

**Behavioral Energy Savings Programs:  
Home Energy Reports Persistence Study Part 1  
– October 2014 to March 2015**

**Draft**

**Presented to  
Nicor Gas**

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## E. Executive Summary

### E.1. Study Description

The Nicor Gas Behavioral Energy Savings Programs (BESP) included a Home Energy Report (HER) program during GPY3<sup>1</sup>. In the GPY3 evaluation report, Navigant estimated savings from the HER program during the first year that it was run, covering the period from October 2013 to September 2014.<sup>2</sup> Navigant found savings of 4.1 million therms in the GPY3 evaluation. For purposes of assessing the persistence of savings beyond the program year, Navigant broke the year after the original program was offered into two six-month parts. The purpose of this study, Part 1, is to look at whether the HER program continued to generate savings in the first six months after it was discontinued (in September 2014), covering the period from October 2014 to March 2015. Part 2 of this study will look at savings for the remainder of the first year after the program was discontinued, from April 2015 to September 2015.

The HER program was an opt-out program designed to generate natural gas savings by providing residential customers with information about their specific gas use and related conservation suggestions and tips. The information was provided in the form of reports that illustrate: a) how customers' recent gas use compares to their use in the past; b) tips on how the customers can reduce gas consumption, some of which are tailored to each customer's unique circumstances; and c) information on how the customers' gas use compares to that of neighbors with similar homes. In other studies, this type of information has stimulated customers to reduce their gas use, creating average savings of around 1%, depending on local gas use patterns.

The HER program was discontinued for all participants in September 2014 after running for one year. Although the program ran for one year, the last reports were sent in March 2014 as reports were sent only during the heating season. The current study looks at persistence savings from this program that accrued in the first six months after the program ended, October 2014 to March 2015. 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 measure life and cost-effectiveness of HER programs. Little evidence exists on the persistence of savings for gas HER programs. Any savings that accrue to Nicor Gas during this GPY4 period from the GPY3 program are essentially without additional program costs and are bonus, unexpected savings from a program planning perspective.

### E.2. Summary of GPY3 Findings – October 2013 to September 2014

In GPY3 Navigant evaluated savings from the first year of the HER program covering the period from October 2013 to September 2014. Table E-1 summarizes Navigant's finding from the GPY3 report.

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<sup>1</sup> GPY3 began June 1, 2013, and ended May 31, 2014.

<sup>2</sup> Navigant Consulting Inc. 2015. "Behavioral Energy Savings Program GPY3 Evaluation Report." Presented to Nicor Gas.

**Table E-1. HER Total Program Gas Savings during its First Year**

Savings Category	Savings (Therms)
Net Savings Goal	3,327,435
Ex Ante Net Savings*	4,140,321
Verified Net Savings, Before Uplift Adjustment	4,264,371
Verified Net Savings, After Uplift Adjustment	4,111,100

Source: Nicor Gas billing data, Opower implementation data, and Navigant analysis.

\* Savings results reported by Opower through October 31, 2014.

### ***E.3. Part 1 Study Savings – October 2014 to March 2015***

Table E-2 summarizes the gas savings from the HER program for the first six months after it was discontinued. The HER program was ended in September 2014 after running for one year, and this report evaluates savings in the period from October 1, 2014 to March 31, 2015. Navigant was unable to consider double-counted savings due to uplift in this study because other energy efficiency program tracking data was unavailable.<sup>3</sup>

**Table E-2. HER Total Gas Savings from October 2014 – March 2015**

Savings Category	Savings (Therms)
Verified Net Savings	1,924,321

Source: Nicor Gas billing data, Opower implementation data, and Navigant analysis.

### ***E.4. Key Findings and Recommendations***

This section summarizes the key impact findings and recommendations.

**Finding 1.** The HER program generated verified net persistence savings of 1,924,321 therms from October 2014 – April 2015. These savings correspond to an estimated 0.41% reduction in usage for program participants, which is statistically significant at the 90% level. This is approximately a 50% reduction compared to the program's first year savings of 0.78%. Put another way, the utility specific decay rate is estimated to be 50% in the first six months after the program was discontinued.

**Finding 2.** The monthly savings do not increase or decrease by a statistically significant amount throughout the analysis period; that is estimated savings, and the decay rate, remain relatively constant from October 2014 to March 2015. Percentage savings for the entire first year were 0.78%. It is unlikely that savings decayed 50% in one month from September to October 2014, so this suggests that the savings during the summer of 2014 were lower than the savings for the

<sup>3</sup> In GPY3 Navigant found that savings from uplift were 3.6% of total program savings.

first year as a whole. This is also likely the case as summer savings for gas programs are typically low and the last reports for this program were sent in March 2015. However, we cannot directly compare monthly savings in October 2014 to March 2015 to earlier periods because monthly savings were not estimated during the earlier analysis.

**Recommendation 1.** Navigant recommends that the Illinois TRM allow persistence savings from gas HER programs to be estimated and claimed as savings for at least one year after the program ends. Given the magnitude of savings found by this study, if persistence savings are not counted, a lot of savings will be “left on the table”, understating the savings estimates, resource value and cost-effectiveness of HER programs. Furthermore, there is precedence for claiming persistence savings for electric HER programs in Illinois; Commonwealth Edison (ComEd) claimed persistence savings from several subgroups from their HER waves in the EPY6 evaluation.<sup>4</sup>

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<sup>4</sup> Navigant Consulting Inc. 2015. “Home Energy Reports Program PY6 Evaluation Report.” Presented to Commonwealth Edison Company.

## 1. Introduction

### 1.1 Study Description

#### 1.1.1 Home Energy Report Persistence Study Description

The Nicor Gas Behavioral Energy Savings Programs (BESP) included a Home Energy Report (HER) program during GPY3<sup>5</sup>. In the GPY3 evaluation report, Navigant estimated savings from the HER program during the first year that it was run, covering the period from October 2013 to September 2014.<sup>6</sup> Navigant found savings of 4.1 million therms in the GPY3 evaluation. The purpose of this current study is to look at whether the HER program continued to generate savings in the first six months after it was discontinued in September 2014, covering the period from October 2014 to March 2015. Part 2 of this study will look at savings for the remainder of the first year after the program was discontinued from April 2015 to September 2015.

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

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

The program was discontinued in September 2014 after running for one year. Because reports were only sent during the heating season, participants received their last report in March 2014. However, HER programs have been shown to cause lasting changes such that savings continue to accrue even after the program is stopped. Little evidence exists on the persistence of savings for gas HER programs. Due to the RCT nature of the program, these persistence savings can be causally assigned to the reports even though they are no longer being sent. Any savings that accrue to Nicor Gas after the program stopped are essentially free of charge and are bonus, unexpected savings from a program planning perspective.

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<sup>5</sup> GPY3 began June 1, 2013, and ended May 31, 2014.

<sup>6</sup> Navigant Consulting Inc. 2015. "Behavioral Energy Savings Program GPY3 Evaluation Report." Presented to Nicor Gas.



## 1.2 Summary of GPY3 Findings

In GPY3 Navigant evaluated savings from the first year of the HER program covering the period from October 2013 to September 2014. Table 1-1 summarizes Navigant's finding from the GPY3 report.

**Table 1-1. HER Total Program Gas Savings during its First Year**

Savings Category	Savings (Therms)
Net Savings Goal	3,327,435
Ex Ante Net Savings*	4,140,321
Verified Net Savings, Before Uplift Adjustment	4,264,371
Verified Net Savings, After Uplift Adjustment	4,111,100

*Source: Nicor Gas billing data, Opower implementation data, and Navigant analysis.*

\* Savings results reported by Opower through October 31, 2014.

## 1.3 Study Objectives

The primary objective of this study is to determine the extent to which participants in the HER program reduced their energy consumption in the first six months after the program's cessation due to the prior HERs. As a secondary objective, Navigant examined how much savings decayed each month.

## 2. Study Approach

### 2.1 Home Energy Report Persistence Study Approach

The study approach for the persistence savings from the HER program relies on statistical analysis appropriate for a RCT. Navigant's approach is identical to the GPY3 evaluation report except that we added a model to estimate savings by month to examine monthly decay as described in Section 2.1.2.3. In this section, Navigant presents the study approach for the following:

1. **Validation of Randomization** identifies the approach used to confirm the program was implemented as a RCT,
2. **Statistical Models used in the Impact Findings** identifies the model specifications used to estimate persistence impacts,
3. **Accounting for Uplift** identifies the method used to estimate savings that may be double-counted due to increased participation in other energy efficiency programs as a result of the HER program, and
4. **Data** describes the data used in the study. This section walks through the data we received from Nicor Gas, the verified number of participants and controls, and how we created the cleaned sample from these verified customers that is used in the impact analysis described in Section 2.1.2.

#### 2.1.1 Validation of Randomization

The HER program was implemented by the program implementer, Opower, as a RCT. The study group for the HER program was selected from Nicor Gas's residential customer base by Opower using their proprietary algorithm to determine customers with the highest potential to save, the primary driver being high usage. The customers in this study group were then randomly assigned to a treatment (participant) group and a control (non-participant) group. If the allocation of the households across the treatment and control groups is truly random, the two groups should have the same distribution of energy usage for each of the 12 months before the start of the program. For this analysis Navigant compared mean energy usage for the treatment and control groups for each of the 12 months before the start of the program (September 2012 through August 2013). Navigant conducted this analysis before the start of the HER program, and the results, showing that the assignment of customers was consistent with an RCT, were delivered to Nicor Gas via memo on September 20<sup>th</sup>, 2013. For reference, this memo is provided in Appendix 1 – RCT Memo.

#### 2.1.2 Statistical Models used in the Impact Findings

Navigant estimates persistence impacts using two approaches applied to monthly billing data: a linear fixed effects regression (LFER) analysis 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 persistence savings in a RCT, and assuming the RCT is well balanced with respect to the drivers of energy use, in a single sample the models generate very similar estimates of persistence savings.

### 2.1.2.1 LFER model

The simplest version of an LFER model convenient for exposition is one in which average daily consumption of therms by household  $k$  in bill period  $t$ , denoted by  $ADC_{kt}$ , is a function of the binary variable  $Post_t$ , taking a value of zero if month  $t$  is in the pre-treatment period, and one if in the post-treatment period and the interaction of  $Post_t$  with the binary variable  $Treatment_k$ , taking a value of zero if household  $k$  is assigned to the control group, and one if assigned to the treatment group. The interaction  $Post_t \times Treatment_k$  takes a value of one when both  $Post_t$  and  $Treatment_k$  equal one, and zero otherwise. Formally,

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

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. Examples include the square footage of a residence, the presence of a pool, and the shell characteristics. 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 therms 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 therms savings due to the program from October 2014 to March 2015.

### 2.1.2.2 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 the treatment variable, a set of monthly fixed effects, and the monthly fixed effects interacted with 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,

$$ADC_{kt} = \sum_j \hat{a}_{1j} Month_{jt} + \sum_j \hat{a}_{2j} Month_{jt} \times ADClag_{kt} + b_3 Treatment_k + e_{kt},$$

where  $Month_{jt}$  is a binary variable taking a value of one when  $j=t$  and zero otherwise<sup>7</sup> and  $ADClag_{kt}$  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,  $b_3$  is the estimate of average daily therms savings due to the program from October 2014 to March 2015.

<sup>7</sup> 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  $t$ . Simply put, these are monthly fixed effects.

### 2.1.2.3 Monthly Savings Model

Navigant also estimated persistence savings by month using a variation on the PPR model. In this variant, the treatment indicator is interacted with the monthly dummies to get an estimate of savings in each month. Formally,

$$ADC_{kt} = \sum_j \alpha_j b_{1j} Month_{jt} + \sum_j \alpha_j b_{2j} Month_{jt} \times ADClag_{kt} + \sum_j \alpha_j b_{3j} Month_{jt} \times Treatment_k + e_{kt},$$

where all variables are as defined above. The set of  $\beta_{3j}$  coefficients give the estimate of average daily therms savings due to the program in each month  $j$ .

### 2.1.3 Accounting for Uplift

The HERs include energy saving tips, some of which encourage participants to enroll in other Nicor Gas energy efficiency programs. Uplift occurs when the HER program causes participants to enroll in other energy efficiency (EE) programs at a higher rate than they otherwise would have. If participation rates in other EE programs are the same for HER participants and controls, the savings estimates from the regression analysis are not attributable to other programs and there is no uplift, as this indicates the HER program had no effect on participation in the other EE programs. However, uplift occurs 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 EE program, but cannot be allocated to both programs simultaneously.

Navigant was unable to estimate uplift in the first six months after the program was discontinued because tracking data from Nicor Gas's other energy efficiency programs was unavailable. Uplift will be accounted for in our study of savings from April to September 2015 occurring later this year when program tracking data is available.

### 2.1.4 Data

For the GPY3 study, Navigant received program tracking data from Opower, the program implementer, and monthly billing data from Nicor Gas, covering the period of September 2012 to September 2014. In particular, Navigant received data for 351,845 participants and 30,000 controls. For the persistence study, Navigant received additional monthly billing data on the same participants and controls for the period of October 2014 to March 2015. Nicor Gas customers typically have their meters read every other month, with estimated reads between meter readings. For this reason, Navigant combined the estimated read with the following actual read to create an extended bill that represents actual usage for the impact analysis. This means that the average bill length is 60 days and about half of the customers have a bill ending in any given month.

To find the number of verified participants and controls, Navigant removed the following customers from the data received:

- Customers marked for exclusion by the program implementer<sup>8</sup>
- Customers with no first report generation date

This results in 341,308 verified participants and 29,090 verified controls.

To create a cleaned sample for the impact analysis, Navigant removed the following customers and data points from the analysis:

- Customers with a delayed first report generation date<sup>9</sup>
- Observations with less than 50 or more than 70 days in the billing cycle
- Observations missing billing usage data
- Observations outside the twelve month pre-program period or the study period
- Outliers, defined as observations with average daily consumption more than one order of magnitude above the median usage in the heating season<sup>10</sup>
- For the PPR model, observations in the study period which did not have a corresponding value for the ADClag variable, described in Section 2.1.2.2.

This results in a cleaned sample for the impact analysis containing 316,185 treatment and 26,884 controls; all together the cleaned sample includes 93% of the verified participants and controls. The cleaned sample includes participants who opt-out and customers whose accounts become inactive up until the point of inactivation (meaning that if a customer's account closed in June, their billing data are included up until June). Including these two groups of participants in the analysis is in line with behavior-based program evaluation protocol. For opt-outs, the State and Local Energy Efficiency Action Network report explains that, "if the households that opt out are excluded from the treatment group...then the results will suffer from selection bias: the households in the control group are no longer the same types of households as those in the treatment group."<sup>11</sup> For accounts that become inactive, "it is unlikely that households move or close their accounts because of an efficiency program; thus, we can safely assume that account closures are random and occur at the same rate for both the control and treatment group."<sup>12</sup> We include customers whose accounts go inactive up until the inactive date to ensure that the results are not biased if certain types of customers are more likely to move than others (for example, if the younger population is more mobile).

The service territory for Nicor Gas overlaps with the Commonwealth Edison (ComEd) electric service territory. ComEd also runs a HER program for their electric customers. The service territory overlap means that some customers in the Nicor Gas HER program control and treatment groups receive electric HERs from ComEd, and vice versa. It is possible that the ComEd electric HERs create cross-

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<sup>8</sup> The program implementer marks for exclusion any "VIP" treatment customers who receive the reports for any reason other than random assignment, for example utility executives who request reports to get the "report experience".

<sup>9</sup> Just under 99% of participants receive their first report on or before October 9<sup>th</sup>, 2013. After that customers' first reports are delayed from a few weeks up to several months.

<sup>10</sup> The median usage from September through April was 6.362 therms per day. Observations with usage values greater than 63.62 therms per day were excluded from the analysis.

<sup>11</sup> State and Local Energy Efficiency Action Network. 2012. *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations*. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory. <http://behavioranalytics.lbl.gov>. Page 13.

<sup>12</sup> Ibid. Page 30.

fuel effects that lower gas usage for those who receive them. However, this does not affect the estimate of the effect of the gas HER program conditional on the state of the world, which happens to include the electric program. This is because, due to random assignment, the treatment group in the gas program is exposed to the electric program at the same rate as the control group for the gas program. Given that our study objective is to estimate gas savings due to the Nicor Gas HER program, we do not need to remove customers receiving ComEd electric HERs, because the “all else equal” condition imposed by the RCT includes the fact that gas treatment and control customers are being exposed at equal rates to the electric treatment (and attendant spillovers to gas consumption) run by ComEd. Navigant verified this assumption by matching Nicor Gas and ComEd customers by name and address; we found that 8.7% of the Nicor Gas treatment group and 8.5% of the control group receives an electric HER from ComEd. Nicor Gas and ComEd are currently considering a study that would estimate cross-fuel savings across their two programs

A summary of the data and data sources used in the study are provided in Table 2-1.

**Table 2-1. Data Sources**

Data	Source	Time Period Covered	Description
Billing Data	Nicor	September 2012 – March 2015	HER program participants and controls during the pre- and post-period.
Tracking Data	Opower	September 2012 – March 2015	HER program participants and controls during the pre- and post-period.

### 3. Gross Impact Findings

#### 3.1 Home Energy Report Impact Findings

As detailed below, the LFER and PPR models generate very similar results for persistence savings. We use PPR results for reporting total persistence savings for the first six months after the HER program was stopped, given that gas usage is highly seasonal. Overall verified net savings for the period of October 2014 to March 2015 were 1,924,321 therms, prior to adjusting for savings uplift. Total therm savings after accounting for uplift are unavailable at this time; in GPY3 they the savings due to uplift were 3.6% of total program savings.

##### 3.1.1 Validation of Randomization

Prior to the start of the HER program, Navigant conducted a statistical analysis to determine whether the assignment of customers to the treatment and control group was statistically consistent with an RCT design. These results were delivered to Nicor Gas via memo on September 20<sup>th</sup>, 2013. The results of the analysis indicated that the differences in energy usage between the treatment and control groups in the pre-program period were not statistically significant. As a result, Navigant concluded that the HER program was implemented in a manner consistent with a RCT.

##### 3.1.2 Savings Estimates

As discussed in Section 2.1.2, Navigant estimates persistence savings of the HER program using both the LFER and PPR models. The savings estimates are based on data from the cleaned sample described in Section 2.1.4. Table 3-1 presents these results. The PPR model estimates a reduction in usage of 0.41% and the LFER model estimate 0.50%; both of these estimates are statistically significant at the 90% confidence level. Detailed results from both models are included in Appendix 2 – Model Results. Navigant reports savings from the PPR model; because gas usage is highly seasonal, the PPR likely does a better job of accounting for unobserved factors that cause slight average differences in gas usage between treatment and control customers over the course of a year because it account for usage in the pre-program period by month rather than as a whole like the LFER model.

**Table 3-1. Savings Estimates**

	HER Savings Estimates	
	LFER	PPR
Percent Savings (Standard Error)	0.50% (0.14%)	0.41% (0.09%)
Average Daily Therms Savings per Participant (Standard Error)	0.0386 (0.011)	0.0320 (0.007)

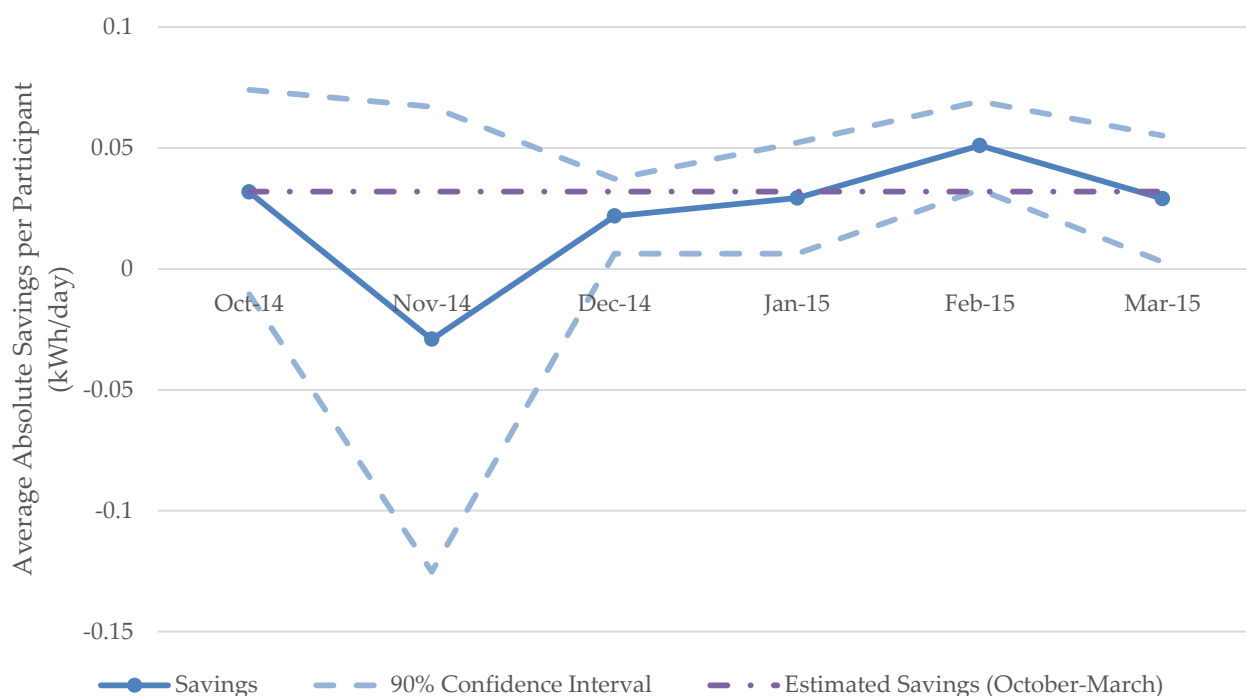
Source: Navigant analysis.

##### 3.1.3 Monthly Savings Estimates

Navigant additionally estimated savings by month for the period from October 2014 to March 2015 in order to look at the decay in savings over time. Figure 3-1 and Figure 3-2 show the absolute and

percentage savings estimates, respectively, with 90% confidence intervals in the period from October 2014 to March 2015. Detailed results from this model are included in Appendix 2 – Model Results. The savings are statistically significant at the 90% confidence level in four of the six months considered. The confidence intervals vary considerably due to the number of observations in each month which varies considerably because of the bimonthly billing cycle on which Nicor Gas operates. The monthly savings do not increase or decrease by a statistically significant amount throughout the time period; that is savings remain relatively constant from October 2014 to March 2015. Percentage savings for the entire first year were 0.78%. It is unlikely that savings decayed 50% in one month from September to October 2014, so this suggests that the savings during the summer of 2014 were lower than the savings for the first year as a whole. This is also likely the case as summer savings for gas programs are typically low and the last reports for this program were sent in March 2015. However, we cannot directly compare monthly savings in October 2014 to March 2015 to earlier periods because monthly savings were not estimated during the earlier analysis.

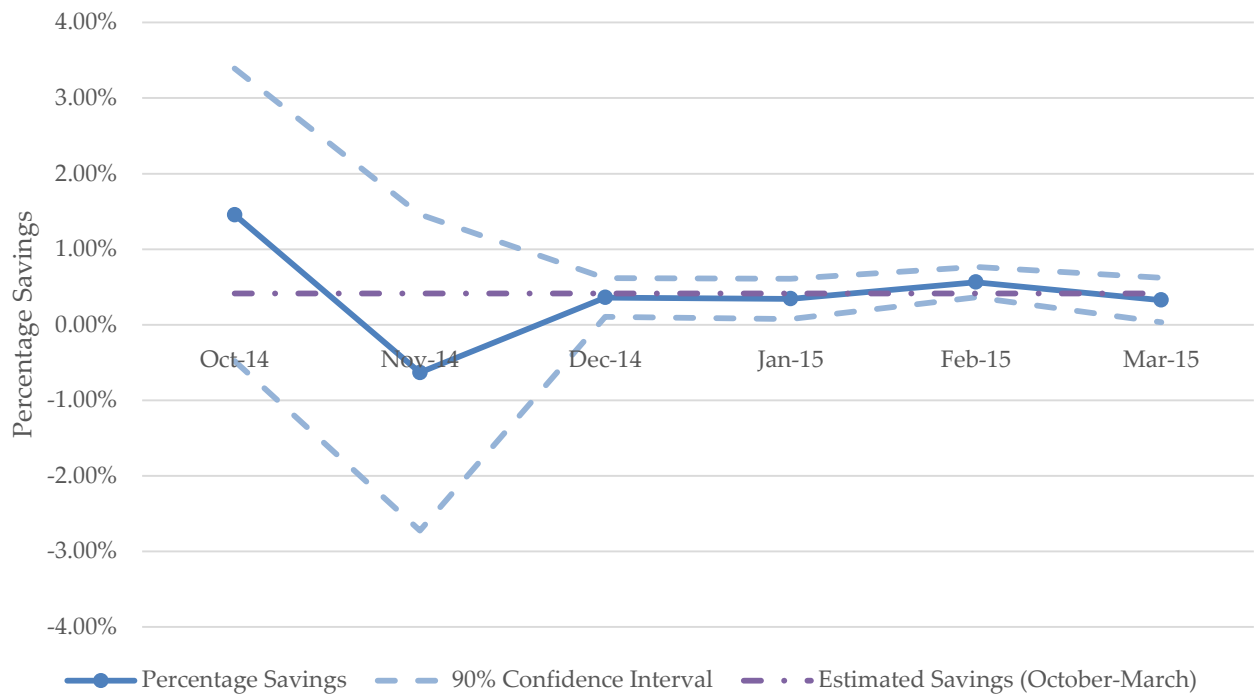
**Figure 3-1. Monthly Absolute HER Persistence Savings (kWh/day) from October 2014 to April 2015**



Source: Navigant analysis



**Figure 3-2. Monthly Percentage HER Persistence Savings from October 2014 to April 2015**



Source: Navigant analysis

### 3.1.4 Verified Net Persistence Impact Results

Table 3-2 presents verified net therms persistence savings. These savings are before the uplift adjustment.

**Table 3-2. HER Net Persistence Savings**

Type of Statistic	Nicor Gas HER Persistence
Number of Verified Participants	341,308
Sample Size, Treatment	316,185
Sample Size, Control	26,884
Percent Savings	0.41%
Average Daily Savings per Participant, Therms	0.032
Verified Net Savings, Before Uplift Adjustment, Therms*	1,924,321

Source: Nicor Gas billing data, Opower implementation data, and Navigant analysis.

\* Total savings are pro-rated for participants that close their accounts during the study period.

## 4. Findings and Recommendations

This section summarizes the key impact findings and recommendations.

**Finding 1.** The HER program generated verified net persistence savings of 1,924,321 therms from October 2014 – April 2015. These savings correspond to an estimated 0.41% reduction in usage for program participants, which is statistically significant at the 90% level. This is approximately a 50% reduction compared to the program’s first year savings of 0.78%. Put another way, the utility specific decay rate is estimated to be 50% in the first six months after the program was discontinued.

**Finding 2.** The monthly savings do not increase or decrease by a statistically significant amount throughout the analysis period; that is estimated savings, and the decay rate, remain relatively constant from October 2014 to March 2015. Percentage savings for the entire first year were 0.78%. It is unlikely that savings decayed 50% in one month from September to October 2014, so this suggests that the savings during the summer of 2014 were lower than the savings for the first year as a whole. This is also likely the case as summer savings for gas programs are typically low and the last reports for this program were sent in March 2015. However, we cannot directly compare monthly savings in October 2014 to March 2015 to earlier periods because monthly savings were not estimated during the earlier analysis.

**Recommendation 1.** Navigant recommends that the Illinois TRM allow persistence savings from gas HER programs to be estimated and claimed as savings for at least one year after the program ends. Given the magnitude of savings found by this study, if persistence savings are not counted, a lot of savings will be “left on the table”, affecting the ability of utilities to design and run HER programs cost-effectively. Furthermore, there is precedence for claiming persistence savings for electric HER programs in Illinois; Commonwealth Edison (ComEd) claimed persistence savings from several subgroups from their HER waves in the EPY6 evaluation.<sup>13</sup>

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<sup>13</sup> Navigant Consulting Inc. 2015. “Home Energy Reports Program PY6 Evaluation Report.” Presented to Commonwealth Edison Company.

## 5. Appendix 1 – RCT Memo

The following is a copy of the memo Navigant provided to Nicor Gas in September 2013 with the results of the RCT consistency check.

**To:** Steve Grzenia; Nicor  
Gina Valo; Opower

**From:** Bethany Glinsmann; Navigant

**Date:** September 20, 2013

**Re:** Validation of Control Group for Nicor Gas HER Program

This memorandum addresses Navigant's validation of the random allocation of households to the treatment and control groups for the Nicor Gas Home Energy Report (HER) program.

### Methodology

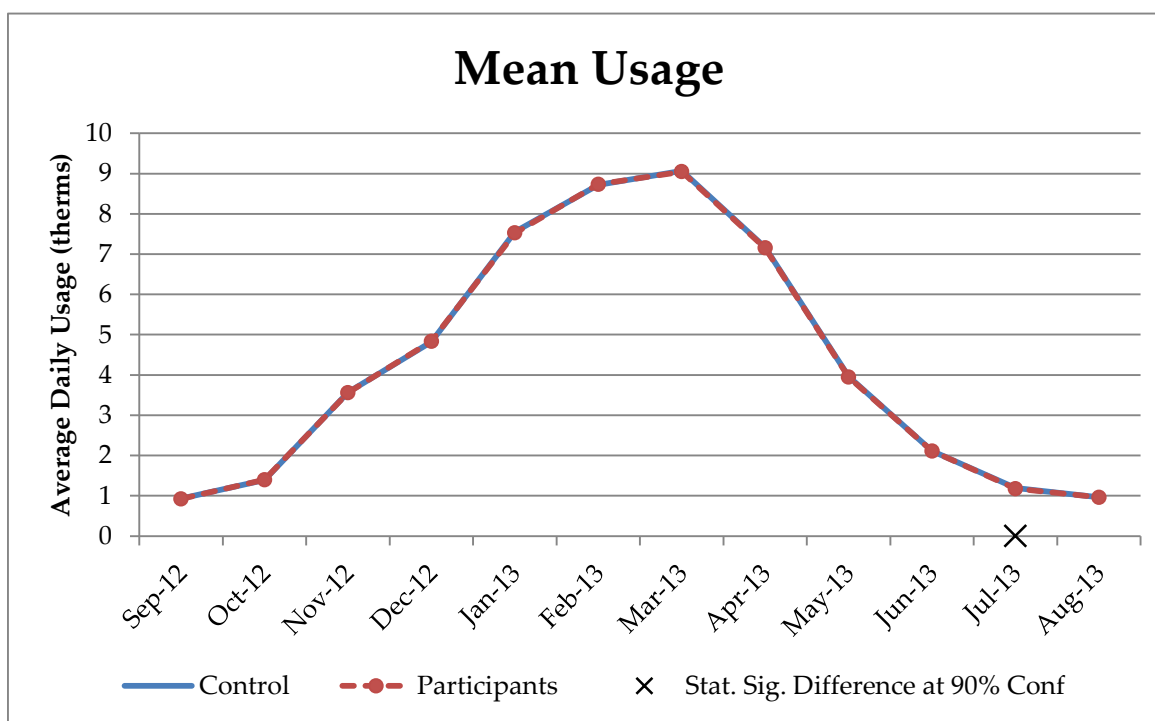
The HER program consists of 351,843 participants and 30,000 control households designated by the program implementer, Opower. Navigant compared the monthly energy usage of the treatment and control groups during the 12 month period prior to the start of the program (September 2012 through August 2013). If the allocation of the households across the treatment and control groups is truly random, the two groups should have the same distribution of energy usage for each of the 12 months before the start of the program. For this analysis, Navigant compared the mean usage for the two groups for each of the 12 months before the start of the program.

Note that Nicor has bi-monthly meter readings. For this analysis Navigant combined estimated reads with the following actual read, creating a long bill with actual usage. Approximately half of the treatment customers and half of the control customers have a bill that ends in any given month.

## Results

The results of the analysis validate that program households were randomly allocated across the treatment and control groups. Figure 5-1 below depicts the average energy usage for treatment and control households for the 12 months prior to the start of the HER program. The blue line indicates the average energy usage for the control group and the red dashed line indicates the average energy usage for the treatment group. The two lines are essentially identical, indicating no difference in average usage patterns for the treatment and control groups. Navigant conducted a statistical test on the difference in the mean energy usage for the two groups in each of the twelve months. In general Navigant found the difference to be statistically insignificant at the 90% confidence level, with the exception of one month.<sup>14</sup> The difference was statistically significant at the 90% confidence level for July 2013. All differences were less than 0.03 therms in magnitude.

**Figure 5-1. Mean Energy Usage for Treatment and Control Households, by Month**



Source: Navigant analysis

<sup>14</sup> Note that using a 90% confidence interval we would expect on average one out of every ten months to have a statistically significant difference in average consumption, due to random chance. Here we found that one month had a statistically significant difference, but had we found that zero, two, or even three months had a statistically significant difference, we would still conclude that the treatment and control groups were determined via random assignment.

## **Conclusion**

Given that the differences in average energy usage for the treatment and control groups were not statistically significant, Navigant concludes that HER program households were randomly allocated to the treatment and control groups.

## 6. Appendix 2 – Model Results

Table 6-1 shows the detailed model output for the PPR model.

**Table 6-1. PPR Detailed Model Output**

	Estimate	Std. Error	t value	Pr(> t )	Signif.
treatment	-0.03196	0.006735	-4.74486	2.09E-06	***
yrmo201410	0.752567	0.05012	15.01521	5.94E-51	***
yrmo201411	0.703396	0.110692	6.354504	2.09E-10	***
yrmo201412	1.009671	0.020715	48.74195	0	***
yrmo201501	0.7202	0.023897	30.1377	2.1E-199	***
yrmo201502	0.442595	0.020163	21.95071	9.2E-107	***
yrmo201503	0.572474	0.026094	21.93858	1.2E-106	***
pre.therms:yrmo201410	0.680094	0.024836	27.38314	5.3E-165	***
pre.therms:yrmo201411	0.988298	0.028796	34.32034	6.3E-258	***
pre.therms:yrmo201412	0.998081	0.004093	243.8611	0	***
pre.therms:yrmo201501	1.028013	0.003193	321.9967	0	***
pre.therms:yrmo201502	0.978699	0.002295	426.5012	0	***
pre.therms:yrmo201503	0.934783	0.002993	312.2852	0	***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.355 on 723411 degrees of freedom

Multiple R-squared: 0.9735, Adjusted R-squared: 0.9735

F-statistic: 2.044e+06 on 13 and 723411 DF, p-value: < 2.2e-16

Source: Navigant analysis

Table 6-2 shows the detailed model output for the LFER model.

**Table 6-2. LFER Detailed Model Output**

	Estimate	Std. Error	t value	Pr(> t )	Signif.
post	3.576963	0.01031	346.9481	0	***
post.trt	-0.03863	0.010733	-3.59881	0.00032	***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 39525000

Residual Sum of Squares: 30755000

R-Squared: 0.22189, Adj. R-Squared: 0.19785

F-statistic: 434517 on 2 and 3047466 DF, p-value: < 2.22e-16

Source: Navigant analysis

Table 6-3 shows the detailed model output for the monthly PPR model.

**Table 6-3. Monthly PPR Detailed Model Output**

	Estimate	Std. Error	t value	Pr(> t )	Signif.
yrmo201410	0.752431	0.055756	13.49515	1.69E-41	***
yrmo201411	0.647023	0.121054	5.344932	9.05E-08	***
yrmo201412	1.000339	0.021579	46.35606	0	***
yrmo201501	0.71777	0.026492	27.09336	1.4E-161	***
yrmo201502	0.46015	0.021668	21.23615	4.8E-100	***
yrmo201503	0.569787	0.029195	19.51642	8.37E-85	***
treatment:yrmo201410	-0.03181	0.025727	-1.23638	0.216318	
treatment:yrmo201411	0.02907	0.058487	0.497037	0.619163	
treatment:yrmo201412	-0.02182	0.009387	-2.32507	0.020069	*
treatment:yrmo201501	-0.02933	0.013967	-2.10028	0.035704	*
treatment:yrmo201502	-0.05103	0.011107	-4.59437	4.34E-06	***
treatment:yrmo201503	-0.02905	0.015878	-1.82977	0.067285	.
yrmo201410:pre.therms	0.680094	0.024836	27.38326	5.3E-165	***
yrmo201411:pre.therms	0.988325	0.028774	34.34754	2.5E-258	***
yrmo201412:pre.therms	0.99808	0.004093	243.8643	0	***
yrmo201501:pre.therms	1.028015	0.003193	321.9918	0	***
yrmo201502:pre.therms	0.978701	0.002295	426.5013	0	***
yrmo201503:pre.therms	0.934784	0.002993	312.2881	0	***
<p>Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1</p> <p>Residual standard error: 1.355 on 723406 degrees of freedom</p> <p>Multiple R-squared: 0.9735, Adjusted R-squared: 0.9735</p> <p>F-statistic: 1.476e+06 on 18 and 723406 DF, p-value: &lt; 2.2e-16</p>					