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Home Energy Report Opower Program Decay Rate and Persistence Study

FINAL

Energy Efficiency/Demand Response Plan: Plan Year 7 (6/1/2014-5/31/2015)

Presented to Commonwealth Edison Company

January 29, 2016

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Acknowledgements
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Table of Contents

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List of Figures and Tables

Tables

E. Executive Summary

This report presents a summary of the findings and results from a persistence and decay rate study for the Home Energy Report (HER) Opower program. Commonwealth Edison Company (ComEd) designed the program to generate energy savings by providing residential customers with sets of information about customer energy use and energy conservation. Program participants received information in the form of regularly mailed home energy reports that gave customers various types of information, including the following:

- Assessment of how their recent energy use compared to their energy use in the past
- Tips on how to reduce energy consumption, some of which were tailored to the customer's circumstances.
- Information on how their energy use compared to that of neighbors with similar homes.

The Opower HER program was discontinued for three subsets of participants in October 2013.[1] These three terminated report (TR) groups are identified in the shaded rows of Table E-1. Customers in Wave 1 TR received reports for just over four years before they were discontinued, Wave 3 TR for two and a half years, and Wave 5 Non-AMI TR for just over one year.

Table E-1. Summary of Opower HER Waves

Wave	Start Date	Stop Date	Restart Date	Length of Treatment Before Termination
Wave 1 CR	July 2009	-	-	-
Wave 1 LR	July 2009	October 2012	August 2013	-
Wave 1 TR	July 2009	October 2013	-	52 months
Wave 2	September 2010	-	-	-
Wave 3 CR	May 2011	-	-	-
Wave 3 LR	May 2011	October 2012	August 2013	-
Wave 3 TR	May 2011	October 2013	-	30 months
Wave 4	January 2012	-	-	-
Wave 5 AMI	May 2012	August 2014	-	-
Wave 5 Non-AMI CR	July 2012	-	-	-
Wave 5 Non-AMI TR	July 2012	October 2013	-	16 months
Wave 6	June 2013	-	-	-
Wave 7 Low	June 2014	-	-	-
Wave 7 High	June 2014	-	-	-

Source: Opower implementation data
Note: CR refers to continued report, LR refers to lapsed report, and TR refers to terminated report.

[1] Wave 5 AMI was discontinued in August 2014 but Navigant has chosen to hold off estimating an annual decay rate for that wave until a full year of data after reports have stopped is available.

The current study looks at persistence savings from this program that accrued in the year after reports were stopped, November 2013 to October 2014, for each of these three TR groups. The persistence, decay, and measure life will be calculated by comparing the TR group from each wave to the continued report (CR) group for each wave. Over the past several years there has been a growing interest in the persistence of savings from HER programs after reports have been stopped. If savings persist after the cessation of reports, it has important implications for the lifetime measure savings and cost-effectiveness of HER programs. The current rule of thumb for electric programs is that the savings decay approximately 20 percent in the first year after reports are stopped.[2]

E.1 Study Savings: November 2013 – October 2014

Table E-2 summarizes the electric savings from the CR and TR customers for each of the three relevant waves in the year after reports were stopped for the TR group. Reports were stopped for the TR customers in October 2013, thus this study evaluates savings in the analysis period from November 1, 2013 to October 31, 2014. Navigant estimated double-counted savings due to uplift in the analysis period but savings from legacy uplift were not estimated; since the analysis period does not line up with a program year Navigant does not have estimates of legacy uplift available for this time period. Navigant did test estimating legacy uplift as the same percentage of current year uplift as was found in the PY7 HER evaluation report[3], but the difference in total savings made a negligible impact on the decay rate and measure life estimation that are the focus of this study, so the adjustment was left out.

Table E-2. HER Total Savings from November 2013 – October 2014

Savings Category	Wave 1 CR	Wave 1 TR	Wave 3 CR	Wave 3 TR	Wave 5 Non-AMI CR	Wave 5 Non-AMI TR
Number of Participants	28,915	8,761	179,057	9,807	22,701	9,941
Sample Size - Treatment	22,450	6,861	150,504	8,204	5,886	5,835
Sample Size - Control	27,623	-	39,272	-	7,403	-
Percentage Savings	2.63%	2.51%	2.53%	2.47%	1.88%	1.46%
Standard Error	*0.25%*	*0.39%*	*0.14%*	*0.29%*	*0.43%*	*0.43%*
Verified Net Savings, Prior to Uplift Adjustment, MWh†	8,710	2,543	72,656	3,848	2,995	2,319
Standard Error	*830*	*391*	*4,018*	*451*	*683*	*691*
Savings Uplift in Other EE Programs in Current Year, MWh‡	17	1	89	3	16	-13
Verified Net Savings, MWh†‡	8,693	2,542	72,567	3,845	2,979	2,332

Source: Navigant analysis

†Total savings are pro-rated for participants that closed their accounts during the analysis period.

‡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.

†‡ Gross savings adjusted for savings uplift are equal to gross savings less the uplift of savings in other EE programs.

[2] Cadmus. 2014. *Long-Run Savings and Cost-Effectiveness of Home Energy Report Programs*. < http://www.cadmusgroup.com/wp-content/uploads/2014/11/Cadmus_Home_Energy_Reports_Winter2014.pdf> Page 7.

[3] Navigant Consulting Inc. 2015. "Home Energy Report Opower Program PY7 Evaluation Report." Presented to Commonwealth Edison Company. (Currently this evaluation report is in draft and expected to be finalized in early 2016.)

E.2 Annual Savings Decay Rate

Table E-3 presents the annual decay rate, the lifetime persistence savings, and the measure life for each of the three TR groups in the first year after reports were stopped, November 2013 to October 2014.[4]

Table E-3. HER Persistence Summary

Type of Statistic	Wave 1 TR	Wave 3 TR	Wave 5 Non-AMI TR	Average
Annual Decay Rate	4.39%	2.12%	22.43%	9.64%
Lifetime Persistence Savings, MWh	85,866	908,385	11,002	-
HER Measure Life, Years	11	14	5	10

Source: Navigant analysis

The decay rate was quite small for Wave 1 and 3 customers who had received reports for approximately four and two and a half years, respectively, before they were stopped. The decay rate was much larger for Wave 5 Non-AMI customers who had received reports for approximately one year before they were stopped. The rate of decay may be slower when customers have received reports for longer either because they have become more ingrained in new behavioral habits formed because of the reports or because they have had more time to purchase new, efficient equipment in response to the reports. It is also possible that these differences in decay are driven by differences in the participants in each wave, for example the average baseline usage for each wave was different. In PY7 baseline usage for Wave 1 TR was 39 kWh per day, Wave 3 TR was 49 kWh/day, and Wave 5 Non-AMI was 60 kWh per day.

E.3. Findings and Recommendations

The following section includes key findings and recommendations.[5]

Finding 1. The Wave specific annual decay rates for the three ComEd HER TR groups were 4 percent for Wave 1, 2 percent for Wave 3, and 22 percent for Wave 5 Non-AMI. The associated persistence factors (the percentage of savings that persist after one year) were 96 percent, 98 percent, and 78 percent, respectively. These results suggest that the decay rate differs depending on the length of time customers had received reports before they were stopped.

Finding 2. The Wave specific estimated measure life for the three ComEd HER TR groups were 11 years for Wave 1, 14 years for Wave 3, and 5 years for Wave 5 Non-AMI. This means that if reports were sent for 52 months, such as in Wave 1, treatment customers would continue to achieve savings for 10 more years after reports stopped; if reports were sent for 30 months, such as in Wave 2, savings continue for 13 more years; and if reports were sent for 16 months, such as in Wave 5 Non-AMI, savings continue for 4 more years.

[4] These estimates assume an annual attrition rate due to residence changes of six percent which was calculated based on the attrition in historical ComEd HER program data.

[5] Numbered findings and recommendations in this section are the same as those found in the Findings and Recommendations section of the evaluation report for ease of reference between each section.

Recommendation 1. The results of this research should be considered in determining persistence factors and measure life for HER programs in the Illinois Technical Reference Manual (IL TRM). Current IL TRM planning includes a "reset" in PY10[6] where all pre-existing HER program waves will be considered to be in Year 1 at that time and adopt one set of persistence factors.[7] This IL TRM measure is planned to account for the fact that HER programs have a multi-year measure life. Of the decay rate and measure life analysis for the three waves presented in this research, Navigant recommends that the findings for Wave 5 Non-AMI (22 percent decay and a 5 year measure life), may be the most applicable values to consider for the IL TRM because Wave 5 Non-AMI was the wave in which customers had only received reports for approximately one year. However, this study represents only one data point in a broader literature and any values created for the IL TRM should also take the broader literature into account.

Recommendation 2. ComEd should continue this study and look at savings in the second year after reports are stopped, from November 2014 to October 2015. The continued study would estimate the decay rate in the second year after reports are stopped. This would add to research on whether decay rates remain constant, increase, or decrease in the second year and the results could be used to inform second year persistence factors in the IL TRM.

[6] PY10 will go from June 1, 2017 to May 31, 2018.

[7] As opposed to adopting multiple persistence factors that differed depending on how long customers had received reports prior to PY10. The "reset" is a simplifying assumption to keep the new behavioral measure calculations straight-forward.

1 Introduction

1.1 Program Description

This report presents a summary of the findings and results from persistence and decay rate study for the Home Energy Report (HER) Opower program. Commonwealth Edison Company (ComEd) designed the program to generate energy savings by providing residential customers with sets of information about customer energy use and energy conservation. Program participants received information in the form of regularly mailed home energy reports that gave customers various types of information, including the following:

- Assessment of how their recent energy use compared to their energy use in the past
- Tips on how to reduce energy consumption, some of which were tailored to the customer's circumstances.
- Information on how their energy use compared to that of neighbors with similar homes.

The Opower HER program was discontinued for three subsets of participants in October 2013.[8] These three terminated report (TR) groups are identified in the shaded rows of Table 1-1. Customers in Wave 1 TR received reports for just over four years before they were discontinued, Wave 3 TR for two and a half years, and Wave 5 Non-AMI TR for just over one year.

Table 1-1. Summary of Opower HER Waves

Wave	Start Date	Stop Date	Restart Date	Length of Treatment Before Termination
Wave 1 CR	July 2009	-	-	-
Wave 1 LR	July 2009	October 2012	August 2013	-
Wave 1 TR	July 2009	October 2013	-	52 months
Wave 2	September 2010	-	-	-
Wave 3 CR	May 2011	-	-	-
Wave 3 LR	May 2011	October 2012	August 2013	-
Wave 3 TR	May 2011	October 2013	-	30 months
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Source: Opower implementation data
Note: CR refers to Continued Report, LR refers to lapsed report, and TR refers to terminated report

[8] Wave 5 AMI was discontinued in August 2014 but Navigant has chosen to hold off estimating an annual decay rate for that wave until a full year of data after reports have stopped is available.

The current study looks at persistence savings from this program that accrued in the year after reports were stopped, November 2013 to October 2014, for each of these three TR groups. The persistence, decay, and measure life were calculated by comparing the TR group from each wave to the continued report (CR) group for each wave. Over the past several years there has been a growing interest in the persistence of savings from HER programs after reports have been stopped. If savings persist after the cessation of reports, it has important implications for the lifetime measure savings and cost-effectiveness of HER programs. The current rule of thumb for electric programs is that the savings decay approximately 20 percent in the first year after reports are stopped.[9]

1.2 Evaluation Objectives

The primary objective of this study is to estimate the annual savings decay rate for each of the three relevant groups in the HER program and the associated program measure life. In this evaluation, the savings decay is defined as the reduction in savings post-stoppage of the HER reports plus the opportunity cost of missed incremental saving. This definition answers the question, "how much less would the HER program save if reports were terminated relative to continuing to receive them?"

[9] Cadmus. 2014. *Long-Run Savings and Cost-Effectiveness of Home Energy Report Programs*. < http://www.cadmusgroup.com/wp-content/uploads/2014/11/Cadmus_Home_Energy_Reports_Winter2014.pdf> Page 7.

2 Study Approach

The study approach for the persistence savings from the HER program relies on statistical analysis appropriate for a RCT and is consistent with the approach used in the annual program year evaluation reports. Navigant estimated program impacts using two approaches: a simple post-program regression (PPR) analysis with lagged controls and a linear fixed-effects regression (LFER) analysis applied to monthly billing data. The persistence, decay, and measure life were calculated by comparing the TR group from each wave to the CR group for each wave.

2.1 *Overview of Data Collection Activities*

Navigant used tracking data and monthly billing data for all program participants and control customers from September 2008 to October 2014 from the program implementer. Table 2-1 provides details.

Table 2-1. Primary Data Collection Activities

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

Source: Navigant analysis

2.2 *Sampling Plan*

The HER program was executed by the program implementer as a RCT, in which individuals were randomly assigned to either a treatment (participant) group or control (non-participant) group.[10] To create the TR subgroups, treatment customers were randomly split between the CR and TR groups.

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 265,078 treatment customers and 105,677 controls. Data during the twelve month pre-period for each wave and the twelve month analysis period from November 2013 to October 2014 was used in the regression analysis for each of the two models described in Section 2.4.

Navigant removed the following customers and data points from the analysis:

- Customers with an active account and less than 11 bills or any customer with more than 13 bills during the analysis period;
- Customers with less than 11 or more than 13 bills during the pre-program year;
- Observations with missing or negative usage;
- Observations with less than 20 or more than 40 days in the billing cycle;
- Outliers, defined as observations with average daily usage more than one order of magnitude from the median usage.[11]

[10] In this design, treatment customers receive HERs, while control customers do not.

[11] Median usage was calculated by wave. Chronologically, the medians were 34.60, 46.60, and 52.60 kilowatt-hours (kWh) per day.

Detailed counts of the customers and observations removed by wave are included in Section 6.1 of the appendix.

2.4 Statistical Models Used in the Impact Evaluation

As indicated above, Navigant estimated program impacts using two approaches: a simple post-program regression (PPR) analysis with lagged controls and a linear fixed-effects regression (LFER) analysis applied to monthly billing data. Navigant used the PPR results to calculate decay and measure life, but ran both models as a robustness check.[12] Although the two models are structurally very different, 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 PPR model combines both cross-sectional and time-series data in a panel format. It uses the post-program data as the dependent variable, with lagged energy use from the same calendar month of the pre-program period serving as a control for any small, systematic differences between the treatment and control customers. The lagged energy use term is similar to the customer fixed effect included in the LFER model explained below.

As with the PPR model, the LFER model combines both cross-sectional and time-series data in a panel format. 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 factors affecting electricity usage that do not change over time, including those that are unobservable. Examples include the square footage of a residence or the number of occupants. 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.

Section 6.2 presents the PPR and LFER models used in this analysis.

2.5 Accounting for Uplift in Other Energy Efficiency Programs

2.5.1 Accounting for Uplift in the Analysis Period

The reports sent to participating households include energy-saving tips, some of which encourage participants to enroll in other ComEd energy efficiency (EE) programs. If participation rates in other EE programs are the same for the HER participant and control groups, the savings estimates from the regression analyses are already "net" of savings from the other programs, as this indicates the HER program did not increase or decrease participation in the other EE programs. However, if the HER program affects participation rates in other EE 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

[12] Navigant prefers to report out the PPR model for two reasons. One, the implementer is also using a post-only model for evaluation. Two, although both the LFER and PPR models generate unbiased estimates of program savings, as an empirical matter—based on our past analyses and those in the academic literature—estimated savings from the PPR model tend to have lower standard errors than those from the LFER model, though the differences are usually very small.

program increases participation in other EE programs, the increase in savings may be allocated to either the HER program or the EE program, but cannot be allocated to both programs simultaneously.[13]

As data permitted, Navigant used a difference-in-difference (DID) statistic to estimate uplift in other EE programs. To calculate the DID statistic, Navigant subtracted the change in the participation rate in another EE program between the analysis period and the pre-program year for the control group from the same change for the treatment group. For instance, if the rate of participation in an EE program during the analysis period is five percent for the treatment group and three percent for the control group, and the rate of participation during the year before the start of the HER program is two percent for the treatment group and one percent for the control group, then the rate of uplift due to the HER program is one percent, as reflected in Equation 2-1.

Equation 2-1. DID Statistic Calculation

$$(analysis\ period\ treatment\ group\ participation - prePY\ treatment\ group\ participation) - (analysis\ period\ control\ group\ participation - prePY\ control\ group\ participation) = DID\ statistic$$

$$(5\% - 2\%) - (3\% - 1\%) = 1\%$$

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 the analysis period. Navigant uses this alternative statistic –the "post-only difference" (POD) statistic –in cases where the EE program did not exist for the entire pre-program year.

Navigant examined the uplift associated with four EE programs: the Fridge and Freezer Recycling (FFR) program, the Home Energy Assessment (HEA) program, the Home Energy Rebates (Rebate) program, and the Multi-family Energy Savings Program (MESP). In this study, we refer to the EE programs by the names used in PY7 since the analysis period spans two program years. The FFR program achieves energy savings through retirement and recycling of older, inefficient refrigerators, freezers, and room air conditioners. In PY7, the HEA program replaced two PY6 programs: the Home Energy Savings (HES) program and the Home Energy Jumpstart (HEJ) program. The HEA program is offered jointly with the local gas utilities and achieves savings by providing direct installation of low-cost efficiency measures for single family homes, such as compacts fluorescent lightbulbs (CFLs) and low-flow showerheads. The Rebate program, which replaced the Complete System Replacement (CSR) program from PY6, offers weatherization and incentives to residential customers to encourage customer purchases of higher efficiency heating, ventilating, and air-conditioning (HVAC) equipment. The MESP offers direct installation of low-cost efficiency measures, such as water efficiency measures and CFLs at eligible multifamily residences.

For each EE program, double-counted savings were calculated separately for the CR and TR subgroups in Waves 1, 3, and 5 Non-AMI.

[13] It is not possible to avoid double counting of savings generated by programs for which tracking data are not available, such as upstream compact fluorescent lamp (CFL) programs.

2.5.2 Accounting for Legacy Uplift

The uplift adjustment methodology described in Section 2.5.1 only accounts for uplift which occurs in the current year because EE program tracking files in any given program year only capture the new measures installed in that year, regardless of the expected measure lives.[14] However, for other EE programs with multi-year measure lives, HER program savings capture the portion of their savings due to uplift in each year of that program's measure life. For instance, a measure with a ten-year measure life that was installed in PY2 would generate savings captured in the HER program savings not just in PY2, but in PY3 through PY11 as well.

Since the analysis period for this study is off from a regular program year Navigant was unable to accurately estimate legacy uplift for this analysis period. Navigant did test estimating legacy uplift as the same percentage of current year uplift as was found in the PY7 HER evaluation report[15], but the difference in total savings made a negligible impact on the decay rate and measure life estimation that are the focus of this study, so the legacy uplift adjustment was left out.

2.6 Estimating Decay

The annual decay rate is equal to one minus the ratio of the percentage savings for the TR group in the first year after the reports were discontinued to percentage savings for the CR group in that same year. Equation 2-2 shows this calculation where δ is the decay rate.

Equation 2-2. Decay Rate

$$\delta = 1 - \frac{\%\ Savings\ for\ TR\ in\ first\ year\ after\ reports\ stop}{\%\ Savings\ for\ CR\ in\ first\ year\ after\ reports\ stop\ for\ TR}$$

The estimated decay rate is used to estimate the measure life of the HER program for the year reports are stopped contingent on receiving reports for x number of years before they were stopped. This method assumes that the measure life is one year for each year that reports were sent up to the final year reports were sent when the measure life is greater than one assuming any persistence of savings. For example, Wave 1 began receiving reports in PY2, estimating measure life in this way would make the measure life one year in PY2-5 and more than one year in PY6, the year in which reports were stopped, for the TR group.

An intermediate step to estimating the measure life is to estimate the lifetime persistence savings, which is the total savings attributable to the program after reports were stopped. The lifetime persistence savings are calculated via an infinite series which converges to Equation 2-3 where α is the annual attrition due to residence changes.[16,17]

[14] Tracking data files are set-up this way because, in conformity the Illinois Technical Reference Manual Section 3.2, savings are first-year savings, not lifetime savings.
[15] Navigant Consulting Inc. 2015. "Home Energy Report Opower Program PY7 Evaluation Report." Presented to Commonwealth Edison Company. (Currently this evaluation report is in draft and expected to be finalized in early 2016.)
[16] The convergence assumes that savings decay infinitely at a constant annual rate of $(1-\delta)(1-\alpha)$.
[17] The Cadmus Group, Inc. 2014. "Long-Run Savings and Cost-Effectiveness of Home Energy Report Programs." Prepared by M. Sami Khawaja, PhD. And James Stewart, PhD.

Equation 2-3. Lifetime Persistence Savings Convergence

$$Lifetime\ Persistence\ Savings = \frac{Total\ Savings\ for\ CR\ in\ first\ year\ after\ reports\ stop\ for\ TR}{\delta + \alpha - (\delta * \alpha)}$$

The lifetime persistence savings is used to estimate the measure life of the HER program contingent on having received reports for x number of years before they were stopped, as shown in Equation 2-4.

Equation 2-4. Measure Life

$$Meas\ Life = \frac{Total\ Savings\ for\ CR\ in\ first\ year\ after\ reports\ stop\ for\ TR + Lifetime\ Persistence\ Savings}{Total\ Savings\ for\ CR\ in\ first\ year\ after\ reports\ stop\ for\ TR}$$

3 Gross Impact Evaluation

Table 3-1 summarizes the electric savings from the CR and TR customers for each of the three relevant waves in the year after reports were stopped for the TR group. Navigant estimated double-counted savings due to uplift in the analysis period but savings from legacy uplift were not estimated; since the analysis period does not line up with a program year Navigant does not have estimates of legacy uplift available for this time period. Navigant did test estimating legacy uplift as the same percentage of current year uplift as was found in the PY7 HER evaluation report[18], but the difference in total savings made a negligible impact on the decay rate and measure life estimation that are the focus of this study, so the adjustment was left out.

Table 3-1. HER Total Savings from November 2013 – October 2014

Savings Category	Wave 1 CR	Wave 1 TR	Wave 3 CR	Wave 3 TR	Wave 5 Non-AMI CR	Wave 5 Non-AMI TR
Number of Participants	28,915	8,761	179,057	9,807	22,701	9,941
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Percentage Savings	2.63%	2.51%	2.53%	2.47%	1.88%	1.46%
Standard Error	*0.25%*	*0.39%*	*0.14%*	*0.29%*	*0.43%*	*0.43%*
Verified Net Savings, Prior to Uplift Adjustment, MWh†	8,710	2,543	72,656	3,848	2,995	2,319
Standard Error	*830*	*391*	*4,018*	*451*	*683*	*691*
Savings Uplift in Other EE Programs in Current Year, MWh‡	17	1	89	3	16	-13
Verified Net Savings, MWh†‡	8,693	2,542	72,567	3,845	2,979	2,332

Source: Navigant analysis

†Total savings are pro-rated for participants that closed their accounts during the analysis period.

‡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.

†‡ Gross savings adjusted for savings uplift are equal to gross savings less the uplift of savings in other EE programs.

3.1 PPR and LFER Model Parameter Estimates

The PPR and LFER models generated very similar results for program savings estimates for each of the three waves included in this study. Navigant used the PPR results to estimate decay and measure life.[19]

[18] Navigant Consulting Inc. 2015. "Home Energy Report Opower Program PY7 Evaluation Report." Presented to Commonwealth Edison Company. (Currently this evaluation report is in draft and expected to be finalized in early 2016.)

[19] Navigant prefers to report out the PPR model for two reasons. One, the implementer is also using a post-only model for evaluation. Two, although both the LFER and PPR models generate unbiased estimates of program savings, as an empirical matter—based on our past analyses and those in the academic literature—estimated savings from the PPR model tend to have lower standard errors than those from the LFER model, though the differences are usually very small.

Across the two models, the parameter estimates are not statistically different; that is, the estimates for each model are within the 90 percent confidence bounds for the other model. Section 6.3 includes detailed estimate information for each relevant wave and model.

3.2 Uplift of Savings in Other EE Programs

PPR program savings estimates include savings resulting from the uplift in participation in other EE programs caused by the HER program. To avoid double-counting 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: 113 MWh, or 0.12 percent. This estimate includes uplift in the analysis period but Navigant did not include legacy uplift in these results.[20]

Table 3-1 above includes a breakdown of the savings from uplift for each wave and the verified net savings for the HER program obtained by removing these savings from the estimate of verified net program savings prior to uplift adjustment. Section 6.4 in the appendix presents the details of the calculation of uplift in the analysis period for each of the four ComEd EE programs considered in the analysis. As previously mentioned, the programs included in the uplift analysis were the FFR program, the HEA program, the Rebate program and the MESP.[21] Where possible, Navigant used a 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 the analysis period – the POD estimate of double-counted savings.

The estimate of double-counted savings is most likely an *overestimate* because it presumes participation in the other EE programs occurs at the very start of the analysis period. Under the more reasonable assumption that participation occurs at a uniform rate throughout the year, the estimate of double-counted savings would be approximately 56.5 MWh, half the estimated value of 113 MWh. The upshot is that double counting of savings with other ComEd EE programs *is not a significant issue* for the HER program.

3.3 Decay Estimates

Table 3-2 presents the annual decay rate, the lifetime persistence savings, and the measure life for each of the three TR groups in the first year after reports were stopped, November 2013 to October 2014.[22] The estimates of savings after the uplift adjustment were used in these estimations.

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[20] Since the analysis period for this study is off from a regular program year Navigant was unable to accurately estimate legacy uplift for this analysis period. Navigant did test estimating legacy uplift as the same percentage of current year uplift as was found in the PY7 HER evaluation report , but the difference in total savings made a negligible impact on the decay rate and measure life estimation that are the focus of this study, so the legacy uplift adjustment was left out.

[21] 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.

[22] These estimates assume an annual attrition rate due to residence changes of six percent which was calculated based on the attrition in historical ComEd HER program data.

Table 3-2. HER Persistence Summary

Type of Statistic	Wave 1 TR	Wave 3 TR	Wave 5 Non-AMI TR	Average
Annual Decay Rate	4.39%	2.12%	22.43%	9.64%
Lifetime Persistence Savings, MWh	85,866	908,385	11,002	-
HER Measure Life, Years	11	14	5	10

Source: Navigant analysis

The decay rate was quite small for Wave 1 and 3 customers who had received reports for approximately four and two and a half years, respectively, before they were stopped. The decay rate was much larger for Wave 5 Non-AMI customers who had received reports for approximately one year before they were stopped. The rate of decay may be slower when customers have received reports for longer either because they have become more ingrained in new behavioral habits formed because of the reports or because they have had more time to purchase new, efficient equipment in response to the reports. It is also possible that these differences in decay are driven by differences in the participants in each wave, for example the average baseline usage for each wave was different. In PY7 baseline usage for Wave 1 TR was 39 kWh per day, Wave 3 TR was 49 kWh/day, and Wave 5 Non-AMI was 60 kWh per day.

These results show that the average annual decay rate for Wave 1 was 4 percent, meaning that the persistence factor[23] after one year was 96 percent. Based on this decay rate, the measure life for Wave 1 TR was 11 years, meaning that treatment customers will continue to achieve savings for 10 more years after reports stop.

For Wave 3 the annual decay rate was 2 percent, meaning that the persistence factor after one year was 98 percent. Based on this decay rate, the measure life for Wave 3 TR was 14 years, meaning that treatment customers will continue to achieve savings for 13 more years after reports stop.

For Wave 5 Non-AMI the annual decay was 22 percent, meaning that the persistence factor after one year was 78 percent. Based on this decay rate, the measure life for Wave 5 Non-AMI was five years, meaning that treatment customers will continue to achieve savings for four more years after reports stop.

[23] The persistence factor is defined as one minus the decay rate, 1-δ.

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" (NTG) adjustment is necessary.

5 Findings and Recommendations

The following section includes key findings and recommendations.[24]

Finding 1. The Wave specific annual decay rates for the three ComEd HER TR groups were 4 percent for Wave 1, 2 percent for Wave 3, and 22 percent for Wave 5 Non-AMI. The associated persistence factors (the percentage of savings that persist after one year) were 96 percent, 98 percent, and 78 percent, respectively. These results suggest that the decay rate differs depending on the length of time customers had received reports before they were stopped.

Finding 2. The Wave specific estimated measure life for the three ComEd HER TR groups were 11 years for Wave 1, 14 years for Wave 3, and 5 years for Wave 5 Non-AMI. This means that if reports were sent for 52 months, such as in Wave 1, treatment customers would continue to achieve savings for 10 more years after reports stopped; if reports were sent for 30 months, such as in Wave 2, savings continue for 13 more years; and if reports were sent for 16 months, such as in Wave 5 Non-AMI, savings continue for 4 more years.

Recommendation 1. The results of this research should be considered in determining persistence factors and measure life for HER programs in the Illinois Technical Reference Manual (IL TRM). Current IL TRM planning includes a "reset" in PY10[25] where all pre-existing HER program waves will be considered to be in Year 1 at that time and adopt one set of persistence factors.[26] This IL TRM measure is planned to account for the fact that HER programs have a multi-year measure life. Of the decay rate and measure life analysis for the three waves presented in this research, Navigant recommends that the findings for Wave 5 Non-AMI (22 percent decay and a 5 year measure life), may be the most applicable values to consider for the IL TRM because Wave 5 Non-AMI was the wave in which customers had only received reports for approximately one year. However, this study represents only one data point in a broader literature and any values created for the IL TRM should also take the broader literature into account.

Recommendation 2. ComEd should continue this study and look at savings in the second year after reports are stopped, from November 2014 to October 2015. The continued study would estimate the decay rate in the second year after reports are stopped. This would add to research on whether decay rates remain constant, increase, or decrease in the second year and the results could be used to inform second year persistence factors in the IL TRM.

[24] Numbered findings and recommendations in this section are the same as those found in the Findings and Recommendations section of the evaluation report for ease of reference between each section.
[25] PY10 will go from June 1, 2017 to May 31, 2018.
[26] As opposed to adopting multiple persistence factors that differed depending on how long customers had received reports prior to PY10. The "reset" is a simplifying assumption to keep the new behavioral measure calculations straight-forward.

6 Appendix

6.1 Detailed Data Cleaning

Table 6-1 provides a detailed account of the data cleaning done for this analysis. Navigant removed the following customers and data points from the analysis:

- Customers with an active account and less than 11 bills or any customer with more than 13 bills during the analysis period;
- Customers with less than 11 or more than 13 bills during the pre-program year;
- Observations with missing or negative usage;
- Observations with less than 20 or more than 40 days in the billing cycle;
- Outliers, defined as observations with average daily usage more than one order of magnitude from the median usage.[27]

Table 6-1 gives counts of customers removed for the first two steps and observations removed for the last three steps. The table also provides the percentage of customers or observations removed. It is evident from the table that the percentage of customers or observations removed was very similar across the treatment and control groups for each wave. This suggests that non-random biases were not introduced into the data by our cleaning. Across the three waves, the sample size used in our regression analysis represents approximately 76% of the original data received.

Table 6-1. Customers/Observations Removed by Data Cleaning Step and Wave

Data Cleaning Step	Wave 1		Wave 3		Wave 5 Non-AMI	
	Treatment	Control	Treatment	Control	Treatment	Control
Customers with < 11 or > 13 bills during program year	47 / 0.1%	45 / 0.1%	349 / 0.1%	77 / 0.1%	81 / 0.4%	58 / 0.5%
Customers with < 11 or > 13 bills during pre-program year	286 / 0.1%	296 / 0.1%	4,054 / 0.1%	994 / 0.1%	4,748 / 24.1%	3,069 / 24.3%
Remove observations with missing or negative usage	0 / 0.0%	0 / 0.0%	10 / 0.1%	1 / 0.1%	4 / 0.0%	0 / 0.0%
Remove observations with >40 or <20 billing days	22,359 / 3.1%	27,457 / 2.8%	110,027 / 2.8%	30,305 / 3.0%	8,288 / 2.7%	5,349 / 2.7%
Remove outliers (avg. daily use 10x above/below median)	2,439 / 0.3%	3,785 / 0.4%	16,238 / 0.4%	3,752 / 0.4%	2,147 / 0.7%	1,156 / 0.6%

Source: Navigant analysis

[27] Median usage was calculated by wave. Chronologically, the medians were 34.60, 46.60, and 52.60 kilowatt-hours (kWh) per day.

6.2 Detailed Impact Methodology

Navigant used two regression models to estimate impacts, a PPR model and an LFER model. The following sections present each model.

6.2.1 Post Program Regression Model

The PPR model controls for non-treatment differences in energy use between treatment and control customers using lagged energy use as an explanatory variable. In particular, the model frames energy use in calendar month *t* of the post-program period 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 shown in Equation 6-1.

Equation 6-1. Post Program Regression Model

$$ADU_{kt} = \beta_1 Treatment_k + \sum_J \beta_{2j} Month_{jt} + \sum_J \beta_{4j} Month_{jt} \cdot ADUlag_{kt} + \varepsilon_{kt}$$

Where

ADU_{kt}	is average daily consumption of kWh by household *k* in bill period *t*
$Treatment_k$	is a binary variable taking a value of 0 if household k is assigned to the control group, and 1 if assigned to the treatment group
$ADUlag_{kt}$	is household *k*'s energy use in the same calendar month of the pre-program year as the calendar month of month *t*
$Month_{jt}$	is a binary variable taking a value of 1 when j = t and 0 otherwise[28]
e_{kt}	is the cluster-robust error term for household *k* during billing cycle *t;* cluster-robust errors account for heteroskedasticity and autocorrelation at the household level.[29]

The coefficient b_1 is the estimate of average daily kWh energy savings due to the program in PY6.

[28] In other words, if there are *T* post-program months, there are *T* monthly dummy variables in the model, with the dummy variable $Month_{tt}$ the only one to take a value of 1 at time t. These are, in other words, monthly fixed effects.

[29] Ordinary Least Squares (OLS) regression models assume that the data are homoskedastic 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 heteroskedastic 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.

6.2.2 Linear Fixed Effects Regression 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 the following three terms:

1. The binary variable $Treatment_k$
2. 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
3. The interaction between these variables, $Treatment_k \cdot Post_t$

Formally, the LFER model is showing in as shown in Equation 6-2.

Equation 6-2. Linear Fixed Effects Regression Model

$$ADU_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Treatment_k \cdot Post_t + \varepsilon_{kt}$$

Three observations about this specification deserve comment. First, the coefficient α_{0k} captures all household-specific effects on energy use that do not change over time, including those that are unobservable. Second, α_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 α_2. In other words, whereas the coefficient α_1 captures the change in average daily kWh use across the pre- and post-treatment for the *control* group, the sum $\alpha_1 + \alpha_2$ captures this change for the treatment group, and so α_2 is the estimate of average daily kWh energy savings due to the program in PY7.

6.3 Detailed Impact Results: Parameter Estimates

Table 6-2 through Table 6-7 show the results of the PPR and LFER models for each wave. Across the two models, the parameter estimates are not statistically different; that is, the estimates for each model are within the 90 percent confidence bounds for the other model. Furthermore, the pattern across the different program waves between the two models is very similar.

Table 6-2. PPR Model Estimates, Wave 1

	Estimate	Std. Error	t value	Pr(>|t|)
yrmo201311	5.8685	0.25616	22.9	0.000
yrmo201312	5.76062	0.26821	21.5	0.000
yrmo201401	6.05747	0.27981	21.6	0.000
yrmo201402	6.94798	0.31707	21.9	0.000
yrmo201403	4.89228	0.35602	13.7	0.000
yrmo201404	5.27448	0.31081	17	0.000
yrmo201405	6.10624	0.27277	22.4	0.000
yrmo201406	8.52355	0.24598	34.6	0.000
yrmo201407	7.8359	0.26474	29.6	0.000
yrmo201408	5.0928	0.26043	19.6	0.000
yrmo201409	8.40742	0.25999	32.3	0.000
yrmo201410	5.97789	0.25913	23.1	0.000
treatment:TR0	-1.07291	0.10228	-10.5	0.000
treatment:TR1	-1.02464	0.15766	-6.5	0.000
yrmo201311:pre.use	0.77529	0.00762	101.7	0.000
yrmo201312:pre.use	0.79342	0.0065	122.1	0.000
yrmo201401:pre.use	0.79484	0.00605	131.4	0.000
yrmo201402:pre.use	0.87691	0.00777	112.8	0.000
yrmo201403:pre.use	0.91484	0.00967	94.6	0.000
yrmo201404:pre.use	0.81802	0.00932	87.8	0.000
yrmo201405:pre.use	0.77363	0.00893	86.7	0.000
yrmo201406:pre.use	0.86852	0.00761	114.2	0.000
yrmo201407:pre.use	0.76165	0.00539	141.4	0.000
yrmo201408:pre.use	0.70105	0.0048	145.9	0.000
yrmo201409:pre.use	0.79553	0.00586	135.7	0.000
yrmo201410:pre.use	0.67693	0.00767	88.3	0.000
Residual standard error: 16.7 on 601202 degrees of freedom				
Multiple R-squared: 0.884, Adjusted R-squared: 0.884				
F-statistic: 1.76e+05 on 26 and 601202 DF, p-value: <0.0000000000000002				

Source: Navigant analysis

Table 6-3. LFER Model Estimates, Wave 1

	Estimate	Std. Error	t value	Pr(>|t|)
post	-2.6874	0.0709	-37.92	0.000
post.trt:TR0	-1.0012	0.1047	-9.56	0.000
post.trt:TR1	-0.9614	0.1609	-5.98	0.000
Total Sum of Squares: 444000000; Residual Sum of Squares: 441000000				
R-Squared: 0.00744, Adj. R-Squared : 0.00707				
F-statistic: 3437.3 on 3 and 1375273 DF, p-value: <0.0000000000000002				

Source: Navigant analysis

Table 6-4. PPR Model Estimates, Wave 3

	Estimate	Std. Error	t value	Pr(>|t|)
yrmo201311	16.67	0.24	70.24	0.00
yrmo201312	11.43	0.19	58.87	0.00
yrmo201401	10.91	0.20	55.68	0.00
yrmo201402	8.20	0.24	33.76	0.00
yrmo201403	10.63	0.27	39.61	0.00
yrmo201404	7.35	0.23	31.29	0.00
yrmo201405	16.80	0.21	79.89	0.00
yrmo201406	14.35	0.19	76.33	0.00
yrmo201407	17.23	0.19	90.61	0.00
yrmo201408	17.80	0.20	87.47	0.00
yrmo201409	22.04	0.20	108.37	0.00
yrmo201410	18.24	0.25	74.02	0.00
treatment:TR0	-1.32	0.07	-18.08	0.00
treatment:TR1	-1.29	0.15	-8.54	0.00
yrmo201311:pre.use	0.64	0.01	111.61	0.00
yrmo201312:pre.use	0.76	0.00	218.13	0.00
yrmo201401:pre.use	0.77	0.00	246.94	0.00
yrmo201402:pre.use	0.92	0.00	214.87	0.00
yrmo201403:pre.use	0.91	0.01	161.42	0.00
yrmo201404:pre.use	0.82	0.01	153.72	0.00
yrmo201405:pre.use	0.55	0.01	109.21	0.00
yrmo201406:pre.use	0.61	0.00	184.50	0.00
yrmo201407:pre.use	0.53	0.00	211.22	0.00
yrmo201408:pre.use	0.48	0.00	185.74	0.00
yrmo201409:pre.use	0.56	0.00	164.11	0.00
yrmo201410:pre.use	0.51	0.01	83.49	0.00
Residual standard error: 21 on 2105033 degrees of freedom				
Multiple R-squared: 0.876, Adjusted R-squared: 0.876				
F-statistic: 5.73e+05 on 26 and 2105033 DF, p-value: <0.0000000000000002				

Source: Navigant analysis

Table 6-5. LFER Model Estimates, Wave 3

	Estimate	Std. Error	t value	Pr(>|t|)
post	-2.6874	0.0709	-37.92	0.00
post.trt:TR0	-1.0012	0.1047	-9.56	0.00
post.trt:TR1	-0.9614	0.1609	-5.98	0.00
Total Sum of Squares: 444000000; Residual Sum of Squares: 441000000				
R-Squared: 0.00744; Adj. R-Squared: 0.00707				
F-statistic: 3437.3 on 3 and 1375273 DF, p-value: <0.0000000000000002				

Source: Navigant analysis

Table 6-6. PPR Model Estimates, Wave 5 Non-AMI

	Estimate	Std. Error	t value	Pr(>|t|)
yrmo201311	11.87741	1.00643	11.8	0.000
yrmo201312	7.84636	0.97956	8.01	0.000
yrmo201401	2.31397	0.79323	2.92	0.000
yrmo201402	0.98944	0.85911	1.15	0.250
yrmo201403	6.0073	1.00748	5.96	0.000
yrmo201404	19.6329	0.90043	21.8	0.000
yrmo201405	12.16177	0.83546	14.56	0.000
yrmo201406	7.9369	0.56701	14	0.000
yrmo201407	11.93001	0.65758	18.14	0.000
yrmo201408	9.82193	0.67083	14.64	0.000
yrmo201409	12.05301	0.65327	18.45	0.000
yrmo201410	12.49732	1.09935	11.37	0.000
treatment:TR0	-1.20052	0.27389	-4.38	0.000
treatment:TR1	-0.94082	0.28018	-3.36	0.000
yrmo201311:pre.use	0.79512	0.02001	39.74	0.000
yrmo201312:pre.use	0.96236	0.01588	60.61	0.000
yrmo201401:pre.use	1.09485	0.01177	93.05	0.000
yrmo201402:pre.use	1.21788	0.01328	91.72	0.000
yrmo201403:pre.use	1.14012	0.01765	64.61	0.000
yrmo201404:pre.use	0.80281	0.01977	40.61	0.000
yrmo201405:pre.use	0.74289	0.01799	41.3	0.000
yrmo201406:pre.use	0.78491	0.00992	79.12	0.000
yrmo201407:pre.use	0.71581	0.00962	74.44	0.000
yrmo201408:pre.use	0.62524	0.00866	72.22	0.000
yrmo201409:pre.use	0.81927	0.01133	72.33	0.000
Residual standard error: 26.7 on 199628 degrees of freedom				
Multiple R-squared: 0.878, Adjusted R-squared: 0.878				
F-statistic: 5.55e+04 on 26 and 199628 DF, p-value: <0.0000000000000002				

Source: Navigant analysis

Table 6-7. LFER Model Estimates, Wave 5 Non-AMI

	Estimate	Std. Error	t value	Pr(>|t|)
Post	2.484	0.199	12.5	0.000
post.trt:TR0	-1.125	0.296	-3.8	0.000
post.trt:TR1	-0.839	0.302	-2.78	0.005
Total Sum of Squares: 421000000, Residual Sum of Squares: 420000000				
R-Squared: 0.000945, Adj. R-Squared: 0.000897				
F-statistic: 145.144 on 3 and 460278 DF, p-value: <0.0000000000000002				

Source: Navigant analysis

6.4 Savings Due to Participation Uplift in Other EE Programs

Table 6-8 through Table 6-13 present program savings due to participation uplift in other EE programs. Each table provides the uplift for a single program group in each of four EE programs for which estimates of deemed savings are available: the Fridge and Freezer Recycling (FFR) program, the Home Energy Assessment (HEA) program, the Home Energy Rebates (Rebate) program, and the Multi-family Energy Savings Program (MESP).

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 for the entire 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 FFR program savings are average net verified savings. Average HEA and Rebate program savings are ex-ante savings. Average MESP savings are average gross verified savings.

The tables also include the percentage change in EE program participation rate for HER participants. 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, Navigant does not report them here.

Table 6-8. Estimates of Double-Counted Savings: Wave 1, CR Persistence Group

	Program			
	FFR	HEA	MESP	Rebate
Average program savings (annual kWh per participant)	592	500	304	593
# HER treatment households	28,915	28,915	28,915	28,915
Rate of participation, PY7 (%)	1.48%	0.03%	0.08%	0.30%
Change in rate of participation from pre-program year (%)	0.98%	-	-	-
# HER control households	28,925	27,393	27,393	27,393
Rate of participation, PY7 (%)	1.44%	0.04%	0.11%	0.27%
Change in rate of participation from pre-program year (%)	0.90%	-	-	-
DID/POD statistic	0.07%	0.00%	-0.02%	0.04%
Change in program participation due to HER program	21	-1	-7	12
Statistically significant at the 90% confidence level?	No	No	No	No
Savings attributable to other programs (kWh)	12,485	-498	-2,127	7,135
Percentage change in EE program participation rate for HER participants	5%	-14%	-28%	10%

Source: Navigant analysis

Table 6-9. Estimates of Double-Counted Savings: Wave 1, TR Persistence Group

	Program			
	FFR	HEA	MESP	Rebate
Average program savings (annual kWh per participant)	592	500	304	593
# HER treatment households	8,761	8,761	8,761	8,761
Rate of participation, PY6 (%)	1.34%	0.06%	0.05%	0.29%
Change in rate of participation from pre-program year (%)	0.92%	-	-	-
# HER control households	35,592	27,393	27,393	27,393
Rate of participation, PY6 (%)	1.46%	0.05%	0.14%	0.31%
Change in rate of participation from pre-program year (%)	0.92%	-	-	-
DID/POD statistic	0.00%	0.01%	-0.06%	0.04%
Change in program participation due to HER program	0	1	-6	4
Statistically significant at the 90% confidence level?	No	No	Yes	No
Savings attributable to other programs (kWh)	155	654	-1,704	2,273
Percentage change in EE program participation rate for HER participants	0%	4%	-68%	-9%

Source: Navigant analysis

Table 6-10. Estimates of Double-Counted Savings: Wave 3, CR Persistence Group

	Program			
	FFR	HEA	MESP	Rebate
Average program savings (annual kWh per participant)	592	500	304	593
# HER treatment households	179,057	179,057	179,057	179,057
Rate of participation, PY6 (%)	1.44%	0.06%	0.04%	0.31%
Change in rate of participation from pre-program year (%)	-1.16%	-	-	-
# HER control households	46,636	27,393	27,393	27,393
Rate of participation, PY6 (%)	1.30%	0.08%	0.08%	0.55%
Change in rate of participation from pre-program year (%)	-1.24%	-	-	-
DID/POD statistic	0.08%	0.01%	-0.01%	-0.01%
Change in program participation due to HER program	150	27	-12	-16
Statistically significant at the 90% confidence level?	No	No	No	No
Savings attributable to other programs (kWh)	88,733	13,266	-3,795	-9,445
Percentage change in EE program participation rate for HER participants	6%	-23%	-50%	-43%

Source: Navigant analysis

Table 6-11. Estimates of Double-Counted Savings: Wave 3, TR Persistence Group

	Program			
	FFR	HEA	MESP	Rebate
Average program savings (annual kWh per participant)	592	500	304	593
# HER treatment households	9,807	9,807	9,807	9,807
Rate of participation, PY6 (%)	1.71%	0.02%	0.06%	0.35%
Change in rate of participation from pre-program year (%)	-1.20%	-	-	-
# HER control households	46,636	27,393	27,393	27,393
Rate of participation, PY6 (%)	1.30%	0.08%	0.08%	0.55%
Change in rate of participation from pre-program year (%)	-1.24%	-	-	-
DID/POD statistic	0.04%	-0.03%	0.01%	0.03%
Change in program participation due to HER program	4	-3	1	2
Statistically significant at the 90% confidence level?	No	No	No	No
Savings attributable to other programs (kWh)	2,349	-1,313	418	1,458
Percentage change in EE program participation rate for HER participants	2%	-75%	-24%	-37%

Source: Navigant analysis

Table 6-12. Estimates of Double-Counted Savings: Wave 5 Non-AMI, CR Persistence Group

	Program			
	FFR	HEA	MESP	Rebate
Average program savings (annual kWh per participant)	592	500	304	593
# HER treatment households	9,945	9,945	9,945	9,945
Rate of participation, PY6 (%)	0.86%	0.05%	0.12%	0.21%
Change in rate of participation from pre-program year (%)	-0.41%	-0.01%	-	-
# HER control households	12,756	27,393	27,393	27,393
Rate of participation, PY6 (%)	0.73%	0.01%	0.09%	0.09%
Change in rate of participation from pre-program year (%)	-0.68%	-0.01%	-	-
DID/POD statistic	0.27%	0.00%	-0.07%	0.02%
Change in program participation due to HER program	27	2	-7	2
Statistically significant at the 90% confidence level?	Yes	No	No	No
Savings attributable to other programs (kWh)	15,882	1,059	-2,043	895
Percentage change in EE program participation rate for HER participants	45%	10%	38%	131%

Source: Navigant analysis

Table 6-13. Estimates of Double-Counted Savings: Wave 5 Non-AMI, TR Persistence Group

	Program			
	FFR	HEA	MESP	Rebate
Average program savings (annual kWh per participant)	592	500	304	593
# HER treatment households	9,941	9,941	9,941	9,941
Rate of participation, PY6 (%)	0.67%	0.02%	0.12%	0.13%
Change in rate of participation from pre-program year (%)	-0.82%	-0.01%	-	-
# HER control households	12,756	27,393	27,393	27,393
Rate of participation, PY6 (%)	0.73%	0.01%	0.09%	0.09%
Change in rate of participation from pre-program year (%)	-0.68%	-0.01%	-	-
DID/POD statistic	-0.14%	0.00%	-0.07%	-0.07%
Change in program participation due to HER program	-14	2	-7	-6
Statistically significant at the 90% confidence level?	No	No	No	No
Savings attributable to other programs (kWh)	-8,406	1,059	-2,040	-3,846
Percentage change in EE program participation rate for HER participants	-17%	29%	38%	43%

Source: Navigant analysis