



Opinion **Dynamics**

Boston | Headquarters

617 492 1400 tel
617 497 7944 fax
800 966 1254 toll free

1000 Winter St
Waltham, MA 02451



Process and Impact Evaluation of 2014 (PY7) Ameren Illinois Company Behavioral Modification Program

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Contributors

Olivia Patterson
Behavioral Research Manager, Opinion Dynamics

Katherine Randazzo
Director of Analytics, Opinion Dynamics

Seth Wayland
Associate Director, Opinion Dynamics

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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; Leidos and OPower implement the program. 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.

In PY7, the program offered two treatment types: a hard copy home energy report (HER) mailed to the customer’s home, and an online portal that customers can access to view the same report along with additional information. Below we present the key findings from the PY7 (June 2014-May 2015) Behavioral Modification Program evaluation.

The Behavioral Modification Program reached about a third of AIC’s approximately one million residential customers in PY7 (June 2014-May 2015). Just under 320,000 participants received reports in PY7 (including both dual fuel and gas only customers), the majority of whom are in their fourth year with the program. PY7 introduced 100,796 new participating residential customers in the form of Expansion Cohort 5 and Expansion Cohort 6 (see Table 1).

Program Impacts

In PY7, the program achieved adjusted net savings of 33,194 MWh and 1,754,669 therms (see Table 1). Adjusted net savings remove the energy savings that resulted from customer participation in other AIC programs.

Table 1. PY7 Behavioral Modification Program Impacts

Cohort Name	Adjusted Net Savings (% per HH)	Adjusted Net kWh Savings (per HH)	Number of Customers Treated in PY7	Adjusted Net MWh Program Savings
Original Cohort	1.70%	199.0	37,243	7,410
Expansion Cohort 1	1.64%	214.6	56,788	12,189
Expansion Cohort 2	0.59%	57.9	85,893	4,975
Expansion Cohort 4	1.25%	212.8	25,506	5,429
Expansion Cohort 5	0.66%	50.7	62,996	3,192
Expansion Cohort 6	NA	NA	NA	NA
Total MWh^a	NA	125.3	268,426	33,194

^a Totals may not be exact, due to rounding.

Note: We did not calculate savings for Expansion Cohort 6 because insufficient (only one month) billing data is available.

Note: Number of customers treated in PY7 include customers who received at least one report in PY7.

Table 2. PY7 Behavioral Modification Program Impacts

Cohort Name	Adjusted Net Savings (% per HH)	Adjusted Net Therm Savings (per HH)	Number of Customers Treated in PY7	Adjusted Net Therm Program Savings
Gas Savings (Therms)				
Original Cohort	0.84%	8.77	37,243	326,486
Expansion Cohort 1	0.78%	9.75	56,788	553,906
Expansion Cohort 2	0.36%	3.59	85,893	308,592
Expansion Cohort 3	1.65%	13.90	13,621	189,279
Expansion Cohort 4	0.72%	5.70	25,506	145,498
Expansion Cohort 5	0.43%	3.67	62,996	230,907
Expansion Cohort 6	NA	NA	NA	NA
Total Therms^a	NA	5.88	282,047	1,754,669

^a Totals may not be exact, due to rounding.

Note: We did not calculate savings for Expansion Cohort 6 because insufficient (only one month) billing data is available.

Note: Number of customers treated in PY7 include customers who received at least one report in PY7.

Key Findings and Recommendations

The Behavioral Modification Program is achieving its stated goals to reduce energy consumption and educate customers about energy savings measures and behaviors. In PY7, the Behavioral Modification Program added two additional cohorts, made substantial changes to program operations (both in terms of administration and implementation), and achieved energy savings reductions across all cohorts.

One of the most notable results in PY7 was a decrease in energy savings from PY6 across most cohorts, likely due to a reduction in the total number of reports delivered to customers. However, we continue to find that participants, when compared to control group respondents, more frequently indicate that they have learned new ways to save energy in their homes and have read their utility bills to understand their home’s energy use in the past 12 months. This result shows that the program is achieving its goal of boosting customer engagement and education by helping participants to understand energy efficiency and save energy in their homes. The following recommendations for the program are based on the findings of our program evaluation:

- **Key Finding #1:** Behavioral Modification Program participants achieved 125 kWh and 5.88 therms per household per year. 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.
 - **Recommendation:** For future program planning and goal setting, AIC might consider using the average savings estimates for kWh and therms over the evaluated period. 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, using a predictive model, 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.

- **Key Finding #2:** High baseline consumption predicts high savings, but some high users can be persistent negative savers.
 - **Recommendation:** As AIC continues to move to a pay-for-performance model, continue targeting future cohorts with the high consumption but stop, modify, or customize reports for participants who have significant increases in usage despite receiving home energy reports. Our multilevel modeling found that customers with significantly negative savings after receiving reports rarely improve to positive savings while continuing to receive the standard home energy report. Incorporating an experimental design into this effort is a simple and low-cost way to confirm that any differences in savings that result are attributable to the predictive model. If this recommendation is implemented, design the implementation effort to ensure the ability to assess the impacts associated with increases and decreases of report delivery (e.g., an experimental design).
- **Key Finding #3:** Reduction in reports may have contributed to lower energy savings reductions in PY7. Across all cohorts, with the exception of the gas only cohort (Expansion Cohort 3), energy savings declined when compared to PY6 (for both original and weather adjusted model results).
 - **Recommendation:** Consider the value of the cost reductions associated with fewer reports compared to higher energy savings with more frequent reports. It may be worthwhile to identify those customers who yield the highest savings and continue to send reports at a higher frequency, while reducing reports for negative or moderate savers. Tailoring report frequency could also involve a review of current summer average daily consumption to identify those customers with relatively higher savings potential. Further, it may be beneficial to understand the impacts of delivering less costly eHERs more frequently than paper HERs.¹ If this recommendation is implemented, design the implementation effort to ensure the ability to assess the impacts associated with increases and decreases of report delivery (e.g., an experimental design).
- **Key Finding #4:** Survey results indicate that participants demonstrate higher understanding of their energy usage, but do not demonstrate increased uptake in energy efficiency actions and in some cases lower satisfaction with AIC overall. In particular, participants who have been in the program for a longer period of time may be less satisfied with energy reports.
 - **Recommendation:** The Target Rank campaign was designed to provide tailored messaging to high baseline users who were dissatisfied with the report (particularly the normative comparisons). We recommend that AIC continue to identify opportunities to engage existing customers with the report, particularly as they may develop 'report-fatigue'. Further, customers may be exposed to multiple behavioral messaging (both HER and Aclara web-portal); future research efforts should seek to identify those customers who overlap and understand if multiple sources of messaging is conflicting or reinforcing for behavioral practices and program participation.

¹ This would cover only those customers who have an email address on record.

2. Evaluation Approach

The PY7 evaluation of the Behavioral Modification Program involved both process and impact assessments. To support the process evaluation, we conducted a review of program materials and program-tracking data, interviews with program implementation staff, interviews with treatment and control group customers, and multilevel modeling to identify high, medium, and low savers. To evaluate impacts, the evaluation team conducted a billing analysis and channeling adjustment.

2.1 Research Objectives

The evaluation team sought to answer the following research questions as part of the PY7 Behavioral Modification Program evaluation:

2.1.1 Impact Questions

1. Were the new treatment and control groups equivalent?
2. What are the estimated MWh and therm savings from this program for all cohorts in PY7?
3. Did the program achieve savings year-over-year for each of the cohorts?
4. Do program savings need to be adjusted due to the treated population’s participation in other AIC programs?

2.1.2 Process Questions

1. Who were the high savers, low savers, negative savers? Can we isolate top-tier savers and lower-tier savers, to better understand who is driving savings, and potentially, through leveraging secondary data, what their characteristics are?
2. What types of actions did customers take because of the program?
3. Did the HERs improve participants’ energy-related self-efficacy?
4. How satisfied were participants with the program, and how satisfied were respondents with AIC?

2.2 Evaluation Tasks

Table 2 summarizes the PY7 evaluation activities conducted for the Behavioral Modification Program.

Table 3. Summary of Evaluation Activities for PY7

Activity	Impact	Process	Forward Looking	Details
Program Staff Interviews		✓		Interviewed program managers from AIC, Leidos, and OPower to discuss program theory and implementation and to collect process-related feedback.
Program Materials Review	✓	✓		Reviewed materials to assess program design, implementation, and operations.

Activity	Impact	Process	Forward Looking	Details
Treatment/Control Surveys		✓	✓	Conducted Internet surveys with the treatment and control group customers to understand the program’s benefits and the energy-saving actions taken by customers.
Multilevel Modeling		✓	✓	The evaluation team developed a multilevel model designed to estimate individual savings for each participant.
Equivalency Analysis	✓			The evaluation team did not select the new Expansion Cohorts 5 or Expansion Cohort 6 treatment and control groups; therefore, 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.

We summarize each of these activities in detail below.

2.2.1 Program Staff Interviews

We conducted telephone interviews with key program staff from AIC, Leidos, and OPower. The interviews provided our team with a comprehensive understanding of the program and its implementation, including insights into the daily workings of the program, revealing changes made to the program in PY7, and uncovering areas of success and challenges. Our three in-depth interviews also helped inform the development of the survey instrument.

2.2.2 Program Materials Review

The evaluation team reviewed the program-tracking database and other program materials, including the PY7 HERs. We reviewed these materials to determine if there are any data gaps, as well as to inform our research efforts. Table 3 provides a list of data reviewed by source and a description of the type of data reviewed.

Table 4. PY7 Behavioral Modification Program Evaluation Data Reviewed by Source

Data Source	Data Details
Behavioral Modification Program Information	PY7 program energy and demand savings goals, budget and expenditures, opt-in or move-out dates, treatment and control group information
HER Report Information	Sample reports, tips and recommendations provided in HERs and ActOnEnergy.com/save website, delivery dates for HERs
Customer Billing Information	For all customer treatment and control groups, electric and gas consumption/billing data from June 2013 to May 2015
Customer Information	Customer account information including contact information (email) Experian data (including demographic data, housing characteristics, and psychographic data)
AIC Program Tracking Databases	For all AIC residential programs from June 2011-May 2015 (PY4-PY7)
Weather Data	Heating degree days and cooling degree days for specific weather stations in AIC service territory

2.2.3 Treatment/Control Survey Effort

The evaluation team implemented a computer-assisted web interviewing (CAWI) survey with 34,905 treatment and 12,630 control group customers across all program cohorts.

The evaluation team conducted interviews with treatment and control group customers 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) energy saving attitudes (including perceived barriers and motivations). The survey covered the following key questions:

- Engagement with reports (participant only)
- Attitudes towards energy use
- Motivators and barriers to energy reduction
- Energy saving actions (energy efficiency and behaviors)
- Satisfaction with AIC and the HER report (if participants)
- Demographic and household characteristics

The survey content for treatment and control groups was identical when possible. Questions about actions taken, behavior and equipment decisions, and the period in which they were taken are phrased exactly the same for both groups. However, we did not ask control group customers about the HER report itself, as they never received the report. The survey instrument screened respondents for their recall of the HER to ensure that the survey gathered data only from household members with exposure to and recall of the report.

The survey was designed to:

- Compare differences between participants and control groups regarding self-reported equipment retrofits, general energy efficiency actions, and regularly taken energy efficiency behaviors.
- Compare differences in timing of these actions/behaviors by asking customers if they took the specific actions after their enrollment into the program.²
- Tailor response differences between dual fuel and gas only customers based on the type of tips they may receive regarding reducing their energy consumption.

This report covers a survey fielded to cover the July/August 2015 HER. The recommendations in the HER for this evaluation were generic, providing general energy efficiency recommendations, not tailored, measure-specific recommendations.

The evaluation team initially planned to conduct four rolling Internet surveys with program participants and control group customers timed to coincide with recent receipt of a HER. However, the evaluation team conducted one survey during the evaluation period because none of the subsequent reports promoted

² The evaluation team created a survey read-in for the duration of time that a customer has been a part of either the treatment or control groups; this allowed the question to be fielded to both treatment and control group customers.

specific energy savings actions, providing generic rather than tailored, measure-specific recommendations. In PY8, the evaluation team plans to field surveys timed to coincide with reports that offer measure-specific tips. The evaluation team will, with AIC, find the best times to field additional surveys as HERs are delivered in PY8.

Survey Sample Design

To develop our sample frame, we split the total population of treatment and control group customers into four groups, corresponding to the four surveys that the team anticipated fielding when planning this evaluation.³ We fielded an internet survey to a quarter of all customers for whom we had email addresses using a census approach, seeking to recruit all customers with email address information. Notably, approximately 53% of the total population of customers had an email address.

The database yielded a total population of 47,535 customers in the first group (e.g., one fourth of the total population of participants), the only one relevant to this analysis. Table 4 presents the breakdown of these customers by cohort, fuel type, time in the program, and treatment/control group.

Table 5. Population and Sample Frame (Behavioral Modification Customers with Email Address)

Cohort Name	Duration of Time in Program	Fuel Type	Population		Sample Frame (N)	
			Treatment	Control	Treatment	Control
Original Cohort	5 years	Dual	16,564	16,952	3,899	3916
Expansion Cohort 1	4 years	Dual	27,190	9,097	6,472	2121
Expansion Cohort 2	4 years	Dual	27,190	5,384	7,639	1268
Expansion Cohort 3	4 years	Gas	4,786	2,289	1,191	563
Expansion Cohort 4	2 years	Dual	13,359	4,497	3,102	1041
Expansion Cohort 5	1 year	Dual	33,750	6,762	7,744	1561
Expansion Cohort 6	3 months	Dual	21,712	9,531	4,858	2,160
Total			148,703	54,512	34,905	12,630

Survey Fielding, Disposition & Response Rate

The evaluation team sent emails inviting 47,535 customers (34,905 treatment group and 12,630 control group customers) in the sample frame to take the online survey, and followed up with one reminder email. The survey was fielded from July 30, 2015 through August 21, 2015. The average time to complete the internet survey was just under 12 minutes. About 13% of customers were unreachable because the email bounced (probably the result of an incorrect or terminated email address).

³ Note that the evaluation team conducted one survey during the evaluation period. We made this decision because none of the subsequent reports that were sent promoted specific energy savings actions.

Table 6. Sample Frame & Responses

Cohort Name	Duration of Time in Program	Fuel Type	Sample Frame (N)		Survey Completed (n)	
			Treatment	Control	Treatment	Control
Original Cohort	5 years	Dual	3,899	3916	391	359
Expansion Cohort 1	4 years	Dual	6,472	2121	579	183
Expansion Cohort 2	4 years	Dual	7,639	1268	746	132
Expansion Cohort 3	4 years	Gas	1,191	563	106	56
Expansion Cohort 4	2 years	Dual	3,102	1041	240	78
Expansion Cohort 5	1 year	Dual	7,744	1561	582	120
Expansion Cohort 6	3 month	Dual	4,858	2,160	352	162
Total			34,905	12,630	2,996	1,090

The survey response rate is the number of completed surveys divided by the total number of potentially eligible respondents in the population. We calculated the response rate using standards and formulas set forth by the American Association for Public Opinion Research (AAPOR using Response Rate 1 [RR1]).⁴ The overall survey response rate was 9.87%. The formulas used to calculate RR1 are presented below. The letters used in the formulas are defined in the survey disposition tables that follow.

$$RR1 = I \div (I + R)$$

Table 7. Survey Dispositions and Response Rates

	Overall	Control	Treatment
Completed Interviews (I)	4,085	1,090	2,995
Eligible Non-Interviews (R)	41,393	10,855	30,520
<i>Refusals</i>	18	3	15
<i>Mid-Interview Terminate</i>	2,111	558	1,553
<i>No Response</i>	35,179	9,204	25,957
Not Eligible (e)	6,142	1,775	4,385
<i>Bounce Backs</i>	5,957	1,726	4,249
<i>Known Ineligibles (replied with reason)</i>	40	13	27
<i>Known Ineligibles (screened out)</i>	145	36	109
Total Participants in Sample	47,535	12,630	34,905
Response Rate	9.9%	10.0 %	9.8%

⁴ The evaluation team felt that RR1 was the most appropriate because the survey was fielded to known eligible customers. Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys, AAPOR, 2011.

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 overall, as well as over participants' duration in the program. To do so, the evaluation team compared the treatment and control group responses for each survey question across these various sub-groups to find statistically significant differences at the 90% confidence level.

With all survey work, it is important to assess whether the survey respondents are representative of the population of interest. If they are not, post-stratification weighting by key variables may be needed. Table 7 shows the breakdown of the sample frame (all program enrollees with email information, after data cleaning) and survey respondents by analysis group and treatment or control group. The percentages line up well, mirroring each other exactly in most cases, leading the evaluation team to the conclusion that no weighting is necessary and that survey respondents properly reflect the sample frame and population. Notably, characteristics of these customers may differ despite having similar proportion of respondents across cohorts. We tested for differences across other key variables and discuss results in Section 2.3.

Table 8. Population, Sample Frame, & Respondent Comparison

Cohort Name	Analysis Group	Population (n=436,878)		Sample Frame (n=47,535)		Respondents (n=4,086)	
		Treatment Group	Control Group	Treatment Group	Control Group	Treatment Group	Control Group
Original Cohort	5 years	49%	51%	50%	50%	52%	48%
Expansion Cohort 1, 2, 3	4 years	79%	21%	79%	21%	79%	21%
Expansion Cohort 4	2 years	75%	25%	75%	25%	75%	25%
Expansion Cohort 5	1 year	83%	17%	83%	17%	83%	17%
Expansion Cohort 6	3 month	70%	30%	69%	31%	68%	32%
	Totals	73%	27%	73%	27%	73%	27%

2.2.4 Multilevel Modeling

We used a multilevel billing analysis to estimate individual savings for each participating customer. We then used those individual savings estimates to group customers into five categories (high, medium, neutral, negative and very negative savers) and analyze the correlation of these categories with demographics and household characteristics. The savings results from these multilevel models do not exactly match the savings from the impact analysis, as we have parameterized this model to understand the responses of different types of customers to the HERs rather than calculate total savings attributable to the program.

One method of estimating savings levels for individual households is to run individual regression models for each participant. However, in this evaluation we used a multilevel modeling approach which provides clear advantages over individual regression to establish individual household savings levels. These include:

- Multilevel modeling statistically controls for weather differences between pre- and post-periods for an individual household as well as across households. In contrast, individual models solely control for weather differences between pre- and post-periods for an individual household.
- Multilevel modeling allows for modeling the influence of variables that do not change over time that apply to customers and for generating appropriate standard errors and statistical tests.

- Results from multilevel regression models adjust individual savings estimates based on control group usage during the treatment period, so the savings estimates are much closer to net savings than results from individual regressions.
- Information is shared across customers in multilevel models, so the unexplained variance in individual savings across participants is much lower when we make estimates using a multilevel model.

Savings Groups

We used the individual savings results from the PY7 multilevel model to split participants into five savings groups. We did this separately for the gas savings results and the electric savings results, so a participant might be a medium gas saver and a neutral electric saver. We define the groups as:

Table 9. PY7 Multilevel Model Savings Groups

Group	Percent of Population in PY7	kWh Savings per Day	Therm Savings per Day
High Savers	Top 10%	>7 kWh	>0.33 therms
Medium Savers	Next 30%	>1 and <=7 kWh	>0.08 and <= 0.33 therms
Neutral Savers	Middle 20%	>-0.5 and <=1 kWh	>-0.02 and <= 0.08 therms
Negative Savers	Next 30%	>-6 and <=-0.5 kWh	>-0.25 and <=-0.02 therms
Very Negative Savers	Bottom 10%	<-6 kWh	<-0.25 therms

Group Mobility

We examined savings group mobility for the first three years of program participation to examine how savings change from year to year for each participant for the Original, Expansion 1, and Expansion 2 cohorts. We did not look at mobility for the other three cohorts due to insufficient data.

Model Description

A multilevel model estimates two equations, one for intercepts, and another for slopes. The model shown in Equation 1 fits both equations simultaneously, estimating household-specific savings for each participant. We ran the model for PY7 for gas and electric savings for all participants, and ran models by year of participation for the first three years of participation to examine participant mobility between savings groups, for a total of eight models. We then used these annual household-specific savings estimates to order customers by their estimated savings, and allotted them into five groups for each model:

Equation 1. Multilevel Model

$$ADC_{it} \sim N(\alpha_i + \theta_i Treatment_t + \beta_1 HDD_t + \beta_2 CDD_t + \beta_3 PreADC_t + \beta_4 PreADC * Treatment_t, \sigma_{ADC}^2),$$

$$for t = 1, \dots, t, i = 1, \dots, n;$$

$$\begin{pmatrix} \alpha_i \\ \theta_i \end{pmatrix} \sim N \left(\begin{pmatrix} \mu_\alpha \\ \mu_\theta \end{pmatrix}, \begin{pmatrix} \sigma_\alpha^2 & \rho\sigma_\alpha\sigma_\theta \\ \rho\sigma_\alpha\sigma_\theta & \sigma_\theta^2 \end{pmatrix} \right), for i = 1, \dots, n$$

Where:

Evaluation Approach

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

α_i = Household-specific intercept for household i

θ_i = Household-specific change in consumption for the treatment group in the post period

β_1 = Coefficient for HDD

β_2 = Coefficient for CDD

β_3 = Coefficient for PreADC

β_4 = Coefficient for PreADC by Treatment interaction

σ_{ADC}^2 = Variance of ADC

μ_α = Mean of household-specific intercept

μ_θ = Mean of household-specific change in consumption due to treatment

σ_α^2 = Variance of household-specific intercept

σ_θ^2 = Variance of household-specific change in consumption due to treatment

$\rho\sigma_\alpha\sigma_\theta$ = Covariance of household-specific intercept and change in consumption

$N=??$

We drew data for this analysis from several sources, including program-tracking data, customer billing data, and demographic and household data purchased from Experian. All of the calculations and modeling used R⁵ statistical software, with multilevel models using the lme4⁶ package.

2.2.5 Impact Analysis

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:

- Equivalency analysis of the new Expansion Cohort 5 treatment and control groups to ensure the study's internal validity. The evaluation team will assess the equivalency of Expansion Cohort 6 in PY8.

⁵ R Core Team (2015). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

⁶ Douglas Bates, Martin Maechler, Ben Bolker, Steve Walker (2015). Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software, 67(1), 1-48. doi:10.18637/jss.v067.i01.

- 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.

Equivalency Analysis

Given that the evaluation team did not assign the customers to treatment and control groups in the new Expansion Cohort 5, we conducted an analysis to test whether the treatment and control groups are equivalent. By confirming equivalence, we reduced the potential for biased savings estimates and strengthened the defensibility of the research design. To assess equivalency, we utilized Experian data appended to the treatment and control group's monthly usage data.

The evaluation team used two methods to determine whether there are any systematic differences 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 variation in distribution of consumption for the 2013 billing period. Second, the evaluation team examined the demographic, housing, and psychographic data from Experian, comparing treatment to control customers. These observable characteristics may reflect other characteristics such as attitudes and beliefs.

An equivalency analysis conducted during the PY4 evaluation showed the treatment and control groups were equivalent for the Original Cohort and Expansion Cohorts 1, 2, and 3. Because there has been some attrition, the evaluation team compared usage between the treatment and control groups for all cohorts for the 12 months prior to when the first reports were received, but did not include an examination of demographic, housing, and psychographic data from Experian because we conducted this analysis in prior years.

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

Billing Analysis

We determined program impacts in this evaluation using a billing analysis that leverages the randomized control trial experimental design. The estimated savings from this analysis are net savings, but may still include some savings from other programs, which we later adjusted using channeling analysis. The billing analysis used a regression model on treatment and control group monthly billing data to estimate net savings per household over the program period. 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 2015, from AIC.
- Program launch date specific to each customer (treatment and control), from OPower.

Evaluation Approach

- Weather data (heating degree-days and cooling degree-days), from NOAA. (The data came from 26 weather stations across the state and are appended at the zip code level.⁷)

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

- Clean billing data
 - Removed exact duplicates
 - Dropped billing periods in excess of 90 days
 - Combined overlapping billing periods
 - Combined estimated bills with actual bills to correct for bill estimation
- 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 0.3% to 12% of customers within the electric analysis and 0.1% to 12% of customers within the gas analysis. We provide the accounting of the number and percentage of accounts removed due to these activities in Appendix C of this report.

Modeling Program Impacts

The evaluation team conducted a billing analysis to assess energy savings 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 an average treatment effect on the treated (ATT) estimate of program savings. The ATT approach takes advantage of the presence of a randomly assigned control group for each

⁷ We provide details about the weather stations in Appendix D.

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 comparable effects on their energy use. Moreover, because these groups experienced generally similar weather conditions, it was not necessary to measure or include weather in the original model. This is the model used to calculate program savings in this and past evaluations. The original model specification was:

Equation 2. Model Estimating Equation – Original Model (Model 1)

$$ADC_{it} = \alpha_i + \beta_1 Post_t + \beta_2 Treatment_i \cdot Post_t + \varepsilon_{it}$$

However, to improve precision in the modeled results for PY7, 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 weather adjusted model specification was:

Equation 3. Model Estimating Equation – Weather Adjusted Model (Model 2)

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

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 addition of weather terms also enables us to generate savings estimates that are comparable across program years.

In order to enable comparisons with vendor supported models (i.e., OPower – the program implementer’s estimates), we also estimated lagged dependent variable (LDV) models. A LDV model differs from the LFER model in that only data from the post-period is used in estimating the model. Information from the pre-period comes in as the pre-usage variables. In this case, we used three levels of pre-period usage for each customer: overall, pre-period ADC, summer pre-period ADC, and winter pre-period ADC. The LDV model uses the control group in just the same way as the LFER model, in that the treatment effect is corrected for control group ADC so that the coefficient of the treatment variable is the average treatment effect on the treated (ATT). OPower recently introduced this model as part of their own internal assessment of energy impacts, and as such, this is the first time the evaluation team has evaluated the program using this model.

Equation 4. Lagged Dependent Variable Model Estimating Equation (Model 3)

$$ADC_{it} = \alpha_i + \beta_1 Treatment_i + \beta_2 PreUsage_i + \beta_3 PreWinter_i + \beta_4 PreSummer_i + \beta_5 MonthYear_t + \beta_6 PreUsage_i \cdot MonthYear_t + \beta_7 PreWinter_i \cdot MonthYear_t + \beta_8 PreSummer_i \cdot MonthYear_t + \varepsilon_{it}$$

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 for the treatment group

β_2 = Coefficient for the average daily usage across household i available pre-treatment meter reads

β_3 = Coefficient for the average daily usage over the months of December, January, February, and March across household i available pre-treatment meter reads

β_4 = Coefficient for the average daily usage over the months of June, July, August, and September across household i available pre-treatment meter reads

β_5 = Vector of coefficients for month- year dummies

β_6 = Vector of coefficients for month- year dummies by average daily pre-treatment usage

β_7 = Vector of coefficients for month- year dummies by average daily winter pre-treatment usage

β_8 = Vector of coefficients for month- year dummies by average daily summer pre-treatment usage

$Treatment_i$ = Dummy variable for treatment (Treatment=1) and control (Treatment=0)

$MonthYear_t$ = Vector of month-year dummies

$PreUsage_i$ = Average daily usage for household i over the entire pre-participation period

$PreWinter_i$ = Average daily usage for household i over the pre-participation months of December, January, February, and March

$PreSummer_i$ = Average daily usage for household i over the pre-participation months of June, July, August, and September

ε_{it} = Error

Because Models 2 and 3 address the problem of underlying time trends in the data in slightly different ways, it may be useful to think of their estimates as representing boundaries of the true savings estimate. The results from Model 2, which we present as our main findings, are a slightly conservative estimate of the true treatment effect, while the results from Model 3 may be a slight overestimate. That said, the savings estimates generated by both models are nearly identical, which improves our confidence that we have accurately identified savings.

Finally, we estimated a difference-in-difference model without weather terms in order to provide simple results across all years (see Table 9). The savings estimates from this model are also very similar to those produced by Models 1–3.

Estimating Program Savings

The evaluation team calculated savings by evaluating the model under two conditions: 1) with treatment and 2) without treatment. We did this using the coefficient in the model that estimates the treatment effect. For Model 1 and Model 2, this is the coefficient of the Post*Treatment interaction, and for Model 3 this is the coefficient of the Treatment variable. The average daily household savings attributable to the program is the value of this coefficient.

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.⁸ 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 during the program year (i.e., the average number of days between receiving the first report and the endpoint of the post-participation billing periods).

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 counted by other AIC residential energy efficiency programs? (savings adjustment)

The savings tips provided in the reports could lead to additional program participation; however, we understand that many of the reports provided generic tips not associated with specific programs. 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 could appear in both

⁸ 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.

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 the Behavioral Modification Program treatment generated lift in other energy efficiency programs in PY7, 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:⁹

- Appliance Recycling (Electric only)
- HVAC (Electric Only)
- Residential Lighting (online platform only)¹⁰
- Home Performance with Energy Star (Electric and Gas)
- Moderate Income (Electric and Gas)

AIC discontinued the following programs in PY7. However, these programs still exhibit lift because of participation in the defined pre-period. In addition, the cumulative savings from these programs claimed in previous programs years are included in the savings adjustment (see below).

- HVAC (Gas)
- 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.

Savings Adjustment for Channeling

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

⁹ 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. The CFL Distribution program chooses customers randomly, and thus whether customers obtain CFLs cannot be influenced by the Behavioral Modification Program. The Energy Kit program provides energy savings measures 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 Modification Program database.

¹⁰ 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.

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.

In PY7, we incorporated channeled savings generated from prior participation years that remain in effect in the current year. The evaluation team looked at cumulative 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 over year. As such, the adjustment would likely increase from the prior program evaluation approach, which took into account only current program year channeling. To determine the net savings component of the channeling analysis for the current cycle evaluation, we followed these modified steps:

- **Step 1: Determine Overlap in Measures:** Similar to the participation lift analysis, the evaluation team cross-referenced the Behavioral Modification Program database, for both treatment and control groups. This allowed us to determine who installed measures during the pre- and the post-program periods, for both treatment and control groups.
- **Step 2: Evaluate Savings of Overlapping Measures:** Once we established what was installed by whom in what time period, we applied a pro-rated¹¹ per-measure (per-program) net savings value to the units to determine the kWh savings for the pre- and post-program periods for the treatment and control groups. We also projected the net kWh savings per measure throughout its entire effective useful life (EUL). This results in net cumulative savings from previously installed measures (PY4-PY6). We then added the cumulative savings to the pro-rated savings overlapping in PY7.
- **Step 3: Calculate Per-Household Adjustment:** The team then divided the calculated savings adjustment by the total number of customers in the control or treatment group in PY7 and by the modeled average baseline consumption to obtain the household-level adjustment value. This household-level adjustment value represents the percent savings per participant.
- **Step 4: Difference-of-Differences (DoD) Approach:** Following the DoD approach, the evaluation team used the net deemed savings to calculate the savings adjustments (see Table 9).¹²

Table 10. 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 percent of kWh savings per OPower participant. We calculated this

¹¹ Using pro-rated savings means that we discount the savings by the number of days that the measure has been installed in that program year. Therefore, measures installed later in the program year will have accumulated smaller savings than the same measure installed near the beginning of the program year. Using the pro-rated approach, as opposed to the deemed savings approach, allows us to more accurately estimate actual savings accumulation and project it throughout its EUL.

¹² For all program years, we used ex post values except in P7 and PY4 as we did not have ex post values at the time of the analysis.

	Pre	Post	Post-Pre Difference
	percentage by dividing the overlap found between the Behavioral Modification Program treatment/control groups with the other residential AIC programs and the modeled baseline usage.		

The result of this database crossing and calculation is a channeled savings estimate, which we subtract 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.

2.3 Sources and Mitigation of Error

Table 10 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 11. Possible Sources of Error

Research Task	Survey Error		Non-Survey Error
	Sampling Error	Non-Sampling Survey Error	
Treatment/Control Surveys	<ul style="list-style-type: none"> • Sample frame error • Sampling error 	<ul style="list-style-type: none"> • Measurement error • Non-response error 	NA
Multilevel Modeling	NA	NA	<ul style="list-style-type: none"> • Model specification error • Measurement error
Billing Analysis	NA	NA	<ul style="list-style-type: none"> • 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 PY7 evaluation.

Survey Error

■ Sample Frame Error

- The evaluation team fielded a survey to all treatment and control group customers with an email address. This reflects approximately half of the customers in the program. Customers with no email address on file are much older, more likely to be retired, and less likely to have a child living in the house than those with an email address. These two groups vary to a lesser extent on many other demographic and psychographic characteristics. As a result, survey results are not generalizable to customers without email addresses (see Appendix H).

■ Sampling Error

- We surveyed 4,086 customers out of a sample frame of 47,535, and 2,996 treatment customers and 1,090 control customers.¹³ This sample size and distribution provides us with the ability to detect a 3% difference between the means of the two groups at the 90% confidence level, assuming a coefficient of variation of 0.5 for any given variable under analysis. The asymmetric sample sizes between treatment and control customers means that the power of any test applied will be largely governed by the smaller of the two samples. However, a small amount of power is gained by the larger size of the surveyed treatment group.

■ Non-Sampling Errors

- **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, and that have demonstrated predictive power in past studies. 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 response possibility) 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 that 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. We also pre-tested the survey instrument. The team also reviewed the pre-test survey data, and we used the pre-tests to assess whether respondents became confused, gave highly inconsistent answers, or answers with insufficient variation over the sample. It also allowed us to test 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:** This type of error is most likely to produce the biggest threat to 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 a survey than non-participants.

We assessed non-response error by making two sets of comparisons. First, we compared the demographics for the treatment versus control group customers who responded to the survey. The surveyed groups were never more than 3 percentage points different on any variable tested, and most were exactly the same percentage or one point different. For the surveyed group, the variables tested were fuel type, home square footage, home type, age of respondent, number of people in household, and annual household income. In this case, we did not find non-response

¹³ This sample frame was derived by cleaning the database, including but not limited to dropping all customers in the database without valid email addresses, who had moved out, and those who had opted out of the program.

bias. We thus felt comfortable that comparisons between surveyed treatment and control groups were reasonable. Details are in Appendix H.

Then we compared the demographics of the surveyed treatment group customers to the demographics of all treatment group customers using Experian data, and the same for control group customers. When comparing the surveyed groups to their corresponding sample frames using Experian data, we compared on percent single-family home type, age, and annual household income. Across these variables, comparing the surveyed treatment group with the treatment group sample frame and surveyed control group to the control group sample frame, differences were never more than 3 percentage points in any category for age and income. For home description, the differences were greater. Based on Experian data, among the sample frame of the treatment group 90% live in single family homes, while 95% of the comparable survey group live in that type of home. For control group customers, the sample frame includes 91% who live in single-family homes, compared to 97% of surveyed control group customers. Thus, single-family home dwellers are somewhat overrepresented in our survey respondents, suggesting evidence of non-response bias. Details are in Appendix H.

We decided not to weight the survey results because the focus of the analysis was on comparing treatment and control groups, and those two groups were extremely similar. Further, there is no reason to expect that comparison to be affected by both groups having their homeowners weighted down. Weighting both groups' homeowners down would have the effect of reducing statistical power. We judged the loss of power not worthwhile given the focus on comparing treatment and controls groups, which were very similar.

Non-Survey Error

■ Analysis Errors: Impact Evaluation

- 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, possibly 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 adjusted by the customer-specific intercept.
- 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), though the relatively simple models used in the impact analysis have essentially no chance of problems with multi-collinearity.

- Heteroskedasticity: This type of modeling error can result in imprecise model results due to variance changing across customers with different levels of consumption. The team addressed this type of error by using robust standard errors. Most statistical packages offer a robust standard error option 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 and using robust error estimation.

3. Evaluation Findings

3.1 Program Description

The Behavioral Modification Program began in August 2010. AIC oversees the Behavioral Modification Program and reviews and approves any program materials or changes that are made to the program during the year. Leidos 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).

In PY7, the program offered two treatment formats: a printed report mailed to the customer's billing address and the online portal, which customers can log onto to view the same report and access additional information.

The PY7 evaluation focuses on the period from June 2014 through May 2015. Based on the 3 Year Plan, the expected energy savings from this program are 29,350 MWh and 1,887,500 therms for PY7, representing 38% of electric savings and 74% of gas savings for the overall residential portfolio.¹⁴

3.2 Program Design and Implementation Changes

Based on the interviews with program staff and implementers, there have been several changes made to the program in PY7. We outline these, as well as successes and challenges faced, below.

The program underwent substantial changes to its design and implementation in PY7. Specifically, Leidos became the program implementer instead of Conservation Services Group (CSG). Further, the budget for this program was reduced by 20%. These changes to program design and implementation had implications in terms of the number, timing and frequency of report delivery, which we outline below.

- **The reports were delayed.** Interviews with program staff revealed that AIC and Leidos experienced contracting issues that resulted in delays for sending out HERs to customers in PY7. Instead of the typical 12 month cycle, the reports for PY7 were issued over 9 months.
- **The frequency of reports to dual fuel customers was reduced from six per year to four per year.** OPower decreased the frequency of HERs for all dual fuel cohorts from six to four reports per year on

¹⁴ Source: AIC Plan 3 Corrected Compliance Filing, p. 13, Docket 13-0498 (Filed February 28, 2014). <http://www.icc.illinois.gov/downloads/public/edocket/370747.pdf>.

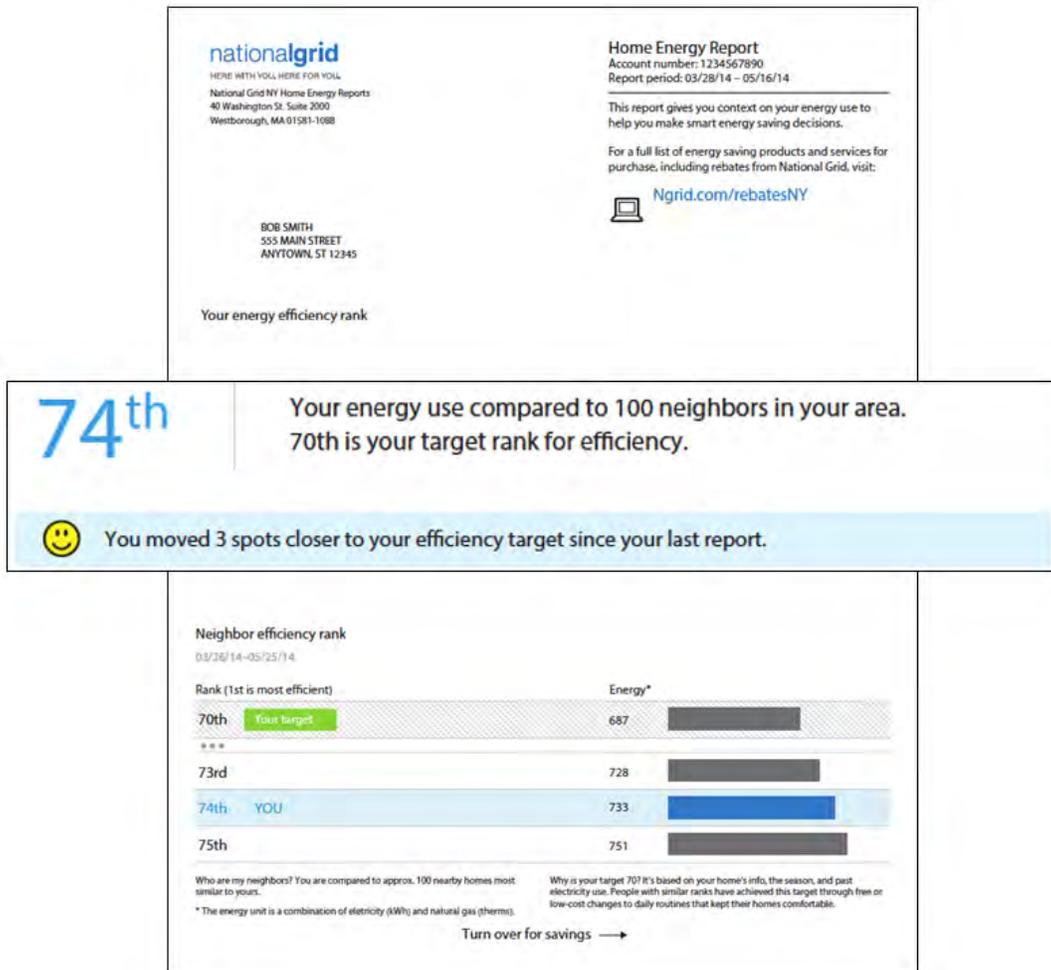
the electric side; for gas cohorts, reports remained steady at six per year. The reason for this change was a 20% decrease in the program budget and the duration of exposure customers have had to reports. At the beginning of the program year, most cohorts, except for Expansion Cohort 4, have been in the program for at least three years. OPower program staff indicate that these customers' energy-saving behaviors are now habitual and no longer need prompting via the reports. OPower staff also indicated that the reduced report frequency will help increase the program's cost-effectiveness. This change in report frequency did not apply to the program's gas customers, who continued to receive six annual reports, with no anticipated reductions in PY8.

- **Electronic Home Energy Reports (eHERs) were suspended in PY7.** eHERs, or electronic home energy reports that are emailed to participants, were initially intended to be distributed during PY7, however, internal technical issues prevented these reports from being delivered. The technical issues prevented AIC from sending customer email addresses to OPower, and technical issues were experienced with the email address database itself, resulting in electronic reports being discontinued for PY7. Although the issues have since been resolved, this complication resulted in a loss of some expected savings for PY7. In July 2015, eHERs were re-implemented on a monthly schedule to program participants with email addresses.

In addition to changes in report delivery, there were changes in terms of the number of participants in the program as well as new campaigns and initiatives introduced to customers. We document these below.

- **Added two expansion cohorts in PY7.** Expansion Cohort 5 was introduced in September 2015. In order to address attrition, and maintain the contractual goal of at least 260,000 program participants, AIC added Expansion Cohort 6 in April 2015. Expansion Cohorts 5 and 6 consisted of approximately 12,600 and 16,500 participants, respectively. Both Cohorts are dual fuel customers.
- **AIC and OPower introduced a “target rank campaign.”** This campaign provides customized short-term goals to high-energy users from Expansion Cohort 1 (approximately 17,000 customers). Messaging encourages recipients to improve their energy efficiency rank, providing positive feedback for incremental improvements, and dynamic rank tracking that allows customers to follow their progress from report to report. A survey fielded by OPower discovered that Expansion Cohort 1 participants were very dissatisfied with the reports they received. Further investigation revealed that this subset of program participants consistently ranked poorly in energy savings. The campaign was launched to help this particular subset of program participants (high-energy users in Expansion Cohort 1) improve their energy efficiency ranking, providing positive messaging to help reinforce improvements – contrasting with the social norming messages typically present in the report. The campaign was launched in fall 2014 and was completed in summer 2015. OPower indicated that they planned to field a follow-up survey to these participants in fall 2015 to gauge any change in satisfaction with the HERs.

Figure 1. Target Rank Campaign Insert – Sample



- Additional Behavioral Pilot Initiated:** The Aclara opt-in program is a customer engagement tool (with no savings associated to it) being rolled out to customers in tandem with AIC’s AMI deployment. We document this pilot effort, as there is reportedly overlap between the customers opting into this program and those who receive HERs. Furthermore, our interviews revealed that customers might be receiving information from Aclara that conflicts with the HERs, generating confusion (e.g., receiving different tips and recommendations).

3.3 Program Participation

Approximately 320,000¹⁵ customers participated in the Behavioral Modification Program in PY7, close to one-third of all AIC’s residential customers. Most of these customers are in their fourth year of participation; about 100,000 participated for the first time in PY7.

In 2010, the program began as a pilot by targeting dual fuel customers with higher than average energy consumption. These customers are now in their fifth year with the program. Over the following five years, six additional cohorts were added to the program. All cohorts are dual fuel customers, except for Expansion Cohort 3, which is gas only. In PY7, two new cohorts were added: Expansion Cohort 5 and Expansion Cohort 6. The program implementer develops each expansion cohort based on several characteristics: energy usage tier, residential customer, and available energy use history. Table 11 provides all treatment customers who received reports for at least one month in PY7.

Table 12. Behavioral Modification Program Participation in PY7

Cohort Name	Fuel Type	Number of Treated Customers in PY7	Start Date	Program Year
Original Cohort	Dual Fuel	37,243	August 2010	5 th year in the program
Expansion Cohort 1	Dual Fuel	56,788	April 2011	4 th year in the program
Expansion Cohort 2	Dual Fuel	85,893	November 2011	4 th year in the program
Expansion Cohort 3	Gas only	13,621	November 2011	4 th year in the program ^a
Expansion Cohort 4	Dual Fuel	25,506	June 2013	2 nd year in the program
Expansion Cohort 5	Dual Fuel	62,996	September 2015	1 st year in the program
Expansion Cohort 6	Dual Fuel	37,800	April 2015	1 st year in the program
Total		319,847		

^a 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 and PY7.

As expected, each cohort experienced some attrition as customers opted out or moved and closed their accounts. The attrition rates shown in Table 12 are based on numbers in OPower’s program tracking database. We include earlier program year attrition rates to provide context year over year.

¹⁵ Includes all participants who received at least one report in PY7 (including opt-outs and move-outs).

Table 13. Behavioral Modification Program Attrition Rates in PY7

Cohort	PY 3	PY 4	PY 5	PY 6	PY 7
Original Cohort	6.6%	7.2%	7.2%	6.7%	6.3%
Expansion Cohort 1	2.1%	9.4%	8.2%	7.5%	6.9%
Expansion Cohort 2	--	7.6%	9.6%	8.5%	7.8%
Expansion Cohort 3	--	24.0%	6.5%	7.0%	6.6%
Expansion Cohort 4	--	--	--	16.2%	11.8%
Expansion Cohort 5	--	--	--	--	13.7%
Expansion Cohort 6	--	--	--	--	6.4% (April and May only) ^a

Source: OPower program tracking databases for PY6 and PY7.

^aThis evaluation provides attrition rates for the first two months of participation for Expansion Cohort 6.

Percents are based on the number of active participants in each cohort at the beginning of each program year

A review of participation data indicates that attrition rates for Expansion Cohort 4 and 5 in PY7 were primarily driven by move-outs, rather than opt-outs.

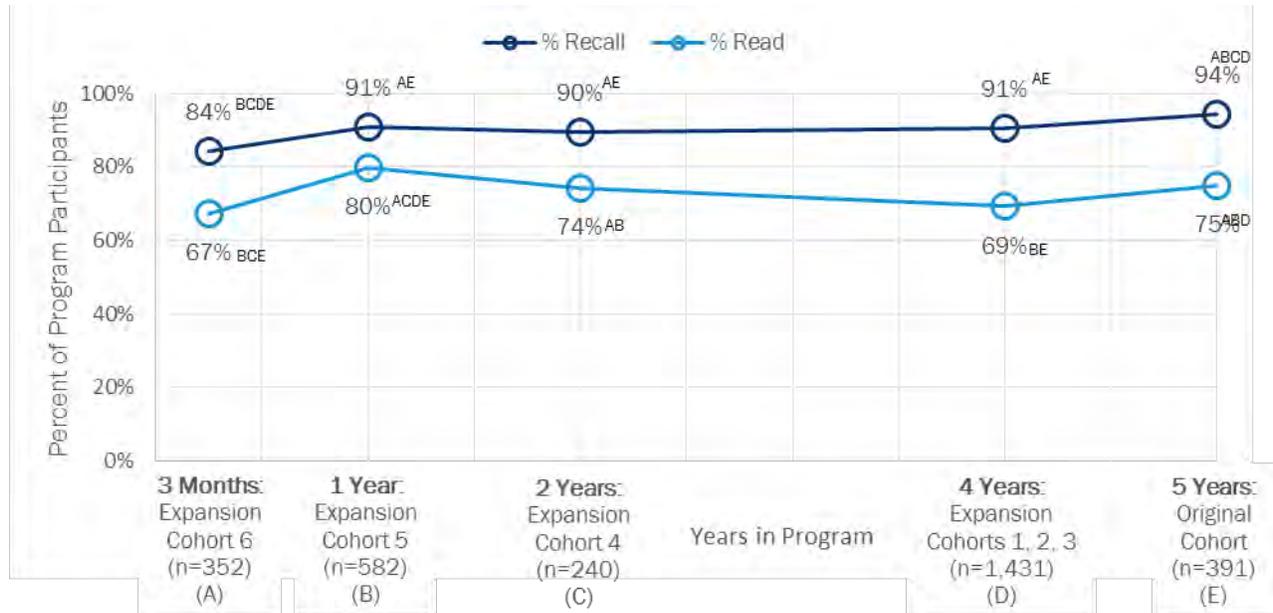
3.4 Participation Experience

The evaluation team completed 4,086 interviews, 2,996 with treatment group and 1,090 with control group customers across all program cohorts (from the Original Pilot Cohort to Expansion Cohort 6). This section summarizes the main findings from the survey effort. We provide additional survey results in Appendix I.

Report Recall

Overall, most customers recall receiving the reports (90%) and have read their most recent report (72%). These findings are consistent by both cohort and the amount of time a customer has been in the program. Figure 2 displays the percentage of treated customers within a period of time that recall receiving the home energy reports and have read their most recent report (sent around July 10). There is some variation across cohort expansion groups and time; Figure 2 indicates where these differences are statistically significant. Most notable among these statistical differences is the fact that the Original Pilot Cohort customers recall receiving reports more than any other cohort, and the Expansion Cohort 6 recalls receiving reports the least of all seven cohorts. Although more Original Pilot Cohort customers recall receiving the report, Expansion Cohort 5 customers are the most likely to report reading it. Notably, the Target Rank Campaign (see Section 3.2) may be a potential reason for higher awareness of HERs that we found in our survey.

Figure 2. Participants’ Recall and Readership of Home Energy Reports over Time in Program (n=2,996)



Note: Superscript letters indicate statistical significance across time periods named in the superscript based on the following: 3 Months (A), 1 Year (B), 2 Years (C), 4 Years (D), and 5 Years (E).

Participant Characteristics by Savings Group

Our team used a multilevel modeling approach to identify high, medium, neutral, negative, and very negative savers within the treatment population, and to identify characteristics to support future targeting efforts. We examined the savings groups for gas and electricity consumption during PY7 and looked at the first three years of participation for the Original, Expansion 1 and Expansion 2 cohorts to help understand the evolution of the savings groups over time.

We divided the PY7 participants into five savings groups by their individual savings estimates. The top and bottom groups each have about ten percent of the participants, the medium and negative savers groups each have about 30% of participants, and the neutral saver group has about 20% of participants. Table 13 shows the percentage savings, average savings in therms, and three pre-treatment average daily consumption (ADC) measures, as well as the year the average home in the savings group was built and the number of years of residence from Experian. Participants in the high savings group generally have higher winter and summer ADC, older houses, and have lived in their residences for less time than those in other groups.

Table 14. PY7 Gas Savings Groups

Savings Group	Percentage Savings	Average Therm Savings Per Day	Pre-ADC	Summer Pre-ADC	Winter Pre-ADC	Year Home Built	Years of Residence
High	22%	0.55	2.85	0.59	6.72	1967	7.8
Medium	9%	0.18	2.38	0.52	5.83	1972	9.2

Savings Group	Percentage Savings	Average Therm Savings Per Day	Pre-ADC	Summer Pre-ADC	Winter Pre-ADC	Year Home Built	Years of Residence
Neutral	1%	0.03	2.30	0.50	5.76	1975	9.8
Negative	-6%	-0.11	2.19	0.47	5.66	1975	10.9
Very Negative	-21%	-0.44	2.61	0.51	6.93	1971	12.9

Table 14 shows the same measures as Table 13, but for electric savings groups. It is more difficult to discern demographic and household differences between the high savings group and other groups in this case, but the pre-treatment ADC differential is much larger between the negative and high savings groups than it is in the gas groups.

Table 15. PY7 Electric Savings Groups

Savings Group	Percentage Savings	Average kWh Savings Per Day	Pre-ADC	Summer Pre-ADC	Winter Pre-ADC	Year Home Built	Years of Residence
High	28%	12.33	47.3	64.6	48.4	1972	10.0
Medium	10%	3.26	37.5	53.1	36.1	1973	9.7
Neutral	1%	0.23	30.6	44.2	29.1	1973	10.1
Negative	-10%	-2.38	27.6	39.0	27.3	1972	10.3
Very Negative	-37%	-11.44	36.7	49.2	39.6	1973	9.5

Notably, some participants with relatively high usage fall into the very negative saver group in both the gas and electric analyses. This may mean that it could be difficult to select a group of customers with high propensity to save through choosing customers with high pre-treatment usage. For this reason, it could be valuable from a program performance standpoint to adjust or stop delivery of the reports to very negative savers as soon as they can be identified. However, if such an approach is made, the implementation should use an experimental design to maintain design fidelity.

We performed an analysis to see whether participants moved across savings groups over time. We examined the participant specific savings for the Original, Expansion 1, and Expansion 2 cohorts. To examine the evolution of savings groups, we included participants who stayed in the program for a minimum of three years, which makes the groups look slightly different than the PY7 participant specific groups above.

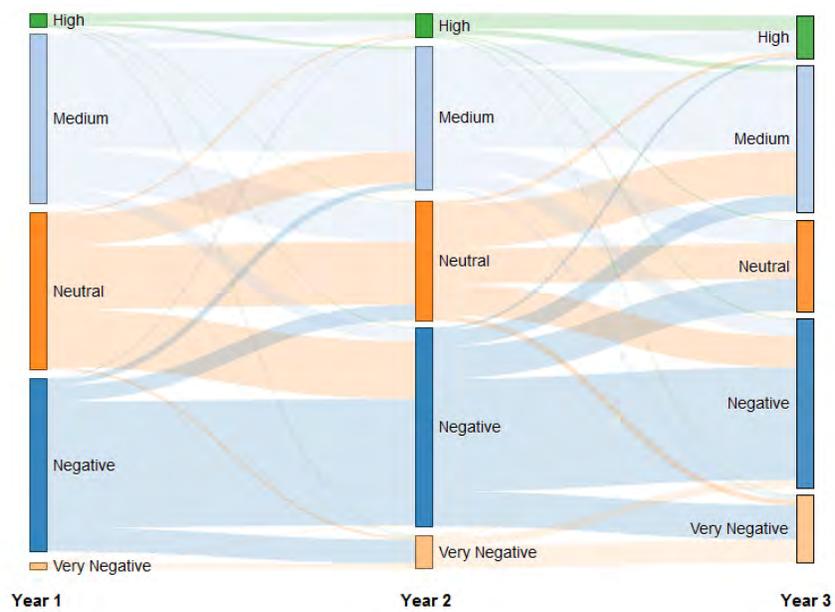
For this analysis, we expected that savings would increase from the first year of participation to the third, as participants are able to make more program related changes over time. What we found was that for some participants this was the case, but some negative savers increased their usage more over the years of participation and moved from being negative savers to very negative savers.

Figure 3 and Figure 4 show the temporal evolution of the proportion of participants who fall into each savings group. Initially, nearly all participants fall into the middle three savings categories, and over time, some move into the extremes. We expected to see an increasing spread of savings over time with evolution of some customers from lower to higher savings as they made behavioral and equipment changes. The

Evaluation Findings

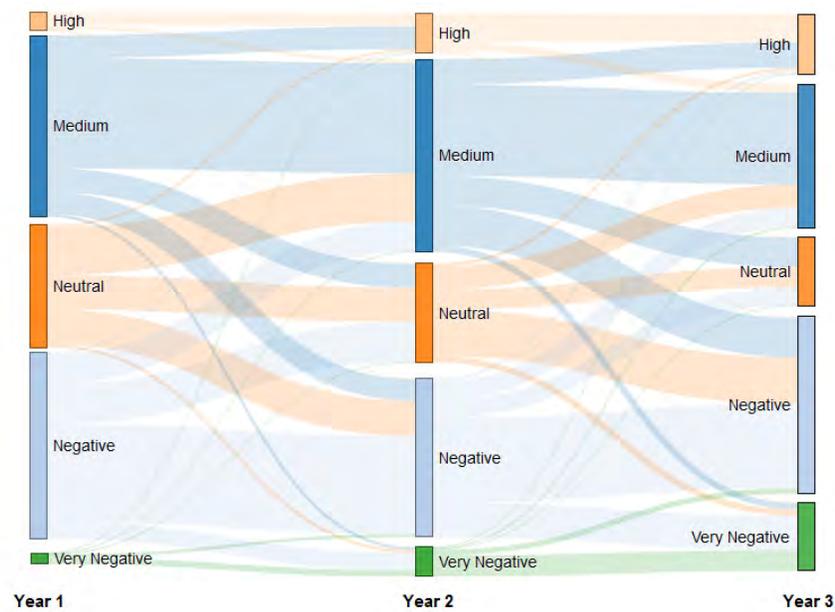
increase in the size of the very negative savings group may mean that some participants are responding to the home energy reports in ways that increase usage.

Figure 3. Gas Savings Group Evolution



Note: Each bar represents percent of participants in each savings group.

Figure 4. Electric Savings Group Evolution



Note: Each bar represents percent of participants in each savings group.

We found that approximately 40% of customers stayed in the same savings group over the three years, while about 20% moved one group to higher savings and 20% moved one group to lower savings. Of the remaining 20% of customers, we found that slightly more customers moved more than one step toward lower savings than moved more than one step toward higher savings.

One interesting and potentially useful finding is that those customers who were in the very negative savings group in the first year very rarely achieved positive savings. For instance, in the gas analysis, 90% of those who started as very negative savers remained in the very negative or negative groups for all three years of the analysis. These customers might benefit from significant modifications to the reports they receive or from stopping reports entirely.

The primary predictor of savings is pre-treatment usage. Higher users have a higher potential to save, and more often fall into the high saver group. We also found that housing characteristics and demographics are related to savings, though the magnitude of the relationship between the housing characteristics and savings varies by pre-treatment usage and interactions with other characteristics. To assess the importance of these non-linear relationships, we used a side effect of random forests¹⁶ modeling that prioritizes the importance of the available variables for predicting savings¹⁷. The most predictive characteristics after pre-treatment usage were the age of the house, the customer's age, educational level, occupation, and number of people living at the residence. For gas, participants with older houses tend to save more, as do those who have lived in their home for less time. For electric, older participants, and those with fewer people living at the residence tend to save more.

Future Research & Considerations for Future Targeting

Future research could provide a way to identify customers with high savings potential or especially low savings potential. An experiment using predictive modeling could yield valuable information on the usability of predictions to select a high savings propensity group, comparing that group's savings to another where participants are selected as usual. If effective, predictive modeling could reduce the number of reports required to make savings goals, thereby increasing cost effectiveness.

This analysis suggests that stopping or modifying reports for participants in the negative or very negative savings groups could increase program impact because it is relatively rare for participants to move from a negative savings group to a positive savings group while continuing to receive the same treatment.

As AIC moves to a pay for performance model: first, we recommend continuing to target high usage customers for the program. Second, consider moving to predictive modeling to target customers with high propensity to save, as the added modeling cost may be offset by reduction in the number of new participants required to achieve similar savings. Finally, consider identifying significantly negative savers and modifying or stopping home energy reports for those participants since the reports may have a deleterious effect on some customer's usage, and most very negative savings group participants persist as negative savers with continued treatment.

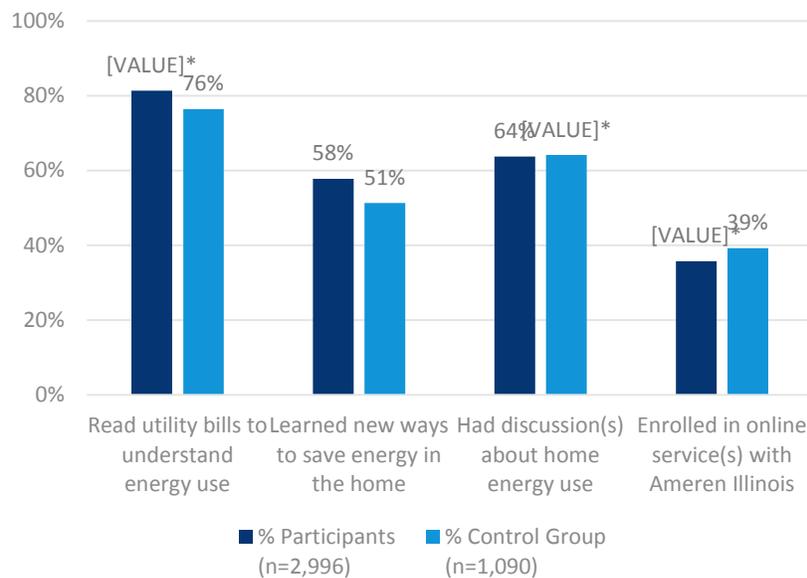
¹⁶ A. Liaw and M. Wiener (2002). Classification and Regression by randomForest. R News 2(3), 18–22.

¹⁷ Random forests makes many small recursive partitioning models with subsets of the variables, and uses the ordering of the partitions in the hundreds of models to order the predictive variables from most to least predictive.

Customer Engagement, Barriers & Drivers

Program participants tend to be more engaged with their home’s energy use than their control group respondent counterparts. Compared to the control group respondents, more participants indicated they have learned new ways to save energy in their homes and have read their utility bills to understand their home’s energy use in the past 12 months (see Figure 5). 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, control group respondents are more likely to have engaged with AIC using online services (e.g., the AIC website). Furthermore, they were just as likely as the treatment group to have discussed energy use in their homes. Notably, differences for enrolling in online services overall were driven by individuals from the 3 month control group.

Figure 5. Energy Usage Engagement (Overall)



* Indicates a statistically significant difference at the 90% confidence level.
 Note: Graph based on percent responding “Yes” for Yes/No questions.

Survey respondents graded the barriers to reducing energy usage shown in Figure 6 on a 0 to 10 scale. At the low end of the scale, 0 indicates that they “strongly disagree”, while a 10 indicates that they “strongly agree” that the listed item is a barrier. There were few statistically significant differences between the treatment and control groups when compared across their duration of exposure to the program, which may reflect market adoption across all groups of energy efficiency equipment over time.

For this reason, Figure 6 displays overall means for the treatment and control groups, with indicators for statistically significant differences at the 90% confidence level. As a whole, respondents do not perceive these barriers to be very significant. Relatively, however, participants are more likely to feel that they cannot afford to spend money on energy efficient appliances or upgrades and that they are too busy to worry about saving energy than their control group counterparts. The control group is more likely to feel that they are lacking information on what they can do to save energy in their homes. This relative comparison indicates that the HERs do a good job of educating homeowners on what they can do to minimize their energy usage.

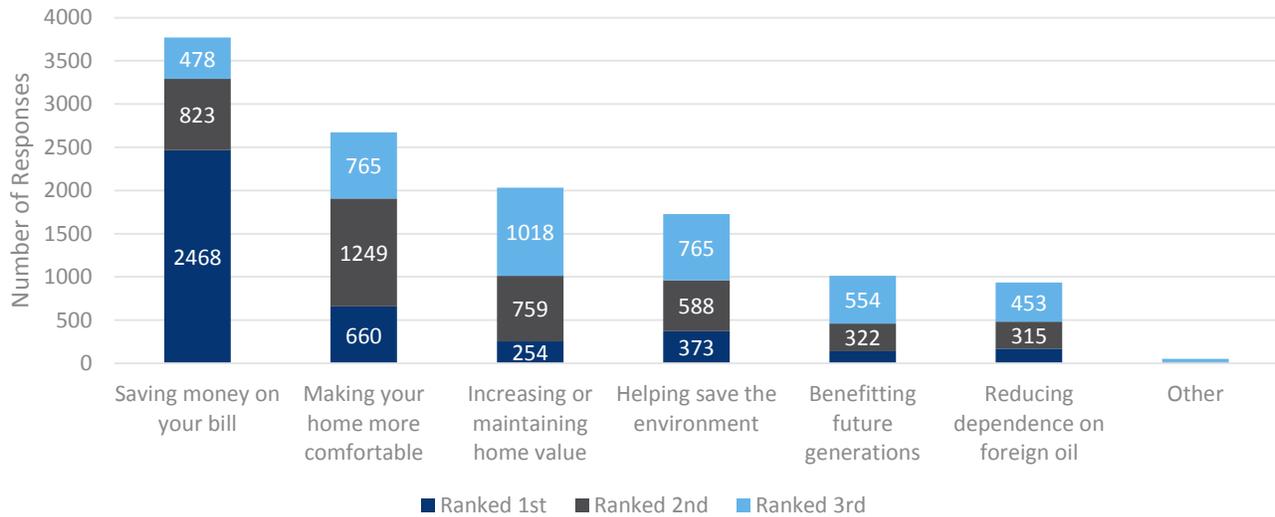
Figure 6. Barriers to Reducing Energy Usage (n=2,996)

Barrier	3 Months (A)	1 Year (B)	2 Years (C)	4 Years (D)	5 Years €
	Expansion Cohort 6 (n=352)	Expansion Cohort 5 (n=582)	Expansion Cohort 4 (n=240)	Expansion cohorts 1,2,3 (n=1,431)	Original Cohort (n=391)
I feel guilty when I waste energy	6.6 ^E	6.4 ^E	6.2	6.4 ^E	6.0 ^{A,B,D}
I can't afford to spend money on energy efficient appliances or upgrades	5.9 ^{D,E}	6.0 ^{D,E}	5.6	5.2 ^{A,B}	5.1 ^{A,B}
It is hard to get everyone in my household to cooperate to save energy	4.5 ^D	4.4 ^D	4.7 ^D	3.9 ^{A,B,C,E}	4.4 ^D
I don't have enough information about what I could do to save energy	3.9 ^D	3.9 ^D	3.8 ^D	3.4 ^{A,B,C}	3.5 ^B
I'm too busy to worry about saving energy	2.2 ^E	2.2 ^E	2.0 ^E	2.1 ^E	2.6 ^{A,C,D}
I don't feel responsible for conserving energy because my personal contribution is small	2.1 ^E	2.2 ^E	2.0 ^E	2.1 ^E	2.5 ^{A,B,C,D}
Note: Superscript letters indicate statistical significance across time periods named in the superscript based on the following: 3 Months (A), 1 Year (B), 2 Years (C), 4 Years (D), and 5 Years (E). Figure displays averages on a scale from 0 to 10, where 0 is "strongly disagree" and 10 is "strongly agree."					

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 7). If not already doing so, 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.¹⁸

¹⁸ The team reviewed some sample HERs, but cannot say conclusively whether such marketing messages are already included in the reports.

Figure 7. Ranking Reasons for Reducing Energy Usage (n=4,067)



Energy Savings Actions

One of the goals of the survey was to study self-reported measure uptake and behavioral change among all program treatment and control groups, analyzing whether program participants are taking more (and deeper) energy saving/efficiency actions than control group members and if time in the program plays a significant role in these actions.

In examining energy saving actions taken by treatment and control groups, we focused on three particular types of actions: replacing old equipment with ENERGY STAR equivalents, low-cost / no-cost efficiency actions, and changes to habitual energy efficiency behaviors. First, we determined whether the customer had ever taken the action; then, for each of these action types, we went on to distinguish if customers had performed the actions before or after they began to receive the HERs.

Generally, many respondents (both treatment and control) report taking energy savings actions. For example, we found that 90% of respondents have installed energy efficient light bulbs; 82% of treatment group customers did so after they had been enrolled into the program (with 83% replacing in the control group)¹⁹; and over 95% of both treatment and control group respondents regularly turn off lights in unoccupied rooms.

Overall, there were few statistically significant differences between the treatment and the control groups. However, the few differences that we were able to identify were as follows:

- **Replacing Equipment:** Unexpectedly, program participants were less likely to have replaced their water heater, furnace, and room/wall A/C units after inclusion in the program than control group respondents. The evaluation team compared treatment and control groups' replacement activities

¹⁹ These percentages are not statistically significantly different.

over their duration in the program. Control group respondents in their third month of the program drove the difference in furnace replacement, those in their fifth year drove the difference in water heater replacement, and those in their fourth year drove the difference in room/wall A/C units.

- **Low Cost/No Cost:** Although treatment group customers are more likely to have adjusted their water heater’s temperature set point than their control group counterparts, there were no other differences between the control and treatment groups.
- **Behaviors:** We also asked survey respondents whether they regularly (2-3 times a week) performed certain actions to help them save energy in their home. Although almost all respondents (99.5%) took at least one of the actions regularly, there were no differences between the treatment and control groups after the treatment group began receiving reports.

Customer Satisfaction

Both treatment and control group customers are satisfied with AIC and its efficiency programs. Curiously, control group respondents are more satisfied with AIC overall, AIC’s website, and AIC’s energy efficiency program offerings than their treatment counterparts (Table 15).

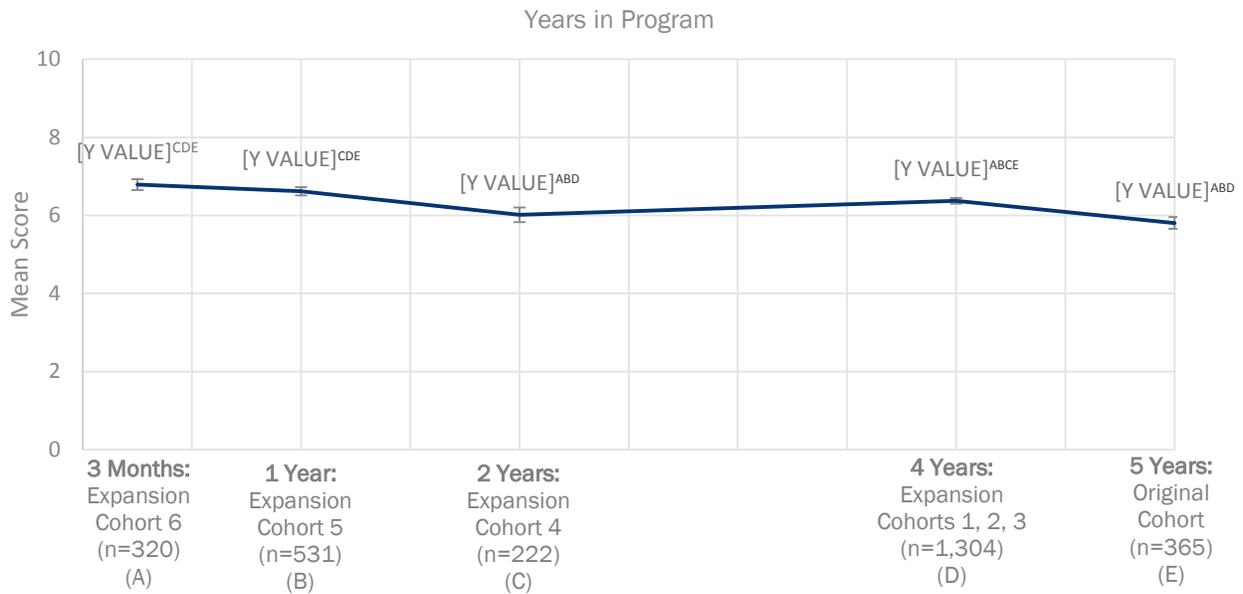
Table 16. Reported Satisfaction with AIC and Program Components (n=4,086)

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...	Treatment (n=2,996)		Control (n=1,090)	
	Mean Score	Standard Error	Mean Score	Standard Error
AIC overall	7.2	0.04	7.4 ^a	0.07
AIC website	7.1	0.05	7.4 ^a	0.08
Home Energy Reports	6.4	0.05	NA	NA
Types of energy efficiency programs offered by AIC	6.2	0.06	6.8 ^a	0.10

^a Indicates statistically significant differences at the 90% level between the treatment and control groups.

The treatment group customers were satisfied with the HER, though not strongly so, with a mean rating of 6.4 on a 0-10 scale. Participants who have been in the program for less than one year (3 months and 1 year) were more satisfied with the reports than those who had been receiving the reports for longer (Figure 8). This may be due to a wide variety of reasons: newer recipients receive a report that has been improved over the program years or there may be a novelty effect to the report that drives satisfaction.

Figure 8. Report Satisfaction over Duration of Exposure (n=2,996)



Note: Means are displayed above with standard error bounds, and all values are statistically significantly different.
 Note: All comparisons were made, but only the significant results are represented in the superscripts.

3.5 Impact Evaluation

Below we provide results from the PY7 Behavioral Modification Program impact assessment.

3.5.1 Equivalency Analysis

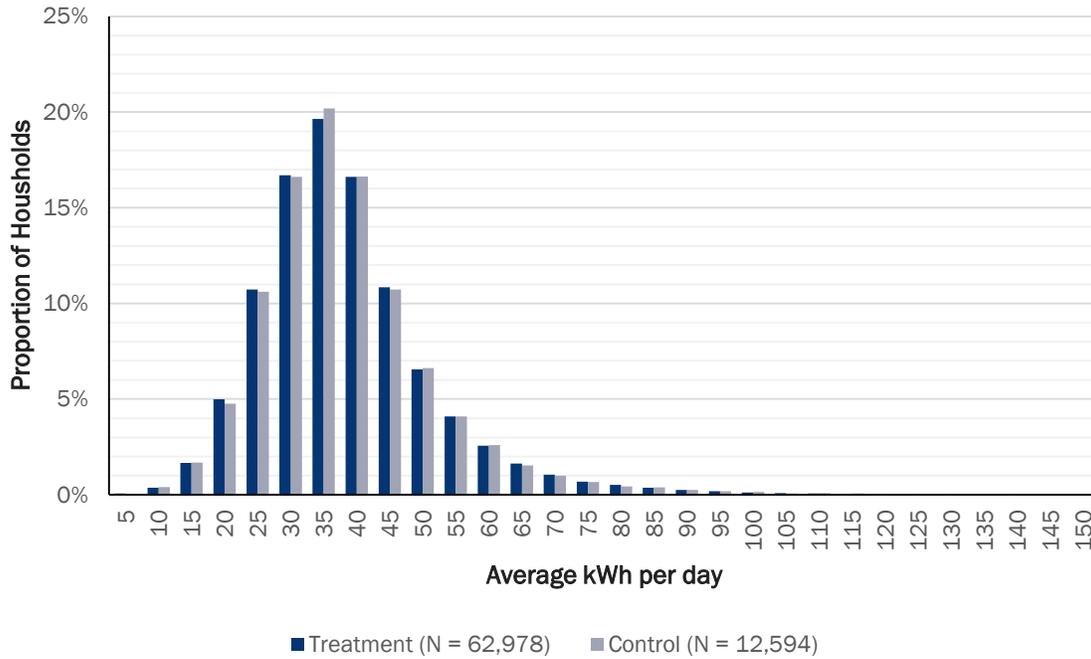
The evaluation team performed an equivalency check between the Expansion Cohort 5 treatment and control groups to understand usage. Given that the evaluation team did not assign the customers to treatment and control groups in the new Expansion Cohort 5, we conducted an equivalency analysis to test whether the treatment and control groups are comparable. When comparability is confirmed, this review strengthens the internal validity and defensibility of the research design.

All cohorts were equivalent based on average daily consumption in the pre-period, while Expansion Cohort 5 was equivalent on both baseline electric and gas usage as well as their demographic, housing, and psychographic characteristics. Based on our equivalency analysis, we conclude that treatment and control groups are equivalent.

Expansion Cohort 5 Electric Usage

We found the Expansion Cohort 5 to be equivalent in terms of electric usage. For the Expansion Cohort 5 electric customers, average daily consumption in the year before the start of the program was 34.74 kWh/day in the control group and 34.77 kWh/day in the treatment group. The distribution of average daily electric consumption is shown below (see Figure 9).

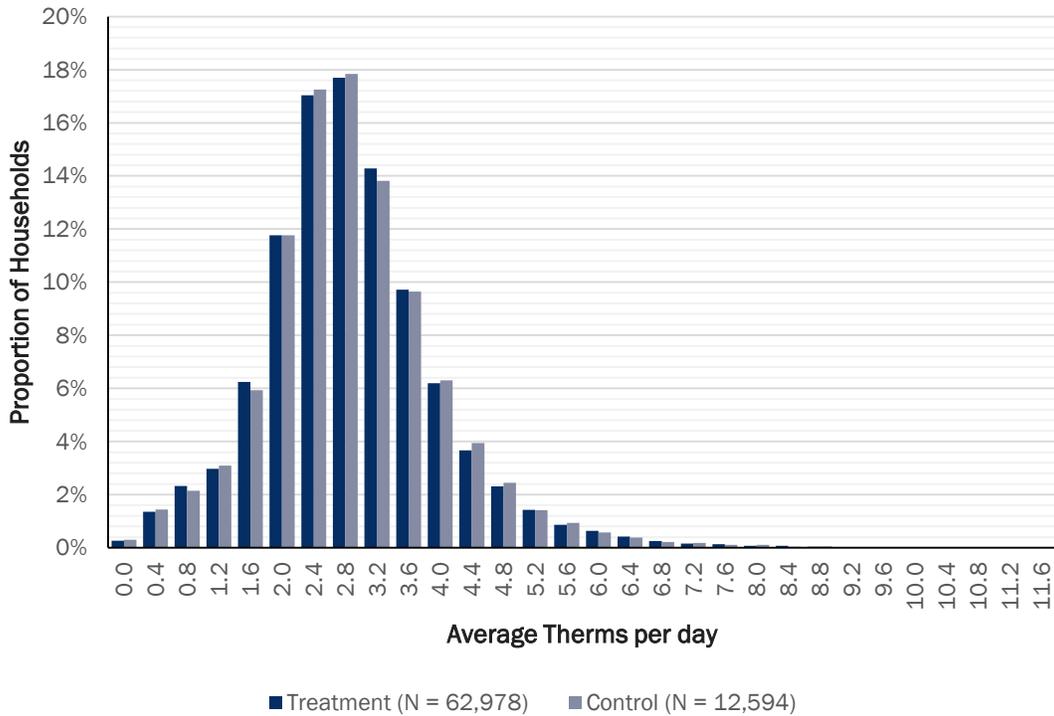
Figure 9. Distribution of Average Daily Electricity Consumption in the Year before Start of the Program



Expansion Cohort 5 Gas Usage

The evaluation team conducted a similar analysis for the Expansion Cohort 5 gas customers and found gas usage to be equivalent. In the year before the start of the program, average daily consumption was 2.76 therm/day for households in the control group and 2.76 therm/day for treatment households. Figure 10 shows the distribution of average daily gas consumption.

Figure 10. Distribution of Average Daily Gas Consumption in the Year before Start of the Program



Expansion Cohort 5 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 treatment and comparison households are similar across all areas studied.

In every category, the treatment and control groups differed by less than 1% on the key demographic and psychographic comparisons. Table 16 summarizes the demographics, housing, and psychographic equivalency analysis.

Table 17. Expansion Cohort 5: Key Demographic, Housing and Psychographic Comparisons

Category		Treatment (n=62,978)	Control (n=12,594)
Household	Homeowner listed as deceased ^a	0.5%	0.4%
Demographics			
Age	Under 35	27.2%	27.2%
	35-54	39.7%	39.9%
	55+	33.1%	32.9%
Household size	Avg. number of Adults ^b	2.2	2.2

Evaluation Findings

Category		Treatment (n=62,978)	Control (n=12,594)
Children in household	At least 1 child <18 yrs.	27.1%	26.3 %
Education of respondent	Less than High School Diploma	11.5%	11.6%
	High School Diploma	31.2%	31.4%
	Some College	33.7%	33.8%
	Bachelor Degree	14.9%	14.8%
	Graduate Degree	8.8%	8.4%
Household Income	Under \$50K	45.7%	46.0%
	\$50-\$100K	37.7%	37.6%
	\$100-\$200K	14.4%	14.2%
	\$200K or higher	2.2%	2.2%
Occupation	Sales/Service	13.0%	13.2%
	Professional/Technical	25.2%	25.0%
	Blue Collar	23.2%	23.1%
	Retired	12.6%	12.4%
Gender	Female	49.1%	49.6%
Housing			
Homeownership	Own	71.7%	71.5%
Housing type	Single-family detached	93.2%	92.7%
Home size	Home square footage of 100-5,999	99.0%	98.9%
	Home square footage of 6,000-9,999	1.0%	1.1%
	Home square footage of over 10,000	0.06%	0.02%
Age of house	Before 1960	55.8%	56.3%
	1960-1990	24.6%	24.4%
	1990 or later	19.5%	19.3%
Length of Residence	0 - 9 Years	67.6%	68.0%
	10 - 20 years	18.0%	17.9%
	21 years or higher	14.4%	14.1%
Psychographic			
Social Causes	Internet Online Subscriber	60.4%	59.4%
	Health	7.9%	8.1%
	Religious	6.1%	6.1%
	Veterans	5.2%	5.3%
	Animal Welfare	4.4%	4.7%
	Political - Conservative	1.6%	1.8%
	Political - Liberal	0.8%	0.8%
	Children	6.8%	7.0%
	Volunteer Work	0.2%	0.1%
	Other Social Cause	9.9%	10.0%

^a Indicated where “number of adults in household” variable is equal to 0.

^b 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 in order to ensure that attrition from the program will not bias findings in PY7. Table 17 and Table 18 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.

Table 18. Pre-Program kWh Average Daily Consumption

Cohort	Treatment (Pre-Consumption) in kWh	Control (Pre-Consumption) in kWh
Original Cohort	34.51	34.53
Expansion Cohort 1	39.71	39.83
Expansion Cohort 2	26.58	26.52
Expansion Cohort 4	51.48	51.33
Expansion Cohort 5	34.77	34.74

Table 19. Pre-Program Therm Average Daily Consumption

Cohort	Treatment (Pre-Consumption) in Therms	Control (Pre-Consumption) in Therms
Original Cohort	2.47	2.46
Expansion Cohort 1	2.87	2.88
Expansion Cohort 2	1.87	1.88
Expansion Cohort 3	2.20	2.21
Expansion Cohort 4	2.09	2.09
Expansion Cohort 5	2.76	2.76

3.5.2 Net Impacts

This section presents PY7 Behavioral Modification Program adjusted net savings. Following the presentation of results, we provide detailed results from the billing and channeling analyses that contributed to the development of a final adjusted net program savings value.

Table 19 shows details of the program’s adjusted net savings of 33,194 MWh and 1,754,669 therms.

Table 20. PY7 Behavioral Modification Program Total Savings

Cohort	PY7 Final Adjusted Net Program Savings (MWh)	PY7 Final Adjusted Net Program Savings (Therms)
Original Cohort	7,410	326,486
Expansion Cohort 1	12,189	553,906
Expansion Cohort 2	4,975	308,592
Expansion Cohort 3	-	189,279
Expansion Cohort 4	5,429	145,498
Expansion Cohort 5	3,192	230,907
Total^a	33,194	1,754,669

^a 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 0.003% to 0.092%, and gas savings by 0.001% to 0.159%, depending on the cohort.²⁰ 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. These included a comparison of baseline usage between treatment and control groups, impact modeling, participation lift analysis, and channeling analysis. Confidence intervals and significance testing usually are provided when evaluating a sample from the participant population. However, 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 – Original Model

As previously noted, the evaluation team used the entire program period in the model to calculate program savings. Table 20 summarizes the PY7 unadjusted net savings for the six dual fuel cohorts and the gas only cohort (Expansion 3). The table shows net savings but does not deduct double-counted savings from participation in other AIC residential programs.

Table 21. PY7 Unadjusted Per-Household Savings (%) – Original Model

Cohort	Average % Savings (Electric)	Average Savings per Customer (kWh)	Average % Savings (Gas)	Average Savings per Customer (therm)
Original Cohort	1.75%	202.4	0.95%	8.8
Expansion Cohort 1	1.73%	218.2	0.94%	9.8

²⁰ For context, in PY6, the evaluation team reduced electric savings by 0% to 0.04%, and gas savings by 0.01% to 0.03%, depending on the cohort.

Cohort	Average % Savings (Electric)	Average Savings per Customer (kWh)	Average % Savings (Gas)	Average Savings per Customer (therm)
Expansion Cohort 2	0.67%	58.3	0.51%	3.6
Expansion Cohort 3	NA	NA	1.67%	14.1
Expansion Cohort 4	1.28%	215.5	0.72%	5.7
Expansion Cohort 5	0.66%	51.0	0.44%	3.7

Weather Adjusted Model Results

The PY7 analysis added weather variables to the model specifications to improve precision in the modeled results used in previous program cycle evaluations. The weather adjusted results are fairly consistent with the original model, with small variations in savings. See Appendix E for the modeled coefficients for original, weather adjusted, and lagged dependent variable models.

Table 22. PY7 Unadjusted Per-Household Savings (%) – Weather Adjusted Model

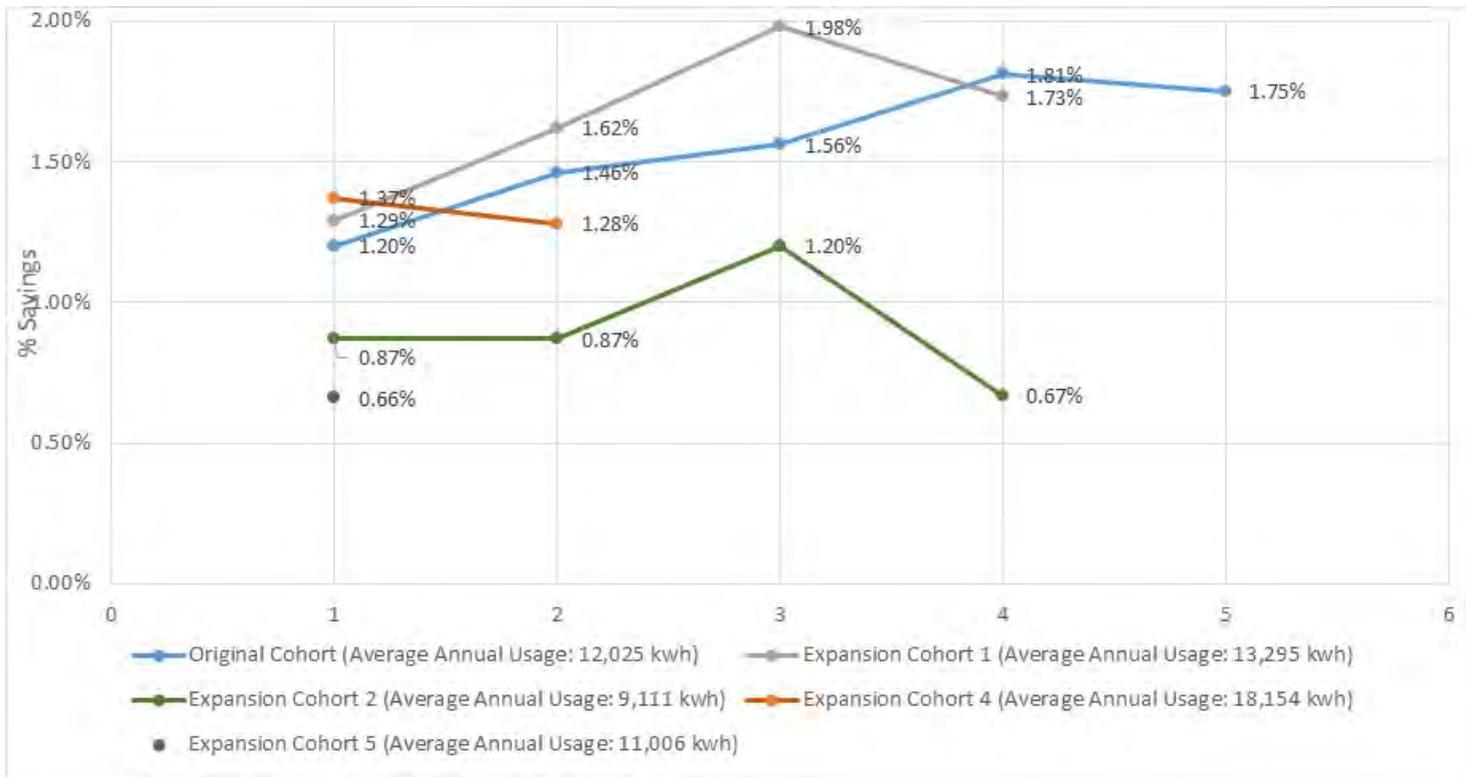
Cohort	Average % Savings (Electric)	Average Savings per Customer (kWh)	Average % Savings (Gas)	Average Savings per Customer (therm)
Original Cohort	1.75%	201.8	0.91%	8.5
Expansion Cohort 1	1.70%	214.0	0.93%	9.8
Expansion Cohort 2	0.65%	56.3	0.60%	4.3
Expansion Cohort 3	NA	NA	1.61%	13.6
Expansion Cohort 4	1.25%	211.8	0.80%	6.4
Expansion Cohort 5	0.66%	53.7	0.36%	2.4

Per Year Savings

In the following figures, we present the billing analysis results using the original model (used for ex post savings claims) across program years. These provide the 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.

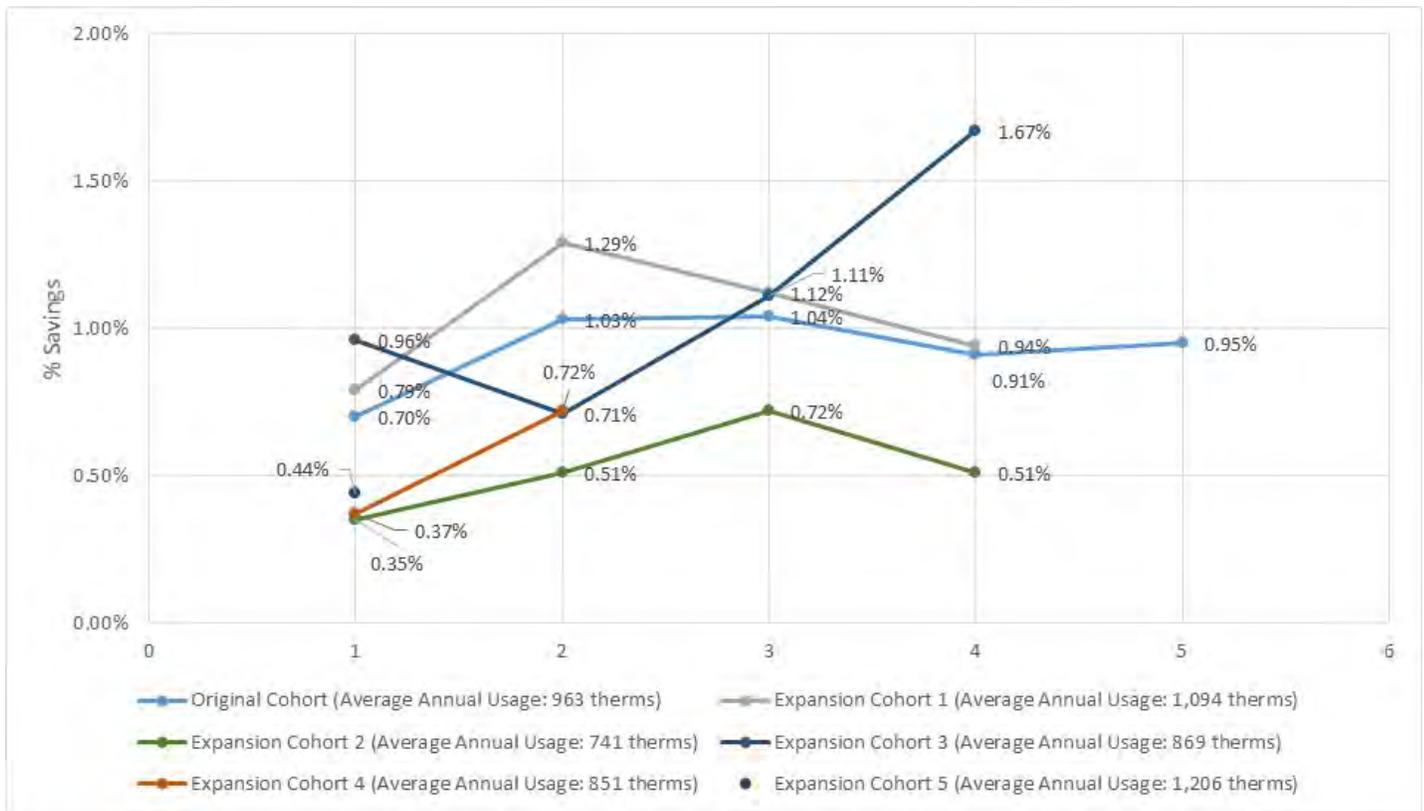
Notably, because these results do not adjust for variations in weather year over year, they cannot be directly compared. However, we do provide weather adjusted results in Appendix E. For electric savings, cohorts that have participated in the program for more time also tend to yield higher percentage savings until PY7 when we see a decrease in savings across all cohorts. This decrease may be due to the reduction in reports sent to all cohorts in PY7. Weather adjusted results provide similar trends to those in Figure 11, except in the case of the Original Cohort who had no decrease in savings from PY6 to PY7. Further, as with earlier evaluations, we find that baseline consumption correlates with increased energy savings by cohort.

Figure 11. Year-Over-Year Savings – Electric



For gas cohorts, we see a varied picture across baseline consumption as well as savings year over year. For gas customers, we see a plateau in savings year over year around 1%; however, for gas only customers (Expansion Cohort 3) we see an increase in energy impacts.

Figure 12. Year-Over-Year Savings – Gas



Channeling Analysis: Participation Lift

The evaluation team cross-referenced the Behavioral Modification Program databases –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), 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 many of these customers 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, except for Expansion Cohort 4, saw higher participation rate increases in the treatment group than in the control group (see Table 22). The HPwES and Appliance Recycling programs are the biggest contributors to the overall participation increase.

Table 23. PY7 Participation Lift by Cohort

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4	Expansion Cohort 5
Appliance Recycling	0.27%	0.14%	0.20%	-0.03%	-0.03%	-0.01%
Lighting (Web Store)	0.01%	0.00%	0.00%	-0.01%	0.00%	0.00%

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4	Expansion Cohort 5
HVAC	-0.03%	-0.08%	0.05%	0.05%	-0.02%	0.06%
REEP	0.00%	-0.04%	-0.11%	0.04%	0.09%	-0.09%
HPwES	0.07%	0.03%	-0.07%	0.09%	-0.04%	0.03%
Moderate Income	0.03%	0.01%	0.01%	0.01%	0.02%	-0.01%
Total	0.35%	0.07%	0.09%	0.14%	-0.07%	0.01%

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 22), every cohort but one experienced an overall lift when all the AIC programs were considered. The likely cause for Expansion Cohort 4’s overall lower participation rates 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 300 customers into other AIC residential programs.

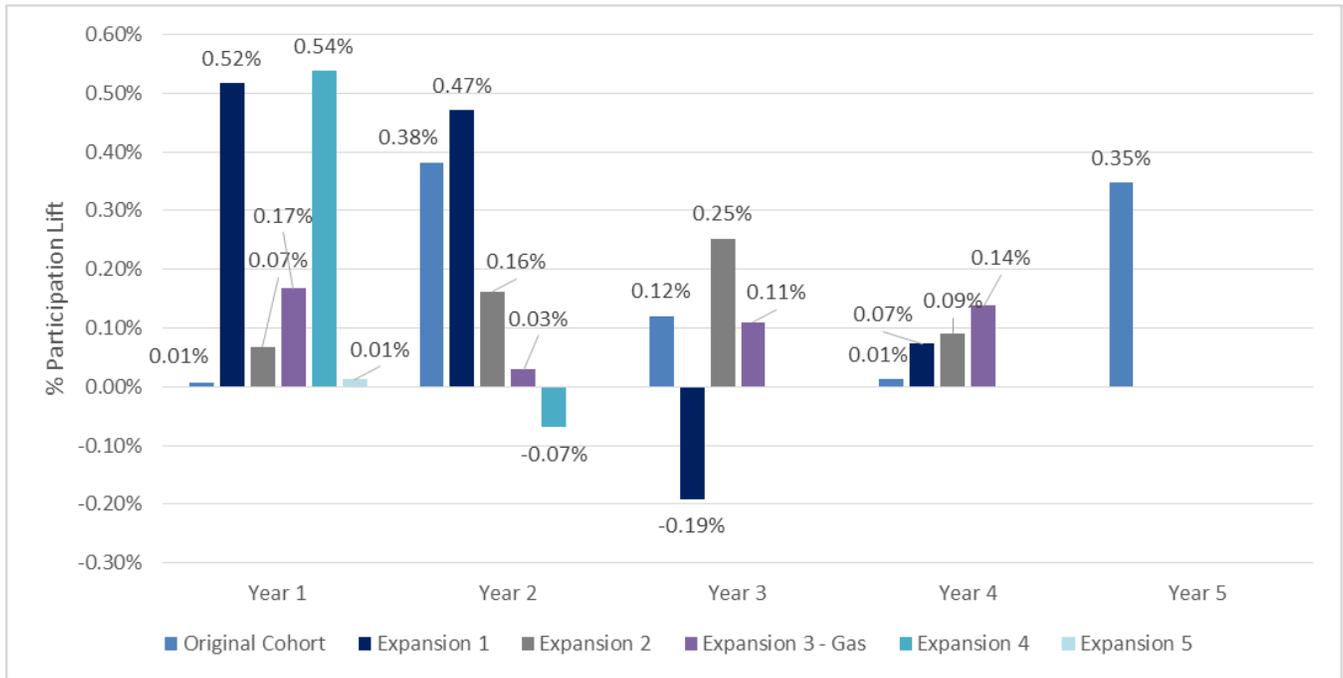
Trends in Program Channeling

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 monthly²¹ and cumulative participation²² rates in each cohort since program inception. Participation tends to vary across duration in the program. However, 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 13). We provide monthly and cumulative participation rates for each cohort in Appendix F (Figure 14 through Figure 19).

²¹ Monthly participation rates are based on the number of accounts that first initiated participation in an AIC energy efficiency program in that month.

²² Cumulative program participation rate captures the proportion of households that have initiated participation in any program on or before a given month.

Figure 13. Participation Lift over Time



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 0.003% to 0.092%, and gas savings by 0.001% to 0.159%, depending on cohort (see Table 23 and Table 24 below).

Table 24. PY7 Behavioral Modification Program Impacts – Electric

Statistic	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 4	Expansion Cohort 5
Annual Net Program Savings (% per HH)	1.75%	1.73%	0.67%	1.28%	0.66%
Annual Incremental Savings from Other Programs (% per HH)	0.052%	0.092%	0.078%	0.029%	0.003%
Annual Final Adjusted Net Savings (% per HH) ^a	1.70%	1.63%	0.59%	1.25%	0.66%
Annual Net Program Savings (kWh per HH)	202.4	218.2	58.3	215.5	51.0
Annual Incremental Savings from Other Programs (kWh per HH)	3.4	3.6	0.3	2.7	0.3
Annual Final Adjusted Net Savings (kWh per HH)	199.0	214.6	57.9	212.8	50.7

^a 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 9,141 kwh compared to the other cohort that have baseline usage between 11,000-18,200 kwh.

Table 25. PY7 Behavioral Modification Program Impacts – Gas

Statistic	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4	Expansion Cohort 5
Annual Net Program Savings (% per HH)	0.95%	0.94%	0.51%	1.67%	0.72%	0.44%
Annual Incremental Savings from Other Programs (% per HH)	0.103%	0.159%	0.153%	0.035%	0.001%	0.007%
Annual Final Adjusted Net Savings (% per HH)*	0.84%	0.78%	0.36%	1.64%	0.72%	0.43%
Annual Net Program Savings (Therms per HH)	8.84	9.83	3.61	14.13	5.75	3.68
Annual Incremental Savings from Other Programs (Therms per HH)	0.07	0.08	0.01	0.23	0.04	0.02
Annual Final Adjusted Net Savings (Therms per HH) ^a	8.77	9.75	3.59	13.90	5.70	3.67

^a 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 744 therms, and other cohorts have usage between 850-1200 therms.

4. Conclusions and Recommendations

The Behavioral Modification Program is achieving its stated goals to reduce energy consumption and educate customers about energy savings measures and behaviors. In PY7, the Behavioral Modification Program added two additional cohorts, as well as made substantial changes to program operations (both in terms of administration and implementation). Leidos became the program implementer instead of Conservation Services Group (CSG). Further, the budget for this program was reduced by 20%. These changes to program design and implementation had implications in terms of the number, timing, and frequency of report delivery. Specifically, the number of electric reports delivered to customers was reduced from six to four, and no monthly electronic reports (eHERs) were sent during the period due to a technical error.

One of the most notable results in PY7 was a decrease in energy savings from PY6 across most cohorts, likely due to a reduction in the total number of reports delivered to customers. However, we continue to find that participants, when compared to control group respondents, more frequently indicate that they have learned new ways to save energy in their homes and have read their utility bills to understand their home's energy use in the past 12 months. This result shows that the program is achieving its goal of boosting customer engagement and education by helping participants to understand energy efficiency and save energy in their homes. The following findings and recommendations for the program are based on the findings of our program evaluation:

- **Key Finding #1: The program reduced energy consumption.** Billing analyses results indicate a reduction of 33,194 MWh and 1,754,669 therms. Consistent with earlier reports, electric cohorts with higher baseline consumption and longer duration in the program are associated with increased energy savings. For gas cohorts, we see a more varied picture across baseline consumption as well as savings year over year. Behavioral Modification Program participants achieved 125 kWh and 5.88 therms per household per year. 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.
- **Recommendation:** For future program planning and goal setting, AIC might consider using the average savings estimates for kWh and therms over the evaluated period. 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, using a predictive model 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.
- **Key Finding #2: High baseline consumption predicts high savings, but some high users can be persistent negative savers.** Participants can be characterized into five profiles: high savers, average savers, low savers, negative savers, and very negative savers. We found that prior average daily consumption is the primary determinant of savings, and that summer pre-average daily consumption is most predictive of higher savings. Other variables related to savings, but not necessarily linearly, include year the home was built and customer age, education and occupation. Taking advantage of all available information may require predictive modeling to select new cohorts with high propensity to save. These results are especially relevant when moving to a pay for performance model for vendors as AIC has done in PY7.

- **Recommendation:** As AIC continues to move to a pay for performance model, continue targeting future cohorts with the high consumption, but stop, modify, or customize reports for participants who have significant increases in usage despite receiving home energy reports. Our multilevel modeling found that customers with significantly negative savings after receiving reports rarely improve to positive savings while continuing to receive the standard home energy report. Incorporating an experimental design into this effort is a simple and low-cost way to confirm that any differences in savings that result are attributable to the predictive model. If this recommendation is implemented, design the implementation effort to ensure the ability to assess the impacts associated with increases and decreases of report delivery (e.g., an experimental design).
- **Key Finding #3:** Reduction in reports may have contributed to lower energy savings reductions in PY7. Across all cohorts, with the exception of the gas only cohort (Expansion Cohort 3), energy savings declined when compared to PY6 (for both original and weather adjusted model results). For nearly all cohorts, we identified a decrease in savings in PY7 when compared to PY6. This decrease is likely due to the reduction in electric reports sent to all cohorts in PY7 or the stoppage of electronic Home Energy Reports (eHERs) due to technical reasons. However, for gas only customers (Expansion Cohort 3) we identified an opposite trend with an increase in energy savings. Six gas reports were delivered in PY7, consistent with PY6.
 - **Recommendation:** Consider the value of the cost reductions associated with fewer reports compared to higher energy savings with more frequent reports. It may be worthwhile to identify those customers who yield the highest savings and continue to send reports at a higher frequency, while reducing reports for negative or moderate savers. Tailoring report frequency could also involve a review of current summer average daily consumption to identify those customers with relatively higher savings potential. Further, it may be beneficial to understand the impacts of delivering less costly eHERs more frequently than paper HERs.²³ If this recommendation is implemented, design the implementation effort to ensure the ability to assess the impacts associated with increases and decreases of report delivery (e.g., an experimental design).
- **Key Finding #4:** Survey results indicate that participants demonstrate higher understanding of their energy usage, but do not demonstrate increased uptake in energy efficiency actions and in some cases lower satisfaction with AIC overall. Key findings indicate that participants recall and engage with reports. Overall, most participants who responded to our survey recall receiving the HERs (90%) and have read their most recent report (72%). Notably, the Original Pilot Cohort respondents recall receiving reports more than any other cohort, and the Expansion Cohort 6 (the newest cohort) recalls receiving reports the least of all seven cohorts. As such, report recall is likely associated with tenure in the program. Compared to the control group survey respondents, more participants indicated they have learned new ways to save energy in their homes and have read their utility bills to understand their home's energy use in the past 12 months. 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. Survey results also indicate lower satisfaction for participants when compared to control group respondents. The treatment group customers were

²³ This would cover only those customers who have an email address on record.

Conclusions and Recommendations

satisfied with the HER, though not strongly so, with a mean rating of 6.4 on a 0-10 scale; participants who have been in the program for less than one year (3 months and 1 year) were more satisfied with the reports than those who had been receiving the reports for longer.

- **Recommendation:** The Target Rank campaign was designed to provide tailored messaging to high baseline users who were dissatisfied with the report (particularly the normative comparisons). We recommend that AIC continue to identify opportunities to engage existing customers with the report, particularly as they may develop 'report-fatigue'. Further, as customers may be exposed to multiple behavioral messaging (both HER and Aclara web-portal), future research efforts should seek to identify those customers who overlap and understand if multiple sources of messaging is conflicting or reinforcing for behavioral practices and program participation.

A. Appendix – Equivalency Analysis Methodology

The evaluation team conducted an equivalency analysis by assessing baseline consumption equivalency for all cohorts, and for the newest cohort we also examined differences in demographic, housing and psychographic information between treatment and control groups. We document our results for Expansion Cohort 5 below.

To conduct the equivalency check for Cohort 5, 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 25 and Table 26).

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 Cohort 5 customers by fuel type (note, the data cleaning performed for this analysis is different from the data cleaning performed for the billing analysis):

Table 26. Number of Cohort 5 Customers with Baseline Usage Data before Data Cleaning

	Number of Customers
Total Unique Customers	75,596
Electric Customers	
Control	12,599
Treatment	62,997
Total	75,596
Gas Customers	
Control	12,599
Treatment	62,997
Total	75,596

The pre-period database for Cohort 5 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 cleaning, 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 1% of the customers.

Table 27. Number of Cohort 5 Customers with Baseline Usage Data after Data Cleaning

	Number of Customers
--	---------------------

	Number of Customers
Electric Customers	
Control	12,594
Treatment	62,978
Total	75,572
Gas Customers	
Control	12,594
Treatment	62,978
Total	75,572

Secondary Demographic and Psychographic Data

The evaluation team obtained secondary data for demographic, housing, and psychographic characteristics for the Cohort 5 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 28. Secondary Data from Experian

Data Type	Description of Data	Match Rate
Total Number of Customers Sent to Experian		75,600
Total Matches		75,598
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%

Appendix – Equivalency Analysis Methodology

Data Type	Description of Data	Match Rate
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		
Dwelling Type	Each household is assigned a dwelling type code based on United States Postal Service (USPS) information.	90.26%
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.	90.26%
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.	90.26%
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.	90.26%
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.	90.26%
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	45.90%
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 28 depicts the mean daily usage for treatment and control groups, pre- and post-participation.

Table 29. Average Daily Consumption by Cohort, Treatment v. Control, Pre- v. Post-Participation

Behavioral Modification Program		Pre		Post	
		Mean	Standard Deviation	Mean	Standard Deviation
Electric Cohorts (in kwh)					
Original	Treatment	34.51	13.73	36.02	19.98
	Control	34.26	13.70	36.26	19.40
Expansion 1	Treatment	39.71	18.30	36.06	23.29
	Control	39.83	18.69	36.79	23.94
Expansion 2	Treatment	26.58	10.87	24.91	15.00
	Control	26.52	10.84	25.01	15.17
Expansion 4	Treatment	51.48	16.73	49.49	27.63
	Control	51.33	16.42	49.99	27.90
Expansion 5	Treatment	34.77	12.92	30.06	17.36
	Control	34.74	12.71	30.24	17.59
Gas Cohorts (in Therms)					
Original	Treatment	2.47	0.88	2.63	2.65
	Control	2.46	0.88	2.65	2.68
Expansion 1	Treatment	2.87	1.01	2.98	3.06
	Control	2.88	1.02	3.01	3.09
Expansion 2	Treatment	1.87	0.48	2.02	1.94
	Control	1.88	0.48	2.04	1.96
Expansion 3	Treatment	2.20	0.75	2.36	2.34
	Control	2.21	0.75	2.41	2.39
Expansion 4	Treatment	2.09	1.24	2.32	2.78
	Control	2.09	1.23	2.34	2.80
Expansion 5	Treatment	2.76	1.05	3.29	2.85
	Control	2.76	1.04	3.31	2.86

C. Appendix – Billing Analysis Data Cleaning Results

Table 29 through Table 40 show the results of the data cleaning effort for the billing analysis. Results include all customers who were ever assigned to a treatment or control group with available billing data.

Table 30. Data Cleaning Results: Original Cohort, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	99,382	49,694	49,688	6,218,518	3,107,011	3,111,507
# removed due to first report after final bill	99,382	49,694	49,688	6,218,518	3,107,011	3,111,507
# after	48	29	19	604	370	234
# removed due to no post period bills	246	112	134	3,241	1,472	1,769
# after	99,088	49,553	49,535	6,214,673	3,105,169	3,109,504
# removed due to low overall average usage	1	1	0	70	70	0
# after	99,087	49,552	49,535	6,214,603	3,105,099	3,109,504
# removed due to too few pre-period bills	234	126	108	12,010	6,272	5,738
# after	98,853	49,426	49,427	6,202,593	3,098,827	3,103,766
Final #	98,853	49,426	49,427	6,202,593	3,098,827	3,103,766
% Removed	0.23	0.25	0.21	0.19	0.20	0.18

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

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	100,890	75,688	25,202	5,301,085	3,973,235	1,327,850
# removed due to first report after final bill	1,254	948	306	15,191	11,468	3,723
# after	99,636	74,740	24,896	5,285,894	3,961,767	1,324,127
# removed due to no post period bills	394	280	114	4,943	3,509	1,434
# after	99,242	74,460	24,782	5,280,951	3,958,258	1,322,693
# removed due to low overall average usage	1	-	1	42	-	42
# after	99,241	74,460	24,781	5,280,909	3,958,258	1,322,651

Appendix – Billing Analysis Data Cleaning Results

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
# removed due to too few pre-period bills	820	611	209	37,192	27,486	9,706
# after	98,421	73,849	24,572	5,243,717	3,930,772	1,312,945
Final #	98,421	73,849	24,572	5,243,717	3,930,772	1,312,945
% Removed	0.81	0.81	0.8232	0.7	0.69	0.73

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

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	132,256	112,673	19,583	6,270,392	5,342,534	927,858
# removed due to first report after final bill	2,416	2,024	392	26,822	22,478	4,344
# after	129,840	110,649	19,191	6,243,570	5,320,056	923,514
# removed due to no post period bills	632	531	101	7,240	6,090	1,150
# after	129,208	110,118	19,090	6,236,330	5,313,966	922,364
# removed due to low overall average usage	-	-	-	-	-	-
# after	129,208	110,118	19,090	6,236,330	5,313,966	922,364
# removed due to too few pre-period bills	3,701	3,112	589	123,214	103,186	20,028
# after	125,507	107,006	18,501	6,113,116	5,210,780	902,336
Final #	125,507	107,006	18,501	6,113,116	5,210,780	902,336
% Removed	2.8	2.76	3.01	1.97	1.93	2.16

Table 33. Data Cleaning Results: Expansion Cohort 4, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	41,986	31,489	10,497	1,341,535	1,005,555	335,980
# removed due to first report after final bill	1,328	1,006	322	13,917	10,550	3,367
# after	40,658	30,483	10,175	1,327,618	995,005	332,613
# removed due to no post	375	272	103	3,998	2,872	1,126

Appendix – Billing Analysis Data Cleaning Results

	Unique Customers			Observations		
period bills						
# after	40,283	30,211	10,072	1,323,620	992,133	331,487
# removed due to low overall average usage	1	1	-	38	38	-
# after	40,282	30,210	10,072	1,323,582	992,095	331,487
# removed due to too few pre-period bills	3,951	2,983	968	87,362	65,916	21,446
# after	36,331	27,227	9,104	1,236,220	926,179	310,041
Final #	36,331	27,227	9,104	1,236,220	926,179	310,041
% Removed	9.41	9.47	9.22	6.51	6.56	6.38

Table 34. Data Cleaning Results, Expansion Cohort 5, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	75,596	62,997	12,599	1,574,789	1,312,587	262,202
# removed due to first report after final bill	24	19	5	183	147	36
# after	75,572	62,978	12,594	1,574,606	1,312,440	262,166
# removed due to no post period bills	350	289	61	2,615	2,131	484
# after	75,222	62,689	12,533	1,571,991	1,310,309	261,682
# removed due to low overall average usage	1	1	-	16	16	-
# after	75,221	62,688	12,533	1,571,975	1,310,293	261,682
# removed due to too few pre-period bills	8,731	7,245	1,486	120,020	99,416	20,604
# after	66,490	55,443	11,047	1,451,955	1,210,877	241,078
Final #	66,490	55,443	11,047	1,451,955	1,210,877	241,078
% Removed	11.55	11.5	11.79	7.62	7.57	7.86

Table 35. Data Cleaning Results: Original Cohort, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	99,382	49,694	49,688	6,213,993	3,104,522	3,109,471

Appendix – Billing Analysis Data Cleaning Results

	Unique Customers			Observations		
# removed due to first report after final bill	48	29	19	605	370	235
# after	99,334	49,665	49,669	6,213,388	3,104,152	3,109,236
# removed due to no post period bills	234	106	128	3073	1385	1688
# after	99,100	49,559	49,541	6,210,315	3,102,767	3,107,548
# removed due to low overall average usage	1	1	0	72	72	0
# after	99,099	49,558	49,541	6,210,243	3,102,695	3,107,548
# removed due to too few pre-period bills	99	46	53	5172	2437	2735
# after	99,000	49,512	49,488	6,205,071	3,100,258	3,104,813
Final #	99,000	49,512	49,488	6,205,071	3,100,258	3,104,813
% Removed	0.39	0.37	0.40	0.14	0.14	0.15

Table 36. Data Cleaning Results: Expansion Cohort 1, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	100,890	75,688	25,202	5,290,721	3,965,013	1,325,708
# removed due to first report after final bill	1,254	948	306	15,140	11,435	3,705
# after	99,636	74,740	24,896	5,275,581	3,953,578	1,322,003
# removed due to no post period bills	285	199	86	3,501	2,447	1,054
# after	99,351	74,541	24,810	5,272,080	3,951,131	1,320,949
# removed due to low overall average usage	21	13	8	1,098	668	430
# after	99,330	74,528	24,802	5,270,982	3,950,463	1,320,519
# removed due to too few pre-period bills	874	669	205	40,982	31,106	9,876
# after	98,456	73,859	24,597	5,230,000	3,919,357	1,310,643
Final #	98,456	73,859	24,597	5,230,000	3,919,357	1,310,643
% Removed	0.87	0.88	0.81	0.77	0.78	0.74

Table 37. Expansion Cohort 2, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	132,256	112,673	19,583	6,262,569	5,335,525	927,044
# removed due to first report after final bill	2,416	2,024	392	26,722	22,390	4,332
# after	129,840	110,649	19,191	6,235,847	5,313,135	922,712
# removed due to no post period bills	617	521	96	7,019	5,921	1,098
# after	129,223	110,128	19,095	6,228,828	5,307,214	921,614
# removed due to low overall average usage	165	140	25	6,854	5,714	1,140
# after	129,058	109,988	19,070	6,221,974	5,301,500	920,474
# removed due to too few pre-period bills	3,875	3,278	597	130,861	110,241	20,620
# after	125,183	106,710	18,473	6,091,113	5,191,259	899,854
Final #	125,183	106,710	18,473	6,091,113	5,191,259	899,854
% Removed	2.93	2.91	3.05	2.09	2.07	2.22

Table 38. Data Cleaning Results: Expansion Cohort 3, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	30,740	20,632	10,108	1,215,897	818,413	397,484
# removed due to first report after final bill	1,507	1,014	493	18,794	12,654	6,140
# after	29,233	19,618	9,615	1,197,103	805,759	391,344
# removed due to no post period bills	204	140	64	2,423	1,683	740
# after	29,029	19,478	9,551	1,194,680	804,076	390,604
# removed due to low overall average usage	5	4	1	102	71	31
# after	29,024	19,474	9,550	1,194,578	804,005	390,573
# removed due to too few pre-period bills	706	461	245	23,884	15,620	8,264
# after	28,318	19,013	9,305	1,170,694	788,385	382,309

Appendix – Billing Analysis Data Cleaning Results

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Final #	28,318	19,013	9,305	1,170,694	788,385	382,309
% Removed	2.3	2.23	2.42	1.96	1.91	2.08

Table 39. Data Cleaning Results: Expansion Cohort 4, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	41,982	31,488	10,494	1,344,884	1,008,399	336,485
# removed due to first report after final bill	1,328	1,006	322	13,913	10,566	3,347
# after	40,654	30,482	10,172	1,330,971	997,833	333,138
# removed due to no post period bills	348	253	95	3,688	2,675	1,013
# after	40,306	30,229	10,077	1,327,283	995,158	332,125
# removed due to low overall average usage	1,044	808	236	32,689	25,317	7,372
# after	39,262	29,421	9,841	1,294,594	969,841	324,753
# removed due to too few pre-period bills	3,932	2,984	948	87,615	66,650	20,965
# after	35,330	26,437	8,893	1,206,979	903,191	303,788
Final #	35,330	26,437	8,893	1,206,979	903,191	303,788
% Removed	9.37	9.48	9.04	6.51	6.61	6.23

Table 40. Data Cleaning Results: Expansion Cohort 5, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	75,596	62,997	12,599	1,577,136	1,314,401	262,735
# removed due to first report after final bill	24	19	5	183	147	36
# after	75,572	62,978	12,594	1,576,953	1,314,254	262,699
# removed due to no post period bills	334	273	61	2,541	2,043	498
# after	75,238	62,705	12,533	1,574,412	1,312,211	262,201
# removed due to low overall average usage	202	169	33	3,487	2,913	574
# after	75,036	62,536	12,500	1,570,925	1,309,298	261,627

Appendix – Billing Analysis Data Cleaning Results

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
# removed due to too few pre-period bills	8,698	7,235	1,463	120,159	99,733	20,426
# after	66,338	55,301	11,037	1,450,766	1,209,565	241,201
Final #	66,338	55,301	11,037	1,450,766	1,209,565	241,201
% Removed	11.51	11.48	11.61	7.62	7.59	7.77

D. Appendix – Weather Station Details

Table 41. 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

Below we provide the billing analysis model coefficients and per year savings results.

Original Model Coefficients

Table 41 and Table 42 show the original billing analysis model coefficients for the electric and gas cohorts.

Table 42. Original Model Billing Analysis Model Coefficients – Electric

Variable	Coefficient	Standard Error
Original Cohort		
Post	-1.305795	0.02775263
Post x Treatment	-0.575236	0.03952293
Expansion Cohort 1		
Post	-3.055922	0.05051637
Post x Treatment	-0.622875	0.05853076
Expansion Cohort 2		
Post	-1.509787	0.03872703
Post x Treatment	-0.167122	0.04198151
Expansion Cohort 4		
Post	-1.381565	0.09921812
Post x Treatment	-0.634117	0.11470242
Expansion Cohort 5		
Post	0.1775619	0.00532417
Post x Treatment	-0.025128	0.00758227

Table 43. Original Model Billing Analysis Model Coefficients – Gas

Variable	Coefficient	Standard Error
Original Cohort		
Post	0.1775619	0.00532417
Post x Treatment	-0.025128	0.00758227
Expansion Cohort 1		
Post	0.1228605	0.00861367

Appendix – Billing Analysis Model Coefficients

Variable	Coefficient	Standard Error
Post x Treatment	-0.02806	0.00998197
Expansion Cohort 2		
Post	0.1494031	0.00641601
Post x Treatment	-0.010342	0.0069554
Expansion Cohort 3		
Post	0.1866531	0.0119171
Post x Treatment	-0.040258	0.01453553
Expansion Cohort 4		
Post	0.2436426	0.01076564
Post x Treatment	-0.016906	0.01245333
Expansion Cohort 5		
Post	0.5509271	0.0120319
Post x Treatment	-0.014508	0.01317782

Weather Adjusted Model Coefficients

Table 43 and Table 44 show the weather adjusted billing analysis model coefficients for the electric and gas cohorts.

Table 44. Weather Adjusted Model Billing Analysis Model Coefficients – Electric

Variable	Coefficient	Robust Standard Error
Original Cohort		
Post	-1.94617561	0.023772686
Post x Treatment	-0.57363821	0.033790734
HDD	0.00847145	0.000022700
CDD	0.24912344	0.000297868
Expansion Cohort 1		
Post	0.0948766	0.039164402
Post x Treatment	-0.61097888	0.045266975
HDD	0.01091712	0.000026737
CDD	0.26984225	0.000247877
Expansion Cohort 2		

Appendix – Billing Analysis Model Coefficients

Variable	Coefficient	Robust Standard Error
Post	1.05594274	0.029143506
Post x Treatment	-0.16141289	0.031529618
HDD	0.00642460	0.000015199
CDD	0.16906858	0.000129150
Expansion Cohort 4		
Post	1.60916839	0.086635489
Post x Treatment	-0.62317544	0.099866332
HDD	0.01995863	0.000063185
CDD	0.20357669	0.000406118
Expansion Cohort 5		
Post	-0.71076407	0.049779175
Post x Treatment	-0.21157905	0.054040863
HDD	0.00955764	0.000028526
CDD	0.22764752	0.000377170

Table 45. Weather Adjusted Model Billing Analysis Model Coefficients – Gas

Variable	Coefficient	Robust Standard Error
Original Cohort		
Post	-0.13485503	0.002290657
Post x Treatment	-0.02429813	0.003256000
HDD	0.00496962	0.000002186
CDD	0.00496962	0.000028706
Expansion Cohort 1		
Post	-0.0745543	0.003728900
Post x Treatment	-0.02807415	0.004310776
HDD	0.0059483	0.000002548
CDD	0.00320374	0.000023601
Expansion Cohort 2		
Post	0.02728366	0.002379675
Post x Treatment	-0.01228046	0.002574603

Appendix – Billing Analysis Model Coefficients

HDD	0.00402037	0.000001242
CDD	0.00205198	0.000010547
Expansion Cohort 3		
Post	0.01788912	0.005194402
Post x Treatment	-0.03868012	0.006312682
HDD	0.00487895	0.000004043
CDD	0.00263431	0.000030111
Expansion Cohort 4		
Post	0.0560524	0.006273686
Post x Treatment	-0.01870937	0.007235945
HDD	0.00474475	0.000004582
CDD	0.00224917	0.000029525
Expansion Cohort 5		
Post	-0.18442843	0.005323306
Post x Treatment	-0.00952449	0.005779684
HDD	0.0054445	0.000003053
CDD	0.00222029	0.000040391

Lagged Dependent Model Coefficients

The lagged dependent billing model analysis coefficients for the electric and gas cohorts are available in the evaluation binder. However, the following table presents the results for the model. The lagged dependent model is the same model used by the implementation contractor, OPower, to estimate savings.

Table 46. PY7 Unadjusted Per-Household Savings (%) – Lagged Dependent Model

	Average % Savings (Electric)	Average Savings per Customer (kWh)	Average % Savings (Gas)	Average Savings per Customer (therm)
Original Cohort	1.81%	204.9	0.76%	7.7
Expansion Cohort 1	1.82%	227.4	0.90%	10.4
Expansion Cohort 2	0.59%	49.8	0.57%	4.4
Expansion Cohort 3	n/a	NA	1.63%	14.8
Expansion Cohort 4	1.32%	221.4	0.62%	5.5
Expansion Cohort 5	0.66%	48.9	0.31%	2.7

Per Year Savings

Table 46 and Table 47, we present the billing analysis results using the original model (used for ex post savings claims) across program years. These provide the electric and gas percent household

savings by cohort and by year. Notably, because these results do not adjust for variations in weather year over year, they cannot be directly compared.

Table 47. Per Year Percent Household Savings for Electric Cohorts

Electric Cohorts	First Year in Program	Second Year in Program	Third Year in Program	Fourth Year in Program	Fifth Year in Program
Original Cohort (Average Annual Usage: 12,025 kwh)	1.20%	1.46%	1.56%	1.81% (1.76%*)	1.75% (1.75%*)
Expansion Cohort 1 (Average Annual Usage: 13,295 kwh)	1.29%	1.62%	1.98% (1.95%*)	1.73% (1.70%*)	
Expansion Cohort 2 (Average Annual Usage: 9,111 kwh)	0.87%	0.87%	1.2% (1.14%*)	0.67% (0.65%*)	
Expansion Cohort 4 (Average Annual Usage: 18,154 kwh)	1.37% (1.35%*)	1.28% (1.25%*)			
Expansion Cohort 5 (Average Annual Usage: 11,006 kwh)	0.66% (0.66%*)				

Note: Baseline consumption is from the year before the first report was sent.

* Provide weather adjusted results for comparison purposes only.

Table 48. Per Year Percent Household Savings for Gas Cohorts

Gas Cohorts	First Year in Program	Second Year in Program	Third Year in Program	Fourth Year in Program	Fifth Year in Program
Original Cohort (Average Annual Usage: 963 therms)	0.70%	1.03%	1.04%	0.91% (1.03%*)	0.95% (0.91%*)
Expansion Cohort 1 (Average Annual Usage: 1,094 therms)	0.79%	1.29%	1.12% (1.52%*)	0.94% (0.93%*)	
Expansion Cohort 2 (Average Annual Usage: 741 therms)	0.35%	0.51%	0.72% (0.85%*)	0.51% (0.60%*)	
Expansion Cohort 3 (Average Annual Usage: 869 therms)	0.96%	0.71%	1.11% (1.25%*)	1.67% (1.61%*)	
Expansion Cohort 4 (Average Annual Usage: 851 therms)	0.37% (0.24%*)	0.72% (0.80%*)			
Expansion Cohort 5 (Average Annual Usage: 1,206 therms)	0.44% (0.36%*)				

Note: Baseline consumption is from the year before the first report was sent.

* Provide weather adjusted results for comparison purposes only.

F. Appendix – Channeling Analysis

In order for the evaluation team to compare the participation between treatment and control, we normalized participation by the population in each cohort. Essentially, this means translating raw numbers to percentages. This gives us a percentage that represents the participation rate for each cohort and treatment status. Similarly, savings values had to be translated to percentages for use in adjusting percent savings values.

Using the difference-in-difference (DID) approach, the evaluation team applied the evaluated net deemed savings for calculating the savings adjustments (see Table 50).

Table 49. 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)

Note: Y represents percent of kWh savings per OPower participant. We calculated this percentage by dividing the overlap found between the Behavioral Modification Program treatment/control groups with the other residential A/C programs and the modeled baseline usage.

The savings adjustment values were then divided by the modeled baseline values to get the household-level adjustment values (see Table 49). The baseline usage values and the net adjustments per household are shown in Table 50 and Table 51.

Table 50. Modeled Baseline Usage

Cohort	Electric (kWh/year)	Gas (therms/year)
Original Cohort	11,999	969
Expansion Cohort 1	13,170	1,095
Expansion Cohort 2	9,141	744
Expansion Cohort 3	NA	878
Expansion Cohort 4	18,150	854
Expansion Cohort 5	11,057	1,204

Table 51. Savings Adjustment – Electric

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Electric – Original Cohort			
Treatment	0.000%	0.816%	0.816%
Control	0.000%	0.764%	0.764%
T-C Difference	0.000%	0.052%	0.052%
Electric – Expansion Cohort 1			
Treatment	0.001%	0.767%	0.766%
Control	0.001%	0.675%	0.674%
T-C Difference	0.000%	0.092%	0.092%
Electric – Expansion Cohort 2			

Appendix – Channeling Analysis

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Treatment	0.041%	0.830%	0.789%
Control	0.039%	0.751%	0.711%
T-C Difference	0.002%	0.079%	0.078%
Electric – Expansion Cohort 4			
Treatment	0.205%	0.488%	0.283%
Control	0.218%	0.472%	0.254%
T-C Difference	-0.013%	0.016%	0.029%
Electric – Expansion Cohort 5			
Treatment	0.237%	0.310%	0.072%
Control	0.199%	0.269%	0.070%
T-C Difference	0.038%	0.040%	0.003%

Table 52. Savings Adjustment – Gas

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Gas – Original Cohort			
Treatment	0.000%	1.149%	1.149%
Control	0.000%	1.047%	1.046%
T-C Difference	0.000%	0.102%	0.103%
Gas – Expansion Cohort 1			
Treatment	0.001%	1.109%	1.108%
Control	0.000%	0.950%	0.949%
T-C Difference	0.001%	0.160%	0.159%
Gas – Expansion Cohort 2			
Treatment	0.038%	1.097%	1.058%
Control	0.028%	0.934%	0.906%
T-C Difference	0.011%	0.163%	0.153%
Gas – Expansion Cohort 3			
Treatment	0.022%	0.908%	0.886%
Control	0.021%	0.872%	0.851%
T-C Difference	0.001%	0.036%	0.035%
Gas – Expansion Cohort 4			
Treatment	0.348%	0.737%	0.388%
Control	0.484%	0.872%	0.387%
T-C Difference	-0.136%	-0.135%	0.001%
Gas – Expansion Cohort 5			
Treatment	0.269%	0.326%	0.057%
Control	0.223%	0.273%	0.050%
T-C Difference	0.047%	0.053%	0.007%

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 56).

Table 53. Historical Participation Lift by Cohort and Program Year

Cohort	PY 3	PY 4	PY 5	PY 6	PY 7
Original Cohort	0.006%	0.382%	0.121%	0.012%	0.347%
Expansion 1	-	0.516%	0.471%	-0.191%	0.073%
Expansion 2	-	0.068%	0.162%	0.252%	0.091%
Expansion 3 - Gas	-	0.167%	0.030%	0.110%	0.138%
Expansion 4	-	-	-	0.538%	-0.069%
Expansion 5	-	-	-	-	0.013%

In order to determine the number of participants channeled into the program at each stage, we multiply the lift percentage by the total number of active participants in the treatment group for each cohort in each year. The Behavioral Modification Program has cumulatively channeled about 6.5% of participants or about 1,955 participants into other residential AIC programs since PY4.

Table 54. Channeled Participant Count by Cohort and Program Year

Cohort	PY3	PY4	PY5	PY6	PY7	Total
Original Cohort	3	179	53	5	133	373
Expansion 1	-	384	320	0	42	746
Expansion 2	-	79	179	253	84	595
Expansion 3 - Gas	-	31	5	16	19	72
Expansion 4	-	-	-	162	0	162
Expansion 5	-	-	-	-	8	8
Total	3	673	556	436	287	1,955

Table 55. Historical Participation Lift by Program and Cohort

Cohort	PY3	PY4	PY5	PY6	PY7
Appliance Recycling					
Original Cohort	0.000%	0.108%	0.133%	0.020%	0.270%
Expansion Cohort 1	-	0.228%	0.113%	0.097%	0.135%
Expansion Cohort 2	-	0.126%	0.165%	-0.006%	0.203%
Expansion Cohort 3	-	0.027%	0.019%	0.014%	-0.028%
Expansion Cohort 4	-	-	-	0.046%	-0.028%
Expansion Cohort 5	-	-	-	-	-0.006%
Lighting					
Original Cohort	0.000%	0.006%	0.007%	-0.007%	0.013%
Expansion Cohort 1	-	-0.008%	-0.007%	0.008%	-0.002%
Expansion Cohort 2	-	-0.003%	0.009%	0.015%	0.004%
Expansion Cohort 3	-	-	-	0.000%	-0.015%
Expansion Cohort 4	-	-	-	0.020%	0.000%
Expansion Cohort 5	-	-	-	-	0.002%
HVAC					
Original Cohort	0.000%	0.080%	-0.096%	0.040%	-0.029%
Expansion Cohort 1	-	0.118%	0.079%	-0.308%	-0.082%

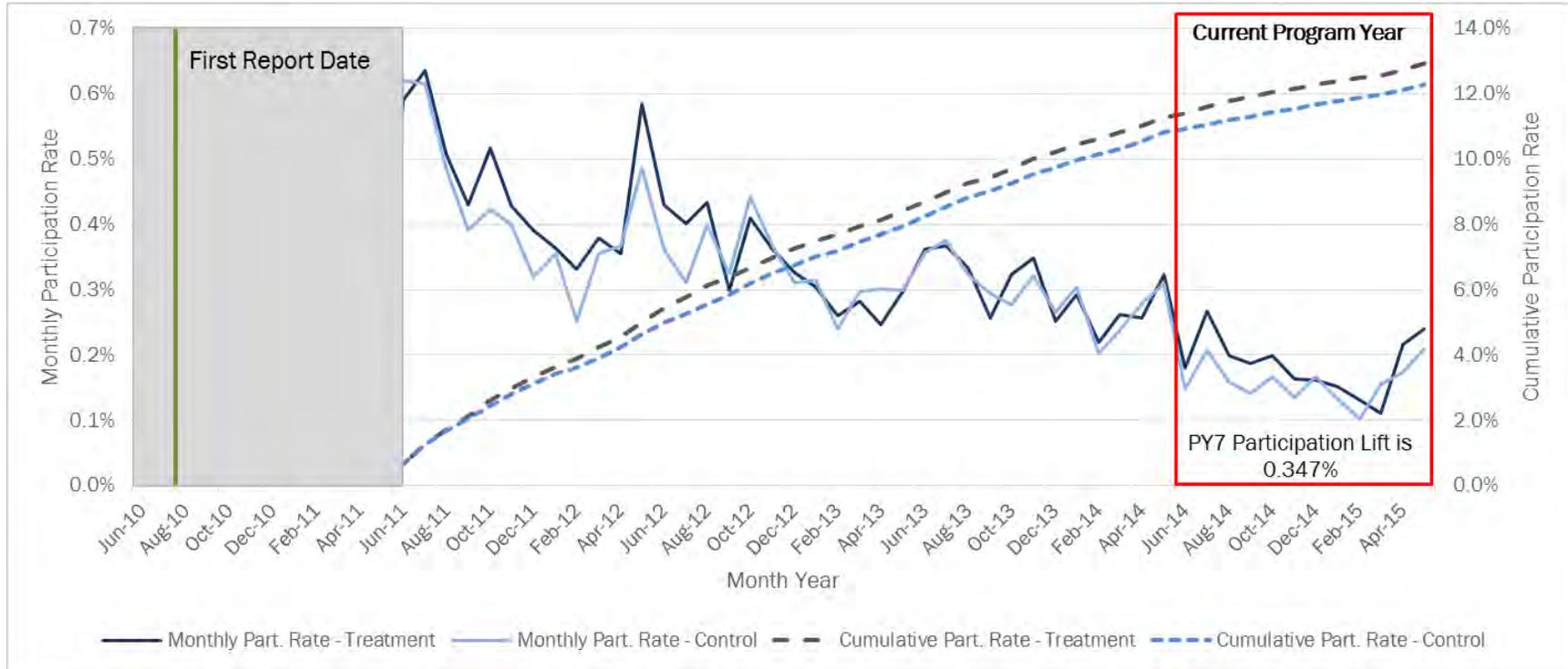
Appendix – Channeling Analysis

Cohort	PY3	PY4	PY5	PY6	PY7
Expansion Cohort 2	-	-0.001%	0.036%	0.171%	0.053%
Expansion Cohort 3	-	-0.050%	-0.080%	0.127%	0.048%
Expansion Cohort 4	-	-	-	0.229%	-0.020%
Expansion Cohort 5	-	-	-	-	0.060%
REEP					
Original Cohort	0.006%	0.151%	-0.019%	-0.083%	-
Expansion Cohort 1	-	-0.011%	0.040%	0.005%	-
Expansion Cohort 2	-	-0.063%	-0.087%	0.086%	-
Expansion Cohort 3	-	0.095%	0.169%	-0.099%	-
Expansion Cohort 4	-	-	-	0.133%	-
Expansion Cohort 5	-	-	-	-	-
Home Performance					
Original Cohort	0.000%	0.086%	0.127%	0.060%	0.067%
Expansion Cohort 1	-	0.306%	0.244%	0.022%	0.029%
Expansion Cohort 2	-	-0.018%	-0.004%	-0.009%	-0.070%
Expansion Cohort 3	-	0.122%	-0.048%	0.049%	0.091%
Expansion Cohort 4	-	-	-	0.186%	-0.039%
Expansion Cohort 5	-	-	-	-	0.029%
Moderate Income					
Original Cohort	0.000%	-0.008%	-0.002%	-0.002%	0.031%
Expansion Cohort 1	-	-0.003%	0.030%	0.000%	0.014%
Expansion Cohort 2	-	0.003%	0.019%	0.007%	0.015%
Expansion Cohort 3	-	-0.006%	-0.013%	0.027%	0.007%
Expansion Cohort 4	-	-	-	0.023%	0.016%
Expansion Cohort 5	-	-	-	-	-0.011%

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 14 through Figure 19 show monthly and cumulative participation rates in other AIC programs in each of the cohorts in the Behavioral Modification Program. The cumulative participation shows that the rate of participation is decreasing over time.

Figure 14. Trended Program Participation Rate: Original Cohort



*Note: Data prior to May 2011 has not been analyzed and as such is not included in this graph

Figure 15. Trended Program Participation Rate: Expansion Cohort 1

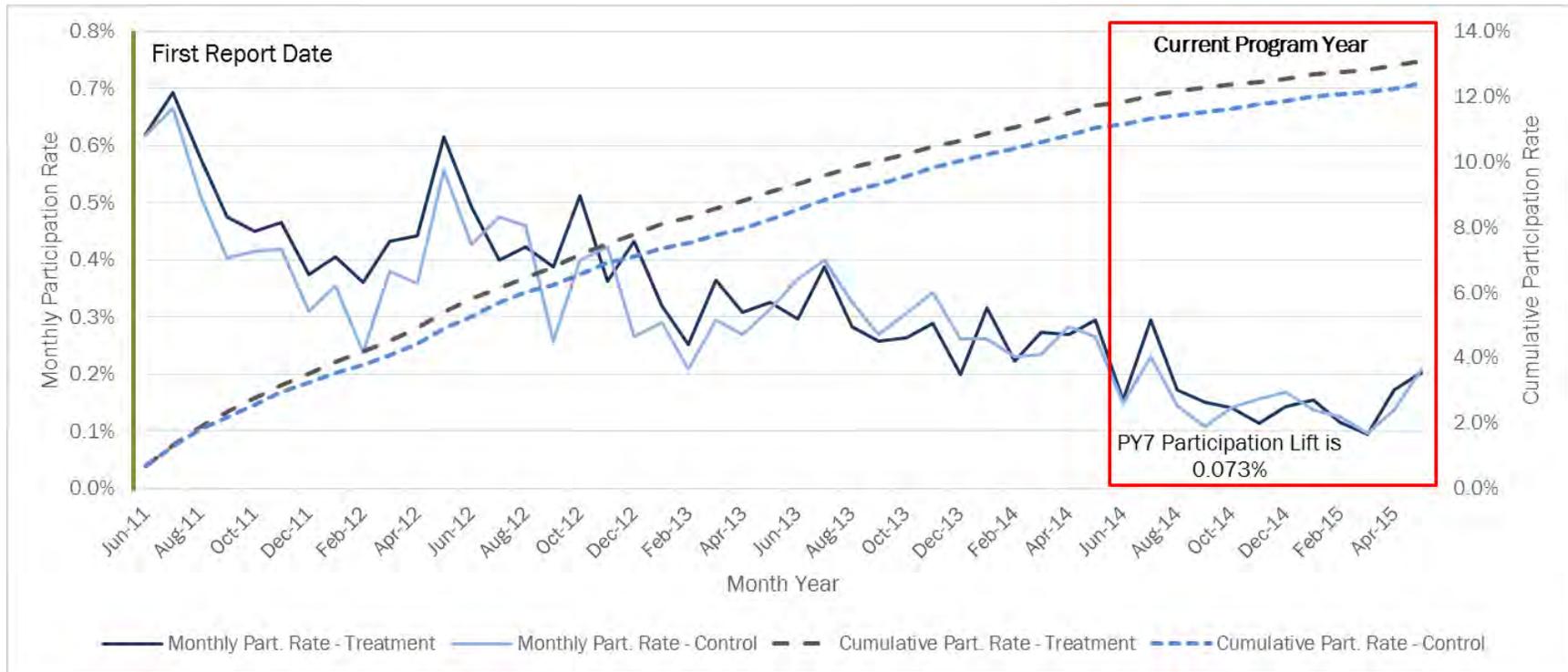


Figure 16. Trended Program Participation Rate: Expansion Cohort 2

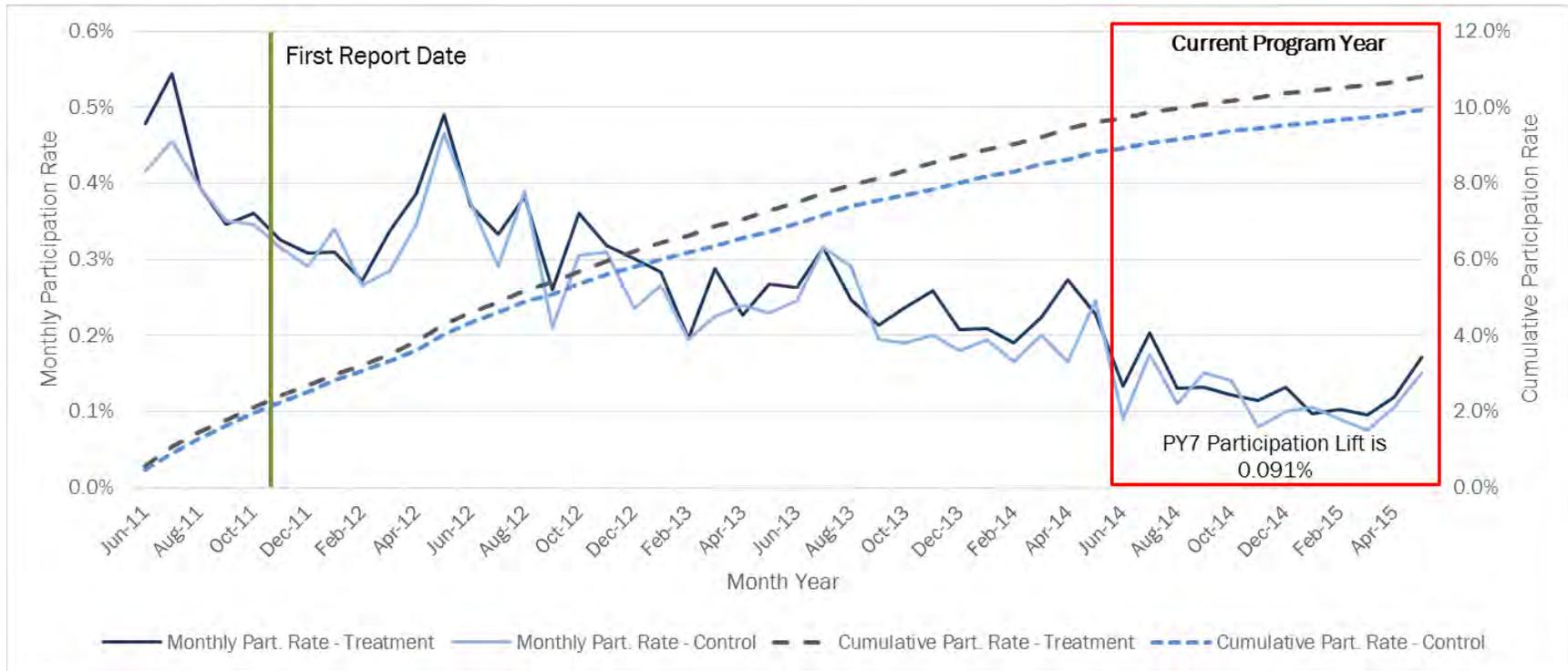


Figure 17. Trended Program Participation Rate: Expansion Cohort 3 (Gas Only)

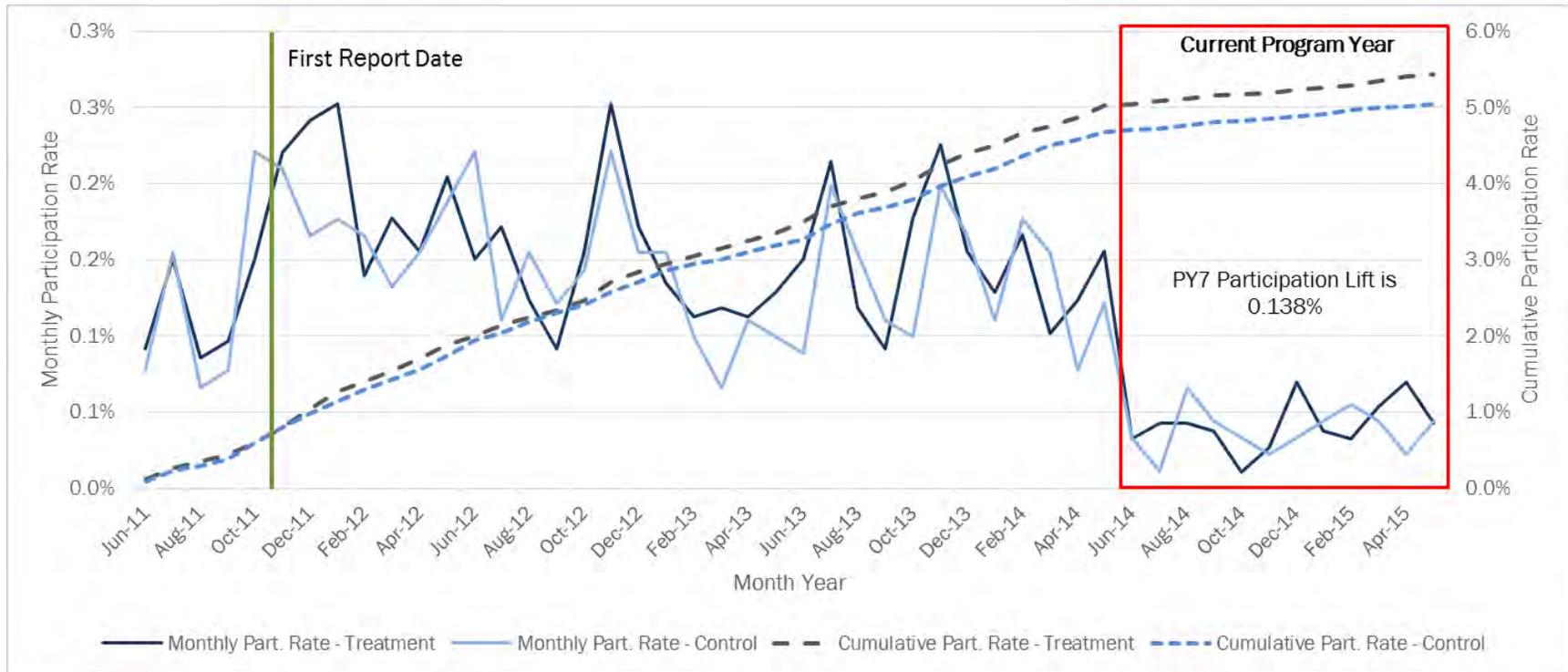


Figure 18. Trended Program Participation Rate: Expansion Cohort 4

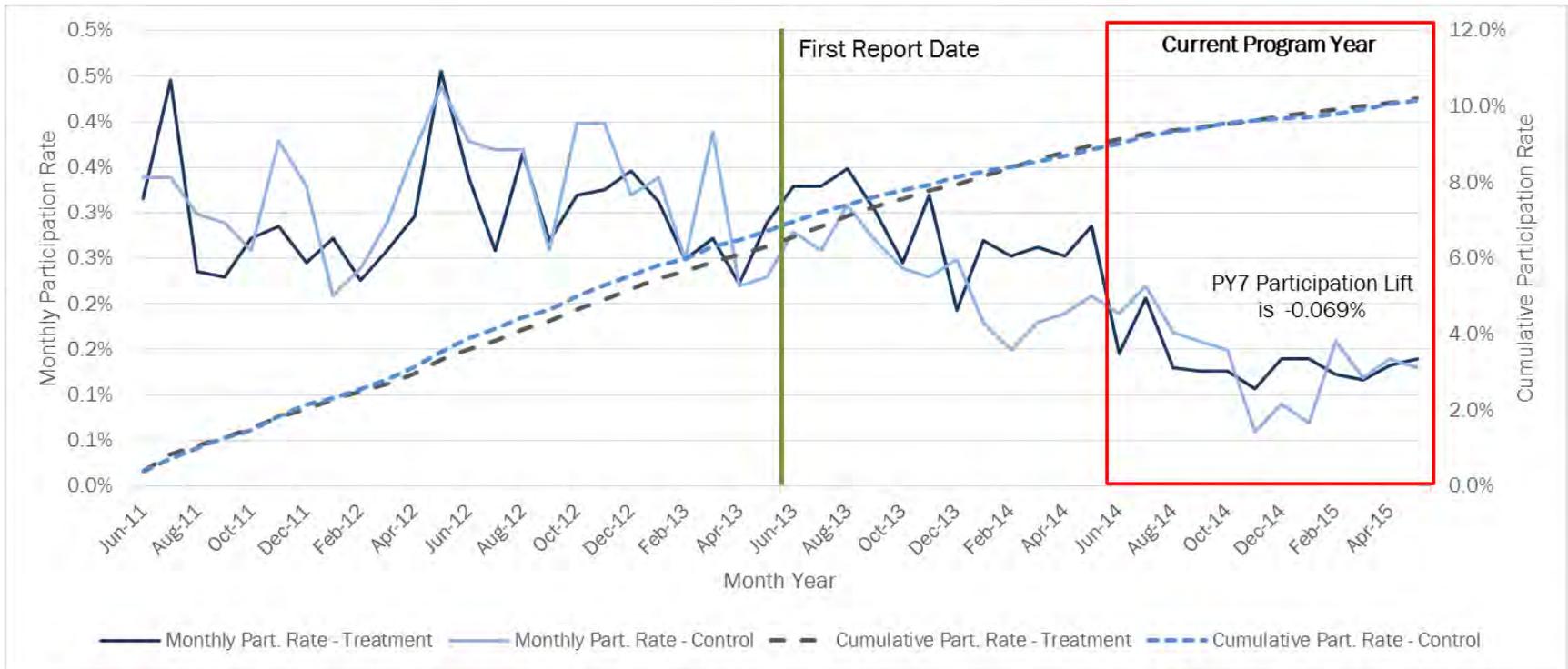
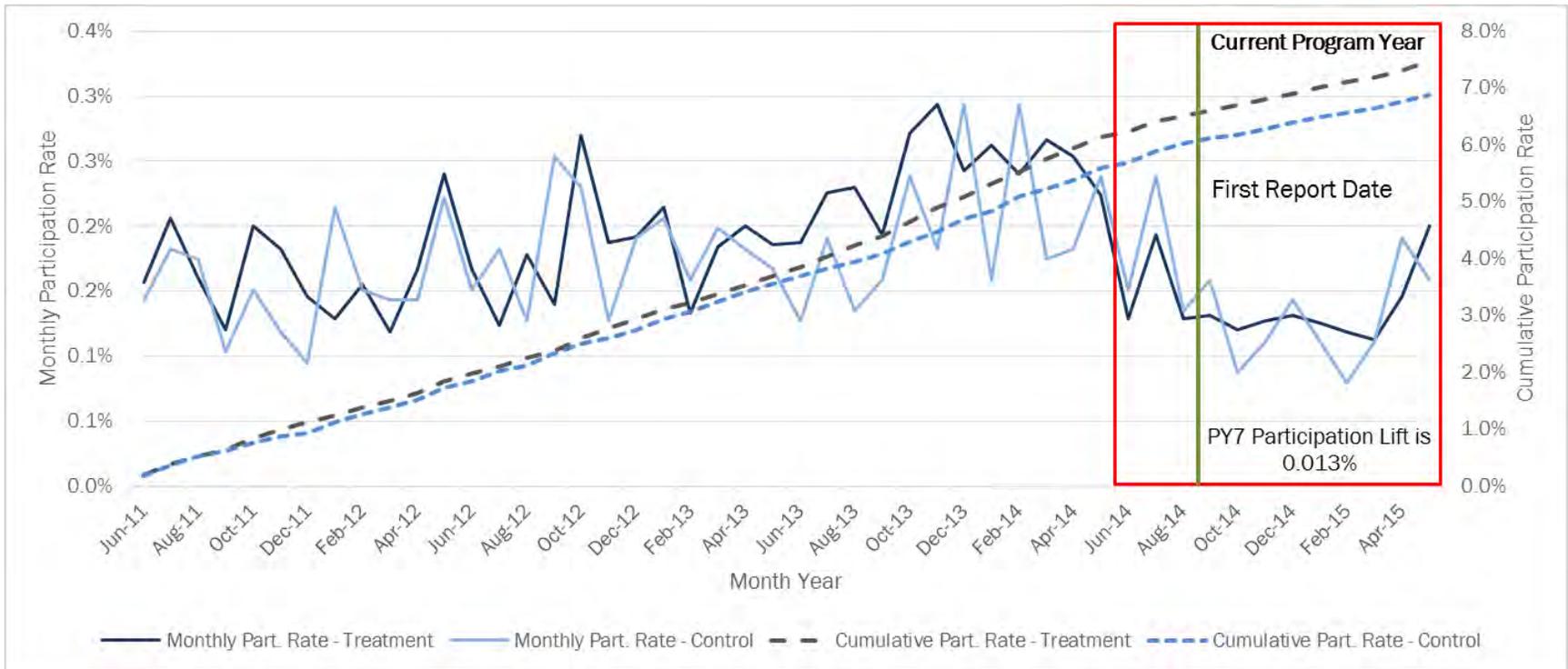


Figure 19. Trended Program Participation Rate: Expansion Cohort 5



G. Appendix – Survey Instrument



Ameren PY6 BM
Phone Survey_Final.

H. Appendix – Additional Survey Results

This appendix provides additional information for the Treatment and Control survey.

Satisfaction

Table 56. Treatment Group Satisfaction with Program Components

On a scale of 0-10, how satisfied are you with...	Average Treatment Group Score (n=4,086)
AIC overall	7.3
AIC's website	7.2
Home Energy Reports you have received	6.4
Types of energy efficiency programs offered by AIC	6.3

Energy Saving Actions

Table 57. Replaced Equipment/Appliances with Energy Star

Equipment Replaced	Ever Replaced		Replaced after Program Enrollment	
	Treatment Group (n=2,996) ¹	Control Group (n=1,090) ¹	Treatment Group (n= 2,996) ¹	Control Group (n=1,090) ¹
Lightbulbs	90%	89%	82%	83%
Television	65%	68%*	45%	49%
Clothes washing machine	60%	60%	31%	32%
Clothes dryer	54%	54%	26%	27%
Programmable thermostat	52%	52%	30%	31%
Refrigerator	51%	52%	24%	26%
Computer	48%	49%	34%	36%
Water heater	47%	47%	26%	29%*
Central air conditioning unit	41%	41%	20%	21%
Dishwasher	40%	43%*	22%	24%
Furnace	37%	39%	16%	19%*
Freezer	24%	24%	11%	12%
Room or wall air conditioning unit	16%	18%*	10%	13%*
Boiler	4%	4%	2%	2%

* Indicates a statistically significant difference at least at the 90% level.

¹ Gas only customers were not asked about their replacement actions for lightbulbs, televisions, refrigerators, computers, or freezers. As such, treatment and control n's vary from those noted in the table heading. For Gas only customers, the treatment group's n=2,890 and the control group's n=1,034.

Lightbulbs, television, refrigerator, computer, freezer

Note: "after Program Enrollment" was only asked for respondents that said they had ever replaced a specific piece of equipment, therefore n's for these equipment vary

Table 58. Low-Cost/No-Cost Energy Savings Actions Taken

Energy Savings Actions	Currently Doing		Started Taking Action after Program Enrollment	
	Treatment Group (n=2,996)	Control Group (n=1,090)	Treatment Group (n= varies)	Control Group (n=varies)
Install efficient light bulbs ¹	90%	92%	86%	86%
Service your central air conditioner	65%	67%	77%	74%
Seal leaky doors or windows	62%	63%	75%	72%
Clean refrigerator coils ¹	49%	51%	77%	74%
Adjust temperature gauge water on heater to 120°F	49%*	44%	69%	69%
Install lights on motion detectors/timers ¹	35%	38%	67%	66%
Recycle a refrigerator or freezer ¹	29%	30%	73%	73%
Seal or insulate ducts	27%	27%	65%	62%
Had a home energy assessment/audit	10%	9%	69%	67%

* Indicates a statistically significant difference between treatment and control groups at the 90% level.

¹ Gas only customers were not asked about this action. As such, treatment (n=2,890) and control (n=1,034).

Note: “Since Enrollment into Program” was only asked for respondents that said they had ever replaced a specific piece of equipment, therefore, n’s for these equipment vary

Table 59. Behavioral Actions Taken Regularly (Multiple Response)

	Regular Behavior		Started Behavior after Program Enrollment	
	Treatment Group (n=2,996)	Control Group (n=1,090)	Treatment Group (n=2,996)	Control Group (n=1,090)
Turn off lights in unoccupied rooms ¹	95%	96%	48%	50%
Run the clothes washer only on full loads	81%	81%	42%	44%
Run the dishwasher only on full loads	72%	75%	37%	40%*
Take shorter showers (10 minutes or less) ¹	72%	73%	37%	41%*
Turn off computer when not in use ¹	64%	62%	35%	36%
Use ceiling or floor fans instead of air conditioner ¹	58%	56%	31%	32%
Set thermostat to 68F (cooling) & 78F (heating) ²	39%	37%	23%	23%
Turn off air conditioner when not home ¹	32%*	27%	18%*	15%
Air dry your laundry	27%	26%	15%	14%
Switch off power strips or unplug devices when not in use	26%	26%	16%	16%

* Indicates a statistically significant difference between treatment and control groups at the 90% level.

¹ Gas only customers were not asked about this action. As such, treatment (n=2,890) and control (n=1,034).

² There was an issue with fielding this particular question. As such, treatment (n=1,711) and control (n=612).

Note: “Since Enrollment into Program” was only asked for respondents that said they had ever replaced a specific piece of equipment; therefore, n’s for these equipment vary.

Demographic and Housing Characteristics

Our comparison of treatment and control group respondents revealed that the groups had some differences in household size, age, occupancy, and income. Control group respondents were more likely than the treatment group to be 51 – 60 years old, have larger homes, have more people in the home, and have higher income.

Table 60. Demographic and Housing Characteristics of Survey Respondents

	Treatment Group (n=2,996)	Control Group (n=1,090)
Fuel Type		
Dual Fuel	96%	95%
Gas Only	4%	5%
Home Square Footage		
Under 1,000 square feet	6%	5%
1,000 – 1,500 square feet	25%*	22%
1,501 – 2,000 square feet	24%	26%
2,001 – 2,500 square feet	16%	17%
2,501 – 3,000 square feet	10%	13%*
More than 3,000 square feet	6%	5%
Don't Know / Refused	12%	12%
Home Description		
Single-family detached	90%	91%
Single-family attached	4%	4%
Multi-family home	1%	1%
A mobile home or trailer	3%	2%
Other	1%	0%
Don't Know / Refused	1%	1%
Age of Respondent		
18-24 years	1%	0%
25-30 years	4%	4%
31-40 years	14%	12%
41-50 years	16%	16%
51-60 years	21%	24%*
Over 61 years	28%	30%
Prefer not to answer	16%*	13%
People in Household		
4 or less	82%	85%*
5 or over	12%*	10%
Prefer not to answer	6%	5%
Annual Household Income		
Less than \$25,000	7%	6%

Appendix – Additional Survey Results

	Treatment Group (n=2,996)	Control Group (n=1,090)
\$25,000 to less than \$35,000	8%	7%
\$35,000 to less than \$50,000	11%	11%
\$50,000 to less than \$75,000	16%	17%
\$75,000 to less than \$100,000	14%	13%
\$100,000 to less than \$150,000	12%	15%*
\$150,000 to less than \$200,000	4%	4%
\$200,000 or more	3%	3%
Don't Know	0%	1%
Prefer not to answer	26%	23%

* Indicates a statistically significant difference between treatment and control groups at the 90% level.

Table 61. Demographic and Housing Characteristics of Email and Non-Email Customers

Variable	Description	No Email (N=233,663)	Has Email (N=203,215)
Household	Homeowner listed as deceased*	0.59%	0.22%
Demographics			
Age	Under 35	9.51%	18.66%
	35-54	33.36%	48.74%
	55+	57.13%	32.6%
Household size	Avg. number of Adults**	2.5	2.61
Children in household	At least 1 child <18 yrs.	22.39%	35.5%
Education of Respondent	Less than High School Diploma	11%	7.97%
	High School Diploma	39.64%	30.09%
	Some College	25.75%	32.39%
	Bachelor Degree	14.03%	18.57%
	Graduate Degree	9.57%	10.98%
Household Income	Under \$50K	43.74%	31.97%
	\$50K-\$100K	37.17%	45.75%
	\$100K-\$200K	16.18%	19.26%
	\$200K or higher	2.91%	3.02%
Occupation	Blue Collar	19.44%	23.02%
	Farm Related	0.78%	0.67%
	Other	7.21%	9.09%

Appendix – Additional Survey Results

	Professional/Technical	25.57%	32.49%
	Retired	25.67%	9.46%
	Sales/Service	21.34%	25.27%
Gender	Female	38.73%	43.43%
Housing			
Homeownership	Own	86.13%	85.34%
Housing type	Single-family detached	90.35%	91.96%
Home Size	100-5999 Square Feet	98.76%	98.57%
	6000-9999 Square Feet	1.17%	1.35%
	Over 10000 Square Feet	0.08%	0.07%
Age of House	Before 1960	24.06%	24.23%
	1960-1989	46.03%	42.33%
	After 1990	29.91%	33.44%
Length of Residence	0-9 Years	58.13%	71.06%
	10-20 Years	22.86%	18.48%
	Over 20 Years	19.01%	10.46%
Psychographic			
Social Causes	Internet Online Subscriber	53.95%	67.92%
	Health	13.66%	11.18%
	Religious	11.9%	9.51%
	Veterans	10.38%	6.81%
	Animal Welfare	7.43%	6.65%
	Political – Conservative	2.96%	2.39%
	Political – Liberal	1.41%	1.22%
	Children	10.13%	9.45%
	Volunteer Work	0.37%	0.28%
	Other Social Cause	16.07%	13.34%

* 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).