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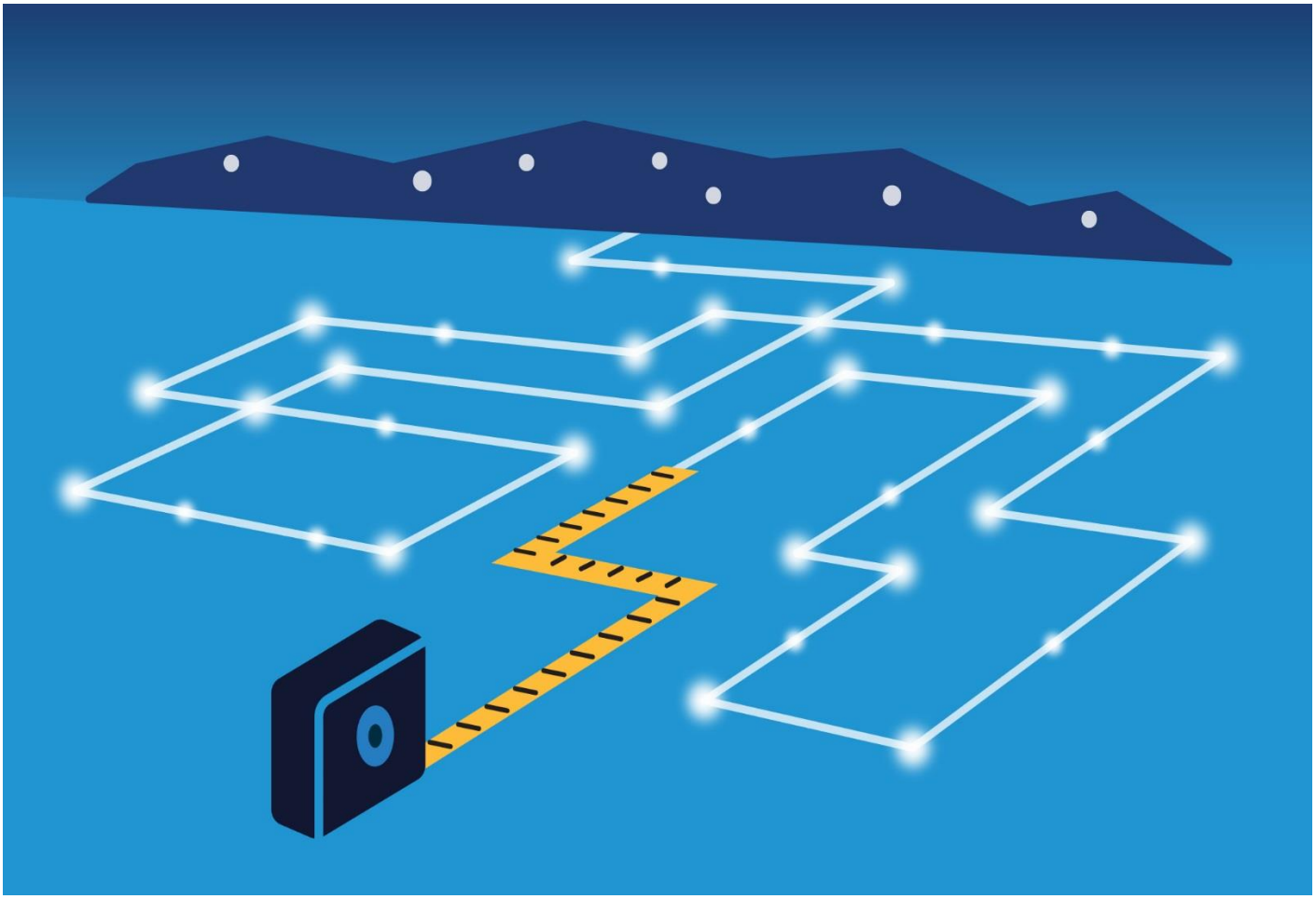

Process and Impact Evaluation of 2013 (PY6) Ameren Illinois Company Behavioral Modification Program

Final

March 6, 2015

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1. Executive Summary

Ameren Illinois Company (AIC) administers the Behavioral Modification Program as a part of its residential portfolio. AIC developed the program to reduce its residential customers' energy consumption. Launched in August 2010, the program seeks to:

- Reduce energy consumption by encouraging energy-efficient behaviors.
- Boost customer engagement and education by helping customers understand energy efficiency and how to save energy in their homes.
- Educate customers about no-cost and low-cost energy-saving measures and behaviors.

The program offers three treatment types: a hard copy home energy report (HER) mailed to the customer's home, an electronic copy of the same report emailed to the customer, and an online portal that customers can access to view the same report along with additional information.

The Behavioral Modification Program reached almost one-third of AIC's 1 million residential customers in PY6. Most of the approximately 224,000 participants are in their third year with the program, although about 26,000 residential customers participated for the first time in PY6 (see Table 1).

1.1 Results

In PY6, the program achieved adjusted net savings of 41,051 MWh and 1,809,293 therms (Table 1). Adjusted net savings remove the energy savings that resulted from customer participation in other AIC programs in PY6.

Table 1. PY6 Behavioral Modification Program Impacts

Cohort Name	Adjusted Net Savings (% per HH)	Adjusted Net Savings (per HH)	Number of Customers Treated in PY6	Adjusted Net Program Savings
Energy Savings (MWh)				
Original Cohort	1.80%	220.59	41,757	9,211
Expansion Cohort 1	1.98%	267.27	63,521	16,977
Expansion Cohort 2	1.17%	107.53	84,035	9,037
Expansion Cohort 4	1.33%	222.85	26,147	5,827
Total MWh*	NA	**186.30**	**215,460**	**41,051**
Gas Savings (Therms)				
Original Cohort	0.88%	9.10	41,787	380,349
Expansion Cohort 1	1.09%	12.47	63,232	788,552
Expansion Cohort 2	0.70%	5.44	82,043	446,039
Expansion Cohort 3	1.10%	10.07	10,672	107,441
Expansion Cohort 4	0.36%	3.26	26,696	86,912
Total Therms*	NA	**7.99**	**224,430**	**1,809,293**

* Note: Total may not equal due to rounding.

The AIC Behavioral Modification program is achieving its stated goals to reduce energy consumption, boost customer engagement and education, and educate customers about energy savings measures and behaviors. We outline these achievements below.

- **The program reduced energy consumption by encouraging energy-efficient behaviors**. Billing analyses indicate a reduction of 41,051 MWh and 1,809,293 therms.

- **The program educated customers about no-cost and low-cost energy-saving measures and behaviors**.

  - *Customers who engage in no-cost energy-saving behaviors are more likely to purchase equipment to achieve energy savings.* Program participants who engage in no-cost energy efficient behaviors (such as turning off lights when not in a room) are more likely to make low-cost energy efficiency purchases (such as buying CFLs) after receiving their HER. AIC should continue sending HERs to encourage customers to make low-cost (and high-cost) energy efficient purchases.

  - *The analysis of the survey results shows that participants have significantly higher levels of knowledge on ways to save energy and are adopting more low-cost and no-cost measures and behaviors than AIC customers who are not exposed to this program*.

- **The program boosted customer engagement and education by helping customers understand energy efficiency and how to save energy in their homes**.

  - *The analysis of the survey results shows that participants are significantly more engaged with and more aware of their home's energy use than AIC customers who are not exposed to this program*. The survey shows that the HER is raising customers' awareness of their home energy consumption. Program participants are more likely to have read their utility bills to understand their home energy usage, discussed their home's energy usage, learned about new ways to save energy in their homes, and researched specific actions, equipment, or technologies to help save energy at home.

  - *The program motivates participants to participate in other residential AIC programs.* All but one treatment cohort had a higher rate of participation in other residential AIC programs during PY6 than did the control cohorts. While the percentage increases are small, the overall effect is substantial given the large number of customers in the treatment cohorts. In addition, survey results show that program participants are more satisfied with the types of energy efficiency programs offered by AIC than the control group. Notably, the channeling analysis shows that while the number of customers participating in other programs is nearly the same in the participant and control groups, the level of participation in those other programs is higher among the participants in the Behavioral Modification Program. However, our historical channeling analysis, which analyzes program participation overtime, indicates that participation rates for treatment and control groups appear to converge after the first year of participation.

- **Consistent with prior evaluations, specific types of customers tend to have different percentage savings. Survey findings reveal the types of participants who take purchase actions.**

  - *Similar to previous evaluations of the program, per-household percent savings tend to increase with the level of baseline consumption.* The evaluation team compared customer savings by baseline usage and found that as baseline consumption increases, the per-household percentage savings also tends to increase.

  - *Similar to previous evaluations of the program, per-household percentage savings tend to differ by fuel type and season.* The evaluation team compared customer savings by season and found

that the dual fuel cohorts tended to have slightly higher electric savings during the summer, while gas savings tended to be slightly higher during the winter when the majority of residential gas consumption occurs.

- *Survey results show that past purchase behaviors could dictate future energy-saving actions.* Findings from two analyses show that actions taken are not different across participants and the control group. Respondents (regardless of treatment or control group) who took high-cost actions (such as installing an HVAC system) before the HER program are more likely to make energy efficient purchases (both high-cost such as weatherization and low-cost such as AC tune-ups) during the program period. Participant actions may be driven as much by participant orientation as by the home energy report; however, additional research is needed to confirm this hypothesis.

2. Introduction

The Behavioral Modification Program began in August 2010 and has about 224,000 participants in PY6. AIC oversees the Behavioral Modification Program and reviews and approves any program materials or changes that are made to the program during the year. Conservation Services Group (CSG) administers the program for AIC and holds the contract with Opower, which provides the software to produce and distribute home energy reports (HERs) and manage customer information.

The program's primary tool for encouraging energy-efficient behaviors is the HER, which includes the following information:

- A comparison of the customer's current and past energy usage.
- A comparison of the customer's energy usage to that of similar households in the same geographical area.
- Tips for reducing energy consumption, tailored to the customer's home energy profile (e.g., type of home, square footage, and number of occupants).

The program treated dual fuel customers during its pilot phase (August 2010), targeting households with higher than average energy consumption. These customers are now in their fourth year with the program. In April 2011 and November 2011, AIC added two cohorts of customers, focusing on the next tier of high-use dual fuel customers. These customers are now in their third year with the program. In November 2011, AIC also added a gas-only cohort, and these customers are in their third year with the program. In June 2013, AIC added one more dual fuel cohort; these customers are in their first year with the program (see Table 2).

Table 2. Behavioral Modification Program Participation in PY6

Cohort Name	Fuel Type	Number of Treated Customers in PY6	Start Date	Program Year
Original Cohort	Dual Fuel	41,787	August 2010	4th year in the program
Expansion Cohort 1	Dual Fuel	63,232	April 2011	3rd year in the program
Expansion Cohort 2	Dual Fuel	82,043	November 2011	3rd year in the program
Expansion Cohort 3	Gas only	10,672	November 2011	3rd year in the program*
Expansion Cohort 4	Dual Fuel	26,696	June 2013	1st year in the program

* Notably, Expansion Cohort 3 (the gas-only cohort) stopped receiving program offerings in April 2012 and resumed receiving reports in April 2013. This cohort continued receiving treatment in PY6.

The program offers three treatment types: a printed report mailed to the customer's billing address, an electronic copy of the same report if an email address is on file, and the online portal, which customers can log onto to view the same report and access additional information. The implementation team sends monthly reports to treated customers during the first three months of program treatment. After that period, the customers receive bimonthly reports (i.e., six reports in one year). The gas-only cohort, Expansion Cohort 3, received four clustered reports during the heating season. In addition, about 5% or 10,000 participants logged into the online portal in PY6.

The PY6 evaluation focuses on the period from June 2013 through May 2014. Based on the PY4-PY6 AIC plan, the expected energy savings from this program are 21,705 MWh and 664,517 therms for PY6, representing 10% of electric savings and 13% of gas savings for the overall residential portfolio[1].

[1] Note that the percentage of expected savings here and through the plan is calculated based on the AIC Filing dated January 20, 2011, which includes Non-Residential New Construction.

3. Evaluation Methods

In this section, we detail the evaluation activities conducted for the PY6 Behavioral Modification Program, along with the methods used.

The data sources used in evaluating the Behavioral Modification Program are:

- Program-tracking databases and ex post savings across other AIC residential programs. (See channeling analysis for more details.)
- Information on key program efforts and dates gathered through stakeholder interviews.
- Electric and gas billing usage data for treatment and control groups.
- Heating degree days and cooling degree days.

Table 3 summarizes the tasks conducted for the PY6 evaluation.

Table 3. Summary of Evaluation Activities for PY6

Activity	Impact	Process	Forward Looking	Details
Program Materials Review	✓	✓		Reviewed materials to assess program design, implementation, and operations.
Interviews with Program Managers and Implementers		✓		Interviewed program managers from AIC, CSG, and Opower to discuss program theory and implementation and to collect process-related feedback.
Treatment/Control Survey		✓	✓	Conducted telephone surveys with the treatment and control group customers to better understand the program's benefits and the energy-saving actions taken by customers.
Equivalency Analysis	✓			Because the evaluation team did not select the new Expansion Cohort 4 treatment and control groups, we conducted a formal review of the groups to ensure equivalency. This review ensures the study's internal validity and defensibility.
Impact Evaluation Approach	✓		✓	Conducted a billing analysis to quantify the changes in energy use among the treatment and control group members. Also performed a channeling analysis to ensure that savings are not double-counted from participation in other AIC residential programs.

3.1 Data Collection

The following activities informed the PY6 evaluation of the Behavioral Modification Program.

3.1.1 Program Staff Interviews

The evaluation team interviewed program staff members to obtain information about the program's design, implementation, and processes. The team also inquired about data tracking and customer outreach related

to this program. As part of this task, we interviewed three program managers, one each from AIC, CSG, and Opower.

3.1.2 Review of Program Materials and Data

The evaluation team reviewed program data including marketing materials and the program-tracking database.

3.1.3 Survey Effort

The process evaluation activities in PY6 included treatment and control group telephone surveys. Our in-depth interviews with program managers from AIC, CSG, and Opower helped inform the development of the survey instrument.

Survey Instrument

The evaluation team implemented computer-assisted telephone interviewing (CATI) surveys with 180 treatment and 180 control group customers from Expansion Cohort 4.[2] The team conducted the surveys from August 21 through September 18, 2014, and spent an average of 18 minutes with each customer. The primary goals of the survey were to determine (1) what actions participants report taking compared to the control groups, (2) the proportion of actions that customers report to be equipment-based versus behavior-based, and (3) whether customers are increasing their knowledge of energy efficiency.

The evaluation team designed the survey to allow comparisons between the participant and control groups regarding reported purchase actions taken in the year following their first exposure to the behavioral program. Therefore, we first screened respondents for their recall of the HER to ensure that we spoke with household members who were exposed to their report and who could provide some feedback related to the report to ensure completion of the process-related questions.

Key questions in the survey covered:

- Engagement and satisfaction with the HER (if participant)
- Energy saving motivations and barriers
- Energy efficiency and conservation behaviors, including:
  - High-cost actions (such as appliances or envelope measures)
  - Low-cost actions (such as installing CFLs or SmartStrips)
  - No-cost actions (such as unplugging appliances and turning off lights)
- Satisfaction with AIC
- Demographic and household characteristics

[2] We surveyed only customers who participated in the program for the first time in PY6 (i.e., the Expansion 4 cohort) because of budget constraints. This is the first survey effort by the evaluation team for the program. The implementer, Opower, has surveyed other cohorts, primarily to obtain process findings.

According to AIC staff, there were service outages during the fielding of the survey. Since our survey asked about satisfaction with AIC in general, and service outages could adversely affect survey responses, the team obtained the number of customers that experienced some sort of service outage during each day of the survey. If the team found that a large number of survey participants had lost service, an adjustment to the analysis would have been considered. However, since the outages affected only a small number of customers, no adjustments were made to the survey data.[3]

We provide the full survey instrument in Appendix G.

Survey Sample Design

Because of budget constraints, the team surveyed only customers who participated in the program for the first time in PY6 (i.e., the Expansion 4 cohort). The sample included both the treatment and control group customers to obtain equal representation of both groups. The HER participants have been receiving HERs since July 2013, while control group members have never received a HER. We cleaned the database of treatment and control customers to remove those for whom there were no phone numbers or whose phone numbers were incorrect.[4] Table 4 shows the total number of customers after we cleaned the data, the total number of calls made, and the total completes achieved.

Table 4. Sample Frame

	Sample Frame (N)	Total Calls Made	Survey Completed (n)
Expansion Cohort 4 – Treatment Group	27,686	5,500	180
Expansion Cohort 4 – Control Group	9,220	6,002	180
Total Efforts	**36,906**	**11,502**	**360**

Survey Response Rate

We called a total of 11,502 customers to obtain 360 completed interviews. Almost 74% of the customers could not be reached because they did not answer their phone, only their answering machine picked up despite repeated attempts, or the phone number we had was incorrect. We terminated calls with treatment group customers who were not aware of the home energy reports; 80 treatment group customers were not aware of the HERs sent to their homes.[5] The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).[6] The following table provides the response and cooperation rates.

[3] We provide additional details on the number of customers affected by the outages in Appendix K.
[4] We removed from the sample 244 treatment group customers and 87 control group customers whose phone numbers were either unavailable or incorrect.
[5] These 80 customers represent about 1.5% of the total treatment group customers contacted (5,500).
[6] *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2011. http://www.aapor.org/AM/Template.cfm?Section=Standard_Definitions2&Template=/CM/ContentDisplay.cfm&ContentID=3156

Table 5. Survey Response and Cooperation Rates

AAPOR Rate	Overall	Treatment	Control
Response Rate (RR3)	4.6%	4.9%	4.3%
Cooperation Rate	14.9%	15.0%*	12.3%*

* Signifies result is statistically significant at the 90% level.

Additional details about the survey response rate can be found in Appendix H.

3.2 Analytical Methods

The main objective of the impact evaluation was to estimate the energy savings of the program and to determine whether the program leads to additional participation in other residential energy efficiency rebate programs administered by AIC. To address this objective, we conducted the following evaluation tasks:

- Statistical comparison of survey data results between treatment and control group respondents.
- Equivalency analysis of the new Expansion Cohort 4 treatment and control groups to ensure the study's internal validity.
- Billing analysis to estimate the net program energy impacts. This analysis includes a comparison of participant savings by baseline energy usage and season.
- Channeling analysis to adjust net savings for participation in other AIC programs.

3.2.1 Survey Data Analysis

We analyzed the data collected through the survey by conducting a statistical comparison of the results between the treatment and control groups and by running a random effects model. We explain each method below.

Statistical comparison of results between treatment and control groups: The evaluation team compared the treatment and control group responses for each survey question to find statistically significant differences.[7] We tested for any differences at the 90% confidence levels.

Random Effects Model: The team used a regression model to determine whether there were any significant differences in the energy efficiency purchases and behaviors between the treatment and control groups. This analysis can help generate more precise estimates of actions taken during the program period. The statistical comparison of the treatment and control group respondents revealed that, while for the most part the groups were very similar, there were significant differences in education and in household occupancy. Control group respondents were more likely than treatment group respondents to have advanced degrees and less likely to

[7] Statistical significance means there is a good chance that we are right in finding an actual difference between two variables. Higher confidence levels signify greater strength in the results.

have five or more people in the household.[8] Therefore, we controlled the model for education and household occupancy. See Appendix J for model coefficients.

3.2.2 Equivalency Analysis

When third-party evaluators rely on, but did not design the randomized control trial (RCT), the evaluators conduct equivalency analyses. In the case of AIC's Behavioral Modification program, Opower randomly assigned the entire population of customers meeting selection criteria to treatment and control groups.

An equivalency analysis conducted during the PY4 evaluation showed the treatment and control groups for the Original Cohort and Expansion Cohorts 1, Expansion Cohort 2, and Expansion Cohort 3 were equivalent. But because there has been some attrition, the evaluation team compared usage between the treatment and control groups for these cohorts for the 12 months prior to when the first reports were received for treatment and control group customers.

As previously noted, AIC added Expansion Cohort 4 in PY6. Since the evaluation team did not select the new Expansion Cohort 4 treatment and control groups, we conducted a formal review of the groups to assess equivalency. The evaluation team used two methods to determine whether there are any systematic biases between the treatment and control groups. First, we examined average daily fuel consumption in the year before the start of the program by looking at the mean of households' average daily consumption and the distribution of consumption for the 2013 billing period. To compare average daily consumption between treatment and control groups before treatment, the evaluation team performed some basic data cleaning, including removing customers without a first report date and removing customers that received the first report when they were inactive with AIC.[9] Second, the evaluation team obtained demographic, housing, and psychographic data from Experian to examine the treatment and control groups for any differences in observable characteristics, which could reflect differences in unobserved characteristics such as attitudes and beliefs. Because we conducted this analysis on the entire population, we did not perform statistical tests.

We provide a more detailed methodology for the equivalency analysis in Appendix A of this report.

3.2.3 Billing Analysis

Below we outline our approach to conducting the billing analysis.

Data Preparation

The data used in the billing analysis come from three primary sources:

- Monthly billing data from July 2009 to May 2014, from AIC.
- Program launch date specific to each customer (treatment and control), from Opower.
- Weather data (heating degree days and cooling degree days), from NOAA. (The data came from 26 weather stations across the state and appended at the zip code level.[10])

[8] For more details about demographic and housing characteristics, refer to Appendix I (Table 76).
[9] Often times, customers become inactive between the time they are selected into a cohort and the reports are sent out.
[10] We provide details about the weather stations in Appendix D.

To develop the dataset used for the statistical analysis, the evaluation team conducted the following data processing steps:

- Separated the electric and gas monthly billing data by each of the five program cohorts (i.e., Original Cohort, Expansion Cohort 1, Expansion Cohort 2, Expansion Cohort 3, and Expansion Cohort 4).
- Removed observations and customers within each cohort based on the following criteria:
  - No first report dates
  - First report date occurring after inactive date
  - Out-of-range usage data
  - Very low usage data
  - No post period data
- Determined the monthly usage for each customer based on their read cycle. (Each usage record has a start date and a duration; based on these two variables, the team identified the appropriate month for each read cycle.)
- Matched weather data by customer to the geographically closest weather station.

Depending on the cohort, data cleaning removed from 4% to 17% of customers within the electric analysis and 4% to 30% of customers within the gas analysis. We provide the accounting of the number and percentage of accounts removed due to data cleaning in Appendix C of this report.

Modeling Program Impacts

The evaluation team conducted a billing analysis to assess changes in energy consumption attributable to the program. The analysis relied on a statistical analysis of monthly electricity and natural gas billing data for all AIC customers that received a HER (the treatment group) and a randomly selected group of customers that did not receive a HER (the control group).

The evaluation team used linear fixed-effects regression (LFER) analysis to estimate program effects. LFER analysis provides what is called a difference-in-difference (DID) estimate of program savings. The DID approach takes advantage of the presence of a randomly assigned control group for each cohort that received reports in the AIC territory. The fixed-effects modeling approach accounts for time-invariant, household-level factors affecting energy use without entering those factors explicitly in the models. The effects of these factors are contained in a household-specific intercept or constant term in the equation.

Because of the experimental design, we can assume that the treatment and control groups experienced similar historical, political, economic, and other events that had similar effects on their energy use. Moreover, because these groups experienced similar weather conditions, it was not necessary to measure or include weather in the DID models. However, to improve precision in the modeled results for PY6, the evaluation team did include weather terms in the model to account for possible differences in weather experienced by the analyzed population. Specifically, we controlled for weather by entering heating degree days (HDD) and cooling degree days (CDD), using a base of 65 degrees Fahrenheit for HDD and 75 degrees Fahrenheit for CDD. The model specification was:

Equation 1: Model Estimating Equation

$$ADC_{it} = \alpha_i + \beta_1 Post_t + \beta_2 Treatment_i \cdot Post_t + \beta_3 HDD_{it} + \beta_4 CDD_{it} + \varepsilon_{it}$$

Where:

ADC_{it}= Average daily consumption (kWh or therms) for household i at time t

α_i= Household-specific intercept

β_1= Coefficient for the change in consumption between pre and post periods

β_2= Coefficient for the change in consumption for the treatment group in the post period compared to the pre period and to the control group. This is the basis for the net savings estimate.

β_3= Coefficient for HDD

β_4= Coefficient for CDD

Post = dummy variable for pre (Post=0) and post (Post=1) receipt of the first report

Treatment = dummy variable for treatment (Treatment=1) and control (Treatment=0)

HDD_{it}= Sum of heating degree days (base 65 degrees Fahrenheit)

CDD_{it}= Sum of cooling degree days (base 75 degrees Fahrenheit)

ε_{it} = Error

The evaluation team also used this model to test the effect by season and by baseline consumption. We include these modeled results for program design purposes only.

Estimating Program Savings

The evaluation team calculated average program savings by using the coefficients from the estimated equation to estimate average daily consumption (ADC) for the control group in both periods and the treatment group in the post period. We made the first estimate by evaluating the model with the Treatment variable set to 0 (to represent the control group), the Post variable set to 1 (to reflect the control group difference in consumption from pre- to post-periods), and the HDD and CDD variables set to the modeled results. We made the second estimate by evaluating the equation with the Treatment variable set to 1 (to represent participation), the Post variable remaining at 1 (again to represent the post period), and the HDD and CDD variables set to the modeled results. The difference between those two estimates constitutes the average daily savings per household in kWh or therms.

We calculated program savings as a percentage reduction by dividing the average daily savings estimate described above by the estimate of ADC under the conditions of non-participation.[11] To calculate average household savings attributable to the program for the evaluated period, we multiplied the average, raw, per-household daily savings by the average number of days the treatment group was in the post period (i.e., the average number of days between receiving the first report and the endpoint of the post-participation billing periods).

[11] This includes usage by the treatment group prior to participation and usage by the control group during the entire period before and after the treatment group's participation.

3.2.4 Channeling Analysis

The evaluation team conducted the channeling analysis to answer the following research questions:

- Does the program treatment have an incremental effect on participation in other AIC residential energy efficiency programs? (participation lift)
- What portion of savings from the program treatment is double-counted by other AIC residential energy efficiency programs? (savings adjustment)

The savings tips provided in the reports could lead to additional program participation.[12] If program materials were effective, we would expect to see a lift in participation in other AIC residential energy efficiency programs among treatment participants, or a higher rate of participation among the treatment group compared to the control. Increased participation in other AIC energy efficiency programs by the treatment participants would mean that some portion of savings from other programs may be counted by both the Behavioral Modification Program (through the billing analysis savings estimate) and other AIC programs (through deemed savings in their tracking databases or through billing analysis in their impact evaluations).

Participation Lift Analysis

To determine whether Behavioral Modification Program treatment generated lift in other energy efficiency programs in PY6, we calculated whether more treatment than control group members initiated participation in other AIC residential energy efficiency programs after the start of the Behavioral Modification Program. We cross-referenced the databases of the program—both treatment and control groups (for all program cohorts)—with the databases of other residential energy efficiency programs, including:[13]

- Appliance Recycling (Electric only)
- HVAC (Electric and Gas)
- Residential Lighting (online platform only)[14]
- Home Performance with Energy Star (Electric and Gas)
- Moderate Income (Electric and Gas)

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[12] AIC indicated they promoted the Appliance Recycling Program in PY5 through the HER.

[13] We did not include the Multifamily Program in the channeling analysis due to the structure of program-tracking data. Since participation is tracked at a facility level, our team was not able to link measures to specific residential accounts. We did not include the ENERGY STAR® New Homes Program in the channeling analysis because the rebates were given to the builders of new homes. Customers in a new home, if part of the treatment group, received the Home Energy Report after they occupied their home; thus, their decision to move into an energy-efficient home was not influenced by the Behavioral Modification Program.
Additionally, we did not include the three residential IPA programs in the channeling analysis. For the CFL Distribution program the customer are chosen randomly and thus their decision to install CFLs is not influenced by the Behavioral Modification Program. The Energy Kit program provides energy savings measure to schools and thus are not influenced by the Behavioral Modification Program. The All Electric Homes program was not included due to the structure of program-tracking data; participation is not tracked using a unique identifier that can be matched with the Behavioral Program database.

[14] This includes participation through the Web store. We did not include in our analysis energy-efficient lighting sold through stores because the upstream lighting program component does not collect customer information.

- Residential Efficient Products (Electric and Gas)

Through this database cross-referencing, we determined whether each customer (in either a treatment or control group) participated in any other AIC energy efficiency program after receiving the first Behavioral Modification Program report. The difference in treatment and control participation rates is the participation lift.

Historic Channeling

In addition to conducting the current program cycle channeling analysis described above, the evaluation team looked at overall program channeling since the program's inception four years ago. This analysis enables us to better understand the types of programs the treatment group (as compared to the control group) is participating in and whether the program mix changes year after year.

Savings Adjustment

Behavioral Modification Program participants can save energy in three ways: through conservation, through measures installed outside of an energy efficiency program, and through measures installed as part of other AIC energy efficiency programs (channeling). Although savings through other energy efficiency programs may not have occurred in the absence of the Behavioral Modification Program (e.g., if the Behavioral Modification Program induces participation), these savings would still be counted by the other programs. The objective of the savings adjustment is to remove savings already captured in other program evaluations and avoid double counting.

To determine the net savings component of the channeling analysis, these steps were followed:

- Step 1: Determine Overlap in Measures: Similar to the participation lift analysis, the evaluation team cross-referenced the database of the Behavioral Modification Program, for both treatment and control groups, with the databases of other AIC residential programs.
- Step 2: Evaluate Savings of Overlapping Measures: Once the overlapping units were established, we applied the deemed per-measure (per-program) evaluated savings to the units to determine the kWh savings for the pre- and post-program periods for the treatment and control groups.
- Step 3: Difference-of-Differences (DoD) Approach: Following the DoD approach, the evaluation team used the net deemed savings to calculate the savings adjustments (see Table 6). [15]

Table 6. Difference-of-Differences Estimator

	Pre	Post	Post-Pre Difference
Treatment	Y0t	Y1t	Y1t-Y0t
Control	Y0c	Y1c	Y1c-Y0c
T-C Difference	**Y0t-Y0c**	**Y1t-Y1c**	**(Y1t-Y1c) - (Y0t-Y0c)**

Y represents the overlap found between the Behavioral Modification program treatment/control groups with the other residential AIC programs.

[15] We applied the evaluated net deemed savings for all programs except the Home Energy Performance Program and the Moderate Income Program, where the ex-ante deemed savings were applied.

- Step 4: Calculate Per-Household Adjustment: The team then divided the calculated savings adjustment by the modeled baseline consumption to obtain the household-level adjustment value.

The result of this database crossing and calculation is a channeled savings estimate, which is subtracted from the estimate of total program savings. Note that these channeled savings could be attributed to the Behavioral Modification Program and to other residential AIC programs because they would not occur unless both programs were operating, but for accounting purposes only one program can claim these savings.

3.3 Sources and Mitigation of Error

Table 7 provides a summary of possible sources of error associated with data collection conducted for the Behavioral Modification Program evaluation. We discuss each item in detail below.

Table 7. Possible Sources of Error

Research Task	Survey Error		Non-Survey Error
	Sampling Error	Non-Sampling Survey Error	
Participant and Non-Participant Survey	Yes	• Measurement error • Non-response error • Data processing error	NA
Billing Analysis	NA	NA	• Model specification error • Measurement error • Multi-collinearity • Heteroskedasticity • Serial correlation

The evaluation team took a number of steps to mitigate against potential sources of error throughout the planning and implementation of the PY6 evaluation.

Survey Error

- **Sampling Error:**
  - The evaluation team designed the telephone survey sample to achieve 90% confidence and +/- 10% relative precision. We surveyed 360 customers out of a population of 36,906.[16] At the 90% confidence level, the sample size is sufficient to produce a precision of +/- 5% at a coefficient of variation of 0.50. The actual precision of each survey question differs depending on the variance of the responses to each question.
- **Non-Sampling Error**:
  - Measurement Error: We addressed the validity and reliability of quantitative data through multiple strategies. First, we relied on the evaluation team's experience to create questions that measure the ideas or constructs that are of interest. We reviewed the questions to ensure that we did not ask double-barreled questions (i.e., questions that ask about two subjects, but with only one

[16] We removed from the sample 244 treatment group customers and 87 control group customers who either did not have a phone number in the database or whose phone number was incorrect.

response) or loaded questions (i.e., questions that are slanted one way or the other). We also checked the overall logical flow of the questions to ensure the respondents would not become confused, which would decrease reliability.

Key members of the evaluation team, as well as AIC staff members, had the opportunity to review the survey instrument. In addition, to ensure the wording of the questions was clear and unambiguous, we pre-tested each survey instrument and monitored the telephone interviews as they were being conducted. The team also reviewed the pre-test survey data, and we used the pre-tests to assess whether the length of the survey was reasonable and reduced the survey length as needed.

There will always be some degree of measurement error because different respondents will interpret questions differently, or recall things differently. However, after addressing the major forms of non-random errors as described above, the rest of the measurement error is likely to be randomly distributed, and thus would not contribute to biased results.

- Non-Response Error: This type of error is most likely to produce the biggest threat to internal (and external) validity. That is, customers who are willing to complete a survey may be systematically different from those who are not. Furthermore, a higher percentage of participants are more willing to respond to an interview than non-participants. The team addressed this type of error by putting a great deal of effort into recruiting reluctant respondents.

- Data Processing Error: The team addressed processing error through interviewer training and through quality checks of completed survey data. First, Opinion Dynamics interviewers went through a rigorous training before they began interviewing. Interviewers received a general overview of the research goals and the intent of each survey instrument. Through survey monitoring, members of the evaluation team also provided guidance on proper coding of survey responses. In addition, we carried out continuous, random monitoring of all telephone interviews and validation of at least 10% of every interviewer's work.

Non-Survey Error

- Model Specification Error: The most difficult type of modeling error, in terms of bias and the ability to mitigate it, is specification error. In this type of error variables that predict model outcomes are included when they should not be, thus reducing the precision of the results, or left out when they should have been included, thus producing biased estimates. The team addressed this type of error by using a fixed-effects model so that differences from one household to the next would be encased in the customer-specific intercept. In addition, the team chose model specifications very carefully using information such as the Akaike Information Criterion values and R-squared, which are designed to help users choose the best model. Since only a few variables were available to model program impacts, however, only interactions among those variables were at issue. Those interactions (e.g., weather by participation) were included in some models and those more complex models were tested against simpler ones using Akaike Information Criterion information in particular.

- Measurement Error: Measurement error can come from variables such as weather data, which are commonly included in the billing analysis models. If an inefficient base temperature is chosen for calculating degree days, or if an incorrect climate zone weather station is chosen, the model results could be subject to measurement error. We addressed this type of error by very carefully choosing the closest weather station for each customer in the model.

Specifying an incorrect time period (either pre-treatment or post-treatment) can also lead to measurement error. To the extent that the data received from the program implementer are correct, this should not be a problem; however, little can be done if there is an error in the source data.

- Multi-collinearity: This type of modeling error can both bias the model results and produce very large variances in the results. The team dealt with this type of error by using model diagnostics such as VIF (Variance Inflation Factor) and Akaike Information Criterion.
- Heteroskedasticity: This type of modeling error can result in imprecise model results. The team addressed this type of error by using robust standard errors. Most statistical packages offer robust standard error and make conservative assumptions in calculating the errors, which has the effect of making significance tests conservative as well.
- Serial Correlation: This type of modeling error can result in imprecise model results (due to multiple observations being highly correlated within the customer). The team addressed this type of error by clustering the errors by customer.

4. Evaluation Findings

4.1 Program Description and Participation

AIC developed the Behavioral Modification Program to reduce its residential customers' energy consumption and now administers the program as part of its residential portfolio. Launched in August 2010, the program seeks to:

- Reduce energy consumption by encouraging energy-efficient behaviors.
- Boost customer engagement and education by helping customers understand energy efficiency and how to save energy in their homes.
- Educate customers about no-cost and low-cost energy-saving measures and behaviors.

The program offers participants a printed HER mailed to their home, an electronic copy of the same report emailed to the customer, and an online portal that customers can access to view the HER along with additional information.

Approximately 224,000 customers participated in the Behavioral Modification Program in PY6, close to one-third of all AIC's residential customers. Most of these customers are in their third year of participation; about 26,000 participated for the first time in PY6.

As part of the process evaluation, the team reviewed the program-tracking database and available program materials such as sample home energy reports and marketing materials. We also conducted in-depth interviews with program managers from AIC, CSG, and Opower. As it did in PY5, Opower reported to AIC monthly and quarterly, which enabled AIC to track savings in a timely manner and make changes as needed to meet program goals. Based on the interviews with program staff and implementers, the program has run smoothly and there have been few challenges. As expected, each cohort experienced some attrition as customers opted out or moved and closed their accounts. The attrition rates shown in Table 8 are based on numbers provided by Opower.

Table 8. PY6 Attrition Rates

Cohort	Attrition Rate
Original Cohort	5.5%
Expansion Cohort 1	6.3%
Expansion Cohort 2	7.0%
Expansion Cohort 3	5.7%
Expansion Cohort 4	13.7%

The attrition rate for Expansion Cohort 4 is much higher than that of the other four cohorts. CSG and Opower found that a large percentage of the inactive customers in Expansion Cohort 4 had not paid their utility bills. They were not sure why non-payment was greater in Expansion Cohort 4.

Opower conducted participant surveys in 2012 and 2013 to help determine whether customers were reading the reports sent to them and whether they were implementing the tips in the reports. Based on the survey results, Opower staff say, the recommendations and tips in the HERs are now dynamic and are tailored to each recipient based on energy use and household characteristics. In addition, Opower now varies the report

content each year and shifts the recommendations and tips seasonally to keep the reports engaging for customers. Opower now has a tip library of over 100 recommendations for AIC customers.

For the PY7 program cycle, Opower will decrease the frequency of HERs for all cohorts from the current six reports per year to four. The primary reasons for this change are a 20% decrease in the program budget and the fact that customers in every cohort except Expansion Cohort 4 have been in the program for at least three years. Opower believes these customers' energy-saving behaviors are now habitual and no longer need prompting. Opower also believes the reduced report frequency will help increase the program's cost-effectiveness.

4.2 Process Assessment

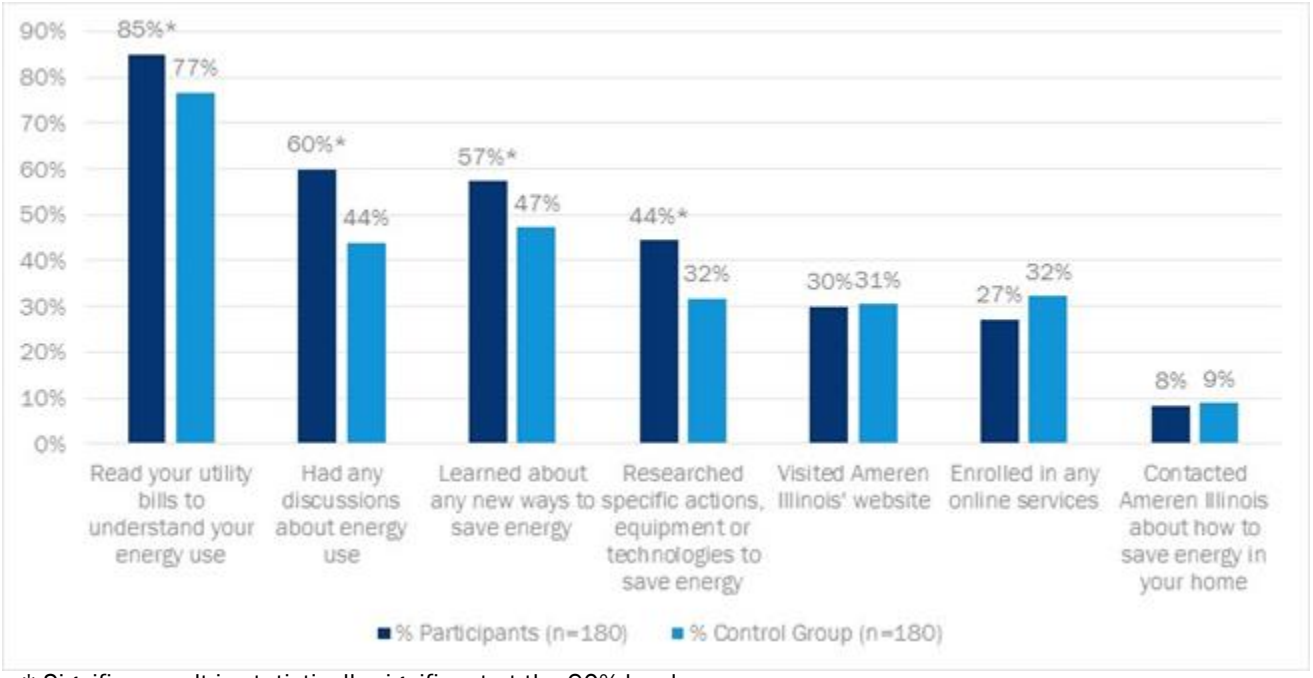
The evaluation team completed 360 interviews, 180 with treatment group members and 180 with control group customers from Expansion Cohort 4. This section summarizes the main findings from the survey effort. We provide additional survey results in Appendix I and Appendix J.

Overall, customers have read at least some of the reports when they arrive. About 87% of respondents reported having read at least some of the reports they received. Over one-third of the respondents read every report received.

Figure 1. Participants' Readership of Home Energy Reports (n=180)

Program participants tend to be more engaged with their home's energy use. Compared to the control group respondents, more participants indicated they read their utility bills to understand their home's energy use, discussed their home's energy use, learned about new ways to save energy in their home, and researched specific actions, equipment, or technologies to help save energy (see Figure 2). This result shows that the program is achieving its goal of boosting customer engagement and education by helping them to understand energy efficiency and save energy in their homes. However, participants were not more likely than control group respondents to have engaged with AIC via its website or online services or to have contacted AIC to learn more about ways to save energy in the home.

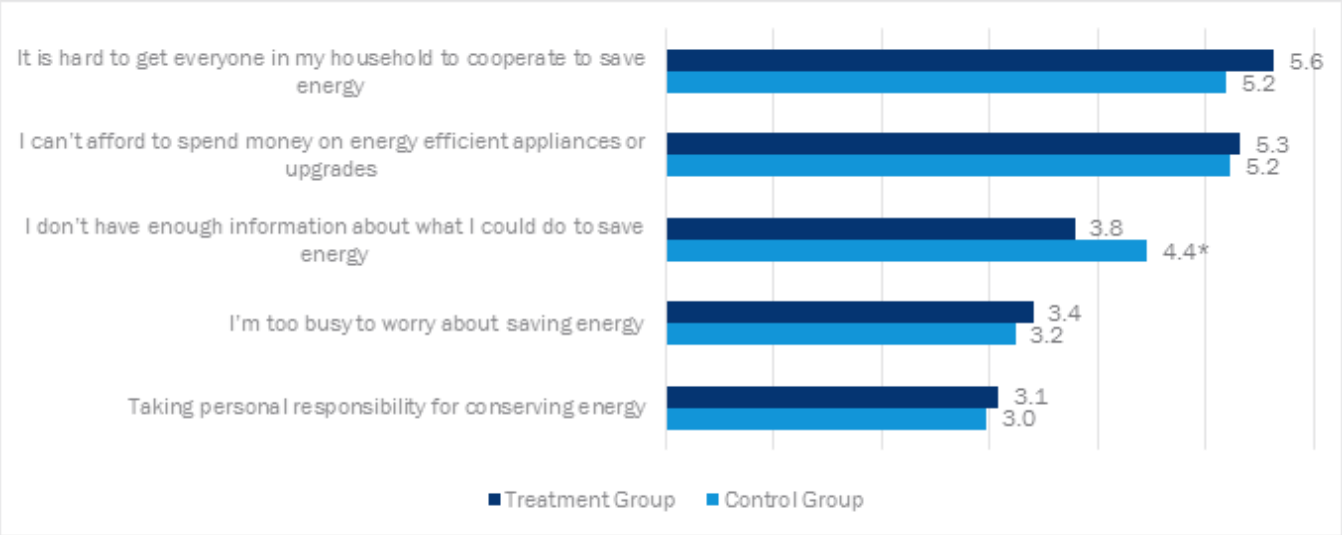
Figure 2. Energy Usage Engagement



* Signifies result is statistically significant at the 90% level.
Note: Graph uses a Yes/No scale.

Program participants noted having information on ways to save energy in their home. Survey respondents were asked to identify barriers to reducing their energy use. In general, getting everyone in a household to cooperate to save energy and the cost of purchasing energy-efficient appliances are the biggest barriers for both treatment and control group respondents (see Figure 3). Participants noted the lack of information was not a barrier for them, but members of the control group noted that, to some extent, it still was.

Figure 3. Barriers to Reducing Energy Usage (n=180 for each group)



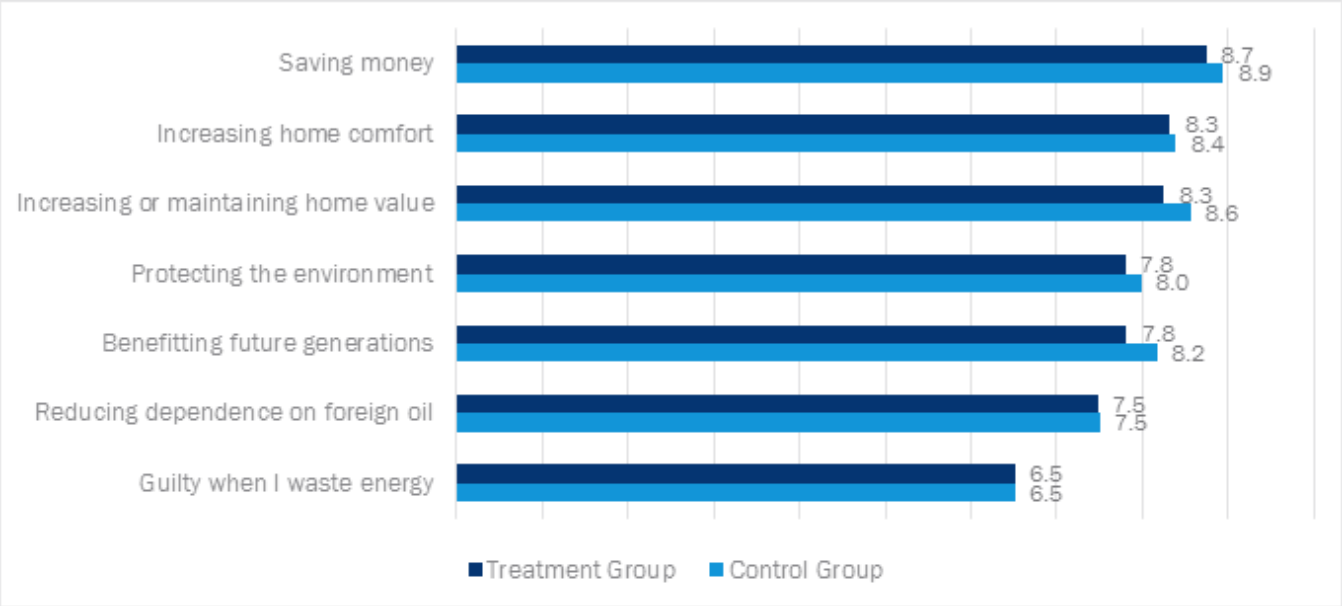
* Signifies result is statistically significant at the 90% level.
Note: Graph uses a scale from 1 to 10, where 1 is "strongly disagree" and 10 is "strongly agree."

No significant differences were found between the treatment and control respondents in energy-saving actions taken during the program period. The evaluation team found that, while 71% of respondents have at some point replaced an appliance or other equipment in their home with an ENERGY STAR-labeled unit, there were no statistically significant differences between treatment and control group respondents. Similarly, when asked whether they had made other changes in their home to help save energy, treatment and control respondents noted making similar changes during the program period. We also asked survey respondents whether they regularly performed certain actions to help them save energy in their home. Almost every respondent (in both the treatment and control groups) did at least one of the actions regularly. No significant differences were found between the treatment and control groups.

The biggest reasons for reducing energy use were the same for both treatment and control group respondents: saving money, increasing home comfort, and increasing or maintaining home value (see Figure 4). If not already doing so,[17] AIC could tailor marketing messages in the HERs to match what customers are saying about the reasons for, and barriers to, reducing home energy use.

[17] The team reviewed some sample HERs, but cannot say conclusively whether such marketing messages are already included in the reports.

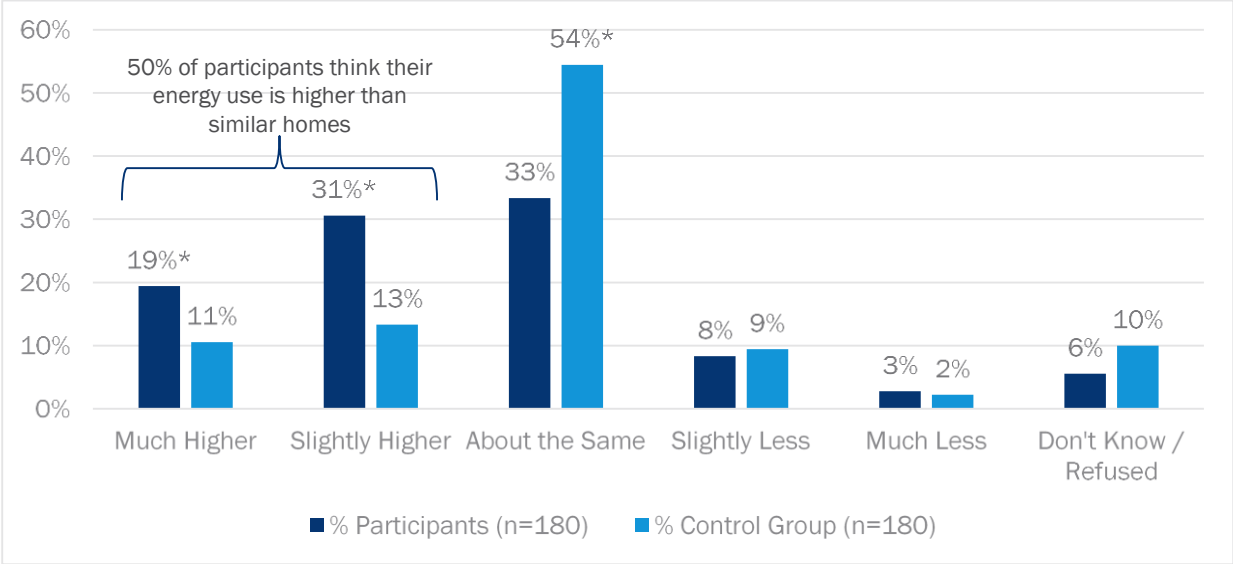
Figure 4. Reasons for Reducing Energy Usage (n=180 for each group)



Note: Graph uses a scale from 1 to 10, where 1 is "not at all important" and 10 is "extremely important."

Program participants perceive energy use is higher in their homes. Survey respondents have similar baseline usage (average daily consumption of 51 kWh for program participants and 53 kWh for the survey control group); however, participants are more likely than the control group to classify their household energy use as greater than their neighbors' (Figure 5). This could mean that participants generally are more attuned to their energy consumption, particularly when compared to that of similar homes.

Figure 5. Perception of Energy Use Compare to Similar Homes (n= 180 for each group)

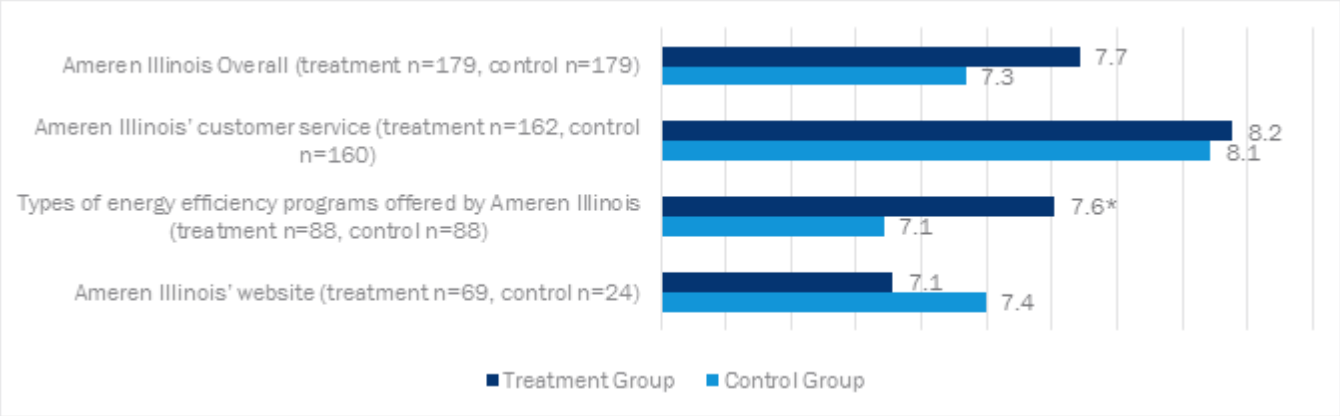


* Signifies result is statistically significant at the 90% level.

The survey results also revealed that participants whose consumption was at or below the daily average were more likely to think their energy use was greater than that of similar homes. This could signify that participants who are already engaged in energy conservation are generally looking for more ways to save energy and thus perceive their homes to have higher consumption levels.

Participants in the Behavioral Modification Program are more satisfied with the other energy efficiency programs offered by AIC. Overall, both treatment and control groups of respondents are satisfied with AIC, AIC's customer service, and its website. However, the participant respondents who have been active in an energy efficiency program are more satisfied with the types of programs than are the control group respondents who have participated in a program (see Figure 6).

Figure 6. Satisfaction Levels



* Indicates that the result is statistically significant at the 90% level.
Note: Graph shows only valid responses (i.e., Don't Know/Refused responses were removed).
Note: Graph uses a scale from 1 to 10, where 1 is "extremely dissatisfied" and 10 is "extremely satisfied."

4.3 Impact Assessment

Below we provide results from the PY6 Behavioral Modification Program impact assessment.

4.3.1 Survey Analysis

We drew the following insights from modeling survey results:

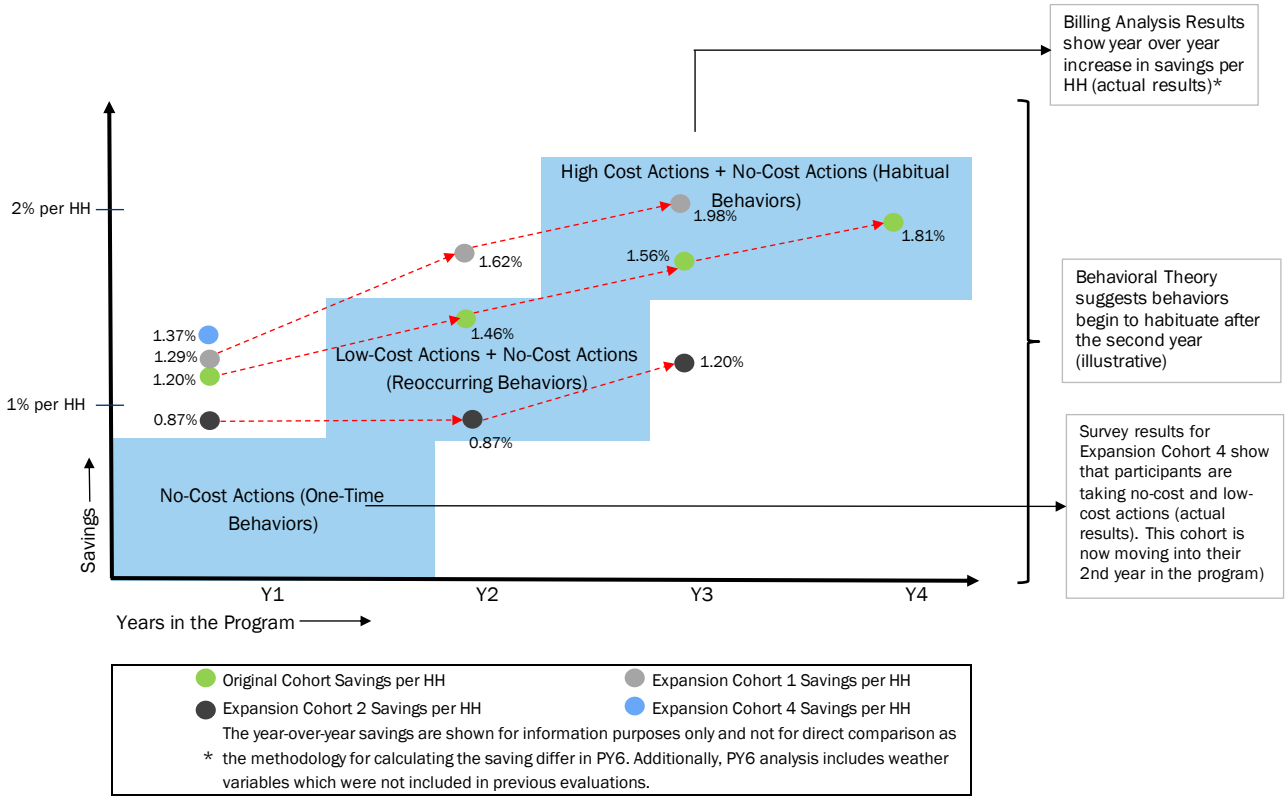
- **Treatment and control group respondents who took high-cost actions before the program are more likely to make energy efficient purchases during the program period.** Our analysis found that customers who are already investing in energy efficiency are more likely to purchase/install additional energy-saving equipment and appliances (both high-cost and low-cost). The analysis also found that, while nearly the same number of treatment and control group customers are participating in other programs, treatment customers are participating in more programs than are control group customers. These findings could give some insight into marketing other AIC programs through the HERs. AIC could think about deeper targeting for current or previous program participants.

- **High-gas-usage participants who engage in no-cost energy efficient behaviors are more likely to make energy efficiency purchases in the program period.** High-gas-usage customers tended to make higher energy efficient purchases after receiving the HERs than did their control group counterparts. This finding aligns with past research and past evaluations of the Behavioral Modification Program, which

have shown that savings are typically driven by high-usage gas customers (but, notably, not high-electric-usage customers). Therefore, the program should continue to target high-usage gas customers. This finding could suggest that high-usage gas customers are more likely to employ the tips and recommendations for reducing gas use than for reducing electricity usage. It could also mean that gas tips (such as adjusting thermostats for gas heating) are easier to implement and, once implemented, affect the equipment that high-usage gas customers have. Regardless of the reason, the program should continue to tailor the messaging in the HERs.

- **Participants engaged in no-cost energy efficient behaviors are more likely to install additional measures during the program period.** As we have seen in other HER programs and in the past evaluations of the Behavioral Modification Program (see Figure 7), customers continue to save energy after each year in the program. Similarly, customers tend to have the highest increase in savings year over year between the first and second years in the program, with savings typically plateauing after the second year. For example, customers in their second year of the program are likely to see greater savings than in the first year. This increase in savings may be the result of customers beginning to habituate behaviors after receiving the reports for two years.[18] Thus, the program should continue sending reports to the Expansion Cohort 4 customers, who will be moving into their second year with the program.

Figure 7. Electric Cohort: Billing Analysis and Survey Analysis



[18] Allcott, Hunt, and Todd Rogers. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." American Economic Review, 104(10): pp. 3003-37. October 2014.

These findings from the survey data modeling confirm that the program is achieving its goal of educating customers about no-cost and low-cost energy savings measures and behaviors. However, we did not find evidence of differences in energy efficiency actions taken between the treatment and control groups.

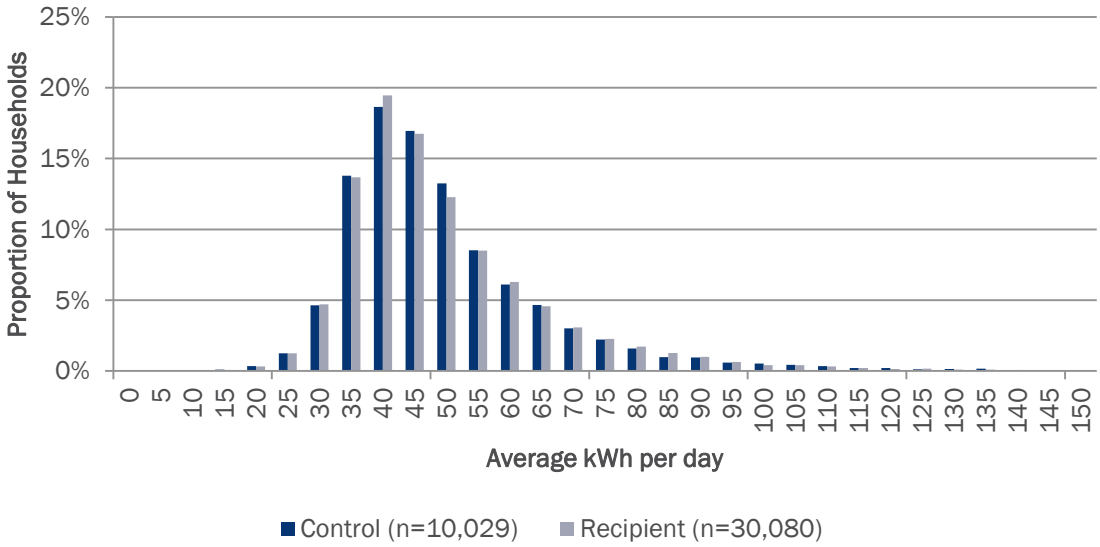
4.3.2 Equivalency Analysis

The evaluation team performed an equivalency check between the Expansion Cohort 4 treatment and control groups to understand usage.

Expansion Cohort 4 Electric Usage

We found the Expansion Cohort 4 to be equivalent in terms of electric usage. For the Expansion Cohort 4 electric customers, average daily consumption in the year before the start of the program was 52.80 kWh/day for households in the control group and 53.10 kWh/day for treatment households. The distribution of average daily electricity consumption is shown below (see Figure 8). Note that the baseline of electric usage is nearly identical between groups.

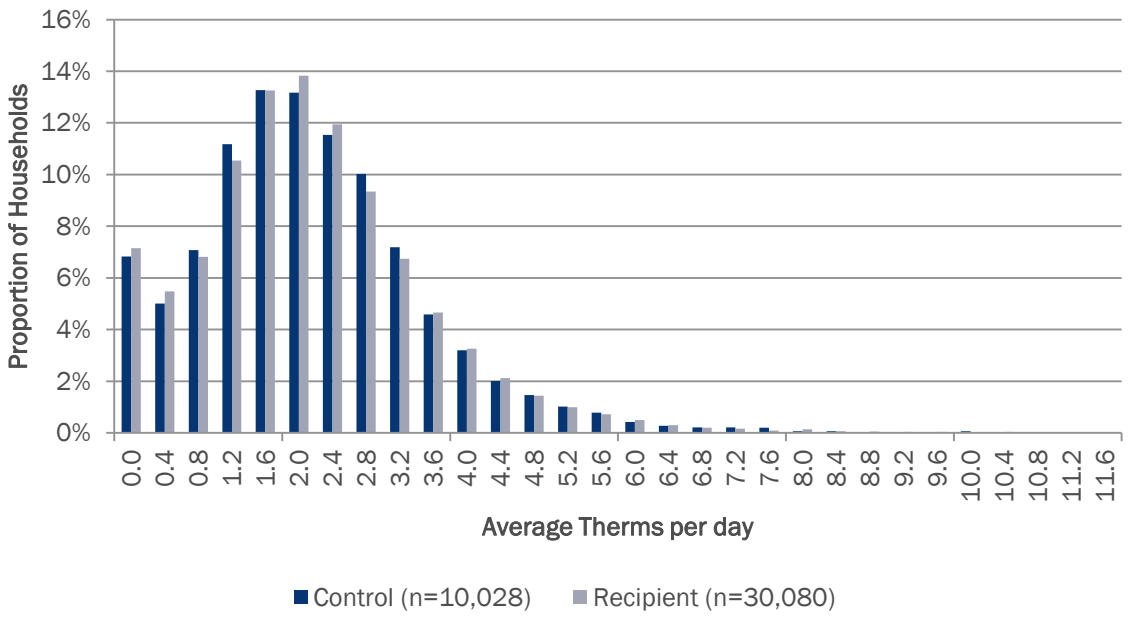
Figure 8: Distribution of Average Daily Electricity Consumption in the Year before Start of the Program



Expansion Cohort 4 Gas Usage

The evaluation team conducted a similar analysis for the Expansion Cohort 4 gas customers and found gas usage to be equivalent. In the year before the start of the program average daily consumption was 2.284 therm/day for households in the control group and 2.281 therm/day for treatment households. Figure 9 shows the distribution of average daily gas consumption. Note that the baseline of gas usage is nearly identical between the groups.

Figure 9: Distribution of Average Daily Gas Consumption in the Year before Start of the Program



Expansion Cohort 4 Demographic, Housing and Psychographic Characteristics

Previous studies have shown that—in addition to usage—demographics, housing, and psychographic characteristics may have an impact on savings realized by treated customers. For this reason, the evaluation team assessed the equivalency across groups of a number of demographic, housing, and psychographic characteristics. The team found that the demographic, housing, and psychographic characteristics of treatment and comparison households are similar.

In every category, the treatment and control groups differed by less than 1% on the key demographic and psychographic comparisons. Only two entries (both in income) had a greater than 1% difference. Based on our equivalency analysis, we conclude that the Expansion Cohort 4 treatment and control groups are equivalent. Table 9 summarizes the demographics, housing, and psychographic equivalency analysis.

Table 9. Expansion Cohort 4: Key Demographic, Housing and Psychographic Comparisons

Category		Treatment (n=30,080)	Control (n=10,029)
Household	Homeowner listed as deceased*	0.35%	0.37%
Demographics			
Age	Under 35	42.5%	42.2%
	35-54	30.3%	30.4%
	55+	17.6%	17.8%
Household size	Avg. number of Adults**	2.5	2.4
Children in household	At least 1 child <18 yrs.	33.5%	33.8%
Education of respondent	Less than High School Diploma	10.2%	10.4%
	High School Diploma	31.5%	31.1%

Category		Treatment (n=30,080)	Control (n=10,029)
	Some College	32.2%	32.0%
	Bachelor Degree	15.3%	15.6%
	Graduate Degree	9.0%	9.2%
Household Income	under $50K	37.4%	36.2%
	$50-$100K	43.7%	45.1%
	$100-$200K	15.7%	15.6%
	$200K or higher	2.8%	2.8%
Occupation	Sales/Service	31.0%	30.8%
	Professional/Technical	27.5%	27.2%
	Blue Collar	24.3%	24.4%
	Retired	10.8%	11.1%
Gender	Female	44.3%	44.7%
Housing			
Homeownership	Own	69.6%	69.4%
Housing type	Single-family detached	84.4%	84.6%
Home size	Home square footage of 100-5,999	42.9%	42.6%
	Home square footage of 6,000-9,999	0.9%	1.1%
	Home square footage of over 10,000	0.1%	0.05%
Age of house	Before 1960	22.0%	21.4%
	1960-1990	31.5%	31.5%
	1990 or later	34.2%	34.8%
Length of Residence	0 - 9 Years	59.5%	59.6%
	10 - 20 years	25.5%	25.5%
	21 years or higher	15.0%	14.9%
Psychographic			
Social Causes	Internet Online Subscriber	45.4%	45.4%
	Use High-speed Internet	8.1%	8.4%
	Health	9.2%	9.0%
	Religious	7.5%	7.8%
	Veterans	5.9%	5.9%
	Animal Welfare	5.2%	5.4%
	Political – Conservative	2.0%	2.0%
	Political – Liberal	0.9%	0.9%
	Children	0.2%	0.2%
	Volunteer Work	0.2%	0.2%
	Other Social Cause	11.1%	11.5%
* Indicated where “number of adults in household” variable is equal to 0.			
**Note: Does not count households where homeowner listed as deceased (number of adults in home = 0).			

All Cohort Electric and Gas Usage

We examined the average daily fuel consumption for the 12 months before the treatment and control group customers received their first reports. Table 10 and Table 11, below, show that all cohorts were equivalent based on average daily consumption in the pre-period, although Expansion Cohort 4 (both treatment and control) shows a noticeably higher average electric consumption than its predecessors do[19].

Table 10. Pre-Program kWh Average Daily Consumption

Cohort	Treatment (Pre-Consumption) in kWh	Control (Pre-Consumption) in kWh
Original Cohort	34.43	34.49
Expansion Cohort 1	40.98	41.07
Expansion Cohort 2	26.98	26.90
Expansion Cohort 4	53.10	52.80

Table 11. Pre-Program Therm Average Daily Consumption

Cohort	Treatment (Pre-Consumption) in Therms	Control (Pre-Consumption) in Therms
Original Cohort	2.695	2.687
Expansion Cohort 1	3.022	3.017
Expansion Cohort 2	2.037	2.047
Expansion Cohort 3	2.408	2.433
Expansion Cohort 4	2.281	2.284

4.3.3 Net Impacts

This section presents PY6 Behavioral Modification Program adjusted net savings. Following the presentation of results, we provide detailed results from the billing and channeling analyses, which contributed to the development of a final adjusted net program savings value.

Table 12 shows details of the program's adjusted net savings of 41,051 MWh and 1,809,293 therms.

[19] It is worth noting that during the pre-period for Expansion Cohort 4, Illinois experienced lower than usual temperatures which could have contributed to the higher pre-period baseline usage.

Table 12. PY6 Behavioral Modification Program Total Savings

Cohort	Final Adjusted Net Program Savings (MWh)	Final Adjusted Net Program Savings (Therms)
Original Cohort	9,211	380,349
Expansion Cohort 1	16,977	788,552
Expansion Cohort 2	9,037	446,039
Expansion Cohort 3	NA	107,441
Expansion Cohort 4	5,827	86,912
Total*	**41,051**	**1,809,293**

* Note: Total may not equal to the sum of all cohorts due to rounding.

"Adjusted net savings" refers to modeled impacts minus savings accounted for from participation in other AIC residential programs. Applying these adjusted net savings, the evaluation team reduced electric savings by 0% to 0.04%, and gas savings by 0.01% to 0.03%, depending on the cohort. These findings confirm that the Behavioral Modification Program is reducing energy consumption.

Detailed Impact Analysis Findings

The evaluation team undertook a variety of efforts to develop adjusted net impact results for the Behavioral Modification Program. They included a comparison of baseline usage between treatment and control groups, impact modeling by season and baseline usage, participation lift analysis, and channeling analysis. Confidence intervals and significance testing usually are provided when evaluating a sample from the participant population. But this evaluation covers the entire participant population. Consequently, we do not provide confidence intervals, since any savings achieved through the program reflect actual population savings and do not require significance testing. We provide detailed results for each evaluation effort below.

Overall Program Savings

As previously noted, the evaluation team used the entire program period in the model to calculate program savings. Table 13 summarizes the PY6 unadjusted net savings for the four electric cohorts and the five gas cohorts. The table shows net savings, but does not deduct double-counted savings from participation in other AIC residential programs. See Appendix E for the modeled coefficients.

Table 13. PY6 Unadjusted Per-Household Savings (%)

	Average % Savings (Electric)	Average Savings per Customer (kWh)	Average % Savings (Gas)	Average Savings per Customer (therm)
Original Cohort	1.81%	221.76	0.91%	9.38
Expansion Cohort 1	1.98%	267.27	1.12%	12.77
Expansion Cohort 2	1.20%	110.42	0.72%	5.55
Expansion Cohort 3	n/a	n/a	1.11%	10.17
Expansion Cohort 4	1.37%	229.30	0.37%	3.37

The PY6 analysis added weather variables to the model specifications, to improve precision in the modeled results, used in previous program cycle evaluations. Consequently, while they can be compared from one year

to another, the results are not estimated using the same model and should be compared with caution[20]. It is worth noting that the trends seen in previous evaluations continued in the PY6 program cycle.[21]

Seasonal Model

The evaluation team also performed an analysis to determine whether customer response to the treatment varied by season. This analysis was conducted for program design purposes only and not for estimating impacts. The percentage of savings, shown in Table 14 and Table 15 below, tends to be slightly higher in the summer for the electric cohorts and slightly higher in the winter for the gas cohorts. The electric cohorts' summer savings constitute about 30% of annual savings, while winter savings account for about 53% to 60% of savings realized by the gas cohorts. This is consistent with findings in similar programs in other jurisdictions. See Appendix E for the modeled coefficients.

Table 14. Unadjusted Per-Household Savings (%) by Season – Electric

Cohort Name	Winter	Summer	Spring	Fall
Original Cohort	26%	31%	23%	20%
Expansion Cohort 1	27%	30%	22%	21%
Expansion Cohort 2	22%	33%	22%	23%
Expansion Cohort 4	41%	15%	21%	20%

Table 15. Unadjusted Per-Household Savings (%) by Season – Gas

Cohort Name	Winter	Summer	Spring	Fall
Original Cohort	56%	3%	18%	24%
Expansion Cohort 1	53%	4%	15%	28%
Expansion Cohort 2	53%	4%	22%	21%
Expansion Cohort 3	60%	4%	18%	18%
Expansion Cohort 4	55%	-2%	11%	28%

* A negative percentage means an increase in usage

Baseline Model

The evaluation team conducted an analysis to determine whether customer response to the treatment varied by baseline usage. This analysis was for program design purposes only and not for estimating impacts. The team identified three groups of equal size based on pre-program (baseline) usage. The percentage of savings, shown in Table 16 and Table 17, tends to increase with the level of baseline consumption. For example, in the electric Original Cohort, high-usage customers contributed 57% of the savings, medium-usage customers contributed 25%, and low-usage customers contributed 18%. This finding is consistent with findings in similar

[20] For the purposes of comparing results, billing analysis results using a model without weather variables is presented in Appendix E.
[21] Appendix E (Table 60 and Table 61) shows the per-year savings for the Behavioral Modification Program.

programs in other jurisdictions and with prior evaluation results for the Behavioral Modification Program. See Appendix E for the modeled coefficients.

Table 16. Percentage of Savings by Baseline Usage – Electric

Cohort Name	High Usage	Medium Usage	Low Usage
Original Cohort	57%	25%	18%
Expansion Cohort 1	58%	26%	16%
Expansion Cohort 2	65%	21%	15%
Expansion Cohort 4	47%	36%	17%

Table 17. Percentage of Savings by Baseline Usage – Gas

Cohort Name	High Usage	Medium Usage	Low Usage
Original Cohort	55%	37%	9%
Expansion Cohort 1	58%	32%	9%
Expansion Cohort 2	59%	19%	22%
Expansion Cohort 3	56%	23%	21%
Expansion Cohort 4*	106%	24%	-30%

* A negative percentage for low-usage customers in Expansion Cohort 4 means an increase in usage. For the Cohort 4 group to have positive savings means that the high- and medium-usage customers are compensating for the increase in energy use by the low-usage customers. This explains why we see a 106% contribution by the high-usage customers.

Channeling Analysis: Participation Lift

The evaluation team cross-referenced the databases of the Behavioral Modification Program—for both the treatment and control groups—with the databases of the other AIC residential energy efficiency programs available to Behavioral Modification Program participants. The other programs were the Appliance Recycling Program, Lighting Program, HVAC Program, Residential Energy-Efficient Products (REEP) Program, Home Performance with Energy Star (HPwES) Program, and Moderate Income (MI) Program.

We determined the treatment group had a higher rate of participation than did the control group, resulting in participation lift. Given that these are dual fuel customers, each customer was counted only once as having participated in the program (i.e., the lift analysis was conducted by cohort, not by cohort and fuel type). Each cohort saw higher participation rate increases in the treatment group than in the control group (see Table 18). The HPwES and Appliance Recycling programs are the biggest contributors to the overall participation increase, possibly because appliance recycling has been promoted in home energy reports and because the HPwES and Behavioral Modification programs have similar eligibility requirements.

Table 18. Participation Lift by Cohort

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4
Appliance Recycling	0.026%	0.061%	-0.061%	0.086%	0.056%
Lighting (online platform only)	0.000%	0.009%	0.015%	0.000%	0.020%
HVAC	0.022%	-0.169%	0.148%	-0.003%	0.172%
REEP	-0.050%	0.016%	0.048%	-0.056%	0.219%
HPwES	0.050%	0.029%	-0.015%	0.043%	0.166%

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4
Moderate Income	-0.006%	0.003%	0.004%	0.021%	0.020%
Total	**0.042%**	**-0.050%**	**0.139%**	**0.090%**	**0.653%**

Note: Total may not equal to the sum of all the programs due to rounding.

Although some treatment groups' participation rates are lower than those of control groups (reflected in the negative percentages in Table 18), every cohort but one experienced an overall lift when all the AIC programs were considered. The likely cause for Expansion Cohort 1's lower participation rates in the HVAC program is not clear. Additional participation lift analysis details are available in Appendix F.

While the percentage increase seems small, the overall effect is substantial given the size of the cohorts. The Behavioral Modification Program channeled about 400 customers into other AIC residential programs.

In line with the channeling analysis, the survey effort showed that respondents were more likely to recall the Home Performance with Energy Star and the Appliance Recycling programs than other AIC programs. See Appendix I, Table 72 for more details about program awareness.

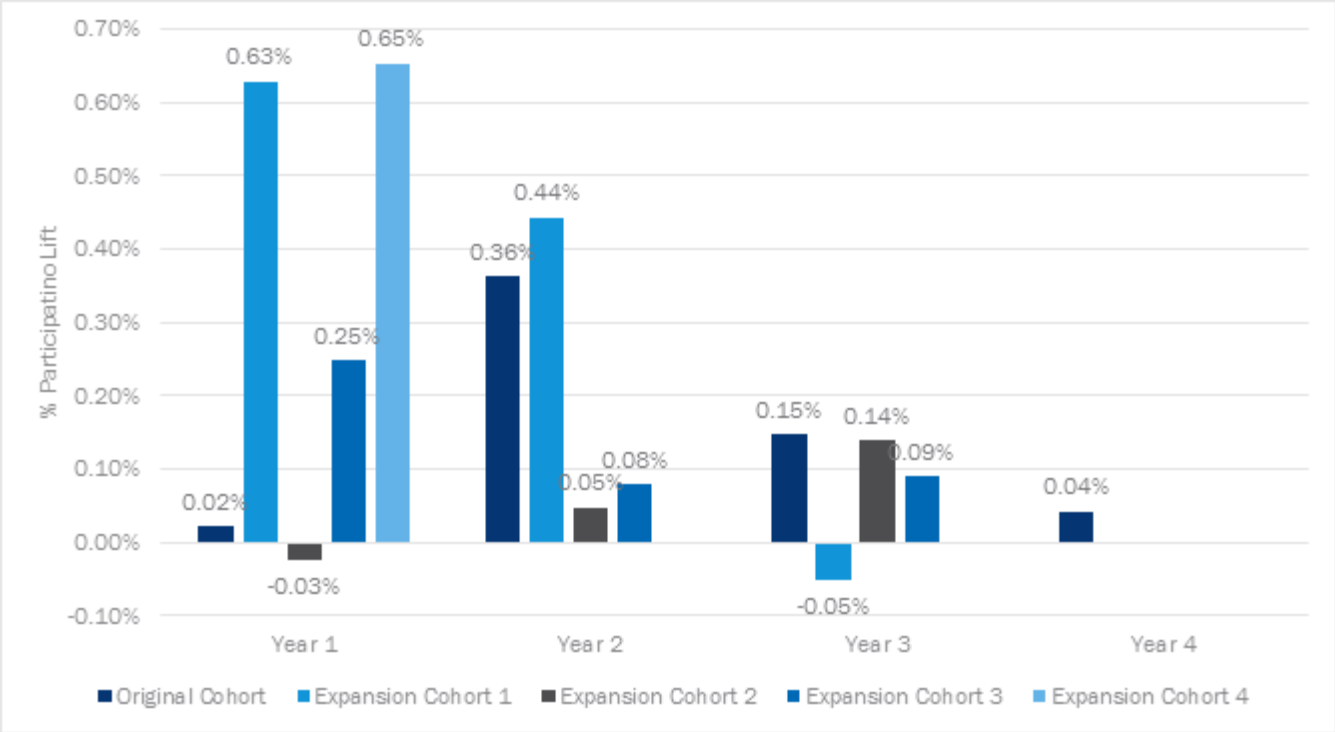
Trends in Program Channeling

In addition to aggregate participation rates in the first year, we examined participation rates over time to better understand differences in timing of treatment and control group program participation. The evaluation team analyzed monthly[22] and cumulative participation[23] rates in each cohort since program inception. This analysis shows that participation tends to be greatest during the first year of receiving the HER (and more specifically increases during the summer for electric cohorts and winter for gas only cohort). The cumulative participation shows that, while the participation lift is still increasing as customers go from one year to the next in the program, the rate of participation is generally highest in the first year (see Figure 10). We provide monthly and cumulative participation rates for each cohort in Appendix F (Figure 13 through Figure 17).

[22] Monthly participation rates are based on the number of accounts that first initiated participation in an AIC energy efficiency program in that month.

[23] Cumulative program participation rate captures the proportion of households that have initiated participation in any program on or before a given month.

Figure 10. Participation Lift over Time



The evaluation team also analyzed whether HER participants were enrolling in other AIC programs at a faster rate than the control group. The analysis showed that, while nearly the same percentage of HER participants and control group customers were participating in other AIC programs, the HER participants are active in more programs. Table 19 shows that on average HER customers tend to participate in more programs at a faster pace. They take about 25 months to participate in three other AIC programs, while the control group takes about 29 months to participate in three other AIC programs.

Table 19. Average Time Taken to Participate in Other AIC Programs (in months)

Timing of…	Treatment	Control
First Program Participation	16 (n=24,212)	20 (n=9,932)
Second Program Participation	21 (n=1,800)	25 (n=724)
Third Program Participation	25 (n=131)	29 (n=51)
Fourth or Fifth Program Participation	35 (n=11)	0

Channeling Analysis: Savings Adjustment

To determine the net savings adjustment, the evaluation team applied evaluated net deemed savings values for each AIC program to the treatment and control group customers who participated in AIC residential energy efficiency programs at the unit level (per measure, per program).

Applying the adjusted savings, we reduced electric savings by 0% to 0.04%, and gas savings by 0.01% to 0.03%, depending on cohort (see Table 20 and Table 21 below). Note that in the case of Expansion Cohort 1, electric, adjusted savings are 0%; this is where the control group participated in programs to a greater extent than the treatment group.

Table 20. PY5 Behavioral Modification Program Impacts – Electric

Statistic	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 4
Net Program Savings (% per HH)	1.81%	1.98%	1.20%	1.37%
Incremental Savings from Other Programs (% per HH)	0.01%	0.00%	0.03%	0.04%
Final Adjusted Net Savings (% per HH)*	1.80%	1.98%	1.17%	1.33%
Net Program Savings (kWh per HH)	221.76	267.27	110.42	229.30
Incremental Savings from Other Programs (kWh per HH)	1.17	0.00	2.89	6.45
Final Adjusted Net Savings (kWh per HH)	220.59	267.27	107.53	222.85

* Note: Total may not equal to the sum of all cohorts due to rounding.
Note: In general, households with a lower baseline usage experience lower savings. This is what we see in the table above where Expansion Cohort 2 has lower savings than the other cohorts; Expansion Cohort 2 has baseline usage of 9,183 kwh compared to the other cohort that have baseline usage between 12,000-16,000 kwh.

Table 21. PY5 Behavioral Modification Program Impacts – Gas

Statistic	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4
Net Program Savings (% per HH)	0.91%	1.12%	0.72%	1.11%	0.37%
Incremental Savings from Other Programs (% per HH)	0.03%	0.03%	0.01%	0.01%	0.01%
Final Adjusted Net Savings (% per HH)*	0.88%	1.09%	0.70%	1.10%	0.36%
Net Program Savings (Therms per HH)	9.38	12.77	5.55	10.17	3.37
Incremental Savings from Other Programs (Therms per HH)	0.28	0.30	0.12	0.11	0.11
Final Adjusted Net Savings (Therms per HH)*	9.10	12.47	5.44	10.07	3.26

* Note: Total may not equal to the sum of all cohorts due to rounding.

Note: In general, households with a lower baseline usage experience lower savings. This is what we see in the table above where Expansion Cohort 2 has lower savings than the other cohorts; Expansion Cohort 2 has baseline usage of 772 therms, and other cohorts have usage between 900-1140 therms.

4.4 Conclusions and Recommendations

The Behavioral Modification Program is achieving its kWh and therm goals. It also is helping customers understand energy efficiency and how to save energy in their homes by educating them about no-cost and low-cost energy-saving measures and behaviors. The following recommendations for the program are based on the findings of our program evaluation:

- **For future program planning and goal setting, AIC might consider using the average savings estimates for kWh and therms over the evaluated period** (191 kWh and 8.06 therms per household). We calculated these values by dividing the total adjusted net program savings for the evaluated period by the total number of program participants for electricity and gas, respectively. Theoretically, AIC could multiply these averages by the planned number of future participants and produce estimates of the next program year's anticipated electricity and gas savings. However, AIC should consider refining these values based on the baseline consumption of the new expansion cohort because the average savings estimates presented above do not account for key differences across cohorts by baseline consumption, fuel mix, and other demographic and household factors.

- **Leverage insights from survey analytics when considering future program designs**. Survey results indicate that participants demonstrate higher understanding of their energy usage, but do not demonstrate increased uptake in energy efficiency actions. AIC may want to consider developing alternative behavioral interventions that engage customers through real-time feedback, competitions, or gamification.

- **Consider examining persistence of engagement and savings for mature cohorts**. Opower is considering reducing the frequency of reports to the mature cohorts in PY7. We recommend that AIC consider examining the persistence of savings with these mature cohorts. Should a reduction in treatment occur, we would recommend randomizing customers into reduced and continued treatment customers to assess decay of savings for reduction prior to making large scale changes to program design. Persistence and decay rate studies are critical to understanding whether and how savings degrade in the absence of a program intervention, as well as providing more accurate lifetime savings results. We understand that, due to the Illinois Commerce Commission's direction to move the Behavioral Modification Program into the IPA procurement process, this effort may not be a viable option until more clarity is brought to Plan 4. For more information regarding considerations for future persistence studies see Appendix L.

A. Appendix – Equivalency Analysis Methodology

To conduct the equivalency check, the evaluation team examined the comparability of treatment and control groups using two methods. First, the team examined average daily fuel consumption in the year before the start of the behavioral program by looking at mean average daily consumption and the distribution of consumption (see Table 22 and Table 23).

Second, the evaluation team examined differences in demographic, housing, and psychographic information between treatment and control groups to determine whether the control group provides an equivalent comparison for the treatment group. Because this analysis was conducted on the entire population, statistical tests were not conducted. To assess whether differences existed between the treatment and control groups within the electric pilot sample and the gas pilot sample, the evaluation team examined the distribution of each demographic, housing, and psychographic characteristic.

Baseline Usage Data

The following table shows the number of customers by fuel type (note, the data cleaning performed for this analysis is different from the data cleaning performed for the billing analysis):

Table 22: Number of Customers with Baseline Usage Data before Data Cleaning

	Number of Customers
Total Unique Customers	41,991
Electric Customers	
Control	10,498
Treatment	31,493
Total	41,991
Gas Customers	
Control	10,494
Treatment	31,492
Total	41,986

The pre-period database for treatment and control customers has usage information for customers in 2013. To compare average daily consumption by treatment and control groups before treatment, the evaluation team performed some basic data, including removing customers without a first report date and removing customers that received the first report when they were inactive. This data cleaning removed less than 5% of the customers.

Table 23: Number of Customers with Baseline Usage Data after Data Cleaning

	Number of Customers
Electric Customers	
Control	10,029
Treatment	30,080
Total	40,109
Gas Customers	

	Number of Customers
Control	10,028
Treatment	30,080
Total	40,108

Secondary Demographic and Psychographic Data

The evaluation team obtained secondary data for demographic, housing, and psychographic characteristics for the treatment and control groups. We obtained the data through Experian; Experian's CONSUMERVIEW Database is the foundation for their consumer marketing lists, data enhancement, and data licensing services. It includes compiled, self-reported, and modeled data built using over 3,500 original public and proprietary sources, including white pages, census data, public records (both state and local), product registrations and surveys (self-reported), property/realty records such as property deeds, mail order transactions, and other proprietary sources. Table 27 lists the data points obtained from Experian, with their match rates.

Table 24: Secondary Data from Experian

Data Type	Description of Data	Match Rate
Total Number of Customers Sent to Experian		40,109
Total Matches		40,109
Overall Match Rate		100%
Demographic Data		
Household Income	Income is the total estimated income for a living unit and incorporates several highly predictive individual, household, and geographical level variables including Summarized Credit Statistics.	100%
Number of Adults in Household	Number of Adults in Household is calculated from the number of records in a household. An adult is anyone 19 years old or older living in a household.	100%
Gender	Gender information is applied during the convert prior to enhancement. Records coded as gender include both those with prefixes of Mr. & Mrs. and/or first names.	100%
Occupation – Group	Information is compiled from self-reported surveys, derived from state licensing agencies, or calculated through the application of predictive models.	100%
Education	Information is compiled from self-reported surveys, derived based on occupational information, or calculated through the application of predictive models.	100%
Age	Date of Birth is acquired from public and proprietary files. These sources provide, at a minimum, the year of birth. The birth month is provided where available.	100%
Number of Children (18 or Less)	Number of Children in Household information is calculated from the number of records in a household that indicate children whose age is 18 or younger.	100%
Housing Data		

Data Type	Description of Data	Match Rate
Dwelling Type	Each household is assigned a dwelling type code based on United States Postal Service (USPS) information.	92%
Homeownership	Homeowner information indicates the likelihood of a consumer owning a home, and is received from tax assessor and deed information. Renter status is derived from self-reported data. Unit numbers are not used to infer rented status because units may be owner condominium/coop.	92%
Year Home Built	Year built is based on county assessor's records, the year the residence was built, or through the application of a predictive model.	92%
Home Square Footage Ranges	The square footage of any buildings associated with the home determined from Grant/Warranty Deed information recorded or other legal documents filed at the county recorder's office in the county where the property is located.	92%
Length of Residence	Length of Residence (LOR) is the length of time a customer has resided at their current address. A primary source of LOR is public source white page compilation initiating a counter showing the first time a name and number appear in the directory.	100%
Psychographic Data		
Internet/Online Subscriber	Internet online subscriber indicates a household has self-reported being an Internet/online subscriber. BehaviorBank® Household Indicators groups similar self-reported elements into slightly broader categories.	54%
Other Social Causes and Concerns	Activities and Interests/Social Causes and Concerns are derived from direct reported survey data that represents a household's interest in each of the social causes/concerns	54%
Religious Social Causes and Concerns		
Health Social Causes and Concerns		
Children Social Causes and Concerns		
Veterans Social Causes and Concerns		
Animal Welfare Social Causes and Concerns		
Political-Conservative Social Causes and Concerns		
Political-Liberal Social Causes and Concerns		
Volunteer Work		

B. Appendix – Mean Daily Usage

Table 25 depicts the mean daily usage for treatment and control groups, pre- and post-participation.

Table 25. Average Daily Consumption by Cohort, Treatment v. Control, Pre- v. Post-Participation

Behavioral Modification Program		Pre		Post	
		Mean	***SD***	**Mean**	***SD***
Electric Cohorts (in kwh)					
Original	Treatment	35.770	*20.065*	33.940	*19.821*
	Control	35.720	*20.004*	34.500	*20.294*
Expansion 1	Treatment	40.410	*25.155*	37.510	*24.309*
	Control	40.490	*25.390*	38.330	*24.948*
Expansion 2	Treatment	27.030	*16.920*	25.790	*16.153*
	Control	27.030	*16.965*	26.090	*16.415*
Expansion 4	Treatment	52.760	*27.180*	51.930	*30.134*
	Control	52.460	*26.797*	52.380	*30.252*
Gas Cohorts (in Therms)					
Original	Treatment	2.670	*2.726*	2.870	*2.976*
	Control	2.660	*2.720*	2.890	*3.006*
Expansion 1	Treatment	3.020	*3.075*	3.190	*3.395*
	Control	3.020	*3.073*	3.230	*3.442*
Expansion 2	Treatment	2.000	*1.928*	2.170	*2.161*
	Control	2.010	*1.928*	2.190	*2.189*
Expansion 3	Treatment	2.370	*2.377*	2.570	*2.611*
	Control	2.380	*2.376*	2.610	*2.662*
Expansion 4	Treatment	2.310	*2.538*	2.840	*3.252*
	Control	2.310	*2.548*	2.850	*3.273*

* Number of treatment and control group customers after data cleaning.

C. Appendix – Billing Analysis Data Cleaning Results

Table 26 through Table 33 show the results of the data cleaning effort for the billing analysis.

Table 26. Data Cleaning Results: Original Cohort, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	87,063	43,493	43,570	6,175,147	3,085,069	3,090,078
# removed due to out of range dates	-	-	-	3,861,053	1,926,710	1,934,343
# after	87,063	43,493	43,570	2,314,094	1,158,359	1,155,735
# removed due to no first report date	794	398	396	9,871	4,977	4,894
# after	86,269	43,095	43,174	2,304,223	1,153,382	1,150,841
# removed due to first report date occurring after inactive date	167	78	89	2,162	1,007	1,155
# after	86,102	43,017	43,085	2,302,061	1,152,375	1,149,686
# removed due to less than 2 months of pre-period summer months	56	27	29	2,446	1,174	1,272
# after	86,046	42,990	43,056	2,299,615	1,151,201	1,148,414
# removed due to no post period months	2,157	1,093	1,064	86,400	44,038	42,362
# after	83,889	41,897	41,992	2,213,215	1,107,163	1,106,052
# removed due to low usage (<2 kwh)	240	140	100	11,714	6,911	4,803
# after	83,649	41,757	41,892	2,201,501	1,100,252	1,101,249
Final #	**83,649**	**41,757**	**41,892**	**2,201,501**	**1,100,252**	**1,101,249**
% Removed	**4%**	**4%**	**4%**			

Table 27. Data Cleaning Results: Expansion Cohort 1, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	90,196	67,566	22,630	6,094,487	4,567,059	1,527,428
# removed due to out of range dates	-	-	-	3,785,270	2,835,825	949,445
# after	90,196	67,566	22,630	2,309,217	1,731,234	577,983
# removed due to no first report date	2,348	1,756	592	27,424	20,474	6,950
# after	87,848	65,810	22,038	2,281,793	1,710,760	571,033

	Unique Customers			Observations		
# removed due to first report date occurring after inactive date	187	142	45	2,383	1,823	560
# after	87,661	65,668	21,993	2,279,410	1,708,937	570,473
# removed due to less than 2 months of pre-period summer months	57	46	11	2,855	2,241	614
# after	87,604	65,622	21,982	2,276,555	1,706,696	569,859
# removed due to no post period months	2,462	1,857	605	94,784	70,566	24,218
# after	85,142	63,765	21,377	2,181,771	1,636,130	545,641
# removed due to low usage (<2 kwh)	314	244	70	15,191	11,584	3,607
# after	84,828	63,521	21,307	2,166,580	1,624,546	542,034
Final #	**84,828**	**63,521**	**21,307**	**2,166,580**	**1,624,546**	**542,034**
% Removed	**6%**	**6%**	**6%**			

Table 28. Data Cleaning Results: Expansion Cohort 2, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	107,833	90,791	17,042	8,335,810	7,103,260	1,232,550
# removed due to out of range dates	-	-	-	5,149,165	4,387,283	761,882
# after	107,833	90,791	17,042	3,186,645	2,715,977	470,668
# removed due to no first report date	3,451	2,926	525	42,832	36,936	5,896
# after	104,382	87,865	16,517	3,143,813	2,679,041	464,772
# removed due to first report date occurring after inactive date	368	310	58	4,104	3,452	652
# after	104,014	87,555	16,459	3,139,709	2,675,589	464,120
# removed due to less than 2 months of pre-period summer months	8	5	3	46	30	16
# after	104,006	87,550	16,456	3,139,663	2,675,559	464,104
# removed due to no post period months	3,517	2,981	536	144,303	122,210	22,093
# after	100,489	84,569	15,920	2,995,360	2,553,349	442,011

	Unique Customers			Observations		
# removed due to low usage (<2 kwh)	623	534	89	28,150	24,080	4,070
# after	99,866	84,035	15,831	2,967,210	2,529,269	437,941
Final #	**99,866**	**84,035**	**15,831**	**2,967,210**	**2,529,269**	**437,941**
% Removed	**7%**	**7%**	**7%**			

Table 29. Data Cleaning Results: Expansion Cohort 4, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	41,991	31,493	10,498	919,445	689,421	230,024
# removed due to out of range dates	-	-	-	57,711	43,232	14,479
# after	41,991	31,493	10,498	861,734	646,189	215,545
# removed due to no first report date	1,759	1,322	437	18,627	14,085	4,542
# after	40,232	30,171	10,061	843,107	632,104	211,003
# removed due to first report date occurring after inactive date	123	91	32	1,340	1,010	330
# after	40,109	30,080	10,029	841,767	631,094	210,673
# removed due to less than 2 months of pre-period summer months	4,673	3,530	1,143	77,654	58,579	19,075
# after	35,436	26,550	8,886	764,113	572,515	191,598
# removed due to no post period months	532	389	143	7,015	5,140	1,875
# after	34,904	26,161	8,743	757,098	567,375	189,723
# removed due to low usage (<2 kwh)	19	14	5	350	244	106
# after	34,885	26,147	8,738	756,748	567,131	189,617
Final #	**34,885**	**26,147**	**8,738**	**756,748**	**567,131**	**189,617**
% Removed	**17%**	**17%**	**17%**			

Table 30. Data Cleaning Results: Original Cohort, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	87,072	43,499	43,573	6,173,358	3,084,141	3,089,217

	Unique Customers			Observations		
# removed due to out of range dates	-	-	-	3,859,274	1,926,107	1,933,167
# after	87,072	43,499	43,573	2,314,084	1,158,034	1,156,050
# removed due to no first report date	794	398	396	9,890	4,987	4,903
# after	86,278	43,101	43,177	2,304,194	1,153,047	1,151,147
# removed due to first report date occurring after inactive date	167	78	89	2,162	1,007	1,155
# after	86,111	43,023	43,088	2,302,032	1,152,040	1,149,992
# removed due to less than 2 months of pre-period winter months	3	2	1	85	70	15
# after	86,108	43,021	43,087	2,301,947	1,151,970	1,149,977
# removed due to no post period months	2,141	1,093	1,048	86,035	44,161	41,874
# after	83,967	41,928	42,039	2,215,912	1,107,809	1,108,103
# removed due to low usage (<0.07 kwh)	271	141	130	14,132	7,335	6,797
# after	83,696	41,787	41,909	2,201,780	1,100,474	1,101,306
Final #	**83,696**	**41,787**	**41,909**	**2,201,780**	**1,100,474**	**1,101,306**
% Removed	**4%**	**4%**	**4%**			

Table 31. Data Cleaning Results: Expansion Cohort 1, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	90,200	67,568	22,632	6,091,915	4,564,876	1,527,039
# removed due to out of range dates	-	-	-	3,779,251	2,830,891	948,360
# after	90,200	67,568	22,632	2,312,664	1,733,985	578,679
# removed due to no first report date	2,348	1,756	592	27,415	20,449	6,966
# after	87,852	65,812	22,040	2,285,249	1,713,536	571,713
# removed due to first report date occurring after inactive date	187	142	45	2,375	1,816	559
# after	87,665	65,670	21,995	2,282,874	1,711,720	571,154
# removed due to less than 2 months of pre-period winter months	1	1	-	44	44	-

	Unique Customers			Observations		
# after	87,664	65,669	21,995	2,282,830	1,711,676	571,154
# removed due to no post period months	2,488	1,877	611	94,979	70,603	24,376
# after	85,176	63,792	21,384	2,187,851	1,641,073	546,778
# removed due to low usage (<0.07 kwh)	732	560	172	29,099	22,327	6,772
# after	84,444	63,232	21,212	2,158,752	1,618,746	540,006
Final #	**84,444**	**63,232**	**21,212**	**2,158,752**	**1,618,746**	**540,006**
% Removed	**6%**	**6%**	**6%**			

Table 32. Data Cleaning Results: Expansion Cohort 2, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	108,585	90,791	17,794	8,333,447	7,100,994	1,232,453
# removed due to out of range dates	-	-	-	5,112,934	4,356,308	756,626
# after	108,585	90,791	17,794	3,220,513	2,744,686	475,827
# removed due to no first report date	3,451	2,926	525	42,553	36,729	5,824
# after	105,134	87,865	17,269	3,177,960	2,707,957	470,003
# removed due to first report date occurring after inactive date	368	310	58	4,110	3,455	655
# after	104,766	87,555	17,211	3,173,850	2,704,502	469,348
# removed due to less than 2 months of pre-period winter months	1,775	1,521	254	42,124	36,047	6,077
# after	102,991	86,034	16,957	3,131,726	2,668,455	463,271
# removed due to no post period months	3,422	2,902	520	143,954	122,084	21,870
# after	99,569	83,132	16,437	2,987,772	2,546,371	441,401
# removed due to low usage (<0.07 kwh)	1,276	1,089	187	64,663	54,890	9,773
# after	98,293	82,043	16,250	2,923,109	2,491,481	431,628
Final #	**98,293**	**82,043**	**16,250**	**2,923,109**	**2,491,481**	**431,628**
% Removed	**9%**	**10%**	**9%**			

Table 33. Data Cleaning Results: Expansion Cohort 3, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	22,573	15,175	7,398	1,664,104	1,118,993	545,111
# removed due to out of range dates	-	-	-	1,003,787	675,993	327,794
# after	22,573	15,175	7,398	660,317	443,000	217,317
# removed due to no first report date	3,217	2,100	1,117	37,291	24,311	12,980
# after	19,356	13,075	6,281	623,026	418,689	204,337
# removed due to first report date occurring after inactive date	787	532	255	8,603	5,797	2,806
# after	18,569	12,543	6,026	614,423	412,892	201,531
# removed due to less than 2 months of pre-period winter months	195	128	67	3,722	2,261	1,461
# after	18,374	12,415	5,959	610,701	410,631	200,070
# removed due to no post period months	2,580	1,690	890	49,443	31,975	17,468
# after	15,794	10,725	5,069	561,258	378,656	182,602
# removed due to low usage (<0.07 kwh)	77	53	24	3,766	2,591	1,175
# after	15,717	10,672	5,045	557,492	376,065	181,427
Final #	**15,717**	**10,672**	**5,045**	**557,492**	**376,065**	**181,427**
% Removed	**30%**	**30%**	**32%**			

Table 34. Data Cleaning Results: Expansion Cohort 4, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	41,986	31,492	10,494	918,386	688,712	229,674
# removed due to out of range dates	-	-	-	57,489	43,053	14,436
# after	41,986	31,492	10,494	860,897	645,659	215,238
# removed due to no first report date	1,755	1,321	434	18,336	13,905	4,431
# after	40,231	30,171	10,060	842,561	631,754	210,807

Appendix – Billing Analysis Data Cleaning Results

	Unique Customers			Observations		
# removed due to first report date occurring after inactive date	123	91	32	1,332	1,005	327
# after	40,108	30,080	10,028	841,229	630,749	210,480
# removed due to less than 2 months of pre-period winter months	2,230	1,674	556	33,506	25,116	8,390
# after	37,878	28,406	9,472	807,723	605,633	202,090
# removed due to no post period months	650	479	171	8,138	5,986	2,152
# after	37,228	27,927	9,301	799,585	599,647	199,938
# removed due to low usage (<0.07 kwh)	1,623	1,231	392	33,593	25,574	8,019
# after	35,605	26,696	8,909	765,992	574,073	191,919
Final #	**35,605**	**26,696**	**8,909**	**765,992**	**574,073**	**191,919**
% Removed	**15%**	**15%**	**15%**			

D. Appendix – Weather Station Details

Table 35. Weather Stations Used for HDD and CDD

Weather Station Name	Abbreviation	US Air Force (USAF)	Weather-Bureau-Army-Navy (WBAN)	Latitude	Longitude
GREATER PEORIA MUNI	KPIA	725320	14842	40.668	-89.684
CAHOKIA/ST. LOUIS	KCPS	725314	3960	38.571	-90.157
SCOTT AFB MIDAMERIC	KBLV	724338	13802	38.55	-89.85
COLES CO MEM	KMTO	725317	53802	39.478	-88.28
ST LOUIS RGNL	KALN	724395	3958	38.883	-90.05
LITCHFIELD MUNI	K3LF	722972	63878	39.163	-89.675
SPRINGFIELD/CAPITAL	KSPI	724390	93822	39.845	-89.684
TAYLORVILLE MUNI	KTAZ	744662	63817	39.534	-89.328
LOGAN CO	KAAA	744672	4862	40.158	-89.335
DECATUR	KDEC	725316	3887	39.834	-88.866
ILLINOIS VALLEY RGNL	KVYS	722149	4899	41.352	-89.153
GALESBURG MUNI	KGBG	722089	94959	40.933	-90.433
SOUTHERN ILLINOIS	KMDH	724336	93810	37.78	-89.25
UNIV OF ILLINOIS WI	KCMI	725315	94870	40.04	-88.278
MACOMB MUNI	KMQB	722157	4949	40.52	-90.652
MARSHALL CO	KC75	720141	4868	41.019	-89.386
VERMILION CO	KDNV	722076	94891	40.2	-87.6
WILLIAMSON CO RGNL	KMWA	724339	3865	37.75	-89
CHAMPAIGN 9 SW	073A	999999	54808	40.053	-88.373
PITTSFIELD PENSTONE	KPPQ	744663	53950	39.639	-90.778
STERLING ROCKFALLS	KSQI	725326	4894	41.743	-89.676
RANTOUL NATL AVIATIO	KTIP	722194	4896	40.293	-88.142
JACKSONVILLE MUNI	KIJX	744666	53944	39.78	-90.238
SPARTA COMMUNITY HUN	KSAR	744653	63814	38.149	-89.699
CENTRALIA MUNI	KENL	744657	53887	38.515	-89.092
MOUNT VERNON	KMVN	724335	93894	38.323	-88.858
EDGAR CO	KPRG	722172	63810	39.7	-87.669
SALEM-LECKRONE	KSLO	724330	3879	38.65	-88.967
MOLINE/QUAD CITY	KMLI	725440	14923	41.465	-90.523
ROBINSON MUNI	KRSV	720319	63841	39.016	-87.65
CENTRAL ILLINOIS RG	KBMI	724397	54831	40.483	-88.95
OLNEY NOBLE	KOLY	744659	53822	38.722	-88.176
FLORA	KFOA	744658	53889	38.665	-88.453
HARRISBURG RALEIGH	KHSB	744652	53897	37.811	-88.549
METROPOLIS MUNICIPAL	KM30	720170	63851	37.186	-88.751
LAWRENCEVILLE VINCEN	KLWV	725342	13809	38.764	-87.606

E. Appendix – Billing Analysis Model Coefficients

Overall Program Model Coefficients

Table 36 and Table 37 show the billing analysis model coefficients for the electric and gas cohorts.

Table 36. Billing Analysis Model Coefficients – Electric

Variable	Coefficient	Robust Standard Error	t
Original Cohort			
Post	-2.03	0.04	-46.56
Post x Treatment	-0.62	0.06	-10.08
HDD	0.01	0.00	156.21
CDD	0.20	0.00	481.82
Constant	25.59	0.04	727.91
Expansion Cohort 1			
Post	-0.79	0.07	-11.80
Post x Treatment	-0.75	0.08	-9.68
HDD	0.01	0.00	174.88
CDD	0.23	0.00	486.32
Constant	25.54	0.04	575.13
Expansion Cohort 2			
Post	0.36	0.05	7.00
Post x Treatment	-0.31	0.06	-5.60
HDD	0.01	0.00	195.38
CDD	0.15	0.00	555.68
Constant	17.51	0.02	717.65
Expansion Cohort 4			
Post	1.43	0.11	13.07
Post x Treatment	-0.72	0.13	-5.61
HDD	0.02	0.00	107.71
CDD	0.18	0.00	293.15
Constant	34.49	0.11	326.25

Table 37. Billing Analysis Model Coefficients – Gas

Variable	Coefficient	Robust Standard Error	t
Original Cohort			
Post	-0.07	0.00	-26.46
Post x Treatment	-0.03	0.00	-6.99
HDD	0.01	0.00	747.12
CDD	0.00	0.00	135.82
Constant	0.16	0.00	41.78

Variable	Coefficient	Robust Standard Error	t
Expansion Cohort 1			
Post	0.00	0.00	-0.07
Post x Treatment	-0.04	0.00	-7.39
HDD	0.01	0.00	737.58
CDD	0.00	0.00	115.22
Constant	0.09	0.00	17.82
Expansion Cohort 2			
Post	0.06	0.00	18.43
Post x Treatment	-0.02	0.00	-4.69
HDD	0.00	0.00	1145.54
CDD	0.00	0.00	159.81
Constant	0.04	0.00	17.01
Expansion Cohort 3			
Post	0.05	0.01	9.99
Post x Treatment	-0.03	0.01	-4.38
HDD	0.00	0.00	405.60
CDD	0.00	0.00	80.22
Constant	0.06	0.01	9.46
Expansion Cohort 4			
Post	0.05	0.01	8.00
Post x Treatment	-0.01	0.01	-1.39
HDD	0.00	0.00	296.15
CDD	0.00	0.00	69.94
Constant	-0.01	0.01	-1.38

Seasonal Model Coefficients

Table 38 and Table 39 show the savings per cohort using the seasonal model.

Table 38. Per-Household Savings (% & kWh) by Season – Electric

Cohort Name	Statistic	Overall	Winter	Summer	Spring	Fall
Original Cohort	Average % Savings	1.79%	1.85%	1.64%	1.95%	1.72%
	Average Annual Savings per Customer	223	57	68	52	46
Expansion Cohort 1	Average % Savings	2.01%	2.12%	1.83%	2.14%	1.93%
	Average Annual Savings per Customer	273	73	83	61	56
Expansion Cohort 2	Average % Savings	1.22%	1.09%	1.21%	1.27%	1.30%
	Average Annual Savings per Customer	115	25	38	25	26
Expansion Cohort 4	Average % Savings	1.41%	1.84%	0.86%	1.62%	1.22%
	Average Annual Savings per Customer	251	103	37	54	50

Table 39. Per-Household Savings (% & Therms) by Season – Gas

Cohort Name	Statistic	Overall	Winter	Summer	Spring	Fall
Original Cohort	Average % Savings	0.87%	0.92%	0.60%	1.00%	0.98%
	Average Annual Savings per Customer	9.73	5.45	0.30	1.76	2.30
Expansion Cohort 1	Average % Savings	1.18%	1.07%	1.07%	1.09%	1.51%
	Average Annual Savings per Customer	13.87	7.32	0.55	2.09	3.95
Expansion Cohort 2	Average % Savings	0.82%	0.73%	0.74%	1.08%	0.73%
	Average Annual Savings per Customer	6.15	3.24	0.26	1.36	1.31
Expansion Cohort 3	Average % Savings	1.12%	1.23%	1.04%	1.32%	0.91%
	Average Annual Savings per Customer	10.80	6.47	0.49	1.90	1.96
Expansion Cohort 4	Average % Savings	0.31%	0.44%	-0.21%	0.31%	0.59%
	Average Annual Savings per Customer	4.37	2.42	-0.07	0.47	1.22

Table 40 through Table 48 show the billing analysis seasonal model coefficients for the electric and gas cohorts.

Table 40. Billing Analysis Model Coefficients – Electric, Original Cohort

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	-1.02	0.07	-14.03
Post x Treatment	-0.64	0.10	-6.29
HDD	0.01	0.00	169.31
CDD	-0.62	0.11	-5.51
Constant	20.78	0.09	241.60
Summer			
Post	-3.38	0.06	-55.71
Post x Treatment	-0.75	0.09	-8.70
HDD	-0.11	0.00	-140.96
CDD	0.10	0.00	225.64
Constant	41.61	0.06	684.23
Spring			
Post	-0.93	0.04	-21.81
Post x Treatment	-0.56	0.06	-9.15
HDD	0.00	0.00	66.51
CDD	0.23	0.00	333.97
Constant	22.80	0.04	631.68
Fall			
Post	-2.28	0.05	-48.83
Post x Treatment	-0.51	0.06	-7.87
HDD	0.01	0.00	150.68
CDD	0.23	0.00	185.25
Constant	23.64	0.04	606.19

Table 41. Billing Analysis Model Coefficients – Electric, Expansion Cohort 1

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	-0.26	0.11	-2.40
Post x Treatment	-0.81	0.13	-6.47
HDD	0.01	0.00	161.32
CDD	-0.18	0.03	-6.68
Constant	23.21	0.09	253.59
Summer			
Post	-4.07	0.10	-40.61
Post x Treatment	-0.91	0.12	-7.94
HDD	-0.13	0.00	-127.40
CDD	0.11	0.00	192.96
Constant	46.56	0.08	563.93
Spring			
Post	-0.72	0.07	-10.59
Post x Treatment	-0.67	0.08	-8.32
HDD	0.01	0.00	63.56
CDD	0.24	0.00	272.28
Constant	25.08	0.05	480.49
Fall			
Post	-0.37	0.07	-5.22
Post x Treatment	-0.63	0.08	-7.60
HDD	0.01	0.00	161.01
CDD	0.23	0.00	185.87
Constant	23.38	0.05	452.97

Table 42. Billing Analysis Model Coefficients – Electric, Expansion Cohort 2

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	0.18	0.09	2.06
Post x Treatment	-0.28	0.10	-2.88
HDD	0.01	0.00	160.47
CDD	-0.19	0.01	-15.29
Constant	15.93	0.06	281.21
Summer			
Post	-1.72	0.07	-24.00
Post x Treatment	-0.42	0.08	-5.39
HDD	-0.07	0.00	-175.63

Variable	Coefficient	Robust Standard Error	t
CDD	0.08	0.00	300.99
Constant	29.57	0.05	641.58
Spring			
Post	-0.07	0.05	-1.28
Post x Treatment	-0.27	0.06	-4.86
HDD	0.00	0.00	66.89
CDD	0.14	0.00	307.91
Constant	17.53	0.03	608.85
Fall			
Post	0.67	0.06	12.12
Post x Treatment	-0.29	0.06	-4.93
HDD	0.01	0.00	178.00
CDD	0.16	0.00	188.06
Constant	15.57	0.03	536.28

Table 43. Billing Analysis Model Coefficients – Electric, Expansion Cohort 4

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	1.51	0.22	6.75
Post x Treatment	-1.14	0.25	-4.64
HDD	0.02	0.00	66.16
CDD	-5.36	0.29	-18.71
Constant	38.57	0.28	138.45
Summer			
Post	0.05	0.15	0.37
Post x Treatment	-0.52	0.17	-3.07
HDD	-0.13	0.00	-77.21
CDD	0.09	0.00	150.30
Constant	54.81	0.14	391.11
Spring			
Post	-1.61	0.12	-13.54
Post x Treatment	-0.68	0.14	-4.91
HDD	0.02	0.00	73.31
CDD	0.23	0.00	110.91
Constant	32.92	0.12	273.61
Fall			
Post	-0.58	0.13	-4.55
Post x Treatment	-0.56	0.14	-3.89
HDD	0.03	0.00	110.36

Variable	Coefficient	Robust Standard Error	t
CDD	0.30	0.00	89.83
Constant	28.99	0.13	229.40

Table 44. Billing Analysis Model Coefficients – Gas, Original Cohort

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	0.08	0.01	12.91
Post x Treatment	-0.06	0.01	-6.87
HDD	0.00	0.00	336.62
CDD	-0.34	0.03	-13.17
Constant	2.20	0.01	176.53
Summer			
Post	-0.04	0.00	-32.47
Post x Treatment	0.00	0.00	-1.78
HDD	0.00	0.00	6.18
CDD	0.00	0.00	-37.95
Constant	0.62	0.00	479.20
Spring			
Post	0.13	0.00	48.40
Post x Treatment	-0.02	0.00	-5.00
HDD	0.00	0.00	303.41
CDD	0.00	0.00	-26.61
Constant	0.55	0.00	122.01
Fall			
Post	-0.18	0.00	-50.85
Post x Treatment	-0.03	0.00	-5.47
HDD	0.01	0.00	608.79
CDD	0.00	0.00	28.49
Constant	-0.04	0.00	-7.90

Table 45. Billing Analysis Model Coefficients – Gas, Expansion Cohort 1

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	0.19	0.01	18.14
Post x Treatment	-0.08	0.01	-6.78
HDD	0.00	0.00	378.11
CDD	-0.12	0.00	-33.75
Constant	2.11	0.01	161.22

Variable	Coefficient	Robust Standard Error	t
Summer			
Post	-0.02	0.00	-9.98
Post x Treatment	-0.01	0.00	-2.26
HDD	0.00	0.00	3.04
CDD	0.00	0.00	-21.85
Constant	0.62	0.00	313.32
Spring			
Post	-0.01	0.00	-2.17
Post x Treatment	-0.02	0.01	-4.48
HDD	0.00	0.00	294.07
CDD	0.00	0.00	-40.87
Constant	0.73	0.01	103.89
Fall			
Post	-0.05	0.01	-9.10
Post x Treatment	-0.04	0.01	-7.09
HDD	0.01	0.00	586.85
CDD	0.00	0.00	23.63
Constant	-0.24	0.01	-38.74

Table 46. Billing Analysis Model Coefficients – Gas, Expansion Cohort 2

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	0.18	0.01	23.53
Post x Treatment	-0.04	0.01	-4.39
HDD	0.00	0.00	461.37
CDD	-0.06	0.00	-38.71
Constant	1.41	0.01	204.82
Summer			
Post	-0.02	0.00	-13.48
Post x Treatment	0.00	0.00	-2.20
HDD	0.00	0.00	40.55
CDD	0.00	0.00	-37.39
Constant	0.41	0.00	608.76
Spring			
Post	0.02	0.00	6.65
Post x Treatment	-0.01	0.00	-4.41
HDD	0.00	0.00	363.50
CDD	0.00	0.00	-51.53
Constant	0.45	0.00	116.25

Variable	Coefficient	Robust Standard Error	t
Fall			
Post	0.04	0.00	9.99
Post x Treatment	-0.01	0.00	-3.33
HDD	0.00	0.00	855.71
CDD	0.00	0.00	33.47
Constant	-0.23	0.00	-80.03

Table 47. Billing Analysis Model Coefficients – Gas, Expansion Cohort 3

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	0.13	0.01	10.14
Post x Treatment	-0.07	0.02	-4.60
HDD	0.00	0.00	175.64
CDD	-0.15	0.01	-27.82
Constant	1.93	0.02	95.98
Summer			
Post	-0.02	0.00	-4.27
Post x Treatment	-0.01	0.00	-1.23
HDD	0.00	0.00	3.28
CDD	0.00	0.00	-20.86
Constant	0.57	0.00	159.77
Spring			
Post	0.02	0.01	2.63
Post x Treatment	-0.02	0.01	-2.92
HDD	0.00	0.00	150.04
CDD	0.00	0.00	-14.68
Constant	0.56	0.01	53.02
Fall			
Post	0.03	0.01	4.49
Post x Treatment	-0.02	0.01	-2.38
HDD	0.00	0.00	317.65
CDD	0.00	0.00	17.16
Constant	-0.31	0.01	-32.93

Table 48. Billing Analysis Model Coefficients – Gas, Expansion Cohort 4

Variable	Coefficient	Robust Standard Error	t
Winter			
Post	0.78	0.02	50.35

Variable	Coefficient	Robust Standard Error	t
Post x Treatment	-0.03	0.02	-1.60
HDD	0.00	0.00	83.69
CDD	-1.16	0.02	-46.93
Constant	2.71	0.03	103.21
Summer			
Post	0.00	0.00	1.18
Post x Treatment	0.00	0.00	0.25
HDD	0.00	0.00	15.38
CDD	0.00	0.00	-6.83
Constant	0.46	0.00	150.67
Spring			
Post	-0.05	0.01	-7.67
Post x Treatment	-0.01	0.01	-0.73
HDD	0.00	0.00	162.93
CDD	0.00	0.00	-16.77
Constant	0.48	0.01	42.15
Fall			
Post	0.00	0.01	0.41
Post x Treatment	-0.01	0.01	-1.48
HDD	0.00	0.00	230.17
CDD	0.00	0.00	18.51
Constant	-0.25	0.01	-22.70

Baseline Usage Model Coefficients

Table 49 shows the savings per cohort using the baseline usage model.

Table 49. Per-Household Savings (% & kWh) by Baseline Usage – Electric

Cohort Name	Statistic	Overall	High Usage	Medium Usage	Low Usage
Original Cohort	Average % Savings	1.70%	2.21%	1.40%	1.50%
	Average Annual Savings per Customer	221	378	164	121
Expansion Cohort 1	Average % Savings	1.84%	2.35%	1.64%	1.54%
	Average Annual Savings per Customer	266	467	208	124
Expansion Cohort 2	Average % Savings	1.12%	1.62%	0.81%	0.92%
	Average Annual Savings per Customer	113	218	70	49
Expansion Cohort 4	Average % Savings	1.33%	1.43%	1.61%	0.97%
	Average Annual Savings per Customer	230	326	245	119

Table 50, below, provides gas savings (in percentage terms) by baseline usage.

Table 50. Per-Household Savings (% & Therms) by Baseline Usage – Gas

Cohort Name	Statistic	Overall	High Usage	Medium Usage	Low Usage
Original Cohort	Average % Savings	0.83%	1.10%	1.06%	0.34%
	Average Annual Savings per Customer	9.45	15.43	10.43	2.43
Expansion Cohort 1	Average % Savings	0.97%	1.41%	1.10%	0.40%
	Average Annual Savings per Customer	12.23	21.38	11.90	3.34
Expansion Cohort 2	Average % Savings	0.69%	1.04%	0.41%	0.62%
	Average Annual Savings per Customer	5.59	9.96	3.14	3.67
Expansion Cohort 3	Average % Savings	1.09%	1.42%	0.86%	0.99%
	Average Annual Savings per Customer	10.48	17.64	7.37	6.48
Expansion Cohort 4	Average % Savings	0.11%	0.69%	0.26%	-0.64%
	Average Annual Savings per Customer	3.12	9.86	2.22	-2.78

Table 51 through Table 58 show the billing analysis baseline usage model coefficients for the electric and gas cohorts.

Table 51. Billing Analysis Model Coefficients – Electric, Original Cohort

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	-4.24	0.10	-44.56
Post x Treatment	-1.06	0.13	-7.85
HDD	0.01	0.00	98.55
CDD	0.26	0.00	295.06
Constant	36.96	0.08	447.04
Medium Usage			
Post	-1.55	0.07	-23.06
Post x Treatment	-0.46	0.10	-4.82
HDD	0.01	0.00	95.98
CDD	0.20	0.00	328.00
Constant	24.39	0.05	488.06
Low Usage			
Post	-0.22	0.05	-3.97
Post x Treatment	-0.34	0.08	-4.43
HDD	0.00	0.00	108.29
CDD	0.15	0.00	298.76
Constant	15.56	0.04	408.34

Table 52. Billing Analysis Model Coefficients – Electric, Expansion Cohort 1

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	-2.14	0.15	-14.06

Variable	Coefficient	Robust Standard Error	t
Post x Treatment	-1.31	0.18	-7.43
HDD	0.02	0.00	106.20
CDD	0.31	0.00	310.45
Constant	39.05	0.11	370.27
Medium Usage			
Post	-0.51	0.10	-4.96
Post x Treatment	-0.59	0.12	-4.98
HDD	0.01	0.00	110.04
CDD	0.23	0.00	345.64
Constant	23.98	0.06	389.07
Low Usage			
Post	0.38	0.08	4.78
Post x Treatment	-0.35	0.09	-3.84
HDD	0.01	0.00	123.78
CDD	0.16	0.00	303.69
Constant	14.05	0.04	315.14

Table 53. Billing Analysis Model Coefficients – Electric, Expansion Cohort 2

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	-0.47	0.12	-3.96
Post x Treatment	-0.62	0.13	-4.87
HDD	0.01	0.00	116.77
CDD	0.18	0.00	348.16
Constant	27.40	0.06	488.63
Medium Usage			
Post	0.83	0.08	10.61
Post x Treatment	-0.20	0.09	-2.34
HDD	0.00	0.00	120.39
CDD	0.15	0.00	431.16
Constant	16.18	0.03	468.57
Low Usage			
Post	0.78	0.06	12.84
Post x Treatment	-0.14	0.07	-2.13
HDD	0.00	0.00	137.62
CDD	0.10	0.00	322.40
Constant	9.14	0.03	339.29

Table 54. Billing Analysis Model Coefficients – Electric, Expansion Cohort 4

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	1.01	0.24	4.15
Post x Treatment	-1.02	0.29	-3.54
HDD	0.04	0.00	84.83
CDD	0.21	0.00	158.22
Constant	43.46	0.24	177.51
Medium Usage			
Post	1.53	0.16	9.40
Post x Treatment	-0.77	0.19	-4.04
HDD	0.01	0.00	61.80
CDD	0.18	0.00	185.61
Constant	33.03	0.13	246.84
Low Usage			
Post	1.69	0.15	11.52
Post x Treatment	-0.37	0.17	-2.21
HDD	0.01	0.00	52.34
CDD	0.16	0.00	197.79
Constant	26.93	0.10	261.72

Table 55. Billing Analysis Model Coefficients – Gas, Original Cohort

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	-0.17	0.01	-28.29
Post x Treatment	-0.04	0.01	-5.06
HDD	0.01	0.00	572.32
CDD	0.00	0.00	52.50
Constant	0.32	0.01	44.39
Medium Usage			
Post	-0.05	0.00	-13.33
Post x Treatment	-0.03	0.01	-5.29
HDD	0.00	0.00	831.03
CDD	0.00	0.00	80.07
Constant	0.22	0.00	56.41
Low Usage			
Post	0.02	0.00	7.55
Post x Treatment	-0.01	0.00	-1.45
HDD	0.00	0.00	585.48

Variable	Coefficient	Robust Standard Error	t
CDD	0.00	0.00	102.98
Constant	0.11	0.00	30.09

Table 56. Billing Analysis Model Coefficients – Gas, Expansion Cohort 1

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	-0.08	0.01	-8.60
Post x Treatment	-0.06	0.01	-5.44
HDD	0.01	0.00	493.41
CDD	0.00	0.00	46.50
Constant	0.25	0.01	24.97
Medium Usage			
Post	0.00	0.01	-0.03
Post x Treatment	-0.03	0.01	-4.77
HDD	0.01	0.00	784.70
CDD	0.00	0.00	72.51
Constant	0.15	0.00	29.80
Low Usage			
Post	0.07	0.01	14.00
Post x Treatment	-0.01	0.01	-1.55
HDD	0.00	0.00	616.56
CDD	0.00	0.00	102.02
Constant	0.00	0.00	-0.24

Table 57. Billing Analysis Model Coefficients – Gas, Expansion Cohort 2

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	-0.01	0.01	-1.60
Post x Treatment	-0.03	0.01	-4.15
HDD	0.00	0.00	802.39
CDD	0.00	0.00	47.54
Constant	0.20	0.00	49.26
Medium Usage			
Post	0.04	0.00	9.64
Post x Treatment	-0.01	0.00	-1.79
HDD	0.00	0.00	958.13
CDD	0.00	0.00	93.40
Constant	0.08	0.00	29.59

Variable	Coefficient	Robust Standard Error	t
Low Usage			
Post	0.14	0.00	27.45
Post x Treatment	-0.01	0.01	-1.95
HDD	0.00	0.00	659.27
CDD	0.00	0.00	140.66
Constant	-0.09	0.00	-31.68

Table 58. Billing Analysis Model Coefficients – Gas, Expansion Cohort 3

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	0.00	0.01	0.38
Post x Treatment	-0.05	0.02	-3.31
HDD	0.01	0.00	291.14
CDD	0.00	0.00	33.70
Constant	0.23	0.01	16.89
Medium Usage			
Post	0.05	0.01	6.95
Post x Treatment	-0.02	0.01	-2.21
HDD	0.00	0.00	410.98
CDD	0.00	0.00	58.70
Constant	0.07	0.01	9.89
Low Usage			
Post	0.10	0.01	14.79
Post x Treatment	-0.02	0.01	-2.29
HDD	0.00	0.00	358.57
CDD	0.00	0.00	69.42
Constant	-0.03	0.01	-4.15

Table 59. Billing Analysis Model Coefficients – Gas, Expansion Cohort 4

Variable	Coefficient	Robust Standard Error	t
High Usage			
Post	0.01	0.01	0.87
Post x Treatment	-0.03	0.02	-1.86
HDD	0.01	0.00	262.56
CDD	0.00	0.00	29.44
Constant	0.15	0.02	9.26
Medium Usage			

Variable	Coefficient	Robust Standard Error	t
Post	0.06	0.01	7.78
Post x Treatment	-0.01	0.01	-0.75
HDD	0.00	0.00	385.44
CDD	0.00	0.00	61.41
Constant	0.00	0.01	0.45
Low Usage			
Post	0.11	0.01	15.04
Post x Treatment	0.01	0.01	0.96
HDD	0.00	0.00	157.29
CDD	0.00	0.00	43.84
Constant	-0.06	0.01	-6.47

Per Year Savings

The PY6 analysis uses different model specifications from previous program cycle evaluations and the results cannot be directly compared. However, we also present the billing analysis results using a model without weather variables for direct comparison purposes only. Table 60 and Table 61 provide both electric and gas percent household savings by cohort and by year. These include the two key factors that correlate with program energy impacts: baseline usage and number of years a participant has been in the program. As can be seen in the table, cohorts with higher baseline consumption tend to yield higher percentage savings. In addition, cohorts that have participated in the program for more time also tend to yield higher percentage savings.

Table 60. Per Year Saving for Electric Cohorts

Electric Cohorts	First Year in Program	Second Year in Program	Third Year in Program	Fourth Year in Program
Original Cohort (Average Annual Usage: 12,286 kwh)	1.20%	1.46%	1.56%	1.81% (1.76%*)
Expansion Cohort 1 (Average Annual Usage: 13,501 kwh)	1.29%	1.62%	1.98% (1.95%*)	
Expansion Cohort 2 (Average Annual Usage: 9,183 kwh)	0.87%	0.87%	1.20% (1.14%*)	
Expansion Cohort 4 (Average Annual Usage: 16,967 kwh)	1.37% (1.35%*)			

(*) Results using a model without weather variables for comparison purposes only.
Note: Baseline consumption is from the year before the first report was sent.

Table 61. Per Year Saving for Gas Cohorts

Gas Cohorts	First Year in Program	Second Year in Program	Third Year in Program	Fourth Year in Program
Original Cohort (Average Annual Usage: 1,033 therms)	0.70%	1.03%	1.04%	0.91% (1.03%*)
Expansion Cohort 1 (Average Annual Usage: 1,142 therms)	0.79%	1.29%	1.12% (1.52%*)	
Expansion Cohort 2 (Average Annual Usage: 772 therms)	0.35%	0.51%	0.72% (0.85%*)	

Gas Cohorts	First Year in Program	Second Year in Program	Third Year in Program	Fourth Year in Program
Expansion Cohort 3 (Average Annual Usage: 918 therms)	0.96%	0.71%	1.11% (1.25%*)	
Expansion Cohort 4 (Average Annual Usage: 908 therms)	0.37% (0.24%*)			

(*) Results using a model without weather variables for comparison purposes only.

Figure 11 and Figure 12 show there is an increase in savings year-over-year (when comparing the results without weather variables in the model). However, this comparison is for informational purposes only as direct comparisons cannot be made without comparing for weather.

Figure 11. Year-Over-Year Savings – Electric

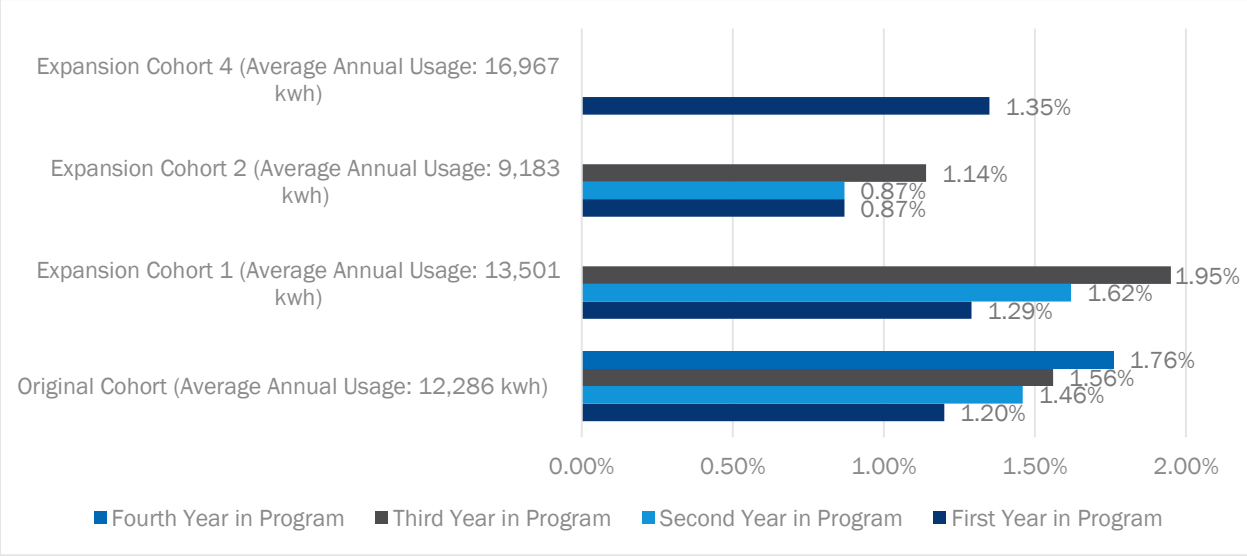
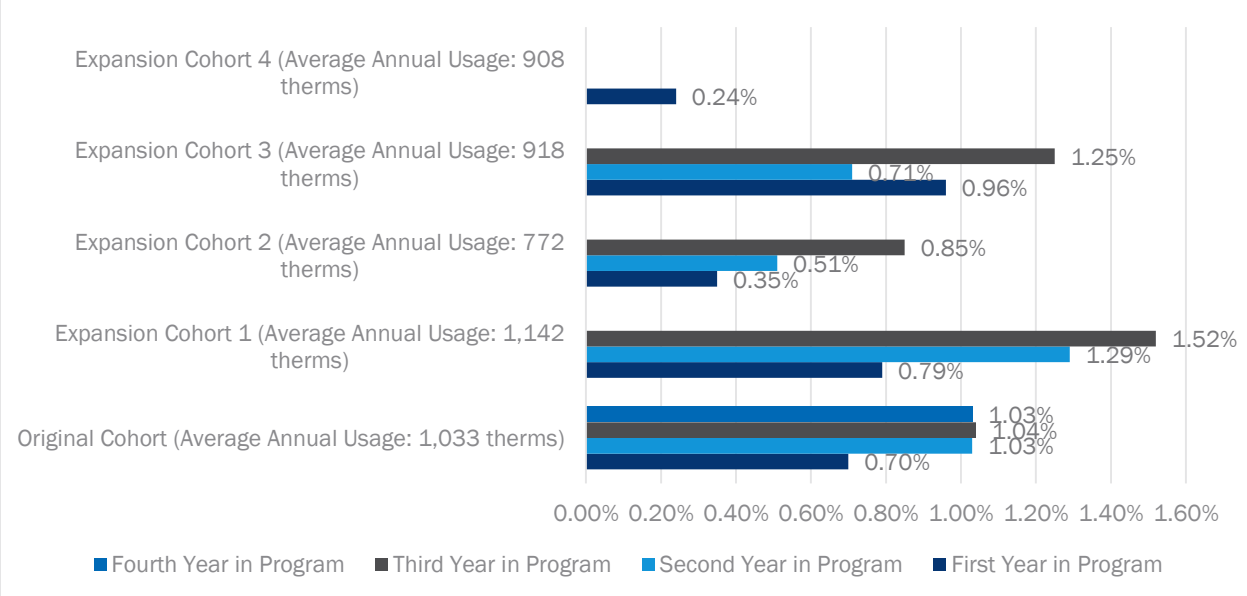


Figure 12. Year-Over-Year Savings – Gas



F. Appendix – Channeling Analysis

In order for the evaluation team to compare the participation between treatment and control, we have to normalize the participation by the population in each cohort. Essentially, this gives us a percentage that represents the participation rate for each cohort and treatment status. Table 62 shows the population group sizes for each of the cohorts.

Table 62. Treatment and Control Group Sizes – Electric & Gas

Cohort	Treatment	Control
Original Cohort	49,601	49,601
Expansion Cohort 1	74,597	24,858
Expansion Cohort 2	116,988	20,274
Expansion Cohort 3 (Gas Only)	19,089	9,282
Expansion Cohort 4	30,171	10,061

Using the difference-in-difference (DID) approach, the evaluation team applied the evaluated net deemed savings for calculating the savings adjustments (see Table 63).

Table 63. Difference-in-Differences Estimator

DID Estimator	Pre	Post	Post-Pre Difference
Treatment	Y0t	Y1t	Y1t-Y0t
Control	Y0c	Y1c	Y1c-Y0c
T-C Difference	**Y0t-Y0c**	**Y1t-Y1c**	**(Y1t-Y1c) - (Y0t-Y0c)**

The savings adjustment values were then divided by the modeled baseline assumptions to get the household-level adjustment values (see Table 64).

Table 64. Modeled Baseline Usage

Cohort	Electric (kWh/year)	Gas (therms/year)
Original Cohort	12,286	1,033
Expansion Cohort 1	13,501	1,142
Expansion Cohort 2	9,183	772
Expansion Cohort 3	NA	918
Expansion Cohort 4	16,767	908

The baseline usages values and the net adjustments per household are shown in Table 65 and Table 66.

Table 65. Savings Adjustment – Electric

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Electric – Original Cohort			
Treatment	0.000%	0.169%	0.169%
Control	0.000%	0.159%	0.159%
T-C Difference	0.000%	0.010%	0.010%
Electric – Expansion Cohort 1			
Treatment	0.008%	0.148%	0.140%

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Control	0.009%	0.150%	0.141%
T-C Difference	-0.001%	-0.002%	-0.001%
Electric – Expansion Cohort 2			
Treatment	0.149%	0.174%	0.025%
Control	0.145%	0.139%	-0.007%
T-C Difference	0.004%	0.035%	0.031%
Electric – Expansion Cohort 4			
Treatment	0.121%	0.148%	0.027%
Control	0.130%	0.119%	-0.012%
T-C Difference	-0.009%	0.029%	0.038%

Table 66. Savings Adjustment – Gas

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Gas – Original Cohort			
Treatment	0.000%	0.189%	0.189%
Control	0.001%	0.162%	0.162%
T-C Difference	-0.001%	0.026%	0.027%
Gas – Expansion Cohort 1			
Treatment	0.004%	0.166%	0.162%
Control	0.002%	0.139%	0.137%
T-C Difference	0.001%	0.027%	0.026%
Gas – Expansion Cohort 2			
Treatment	0.149%	0.162%	0.014%
Control	0.119%	0.118%	-0.001%
T-C Difference	0.030%	0.045%	0.015%
Gas – Expansion Cohort 3			
Treatment	0.099%	0.085%	-0.014%
Control	0.092%	0.066%	-0.026%
T-C Difference	0.007%	0.018%	0.012%
Gas – Expansion Cohort 4			
Treatment	0.205%	0.126%	-0.079%
Control	0.213%	0.121%	-0.091%
T-C Difference	-0.008%	0.005%	0.012%

The evaluation team also reviewed historical participation lift to look at how participation in each of the programs has shifted for each cohort throughout each of the program years (see Table 70). Behavioral Modification program has channeled about 2.8% of participants or about 1,500 participants into other residential AIC programs.

Table 67. Historical Participation Lift by Program and Cohort

Cohort	PY3	PY4	PY5	PY6
Appliance Recycling				
Original Cohort	0.016%	0.058%	0.131%	0.026%
Expansion Cohort 1	-	0.234%	0.091%	0.061%
Expansion Cohort 2	-	0.037%	0.090%	-0.061%
Expansion Cohort 3	-	0.064%	0.050%	0.086%
Expansion Cohort 4	-	-	-	0.056%
Lighting				
Original Cohort	0.000%	0.006%	0.006%	0.000%
Expansion Cohort 1	-	-0.012%	-0.007%	0.009%
Expansion Cohort 2	-	-0.002%	0.004%	0.015%
Expansion Cohort 3	-	0.000%	0.000%	0.000%
Expansion Cohort 4	-	-	-	0.020%
HVAC				
Original Cohort	0.000%	0.083%	-0.091%	0.022%
Expansion Cohort 1	-	0.107%	0.072%	-0.169%
Expansion Cohort 2	-	0.010%	0.034%	0.148%
Expansion Cohort 3	-	-0.038%	-0.063%	-0.003%
Expansion Cohort 4	-	-	-	0.172%
REEP				
Original Cohort	0.006%	0.143%	-0.022%	-0.050%
Expansion Cohort 1	-	-0.007%	0.035%	0.016%
Expansion Cohort 2	-	-0.053%	-0.094%	0.048%
Expansion Cohort 3	-	0.098%	0.144%	-0.056%
Expansion Cohort 4	-	-	-	0.219%
Home Energy Performance				
Original Cohort	0.000%	0.081%	0.129%	0.050%
Expansion Cohort 1	-	0.310%	0.226%	0.029%
Expansion Cohort 2	-	-0.019%	-0.004%	-0.015%
Expansion Cohort 3	-	0.119%	-0.041%	0.043%
Expansion Cohort 4	-	-	-	0.166%
Moderate Income				
Original Cohort	0.000%	-0.008%	-0.006%	-0.006%
Expansion Cohort 1	-	-0.001%	0.027%	0.003%
Expansion Cohort 2	-	0.002%	0.017%	0.004%
Expansion Cohort 3	-	0.005%	-0.011%	0.021%
Expansion Cohort 4	-	-	-	0.020%

Trends in Program Channeling

In addition to aggregate participation rates in the first year, we examined participation rates over time to better understand differences in timing of treatment and control group actions. Figure 13 through

Figure 17 show monthly and cumulative participation rates in each of the cohorts in the program. The cumulative participation shows that the rate of participation is decreasing over time.

Figure 13. Trended Program Participation Rate: Original Cohort

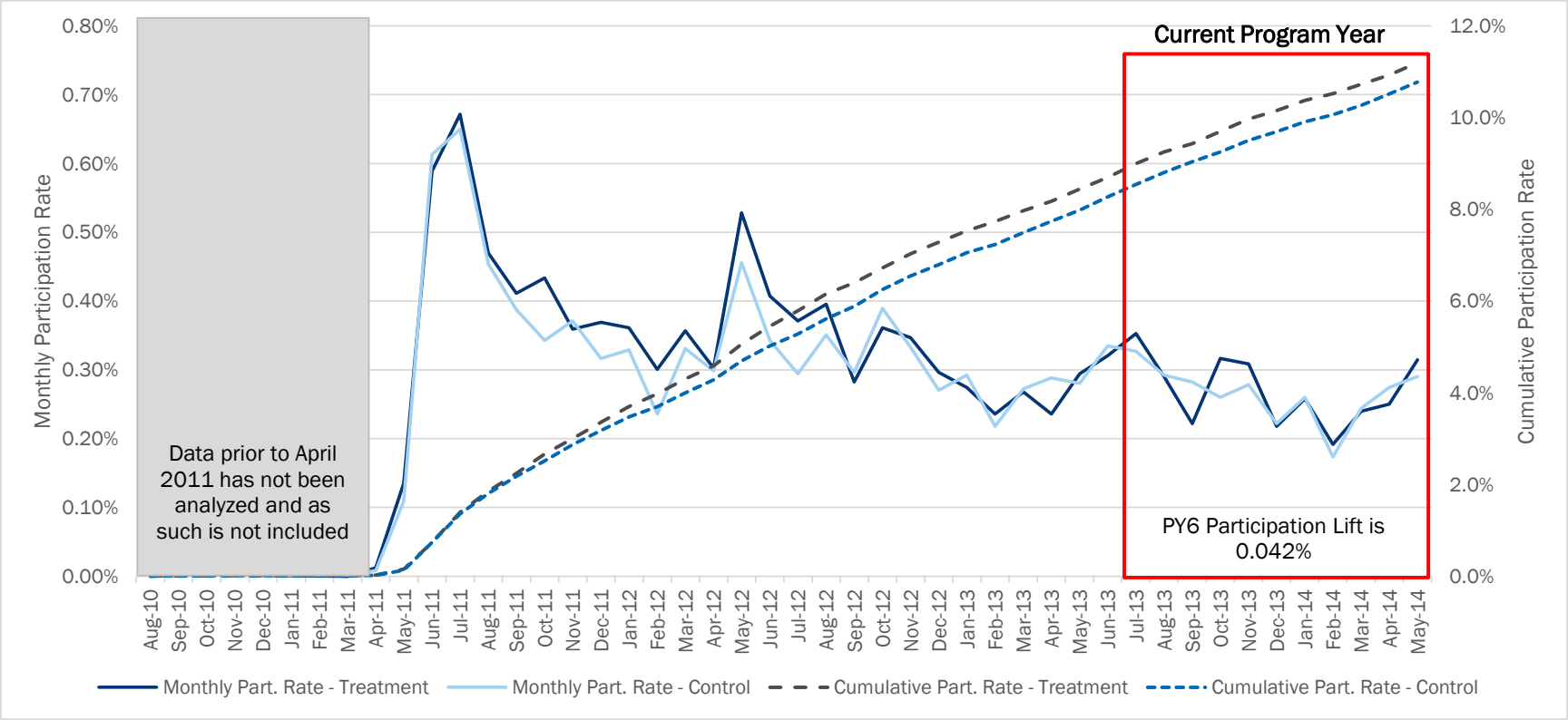


Figure 14. Trended Program Participation Rate: Expansion Cohort 1

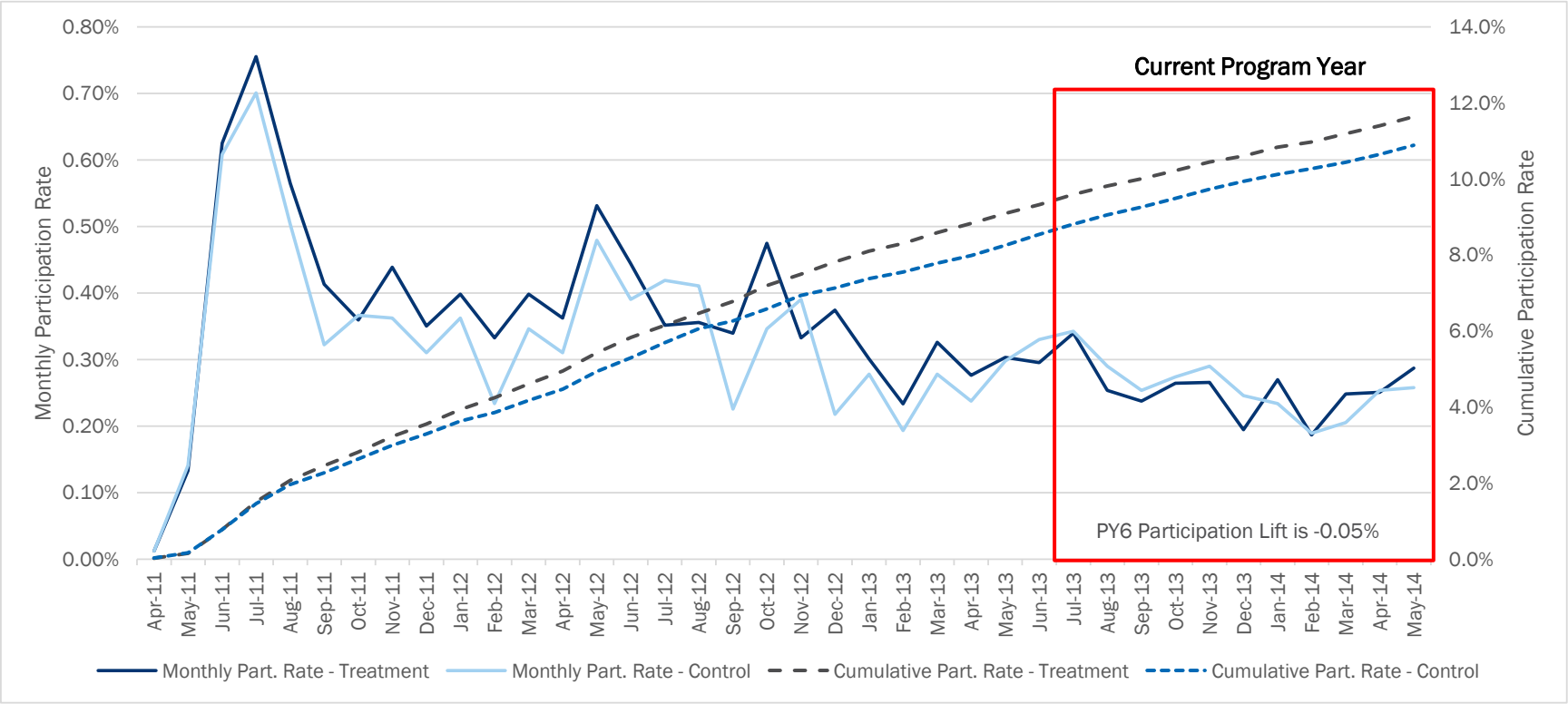


Figure 15. Trended Program Participation Rate: Expansion Cohort 2

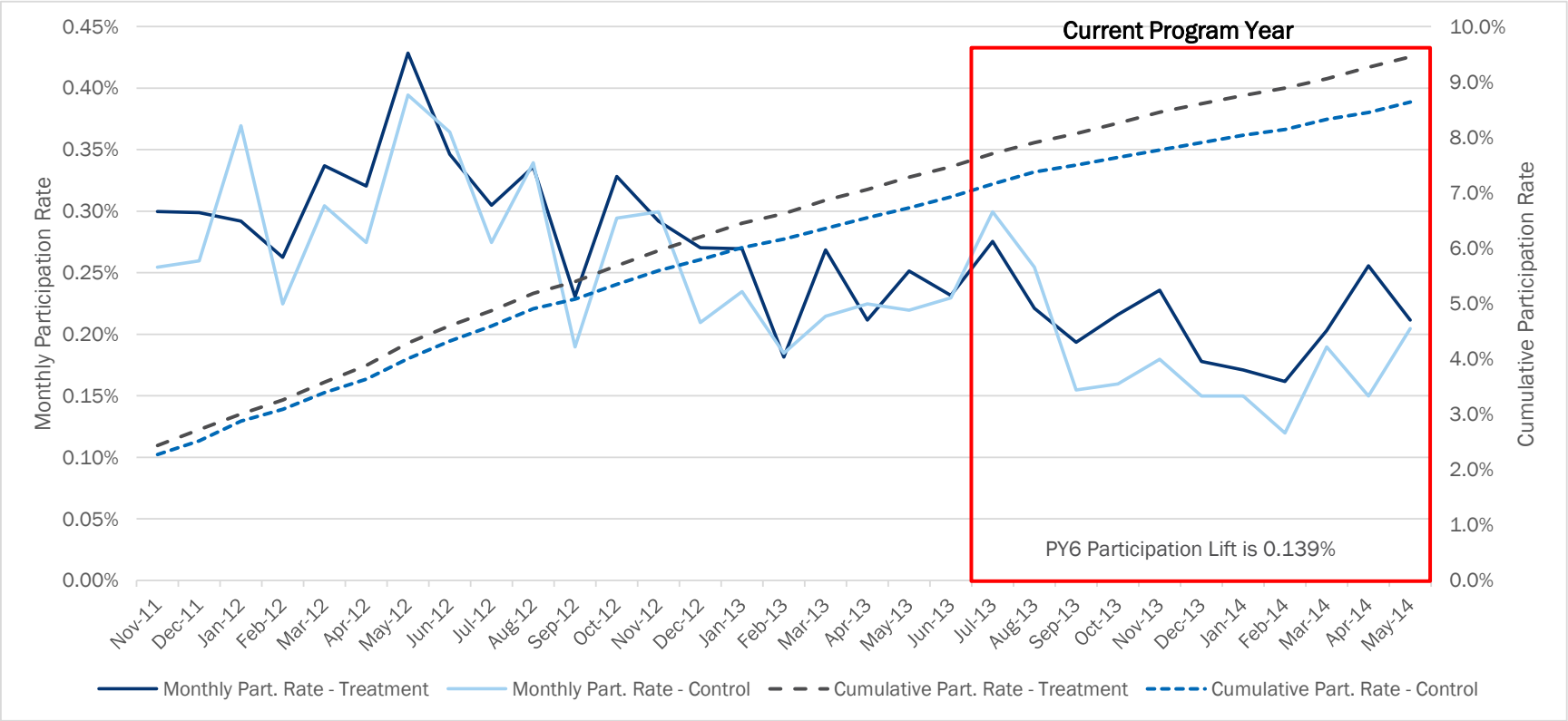


Figure 16. Trended Program Participation Rate: Expansion Cohort 3 (Gas Only)

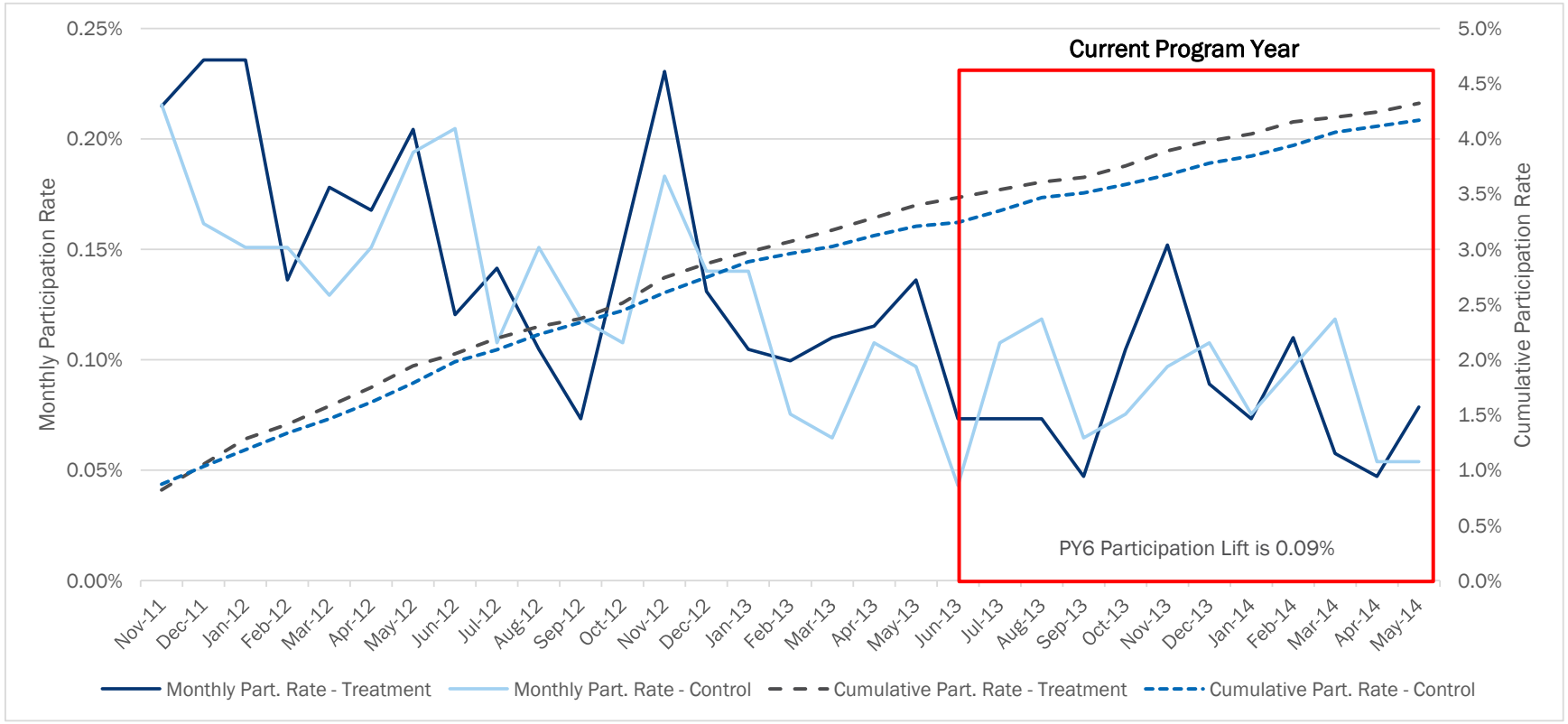
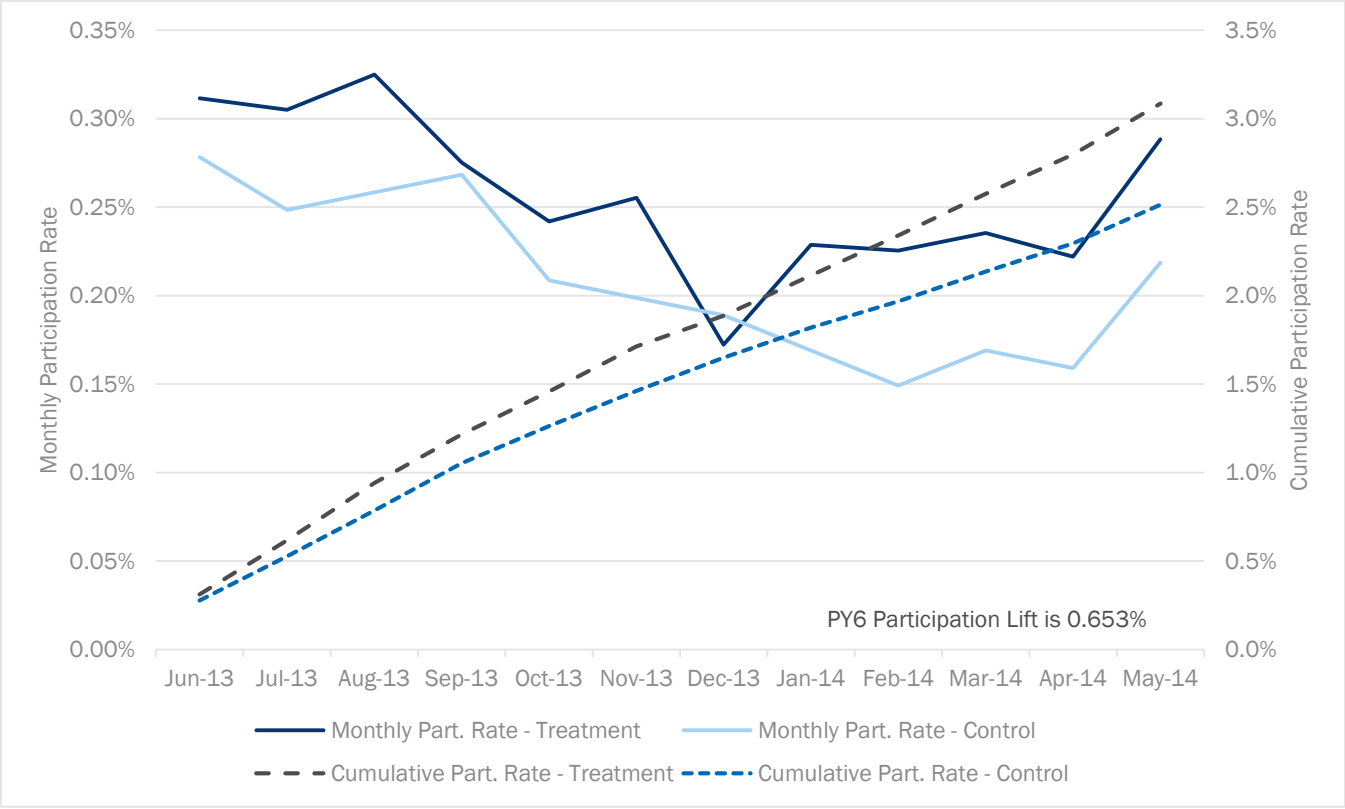


Figure 17. Trended Program Participation Rate: Expansion Cohort 4



G. Appendix – Survey Instrument

Ameren PY6 BM Phone Survey_Final.

H. Appendix – Survey Response Rate Methodology

The evaluation team fielded the survey via telephone from August 21, 2014 through September 18, 2014, resulting in a total of 360 completed interviews. We made 11,502 calls to get these completes.

Table 68. Survey Disposition Codes

Disposition	N
Completed Interviews (I)	360
Eligible Non-Interviews	6,127
Refusals (R)	1,839
Mid-Interview terminate (R)	11
Break-off (R)	212
Respondent never available (NC)	4,067
Language Problem (NC)	9
Not Eligible (e)	2,952
Fax/Data Line	61
Non-Working	2,616
Wrong Number	42
Business/Government	121
No Eligible Respondent	103
Duplicate Number	9
Unknown Eligibility Non-Interview (U)	2,052
No Answer	1,837
Busy	174
Call Blocking	41
Total Participants in Sample	**11,502**

We chose to use AAPOR Response Rate 3 (RR3), which includes an estimate of eligibility for these unknown sample units. The formulas used to calculate RR3 are presented below. The definitions of the letters used in the formulas are displayed in the Survey Disposition tables below.

$$E = (I + R + NC) / (I + R + NC) + e$$

$$RR3 = I / ((I + R + NC) + (E*U))$$

We also calculated a cooperation rate, which is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of participants who completed an interview out of all of the participants with whom we actually spoke. We used AAPOR Cooperation Rate 1 (COOP1), which is calculated as:

$$COOP1 = I / (I + R)$$

I. Appendix – Additional Survey Results

This appendix outlines the various results found through the survey.

Awareness of and Satisfaction with the Home Energy Report

Overall, customers have read at least some of the reports when they arrive. About 87% of respondents reported having read at least some of the reports received. Over one-third of the respondents read every report received.

Nineteen respondents (11%) noted they did not read any of the reports. Asked why, 12 responded "don't know," four said their spouses read the reports, and three noted they lack the time to read the reports. Of the customers who have read at least one report (157 out of 180), only 11% have called the phone number or emailed the address listed on the reports.

The treatment group customers were mostly satisfied with the HER, but were least satisfied with the comparison of usage with similar homes (see Table 69). Although the reports were revised to read "similar homes" rather than the previously used "neighbors," customers appear to still not be completely satisfied with this comparison.

Table 69. Treatment Group Satisfation (n=157)

Using a scale of 0 to 10, where a 0 means you are 'extremely dissatisfied' and a 10 means you are 'extremely satisfied' how satisfied were you with...	Score of 0-3	Score of 4-6	Score of 7-10	Don't Know / Refused	Mean Score
Home Energy Reports overall	6%	20%	71%	3%	7.5
Graph showing your historical usage	8%	17%	69%	6%	7.4
Energy savings tips provided in the reports	4%	29%	64%	2%	7.3
The comparison of your home's usage to similar homes	20%	24%	53%	3%	6.2

Base: Participant who have read at least some reports.

Customers noted that the HERs only somewhat reminded them to take energy savings actions (mean of 6.8) or gave them enough information to take such actions (mean of 6.7). See Table 70, below, for details.

Table 70. Treatment Group Interaction with the HER (n=157)

On a scale of 0 to 10, where 0 is "strongly disagree" and 10 is "strongly agree", how much do you agree with the following statement....	Score of 0-3	Score of 4-6	Score of 7-10	Don't Know / Refused	Mean Score
The reports remind me to take energy savings actions	11%	30%	59%	0%	6.8
The reports provide enough information to take energy saving actions in my home	10%	36%	54%	1%	6.7
The reports motivate me to reduce my energy usage	17%	30%	52%	1%	6.3

Base: Participant who have read at least some reports.

Attitude towards Energy Usage

Treatment and control group customers alike seem to have similar attitudes about trying to conserve energy usage, exploring ways to save energy, and changing actions to reduce energy use. The treatment group had slightly higher mean scores when it came to thinking about their day-to-day life and energy usage.

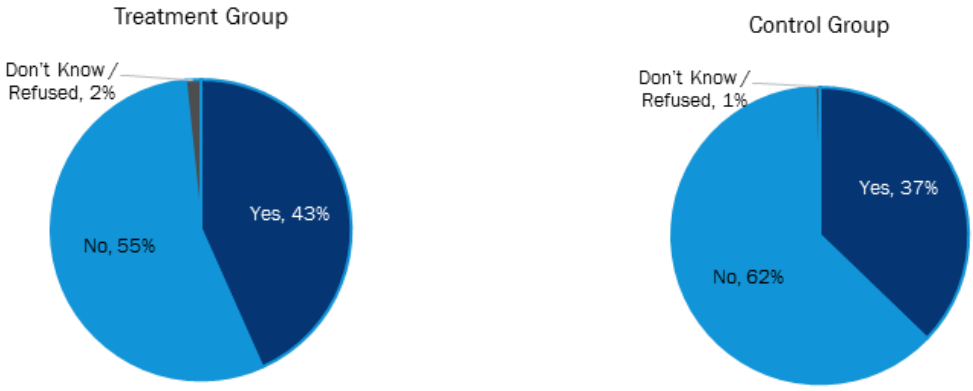
Table 71. Attitude Towards Energy Usage

On a scale of 0 to 10, where 0 is "strongly disagree" and 10 is "strongly agree", how much do you agree with the following	Treatment Group Mean Score (n=180)	Control Group Mean Score (n=180)
We always try to conserve and want to find more ways to save electricity	7.2	7.3
We are exploring ways to reduce our electricity usage, but have not taken action	5.6	5.2
We are not planning to change our actions to reduce our electricity usage	4.7	4.4
Are your actions or behaviors influenced by the amount of energy you plan to use	5.4	5.0
Do you change your actions and behaviors to reduce your energy use	5.5	5.3

Program Awareness

Only slightly more treatment group respondents were aware of any other energy saving programs offered by AIC (see Figure 18).

Figure 18. Aware of AIC Programs? (n=180 for each group)



The survey effort revealed that respondents were more likely to recall the Home Performance with Energy Star and the Appliance Recycling programs than other AIC programs. About 21% of treatment group and 19% of control group respondents could not remember any program names. About 17% of the respondents who were aware of any program said they plan to participate in a program during the next six months.

Table 72. Awareness of Programs (multiple response)

	Treatment Group (n=78)	Control Group (n=67)
Home Performance with Energy Star program	27%	24%
Appliance Recycling program	23%	33%
Energy Efficient Lighting program	18%	21%
Energy Saving Product Rebate program	9%	16%
HVAC Rebate program	8%	16%
Multifamily program	8%	6%
Moderate Income program	5%	7%
Home Audit program (no name given)	4%	4%
Weatherization program (no name given)	4%	1%

	Treatment Group (n=78)	Control Group (n=67)
Act on Energy	3%	1%
Budget Billing	1%	3%
Lighting (no name given)	3%	1%
Thermostat (no name given)	0%	4%
Other	15%	13%
I don't remember any program names	21%	19%
Don't Know / Refused	3%	3%

Energy Saving Actions

One of the goals of the survey was to study self-reported measure uptake and behavioral change among the Expansion Cohort 4 treatment and control groups and to analyze whether program participants are taking more (and deeper) energy saving/efficiency actions than control group members.

The evaluation team found that, while 71% of respondents had at some point replaced equipment or an appliance in their home with an ENERGY STAR labeled one, there were no statistically significant differences between treatment and control group respondents. Respondents were also asked whether they made this switch within the past year (i.e., after the treatment group started receiving the HER). Less than one-third of the respondents (for both the treatment and control groups) noted having made a change in the past year.

Table 73. Number of Customer Who Replaced Equipment or Appliances within the Last year (Multiple Response)

	Treatment Group (n=123)	Control Group (n=133)
Clothes washing machine	17	13
Refrigerator	14	15
Clothes dryer	14	12
Central air conditioning unit	8	5
Furnace	7	5
Dishwasher	6	5
Water heater	5	13
Television	5	11
Freezer	3	6
Room or wall air conditioning unit	1	0
Other	10	12

We also asked respondents whether they made other changes to help them save energy at home. Again, we found that, while respondents tended to make such changes, there were no significant differences between the treatment and control groups (see Table 74).

Table 74. Number of Customers Who Made Changes within the Last year (Multiple Response)

	Treatment Group (n=180)	Control Group (n=180)
Installed efficient light bulbs	103	95
Serviced your central air conditioner	88	95
Cleaned refrigerator coils	81	74
Sealed leaky doors or windows	57	52
Used less gas/electricity in general	38	39
Installed/replaced Weather stripping	30	39
Installed lights on motion detectors or timers	29	28
Recycled your second refrigerator or freezer	20	25
Programmable thermostat	19	21
Installed window insulation film	17	11
Energy smart power strips	16	21
Sealed or insulated ducts	13	19
Attic, ceiling or wall insulation	8	9
Energy efficient or double-paned windows	7	9
Had a home energy assessment or audit	3	5

We also asked survey respondents whether they regularly performed certain actions to help them save energy in their home. Although almost all respondents did at least one of the actions regularly, we did not find any significant differences between the treatment and control groups (see Table 75).

Table 75. Behavioral Actions Taken Regularly

	Treatment Group (n=180)	Control Group (n=180)
Turn off lights in unoccupied rooms	90%	94%
Use appliances in the morning/night or on the weekends	78%	81%
Run the clothes washer only on full loads	77%	80%
Run the dishwasher only on full loads	66%	62%
Turn thermostat to recommended set points (e.g. 78 for cooling/68 for heating)	65%	71%
Use ceiling or floor fans instead of air conditioner	64%	67%
Turn off computer at night/not in use	58%	61%
Take shorter showers	54%	51%
Switch off power strips or unplug devices when not in use (chargers, TVs, stereos, etc.)	48%	47%
Adjust temperature gauge on water heater to be lower	47%	41%
Turn off AC when not home	39%	34%
Air dry your laundry	38%	32%

Demographic and Housing Characteristics

Our comparison of treatment and control group respondents showed that, for the most part, the groups were very similar. We did, however, find differences in education and in household occupancy. Control group respondents were more likely than treatment group respondents to have advanced degrees and less likely to have five or more people in their household.

Table 76. Demographic and Housing Characteristics of Survey Respondents

	Treatment Group (n=180)	Control Group (n=180)
Rent or Own Home		
Own	86%	85%
Rent	12%	12%
Other	1%	1%
Don't Know / Refused	1%	2%
Age of Home		
Before 1900	2%	3%
1900 - 1939	13%	14%
1940 - 1959	17%	16%
1960 - 1979	19%	22%
1980 - 1989	10%	4%
1990 - 1999	13%	14%
2000 - 2004	6%	7%
2005 or later	9%	8%
Don't Know / Refused	10%	11%
Responsible for Paying Utility Bill		
Electric	98%	97%
Gas	98%	92%
Home Square Footage		
More than 3,000 square feet	14%	14%
Under 1,000 square feet	7%	3%
1,000 - 1,500 square feet	16%	11%
1,501 - 2,000 square feet	16%	17%
2,001 - 2,500 square feet	14%	14%
2,501 - 3,000 square feet	13%	12%
Don't Know / Refused	20%	29%
Home Description		
Single-family detached	79%	77%
Single-family attached	11%	12%
Multi-family home	2%	4%
A mobile home or trailer	5%	2%
Other	1%	3%
Don't Know / Refused	2%	2%
Age of Respondent		

	Treatment Group (n=180)	Control Group (n=180)
18-24 years	1%	1%
25-30 years	9%	6%
31-40 years	18%	18%
41-50 years	22%	18%
51-60 years	16%	19%
Over 61 years	26%	30%
Don't Know / Refused	8%	9%
People in Household		
4 or less	**73%**	**86%***
5 or over	**20%***	**11%**
Don't Know / Refused	7%	3%
Change in Number of People in Household		
Yes, an increase in occupancy	8%	12%
Yes, a decrease in the number of people	16%	13%
No change	74%	73%
Don't Know / Refused	2%	2%
Education of Respondent		
Less than high school	2%	3%
High school graduate or equivalent	26%	22%
Some college, no degree	24%	26%
Associate's degree	12%	14%
Bachelor's degree	18%	13%
Graduate or professional degree	**14%**	**20%***
Don't Know / Refused	4%	2%
Annual Household Income		
Less than $25,000	10%	14%
$25,000 to less than $35,000	9%	9%
$35,000 to less than $50,000	16%	9%
$50,000 to less than $75,000	17%	17%
$75,000 to less than $100,000	8%	13%
$100,000 to less than $150,000	13%	7%
$150,000 to less than $200,000	5%	4%
$200,000 or more	4%	4%
Don't Know / Refused	17%	22%

* Signifies result is statistically significant at the 90% level.

J. Appendix – Survey Data Modeling (Random Effects Model)

The evaluation team reviewed the survey results using a regression model to see whether there were any significant differences in the energy efficiency purchases and behaviors between the treatment and control groups. This analysis can help generate more precise estimates of actions taken during the program period. The statistical comparison of the treatment and control group respondents revealed that, while for the most part the groups were very similar, there were significant differences in education and in household occupancy. Control group respondents were more likely than treatment group respondents to have advanced degrees and less likely to have five or more people in the household.[24] Such differences were statistically controlled for in the random effects regression model. For this analysis, the evaluation team grouped the self-reported energy saving actions into three broad categories: high-cost measure installations (equipment and appliances), low-cost measure installation (equipment and appliances), and no-cost actions (conservation behaviors).

For creating the model variables, we grouped the energy-saving actions into high-cost, low-cost, and no-cost actions (see Table 77) and sorted these groups by whether the actions were taken during the past year or before (see Table 73 and Table 74). We established five groups:

- High-cost actions taken more than a year ago (i.e., before receiving HERs).
- High-cost actions taken in past year (i.e., after receiving HERs).
- Low-cost actions taken more than a year ago (i.e., before receiving HERs).
- Low-cost actions taken in past year (i.e., after receiving HER).
- No-cost actions regularly taken (not divided by time period).

In our analyses, we used three outcome variables:

- Total measures installed in the in past year.
- Total high-cost measures installed in the past year.
- Total low-cost measures installed in the past year.

Table 77. High-Cost, Low-Cost, and No-Cost Actions

	High-Cost	Low-Cost	No-Cost
Central air conditioning unit	x		
Room or wall air conditioning unit	x		
Clothes washing machine	x		
Clothes dryer	x		
Dishwasher	x		
Television	x		
Computer	x		
Boiler	x		

[24] For more details about demographic and housing characteristics, refer to Appendix I (Table 76).

	High-Cost	Low-Cost	No-Cost
Furnace	x		
Refrigerator	x		
Freezer	x		
Water heater	x		
Attic, ceiling or wall insulation	x		
Energy efficient or double-paned windows	x		
Programmable thermostat		x	
Energy smart power strips		x	
Serviced your central air conditioner		x	
Cleaned refrigerator coils		x	
Installed lights on motion detectors or timers		x	
Sealed leaky doors or windows		x	
Installed efficient light bulbs		x	
Sealed or insulated ducts		x	
Installed window insulation film		x	
Installed/replaced Weather stripping		x	
Had a home energy assessment or audit		x	
Used less gas/electricity in general			x
Recycled your second refrigerator or freezer			x
Air dry your laundry			x
Run the dishwasher only on full loads			x
Run the clothes washer only on full loads			x
Turn off lights in unoccupied rooms			x
Turn thermostat to recommended set points			x
Turn off AC when not home			x
Use ceiling or floor fans instead of air conditioner			x
Adjust temperature gauge on water heater to be lower			x
Switch off power strips or unplug devices when not in use			x
Use appliances in the morning/night or on the weekends			x
Take shorter showers			x
Turn off computer at night/not in use			x

The model coefficients are shown in the tables below.

Table 78. No-Cost Actions Predict Program Period Low-Cost/High-Cost Actions

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.199	.370		8.642	.000
high_pre	.542	.118	.244	4.588	.000
Low_pre	-.120	.082	-.077	-1.461	.145

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
People_Flag	.256	.386	.036	.664	.507
Grad_Flag	.234	.375	.033	.625	.533
part	-1.666	.658	-.310	-2.533	.012
NoCostXPart	.207	.076	.334	2.722	.007
R-sq =.083, adj R-sq =.077					

Table 79. No-Cost Actions Predict Program Period Low-Cost Actions

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.573	.261		9.867	.000
high_pre	.356	.083	.224	4.276	.000
Low_pre	-.238	.058	-.214	-4.117	.000
People_Flag	.418	.272	.081	1.537	.125
Grad_Flag	-.028	.264	-.005	-.105	.916
part	-1.370	.463	-.355	-2.957	.003
NoCostXPart	.171	.054	.384	3.193	.002
R-sq=.125, Adj R-sq=.109					

Table 80. High-Usage Gas Customers with No-Cost Actions Predict Program Period Low-Cost Actions

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.711	.460		5.894	.000
high_pre	.719	.181	.437	3.976	.000
ItemTot_pre	-.333	.100	-.364	-3.333	.001
People_Flag	.046	.442	.010	.105	.917
Grad_Flag	-.282	.411	-.067	-.687	.494
part	-2.353	.911	-.626	-2.584	.011
NoCostXPart	.291	.106	.672	2.757	.007
R-sq =.243, Adj R-sq =.19					

K. Appendix – Outages During Survey Fielding

The evaluation team recorded the ZIP codes and customers affected by outages during the survey fielding. This was done because if a high percentage of customers were affected, the survey results could show more unsatisfied customers than normal. Outages affected only a very small percentage of customers (maximum of 2.16%), however, so no adjustments had to be made to the survey data.

Table 81. Customers Affected by Outages

Date	# of Zip Code Affected by Outage	# of Customers Affected by Outage	Total # of Customers Served	%
8/21/2014	18	126	99427	0.13%
8/22/2014	61	2155	185867	1.16%
8/25/2014	15	24	70890	0.03%
8/26/2014	24	86	165668	0.05%
8/28/2014	11	384	48858	0.79%
8/29/2014	15	65	67369	0.10%
9/2/2014	20	313	113473	0.28%
9/3/2014	9	77	37851	0.20%
9/4/2014	25	1741	80513	2.16%
9/5/2014	16	275	72457	0.38%
9/8/2014	7	86	43936	0.20%
9/9/2014	33	2471	148934	1.66%
9/10/2014	48	1682	185215	0.91%
9/11/2014	40	749	175273	0.43%
9/12/2014	12	69	89644	0.08%
9/15/2014	12	31	49924	0.06%
9/16/2014	13	61	108639	0.06%
9/17/2014	11	72	102315	0.07%
9/18/2014	12	37	39618	0.09%
9/19/2014	8	173	44490	0.39%

L. Appendix – Considerations for Persistence Study Design

Persistence and decay rate studies are critical to understanding whether and how savings degrade in the absence of a program intervention, as well as providing more accurate lifetime savings results. Typically, persistence studies seek to answer the following research questions:

- What is the difference in program savings between customers experiencing a *stoppage*[25] or *reduction* in treatment compared to those who continue to receive regular treatment?
- What is the difference in program savings for *dual fuel or gas only* customers receiving a reduction or stoppage in treatment compared to those who continue to receive regular treatment?
- What is the difference in program savings between *customers who have received the report for longer (e.g. duration)* than customers who have received the report for a shorter duration (i.e., are there differences across cohorts)?

Should AIC consider a study in the future, the evaluation team offers the following considerations when designing and implementing a persistence study.

- **Develop a research design relevant to program planning goals and program implementation**: Given that there are many cohorts who have received program reports for multiple years, we recommend that AIC work with the evaluation contractor and the program implementer to:
  - Determine the persistence study approach*:* Prior to executing the study, the administrator, evaluator and implementers should determine if they plan to conduct a stoppage or reduction in treatment, how long the reduction periods will last, how long customers should be in the program before stopping or reducing treatment, and how frequently reports will be sent during a reduction. The team can leverage prior evaluation reports and implementation plans to support making these decisions, as well as prioritize these decisions based on program administration goals.
  - Determine which customers to include in the persistence study*:* AIC should work with the team to clarify the important customer/cohort types to be included in the study, and outline those customers for whom results can be extrapolated. Customer characteristics are important to consider when generalizing results to other populations of existing or future participants.
- **Design a study that considers factors known to affect persistence:** The evaluation team's experience evaluating similar programs indicates that a variety of factors affect persistence. Many factors affect the rate of savings decay, such as fuel type, seasonality, and duration. These factors are as follows:
  - Treatment duration prior to the experiment: Studies indicate that the duration of treatment has implications on persistence. For example, a study that stopped treatment after 6 months of reports resulted in a precipitous decline in savings, whereas studies that stopped treatment after two years resulted in smaller declines in savings.

[25] Stoppage refers to a discontinuation of reports, whereas a reduction refers to customers who receive reports less frequently or for a period prior to resuming receipt of reports.

- Seasonality of reduction: Studies also indicate that the timing of the reduction or stoppage in treatment may have implications on savings, particularly for gas cohorts. How does a gap in treatment in the winter compare with a summer gap? Is there a way to optimize winter gaps to achieve greater persistence?
- Fuel-specific differences: Studies also suggest that there may be differences in persistence based on fuel type (i.e., gas or electric or both). A study should test similar reductions with participants at the same program maturity (i.e., same duration of treatment) level between electric and gas.

- **Execute the study in a way that answers the research objectives**: Results from persistence studies are only as good as the study design and faithful execution of that design. Should a reduction or stoppage in treatment occur, we recommend:
  - Prior to making large-scale changes to program design, conduct a study to assess decay of savings by randomizing customers into reduced/or discontinued and continued treatment groups.
  - Design samples that incorporate target characteristics that are consistent with past studies and program goals.

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