As was found for final year electric savings, the 201906_D wave had volatile savings, this time with a large negative percentage savings estimate. This observation may be explained by the fact that savings were only estimated for June through October 2019 for this wave, a time of year which also typically corresponds with very low gas usage.

Figure B-2. Gas Savings and Pre-Period Usage by Wave – Final Year



Source: Guidehouse and ILLUME analysis

Table B-2 presents wave-specific percent savings, total savings, and total savings net of uplift. As is the case with the electric savings, it does not appear that sample size is correlated with significance. Instead, earlier waves tend to net greater percentage and absolute savings relative to later waves, with this difference being greater between earlier and later waves than was observed for electric savings.

Table B-2. Home Energy Reports Program Gas Savings by Wave – Final Year

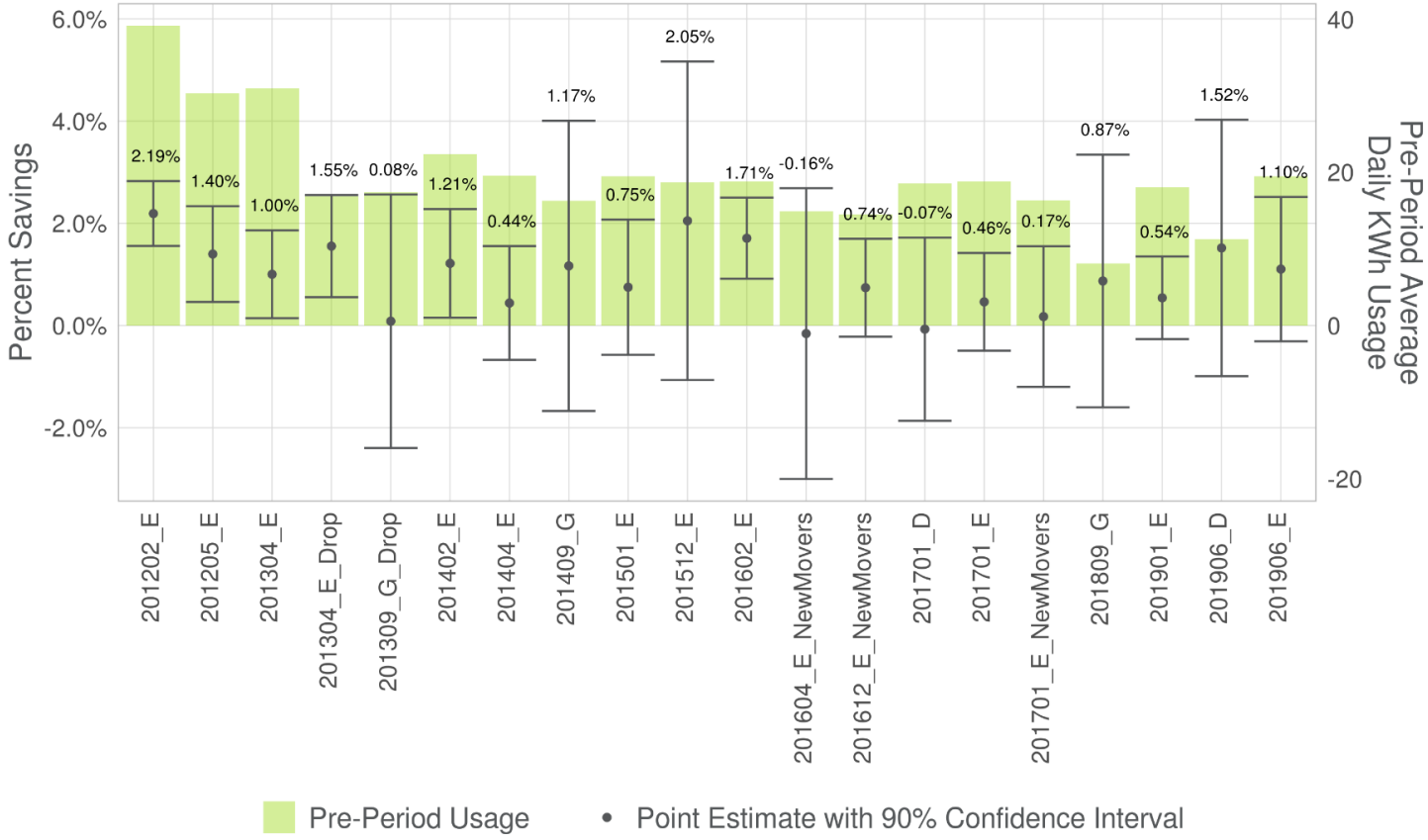
Wave	Treatment Customer Count*	Control Customer Count*	Percentage Savings	Standard Error (Percent)	Verified Net Savings, Prior to Uplift Adjustment (Therms)	Standard Error (Therms)	Savings Uplift in Other EE Program (Therms)	Verified Net Savings (Therms)
201008_G	15,079	14,999	1.52%†	0.25%	273,666	45,930	-3,021	276,687
201101_G	14,259	11,416	1.44%†	0.30%	216,786	44,470	2,817	213,969
201309_G	20,461	8,328	0.56%	0.41%	97,930	71,496	1,744	96,186
201309_G_Drop	8,597	6,522	1.46%†	0.56%	89,953	34,221	-5,267	95,220
201409_G	7,901	3,786	1.69%†	0.52%	126,168	38,635	10,134	116,034
201610_G	13,206	5,802	0.44%	0.53%	43,834	53,023	-242	44,077
201612_E_NewMovers	7,154	2,377	0.04%	1.03%	1,517	42,981	-2,060	3,577
201701_D	3,324	3,331	0.09%	0.73%	2,340	18,613	4,599	-2,259
201809_G	18,820	14,711	0.34%	0.45%	38,760	51,228	3,061	35,699
201906_D	4,669	3,290	-3.53%†	1.77%	-10,134	5,089	-4,900	-5,235

**These counts are the analysis sample size.*
† Denotes results are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

B.3 kWh Persistence Savings by Wave

Figure B-3 and Table B-3 show similar results to the final-year electric savings values, where the observed pattern of early years having larger percent savings remains for the first persistence year. Notably, electric savings are less volatile for the 201906_D wave, which is likely attributed to the availability of one full year of post-treatment data spanning January through December 2020.

Figure B-3. Electric Savings and Pre-Period Usage by Wave – First Persistence Year



Source: Guidehouse and ILLUME analysis

Table B-3. Home Energy Reports Program Electric Savings by Wave – First Persistence Year

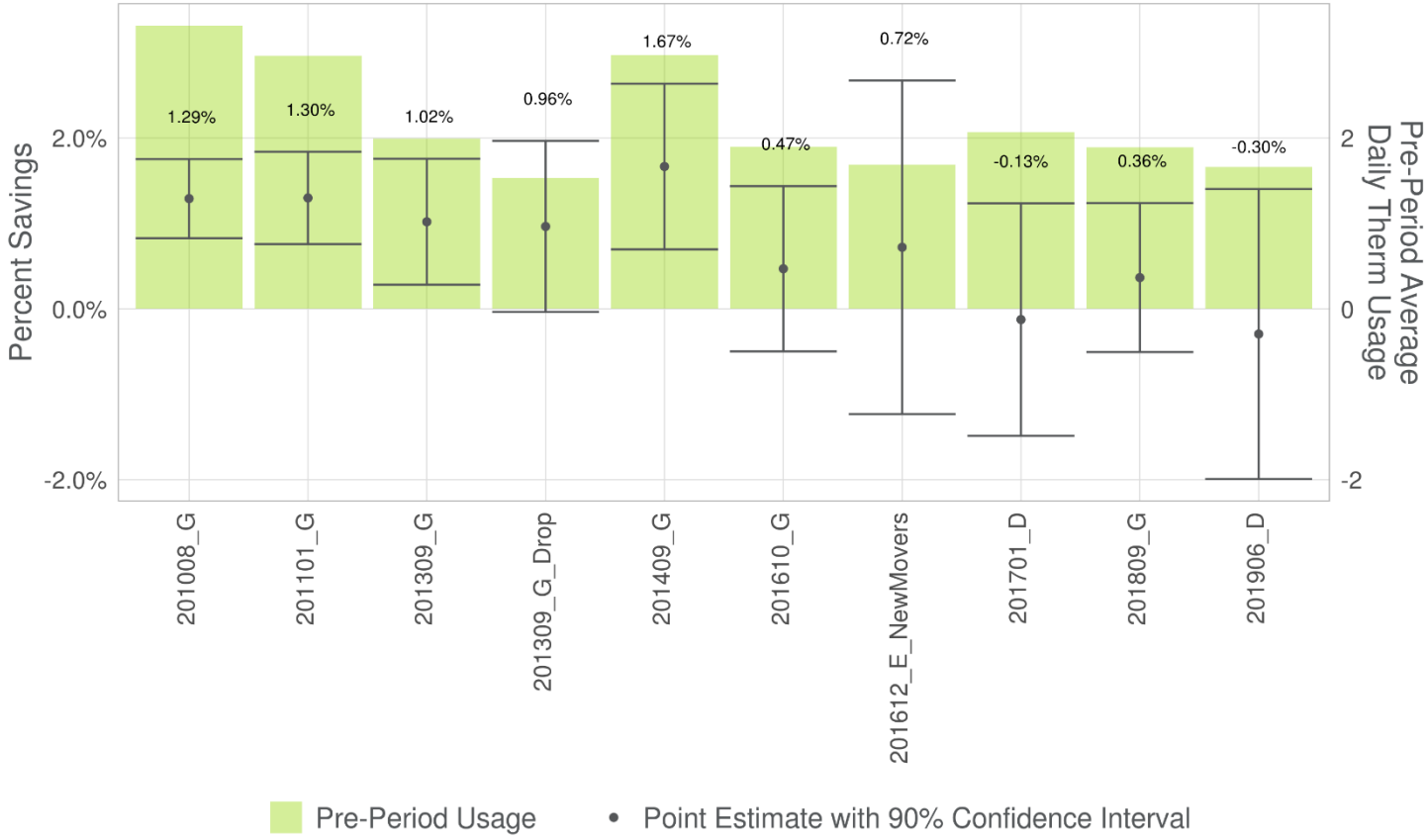
Wave	Treatment Customer Count*	Control Customer Count*	Percentage Savings	Standard Error (Percent)	Verified Net Savings, Prior to Uplift Adjustment (kWh)	Standard Error (kWh)	Savings Uplift in Other EE Programs (kWh)	Verified Net Savings (kWh)
201202_E	41,975	13,942	2.19%†	0.38%	10,854,796	1,907,815	87,499	10,767,297
201205_E	11,883	8,955	1.4%†	0.57%	1,665,128	679,203	-43,716	1,708,845
201304_E	23,097	8,663	1.00%†	0.52%	2,586,960	1,349,801	-59,334	2,646,295
201304_E_Drop	38,649	5,516	1.55%†	0.61%	3,814,778	1,491,669	-27,063	3,841,841
201309_G_Drop	1,992	1,490	0.08%	1.51%	10,796	194,998	14,662	-3,866
201402_E	79,061	7,012	1.21%†	0.65%	6,541,743	3,473,635	9,216	6,532,527
201404_E	38,315	4,990	0.44%	0.68%	1,232,100	1,896,391	-15,897	1,247,997
201409_G	2,276	1,027	1.17%	1.73%	181,550	268,717	845	180,705
201501_E	15,385	6,296	0.75%	0.8%	701,849	753,545	-7,429	709,278
201512_E	7,572	1,125	2.05%	1.89%	958,447	886,431	361	958,086
201602_E	31,844	9,888	1.71%†	0.48%	4,234,725	1,195,775	-16,184	4,250,909
201604_E_NewMovers	4,325	1,924	-0.16%	1.73%	-49,867	542,918	6,767	-56,634
201612_E_NewMovers	42,477	14,159	0.74%	0.58%	2,286,519	1,801,448	6,885	2,279,634
201701_D	2,662	2,606	-0.07%	1.09%	-15,360	231,223	2,627	-17,987
201701_E	15,900	9,299	0.46%	0.58%	633,275	798,012	52,800	580,475
201701_E_NewMovers	14,295	14,318	0.17%	0.84%	198,599	958,516	-17,284	215,884
201809_G	3,151	2,476	0.87%	1.5%	129,815	223,952	-6,819	136,634
201901_E	29,247	10,975	0.54%	0.49%	1,147,826	1,044,069	83,082	1,064,744
201906_D	2,509	1,802	1.52%	1.52%	92,801	93,311	-11,680	104,481
201906_E	5,697	3,139	1.10%	0.86%	205,785	160,256	-6,321	212,106

** These counts are the analysis sample size.*
† Denotes results are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

B.4 Therms Persistence Savings by Wave

Figure B-4 and Table B-4 show similar results to the final-year gas savings values, where the observed pattern of early years having larger percent savings remaining for the first persistence year. Notably, gas savings are less volatile for the 201906_D wave, which is likely attributed to the availability of one full year of post-treatment data spanning January through December 2020.

Figure B-4. Gas Savings and Pre-Period Usage by Wave – First Persistence Year



Source: Guidehouse and ILLUME analysis

Table B-4. Home Energy Reports Program Gas Savings by Wave – First Persistence Year

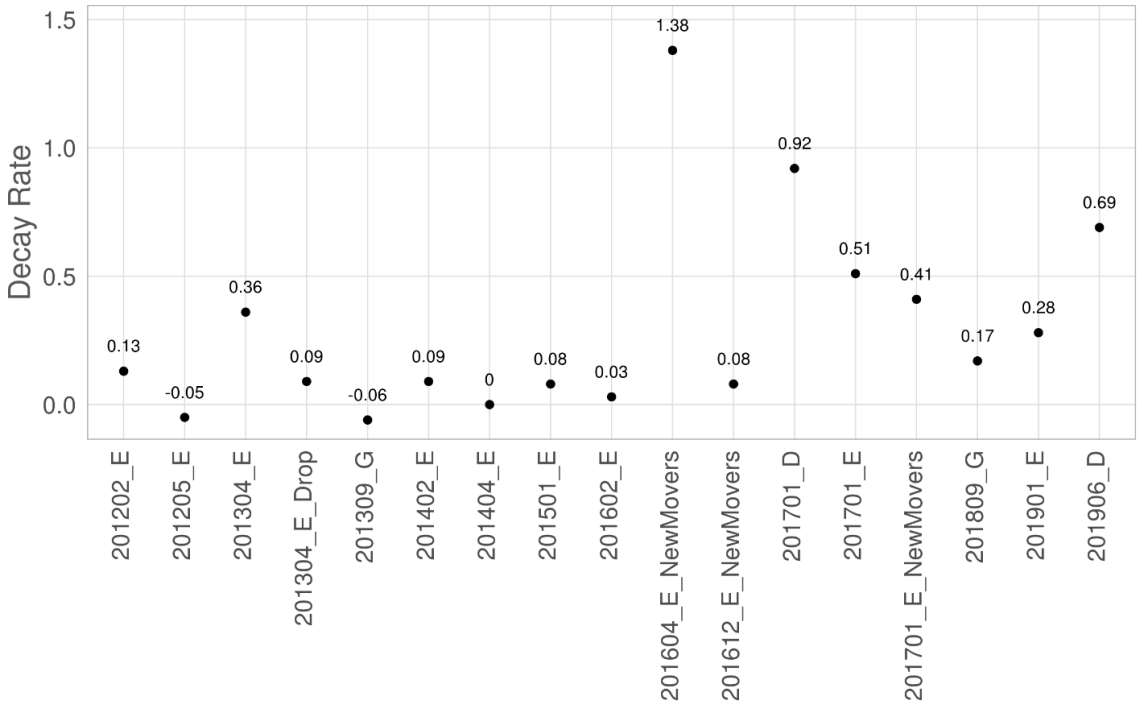
Wave	Treatment Customer Count*	Control Customer Count*	Percentage Savings	Standard Error (Percent)	Verified Net Savings, Prior to Uplift Adjustment (Therms)	Standard Error (Therms)	Savings Uplift in Other EE Program (Therms)	Verified Net Savings (Therms)
201008_G	14,390	14,247	1.29%†	0.28%	220,740	48,254	2,679	218,061
201101_G	13,536	10,789	1.30%†	0.33%	186,171	47,106	-516	186,688
201309_G	18,989	7,699	1.02%†	0.45%	169,596	74,669	5,983	163,613
201309_G_Drop	8,003	6,052	0.96%	0.61%	58,134	36,722	31	58,103
201409_G	7,153	3,429	1.67%†	0.59%	118,553	41,937	-963	119,516
201610_G	11,142	4,952	0.47%	0.59%	45,545	57,145	-3,328	48,873
201612_E_NewMovers	5,230	1,781	0.72%	1.19%	30,770	50,738	450	30,320
201701_D	2,810	2,873	-0.13%	0.83%	-3,118	20,419	-47	-3,071
201809_G	13,976	10,948	0.36%	0.53%	40,799	59,227	2,521	38,278
201906_D	3,714	2,623	-0.30%	1.03%	-3,059	10,683	69	-3,128

** These counts are the analysis sample size.*
† Denotes results are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

B.5 Decay Rates by Wave

Figure B-5 and Table B-5 present the electric decay rates and persistence factors for all waves enrolled in the HER program. Decay rates for electric waves range from -5.92 to 9.09; however, these extrema come from non-standard waves – a gas wave with electric savings and a 2019 wave with only a partial year of HER program treatment from June through October 2019. Persistence factors and decay rates are muddled slightly by the presence of extrema. However, it appears that earlier waves consistently have higher final-year and first-year persistence savings that are statistically significant at the 90% level. This leads to more stable, lower decay rates for the earlier waves and could point to length of treatment as a key indicator for the "stickiness" of program savings.

Figure B-5. Home Energy Reports Electric Decay Rates by Wave[13]



Source: Guidehouse and ILLUME analysis

Table B-5. Home Energy Reports Electric Persistence Factors and Decay Rates by Wave

Wave	Final-Year Savings (percent)	First Year Persistence Savings (percent)	Persistence Factor	Decay Rate
201202_E	2.52%†	2.19%†	0.87	0.13
201205_E	1.34%†	1.40%†	1.05	-0.05
201304_E	1.56%†	1.00%†	0.64	0.36

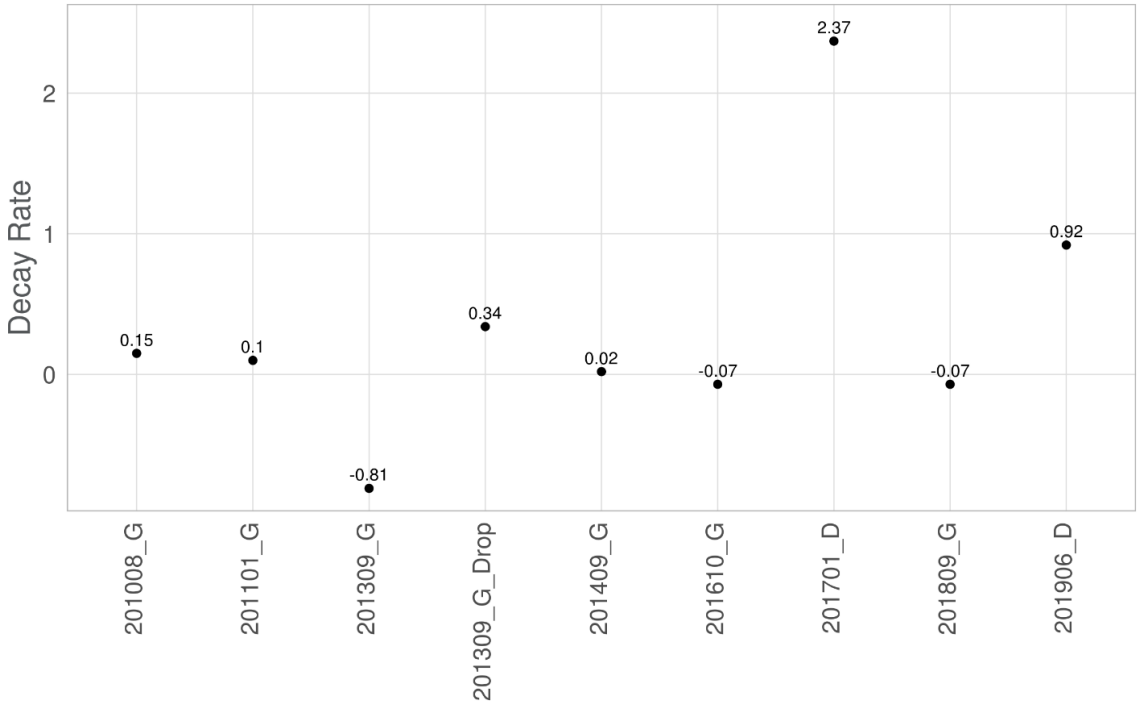
[13] Waves 201409_G, 201512_E, and 201906_E were removed from the graph due to their savings' magnitudes of decay. The decay rates for these waves can be found in the table below.

Wave	Final-Year Savings (percent)	First Year Persistence Savings (percent)	Persistence Factor	Decay Rate
201304_E_Drop	1.71%†	1.55%†	0.91	0.09
201402_E	1.33%†	1.21%†	0.91	0.09
201404_E	0.44%	0.44%	1.00	0
201501_E	0.81%	0.75%	0.92	0.08
201512_E	0.49%	2.05%	4.16	-3.16
201602_E	1.76%†	1.71%†	0.97	0.03
201604_E_NewMovers	0.42%	-0.16%	-0.38	1.38
201612_E_NewMovers	0.81%	0.74%	0.92	0.08
201701_D	-0.88%	-0.07%	0.08	0.92
201701_E	0.94%†	0.46%	0.49	0.51
201701_E_NewMovers	0.29%	0.17%	0.59	0.41
201901_E	0.75%†	0.54%	0.72	0.28
201906_D	4.94%†	1.52%	0.31	0.69
201906_E	-0.14%	1.10%	-8.09	9.09
201309_G	0.66%	0.08%	1.06	-0.06
201409_G	0.17%	1.17%	6.92	-5.92
201809_G	1.04%	0.87%	0.83	0.17

† Denotes results are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

Figure B-6 and Table B-6 present the gas decay rates and persistence factors for all waves enrolled in the HER program. Gas decay rates range from -18.89 for an electric wave with gas savings to 0.92 for a dual fuel wave with only a partial year of treatment between June 2019 and October 2019. Similar to findings for electric decay rates and persistence factors, it appears that earlier waves consistently have higher final year and first year persistence savings that are statistically significant at the 90% level. This leads to more stable, lower decay rates for the earlier waves.

Figure B-6. Home Energy Reports Gas Decay Rates by Wave[14]



Source: Guidehouse and ILLUME analysis

Table B-6. Home Energy Reports Gas Persistence Factors and Decay Rates by Wave

Wave	Final-Year Savings (percent)	First Year Persistence Savings (percent)	Persistence Factor	Decay Rate
201008_G	1.52%†	1.29%†	0.85	0.15
201101_G	1.44%†	1.30%†	0.90	0.10
201309_G	0.56%	1.02%†	1.81	-0.81
201309_G_Drop	1.46%†	0.96%	0.66	0.34
201409_G	1.69%†	1.67%†	0.98	0.02
201610_G	0.44%	0.47%	1.07	-0.07
201612_E_NewMovers	0.04%	0.72%	19.89	-18.89
201701_D	0.09%	-0.13%	-1.37	2.37
201809_G	0.34%	0.36%	1.07	-0.07
201906_D	-3.53%†	-0.30%	0.08	0.92

† Denotes results are statistically significant at 90%.
Source: Guidehouse and ILLUME analysis

[14] Wave 201612_E_NewMovers was removed from the graph due to its savings' magnitude of decay. The decay rate for this wave can be found in the table below.

B.6 Uplift Analysis Results

The evaluation team estimated uplift primarily to ensure the evaluated savings only represent savings from behavioral messaging, excluding any effect from increased participation in other energy efficiency programs. However, the evaluation team also conducted more detailed analyses to provide Eversource additional insight into their programs' impacts. In the subsections below, the evaluation team describes secondary literature on uplift from upstream programs, provides program-specific uplift results, highlights the most-installed measures between the treatment and control groups, and highlights measure-specific uplift results.

Uplift for Upstream Programs

In a recent secondary literature review presented to the Michigan utilities, a Guidehouse evaluation found 10 evaluations of HER programs from 2013 to 2018 that addressed the effects of upstream lighting.[15] Five of these evaluations relied on surveys (three phone, one online, one in person), one relied on an onsite home inventory, three on secondary literature, and one used a deemed savings factor. The onsite inventory found the highest rate of uplift savings at 2.6%. Three reported no difference in purchases between treatment and control customers. Others ranged from -0.9 kWh/household/year to 11.1 kWh/household/year. The team presenting to Michigan utilities concluded that most efforts to calculate the uplift rate of upstream programs result in 0% or negative results or the differences are statistically insignificant. Based on the experience of these other programs, we recommend making no uplift adjustment for upstream programs.

Program-Level Uplift Results

In this section, the evaluation team presents the uplift participant counts and uplift savings by program for electric and gas savings in both the final program year, shown in Table B-7, and first persistence year, shown in Table B-8. The program-specific cross-participation uplift counts were all less than one percent of the HER treatment population, which underscores the relatively small uplift effect. For example, the Residential Conservation Service and Res Products programs have the highest electric uplift effect, yet still affect less than one percent of treatment customers and less than 0.1% of baseline usage.

Table B-7. Final Year Program-Specific Cross-Participation and Savings Uplift

Eversource EE Program	Units	Uplift Participation Count	Percent of HER Treatment Customers	Uplift Savings as a % of Baseline Usage[1]
Residential Conservation Service	kWh	613	0.118%	0.022%
Elec. Products	kWh	100	0.019%	0.001%
ENERGY STAR HVAC	kWh	-43	-0.008%	0.000%
ENERGY STAR Lighting	kWh	7	0.001%	0.000%
Multi-Family Program	kWh	-172	-0.034%	-0.002%
High Efficiency Heating Rebate - Res	Therms	4	0.002%	0.012%

[15] Avoiding the Double-Counting of Savings in Michigan's Behavioral EWR Programs: Current Practice & Future Options. April 16, 2019. https://www.michigan.gov/documents/mpsc/Avoiding_Double_Counting_-_20190416_652854_7.pdf

Eversource EE Program	Units	Uplift Participation Count	Percent of HER Treatment Customers	Uplift Savings as a % of Baseline Usage[1]
Residential Conservation Service - Gas	Therms	138	0.073%	0.001%
ENERGY STAR Thermostat Rebate - Res	Therms	32	0.017%	-0.001%
Multi-Family Gas Program	Therms	20	0.011%	-0.002%
High Efficiency Water Heating Rebate - Res	Therms	-16	-0.009%	-0.005%

1. Percent of total HER population and percent of baseline usage may have different signs; while there may be more treatment participants than control participants, the magnitude of savings could be different between the groups.
Source: Guidehouse and ILLUME analysis

Table B-8. First Persistence Year Program-Specific Cross-Participation Uplift

Eversource EE Program	Units	Uplift Participation Count	Percent of HER Treatment Customers	Uplift Savings as a % of Baseline Usage[1]
RES - Products	kWh	248	0.054%	0.002%
ENERGY STAR Appliances	kWh	4	0.001%	0.001%
ENERGY STAR Lighting	kWh	-16	-0.004%	0.000%
Residential Conservation Service	kWh	94	0.020%	0.000%
Multi-Family Program	kWh	-47	-0.011%	0.000%
RES - Retrofit	kWh	-35	-0.008%	-0.001%
ENERGY STAR HVAC	kWh	-26	-0.006%	-0.001%
RES - Retrofit	Therms	65	0.040%	0.004%
Multi-Family Gas Program	Therms	9	0.006%	0.002%
ENERGY STAR Thermostat Rebate - Res	Therms	-8	-0.005%	0.000%
RES - Products	Therms	3	0.002%	0.000%
Residential Conservation Service - Gas	Therms	-23	-0.014%	0.000%
High Efficiency Heating Rebate - Res	Therms	-65	-0.040%	-0.001%

1. Percent of total HER population and percent of baseline usage may have different signs; while there may be more treatment participants than control participants, the magnitude of savings could be different between the groups.
Source: Guidehouse and ILLUME analysis

Highlighting the Most Installed Measures between the Treatment and Control Group

Below the evaluation team highlights the five most installed measures amongst the treatment and control groups for gas and electric savings in the final program year and first persistence year. As shown in the tables below, the most installed measures are nearly identical for the treatment and control group, which again emphasizes the relatively small observed uplift effect. For electric savings, shown in Table B-9 and Table B-10, LED bulbs and controls are consistently the most installed measures.

Table B-9. Final Year Proportion of Electric Measures Installed by Treatment and Control

Measure Category	Control Group	Treatment Group
LED Bulbs	55%	55%
Controls	18%	17%
Thermostat	12%	12%
HVAC Equipment	5%	5%
Insulation	3%	3%

Source: Guidehouse and ILLUME analysis

Table B-10. First Persistence Year Proportion of Electric Measures Installed by Treatment and Control

Measure Category	Control Group	Treatment Group
LED Bulbs	41%	42%
Controls	10%	10%
Smart Strip	7%	7%
Thermostat	6%	6%
Insulation	5%	5%

Source: Guidehouse and ILLUME analysis

For gas savings, covered in Table B-11 and Table B-12, the predominant gas measures shift a bit over time. While insulation is consistently installed over time, thermostats and water heaters become a smaller proportion of installs between the final program year and first persistence year and air sealing becomes a larger proportion of installs over time.

Table B-11. Final Year Proportion of Gas Measures Installed by Treatment and Control

Measure Category	Control Group	Treatment Group
Thermostat	32%	33%
Insulation	29%	27%
Domestic Hot Water Measures	19%	19%
Air Sealing	9%	9%
Heating System	5%	5%

Source: Guidehouse and ILLUME analysis

Table B-12. First Persistence Year Proportion of Gas Measures Installed by Treatment and Control

Measure Category	Control Group	Treatment Group
Insulation	34%	35%
Air Sealing	19%	18%
Thermostat	17%	17%
Domestic Hot Water Measures	6%	6%
Low Flow Showerhead Gas	4%	4%

Source: Guidehouse and ILLUME analysis

Highlighting Measure-Level Uplift Results

The evaluation team highlights the top and bottom three measures with the highest and lowest uplift for each fuel type and analysis period in Table B-13 and Table B-14. The evaluation team provides these results to share additional insight, and not for strict evaluation purposes. As such, the evaluation team conducted only minimal processing of measure names. There are changes in the measure mix between analysis periods, and it is unclear as to whether the change in measure mix is due to discontinuing the HER program or natural variability in the measure mix and relatively small and well-distributed contributions to uplift. For example, while a measure may show up as one of the top three measures in one year and the bottom three the next year, we also see similar measures showing up in both the top and bottom three for a given analysis period. Likewise, the difference in uplift between the top and bottom three measures may only be a small fraction of a percent of baseline usage.

Table B-13. Final Year Positive and Negative Uplift Savings by Measure

	Measure	Units	Percent of HER Treatment Customers	Uplift Savings as a % of Baseline Usage[1]
Top 3 Meas.	LED	kWh	0.051%	0.017%
	Thermostat	kWh	0.069%	0.002%
	Insulation	kWh	0.013%	0.001%
Bottom 3 Meas.	Controls	kWh	0.006%	0.000%
	Heat pump	kWh	-0.015%	-0.001%
	Fixture	kWh	-0.005%	-0.001%
Top 3 Meas.	Heating system	Therms	-0.002%	0.006%
	Boiler	Therms	0.006%	0.001%
	Water heater	Therms	0.024%	0.001%
Bottom 3 Meas.	Insulation	Therms	-0.005%	-0.001%
	Controls -res	Therms	0.001%	-0.002%
	Thermostat	Therms	0.039%	-0.003%

1. Percent of total HER population and percent of baseline usage may have different signs; while there may be more treatment participants than control participants, the magnitude of savings could be different between the groups.
Source: Guidehouse and ILLUME analysis

Table B-14. First Persistence Year Positive and Negative Uplift Savings by Measure

	Measure	Units	Percent of HER Treatment Customers	Uplift Savings as a % of Baseline Usage[1]
Top 3 Meas.	Refrigeration	kWh	0.008%	0.001%
	Refrigerator recycling	kWh	0.018%	0.001%
	Controls	kWh	0.028%	0.001%
Bottom 3 Meas.	LED	kWh	-0.005%	0.000%
	DHW	kWh	-0.012%	0.000%
	HVAC	kWh	0.001%	-0.002%
Top 3 Meas.	Thermostat	Therms	0.007%	0.001%
	Combination boiler gas	Therms	0.006%	0.000%
	Insulation	Therms	-0.008%	0.000%

	Measure	Units	Percent of HER Treatment Customers	Uplift Savings as a % of Baseline Usage[1]
Bottom 3 Meas.	Boiler	Therms	-0.008%	0.000%
	Furnace	Therms	-0.035%	0.000%
	Forced hot water boiler 95%	Therms	-0.009%	0.000%

1. Percent of total HER population and percent of baseline usage may have different signs; while there may be more treatment participants than control participants, the magnitude of savings could be different between the groups.
Source: Guidehouse and ILLUME analysis