NAVIGANT

Home Energy Reports Program
PY5 Evaluation Report

Final

Energy Efficiency / Demand Response Plan:
Plan Year 5
(6/1/2012-5/31/2013)

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Table of Contents

NAVIGANT

List of Figures and Tables

Figures

Tables

E. Executive Summary

This report presents a summary of the findings and results from the Impact Evaluation of the EPY5[1] ComEd Home Energy Reports (HER) behavioral program. The program is designed to generate energy savings by providing residential customers with sets of information about customer energy use and energy conservation. The information is provided in the form of Home Energy Reports that give customers various types of information, including: a) how their recent energy use compares to their energy use in the past; b) tips on how to reduce energy consumption, some of which are tailored to the customer's circumstances (e.g. customers with pools receive information on how to reduce energy use by pools); and c) information on how their energy use compares to that of neighbors with similar homes. This set of information has been shown in other studies to induce customers to reduce their energy use, creating average energy savings in the 1% to 3% range.

The design of the program did not change in EPY5, but the enrollment configuration did. In particular, it included two related modifications. The first is that approximately 10,000 customers each in program waves 1 and 3 were targeted for termination of reports in autumn 2012 as part of a persistence study, with the termination lasting throughout EPY5. The second is that, to compensate for the potential reduced savings due to this termination, a "fill-in" wave –wave 5 in this report— targeting 20,000 new customers was added in July 2012.

E.1. Program Savings

Table E-1 summarizes the electricity savings from the HER Program.

Table E-1. EPY5 Total Program Electric Savings

Savings Category	Energy Savings (MWh)
Verified Net Savings, Prior to Uplift Adjustment	97,746
Verified Net Savings	97,442

Source: ComEd billing data, Opower implementation data, and Navigant analysis.

E.2. Program Savings by Participant Wave

For the purposes of this report, the ComEd Home Energy Report (HER) program is characterized as rolled out in five waves: A pilot program targeting 50,000 residential customers initiated in July 2009 (Wave 1); a wave of about 3,000 customers (Wave 2) targeted for program enrollment in September 2010 to "fill-in" for Wave 1 drops; a major expansion targeting 200,000 customers begun in May 2011 (Wave 3); another fill-in wave of 20,000 customers in January 2012 (Wave 4); and a third fill-in wave of 20,000 customers in July 2012 (Wave 5). Moreover, 10,000 customers within both Waves 1 and 3 were targeted to have home energy reports terminated beginning in October 2012 for the remainder

[1] The EPY5 program year began June 1, 2012 and ended May 31, 2013.

of EPY5, thereby creating two subgroups within each of these waves: a terminated report (TR) group, and a continued report (CR) group.

Table E-2 summarizes program savings by participant wave. The number of participants represents the number of customers assigned to each participant group, while the sample size indicates the number of customers with sufficient data for inclusion in the regression analysis.

Table E-2. EPY5 Program Savings, by Wave

Type of Statistic	Wave 1 CR	Wave 1 TR	Wave 2	Wave 3 CR	Wave 3 TR	Wave 4	Wave 5	Total
	Standard errors are provided in italics							
Number of Participants	37,535	8,783	2,928	186,500	9,694	20,377	18,189	284,006
Sample Size, Treatment	30,429	7,146	2,269	162,504	8,388	18,490	11,506	-
Sample Size, Control	35,304		2,276	42,290		18,572	7,302	-
Percent Savings	2.17%	2.13%	2.45%	2.11%	2.40%	1.44%	1.44%	2.04%
	0.19%	*0.32%*	*0.66%*	*0.10%*	*0.21%*	*0.19%*	*0.40%*	-
kWh Savings per customer	344.39	335.68	360.37	421.14	478.54	190.61	270.06	383.47
	30.24	*51.26*	*96.96*	*19.44*	*42.90*	*24.86*	*74.02*	-
Verified Gross Savings, Prior to Uplift Adjustment, MWh (1)	10,817	2,475	910	71,969	4,238	3,670	3,666	97,746
	949.69	*377.92*	*244.80*	*3322.33*	*379.96*	*478.59*	*1004.91*	-
Savings Uplift in other EE programs, MWh (2)	103	-4	1	258	-38	-2	-14	304
Verified Gross Savings, MWh (3)	10,714	2,479	908	71,711	4,276	3,672	3,681	97,442

Source: Navigant analysis.
(1) Total savings are pro-rated for participants that close their accounts during PY5.
(2) Negative double counted savings indicate that the participation rate in the EE program is higher for the control group than the treatment group. This lowers the baseline and underestimates HER program savings.
(3) Gross savings adjusted for savings uplift are equal to gross savings less the uplift of savings in other EE programs.

E.3. Conclusions and Recommendations

Key findings revealed in Table E-1 and Table E-2 include the following:

1. Total program verified net savings in EPY5 are 97,442 MWh.
2. On a percentage basis, savings for Wave 1, 2, and 3 participants who have been enrolled in the program at least two years are statistically no different from one another (at the 90% confidence level), averaging roughly 2.14%.
3. Using past reported savings from the EPY3 and EPY4 evaluation reports, over the past three years energy savings by Wave 1 customers have been remarkably stable: 2.05% in EPY3, 2.20% in EPY4, and 2.16% in EPY5. This is a significant finding and indicates that going forward the program is likely to continue to generate savings of approximately 2% for this group.

4. On a percentage basis, savings per customer are lowest for Wave 4 and Wave 5 participants (1.44% for each). For Wave 5, which enrolled in July 2012, the relatively low savings can be attributed to a ramp-up phase during EPY5. For Wave 4, which began receiving reports in January 2012, this explanation is somewhat less persuasive, though Navigant's experience in evaluating the first year of this program for Waves 1-3, and for the same program for other utilities, is that the ramp-up phase is typically 8-13 months, which means that for Wave 4 the program ramp-up extended into EPY5 by at least several months. Moreover, low savings for Wave 4 may reflect the relatively low energy use by customers in the wave.

A set of 10,000 customers from both Waves 1 and 3 were terminated in October 2013, with the intention to measure the long-run persistence of savings in the absence of reports. However, the terminated customers in Waves 1 and 3 began receiving reports again in summer 2013 (EPY6), halting the planned persistence study. The evaluation will use this group to test the velocity of the rebound to "full" energy savings –the expected savings in the absence of termination. This will provide insight to whether intermediate termination of reports after an initial period of constant messaging is more cost-effective than long-run constant messaging, which could be the case if energy-saving behaviors become stable habits, or perhaps quasi-habits with a slow decay

With these experiments underway, and the program otherwise performing well, major recommendations are limited:

- Continuing the program in its current form for at least another year.
  If the program is expanded again, Navigant should continue to review the billing data for the new treatment and control households for the year prior to the date households are added to the program. Navigant will verify that the allocation of households across the two groups is consistent with a randomized controlled trial.

1. Introduction

1.1 Program Description

The Home Energy Report (HER) program is designed to generate energy savings by providing residential customers with sets of information about their specific energy use and related energy conservation suggestions and tips. The information is provided in the form of Home Energy Reports that give customers various types of information, including: a) how their recent energy use compares to their energy use in the past; b) tips on how to reduce energy consumption, some of which are tailored to the customer's circumstances; and c) information on how their energy use compares to that of neighbors with similar homes. Currently, participating households receive the reports bimonthly. This set of information has been shown in other studies to stimulate customers to reduce their energy use, creating average energy savings in the 1% to 3% range, depending on local energy use patterns.

An important feature of the program is that it is a randomized controlled trial (RCT). Customers in the feasible set of customers (that is, those customers meeting program criteria) are randomly assigned to a treatment (participant) group and a control (non-participant) group, for the purpose of estimating changes in energy use due to the program.

The ComEd program has been rolled out in five waves: A pilot program targeting 50,000 residential customers begun in July 2009 (Wave 1); a wave of about 3,000 customers (Wave 2) begun in September 2010 to "fill-in" for Wave 1 drops; a major expansion targeting 200,000 customers beginning in May 2011 (Wave 3); another fill-in wave of about 20,000 customers beginning in January 2012 (Wave 4); and a final fill-in wave targeting 20,000 customers beginning in July 2012. The second fill-in wave was to compensate for the approximately 10,000 customers in each of waves 1 and 3 (total of 20,000 customers) for whom reports were terminated in October 2012 as part of an experiment to examine how the termination of reports affects energy savings (the Persistence Group in the table below). In this report, for Waves 1 and 3 we distinguish between terminated report (TR) customers and continued report (CR) customers. Net savings are reported by wave, and, for Waves 1 and 3, by TR and CR customers. Since TR customers stopped receiving reports in October 2012, their energy savings in PY5 represents energy savings associated with receiving reports through September 2012, followed by a termination period from October 2012 through May 2013.

Wave 1 of the program received initial reports during August-September 2009, and involved three groups of customers that received different treatments in the first year of the program, as follows:

- Group 1: approximately 20,000 customers receive bimonthly reports after having started the program with six monthly reports. This group was randomly drawn from a set of about 40,000 high-use customers (that is, customers with relatively high energy consumption in the pre-program year), with the remaining 20,000 customers assigned to serve as control households for evaluating program savings.
- Groups 2 and 3, and sets of control households of equal size, were randomly drawn from a set of approximately 60,000 households with relatively low energy consumption in the pre-program year:

- Group 2: about 15,000 customers receive bimonthly reports for the duration of the program.
- Group 3: about 15,000 customers received monthly reports for the first three months of the program, and then switched to quarterly reports for two quarters, and then switched to bimonthly reports at the start of EPY3.

In the past, Navigant has reported results separately for each one of these groups. Given that all three groups received bi-monthly reports for the full two years before the start of EPY5 and that the ratio of treatment to control customers is constant across the groups, in this report we combine them, only reporting results for Wave 1 overall.

Table 1-1 provides a synopsis of the program rollout.

Table 1-1. Synopsis of the HER program

Wave	Persistence Group Indicator	Month of First Report†	Month of Last Report	Targeted Number of Participants‡	Targeted Number of Controls‡	Average Daily Usage in Post Period (kWh)
1	-	July 2009	-	50,000	50,000	43
1	TR		August 2012	10,000		42
2	-	September 2010	-	3,000	3,000	39
3	-	May 2011	-	200,000	50,000	54
3	TR	-	August 2012	10,000		53
4	-	January 2012	-	20,000	20,000	36
5	-	July 2012	-	20,000	20,000	61

† This is the month of the "first generated date" in the Opower dataset when a wave is initiated. Participants likely received their first report approximately one month later than this date.
‡ These numbers are the targeted numbers for each wave. The actual number of participants and control customers at the start of EPY5 is used in the evaluation.

1.2 Evaluation Objectives

The primary objective of the analysis in this report is to determine the extent to which participants in each wave of the HER program reduced their energy consumption in EPY5 due to the program. A secondary question addressed in this report concerns the tracking of how program savings change over time. EPY5 marks the fourth year of the program for Wave 1 participants and the second full year of the program for participants in Waves 2 and 3.

2. Evaluation Approach

The evaluation approach is consistent with that of the evaluations in previous years, relying on statistical analysis appropriate for RCTs.

2.1 Overview of Data Collection Activities

Navigant received tracking data and monthly billing data for all program participants and control customers for the period of September 2008 to May 2013 from the program implementer. Details are provided Table 2-1.

Table 2-1. Primary Data Collection Methods

Collection Method	Subject Data	Quantity	Net Impact	Process
Billing Data	Program participants and controls	All	X	N/A
Tracking Data	Program participants and controls	All	X	N/A
Tracking Data for Other Programs	Participants in other programs	All	X	N/A

2.2 Sampling Plan

The HER program was implemented by the program implementer as a randomized controlled trial (RCT) in which individuals are randomly assigned to a treatment (participant) group and a control group, for the purpose of estimating changes in energy use due to the program. Data for all participants and controls are included in this impact evaluation.

Navigant conducted a statistical analysis to determine whether the assignment of customers to the terminated groups for Waves 1 and 3 is statistically consistent with an RCT design, and further examined whether the allocation of customers in the newest wave –Wave 5—is consistent with an RCT. A detailed description of this analysis appears in Section 6.

Analysis results for Wave 5 are consistent with an RCT, but the assignment of terminated customers in Waves 1 and 3 are not. In particular, in Wave 1 control customers consistently use more energy than terminated participants, averaging about 1.5% greater energy use, and in Wave 3 control customers use more energy than terminated participants in the summer and less in the winter, with the difference in summer being most pronounced. In its evaluation, Navigant attempts to control for these differences in its regression modeling.

2.3 Data Used in Impact Analysis

In preparation for the impact analysis, Navigant combined and cleaned the data provided by the implementer. The dataset included 293,742 participants and 128,423 controls. Navigant removed the following customers and data points from the analysis:

- Customers with no first report generation date (11 participants, 9 controls)
- Customers with delayed first report generation dates[2] (5,562 participants, 2,308 controls)
- Customers with less than 11 or more than 13 bills during the pre-program year[3] (3,725 participants, 1,598 controls)
- Customers with less than 11 or more than 13 bills during EPY5[4] (31,264 participants, 15,600 controls)
- Observations with less than 20 or more than 40 days in the billing cycle
- Observations missing billing usage data
- Observations outside of the twelve month pre-program period or the EPY5 post period
- Outliers, defined as observations with average daily usage more than one order of magnitude from the median usage[5]

2.4 Statistical Models used in the Impact Evaluation

Navigant estimated program impacts using two approaches: linear fixed effects regression (LFER) analysis applied to monthly billing data, and a simple post-program regression (PPR) analysis with lagged controls. We run both models as a robustness check. Although the two models are structurally very different, both generate unbiased estimates of program savings in an RCT, and assuming the RCT is well balanced with respect to the drivers of energy use, in a single sample they generate very similar estimates of program savings.

The LFER model combines both cross-sectional and time series data in a panel dataset. The regression essentially compares pre- and post-program billing data for participants and controls to identify the effect of the program. The customer-specific fixed effect is a key feature of the LFER analysis and captures all customer-specific effects on electricity usage that do not change over time, including those that are unobservable. Examples include the square footage of a residence, the number of occupants, and thermostat settings. The fixed effect represents an attempt to control for any small systematic differences between the treatment and control customers that might occur due to chance.

As with the LFER model, the PPR model combines both cross-sectional and time series data in a panel dataset, but it uses the post-program data only, with lagged energy use for the same calendar month of the pre-program period replacing the customer-specific fixed effect serving as a control for any small systematic differences between the treatment and control customers.

[2] The majority of customers within a wave have first report generation dates clustered within a few weeks. However, some customers have delayed first report generation dates. For some customers, the delays are up to several years. Therefore, Navigant excluded all customers with a delayed first report generation date from the regression analysis in order to study a more homogeneous treatment group. Customers with a delayed first report generation date count towards total program savings, accruing savings once they have received their first report. The program implementer stated that delayed first report dates are typically caused by insufficient or erroneous data.

[3] Most customers in Wave 5 did not have a full year of pre-program data. Therefore, Navigant included Wave 5 customers with 10-13 bills in the pre-program year.

[4] Many of these customers have inactive accounts.

[5] The median usage was 41.233 kWh per day. Observations with usage values greater than 412.33 kWh per day or less than 4.1233 kWh per day were excluded from the analysis.

Section 6.2.1 of the appendix presents the LFER and PPR models used in the analysis.

2.5 Accounting for Uplift in other Energy Efficiency Programs

The HERs include energy saving tips, some of which encourage participants to enroll in other ComEd energy efficiency programs. If participation rates in other energy efficiency programs are the same for HER participants and controls, the savings estimates from the regression analysis are already "net" of savings from the other programs, as this indicates the HER program had no effect on participation in the other energy efficiency (EE) programs. However, if the HER program affects participation rates in other energy efficiency programs, then savings across all programs are lower than indicated by the simple summation of savings in the HER and EE programs. For instance, if the HER program increases participation in other EE programs, the increase in savings may be allocated to either the HER program or the energy efficiency program, but cannot be allocated to both programs simultaneously.[6]

As data permitted, Navigant used a difference-in-difference (DID) statistic to estimate uplift in other EE programs, in which the change in the participation rate in another EE program between EPY5 and the pre-program year for the control group was subtracted from the same change for the treatment group. For instance, if the rate of participation in an EE program during EPY5 is 5% for the treatment group and 3% for the control group, and the rate of participation during the year before the start of the HER program is 2% for the treatment group and 1% for the control group, then the rate of uplift due to the HER program is 1%, which is reflected the calculation (5%-2%)-(3%-1%) =1%. The DID statistic generates an unbiased estimate of uplift when the baseline average rate of participation is the same for the treatment and control groups, or when they are different due only to differences between the two groups in time-invariant factors, such as the square footage of the residence.

An alternative statistic that generates an unbiased estimate of uplift when the baseline average rate of participation in the EE program is the same for the treatment and control groups is a simple difference in participation rates during EPY4. Navigant uses this alternative statistic –the "post-only difference" (POD) statistic –in cases where the EE program did not exist during the pre-program year.

Navigant examined the uplift associated with five energy efficiency programs: Residential Fridge and Freezer Recycle Rewards (FFRR) program, Complete System Replacement (CSR) program, Clothes Washers (CW), Multifamily (MF), and Single Family Home Energy Savings (SFHES) program. The FFRR program achieves energy savings through retirement and recycling of older, inefficient refrigerators, freezers, and room air conditioners. The SFHES program provides customers in single family homes a discounted home energy assessment and free or incentivized direct install and weatherization measure recommendations and installations. The CSR program offers education and cash incentives to ComEd's, Nicor Gas', North Shore Gas', and Peoples Gas' residential customers to encourage customer purchases of higher efficiency HVAC equipment. The CW program offers point-of-sale discounts for qualified clothes washers. The MF program offers direct installation of low-cost efficiency measures, such as water efficiency measures and CFLs at eligible multifamily residences.

[6] It is not possible to avoid double counting of savings generated by programs for which tracking data is not available, such as upstream CFL programs.

For each EE program, double-counted savings were calculated separately for each wave of the HER program. This is discussed fully in Section 4's Net Impact Evaluation, below.

2.6 Process Evaluation

The evaluation of the HER program involved no process evaluation.

3. Gross Impact Evaluation

As detailed below, the LFER and PPR models generate very similar results for program savings, with LFER estimates slightly lower than PPR estimates. We use LFER results for reporting total program savings for EPY5. Overall gross program savings for EPY5 were 97,746 MWh, prior to adjusting for savings uplift.

3.1 LFER and PPR Model Parameter Estimates

Regression parameter estimates for program savings are found in Table 6-1 in the Appendix. In the table, estimates for the LFER and PPR models are presented together, by wave, to provide a better sense of the similarity of estimates across the two models for the same wave. With the exception of Wave 4, savings parameter estimates are higher for the PPR model than for the LFER model, ranging from 1.40% higher for Wave 2 customers (0.988 kWh/day compared to 1.002 kWh/day), to 10.33% higher for the Wave 1-Terminated customers (1.015 kWh/day compared to 0.920 kWh/day). For Wave 4 customers, savings were 0.39% higher for the LFER model than for the PPR model (0.522 kWh/day compared to 0.520 kWh/day). Notably, the results of the LFER and PPR models are not statistically significantly different at the 90% confidence level.

3.2 Uplift of Savings in Other EE programs

LFER program savings include savings resulting from the uplift in participation in other energy efficiency programs caused by the HER program. To avoid double-counting of savings, program savings due to this uplift must be counted towards either the HER program or the other EE programs, but not both programs. The uplift of savings in other EE programs was a very small proportion of the total savings: 304 MWh or 0.31%. Subtracting these savings from gross savings (97,746 MWh) generates a net savings estimate of 97,442 MWh. To put this in perspective, across all waves the weighted average percent savings for EPY5 due to the HER program is 2.041% of total energy use, and removing the savings uplift in other EE programs reduces this value to 2.035%.[7]

Table 3-1 presents a summary of the EPY5 double-counted savings due to uplift in other EE programs and the verified gross savings for the HER program obtained by removing these savings from the estimate of verified gross program savings prior to uplift adjustment, by program wave. Table 6-2 to Table 6-8 in the appendix present the details of the calculation of the double-counted savings for each for the five ComEd energy efficiency programs considered in the analysis. The programs included in the uplift analysis were the Residential Fridge and Freezer Recycle Rewards (FFRR) program, Complete System Replacement (CSR) program, Clothes Washer (CW) program, Multifamily (MF), and Single Family Home Energy Savings (SFHES) program.[8] Where possible Navigant used a

[7] Multiplying 2.041% (the percent of total energy use saved) by 0.31% (the percentage of total savings uplift in other EE programs) generates the value 0.006%. Formally, 0.02041·0.0031=0.00006. Subtracting this value from 0.02041 gives 0.02035, or 2.035%.

[8] ComEd has other residential programs that were not included in the analysis. The Residential Lighting and Elementary Education programs do not track participation at the customer level, and so do not have the data necessary for the uplift analysis. Double counting between the Residential New Construction and HER programs is not possible due to the requirement that HER participants have sufficient historical usage data.

difference-in-difference (DID) statistic to estimate double-counted savings, and otherwise used a simple comparison of the rate of participation in EE programs by treatment and control households in EPY5–the "post-only difference" (POD) estimate of double-counted savings. The statistic used for each calculation is indicated in the tables.

The estimate of double-counted savings is surely an *overestimate* because it presumes participation in the other EE programs occurs at the very start of EPY5. Under the more reasonable assumption that participation occurs at a uniform rate throughout the year, the estimate of double-counted savings would be approximately 152 MWh, half the estimated value of 304 MWh. The upshot is that double counting of savings with other ComEd energy efficiency programs *is not a significant issue* for the HER program.

3.3 Verified Gross Program Impact Results

Table 3-1 presents gross savings across all program groups, and Figure 3-1 shows the percent savings for each group across multiple program years. The three waves that entered EPY5 with at least one full year in the program –waves 1-3—achieved savings of at least 2.1% in EPY5.[9]

Note that savings for the Wave 3 TR participants exceeded savings for the Wave 3 CR participants during EPY5. As noted in section 6.1, Navigant identified statistically significant differences in pre-program usage patterns between the TR and control groups for Waves 1 and 3, indicating that they are not drawn from the same population. Consequently, it is not possible to conclude that the difference in the savings rates for the TR and CR groups is solely attributable to the termination of reports.

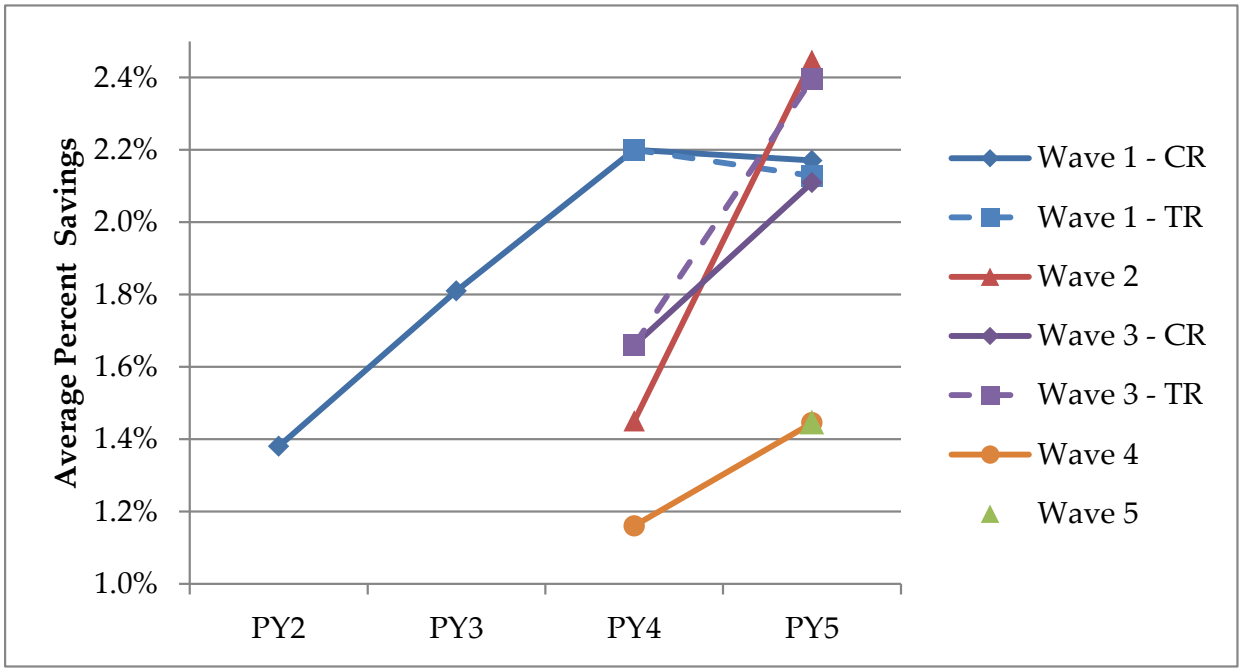
[9] As seen in Figure 3-1, savings were recorded for Wave 4 in EPY4, but reports for this wave were first generated in January 2012, 7 months into EPY4, and so, keeping in mind that the program start date is typically one month after the generation of first reports, entered EPY5 with only 4 months in the program.

Table 3-1. EPY5 Gross Program Savings and Uplift of Savings in Other EE programs, by Wave

Type of Statistic	Wave 1 CR	Wave 1 TR	Wave 2	Wave 3 CR	Wave 3 TR	Wave 4	Wave 5	Total
	Standard errors are provided in italics							
Number of Participants	37,535	8,783	2,928	186,500	9,694	20,377	18,189	284,006
Sample Size, Treatment	30,429	7,146	2,269	162,504	8,388	18,490	11,506	-
Sample Size, Control	35,304		2,276	42,290		18,572	7,302	-
Percent Savings	2.17%	2.13%	2.45%	2.11%	2.40%	1.44%	1.44%	2.04%
	0.19%	*0.32%*	*0.66%*	*0.10%*	*0.21%*	*0.19%*	*0.40%*	-
kWh Savings per customer	344.39	335.68	360.37	421.14	478.54	190.61	270.06	383.47
	30.24	*51.26*	*96.96*	*19.44*	*42.90*	*24.86*	*74.02*	-
Verified Gross Savings, Prior to Uplift Adjustment, MWh (1)	10,817	2,475	910	71,969	4,238	3,670	3,666	97,746
	949.69	*377.92*	*244.80*	*3322.33*	*379.96*	*478.59*	*1004.91*	-
Savings Uplift in other EE programs, MWh (2)	103	-4	1	258	-38	-2	-14	304
Verified Gross Savings, MWh (3)	10,714	2,479	908	71,711	4,276	3,672	3,681	97,442

Source: Navigant analysis.
(1) Total savings are pro-rated for participants that close their accounts during PY5.
(2) Negative double counted savings indicate that the participation rate in the EE program is higher for the control group than the treatment group. This lowers the baseline and underestimates HER program savings.
(3) Gross savings adjusted for savings uplift are equal to gross savings less the uplift of savings in other EE programs.

Figure 3-1. Behavioral program savings over time



Source: Navigant analysis

4. Net Impact Evaluation

A key feature of the RCT design of the HER program is that the analysis inherently estimates net savings because there are no participants who otherwise might have received the individualized reports in the absence of the program. While some customers receiving reports may have taken energy conserving actions or purchased high efficiency equipment anyway, the random selection of program participants (as opposed to voluntary participation) implies that the control group of customers *not* receiving reports is expected to exhibit the same degree of energy conserving behavior and purchases. Thus, there is no free ridership, and no "net-to-gross" adjustment is necessary. Therefore, Navigant applied a net-to-gross ratio of 1.0.

5. Conclusions and Recommendations

This section summarizes the key impact findings and recommendations.

Program Savings Goals Attainment

Finding 1. Overall the program continues to generate savings at the level expected. The verified net savings are 97,442 MWh for EPY5, corresponding to a 2.04% reduction in usage for program participants. For three of the four waves for which EPY5 was at least the second full year of participation in the program, energy savings were over 2%. Average savings for Wave 4, which entered the program only 6 months before the start of EPY5 and for which average customer energy use is relatively low, were 1.44%. Customers in Wave 5 started the program in July 2012, and in their first year generated average savings (1.44%) that indicate they are also likely to save over 2% in the second year of the program.

Recommendation. Continue the program in its current form. There are no apparent changes needed in program design or implementation.

Other Findings

Finding 2. Customers terminated in October 2012 in Waves 1 and 3 and then re-started in May 2013 generated savings in EPY5 at least as high as their counterparts who continued to receive reports. This result might reflect that program effects persist for at least 7-8 months, or that terminated customers are somehow different than customers who continued in the program, or a combination of both.

Recommendation. Navigant recommends caution when interpreting differences in savings for the TR and CR groups. Navigant is aware that ComEd intends to conduct a second persistence study which should provide a more robust understanding of the persistence of program impacts after reports are terminated.

6. Appendix

6.1 Statistical verification of the RCT design

Statistical analysis can be used to determine whether the assignment of customers to the treatment and control groups is consistent with an RCT design. The analysis involves comparing the means of the two groups with respect to demographic variables and energy use in the pre-program year. Navigant previously evaluated the RCT design for Waves 1-4. It found an anomaly in Group 1 of Wave 1 – evidence against an RCT – but found that the standard statistical analysis for an RCT design corrected for it.

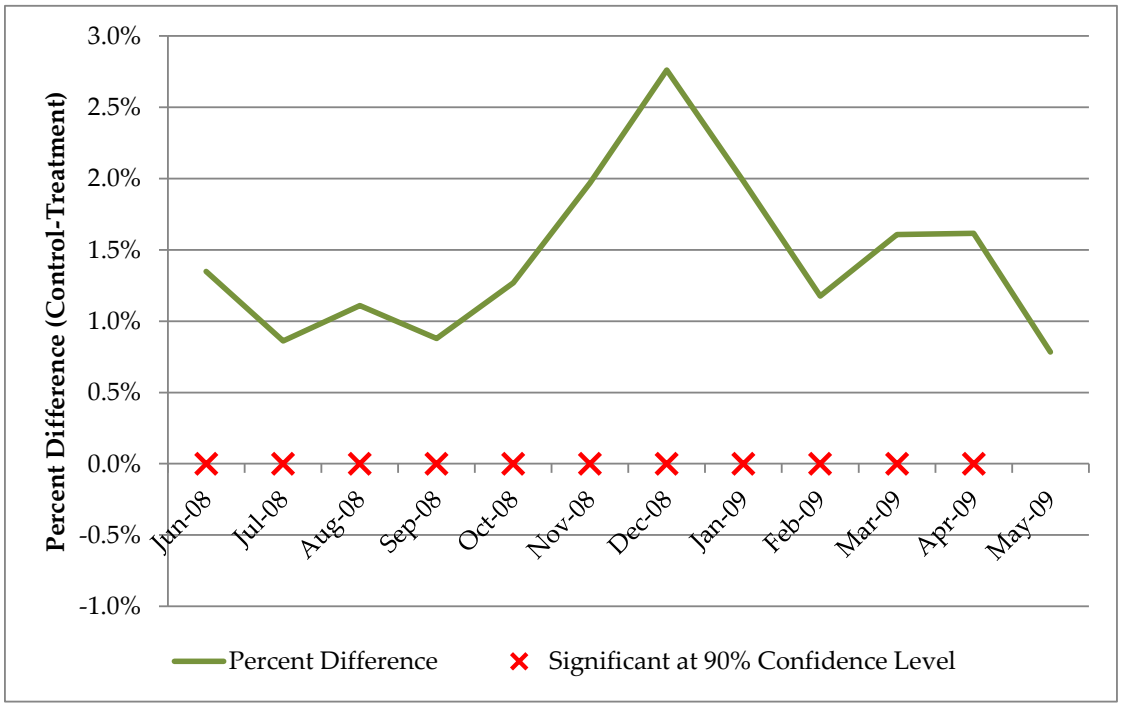
In the current analysis we examined whether the assignment of customers to the terminated groups for Waves 1 and 3 is statistically consistent with an RCT design, and further examined whether the allocation of customers in the newest wave –Wave 5—is consistent with an RCT.

Figure 6-1 through Figure 6-3 below present estimation results. The analysis involves comparing the mean energy use of participant and control groups in each month of the particular wave's pre-program year. Under the assumption of an RCT, and at the 90% confidence level, we would expect that for each wave, chance alone would yield a statistical difference in mean consumption between the treatment and control groups for 0-2 months of the pre-program year.

Analysis results for Wave 5 (see Figure 6-3) are consistent with an RCT, but the assignment of terminated customers in Waves 1 and 3 are not. In particular, in Wave 1 control customers consistently use more energy than terminated participants (see Figure 6-1), averaging about 1.5% greater energy use, and in Wave 3 control customers use more energy than terminated participants in the summer and less in the winter (see Figure 6-2), with the difference in summer being most pronounced. In its evaluation, Navigant controls for these differences in its regression modeling, finding that in both cases two quite different models give very similar estimates of savings. This suggests that differences between the control group and the terminated treatment group that are not program-related are properly controlled for.[10]

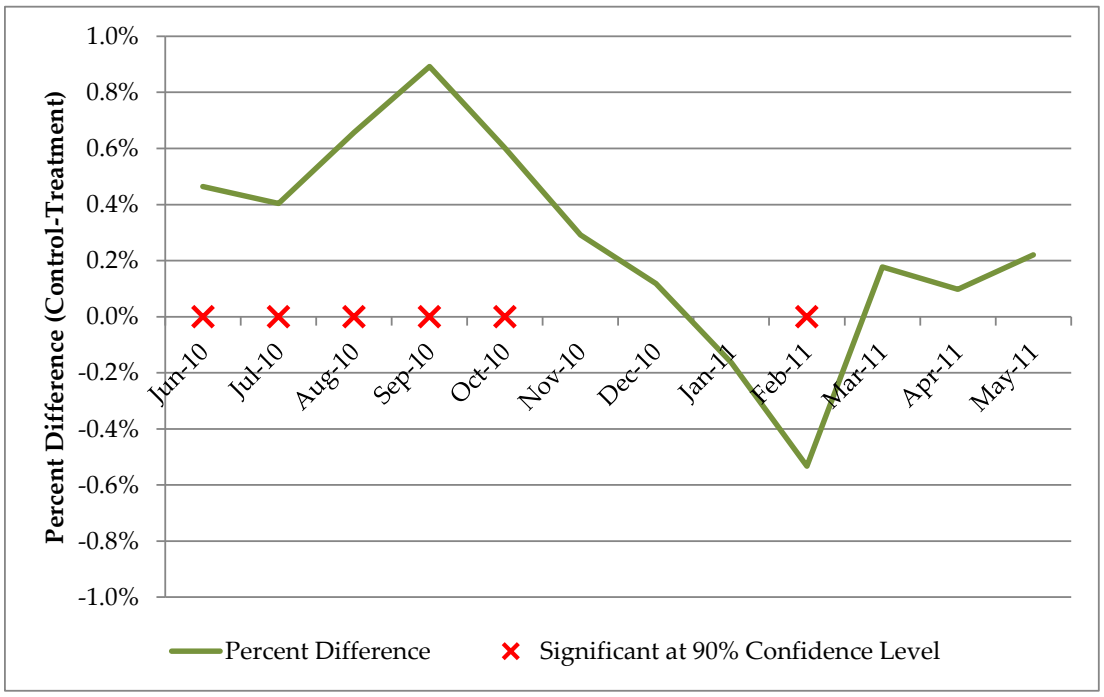
[10] These statistical differences raise the possibility that statistical differences also exist between control customers and continuing participants. We find that continuing participants are statistically different than control customers in Wave 1, but in the opposite direction, as would be expected: whereas the control group uses consistently more energy than the terminated participants during the pre-program year, the control group uses consistently *less* energy than the continuing participants. We correct for this difference in the regression modeling. In Wave 3 we found no statistically significant difference in energy use between the control group and the continuing participants during the pre-program year.

Figure 6-1. Percent Difference in Average Daily Energy Use between Wave 1 Control Group and TR Participants, Pre-Program Year



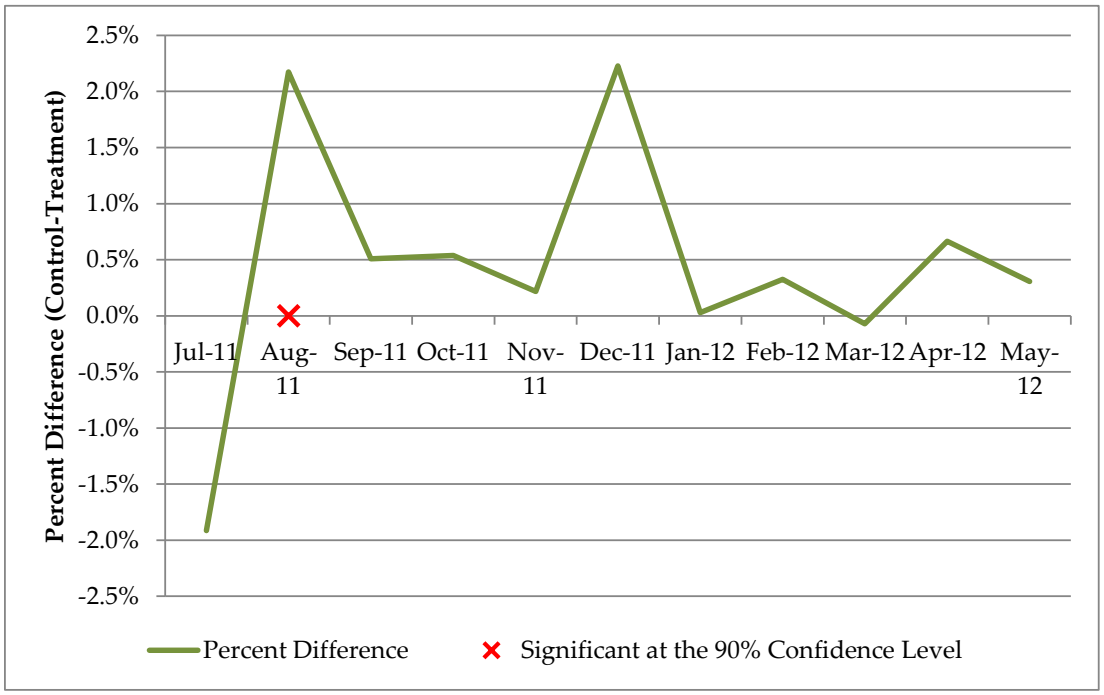
Source: Navigant analysis

Figure 6-2. Percent Difference in Average Daily Energy Use between Wave 3 Control Group and TR Participants, Pre-Program Year



Source: Navigant analysis

Figure 6-3. Percent Difference in Average Daily Energy Use between Wave 5 Control Group and Participants, Pre-Program Year



Source: Navigant analysis

6.2 Detailed impact methodology

Navigant used two regression models to estimate impacts, a linear fixed effects regression (LFER) model, and a post program regression (PPR) model. Each is presented below.

6.2.1 LFER model

The simplest version of an LFER model convenient for exposition is one in which average daily consumption of kWh by household *k* in bill period t, denoted by ADU_{kt}, is a function of three terms: the binary variable $Treatment_k$, taking a value of 0 if household *k* is assigned to the control group, and 1 if assigned to the treatment group; the binary variable $Post_t$, taking a value of 0 if month *t* is in the pre-treatment period, and 1 if in the post-treatment period; and the interaction between these variables, $Treatment_k \cdot Post_t$. Formally,

$$ADU_{kt} = a_{0k} + a_1 Post_t + a_2 Treatment_k \times Post_t + e_{kt}$$

Three observations about this specification deserve comment. First, the coefficient a_{0k} captures **all** household-specific effects on energy use that do not change over time, including those that are unobservable. Second, a_1 captures the average effect *across all households* of being in the post-treatment period. Third, the effect of being both in the treatment group and in the post period –the effect directly attributable to the program—is captured by the coefficient a_2. In other words, whereas the coefficient a_1 captures the change in average daily kWh use across the pre- and post-treatment

for the *control* group, the sum $a_1 + a_2$ captures this change for the treatment group, and so a_2 is the estimate of average daily kWh energy savings due to the program in EPY5.

6.2.2 PPR Model

Whereas the LFER model controls for non-treatment differences in energy use between treatment and control customers using the customer-specific fixed effect, the PPR model controls for these differences using lagged energy use as an explanatory variable. In particular, energy use in calendar month *m* of the post-program period is framed as a function of both the treatment variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between control and treatment customers will be reflected in differences in their past energy use, which is highly correlated with their current energy use. Formally, the model is,

$$ADU_{kt} = b_0 + b_1 ADUlag_{kt} + b_2 Treatment_k + e_{kt},$$

where $ADUlag_{kt}$ is customer *k*'s energy use in the same calendar month of the pre-program year as the calendar month of month *t*. In this model, b_2 is the estimate of average daily kWh energy savings due to the program in EPY5.

6.2.3 Detailed impact results: parameter estimates

For each wave in the analysis, and for each of the two regression models presented above, Table 6-1 provides the estimate of the average daily kWh savings, and the standard error, for EPY5. For the LFER model, this value is the coefficient a_2. For the PPR model it is the coefficient b_2.

Table 6-1. Savings Parameter Estimates

		LFER Model		PPR Model	
Wave	Persistence	Parameter Estimate	*Standard Error*	Parameter Estimate	*Standard Error*
1	CR	0.944	*0.083*	0.988	*0.081*
1	TR	0.920	*0.140*	1.015	*0.137*
2	-	0.988	*0.266*	1.002	*0.267*
3	CR	1.154	*0.053*	1.212	*0.057*
3	TR	1.311	*0.118*	1.374	*0.123*
4	-	0.522	*0.068*	0.520	*0.060*
5	-	0.888	*0.243*	0.969	*0.205*

Source: Navigant analysis.

6.2.4 Savings due to participation uplift in other EE programs

Table 6-2 to Table 6-8 present program savings due to participation uplift in other EE programs. Each table provides the uplift for a single program group in each of three EE programs for which estimates of deemed savings are available: The Residential Fridge and Freezer Recycle Rewards (FFRR) program, Complete System Replacement (CSR) program, Clothes Washer (CW) program,

Multifamily (MF) program, and Single Family Home Energy Savings (SFHES) program. In all tables, a dash (-) in a row concerning the change in rate of participation from the pre-program year indicates the EE program did not exist during the pre-program year. For all cases where the EE program did not exist in the pre-program year, the estimate is based on a POD statistic, otherwise it is based on a DID statistic. Average FFRR program savings are average net verified savings. Average CSR, CW, and SFHES program savings are ex-ante savings. Average MF program savings are average gross verified savings.

The tables also include the percent change in EE program participation rate for HER participants. Note that this differs from the change in EE program participation rate for the entire EE program, which is not reported here. These rates should be interpreted with caution because they likely have very wide error bounds, many of which likely include zero. The calculation of standard errors on these rates is not straightforward, and therefore is not reported here.

Table 6-2. Estimates of Double Counted Savings: Wave 1, CR Persistence Group

	Program				
	FFRR	CSR	CW	MF	SFHES
Average program savings (annual kWh per participant)	592	769	65	372	451
# HER Treatment Households	37,535	37,535	37,535	37,535	37,535
Rate of participation, PY5 (%)	2.03%	0.43%	1.29%	0.05%	0.06%
Change in rate of participation from pre-program Year (%)	1.58%	-	-	0.05%	-
# HER control households	35,432	35,432	35,432	35,432	35,432
Rate of participation, PY5 (%)	1.74%	0.29%	1.13%	0.05%	0.08%
Change in rate of participation from pre-program Year (%)	1.30%	-	-	0.05%	-
DID/(POD) statistic	0.28%	0.14%	0.16%	0.00%	-0.02%
Change in program participation due to HER program	106.76	50.89	61.32	0.99	-8.78
Statistically Significant at the 90% Confidence Level?	Yes	Yes	Yes	No	No
Savings attributable to other programs (kWh)	**63,249**	**39,118**	**4,010**	**368**	**-3,960**
Percent change in EE program participation rate for HER participants	16%	47%	15%	6%	-28%

Source: Navigant analysis.

Table 6-3. Estimates of Double Counted Savings: Wave 1, TR Persistence Group

	Program				
	FFRR	CSR	CW	MF	SFHES
Average program savings (annual kWh per participant)	592	769	65	372	451
# HER Treatment Households	8,783	8,783	8,783	8,783	8,783
Rate of participation, PY5 (%)	1.94%	0.34%	1.29%	0.07%	0.11%
Change in rate of participation from pre-program Year (%)	1.38%	-	-	0.07%	-
# HER control households	8,229	8,229	8,229	8,229	8,229
Rate of participation, PY5 (%)	1.82%	0.41%	1.17%	0.05%	0.06%
Change in rate of participation from pre-program Year (%)	1.42%	-	-	0.05%	-
DID/(POD) statistic	-0.04%	-0.07%	0.12%	0.02%	0.05%
Change in program participation due to HER program	-3.88	-6.29	10.54	1.73	4.66
Statistically Significant at the 90% Confidence Level?	No	No	No	No	No
Savings attributable to other programs (kWh)	**-2,297**	**-4,835**	**689**	**643**	**2,103**
Percent change in EE program participation rate for HER participants	-2%	-17%	10%	41%	87%

Source: Navigant analysis.

Table 6-4. Estimates of Double Counted Savings: Wave 2

	Program				
	FFRR	CSR	CW	MF	SFHES
Average program savings (annual kWh per participant)	592	769	65	372	451
# HER Treatment Households	2,928	2,928	2,928	2,928	2,928
Rate of participation, PY5 (%)	0.82%	0.27%	1.02%	0.17%	0.03%
Change in rate of participation from pre-program Year (%)	0.24%	-	-	0.17%	-
# HER control households	2,928	2,928	2,928	2,928	2,928
Rate of participation, PY5 (%)	0.72%	0.31%	1.16%	0.00%	0.03%
Change in rate of participation from pre-program Year (%)	0.20%	-	-	0.00%	-
DID/(POD) statistic	0.03%	-0.03%	-0.14%	0.17%	0.00%
Change in program participation due to HER program	1.00	-1.00	-4.00	5.00	0.00
Statistically Significant at the 90% Confidence Level?	No	No	No	Yes	No
Savings attributable to other programs (kWh)	**592**	**-769**	**-262**	**1,858**	**0**
Percent change in EE program participation rate for HER participants	4%	-11%	-12%	N/A	0%

Source: Navigant analysis.

Table 6-5. Estimates of Double Counted Savings: Wave 3, CR Persistence Group

	Program				
	FFRR	CSR	CW	MF	SFHES
Average program savings (annual kWh per participant)	592	769	65	372	451
# HER Treatment Households	186,500	186,500	186,500	186,500	186,500
Rate of participation, PY5 (%)	1.86%	0.41%	0.98%	0.11%	0.13%
Change in rate of participation from pre-program Year (%)	-0.82%	-	-	0.11%	0.03%
# HER control households	46,069	46,069	46,069	46,069	46,069
Rate of participation, PY5 (%)	1.64%	0.33%	0.96%	0.11%	0.10%
Change in rate of participation from pre-program Year (%)	-0.93%	-	-	0.11%	0.00%
DID/(POD) statistic	0.11%	0.08%	0.02%	-0.01%	0.03%
Change in program participation due to HER program	207.76	147.66	34.57	-12.51	52.95
Statistically Significant at the 90% Confidence Level?	Yes	Yes	No	No	Yes
Savings attributable to other programs (kWh)	**123,088**	**113,512**	**2,260**	**-4,650**	**23,881**
Percent change in EE program participation rate for HER participants	6%	24%	2%	-6%	29%

Source: Navigant analysis

Table 6-6. Estimates of Double Counted Savings: Wave 3, TR Persistence Group

	Program				
	FFRR	CSR	CW	MF	SFHES
Average program savings (annual kWh per participant)	592	769	65	372	451
# HER Treatment Households	9,694	9,694	9,694	9,694	9,694
Rate of participation, PY5 (%)	1.69%	0.35%	1.05%	0.10%	0.13%
Change in rate of participation from pre-program Year (%)	-0.91%	-	-	0.10%	0.05%
# HER control households	2,391	2,391	2,391	2,391	2,391
Rate of participation, PY5 (%)	1.76%	0.71%	1.17%	0.00%	0.13%
Change in rate of participation from pre-program Year (%)	-0.63%	-	-	0.00%	0.00%
DID/(POD) statistic	-0.28%	-0.36%	-0.12%	0.10%	0.05%
Change in program participation due to HER program	-27.18	-34.92	-11.52	10.00	5.00
Statistically Significant at the 90% Confidence Level?	No	Yes	No	No	No
Savings attributable to other programs (kWh)	**-16,106**	**-26,847**	**-753**	**3,717**	**2,255**
Percent change in EE program participation rate for HER participants	-14%	-51%	-10%	N/A	63%

Source: Navigant analysis.

Table 6-7. Estimates of Double Counted Savings: Wave 4

	Program				
	FFRR	CSR	CW	MF	SFHES
Average program savings (annual kWh per participant)	592	769	65	372	451
# HER Treatment Households	20,377	20,377	20,377	20,377	20,377
Rate of participation, PY5 (%)	1.93%	0.37%	1.00%	0.12%	0.08%
Change in rate of participation from pre-program Year (%)	-0.08%	-	-	0.12%	-0.09%
# HER control households	20,410	20,410	20,410	20,410	20,410
Rate of participation, PY5 (%)	1.90%	0.39%	1.21%	0.12%	0.08%
Change in rate of participation from pre-program Year (%)	-0.12%	-	-	0.12%	-0.07%
DID/(POD) statistic	0.04%	-0.02%	-0.21%	0.01%	-0.02%
Change in program participation due to HER program	7.96	-3.87	-42.60	1.04	-4.02
Statistically Significant at the 90% Confidence Level?	No	No	Yes	No	No
Savings attributable to other programs (kWh)	**4,717**	**-2,977**	**-2,786**	**386**	**-1,815**
Percent change in EE program participation rate for HER participants	2%	-5%	-17%	4%	-20%

Source: Navigant analysis.

Table 6-8. Estimates of Double Counted Savings: Wave 5

	Program				
	FFRR	CSR	CW	MF	SFHES
Average program savings (annual kWh per participant)	592	769	65	372	451
# HER Treatment Households	18,189	18,189	18,189	18,189	18,189
Rate of participation, PY5 (%)	0.51%	0.10%	0.37%	0.06%	0.07%
Change in rate of participation from pre-program Year (%)	-0.35%	0.02%	0.51%	0.06%	0.02%
# HER control households	11,583	11,583	11,583	11,583	11,583
Rate of participation, PY5 (%)	0.61%	0.07%	0.29%	0.10%	0.03%
Change in rate of participation from pre-program Year (%)	-0.15%	-0.03%	0.43%	0.10%	0.00%
DID/(POD) statistic	-0.21%	0.06%	0.08%	-0.04%	0.02%
Change in program participation due to HER program	-37.30	10.28	14.48	-7.84	4.00
Statistically Significant at the 90% Confidence Level?	Yes	No	No	No	No
Savings attributable to other programs (kWh)	**-22,101**	**7,904**	**947**	**-2,915**	**1,804**
Percent change in EE program participation rate for HER participants	-29%	118%	28%	-42%	50%

Source: Navigant analysis.