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Impact and Process Evaluation of 2015 Illinois Power Agency Behavioral Modification Program

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NAVIGANT

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1. Executive Summary

This report presents results from the Behavioral Modification Program implemented by OPower, which is one of seven stand-alone Illinois Power Agency (IPA) energy efficiency programs implemented from June 2015 to May 2016 (also referred to as Program Year 8 (PY8)). The Behavioral Modification Program has been offered by AIC since August 2010, but PY8 is the first year that the electric portion of the program was adopted through the IPA procurement plan process.

The Behavioral Modification Program is offered to Ameren Illinois Company (AIC) residential customers and is designed to reduce residential customers' energy consumption. Overall, 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 PY8, the program offered three treatment types: a hard-copy home energy report (HER) mailed to the customer's home, an electronic Home Energy Report (eHER) sent on a monthly basis to all customers with email addresses, and an online portal that customers can access to view the same report along with additional information. It is also important to note that the majority of customers participating in this program receive both gas and electricity from AIC, as a result, we conducted a joint evaluation of the AIC and IPA programs. As such, the findings and recommendations presented in this report apply to both the AIC and IPA implementer.

Program Impacts

The Behavioral Modification Program reached about a third of AIC's approximately 1 million residential customers in PY8. Just under 300,000 participants received a report in PY8 (including both dual-fuel and gas-only customers), the majority of whom are in their fifth year with the program.

In PY8, the program achieved adjusted net savings of 35,929 MWh (see

Table 1). Adjusted net savings remove the energy savings that resulted from customer participation in other AIC programs. The energy savings for the program were calculated using a model that included weather terms to account for an imbalance in the treatment and control groups detected during the equivalency analysis. The estimated savings are less than the forecasted results for several reasons. First, the weather in both the pre-participation period year and PY8 affected the net savings estimates differently for each cohort. In addition, due to attrition, the customer counts used for estimating forecasted savings were different from the number of customers who participated during PY8.

Table 1. PY8 Behavioral Modification Program Impacts

Cohort Name	Adjusted Net Savings (% per household)	Adjusted Net Savings (per household)	Number of Customers Treated in PY8	Adjusted Net Program Savings
Energy Savings (MWh)				
Original Cohort	1.15%	131.7	35,147	4,629
Expansion Cohort 1	1.60%	201.5	53,431	10,769
Expansion Cohort 2	0.68%	59.0	85,967	5,071
Expansion Cohort 4	1.65%	272.7	22,410	6,111
Expansion Cohort 5	1.29%	139.5	53,791	7,507
Expansion Cohort 6	0.55%	52.7	34,954	1,843
Total MWh*	**NA**	**125.8**	**285,700**	**35,929 (MWh)**

[a] Totals may not be exact due to rounding.
Note: Number of customers treated in PY8 includes customers who received at least one report in PY8.

Key Findings and Recommendations

The Behavioral Modification Program achieved its stated goals to reduce energy consumption and educate customers about energy savings measures and behaviors. Further, PY8 was characterized by limited program implementation changes, although program staff faced some technical challenges. In particular, program staff added a new cohort of approximately 54,000 dual-fuel customers in April 2015 and offered a new income-qualified customer module initiative to support the Home Efficiency Income Qualified Program. In addition, program implementers continued the "target rank campaign," which provided customized short-term goals for high-energy users.

However, technical issues resulted in reductions to report frequency for many customers. Specifically, there were widespread issues with monthly billing reads in the fall of 2015 that reduced the frequency of reports for more than 100,000 customers. The AIC information technology team quickly restored missing reads, and these customers received three mailed reports instead of the usual four. Finally, eHERs were delivered to all customers with email addresses (45% of the total participant population) on a monthly basis.

Survey findings indicate that participants recalled and engaged with reports. Overall, most participants who responded to our survey recalled receiving the HERs (90%) and reported reading every report (44%). We continue to find that participants, when compared to control group respondents, more frequently indicated that they have discussions about ways to save in their homes and have read their utility bills to understand their home's energy use in the past 12 months. However, survey results also indicate lower satisfaction for participants when compared to control group respondents. Further, participants were moderately satisfied with the HER, with a mean rating of 6.5 on a 0–10 scale. These results show that the program achieved its goal of boosting customer engagement and education by helping participants understand energy efficiency in their homes, but there are opportunities to enhance customer satisfaction with the report.

The evaluation team provides the following key findings and recommendations for the program:

- **Key Finding #1: The program reduced energy consumption.** Billing analyses results indicate a reduction of 35,929 MWh. Program participants achieved 126 kWh savings 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, OPower might consider using the average savings estimates for kWh and therms over the evaluated period. Theoretically, OPower 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.

- **Key Finding #2: Overall, energy savings results appeared to plateau when compared to prior years (with some cohorts increasing and others decreasing usage year over year).** Changes in program delivery, specifically, the reduction in the frequency of electric reports (in PY7) from six to four reports per year, as well as the missing bill reads for some program participants, may have contributed to a dampening effect in savings in PY8. However, reductions in energy savings may have been tempered by the implementation of eHERs in PY8.

  - **Recommendation:** For future program years, OPower should assess if the costs associated with delivering paper reports outweigh the benefits of sending reports only electronically. One such way to test this hypothesis would be to assess the effectiveness of substituting paper reports for eHERs moving forward. We recommend developing a research design where customers would be randomly selected to discontinue paper reports, while continuing to receive eHERs, while another group continues to receive both paper reports and eHERs to assess the incremental savings from these reports.

- **Key Finding #3: Our evaluation identified a lack of equivalency in terms of average daily consumption in the pre-participation period for the electric Original Cohort.** Specifically, our analysis found that the electric Original Cohort had slightly higher pre-participation period consumption in summer months. Although overall average pre-participation period consumption differed by less than 1 kWh, it is possible that these differences in average daily pre-participation period usage during the summer months artificially inflated kWh savings estimates for the electric Original Cohort in models that did not control for this difference. Because it seems likely that differences in the weather conditions experienced by the treatment and control customers during the pre-participation period drove this difference in consumption, we used a weather-adjusted model specification to estimate impacts because it provided the most accurate electric savings estimates for the electric Original Cohort. This is in contrast to prior evaluations, where we used the original model[1] to report savings estimates.

  - **Recommendation**: Moving forward, we recommend that OPower work with the program evaluators to continue to monitor the lack of equivalency of each cohort and to apply the best model specification to account for differences across groups.

- **Key Finding #4: Predicted savings were not always consistent with evaluated savings.** Savings predictions used different data, data cleaning methods, weather, and models than evaluated savings. These differences, in combination with prediction error, led to the observed differences between predicted and evaluated savings.

  - **Recommendation:** For future program years, consider requesting interim evaluated savings estimates as part of the evaluation work plan. This would allow for program adjustments when partial-year savings do not align with predicted savings.

- **Key Finding #5: In PY8, AIC launched a new marketing module directed toward income-qualified customers.** AIC conducted this new initiative in PY8 by sending tailored messaging regarding the Home Efficiency Program to HER participants who qualified as income-qualified as part of their HER. The

[1] The original model does not include weather terms within the model specification. See Chapter 2.2, Equation 1.

HERs offered a new, customizable marketing module that attempted to channel income-qualified customers into relevant AIC programs. As a result of this initiative, the evaluation team attempted to better understand if customers were more aware of, or had increased their participation in, the income-qualified Home Efficiency Program. Our results suggest that 18% of income-qualified customers had heard of the Home Efficiency Program, which was not statistically significantly different from non-income-qualified customers who had not received the marketing module. In terms of program participation, our review of AIC residential program databases suggests that those customers flagged as income-qualified customers and who received messaging on their HER marketing on the Home Efficiency Program in PY8 did indeed have higher rates of program participation than customers who did not receive this messaging. However, we conducted a similar analysis for the same customers for prior program years and found that those flagged as income-qualified customers also participated at a higher rate than non-flagged HER participants.

- **Recommendation**: AIC should continue to investigate the merits of offering marketing modules to income-qualified customers via the HERs. We recommend that the program implementer flag both treatment and control group customers as income-qualified, providing a natural experiment to assess the effectiveness of the marketing efforts. In addition, we recommend assessing program uplift in PY9 given that it may take some customers time to make a decision to enroll and participate in a program after receiving the marketing materials.

- **Key Finding #6: Persistent "Very Negative" savers tended to have different characteristics than other program participants.** In PY7, our team conducted a multilevel model analysis that placed participants in five profiles: "High" savers, "Medium" savers, "Neutral" savers, "Negative" savers, and "Very Negative" savers. The evaluation team conducted a follow-up survey to better understand whether we could identify customer characteristics correlated with these savings groups. Primarily, we found that electric "Very Negative" savers tended to be distinct from other electric savings groups. First, their engagement and satisfaction with the HERs were significantly lower, on average, than other savings groups. In addition, despite having similar frequency of reported energy savings actions, electric "Very Negative" savers were much less likely than members of other groups to attribute this behavior to the reports. There also appear to be intrinsic features that are correlated with this particular energy savings group. For example, electric "Very Negative" savers reported a much higher rate of making changes to increase energy usage in their home, while "Very Positive" savers reported a higher rate of making changes to decrease energy usage.[2] In addition, these customers were much less interested or concerned about climate change than other groups and tended to fall within the AIC "Concerned Parents" marketing segmentation group.[3]

  - **Recommendation:** AIC should consider targeting electric "Very Negative" savers for new interventions and consider what types of constraints or barriers these customers may be facing and what types of messaging may be more or less relevant to these customers. After doing so, AIC can establish whether these results can serve to enhance or optimize program delivery. In addition, for any future cohorts, we recommend focusing on other segments rather than "Concerned Parents." Notably, these results are exploratory and require additional research to confirm trends that appear within the data.

[2] By this we mean changes in lifestyle, housing, or personal circumstances that could lead to a change in energy usage independent of the customer following HER suggestions. For example, spending more time at home during the day, developing a medical condition that required specialized equipment or strict temperature control, or adding a pool would likely increase energy use. Spending more time out of the house or having a child leave for college could reduce usage.

[3] For more information on the marketing segmentation groups deployed by AIC see Appendix H.3.

2. Evaluation Approach

The PY8 assessment of the Behavioral Modification Program included both process and impact analyses as outlined in the following sections.

2.1 Research Objectives

The PY8 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, and interviews with treatment and control group customers. To evaluate impacts, the evaluation team conducted a billing analysis and channeling adjustment.

The evaluation team sought to answer the following research questions as part of the PY8 program evaluation.

2.1.1 Impact Questions

1. Were the new treatment and control groups equivalent?
2. What were the estimated MWh savings from this program for all cohorts in PY8?
3. Did the program achieve savings year over year for each of the cohorts?
4. Did estimated program savings need to be adjusted due to the treated population's participation in other AIC programs? If yes, how much savings should be removed from the program?
5. What research design would be needed to assess persistence?[4]

2.1.2 Process Questions

1. What were the characteristics of the various savings groups ("High" savers, "Medium" savers, "Neutral" savers, "Negative" savers, and "Very Negative" savers) identified through the PY7 multilevel modeling analysis?
2. Can we identify top-tier savers and lower-tier savers based on customer segmentation schemes and survey data to better understand engagement with reports and participant household energy practices?
3. How satisfied were participants with the program and with AIC?

[4] The evaluation team delivered a separate memo in September 2016 to AIC and the Illinois Commerce Commission (ICC) regarding research designs required to support a persistence assessment.

2.2 Evaluation Tasks

Table 3 summarizes the PY8 evaluation activities conducted for the Behavioral Modification Program.

Table 2. Summary of Behavioral Modification Program Evaluation Activities for PY8

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.
Web Surveys		✓	✓	Conducted web surveys with treatment and control group customers to understand program satisfaction and to explore any drivers of the different savings groups identified by the multilevel modeling effort conducted in PY7.
Equivalency Analysis	✓			The evaluation team did not select the Expansion Cohort 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 groups. Also performed a channeling analysis to ensure that savings were not double-counted from participation in other AIC residential programs.

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, program changes in PY8, and areas of success and challenges. Three in-depth interviews 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 PY8 HERs. We reviewed these materials to determine if there were any data gaps, as well as to inform our research efforts. Table 3 provides a description of the data we reviewed, as well as their source.

Table 3. PY8 Behavioral Modification Program Evaluation Data Reviewed by Source

Data Source	Data Details
Behavioral Modification Program Information	PY8 program energy and demand savings goals, budget and expenditures, opt-in or move-out dates, treatment and control group information
HER 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 July 2009 to May 2016

Data Source	Data Details
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 to May 2016 (PY4–PY8)
Weather Data	Heating degree days (HDD) and cooling degree days (CDD) for specific weather stations in AIC service territory

2.2.3 Web Surveys

The evaluation team implemented a computer-assisted web interviewing (CAWI) survey with 48,374 treatment and 17,946 control group customers across all program cohorts. The treatment group was inclusive of PY7 evaluation multilevel model savings groups and income-qualified customers.[5] Broadly, the survey was designed to compare differences between treatment and control groups in regard to self-reported energy efficiency actions and behaviors, structural retrofits, and household changes; determine whether energy-saving measures were in response to the Behavioral Modification Program; measure differences in satisfaction and customer engagement between PY7 savings groups; and understand the impact of the Behavioral Modification Program on income-qualified customers.

To address these objectives, the survey covered the following key questions:

- Do reports increase customer satisfaction with AIC?
- Do reports increase customer awareness of or engagement with AIC?
- What aspects of the report motivate customers to take energy-saving actions? Are there differences across key subgroups?
- What are the characteristics of the various savings groups ("High" savers, "Medium" savers, "Neutral" savers, "Negative" savers, and "Very Negative" savers) identified through the PY7 multilevel modeling analysis?
- How do income-qualified customers currently engage with AIC?

The survey content for treatment, control, and savings groups was identical when possible. However, we did not ask control group customers about the HER itself. The survey instrument screened treatment 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.

Survey Sample Design

We fielded an internet survey to a third of all customers for whom we had email addresses. The survey sample was proportionally stratified to represent the true distribution of customers across the prior evaluation's gas and electric savings groups. From these groups, we drew a proportionally stratified sample for "High" savers,

[5] Notably, we were unable to query customers about their participation and satisfaction with the Target Rank campaign and Aclara web portal given the limited number of survey respondents who participated in each of these offerings. The Target Rank campaign provided customized short-term goals to high-energy users from Expansion Cohort 1. The campaign was launched in fall 2014 and was completed in summer 2015. The Aclara web portal is a separate initiative provided by AIC to give customers information about their bill and energy savings recommendations.

"Medium" savers, "Neutral" savers, "Negative" savers, and "Very Negative" savings groups. This approach yielded an outgoing sample of 66,320 people, including the control group.

Survey Fielding, Disposition, and Response Rate

The evaluation team sent emails inviting 66,320 customers (48,374 treatment customers and 17,946 control customers) to take the online survey and followed up with three reminder emails. The treatment group was inclusive of 10,812 income-qualified customers. Table 4 reports the number of gas and electric savings group customers in the email population, sample frame (N invited), and survey response group (n respondents). Out of the 10,812 income-qualified customers invited to take the survey, 639 customers responded. All income-qualified customers were HER recipients.[6]

Table 4. Population, Sample Frame, and Responses

Fuel Type	Savings Group	Email Population	N Invited	n Respondents
Gas	High	15,109	4,987	331
	Medium	33,442	11,036	892
	Neutral	18,478	6,099	472
	Negative	32,123	10,602	788
	Very Negative	13,134	4,335	238
Electric	High	15,195	5,015	363
	Medium	36,175	11,939	934
	Neutral	13,106	4,326	339
	Negative	32,062	10,582	776
	Very Negative	15,748	5,197	309
Control Group	N/A	54,382	17, 946	1,531

Note: Because some customers are included in both gas and electric savings groups, counts in this table do not sum to the total of treatment customers in the email, invitation, or respondent group.

The survey was fielded from August 24, 2016 through September 29, 2016. The average time to complete the internet survey was 15 minutes. About 13% of customers were unreachable because the email bounced back, which was most likely the result of an incorrect or terminated email address.

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 by the American Association for Public Opinion Research (AAPOR) using Response Rate 1 (RR1).[7] The overall survey response rate was 8.7%, and details of the overall response rate and those of the treatment and control groups are presented in Table 5. The formulas used to calculate RR1 are presented below. The letters used in the formulas are defined in the survey disposition tables that follow.

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

[6] As described in this section, AIC conducted a new initiative in PY8 by sending tailored messaging regarding the Home Efficiency Program to HER participants who were characterized as income-qualified as part of their HER. As a result, we were able to identify treatment customers who were income-qualified as part of the survey effort.

[7] 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.

Table 5. Survey Dispositions and Response Rates

	Overall	Control	Treatment
Completed Interviews (I)	4,964	1,531	3,433
Eligible Non-Interviews (R)	52,739	13,928	38,811
Refusal	*51*	*12*	*39*
Mid-Interview Terminate	*1,872*	*490*	*1,382*
No Response	*35,179*	*13,438*	*37,429*
Not Eligible (e)	8,566	2,475	6,091
Bounceback	8,488	2,447	6,041
Known Ineligibles (replied with reason)	78	28	50
Known Ineligibles (screened out)	0	0	0
Total Participants in Sample	**66,320**	**17,946**	**48,374**
Response Rate	**8.7%**	**10.0 %**	**8.2%**

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 6 reports the proportions of the sample frame (i.e., all program enrollees with email information after data cleaning), survey sample, and survey respondents represented by gas and electric savings groups. The proportions were similar, leading the evaluation team to conclude that no weighting was necessary in that part of the survey data analysis.

However, there were differences between the sample frame and the population as a whole. Customers with email addresses on file tended to be younger, more highly educated, more likely to be female, more likely to have children, less likely to own a home, and less likely to have an older home than those without an email address. As a result, our survey analysis results apply only to customers with email addresses on file and not to the general AIC population.

Table 6. Population, Sample Frame, and Respondent Comparison, by Savings Group

Fuel Type	Savings Group	Email Population	Sample Frame	Respondents
Gas	High	8%	8%	7%
	Medium	17%	17%	18%
	Neutral	9%	9%	10%
	Negative	16%	16%	16%
	Very Negative	7%	7%	5%
Electric	High	8%	8%	7%
	Medium	18%	18%	19%
	Neutral	7%	7%	7%
	Negative	16%	16%	16%
	Very Negative	8%	8%	6%

Survey Data Analysis

We analyzed survey data by conducting a statistical comparison of the results between the treatment and control groups overall (across all cohorts), as well as between PY7 evaluation gas and electric savings groups. For the purpose of the PY8 evaluation, the five gas and electric savings groups from the PY7 analysis were

condensed into three groups: "Positive" savers, which included only "High" savers from the PY7 evaluation; "Neutral" savers, which included medium, neutral, and negative savers from the PY7 evaluation; and "Negative" savers, which included only "Very Negative" savers from the PY7 evaluation. In addition, the evaluation team assessed any correlations in savings groups and AIC customer segmentation profiles. Income-qualified customers who received HERs were compared to treatment customers overall to assess differences in satisfaction and engagement with reports. The evaluation team also analyzed a set of questions aimed at determining whether or not the HER program promotes awareness of and participation in the Home Efficiency Program. Statistically significant differences were assessed at the 90% confidence level.

2.2.4 Impact Analysis

Equivalency Analysis

For the new Expansion Cohort added to the program in PY8, we evaluated the equivalency of the treatment and control groups. The analysis included a comparison of baseline household energy consumption and household characteristics. For this analysis, the evaluation team purchased customer data—including demographic, household, and psychographic information—and, through the review of these data, we measured key differences between the treatment and control groups.

Below, we list variables used in the equivalency check:

Demographic Characteristics

Age	Education
Dwelling type	Homeowner/renter indicator
Estimated household income	Number of adults
Occupation group	Number of children

Household Characteristics

Building square footage	Year built

Psychographic characteristics

Behavior bank (Social causes and concerns, e.g., the environment)	Behavior bank (e.g., computers – internet/online subscriber or use internet services)

The evaluation team used two methods to identify 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 calculating mean household daily consumption and variation in 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.

Equivalency analyses conducted in previous evaluations showed the treatment and control groups were equivalent for the Original Cohort and Expansion Cohorts 1 through 5. 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 using a billing analysis that leveraged 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 came from three primary sources:

- Monthly billing data from July 2009 to May 2016, from AIC
- Program launch date specific to each customer (treatment and control), from OPower
- Weather data (HDD and CDD), from NOAA (the data came from 61 weather stations across the state and are appended at the zip code level[8])

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

- Cleaned 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-participation period data
- Determined the monthly usage for each customer based on his/her 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

[8] We provide details about the weather stations in Appendix D.

Depending on the cohort, data cleaning and attrition removed from 13% to 33% of customers in the electric analysis and 14% to 40% of customers in the gas analysis. The majority of these drops are due to program attrition over time, with data cleaning removing 1% to 10% in the electric analysis and 1% to 21% in the gas analysis, primarily due to insufficient pre-participation period data. We provide the accounting of the number and percentage of accounts removed due to these activities in Appendix C of this report. Before creating the statistical models to estimate program impacts, the Evaluation Team also dropped all bills that occurred more than 12 months before the customer's first report date.

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 who received a HER (the treatment group) and a randomly selected group of customers who did not receive a HER (the control group).

The evaluation for PY8 built on the methods and results of the PY7 study. We estimated average daily consumption savings using a difference-in-differences (DID) approach, which utilized a fixed-effects regression analysis of treatment and control monthly electric and gas bills in PY8 (June 2015–May 2016). The PY7 period covered the period June 2014 – May 2015. The DID refers to the model's implicit comparison of consumption before and after treatment for both treatment and control groups. The model included customer-specific intercepts (i.e., fixed effects) to capture unobserved differences between customers that do not change over time and that affect customers' energy use. We employed four models to calculate energy impacts associated with the program, as well as to report comparisons of savings across program years and to vendor-stated impacts.

1. A simple overall model (Equation 1), which is consistent with previous years' evaluations
2. An overall model with the addition of weather adjustments (Equation 2), which allows direct year-to-year savings comparison
3. An overall model that incorporates post-participation period only (consistent with vendor modeling) (Equation 3)
4. An overall model that incorporates standard weather-years (consistent with the proposed Technical Reference Manual [TRM] framework) (Equation 4)

We report savings from the four different models to aid in comparisons to previous evaluations:

Model 1: Overall Model

Equation 1. Overall Model Estimating Equation

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

Where:

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

α_i = Household-specific intercept

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

β_2 = Coefficient for the change in consumption for the treatment group in the post-participation period compared to the pre-participation period and to the control group; this is the basis for the net savings estimate

$Treatment_i$ = Variable to represent treatment and control groups (0 = control group, 1 = treatment group)

$Post_t$ = Variable to represent the pre- and post-participation periods (0 = pre-participation period, 1 = post participation period[9])

ε_{it} = Error

Model 2: Weather-Adjusted Model

To enable better comparisons across program years, we incorporated weather terms. This also improved the precision in the modeled results by accounting for possible differences in weather experienced by the study population. Specifically, we controlled for weather by accounting for HDD and CDD, using a base of 65°F for HDD and 75°F for CDD. This model also helps account for differences between treatment and control group usages that correlate with weather.

Equation 2. Weather-Adjusted Model Estimating Equation

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

Where:

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

α_i = Household-specific intercept

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

β_2 = Coefficient for the change in consumption for the treatment group in the post-participation period compared to the pre-participation 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

$Treatment_i$ = Variable to represent treatment and control groups (0 = control group, 1 = treatment group)

$Post_t$ = Variable to represent the pre- and post-participation periods (0 = pre-participation period, 1 = post-participation period)

HDD_{it} = Sum of HDD (base 65°F)

CDD_{it} = Sum of CDD (base 75°F)

ε_{it} = Error

[9] We defined the pre-period as the 12 months before the customer's first report. The month in which a customer receives his or her first report is neither pre-period nor post-period. The post period is the time period after the month in which the customer received his or her first report. For the purposes of this evaluation, we focused specifically on the PY8 post period and dropped post period data outside of the program year window (June 2015 through May 2016).

Model 3: Post-Participation Period Only Model

To enable comparisons to vendor-supported models (i.e., OPower, the program implementer's estimates), we estimated a lagged dependent variable (LDV) model. A LDV model differs from the linear fixed effects regression (LFER) model in that only usage from the post-participation period are used in estimating the model. Information from the pre-participation period informs pre-usage variables that are incorporated into the LDV model, but pre-period usage is not directly modeled. Following last year's evaluation, we used three levels of pre-participation period usage for each customer: overall pre-participation period average daily consumption (ADC), summer pre-participation period ADC, and winter pre-participation period ADC. The LDV model uses the control group in 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. We employed the following estimating equation. This model can also be used for year-to-year comparison.

Equation 3. Post-Participation Period Only Model Estimating Equation

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

Where:

ADC_{it} = Average daily consumption (kWh) for household *i* at time *t* in the post period

α = 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 pretreatment meter reads

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

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

β_5 = Vector of coefficients for month-year dummies

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

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

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

$Treatment_i$ = Variable to represent treatment and control groups (0 = control group, 1 = treatment group)

$MonthYear_t$ = 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

Model 4: Standard Weather-Year-Adjusted Model

To enable accurate comparisons across program years, we adjusted for weather influences over years. This improves the precision in the modeled results by accounting for possible differences in weather experienced by the study population. Specifically, we controlled for weather by accounting for HDD and CDD, using a base of 65°F for HDD and 75°F for CDD for standard weather-years leveraging the Illinois Statewide Technical Reference Manual Version 4.0 (IL-TRM V4.0). We can compare savings estimates made with this standard weather-year model with the weather-adjusted savings estimates to understand how much of an effect idiosyncratic weather affects the savings. These results also help inform development of the IL-TRM V4.0, according to proposal that savings estimates use a standard weather-year rather than actual program-year weather.

Equation 4. Standard Weather-Year-Adjusted Model Estimating Equation

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

$$\beta_5 HDD_{it} \cdot Treatment_i \cdot Post_t + \beta_6 CDD_{it} \cdot Treatment_i \cdot Post_t + \varepsilon_{it}$$

Where:

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

α_i = Household-specific intercept

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

β_2 = Coefficient for the change in consumption for the treatment group in the post-participation period compared to the pre-participation period and to the control group; this is the basis for the net savings estimate

β_3 = Coefficient for HDD for standard weather-year

β_4 = Coefficient for CDD for standard weather-year

β_5 = Coefficient for HDD for standard weather-year for the treatment group in the post-participation period

β_6 = Coefficient for CDD for standard weather-year for the treatment group in the post-participation period

$Treatment_i$ = Variable to represent treatment and control groups (0 = control group, 1 = treatment group)

$Post_t$ = Variable to represent the pre- and post-participation periods (0 = pre-participation, 1 = post-participation period)

HDD_{it} = Sum of HDD (base 65°F) for standard weather-year

CDD_{it} = Sum of CDD (base 75°F) for standard weather-year

ε_{it} = Error

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; for Model 3, this is the coefficient of the Treatment variable; and Model 4, this is the combination of the Post * Treatment interactions

and the Post * Treatment * Degree Day interactions. 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.[10] 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-participation 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)?

We calculated a savings adjustment to account for the portion of net savings estimated from the billing analysis that had been claimed by other AIC programs. Savings from the Behavioral Modification Program reflect both non-purchase behavioral changes, such as turning off lights in unoccupied rooms and adjusting thermostat settings, and investments in energy-saving equipment, such as high-efficiency furnaces and CFLs. The savings from measures that AIC's energy efficiency programs rebate appear in both the Behavioral Modification Program and the rebate programs, and thus would be double-counted if an adjustment were not made. We subtracted these joint savings from the savings estimated by billing analysis.

The evaluation team assumes that customers in the treatment and control groups receive the same treatment from the utility for the program promoting Measure A (i.e., they encounter the same marketing and incentives). Because the OPower program design randomly assigns customers to the treatment and control groups, any difference between the groups in the installation of Measure A can be attributed to the Behavioral Modification Program. We based the savings associated with participation in other AIC programs on the deemed savings values associated with the measures that other programs have claimed in PY8. As such, we conducted a participation lift and channeling analysis (incorporating historical trend analysis) to assess trends in program participation over time and adjusted net savings estimates. This analysis also accounts for and removes channeling savings for current participants from prior program years (PY3–PY8).

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 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).

[10] 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.

Participation Lift Analysis

To determine whether the Behavioral Modification Program treatment generated lift in other energy efficiency programs in PY8, 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[11]:

- Appliance Recycling (Electric Only)
- HVAC (Electric Only)
- Home Performance with ENERGY STAR® (Electric and Gas)
- Income Qualified (Formerly Moderate Income) (Electric and Gas)

AIC discontinued the following programs in PY7 and PY8:

- HVAC (Gas)
- Residential Efficient Products (Electric and Gas)
- Residential Lighting (Online Platform Only)[12]

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

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 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

[11] 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 HER 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 or not customers obtain CFLs cannot be influenced by the Behavioral Modification Program. The Energy Kit Program provides energy savings measures to schools and thus is 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.

[12] 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.

the savings adjustment is to remove savings already captured in other program evaluations and thereby avoid double-counting.

In PY8, 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 4 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-participation 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 prorated[13] per-measure (per-program) net savings value to the units to determine the kWh savings for the pre- and post-participation periods for the treatment and control groups. We also projected the net kWh savings per measure throughout its entire EUL. This results in net cumulative savings from previously installed measures (PY4–PY6). We then added the cumulative savings to the prorated savings overlapping in PY8.

- **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 PY8 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 7).[14]

Table 7. Difference-of-Differences Estimator

	Pre-Participation	Post-Participation	Difference
Treatment (t)	Y0t	Y1t	Y1t – Y0t
Control (c)	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 AIC programs and the modeled baseline usage.

The result of this database crossing and calculation is a channeled savings estimate, which we subtracted from the estimate of total program savings. Note that these channeled savings could be attributed to the

[13] Using prorated 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 prorated approach, as opposed to the deemed savings approach, allows us to more accurately estimate actual savings accumulation and project it throughout its effective useful life (EUL).

[14] For all program years, we used ex post values except in PY7 and PY4 as we did not have ex post values at the time of the analysis.

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 8 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 8. Possible Sources of Error

Research Task	Survey Error		Non-Survey Error
	Sampling Error	Non-Sampling Survey Error	
Web Surveys	• Sample frame error • Sampling error	• Measurement error • Non-response error	N/A
Impact Analysis	N/A	N/A	• 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 PY8 evaluation.

Survey Error

- Sampling Error
  - **Sample Frame Error:** The evaluation team fielded a survey to a third of all treatment and control group customers with an email address. Only about half of the customers in the program have an email address on file and were eligible for participation in the survey. 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 I).
  - **Sampling Error:** We surveyed 4,964 customers out of a sample frame of 66,320, which included 3,433 treatment and 1,531 control customers.[15] 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 Error
  - **Measurement Error**: We addressed the validity and reliability of quantitative data through multiple strategies. First, we relied on the evaluation team's experience to create questions that measure

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

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 another). 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 pretested the survey instrument. The team also reviewed the pretest survey data, and we used the pretests to assess whether respondents became confused or 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 Error:** 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. Importantly, the survey effort is not meant to be generalizable to the entire population of HER participants, but rather an exploratory effort to better understand customer engagement and satisfaction with the reports, as well as to identify any differences in savings groups. With that framework in mind, we provide the following information regarding key differences between survey respondents, our sample frame, and the population of participants. We provide details from our assessment of non-response bias in Appendix H.

  - **Equivalency of sample frame and population:** The evaluation team compared the demographic, housing, and psychographic characteristics of customers with and without email addresses to assess the appropriateness of a web-based survey. Compared to customers without an email address, customers with email addresses on file tended to be younger, more highly educated, and female; more likely to have children; and less likely to have lived in the home a long time, own a home, and have an older home. These findings are consistent with general differences between populations with and without email addresses. Although these differences mean that our survey results are not generalizable to AIC's non-email population, this effort was designed to be exploratory in nature and not generalizable to the full population of participants.

  - **Equivalency of treatment and control group respondents:** Given that we know that there are several differences between customers who have email addresses on record and those who do not, the critical question for potential non-response bias is whether non-response patterns may have created differences between treatment and control groups among the email population. While there were some small differences, as described in Appendix H, only one was slightly more than 3 percentage points: age of home, where 35.4% of the treatment group respondents were in homes built in 1990 or later compared to 32.3% of control group respondents. All other differences were smaller. As a result, our comparisons between treatment and control group customers are not seriously compromised by response bias.

- **Equivalency of treatment and control group respondents and non-respondents.** The evaluation team compared respondents to non-respondents within the treatment group. In this analysis, we found larger differences. Here, the differences mirrored the differences we generally expected to see between respondents and non-respondents, although there were some anomalies. Respondents tended to represent an older group less likely to have children in the home, with somewhat higher education, with more technical and professional workers, with more homeownership, and with a longer tenure in their homes, though their homes tended to be newer. We also found more social engagement with causes among respondents. We also compared control group respondents to non-respondents. Those differences very much mirrored the results from the within-treatment group comparison. This is not surprising, given that the differences between treatment and control group respondents were small.

- **Equivalency of savings group respondents and non-respondents**. The team also compared respondents to non-respondents within each savings group. We found relatively large differences, especially with regard to age and income. Survey respondents were generally older and wealthier than non-respondents. To determine whether we should weight the data for the savings group analysis, the team next assessed the correlations between each of the demographic variables and the survey questions we planned to use in that analysis. High correlations would indicate that we would need to weight. Although correlations were relatively low (the largest correlation was less than 0.25), the team also created a preliminary set of post-stratification weights based on age and income. The team then compared the correlation of the weights with the survey questions of interest. The correlations were again relatively low (the largest correlation was less than 0.20). Finally, the team analyzed responses to the questions most highly correlated with our weighting variables both with and without using the post-stratification weights. The analysis results did not change in any meaningful way. The evaluation team therefore concluded that it was not necessary to weight the data for the savings group analysis despite the demographic differences.

Non-Survey Error

- Analysis Error: 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 or left out when they should be included, possibly producing biased estimates. The team addressed this type of error by using a fixed-effects model, which adjusts for constant differences from one household to the next using customer-specific intercepts. Over time, treatment and control groups in a randomized experiment can drift apart due to attrition, causing imbalance between the groups that must be addressed in the model specification. When there is imbalance in consumption, weather, or other factors between treatment and control groups, model specification error can become much more pronounced. For this reason, the team also included models that control for weather conditions to account for differences in temperatures experienced by treatment and control populations.

  - **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. A list of all included weather stations and a map of their locations is available in Appendix E. 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 variance inflation factor (VIF), 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. Detailed Evaluation Findings

This section provides process and impact findings for the PY8 Behavioral Modification Program.

3.1 Process Findings

3.1.1 Program Description

The Behavioral Modification Program has been offered by AIC since August 2010, but PY8 is the first year that the electric portion of the program was adopted through the IPA procurement plan process. OPower implements both the AIC and IPA programs,[16] which involves providing the software to produce and distribute 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 PY8, the program offered three treatment types: a hard-copy printed report mailed to the customer's billing address; an eHER sent on a monthly basis to all customers with email addresses; and an online portal, which customers can log onto to view the same report and access additional information.

3.1.2 Program Design and Implementation Changes

Based on the interviews with program staff and implementers, there were several changes made to the program in PY8. We discuss them below.

OPower remained the primary program implementer in PY8. Overall, technical issues resulted in changes in report frequency for many customers.

- **Widespread issues with monthly billing reads led to a reduction in reports for many customers.** AIC experienced 300,000 missing monthly bill reads in September and October 2015. Although the AIC information technology team eventually restored the missing reads, in PY8, affected customers received only three mailed reports instead of the typical four. This resulted in about 100,000 customers receiving fewer reports than anticipated in the September–October 2015 period.
- **The frequency of reports to gas customers was reduced from six per year to four per year.** Dual-fuel customers continued to receive four reports. Additionally, although the frequency of traditional HERs was decreased, customers with an email address on file began receiving eHERs (see below).

[16] Leidos oversees and manages OPower's work within the AIC portfolio.

- **eHERs were reinstated.** eHERs were initially intended to be distributed during PY7. However, internal technical issues prevented these reports from being delivered. The AIC and OPower teams resolved these issues and began delivery of eHERs in July 2015. All customers with email addresses on file (about 126,000 customers, or 45% of the total treated population) received monthly eHERs unless they opted out.

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.

- **Behavioral Modification Program staff focused on income-qualified customers.** AIC conducted a new initiative in PY8 by sending tailored messaging regarding the Home Efficiency Program to HER participants who qualified as income-qualified as part of their HER. The HERs offered a new, customizable marketing module that attempted to channel income-qualified customers into relevant AIC programs. OPower targeted these modules based on customer information from Leidos. Leidos used zip codes to identify HER recipient customers who would likely be eligible for income-qualified programs. As a result, we were able to identify treatment customers who are income-qualified as part of the survey effort.

- **Behavioral Modification Program staff continued the "target rank campaign."** This campaign provided customized short-term goals to high-energy users from Expansion Cohort 1 (approximately 17,000 customers). Messaging encouraged recipients to improve their energy efficiency rank, providing positive feedback for incremental improvements and dynamic rank tracking that allowed customers to follow their progress from report to report. This initiative was conducted because a survey fielded by OPower discovered that Expansion Cohort 1 participants were very dissatisfied with the reports that they received. Further investigation revealed that this subset of program participants consistently ranked poorly in energy savings. The target rank campaign was launched to help this particular subset of program participants 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. A follow-up survey from OPower indicated that the target rank campaign improved customer satisfaction with the HERs by about 8%.[17] This initiative will not continue in PY9.

3.1.3 Program Participation

Approximately 299,000[18] customers participated in the Behavioral Modification Program in PY8, close to one-third of all AIC's residential customers. In 2010, the program began as a pilot by targeting dual-fuel customers with higher-than-average energy consumption. The program implementer developed each expansion cohort based on several characteristics: energy usage tier, residential customer, and available energy use history. Original Cohort customers are now in their fifth year with the program. Over the following 5 years, six additional cohorts were added to the program. All cohorts were dual-fuel customers, except for Expansion Cohort 3, which is gas only. The most recent cohort, Expansion Cohort 6, began receiving reports late in PY7, making PY8 this group's first full year in the program. Table 9 provides a breakdown by cohort of all treatment customers who received reports for at least 1 month in PY8.

[17] Satisfaction scores improved from an average of 5.83/10 to an average of 6.30/10.

[18] Includes all participants who received at least one report in PY8 (including opt-outs and move-outs).

Table 9. Behavioral Modification Program Participation in PY8

Cohort Name	Fuel Type	Number of Treated Customers in PY8	Start Date	Program Year
Original Cohort	Dual-Fuel	35,147	August 2010	6th year in the program
Expansion Cohort 1	Dual-Fuel	53,431	April 2011	5th year in the program
Expansion Cohort 2	Dual-Fuel	85,967	November 2011	5th year in the program
Expansion Cohort 3[a]	Gas-Only	13,181	November 2011	5th year in the program[b]
Expansion Cohort 4	Dual-Fuel	22,410	June 2013	3rd year in the program
Expansion Cohort 5	Dual-Fuel	53,791	September 2014	2nd year in the program
Expansion Cohort 6	Dual-Fuel	34,954	April 2015	2nd year in the program
	Total	298,881		

[a] Expansion Cohort 3 was a gas-only cohort and is therefore not listed in the "Energy Savings" section.

[b] 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 PY8.

As expected, each cohort experienced some attrition as customers opted out or moved and closed their accounts. The attrition rates shown in Table 10 are based on numbers in OPower's program-tracking database. We include earlier program year attrition rates to provide context year over year.

Table 10. Behavioral Modification Program Attrition Rates in PY8

Cohort	PY3	PY4	PY5	PY6	PY7	PY8
Original Cohort	6.6%	7.2%	7.2%	6.7%	6.3%	6.0%
Expansion Cohort 1	2.1%	9.4%	8.2%	7.5%	6.9%	6.4%
Expansion Cohort 2	--	7.6%	9.6%	8.5%	7.8%	6.8%
Expansion Cohort 3	--	24.0%	6.5%	7.0%	6.6%	5.9%
Expansion Cohort 4	--	--	--	16.2%	11.8%	9.2%
Expansion Cohort 5	--	--	--	--	13.7%	15.0%
Expansion Cohort 6	--	--	--	--	6.4% (April and May only)[a]	19.6%

Source: OPower tracking databases for PY6, PY7, and PY8.

[a] Last year's evaluation provided attrition rates for the first 2 months of participation for Expansion Cohort 6. Percentages are based on the number of active participants in each cohort at the beginning of each program year.

These attrition rates are significantly higher than the 1.3% rate reported by OPower. One potential reason for the difference is that OPower includes opt-outs in its customer counts. However, a review of the participation data indicates that move-outs rather than opt-outs drove attrition across all waves in PY8[19]. OPower's definition of attrition must differ significantly from ours for rates to differ so substantially.

[19] Opt-outs accounted for less than 2% of report recipients who ended participation in PY8, so differences in how opt-outs are treated is unlikely to be driving the difference in attrition rates.

3.1.4 Participation Experience

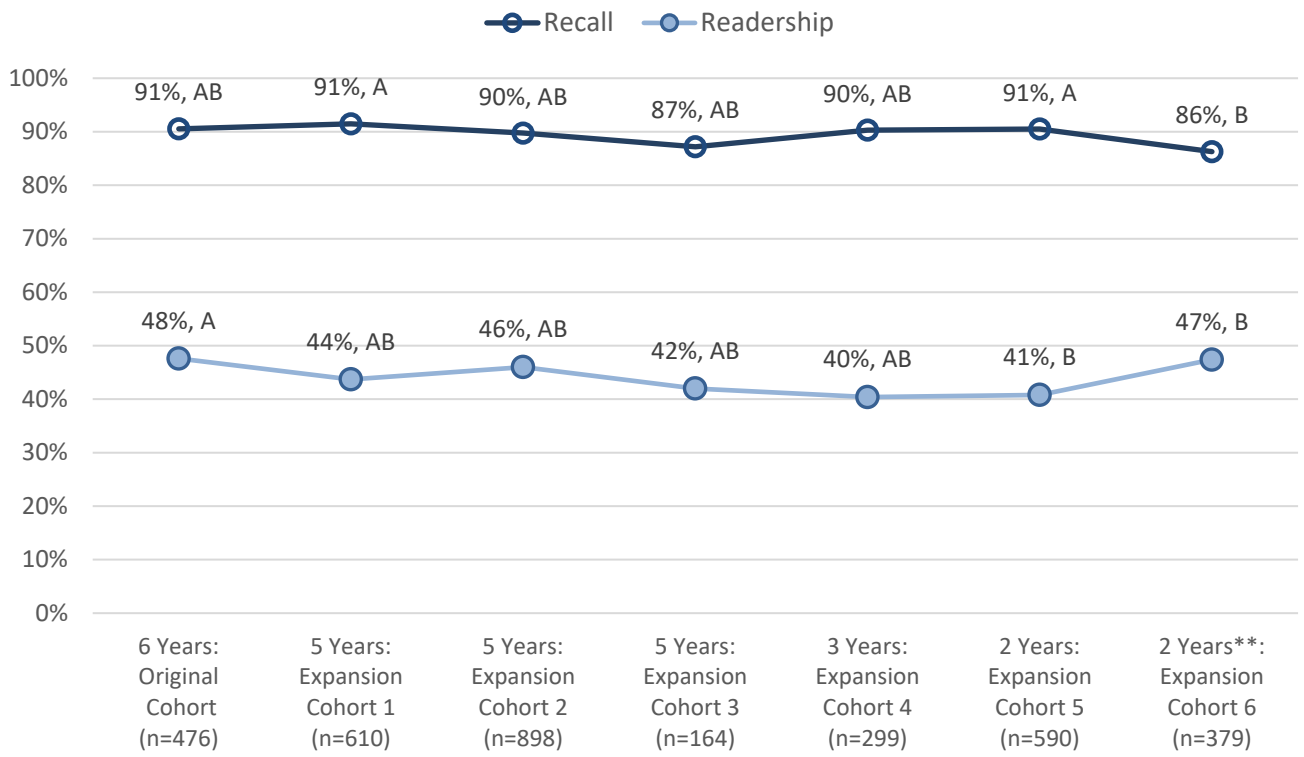
Overall Customer Experience

Results from PY8 surveys were consistent with prior surveys conducted in PY7 and PY6 regarding customer readership and recall, engagement with energy use, and satisfaction. We provide details on these three areas below.

Report Readership and Recall

Overall, most customers recalled receiving the reports, and nearly half of the participants responded that they read every report (Figure 1). For the most recent expansion cohort (Cohort 6), recall of the reports was lower than previous cohorts, at 86%. Most notable among these differences is the fact that the original pilot cohort customers had higher recall and readership of the reports.

Figure 1. Participants' Recall and Readership of Every* Home Energy Report over Time in Program (n=3, 416)



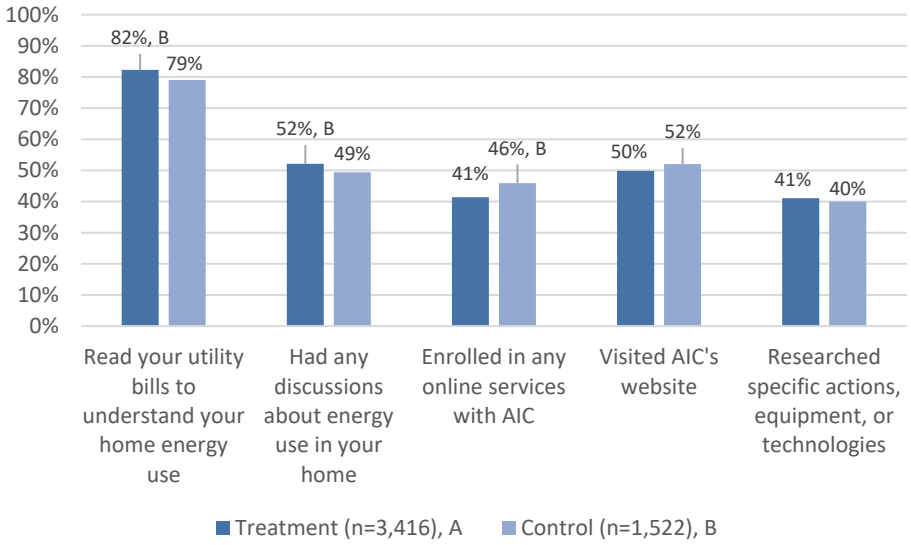
Note: Letters indicate statistical significance between cohorts across time periods at the 90% confidence level.
* Percentages for readership represent customers who responded that they read every HER.
** Expansion Cohort 6 began treatment in April 2015, just before the beginning of PY8.

Engagement with Energy Use

Program participants tended to be equally engaged with their home's energy use as control group respondents. However, a significantly higher proportion of program participants read their energy bills and had

discussions about home energy use, but a significantly lower proportion of program participants enrolled in online services with AIC (Figure 2). This may be due to the fact that program participants feel that they are already receiving information via their HER that control group customers may seek online.

Figure 2. Respondents' Energy Use Engagement



Note: Letters indicate a statistically significant difference at the 90% confidence level.
Note: Graph based on percent responding "Yes" to Yes/No questions.

Satisfaction

Both treatment and control group customers were satisfied with AIC and its efficiency programs. Interestingly, control group respondents were significantly more satisfied with AIC's website and energy efficiency program offerings than were treatment customers (Table 11). Notably, because we surveyed many customers many results may be statistically significant. However, it is those differences that are large in absolute terms that have the most implications for program design, delivery and marketing. The treatment group customers were satisfied with the HER program, though not strongly so, with a mean rating of 6.3 on a 0–10 scale.

Table 11. Satisfaction with AIC and Its Program Components

How satisfied were you with…	Treatment (n=3,358)		Control (n=1,479)	
	Mean Score[a]	Standard Error	Mean Score[a]	Standard Error
AIC overall	7.3	0.06	7.2	0.04
AIC website	7.1	0.05	7.3[b]	0.07
HER program	6.5	0.05	N/A	N/A
Types of energy efficiency programs offered by AIC	6.5	0.05	6.8[b]	0.09
Energy management tools on the AIC website	6.1	0.05	6.1	0.07

[a] This question was asked using a scale of 0–10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied."
[b] Indicates statistically significant differences at the 90% confidence level.

Income-Qualified Customer Experience

As mentioned above, AIC conducted a new initiative in PY8 by sending tailored messaging regarding the Home Efficiency Program to HER participants who qualified as income-qualified as part of their HER. The HERs offered a new, customizable marketing module that attempted to channel income-qualified customers into relevant AIC programs. OPower targeted these modules based on customer information from Leidos. Leidos used zip codes to identify HER recipient customers who would likely be eligible for income-qualified programs. As a result, we were able to identify treatment customers who are income-qualified as part of the survey effort (but not their respective control group counterparts). We completed interviews with 639 income-qualified customers.

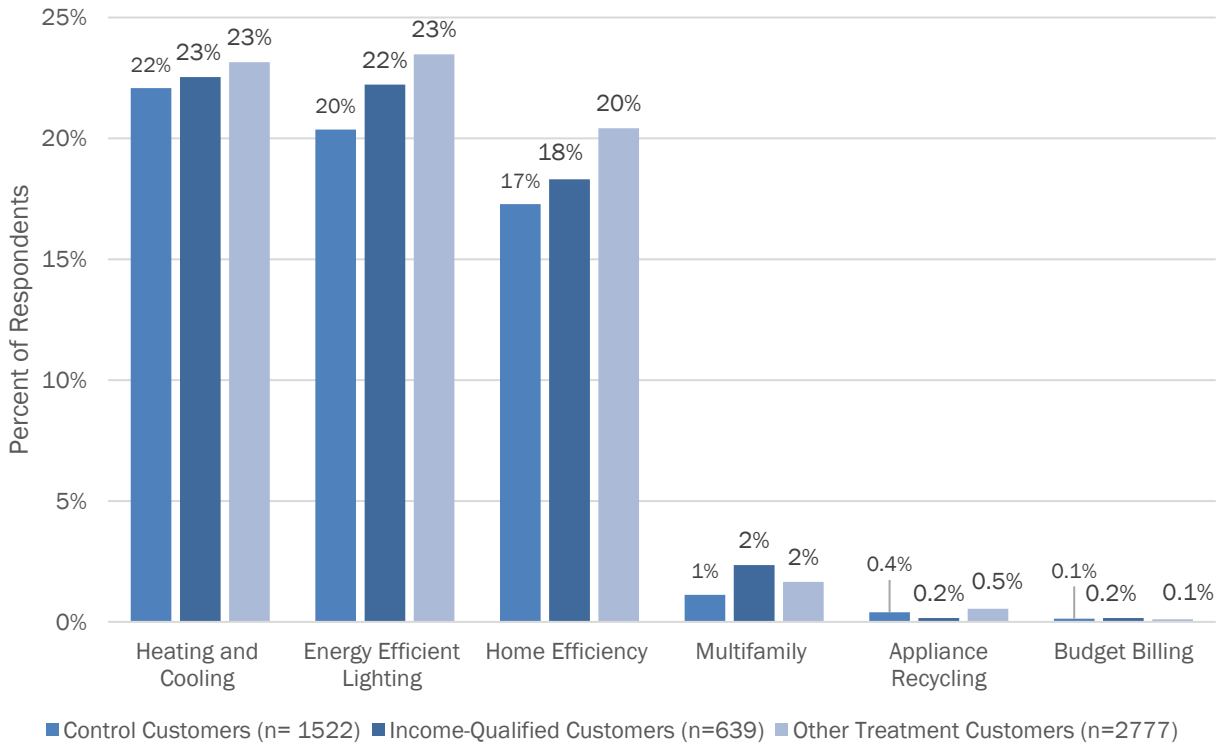
Report Readership and Recall

Our survey analysis indicates that report recall for income-qualified customers was statistically significantly higher than other treatment customers, at 92% versus 89%, but the difference is small in practical terms. However, readership of every report was significantly lower than other treatment customers, at 39% compared to 47%.

Program Awareness

Income-qualified customers who received HERs were queried about their awareness of the Home Efficiency Program. Of 639 income-qualified customers who completed the survey, 18% had heard of the Home Efficiency Program, whereas 20% of other treatment customers had heard of the program. Generally, a higher percentage of income-qualified customers who received HERs knew about programs than control customers, but differences were not statistically significant. Figure 3 reports the percentage of income-qualified customers that received HERs, other treatment customers, and control group customers who had heard of each of AIC's energy-saving programs.

Figure 3. Percent of Income-Qualified, Other Treatment, and Control Group Customers Who Have Heard of Other AIC Programs (Multiple Response)



According to respondents, the HERs and bill inserts from AIC were the most common sources that respondents recall about the Home Efficiency Program, with 10% and 11%, respectively, of all income-qualified respondents having heard of the program through those channels. Community events were least associated with recall, with only 7 of the 639 respondents having heard of the program that way.

Engagement with the Income Qualified Program

Overall, 21% of HER recipients in PY8 were flagged as income-qualified. As can be seen in Table 12, this percentage has been steadily increasing since PY4.

Table 12. Percent of HER Recipients Who Were Flagged As Income Qualified, by Year

Program Year	# of Home Efficiency Income Qualified Program Participants	# of Treatment Customers Who Are Income-Qualified	% of Treatment Customers Who Are Income-Qualified	% Participation
PY4	51	40,169	16%	0.13%
PY5	48	40,476	17%	0.12%
PY6	55	46,698	19%	0.12%
PY7	48	58,637	20%	0.08%
PY8	200	64,976	21%	0.31%

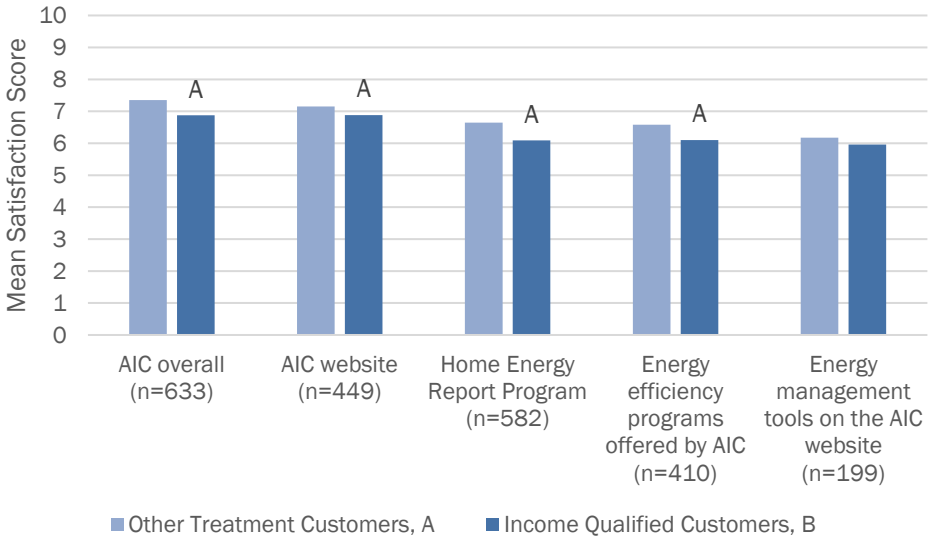
Source: AIC residential program database.

Our review of AIC residential program databases suggests that those customers flagged as income-qualified and who received messaging on their HER marketing the Home Efficiency Program in PY8 did indeed have higher rates of participation in other energy efficiency programs than customers who did not receive this messaging. However, we conducted a similar analysis for the same customers for prior program years and found that those flagged as income-qualified customers also participated at a higher rate than non-flagged HER participants. This result suggests that income-qualified participants may have already been participating at a higher rate (which makes intuitive sense because they are eligible for the program) year over year than those customers who weren't flagged as income-qualified. However, we recommend interpreting this finding with caution for the following reasons: Customers not flagged as income-qualified may in fact qualify for the program, as Leidos used zip codes to identify HER recipient customers who would likely be eligible for income-qualified programs, and it may take customers additional time to decide to participate in a given program after being made aware of its existence.

Customer Satisfaction

Customers identified as income-qualified have significantly lower satisfaction ratings than non-income-qualified treatment group customers on multiple metrics (Figure 4).

Figure 4. Satisfaction Ratings of Income-Qualified Customers



Note: "A" indicates statistically significant differences at the 90% confidence level.

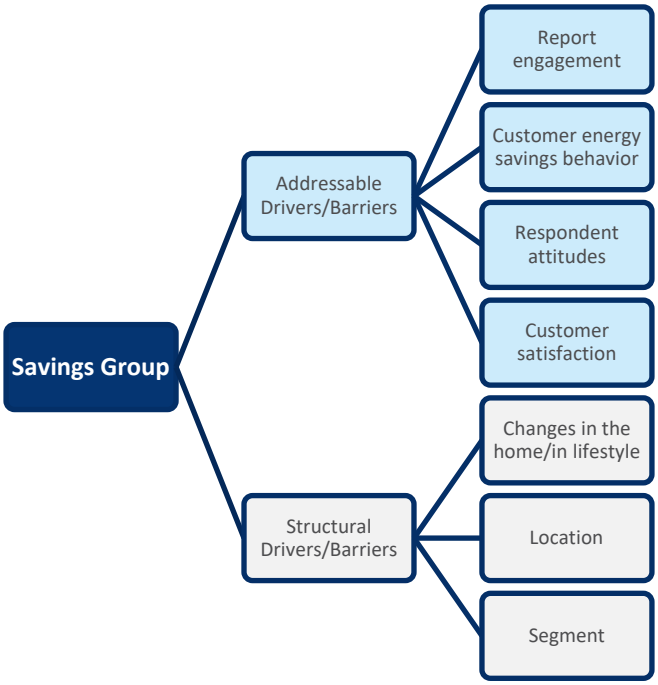
Energy Savings Group Experience

For the PY7 evaluation report, 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 and looked at 3 years of participation for the Original, Expansion 1, and Expansion 2 cohorts to help understand the evolution of the savings groups over time. We present our findings consolidating the five modeled groups into three groups: "Very Positive", which are "High" Savers, "Typical", which are "Medium", "Neutral" and "Negative", and "Very Negative" which are "Very Negative" savers.

This year, we used results from a participant survey[20] to study several sets of potential savings drivers to characterize what could be causing the observed differences in customer savings. We divided these potential barriers or drivers into two broad categories: addressable and structural. Addressable drivers or barriers are those that are likely to respond to adjustments to the HER program. For example, knowing whether different savings groups are concerned about the environment could inform differences in marketing strategy to each of those groups. Understanding which energy savings actions "Very Positive" savers take and do not take could help AIC create suggestions to deepen HER savings. By contrast, it is unlikely that AIC will be able to influence structural drivers or barriers. If a customer is a "Negative" saver because she lives in a very old house or because she needs energy-hungry medical equipment, adjustments to that customer's HER likely will not improve her savings.

Figure 5 summarizes the different drivers and barriers we investigated by type. Understanding the relative importance of these potential drivers and barriers is important for understanding not only which customer characteristics to target to deepen savings, but whether savings can be deepened at all. If fixed drivers or barriers primarily define a savings group, that group will likely be better served with different program offerings. These drivers and barriers are based on survey results, so they are not necessarily causing the savings differences because the reports themselves could have caused the differences, or those differences could have been preexisting.

Figure 5. Potential Drivers/Barriers for Savings Groups



[20] Our survey respondents included 365 very positive electric savers, 2,054 typical electric savers, and 313 very negative savers. Respondents also included 343 very positive gas savers, 2,273 typical gas savers, and 255 very negative gas savers. The prevalence of different savings groups among survey respondents was similar to the prevalence of these groups in the sample frame. See Appendix H for additional details.

Addressable Drivers or Barriers for Energy Savings

Report Readership and Engagement

Report recall was the same across both gas and electric savings groups. However, "Very Negative" electric savers were significantly less likely to read every report than other electric saver groups, with readership being 38% for "Very Negative" savers versus 47% and 45% for "Very Positive" and "Typical" savers, respectively.

"Very Negative" electric savers gave significantly lower scores to all aspects of the report, including their practicality, helpfulness, and motivational value (Table 13). "Very Negative" electric savers had significantly higher agreement with the statement that they do not like being told to use less energy. There were no differences between gas savings groups.

Table 13. Electric Energy Savings Groups Engagement with Home Energy Reports

Customer-Reported Engagement with Home Energy Reports	Very Positive Savers, A (n=365)	Typical Savers, B (n=2,045)	Very Negative Savers, C (n=313)
The reports provide enough information to take energy savings actions.	5.6 *(0.16)*	5.8 *(0.06)*	5.0 [AB] *(0.17)*
The report tips are not practical.	4.4 *(0.16)*	4.2 *(0.07)*	4.8 [B] *(0.18)*
The reports motivate me to take energy savings actions.	5.6 *(0.16)*	5.8 *(0.07)*	5.2 [AB] *(0.17)*
The reports remind me to take energy savings actions.	6.1 *(0.16)*	6.3 *(0.06)*	5.7 [AB] *(0.17)*
I am glad to have help in reducing my energy consumption.	6.8 *(0.15)*	6.9 *(0.06)*	6.58 [B] *(0.16)*
I do not like being told to use less energy.	3.6 *(0.17)*	3.7 *(0.07)*	4.0 [AB] *(0.19)*

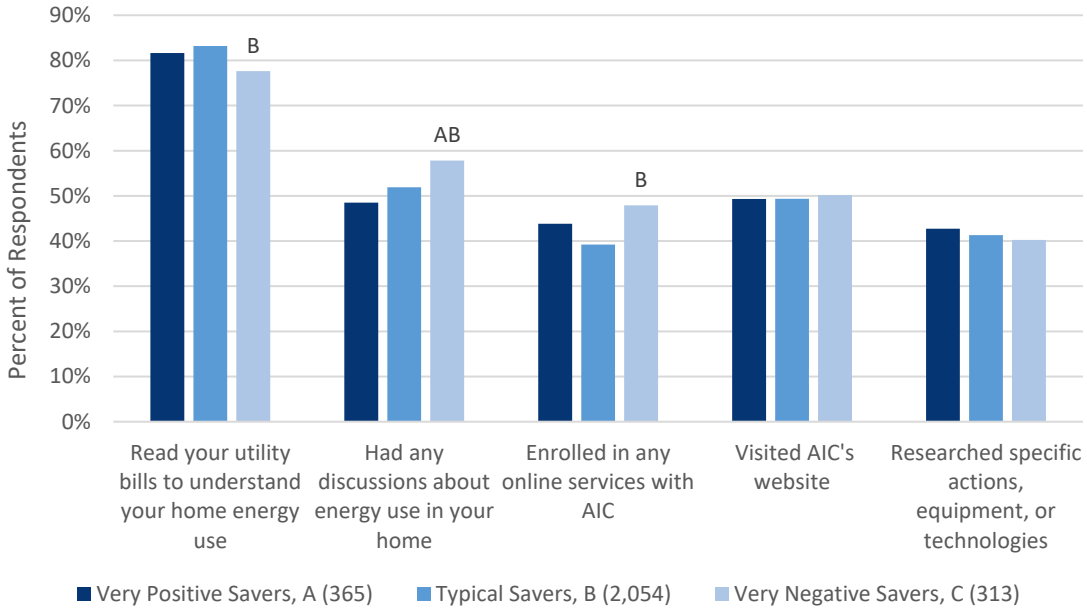
Note: Letters indicate statistically significant differences at the 90% confidence level between savings groups represented by the letter.
Note: The survey items in the table asked about agreement with these statements, where 0 is "strongly disagree," 5 is "neutral," and 10 is "strongly agree."

Note: Values in parentheses represent standard errors.

Engagement with Energy Use

When looking at the results by savings groups, a significantly lower proportion of "Very Negative" electric savers read their utility bills to understand their energy use than "Typical" electric savers (Figure 6). However, "Very Negative" electric savers reported significantly higher rates of discussion about their home energy use and enrolling in online services with AIC. There were no differences between gas savings groups for energy use engagement.

Figure 6. Energy Use Engagement by Electric Savings Group



Note: Letters indicate statistical significance between savings groups at the 90% level.

"Very Positive" electric savers reported significantly higher regular use of the AIC website to manage their energy use (Table 14). Conversely, "Very Negative" electric savers had significantly lower frequency of website use and reported the highest rate of non-use. It is important to note that, while there was no difference between savings groups for the number of customers who visited the AIC website, the use of the website to manage energy use was significantly lower for "Very Negative" savers. This suggests that the number of short visits to the website does not vary between groups, but more in-depth use of the website does differ between different types of savings groups.

Table 14. Percent of Electric Savings Groups That Use the AIC Website to Manage Their Energy Use

Do you use the AIC website to manage your energy use?	Yes, regularly	Yes, occasionally	I have looked at the tools but do not use them regularly	I do not use this
Very Positive Savers, A (n=365)	9.9% BC	7.5%	16.4%	66.3%
Typical Savers, B (n=2045)	5.3%	7.6%	20.4% A	67.1%
Very Negative Savers, C (n=313)	6.4%	4.8% B	21.0%	67.7%

Note: Letters indicate statistically significant differences at the 90% confidence level between that savings group and the one represented by the letter.

Energy Savings Behavior

There were few significant differences in the frequency with which each electric or gas savings group took habitual energy-saving actions. However, within the electric groups, "Very Negative" savers were much less likely than members of other groups to attribute this behavior to their HERs. There were no clear patterns among the gas savings groups.

The same pattern holds for one-time energy-saving actions, such as getting a home energy audit, upgrading insulation or lighting, or replacing or recycling major appliances. While there were generally no differences in the overall rates of different activities for the electric savings groups, more "Very Positive" savers and "Typical" savers attribute their actions to their HERs than do "Very Negative" savers. There were again no clear patterns in the gas savings groups. See Appendix A for more details.

Energy-Saving Attitudes

We also explored three general dimensions of customer attitudes that could help explain different savings levels from the program: the benefits customers expect from participating in an AIC program, customers' general attitudes about the environment and climate changes, and customers' preferences about competition and comparison. The primary goal of this analysis was to understand what types of messaging might be most effective for each savings group.

We found that, compared to other groups, "Very Negative" electric savers were less interested in the environmental implications of participation in AIC programs, felt less responsibility to protect the environment, were less concerned about climate change, and were less convinced that climate change is the result of human activities than "Typical" savers. As a result of these findings, AIC could consider working with their implementation partners to test messaging with these customers who do not draw on these potential motivators to save energy. See Appendix A for more details.

Customer Satisfaction

When comparing specific electric savings groups, we see that "Very Negative" electric savers have significantly lower satisfaction rates with AIC overall; the HER program; and AIC's website, energy efficiency program offerings, and energy management tools (Table 15). In most cases, "Very Negative" electric savers reported having significantly lower satisfaction than both control customers and other electric savings groups. There were fewer significant differences between gas savings groups, with satisfaction of the "Very Negative" savings group being significantly lower only for the HER program and energy efficiency program offerings.

Table 15. Reported Satisfaction by Electric Savings Group

Using a scale of 0 to 10, where 0 means you are "extremely dissatisfied" and 10 means you are "extremely satisfied" how satisfied were you with…	Very Positive Savers, A (n=365)	Typical Savers, B (n=2,045)	Very Negative Savers, C (n=313)	Control, D (n=1,479)
AIC overall	7.1 *(0.13)*	7.4 [A] *(0.05)*	6.6 [ABD] *(0.15)*	7.2 *(0.04)*
AIC website	7 [D] *(0.17)*	7.1 [D] *(0.06)*	6.7 [BD] *(0.17)*	7.3 *(0.07)*
Home Energy Report Program	6.3 *(0.16)*	6.6 [A] *(0.06)*	5.7 [AB] *(0.17)*	N/A
Energy efficiency programs offered by AIC	6.3 [D] *(0.17)*	6.6 *(0.07)*	5.8 [ABD] *(0.20)*	6.8 *(0.09)*
Energy management tools on the AIC website	6.24 *(0.19)*	6.24 *(0.07)*	5.6 [ABD] *(0.19)*	6.1 *(0.07)*

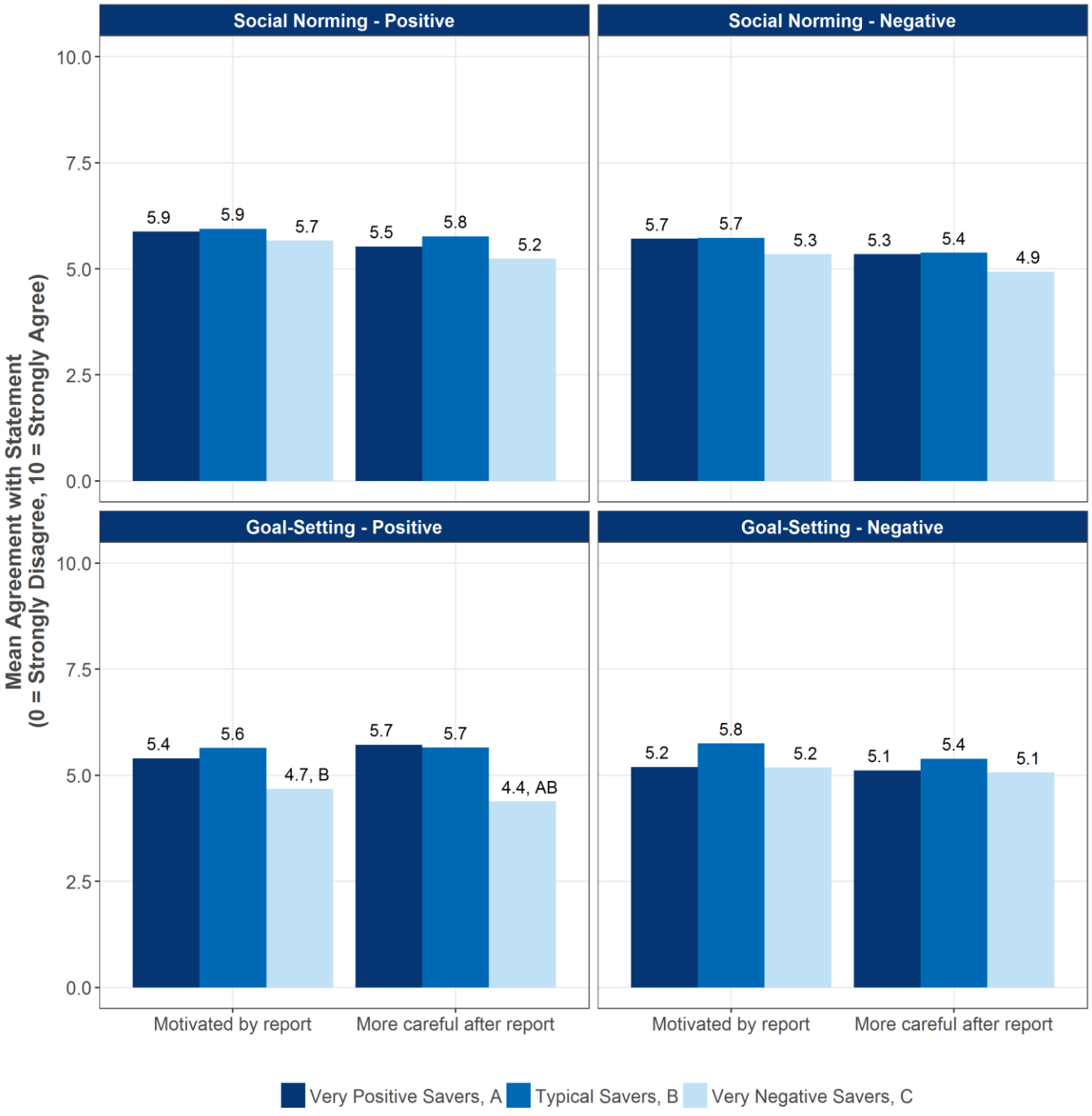
Note: Letters indicate statistically significant differences at the 90% level between savings groups.

Note: Values in parentheses represent standard errors.

As part of our survey effort, we sought to better understand whether customers would be more or less responsive to, or satisfied with, different types of messaging strategies (e.g., social norming and ranking), and whether receiving a positive or negative result was more or less motivational for different savings groups. If differences were found, then AIC could deliver reports that are more motivational or more satisfying to specific groups of customers. As noted earlier, AIC has employed two types of messaging strategies in their reports: social norming and goal-setting (i.e., target rank) comparisons for a specific cohort of customers. We therefore embedded an experiment within our survey to understand if reactions to different types of reports varied by savings group. Respondents were randomly shown an image of one of four reports: a traditional report that they compared favorably to other customers ("Social Norming – Positive"), a traditional report that they compared unfavorably to other customers ("Social Norming– Negative"), a target rank report that they compared favorably ("Goal-Setting – Positive"), and a target rank report that they compared unfavorably ("Goal-Setting – Negative"). We included the report images used for the experiment in Appendix H.

Survey results for two questions about general reactions to the report images suggest that "Very Negative" electric savers responded more negatively than other groups to the positive goal-setting report (Figure 7). The first question asked customers whether they would be motivated to reduce their energy consumption by such a report. The second asked whether they would be more careful about how they used energy in their home after receiving the report. We found no statistically significant differences among the gas savings groups.

Figure 7. Electric Savings Group Report Reactions



Note: Letters indicate statistical significance between savings groups at the 90% confidence level.

For the "Motivated by report" question, n = 697 for Social Norming – Positive; n = 624 for Social Norming – Negative; n = 617 for Goal-Setting – Positive; n = 628 for Goal-Setting – Negative.

For the "More careful after report" question, n = 680 for Social Norming – Positive; n = 619 for Social Norming – Negative; n = 589 for Goal-Setting – Positive; n = 619 for Goal-Setting – Negative.

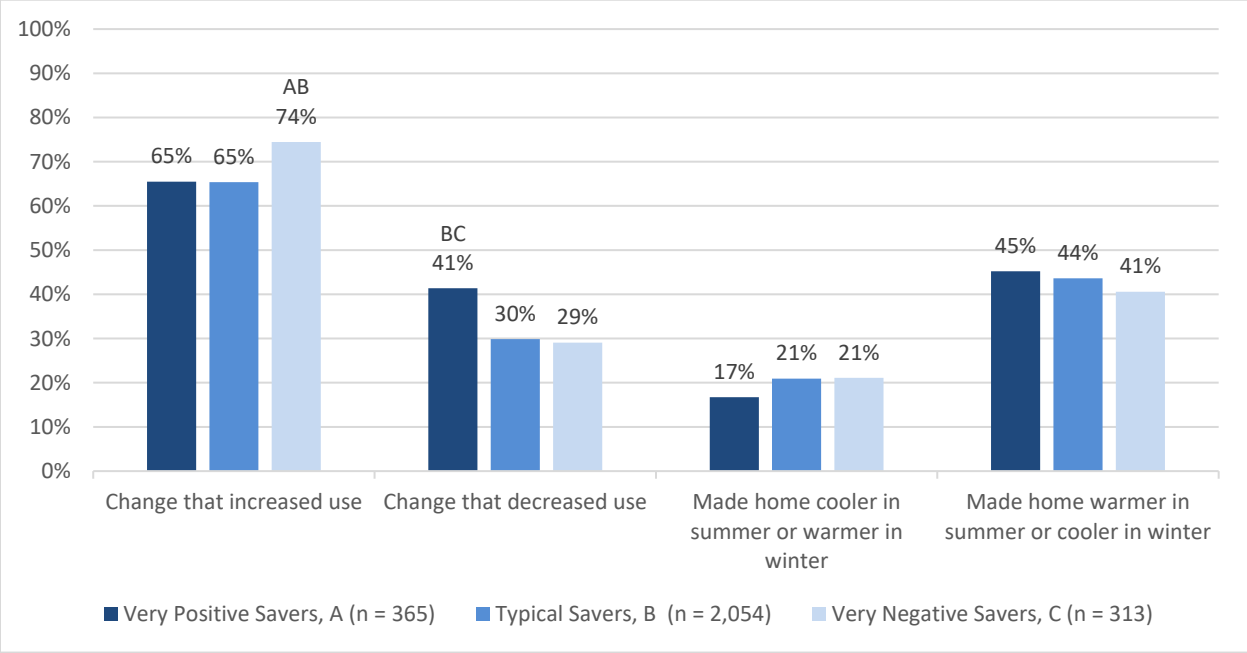
Structural Drivers or Barriers for Energy Savings

Changes in Occupancy and Circumstances

We also examined "unintentional" changes in energy-related behaviors. By this we mean changes in lifestyle, housing, or personal circumstances that could lead to a change in energy usage independent of the customer following or ignoring HER suggestions. For example, spending more time at home during the day, developing a medical condition that required specialized equipment or strict temperature control, or adding a pool would likely increase energy use. Spending more time out of the house or having a child leave for college could reduce usage.

These differences appear to be major drivers of the differences in electric savings groups. "Very Negative" savers reported a much higher rate of usage-increasing changes, while "Very Positive" savers reported many usage-decreasing changes (Figure 8). There were no clear patterns in gas savings groups.

Figure 8. Change in Energy Usage by Electric Savings Group

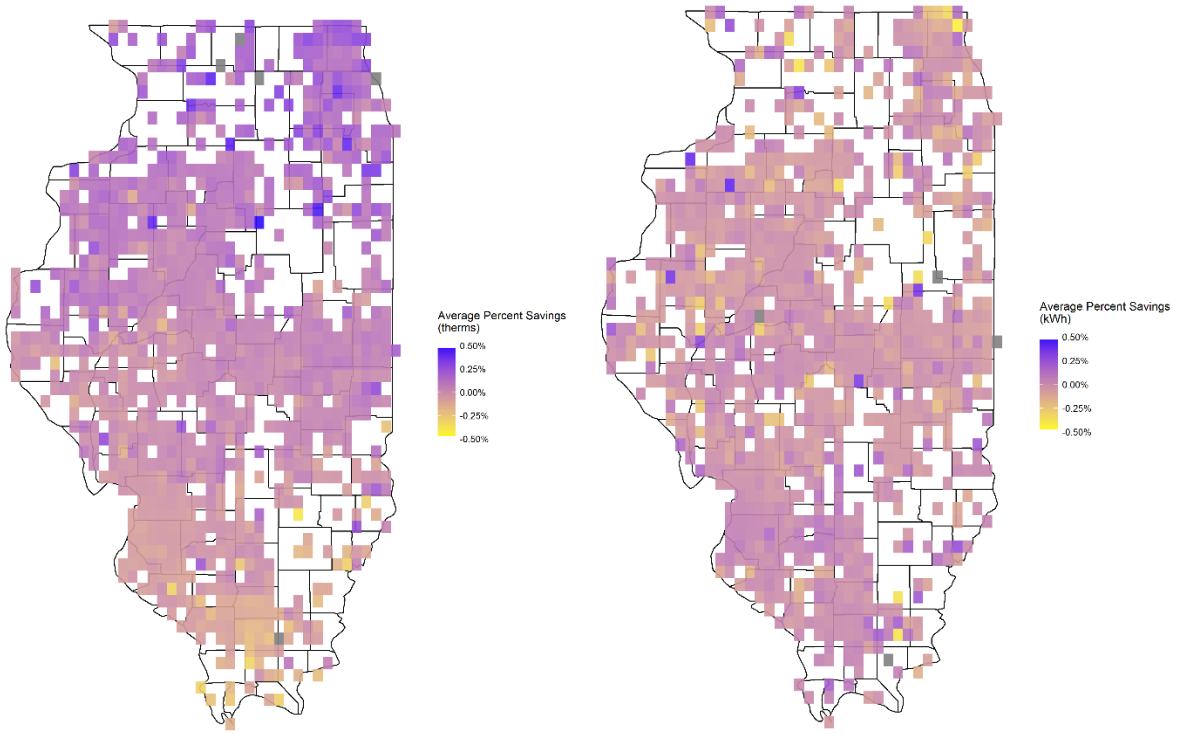


Note: Letters indicate statistical significance between savings groups at the 90% confidence level.

Geographic Location

Notably, one key difference between savings groups for gas customers had to do with geography. One could surmise that gas customers, whose distribution is plotted on the map on the left in Figure 9, have higher savings in the northeast region of the state, which may have more severe weather or different housing stock that facilitate gas savings. This is consistent with last year's modeling efforts, which found that age of housing and length of time in housing were more important predictors of gas savings groups than of electric savings groups.

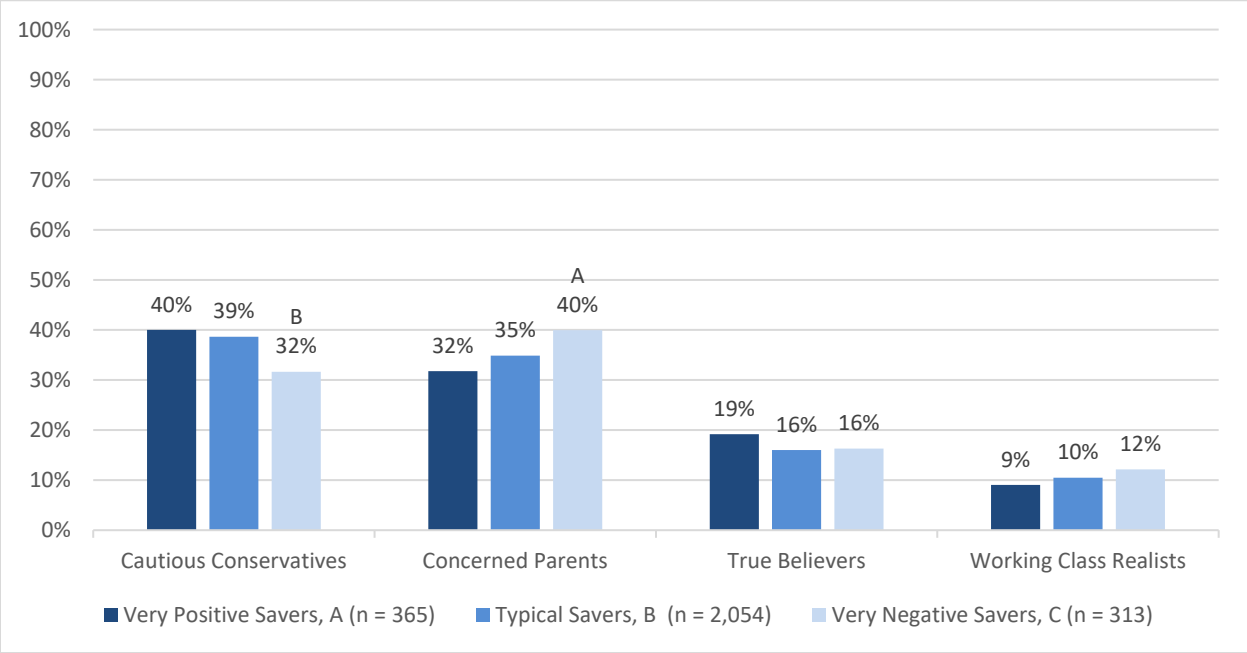
Figure 9. Distribution of Average Percent Gas Savings by Geography, Gas (Left) and Electric (Right)



Customer Segment

AIC has developed four distinct customer segments for their residential customer base. Our team mapped energy savings groups to these segments to identify any correlations between segments and savings groups to support targeting of future cohorts. For electric savings groups, we found that there appears to be a difference in terms of the number of "Very Negative" savers who are "Concerned Parents," as opposed to "Very Positive" savers, who are "Cautious Conservatives." Consistent with our findings regarding changes in occupancy and circumstances, becoming new parents or changing household occupancy may drive much of energy consumption drivers and barriers. As a result, we suggest that AIC work with its program implementers to consider messaging these customers with language that alleviates some of the barriers these customers may face when reducing energy consumption. Further, when identifying future cohorts, AIC could work with program implementers to exclude or minimize participants who are "Concerned Parents." We found little differences for gas savings groups.

Figure 10. Electric Savings Groups by AIC Segments



Note: Letters indicate statistical significance between savings groups at the 90% level between savings groups.

Additionally, AIC should consider incorporating messaging or tactics that reflect the specific constraints that a segment with children at home might face. Reducing energy use with children (especially young children) in the house may present substantial barriers. Such customers might be well served by specialized program offerings (such as occupancy sensors or timers) or messaging that takes the unique challenges they face in reducing energy consumption into account.

3.2 Impact Assessment

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

3.2.1 Equivalency Analysis

The evaluation team performed an equivalency check between the Expansion Cohort 6 treatment and control groups to assess how similar the treatment and control groups were at the start of the program. Confirming the comparability of the treatment and control groups strengthens the internal validity and defensibility of the research design. Because the evaluation team assessed older cohorts when those cohorts first entered the program, the evaluation team focused these efforts on the newest cohort. However, we also investigated whether attrition had caused these older cohorts to become unbalanced in terms of pre-participation period usage. We include both electric and gas equivalency results to contextualize our model specification selection.

All cohorts except for the electric Original Cohort were equivalent based on ADC in the pre-participation period. The electric Original Cohort has slightly higher pre-participation period consumption in summer months (see Figure 11, page 41). Although overall average pre-participation period consumption differs by less than 1 kWh, it is possible that these differences in average daily pre-participation period usage during the summer months artificially inflate kWh savings estimates for the Original Cohort in models that do not control for this difference. Because it seems likely that differences in the weather conditions experienced by the treatment and control customers during the pre-participation period drove this difference in consumption (see discussion below), we believe that the weather-adjusted model provides the most accurate electric savings estimates for the Original Cohort. In past years, we used the Original Model (Equation 1) to report savings estimates, but the usage imbalance in the Original Cohort causes a biased estimate with that model, so we use estimates from the Weather-Adjusted Model (Equation 2) in our energy savings estimates.

Expansion Cohort 6

We found Expansion Cohort 6 to be equivalent in terms of electric usage. For electric customers, ADC in the year before the start of the program was 30.63 kWh/day in the control group and 30.49 kWh/day in the treatment group. The distribution of average daily electric consumption is shown in Appendix A (see Figure 14).

The evaluation team conducted a similar analysis for the Expansion Cohort 6 gas customers and found gas usage to be equivalent. In the year before the start of the program, ADC was 1.75 therm/day for households in the control group and 1.76 therm/day for treatment households. Appendix A shows the distribution of average daily gas consumption (see Figure 15).

Previous studies have shown that demographics, housing, and psychographic characteristics may have an impact on savings realized by treated customers. For this reason, the evaluation team assessed the equivalency of the new treatment and control groups across 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. Only two entries (one in education, one in age of house) had a greater than 1% difference, and these differences were still very small (1.1% and 1.2%, respectively). Table 28 in Appendix A summarizes the demographics, housing, and psychographic equivalency analysis.

All Cohort Electric and Gas Usage

We examined the average daily fuel consumption for the 12 pre-participation period months for treatment and control group customers to ensure that attrition from the program did not bias findings in PY8. Table 16 and Table 17 shows that all cohorts except for electric customers in the Original Cohort were generally equivalent based on ADC in the pre-participation period, although Expansion Cohort 4 (both treatment and control) shows a noticeably higher average electric consumption than its predecessors do.

Table 16. Pre-Participation kWh Average Daily Consumption

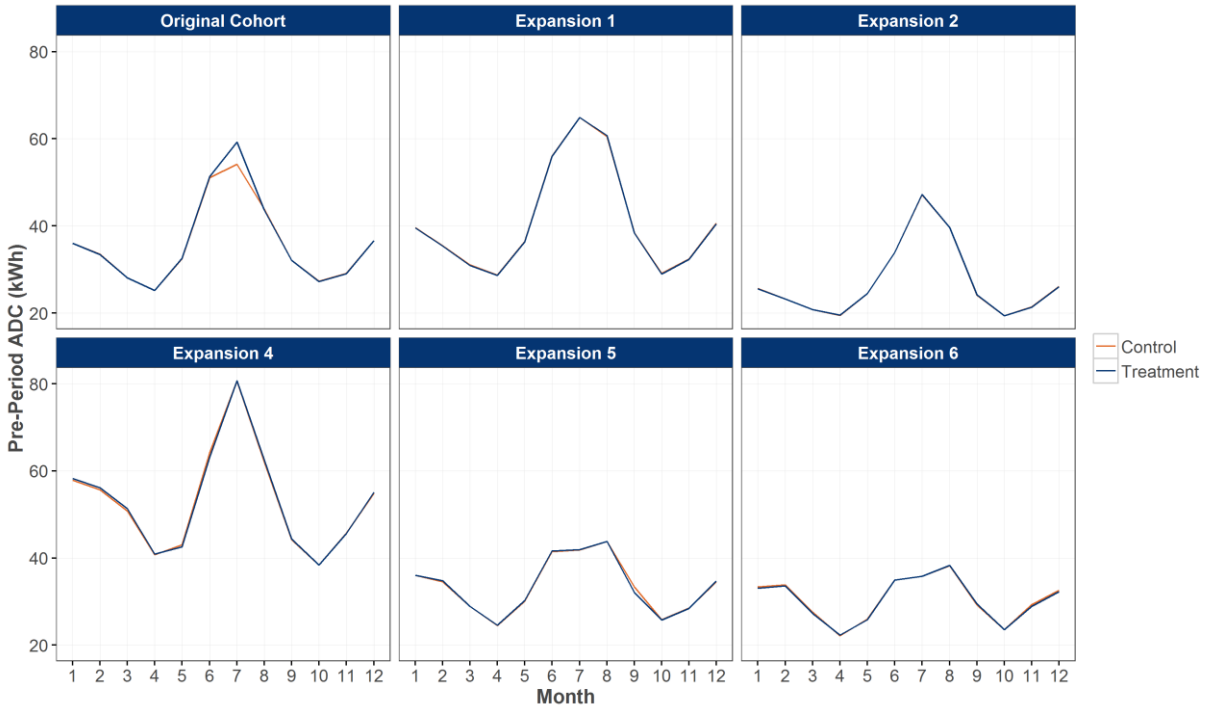
Cohort	Treatment (Pre-Participation) Consumption in kWh	Control (Pre-Participation) Consumption in kWh
Original Cohort	36.21	35.80
Expansion Cohort 1	41.12	41.20
Expansion Cohort 2	27.17	27.17
Expansion Cohort 4	53.14	53.05
Expansion Cohort 5	33.63	33.69
Expansion Cohort 6	30.49	30.63

Table 17. Pre-Participation Program Therm Average Daily Consumption

Cohort	Treatment (Pre-Participation) Consumption in Therms	Control (Pre-Participation) Consumption in Therms
Original Cohort	2.64	2.65
Expansion Cohort 1	3.02	3.02
Expansion Cohort 2	2.01	2.02
Expansion Cohort 3	2.36	2.38
Expansion Cohort 4	2.29	2.30
Expansion Cohort 5	3.07	3.09
Expansion Cohort 6	1.76	1.75

The evaluation team examined the imbalance in Original Cohort electricity consumption in more detail. Although the difference in overall average consumption is less than 1 kWh, there are larger differences during summer months. Figure 11 summarizes pre-participation period average daily electricity consumption by month, and shows that treatment customers in the Original Cohort used more electricity during summer months than control group customers did.

Figure 11. Pre-Participation Period Electric Consumption, Treatment vs Control, All Waves



Although is it difficult to explain the difference in pre-participation period summer usage definitively, one plausible explanation is that the Original Cohort customers who remain active in the program experienced different weather conditions during the pre-participation period. Warmer temperatures generally mean more electricity used to power air conditioners and fans, and thus higher average electricity consumption.

We compared the weather experienced by the treatment and control groups in all waves during the pre-participation period, and found that treatment customers in the Original Cohort experienced hotter summer weather than customers in the control group. The difference in weather conditions was much smaller across all other pre-participation period months and cohorts. Table 53 in Appendix E provides a summary of average pre- and post-participation period heating degree days and cooling degree days for treatment and control customers in each cohort.

3.2.2 Net Impacts

This section presents PY8 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. The program's adjusted net savings is 35,929 MWh (Table 18). Adjusted net savings refers to modeled impacts less savings accounted for from participation in other AIC residential programs. Applying these adjusted net savings, the evaluation team reduced electric savings by 0.005%–0.090% depending on the cohort.[21] These findings confirm that the Behavioral Modification Program is reducing energy consumption.

[21] For context, in PY7, the evaluation team reduced electric savings by 0%–0.09% and gas savings by 0%–0.16%, depending on the cohort.

Table 18. PY8 Behavioral Modification Program Total Savings

Cohort	Final Adjusted Net Program Savings (MWh)
Original Cohort	4,629
Expansion Cohort 1	10,769
Expansion Cohort 2	5,071
Expansion Cohort 3	--
Expansion Cohort 4	6,111
Expansion Cohort 5	7,507
Expansion Cohort 6	1,843
Total MWh*	**35,929**

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

3.2.3 Model Results

The evaluation team fit several statistical models to estimate impacts from the program. This section provides findings from each of these models.

Baseline Model (Equation 1)

As previously noted, the evaluation team used the entire program period in the model to calculate program savings. Table 19 summarizes the PY8 unadjusted net savings for the seven dual-fuel cohorts and the gas-only cohort (Expansion Cohort 3). The table shows net savings but does not deduct double-counted savings from participation in other AIC residential programs. The unusually high electric savings for the Original Cohort are at least partially due to the imbalance in pre-participation period energy use between treatment and control groups noted in the equivalency analysis. The evaluation team investigated several potential reasons for the low gas savings in Expansion Cohort 5, finding that weather does play a large part (compare to the weather-adjusted results in Table 20), but not enough to explain the full difference between Expansion Cohort 5 and the other cohorts.

Table 19. PY8 Unadjusted Per-Household Savings (%) – Original Model

Cohort	Average % Savings (Electric)	Average Savings per Customer (kWh)
Original Cohort	2.81%	323.3
Expansion Cohort 1	1.62%	204.1
Expansion Cohort 2	0.62%	54.1
Expansion Cohort 3	N/A	N/A
Expansion Cohort 4	1.25%	206.0
Expansion Cohort 5	0.86%	93.3
Expansion Cohort 6	0.39%	37.3

Overall Program Savings – Weather-Adjusted Model Results (Equation 2)

To enable accurate comparisons across years, we estimated models that incorporated weather terms for each fuel and cohort. This also improved the precision in the modeled results by accounting for possible differences

in weather experienced by the analyzed population. It is not surprising that the savings results for some cohorts and fuels—most notably electric savings for the Original Cohort—differ somewhat from the savings estimates from the Original Model. As was noted in the equivalency analysis, treatment and control group customers in the Original Cohort experienced fairly different pre-participation period CDD. See Appendix E for the modeled coefficients for the weather-adjusted models and Table 53 for a summary of average CDD and HDD for each cohort.

Table 20. PY8 Unadjusted Per-Household Savings (%) – Weather-Adjusted Model

Cohort	Average % Savings (Electric)	Average Savings per Customer (kWh)
Original Cohort	1.17%	133.7
Expansion Cohort 1	1.60%	201.5
Expansion Cohort 2	0.68%	59.0
Expansion Cohort 3	N/A	N/A
Expansion Cohort 4	1.66%	273.3
Expansion Cohort 5	1.29%	139.4
Expansion Cohort 6	0.57%	54.6

Post-Participation Period Only Model Results (Equation 3)

The following table presents the results for the post-participation period only model or lagged dependent model. This model is the same model used by the implementation contractor, OPower, to estimate savings. LDV models use seasonal usage from the pre-participation period, but do not explicitly adjust for weather differences between the pre- and post-treatment periods. For this reason, their results may be biased in either direction if the weather is substantially different across the periods.

Table 21. PY8 Unadjusted Per-Household Savings (%) – Lagged Dependent Model

Cohort	Average % Savings (Electric)	Average Savings per Customer (kWh)
Original Cohort	2.57%	305.2
Expansion Cohort 1	1.62%	209.3
Expansion Cohort 2	0.72%	64.3
Expansion Cohort 3	N/A	N/A
Expansion Cohort 4	1.14%	192.2
Expansion Cohort 5	0.78%	85.3
Expansion Cohort 6	0.54%	52.7

Standard Weather-Year Model Results (Equation 4)

The PY8 analysis also included a predictive model that used Typical Meteorological Year (TMY) 3 standard weather-years to estimate model results in a typical weather-year. These results, presented in Table 22, are very similar to the weather-adjusted model results. This is unsurprising given the similarity between weather in PY8 and the TMY standard weather-year. See Appendix E for the modeled coefficients and a comparison of standard weather-year assumptions and actual PY8 weather.

Table 22. PY8 Unadjusted Per-Household Predicted Savings (%) – Standard Weather-Year Model

Cohort	Average % Savings (Electric)	Average Savings per Customer (kWh)
Original Cohort	1.17%	133.9
Expansion Cohort 1	1.61%	202.6
Expansion Cohort 2	0.71%	61.1
Expansion Cohort 3	N/A	N/A
Expansion Cohort 4	1.70%	280.1
Expansion Cohort 5	1.30%	140.0
Expansion Cohort 6	0.60%	57.0

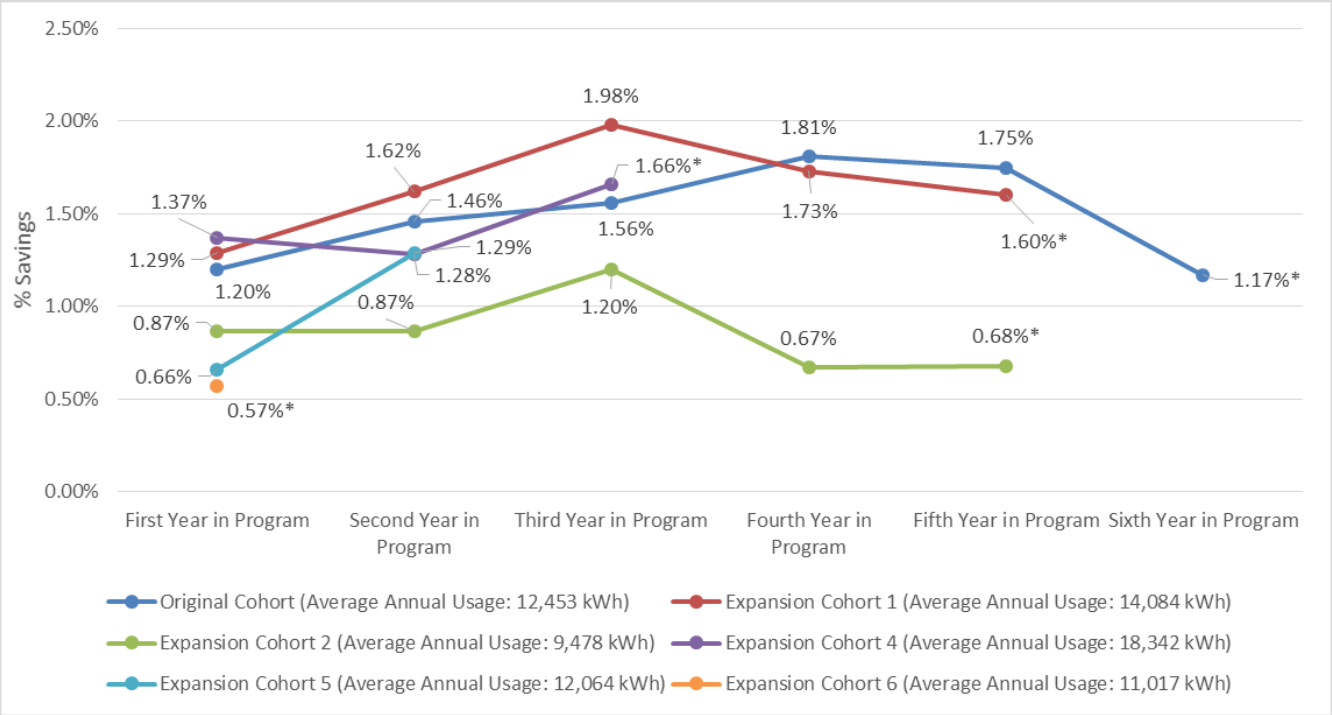
Per-Year Savings

In the following figures, we present the billing analysis results across program years. For all program years but the most recent we present the results of the original model (Equation 1). These provide the electric percent household savings by cohort and by year. These include the two key factors that correlate with program energy impacts: pre-participation period 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. As with earlier evaluations, we find that pre-participation period consumption correlates with increased energy savings by cohort.

Because of our concerns about treatment and control group equivalency in PY8, we present weather-adjusted results for PY8. The weather-adjusted model helps correct for the imbalance between those groups and produces more unbiased results than the original model.

Figure 12. Year-Over-Year Savings – Electric (Baseline Model)



* Weather-adjusted model result.

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, the Lighting Program, the HVAC Program, the Residential Energy Efficient Products (REEP), the Home Efficiency Standard (HES) (formerly Home Performance with ENERGY STAR) Program, and the Income Qualified (IQ) (formerly Moderate Income) 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 Cohorts 1 and 4, saw higher participation rate increases in the treatment group than in the control group (see Table 23). The HES and Appliance Recycling programs were the biggest contributors to the overall participation increase.

Table 23. PY8 Participation Lift by Cohort

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4	Expansion Cohort 5	Expansion Cohort 6
Appliance Recycling	0.11%	−0.11%	0.08%	0.01%	−0.13%	−0.02%	0.00%
Lighting (Web Store)	0.00%	0.00%	0.00%	0.00%	0.00%	−0.01%	0.00%
HVAC	−0.08%	0.00%	0.06%	0.09%	0.04%	0.21%	−0.07%
REEP (Discontinued)	0.00%	−0.02%	−0.11%	0.01%	0.14%	−0.09%	0.01%

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3	Expansion Cohort 4	Expansion Cohort 5	Expansion Cohort 6
HES	0.08%	0.01%	−0.07%	0.09%	0.02%	0.03%	0.13%
Income Qualified	−0.02%	0.00%	0.04%	0.01%	−0.06%	0.03%	0.08%
Total	**0.068%**	**−0.147%**	**0.004%**	**0.209%**	**−0.046%**	**0.161%**	**0.132%**

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

Although some treatment groups' participation rates were lower than those of control groups (reflected in the negative percentages in Table 23), every cohort but two experienced an overall lift when all the AIC programs were considered. The likely cause for Expansion Cohort 1's and 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 189 customers into other AIC residential programs in PY8.

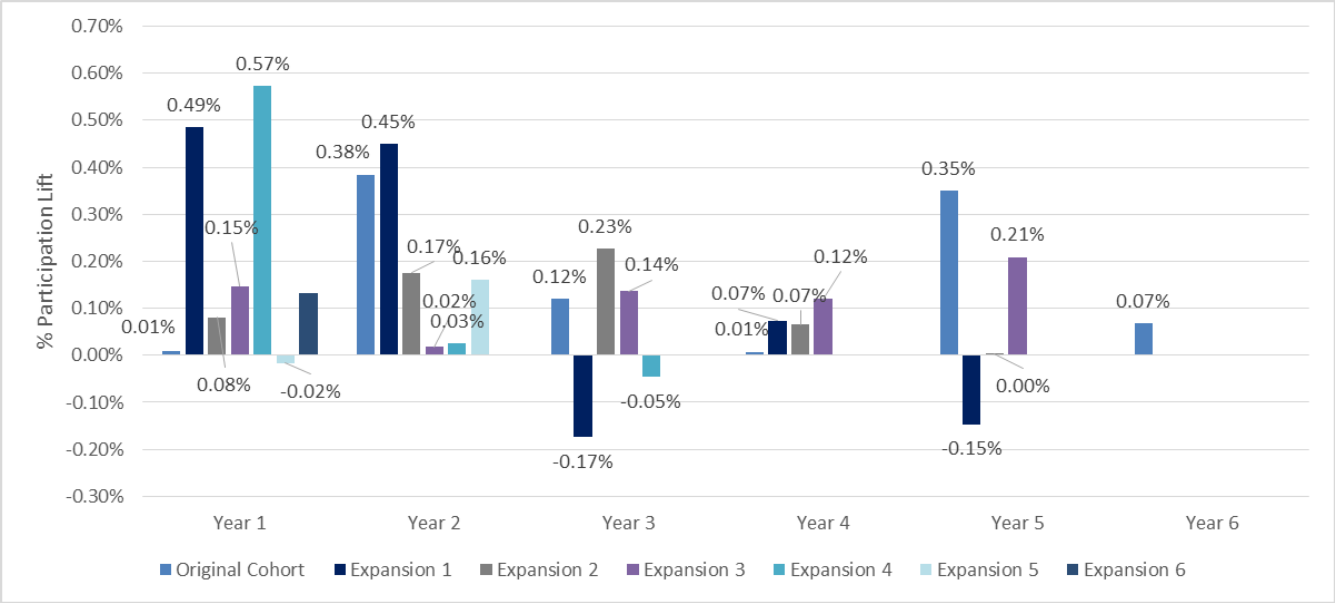
Trends in Program Channeling

In addition to aggregate participation rates in the first year, we examined participation rates over time to better understand differences in timing of treatment and control group program participation. The evaluation team analyzed monthly[22] and cumulative participation[23] rates in each cohort since program inception. 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 or second year (see Figure 13). We provide monthly and cumulative participation rates for each cohort in Appendix F.

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

[23] The 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 0.000%–0.018% depending on cohort (see Table 24).

Table 24. PY8 Behavioral Modification Program Impacts – Electric

Statistic	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 4	Expansion Cohort 5	Expansion Cohort 6
Net Program Savings (% per HH)	1.17%	1.60%	0.68%	1.66%	1.29%	0.57%
Incremental Savings from Other Programs (% per HH)	0.017%	0.000%	0.002%	0.004%	0.000%	0.018%
Final Adjusted Net Savings (% per HH)[a]	1.15%	1.60%	0.68%	1.65%	1.29%	0.55%
Net Program Savings (kWh per HH)	133.7	201.5	59.2	273.3	139.5	54.7
Incremental Savings from Other Programs (kWh per HH)	2.0	0.0	0.2	0.7	0.0	2.0
Final Adjusted Net Savings (kWh per HH)[a]	131.7	201.5	59.0	272.7	139.5	52.7

[a] Total may not equal to the sum of all cohorts due to rounding.
Note: In general, households (HHs) 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 cohorts, which have baseline usage between 11,000 and 18,200 kWh.

Notably, our double counting adjustment uses an approach that deducts cumulative impacts from program participation lift as of PY4 that occurred in PY8. This is consistent with the approach used elsewhere in Illinois,

sometimes referred to as Legacy Savings. As a result, we have seen an increase in the savings deducted year over year for program participants. For electric, we deduct approximately 0.48% from total energy impacts.

Table 25: Channeling Savings Adjustment

Savings Values	Electric (MWh)
Net Unadjusted Savings (Modeled)	36,101
Net Adjusted Savings	172
Program Net Adjusted Savings	35,929
Net Adjusted Savings as Percent of Program Savings	0.48%

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 PY8, the program achieved adjusted net savings of 35,929 MWh. Overall, the estimated savings are below the forecasted results, particularly for gas.

In PY8, the IPA Behavioral Modification_Program was implemented by OPower. PY8 was characterized by limited program implementation changes, while program staff faced some technical challenges. In particular, program staff added a new cohort of approximately 54,000 dual-fuel customers in April 2015 and offered a new income-qualified customer module initiative to support the Home Efficiency Program. In addition, program implementers continued the target rank campaign, which provided customized short-term goals for high-energy users, which, according to OPower survey results, increased customer satisfaction by about 8%.

However, technical issues resulted in reductions to report frequency for many customers. Specifically, there were widespread issues with monthly billing reads in fall 2015 that reduced the frequency of reports for more than 100,000 customers. The AIC information technology team quickly restored missing reads, and these customers received three mailed reports as opposed to four reports. Finally, eHERs were delivered to all customers with email addresses (45% of total participant population) on a monthly basis.

Survey findings indicate that participants recalled and engaged with reports. Overall, most participants who responded to our survey recalled receiving the HERs (90%) and reported reading every report (44%). We continue to find that participants, when compared to control group respondents, more frequently indicated that they have discussions about ways to save in their homes and have read their utility bills to understand their home's energy use in the past 12 months. However, survey results also indicate lower satisfaction for participants when compared to control group respondents. Further, the participants were moderately satisfied with the HER, with a mean rating of 6.5 on a 0–10 scale. These results show that the program achieved its goal of boosting customer engagement and education by helping participants understand energy efficiency in their homes, but there are opportunities to enhance customer satisfaction with the report. The following findings and recommendations for the program are based on the results of our program evaluation:

- **Key Finding #1: The program reduced energy consumption.** Billing analyses results indicate a reduction of 35,929 MWh. Program participants achieved 126 kWh savings 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, OPower might consider using the average savings estimates for kWh over the evaluated period. Theoretically, OPower could multiply these averages by the planned number of future participants and produce estimates of the next program year's anticipated electricity savings.
- **Key Finding #2: Overall, energy savings results appeared to plateau when compared to prior years (with some cohorts increasing and others decreasing usage year over year).** Changes in program delivery, specifically, the reduction in the frequency of electric reports (in PY7) from six to four reports per year, as well as the missing bill reads for some program participants, may have contributed to a dampening effect in savings in PY8. However, reductions in energy savings may have been tempered by the implementation of eHERs in PY8.
  - **Recommendation:** For future program years, OPower should assess if the costs associated with delivering paper reports outweigh the benefits of sending reports only electronically. One such way to test this hypothesis would be to assess the effectiveness of substituting paper reports for eHERs

moving forward. We recommend developing a research design where customers would be randomly selected to discontinue paper reports, while continuing to receive eHERs, while another group continues to receive both paper reports and eHERs to assess the incremental savings of these reports.

- **Key Finding #3: Our evaluation identified a lack of equivalency in terms of average daily consumption in the pre-participation period for the electric Original Cohort.** Specifically, our analysis found that the electric Original Cohort has slightly higher pre-participation period consumption in summer months. Although overall average pre-participation period consumption differed by less than 1 kWh, it is possible that these differences in average daily pre-participation period usage during the summer months artificially inflated kWh savings estimates for the electric Original Cohort in models that did not control for this difference. Because it seems likely that differences in the weather conditions experienced by the treatment and control customers during the pre-participation period drove this difference in consumption, we used a weather-adjusted model specification to estimate impacts because it provides the most accurate electric savings estimates for the electric Original Cohort. This is in contrast to prior evaluations, where we used the Original Model to report savings estimates.

  - **Recommendation**: Moving forward, we recommend that OPower work with the program evaluators to continue to monitor the lack of equivalency of each cohort and to apply the best model specification to account for differences across groups.

- **Key Finding #4: Predicted savings were not always consistent with evaluated savings.** Savings predictions used different data, data cleaning methods, weather, and models than evaluated savings. These differences, in combination with prediction error, led to the observed differences between predicted and evaluated savings. Appendix E.7 contains further discussion on this topic.

  - **Recommendation:** For future program years, consider requesting interim evaluated savings estimates as part of the evaluation work plan. This would allow for program adjustments when partial-year savings do not align with predicted savings.

- **Key Finding #5: In PY8, AIC launched a new marketing module directed toward income-qualified customers.** AIC conducted this new initiative in PY8 by sending tailored messaging regarding the Home Efficiency Program to HER participants who qualified as income-qualified as part of their HER. The HERs offered a new, customizable marketing module that attempted to channel income-qualified customers into relevant AIC programs. As a result of this initiative, the evaluation team attempted to better understand if customers were more aware of, or had increased their participation in, the income-qualified Home Efficiency Program. Our results suggest that 18% of income-qualified customers had heard of the Home Efficiency Program, which was not statistically significantly different from non-income-qualified customers who had not received the marketing module. In terms of program participation, our review of AIC residential program databases suggests that those customers flagged as income-qualified customers and who received messaging on their HER marketing the Home Efficiency Program in PY8 did indeed have higher rates of program participation than customers who did not receive this messaging. However, we conducted a similar analysis for the same customers for prior program years and found that those flagged as income-qualified customers also participated at a higher rate than non-flagged HER participants.

  - **Recommendation**: AIC should continue to investigate the merits of offering marketing modules to income-qualified customers via the HERs. We recommend that the program implementer flag both treatment and control group customers as income-qualified, providing a natural experiment to assess the effectiveness of the marketing efforts. In addition, we recommend assessing

program uplift in PY9 given that it may take some customers time to make a decision to enroll and participate in a program after receiving the marketing materials.

- **Key Finding #6: Persistent "Very Negative" savers tended to have different characteristics than other program participants.** In PY7, our team conducted a multilevel model analysis that placed participants in five profiles: "High" savers, "Medium" savers, "Neutral" savers, "Negative" savers, and "Very Negative" savers). The evaluation team conducted a follow-up survey to better understand whether we could identify customer characteristics correlated with these savings groups. Primarily, we found that electric "Very Negative" savers tended to be distinct from other electric savings groups. First, their engagement with and satisfaction with the HERs were significantly lower, on average, than other savings groups. In addition, despite having similar frequency of reported energy savings actions, electric "Very Negative" savers were much less likely than members of other groups to attribute this behavior to the reports. There also appear to be intrinsic features that are correlated with this particular energy savings group. For example, electric "Very Negative" savers reported a much higher rate of making changes to increase energy usage in their home, while "Very Positive" (e.g., "High") savers reported a higher rate of making changes to decrease energy usage.[24] In addition, these customers were much less interested or concerned about climate change than other groups and tended to fall within the AIC "Concerned Parents" segmentation group.

  - **Recommendation:** AIC should consider targeting electric "Very Negative" savers for new interventions and consider what types of constraints or barriers these customers may be facing and what types of messaging may be more or less relevant to these customers. After doing so, AIC can establish whether these results can serve to enhance or optimize program delivery. In addition, for any future cohorts, we recommend considering focusing on other segments rather than "Concerned Parents." Notably, these results are exploratory and require additional research to confirm trends that appear within the data.

- **Key Finding #7: The program has been offered to AIC residential customers for up to 6 years for some cohorts.** As a result, we recommend conducting a persistence study[25] to estimate decay rates associated with discontinuing sending reports to customers who have benefited from receiving reports for multiple years. We understand that AIC may consider adjusting its implementation of this program as it enters the next planning phase. In addition, the IL-TRM working group has been developing an approach to applying persistence rates for existing programs to effectively estimate first-year savings, measure life, and cost-effectiveness testing, given that evaluation evidence suggests that energy-savings behaviors influenced through these programs can persist beyond the initial period of program intervention, even without continued program participation.[26]

  - **Recommendation**: Conduct a persistence study to estimate AIC-specific decay rates associated with program interventions for use in estimating first-year savings, measure life, and cost-effectiveness of the Behavior Modification Program for the next planning phase.

[24] By this we mean changes in lifestyle, housing, or personal circumstances that could lead to a change in energy usage independent of the customer following HER suggestions. For example, spending more time at home during the day, developing a medical condition that required specialized equipment or strict temperature control, or adding a pool would likely increase energy use. Spending more time out of the house or having a child leave for college could reduce usage.

[25] Persistence and decay rate studies are critical to understanding whether and how savings degrade in the absence of a program intervention, as well as providing more accurate lifetime savings results.

[26] Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 5.0, Volume 4: Cross-Cutting Measures and Attachments.

- **Key Finding #8: The Behavioral Modification Program channeled about 189 customers into other AIC residential programs in PY8.** Although some treatment groups' participation rates were lower than those of control groups, every cohort but two experienced an overall lift when all the AIC programs were considered. 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.

  - **Recommendation**: Consider the benefits of promoting particular initiatives or programs through the HERs through targeted messaging. In particular, some program participants may have either 1) already participated in programs that were marketed through the HER, or 2) are unlikely to participate in those programs. As a result, we recommend focusing on strategic initiatives when marketing other AIC residential programs to Behavior Modification Program participants, especially for many of the cohorts who have been in the program for multiple years. We understand that AIC will be focusing on their income-qualified customers moving into the next planning phase, and HERs may be one avenue to support direct marketing to these customers, as well as to test the efficacy of different marketing messaging (see next finding).

A. Appendix – Equivalency Analysis Methodology

The evaluation team conducted an equivalency analysis by assessing baseline consumption equivalency for all cohorts, and examining differences in demographic, housing, and psychographic information between treatment and control groups in the newest cohort. The evaluation team assessed the demographic, housing, and psychographic comparability of previous cohorts in the years that those cohorts joined the HER program. We document our results for Expansion Cohort 6 below. We include both electric and gas equivalency results to contextualize our model specification selection.

To conduct the equivalency check for Expansion Cohort 6, the evaluation team examined the comparability of treatment and control groups using two methods. First, the team compared the distribution of ADC in the year before the start of the program (see Table 16 and Table 17).

Second, the evaluation team examined differences in demographic, housing, and psychographic information between treatment and control groups (see Table 28). Because this analysis was conducted on the entire population, statistical tests were not conducted.

A.1 Baseline Usage Data

The following table shows the number of Expansion Cohort 6 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 Expansion Cohort 6 Customers with Baseline Usage Data before Data Cleaning

	Number of Customers
Total Unique Customers	54,299
Electric Customers	
Control	16,500
Treatment	37,798
Total	54,298
Gas Customers	
Control	16,500
Treatment	37,799
Total	54,299

The pre-participation period database for Expansion Cohort 6 treatment and control customers has usage information for customers in 2014. To compare ADC 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 who received the first report when they were inactive. This data cleaning removed fewer than 4% of the customers.

Table 27. Number of Expansion Cohort 6 Customers with Baseline Usage Data after Data Cleaning

	Number of Customers
Electric Customers	
Control	16,022
Treatment	36,515
Total	52,537
Gas Customers	
Control	16,022
Treatment	36,515
Total	52,537

The distributions of average daily electric consumption (Figure 14) and average daily gas consumption (Figure 15) during the pre-participation period are shown below.

Figure 14. Distribution of Average Daily Electricity Consumption in the Year before Start of the Program

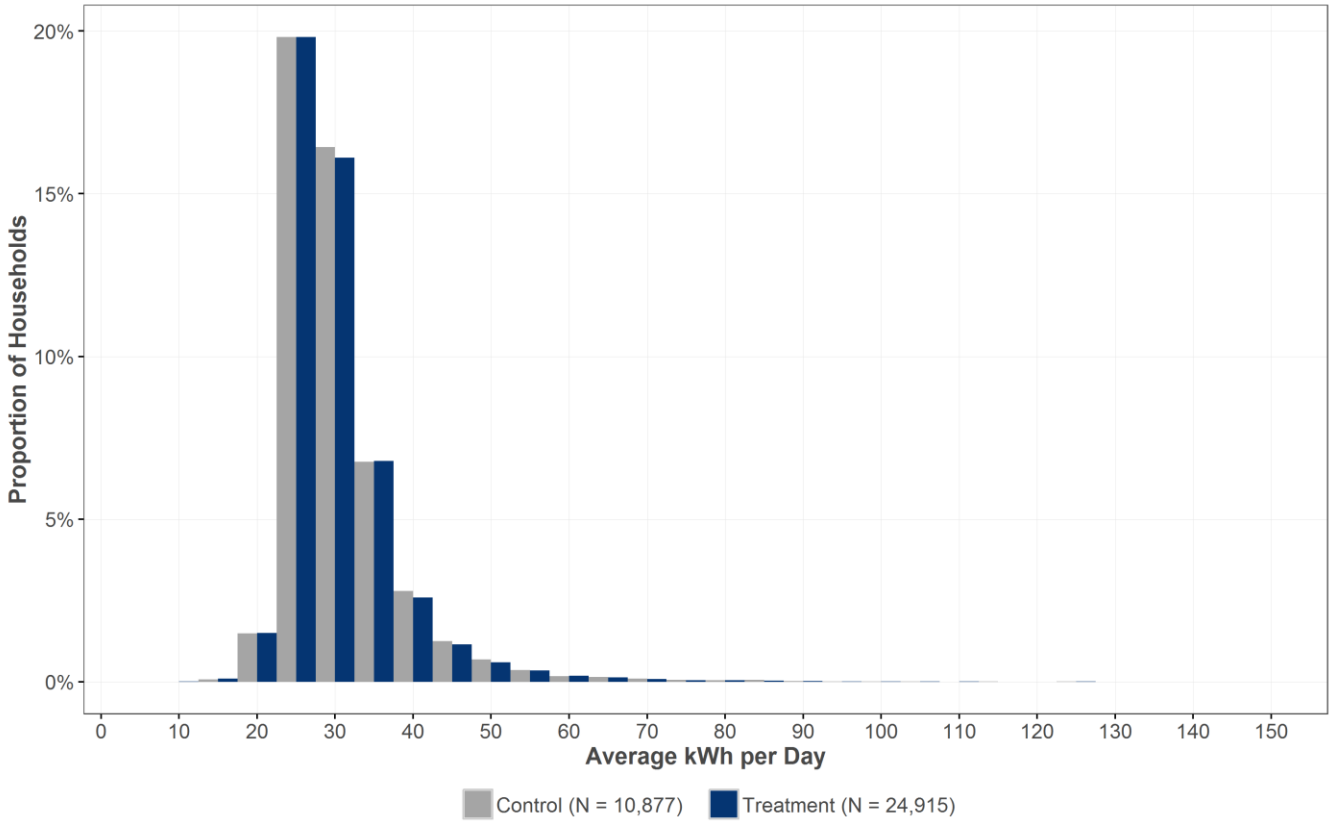
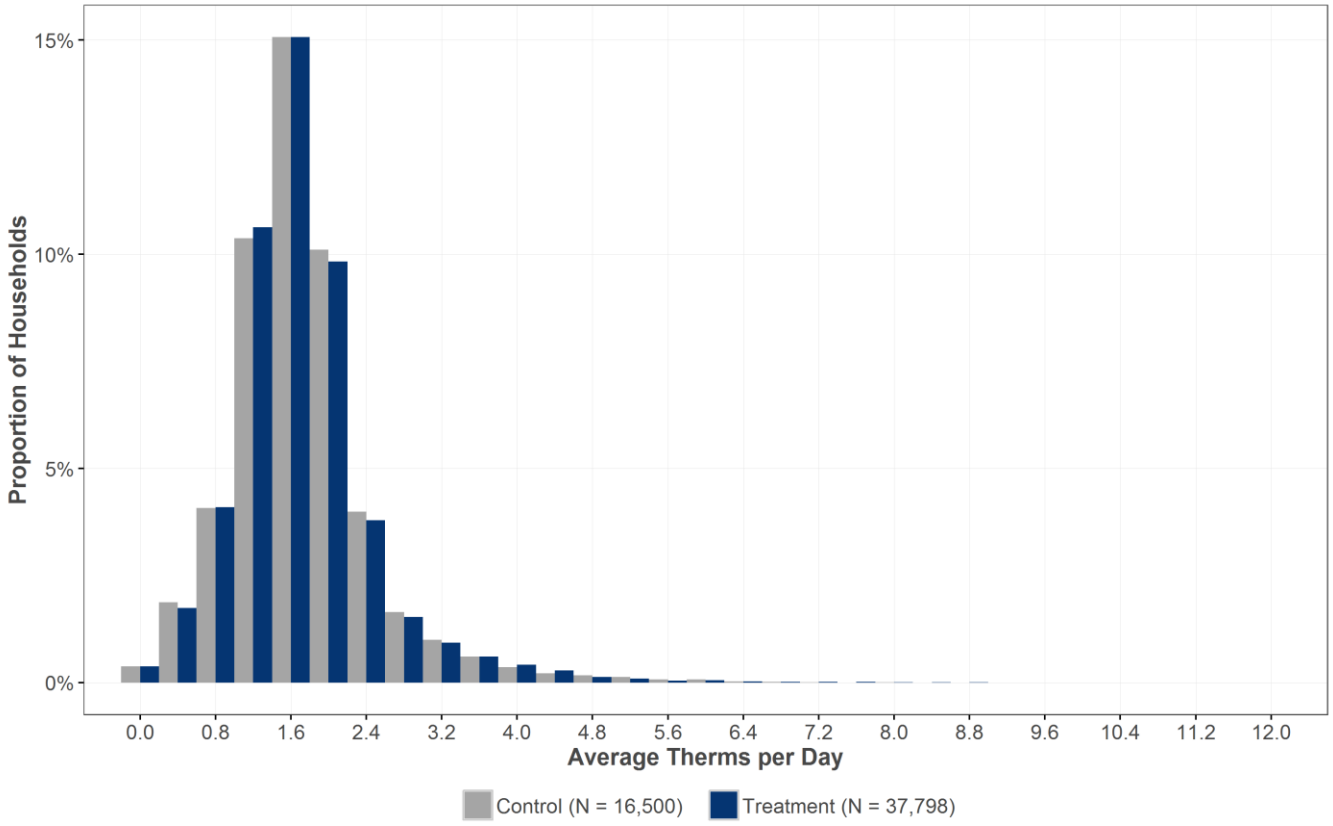


Figure 15. Distribution of Average Daily Gas Consumption in the Year before Start of the Program



A.2 Secondary Demographic and Psychographic Data

The evaluation team obtained secondary data for demographic, housing, and psychographic characteristics for the Expansion Cohort 6 treatment and control groups. Table 28 summarizes key characteristics of treatment and control group members.

Table 28. Expansion Cohort 6: Key Demographic, Housing, and Psychographic Comparisons

Category		Treatment (n=36,515)	Control (n=16,022)
Household	Homeowner listed as deceased[a]	0.33%	0.35%
Demographics			
Age	Under 35	29.6%	30.1%
	35-54	37.1%	37.4%
	55+	33.3%	32.5%
Household size	Avg. number of Adults[b]	2.05	2.06
Children in household	At least 1 child <18 years.	23.2%	23.3%
Education of respondent	Less than High School Diploma	10.5%	10.5%
	High School Diploma	35.5%	36.1%

Category		Treatment (n=36,515)	Control (n=16,022)
	Some College	35.1%	34.0%
	Bachelor Degree	12.1%	12.4%
	Graduate Degree	6.8%	7.1%
Household Income	Under $50K	53.2%	53.1%
	$50-$100K	33.9%	33.7%
	$100-$200K	11.0%	11.3%
	$200K or higher	1.9%	1.9%
Occupation	Sales/Service	12.2%	12.5%
	Professional/Technical	21.4%	21.8%
	Blue Collar	25.8%	25.4%
	Retired	11.7%	11.3%
Gender	Female	48.5%	49.3%
Housing			
Homeownership	Own	64.7%	64.1%
Housing Type	Single-family detached	77.0%	76.8%
Home Size	Home square footage of 100-5,999	99.3%	99.4%
	Home square footage of 6,000-9,999	0.62%	0.54%
	Home square footage of over 10,000	0.04%	0.03%
Age of House	Before 1960	52.4%	53.6%
	1960-1989	27.8%	27.4%
	1990 or later	19.8%	18.9%
Length of Residence	0-9 Years	67.2%	68.1%
	10-20 Years	19.3%	18.8%
	21 Years or Higher	13.4%	13.2%
Psychographic			
Social Causes	Internet Online Subscriber	54.1%	53.7%
	Health	8.1%	8.2%
	Religious	6.1%	6.1%
	Veterans	5.5%	5.4%
	Animal Welfare	4.8%	4.5%
	Political – Conservative	1.5%	1.4%
	Political – Liberal	0.83%	0.73%
	Children	6.7%	6.4%
	Volunteer Work	0.15%	0.18%
	Other Social Cause	10.1%	9.7%

[a] Indicated where "number of adults in household" variable is equal to zero.
[b] Note: Does not count households where homeowner listed as deceased (number of adults in home = 0).

We obtained the data through Experian; Experian's CONSUMERVIEW Database is the foundation for its consumer marketing lists, data enhancement, and data licensing services. It includes compiled, self-reported, and modeled data built using more than 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 29 lists the data points obtained from Experian, with their match rates.

Table 29. Secondary Data from Experian

Data Type	Description of Data	Match Rate
Total Number of Customers Sent to Experian		54,301
Total Matches		54,300
Overall Match Rate		100%
Demographic Data		
Household Income	Income is the total estimated income for a living unit and incorporates several highly predictive individual, household, and geographical level variables including Summarized Credit Statistics.	100%
Number of Adults in Household	Number of Adults in Household is calculated from the number of records in a household. An adult is anyone 19 years old or older living in a household.	100%
Gender	Gender information is applied during the convert prior to enhancement. Records coded as gender include both those with prefixes of Mr. & Mrs. and/or first names.	100%
Occupation – Group	Information is compiled from self-reported surveys, derived from state licensing agencies, or calculated through the application of predictive models.	100%
Education	Information is compiled from self-reported surveys, derived based on occupational information, or calculated through the application of predictive models.	100%
Age	Date of Birth is acquired from public and proprietary files. These sources provide, at a minimum, the year of birth. The birth month is provided where available.	100%
Number of Children (18 or Less)	Number of Children in Household information is calculated from the number of records in a household that indicate children whose age is 18 or younger.	100%
Housing Data		
Dwelling Type	Each household is assigned a dwelling type code based on United States Postal Service (USPS) information.	85.78%
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.	85.78%
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.	85.78%

Data Type	Description of Data	Match Rate
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.	85.78%
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.	85.78%
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	46.23%
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 30 depicts the mean daily usage for treatment and control groups, pre- and post-participation.

Table 30. Average Daily Consumption by Cohort, Treatment v. Control, Pre- v. Post-Participation

Behavioral Modification Program		Pre-Participation		Post-Participation	
		Mean	Standard Deviation	Mean	Standard Deviation
Electric Cohorts (in kWh)					
Original	Treatment	36.21	*20.06*	31.92	*18.76*
	Control	35.80	*19.63*	32.41	*18.99*
Expansion 1	Treatment	41.12	*25.35*	35.29	*22.62*
	Control	41.20	*25.65*	35.93	*23.15*
Expansion 2	Treatment	27.17	*15.92*	24.58	*14.89*
	Control	27.17	*15.91*	24.74	*15.03*
Expansion 4	Treatment	53.14	*27.30*	46.96	*25.40*
	Control	53.05	*27.01*	47.44	*25.38*
Expansion 5	Treatment	33.63	*18.49*	32.04	*18.03*
	Control	33.69	*18.44*	32.37	*18.06*
Expansion 6	Treatment	30.49	*14.60*	29.41	*14.67*
	Control	30.63	*14.71*	29.67	*14.76*
Gas Cohorts (in Therms)					
Original	Treatment	2.64	*2.70*	2.15	*2.15*
	Control	2.65	*2.71*	2.17	*2.17*
Expansion 1	Treatment	3.02	*3.07*	2.43	*2.47*
	Control	3.02	*3.07*	2.47	*2.50*
Expansion 2	Treatment	2.01	*1.90*	1.66	*1.58*
	Control	2.02	*1.90*	1.68	*1.61*
Expansion 3	Treatment	2.36	*2.34*	1.91	*1.90*
	Control	2.38	*2.35*	1.95	*1.95*
Expansion 4	Treatment	2.29	*2.53*	1.91	*2.25*
	Control	2.30	*2.51*	1.92	*2.27*
Expansion 5	Treatment	3.07	*3.20*	2.16	*2.24*
	Control	3.09	*3.22*	2.18	*2.25*
Expansion 6	Treatment	1.76	*1.93*	1.35	*1.48*
	Control	1.75	*1.90*	1.35	*1.49*

C. Appendix – Billing Analysis Data Cleaning Results

Table 31 through Table 43 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. We include both electric and gas data cleaning results to contextualize our results.

Table 31. Data Cleaning Results: Original Cohort, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	99,382	49,694	49,688	7,028,062	3,511,053	3,517,009
No First Report Date	382	382	-	5,342	5,342	-
# remaining	99,000	49,312	49,688	7,022,720	3,505,711	3,517,009
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	99,000	49,312	49,688	7,022,720	3,505,711	3,517,009
First Report Date After Move Out	518	71	447	7,212	1,013	6,199
# remaining	98,482	49,241	49,241	7,015,508	3,504,698	3,510,810
< 9 Month Pre-Participation Period	-	-	-	-	-	-
# remaining	98,482	49,241	49,241	7,015,508	3,504,698	3,510,810
No Post-Participation Period Months	28,102	14,582	13,520	1,189,536	635,777	553,759
# remaining	70,380	34,659	35,721	5,825,972	2,868,921	2,957,051
< 2 ADC Pre-Participation Period	-	-	-	-	-	-
# remaining	70,380	34,659	35,721	5,825,972	2,868,921	2,957,051
< 2 ADC Post-Participation Period	180	93	87	14,285	7,456	6,829
# remaining	70,200	34,566	35,634	5,811,687	2,861,465	2,950,222
Final #	**70,200**	**34,566**	**35,634**	**5,811,687**	**2,861,465**	**2,950,222**
% Removed	**29.36%**	**30.44%**	**28.28%**	**17.31%**	**18.50%**	**16.12%**

Table 32. Data Cleaning Results: Expansion Cohort 1, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	100,890	75,688	25,202	6,197,630	4,644,680	1,552,950
No First Report Date	1,692	1,692	-	22,156	22,156	-
# remaining	99,198	73,996	25,202	6,175,474	4,622,524	1,552,950
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	99,198	73,996	25,202	6,175,474	4,622,524	1,552,950
First Report Date After Move Out	721	135	586	9,482	1,877	7,605
# remaining	98,477	73,861	24,616	6,165,992	4,620,647	1,545,345
< 9 Month Pre-Participation Period	8	4	4	200	177	23
# remaining	98,469	73,857	24,612	6,165,792	4,620,470	1,545,322
No Post-Participation Period Months	27,964	21,374	6,590	1,025,619	793,970	231,649
# remaining	70,505	52,483	18,022	5,140,173	3,826,500	1,313,673
< 2 ADC Pre-Participation Period	-	-	-	-	-	-
# remaining	70,505	52,483	18,022	5,140,173	3,826,500	1,313,673
< 2 ADC Post-Participation Period	208	157	51	14,466	10,939	3,527
# remaining	70,297	52,326	17,971	5,125,707	3,815,561	1,310,146
Final #	**70,297**	**52,326**	**17,971**	**5,125,707**	**3,815,561**	**1,310,146**
% Removed	**30.32%**	**30.87%**	**28.69%**	**17.30%**	**17.85%**	**15.64%**

Table 33. Data Cleaning Results: Expansion Cohort 2, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	132,253	112,670	19,583	7,419,709	6,322,914	1,096,795
No First Report Date	2,686	2,686	-	39,666	39,666	-
# remaining	129,567	109,984	19,583	7,380,043	6,283,248	1,096,795
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	129,567	109,984	19,583	7,380,043	6,283,248	1,096,795
First Report Date After Move Out	789	280	509	9,276	3,356	5,920
# remaining	128,778	109,704	19,074	7,370,767	6,279,892	1,090,875
< 9 Month Pre-Participation Period	2,829	2,388	441	101,042	84,964	16,078
# remaining	125,949	107,316	18,633	7,269,725	6,194,928	1,074,797
No Post-Participation Period Months	34,877	29,848	5,029	1,173,018	1,008,533	164,485
# remaining	91,072	77,468	13,604	6,096,707	5,186,395	910,312
< 2 ADC Pre-Participation Period	-	-	-	-	-	-
# remaining	91,072	77,468	13,604	6,096,707	5,186,395	910,312
< 2 ADC Post-Participation Period	289	241	48	18,187	15,166	3,021
# remaining	90,783	77,227	13,556	6,078,520	5,171,229	907,291
Final #	**90,783**	**77,227**	**13,556**	**6,078,520**	**5,171,229**	**907,291**
% Removed	**31.36%**	**31.46%**	**30.78%**	**18.08%**	**18.21%**	**17.28%**

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

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	41,986	31,489	10,497	1,692,394	1,268,893	423,501
No First Report Date	1,302	1,302	-	14,737	14,737	-
# remaining	40,684	30,187	10,497	1,677,657	1,254,156	423,501
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	40,684	30,187	10,497	1,677,657	1,254,156	423,501
First Report Date After Move Out	517	92	425	5,571	1,049	4,522
# remaining	40,167	30,095	10,072	1,672,086	1,253,107	418,979
< 9 Month Pre-Participation Period	3,334	2,481	853	90,576	67,317	23,259
# remaining	36,833	27,614	9,219	1,581,510	1,185,790	395,720
No Post-Participation Period Months	8,709	6,554	2,155	210,330	159,162	51,168
# remaining	28,124	21,060	7,064	1,371,180	1,026,628	344,552
< 2 ADC Pre-Participation Period	1	1	-	52	52	-
# remaining	28,123	21,059	7,064	1,371,128	1,026,576	344,552
< 2 ADC Post-Participation Period	29	18	11	1,263	779	484
# remaining	28,094	21,041	7,053	1,369,865	1,025,797	344,068
Final #	**28,094**	**21,041**	**7,053**	**1,369,865**	**1,025,797**	**344,068**
% Removed	**33.09%**	**33.18%**	**32.81%**	**19.06%**	**19.16%**	**18.76%**

Table 35. Data Cleaning Results, Expansion Cohort 5, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	75,591	62,993	12,598	2,283,007	1,902,967	380,040
No First Report Date	1,517	1,517	-	22,655	22,655	-
# remaining	74,074	61,476	12,598	2,260,352	1,880,312	380,040
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	74,074	61,476	12,598	2,260,352	1,880,312	380,040
First Report Date After Move Out	481	231	250	5,849	2,736	3,113
# remaining	73,593	61,245	12,348	2,254,503	1,877,576	376,927
< 9 Month Pre-Participation Period	5,782	4,730	1,052	116,637	95,606	21,031
# remaining	67,811	56,515	11,296	2,137,866	1,781,970	355,896
No Post-Participation Period Months	8,635	7,224	1,411	164,893	138,285	26,608
# remaining	59,176	49,291	9,885	1,972,973	1,643,685	329,288
< 2 ADC Pre-Participation Period	1	1	-	24	24	-
# remaining	59,175	49,290	9,885	1,972,949	1,643,661	329,288
< 2 ADC Post-Participation Period	106	85	21	3,071	2,442	629
# remaining	59,069	49,205	9,864	1,969,878	1,641,219	328,659
Final #	**59,069**	**49,205**	**9,864**	**1,969,878**	**1,641,219**	**328,659**
% Removed	**21.86%**	**21.89%**	**21.70%**	**13.72%**	**13.75%**	**13.52%**

Table 36. Data Cleaning Results, Expansion Cohort 6, Electric

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	54,298	37,798	16,500	1,240,224	863,396	376,828
No First Report Date	1,042	1,042	-	10,927	10,927	-
# remaining	53,256	36,756	16,500	1,229,297	852,469	376,828
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	53,256	36,756	16,500	1,229,297	852,469	376,828
First Report Date After Move Out	719	241	478	6,704	2,195	4,509
# remaining	52,537	36,515	16,022	1,222,593	850,274	372,319
< 9 Month Pre-Participation Period	12,183	8,282	3,901	199,057	135,085	63,972
# remaining	40,354	28,233	12,121	1,023,536	715,189	308,347
No Post-Participation Period Months	1,887	1,349	538	25,416	18,222	7,194
# remaining	38,467	26,884	11,583	998,120	696,967	301,153
< 2 ADC Pre-Participation Period	-	-	-	-	-	-
# remaining	38,467	26,884	11,583	998,120	696,967	301,153
< 2 ADC Post-Participation Period	41	25	16	720	442	278
# remaining	38,426	26,859	11,567	997,400	696,525	300,875
Final #	**38,426**	**26,859**	**11,567**	**997,400**	**696,525**	**300,875**
% Removed	**29.23%**	**28.94%**	**29.90%**	**19.58%**	**19.33%**	**20.16%**

Table 37. Data Cleaning Results: Original Cohort, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	99,382	49,694	49,688	7,024,737	3,509,233	3,515,504
No First Report Date	382	382	-	5,351	5,351	-
# remaining	99,000	49,312	49,688	7,019,386	3,503,882	3,515,504
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	99,000	49,312	49,688	7,019,386	3,503,882	3,515,504
First Report Date After Move Out	518	71	447	7,212	1,013	6,199
# remaining	98,482	49,241	49,241	7,012,174	3,502,869	3,509,305
< 9 Month Pre-Participation Period	9	5	4	521	260	261
# remaining	98,473	49,236	49,237	7,011,653	3,502,609	3,509,044
No Post-Participation Period Months	28,139	14,605	13,534	1,190,778	636,724	554,054
# remaining	70,334	34,631	35,703	5,820,875	2,865,885	2,954,990
< 0.07 ADC Pre-Participation Period	-	-	-	-	-	-
# remaining	70,334	34,631	35,703	5,820,875	2,865,885	2,954,990
< 0.07 Post-Participation Period	235	113	122	18,221	8,781	9,440
# remaining	70,099	34,518	35,581	5,802,654	2,857,104	2,945,550
Final #	**70,099**	**34,518**	**35,581**	**5,802,654**	**2,857,104**	**2,945,550**
% Removed	**29.5%**	**30.5%**	**28.4%**	**17.4%**	**18.6%**	**16.2%**

Table 38. Data Cleaning Results: Expansion Cohort 1, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	100,890	75,688	25,202	6,192,104	4,640,372	1,551,732
No First Report Date	1,692	1,692	-	22,132	22,132	-
# remaining	99,198	73,996	25,202	6,169,972	4,618,240	1,551,732
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	99,198	73,996	25,202	6,169,972	4,618,240	1,551,732
First Report Date After Move Out	721	135	586	9,509	1,878	7,631
# remaining	98,477	73,861	24,616	6,160,463	4,616,362	1,544,101
< 9 Month Pre-Participation Period	23	13	10	1,006	585	421
# remaining	98,454	73,848	24,606	6,159,457	4,615,777	1,543,680
No Post-Participation Period Months	28,009	21,408	6,601	1,026,278	794,420	231,858
# remaining	70,445	52,440	18,005	5,133,179	3,821,357	1,311,822
< 0.07 ADC Pre-Participation Period	23	16	7	1,615	1,121	494
# remaining	70,422	52,424	17,998	5,131,564	3,820,236	1,311,328
< 0.07 Post-Participation Period	367	289	78	24,722	19,440	5,282
# remaining	70,055	52,135	17,920	5,106,842	3,800,796	1,306,046
Final #	**70,055**	**52,135**	**17,920**	**5,106,842**	**3,800,796**	**1,306,046**
% Removed	**30.6%**	**31.1%**	**28.9%**	**17.5%**	**18.1%**	**15.8%**

Table 39. Data Cleaning Results: Expansion Cohort 2, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	132,253	112,670	19,583	7,414,010	6,317,767	1,096,243
No First Report Date	2,686	2,686	-	39,320	39,320	-
# remaining	129,567	109,984	19,583	7,374,690	6,278,447	1,096,243
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	129,567	109,984	19,583	7,374,690	6,278,447	1,096,243
First Report Date After Move Out	789	280	509	9,289	3,356	5,933
# remaining	128,778	109,704	19,074	7,365,401	6,275,091	1,090,310
< 9 Month Pre-Participation Period	2,848	2,404	444	101,827	85,609	16,218
# remaining	125,930	107,300	18,630	7,263,574	6,189,482	1,074,092
No Post-Participation Period Months	34,943	29,905	5,038	1,174,524	1,009,750	164,774
# remaining	90,987	77,395	13,592	6,089,050	5,179,732	909,318
< 0.07 ADC Pre-Participation Period	112	93	19	7,452	6,182	1,270
# remaining	90,875	77,302	13,573	6,081,598	5,173,550	908,048
< 0.07 Post-Participation Period	650	558	92	39,300	33,726	5,574
# remaining	90,225	76,744	13,481	6,042,298	5,139,824	902,474
Final #	**90,225**	**76,744**	**13,481**	**6,042,298**	**5,139,824**	**902,474**
% Removed	**31.8%**	**31.9%**	**31.2%**	**18.5%**	**18.6%**	**17.7%**

Table 40. Data Cleaning Results: Expansion Cohort 3, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	30,740	20,632	10,108	1,538,516	1,035,536	502,980
No First Report Date	2,011	2,011	-	26,848	26,848	-
# remaining	28,729	18,621	10,108	1,511,668	1,008,688	502,980
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	28,729	18,621	10,108	1,511,668	1,008,688	502,980
First Report Date After Move Out	1,793	493	1,300	23,601	6,329	17,272
# remaining	26,936	18,128	8,808	1,488,067	1,002,359	485,708
< 9 Month Pre-Participation Period	44	29	15	1,471	967	504
# remaining	26,892	18,099	8,793	1,486,596	1,001,392	485,204
No Post-Participation Period Months	8,223	5,567	2,656	232,251	159,259	72,992
# remaining	18,669	12,532	6,137	1,254,345	842,133	412,212
< 0.07 ADC Pre-Participation Period	-	-	-	-	-	-
# remaining	18,669	12,532	6,137	1,254,345	842,133	412,212
< 0.07 Post-Participation Period	61	43	18	3,741	2,639	1,102
# remaining	18,608	12,489	6,119	1,250,604	839,494	411,110
Final #	**18,608**	**12,489**	**6,119**	**1,250,604**	**839,494**	**411,110**
% Removed	**39.5%**	**39.5%**	**39.5%**	**18.7%**	**18.9%**	**18.3%**

Table 41. Data Cleaning Results: Expansion Cohort 4, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	41,982	31,488	10,494	1,688,735	1,266,218	422,517
No First Report Date	1,301	1,301	-	14,418	14,418	-
# remaining	40,681	30,187	10,494	1,674,317	1,251,800	422,517
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	40,681	30,187	10,494	1,674,317	1,251,800	422,517
First Report Date After Move Out	517	92	425	5,554	1,044	4,510
# remaining	40,164	30,095	10,069	1,668,763	1,250,756	418,007
< 9 Month Pre-Participation Period	3,474	2,581	893	94,730	70,415	24,315
# remaining	36,690	27,514	9,176	1,574,033	1,180,341	393,692
No Post-Participation Period Months	8,722	6,568	2,154	210,748	159,579	51,169
# remaining	27,968	20,946	7,022	1,363,285	1,020,762	342,523
< 0.07 ADC Pre-Participation Period	755	573	182	36,860	27,983	8,877
# remaining	27,213	20,373	6,840	1,326,425	992,779	333,646
< 0.07 Post-Participation Period	525	390	135	23,411	17,466	5,945
# remaining	26,688	19,983	6,705	1,303,014	975,313	327,701
Final #	**26,688**	**19,983**	**6,705**	**1,303,014**	**975,313**	**327,701**
% Removed	**36.4%**	**36.5%**	**36.1%**	**22.8%**	**23.0%**	**22.4%**

Table 42. Data Cleaning Results: Expansion Cohort 5, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	75,591	62,993	12,598	2,281,847	1,901,945	379,902
No First Report Date	1,517	1,517	-	22,660	22,660	-
# remaining	74,074	61,476	12,598	2,259,187	1,879,285	379,902
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	74,074	61,476	12,598	2,259,187	1,879,285	379,902
First Report Date After Move Out	481	231	250	5,857	2,738	3,119
# remaining	73,593	61,245	12,348	2,253,330	1,876,547	376,783
< 9 Month Pre-Participation Period	5,846	4,788	1,058	118,158	97,023	21,135
# remaining	67,747	56,457	11,290	2,135,172	1,779,524	355,648
No Post-Participation Period Months	8,630	7,220	1,410	164,727	138,135	26,592
# remaining	59,117	49,237	9,880	1,970,445	1,641,389	329,056
< 0.07 ADC Pre-Participation Period	134	112	22	4,345	3,640	705
# remaining	58,983	49,125	9,858	1,966,100	1,637,749	328,351
< 0.07 Post-Participation Period	616	501	115	16,195	13,123	3,072
# remaining	58,367	48,624	9,743	1,949,905	1,624,626	325,279
Final #	**58,367**	**48,624**	**9,743**	**1,949,905**	**1,624,626**	**325,279**
% Removed	**22.8%**	**22.8%**	**22.7%**	**14.5%**	**14.6%**	**14.4%**

Table 43. Data Cleaning Results: Expansion Cohort 6, Gas

	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	54,299	37,799	16,500	1,237,617	861,614	376,003
No First Report Date	1,043	1,043	-	10,810	10,810	-
# remaining	53,256	36,756	16,500	1,226,807	850,804	376,003
First Report Date After Opt Out	-	-	-	-	-	-
# remaining	53,256	36,756	16,500	1,226,807	850,804	376,003
First Report Date After Move Out	719	241	478	6,693	2,186	4,507
# remaining	52,537	36,515	16,022	1,220,114	848,618	371,496
< 9 Month Pre-Participation Period	12,440	8,455	3,985	203,586	138,050	65,536
# remaining	40,097	28,060	12,037	1,016,528	710,568	305,960
No Post-Participation Period Months	1,877	1,336	541	25,306	18,058	7,248
# remaining	38,220	26,724	11,496	991,222	692,510	298,712
< 0.07 ADC Pre-Participation Period	500	332	168	12,405	8,228	4,177
# remaining	37,720	26,392	11,328	978,817	684,282	294,535
< 0.07 Post-Participation Period	883	603	280	16,268	11,101	5,167
# remaining	36,837	25,789	11,048	962,549	673,181	289,368
Final #	**36,837**	**25,789**	**11,048**	**962,549**	**673,181**	**289,368**
% Removed	**32.2%**	**31.8%**	**33.0%**	**22.2%**	**21.9%**	**23.0%**

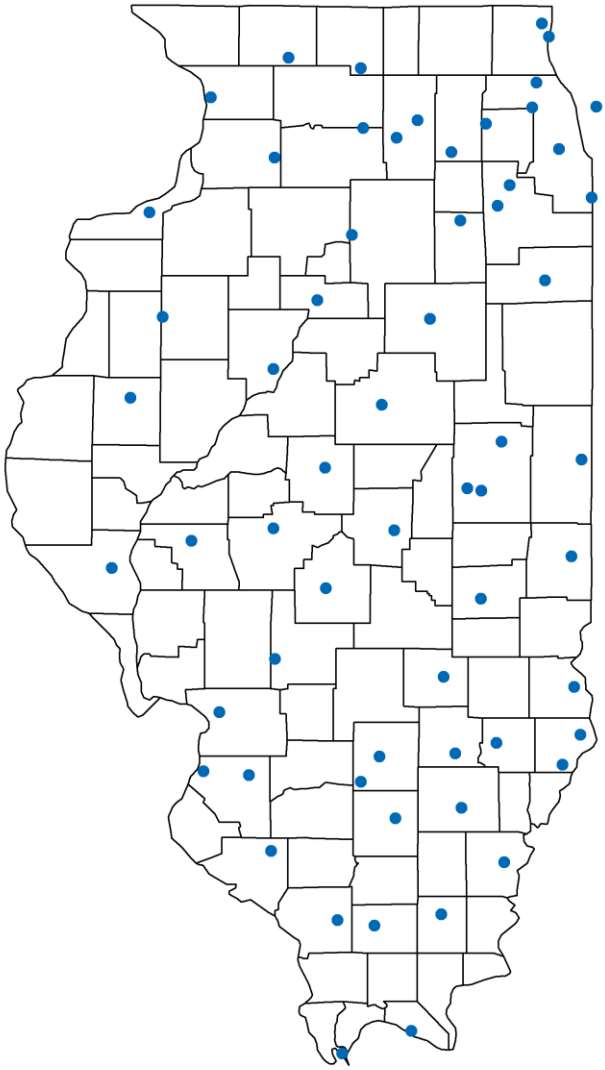
D. Appendix – Weather Station Details

Table 44. Weather Stations Used for HDD and CDD

Weather Station Name	Abbreviation	US Air Force (USAF)	Weather-Bureau-Army-Navy (WBAN)	Latitude	Longitude
QUAD CITY INTERNATIONAL AIRPORT	KMLI	725440	14923	41.465	-90.523
ST LOUIS DOWNTOWN AIRPORT	KCPS	725314	3960	38.571	-90.157
GREATER PEORIA REGIONAL AIRPORT	KPIA	725320	14842	40.668	-89.684
SCOTT AIR FORCE BASE/MIDAMERICA AIRPORT	KBLV	724338	13802	38.55	-89.85
EFFINGHAM COUNTY MEMORIAL ARPT		999999	93816	39.07	-88.533
ST LOUIS REGIONAL AIRPORT	KALN	724395	3958	38.883	-90.05
LITCHFIELD MUNICIPAL AIRPORT	K3LF	722972	63878	39.163	-89.675
ABRAHAM LINCOLN CAPITAL AIRPORT	KSPI	724390	93822	39.845	-89.684
TAYLORVILLE MINICIPAL ARPT	KTAZ	744662	63817	39.534	-89.328
LOGAN COUNTY AIRPORT	KAAA	744672	4862	40.158	-89.335
DECATUR AIRPORT	KDEC	725316	3887	39.834	-88.866
ILLINOIS VALLEY RGNL-WALTER DUNCAN FLD ARPT	KVYS	722149	4899	41.352	-89.153
PALWAUKEE MUNICIPAL ARPT	KPWK	744665	4838	42.121	-87.905
SOUTHERN ILLINOIS AIRPORT	KMDH	724336	93810	37.78	-89.25
UNIVERSI OF IL WILLARD APT	KCMI	725315	94870	40.04	-88.278
MACOMB MUNICIPAL AIRPORT	KMQB	722157	4949	40.52	-90.652
MARSHALL CO	KC75	720141	4868	41.019	-89.386
GALESBURG MUNICIPAL ARPT	KGBG	722089	94959	40.933	-90.433
VERMILION COUNTY AIRPORT	KDNV	722076	94891	40.2	-87.6
MOUNT VERNON AIRPORT	KMVN	724335	93894	38.323	-88.858
WILLIAMSON COUNTY RGNL APT	KMWA	724339	3865	37.75	-89
CHAMPAIGN 9 SW		999999	54808	40.053	-88.373
PITTSFIELD-PENSTON MUNI AP	KPPQ	744663	53950	39.639	-90.778
WHITESIDE CO ARPT-JOS H BITTOR F FLD ARPT	KSQI	725326	4894	41.743	-89.676
SHABBONA 5 NNE		999999	54811	41.843	-88.851
RANTOUL NATL AVN CNTR-F ELLIOTT FIELD AIRPORT	KTIP	722194	4896	40.293	-88.142
JACKSONVILLE MUNICIPAL AIRPORT	KIJX	744666	53944	39.78	-90.238
SPARTA COMMUNITY-HUNTER FIELD AIRPORT	KSAR	744653	63814	38.149	-89.699
COLES COUNTY MEMO AIRPORT	KMTO	725317	53802	39.478	-88.28
CENTRALIA MUNICIPAL ARPT	KENL	744657	53887	38.515	-89.092
LEWIS UNIVERSITY AIRPORT	KLOT	725348	4831	41.604	-88.085
EDGAR COUNTY AIRPORT	KPRG	722172	63810	39.7	-87.669
CHICAGO O'HARE INTERNATIONAL AIRPORT	KORD	725300	94846	41.995	-87.934
SALEM-LECKRONE AIRPORT	KSLO	724330	3879	38.65	-88.967

Weather Station Name	Abbreviation	US Air Force (USAF)	Weather-Bureau-Army-Navy (WBAN)	Latitude	Longitude
AURORA MUNICIPAL AIRPORT	KARR	744655	4808	41.77	-88.481
ROBINSON MUNICIPAL AIRPORT	KRSV	720319	63841	39.016	-87.65
CHICAGO MIDWAY INTL ARPT	KMDW	725340	14819	41.786	-87.752
CENTRAL ILLINOIS REGIONAL AIRPORT	KBMI	724397	54831	40.483	-88.95
WAUKEGAN REGIONAL AIRPORT	KUGN	725347	14880	42.417	-87.867
OLNEY-NOBLE AIRPORT	KOLY	744659	53822	38.722	-88.176
LANSING MUNICIPAL AP	KIGQ	722126	4879	41.54	-87.532
JOLIET REGIONAL AIRPORT	KJOT	725345	14834	41.5	-88.167
DE KALB TAYLOR MUNI ARPT	KDKB	722075	4871	41.932	-88.708
FLORA MUNICIPAL AIRPORT	KFOA	744658	53889	38.665	-88.453
CARMI MINICIPAL AIRPORT	KCUL	722074	63840	38.089	-88.123
ALBERTUS AIRPORT	KFEP	722082	4876	42.246	-89.582
GREATER KANKAKEE AIRPORT	KIKK	722127	4880	41.121	-87.846
DUPAGE AIRPORT	KDPA	725305	94892	41.914	-88.246
HARRISBURG-RALEIGH AIRPORT	KHSB	744652	53897	37.811	-88.549
GREATER ROCKFORD AIRPORT	KRFD	725430	94822	42.193	-89.093
FAIRFIELD MUNICIPAL ARPT	KFWC	744656	53891	38.379	-88.413
METROPOLIS MUNICIPAL AIRPORT	KM30	720170	63851	37.186	-88.751
WAUKEGAN HARBOR		997735	99999	42.35	-87.82
ROCHELLE MUNI ARPT-KORITZ FIELD AIRPORT	KRPJ	722182	4890	41.893	-89.078
MOUNT CARMEL MUNICIPAL AIRPORT	KAJG	720330	63853	38.607	-87.727
CAIRO REGIONAL AIRPORT	KCIR	724975	93809	37.064	-89.219
MORS MUNI-J.R. WSBRN FD AP	KC09	720137	4867	41.425	-88.419
PONTIAC MUNICIPAL AIRPORT	KPNT	722171	4889	40.924	-88.625
TRI-TOWNSHIP AIRPORT	KSFY	722204	4996	42.046	-90.108
CHICAGO		997338	99999	42	-87.5
LRNCVLL-VINCNES INTL ARPT	KLWV	725342	13809	38.764	-87.606

Figure 16. Map of Weather Stations Used for HDD and CDD



E. Appendix – Billing Analysis Model Coefficients

Below we provide the billing analysis model coefficients and per-year savings results. We include both electric and gas model coefficients to contextualize our results.

E.1 Original Model Coefficients

Table 45 and Table 46 show the original billing analysis model coefficients for the electric and gas cohorts.

Table 45. Original Model Billing Analysis Model Coefficients – Electric

Variable	Coefficient	Standard Error
Original Cohort		
Post	-3.423203199	0.032211049
Post x Treatment	-0.91469067	0.045919789
Expansion Cohort 1		
Post	-5.311158623	0.053187981
Post x Treatment	-0.578941089	0.061652371
Expansion Cohort 2		
Post	-2.452151438	0.041295012
Post x Treatment	-0.154333496	0.044773623
Expansion Cohort 4		
Post	-5.658812516	0.104492992
Post x Treatment	-0.593848106	0.120744003
Expansion Cohort 5		
Post	-1.306089768	0.059069017
Post x Treatment	-0.279730217	0.064695957
Expansion Cohort 6		
Post	-0.992439846	0.048537933
Post x Treatment	-0.116075868	0.058071768

Table 46. Original Model Billing Analysis Model Coefficients – Gas

Variable	Coefficient	Standard Error
Original Cohort		
Post	-0.481226723	0.005192944
Post x Treatment	-0.020914912	0.007402429
Expansion Cohort 1		
Post	-0.562117628	0.00838862
Post x Treatment	-0.031031086	0.009723666
Expansion Cohort 2		
Post	-0.342543588	0.006220645
Post x Treatment	-0.012592709	0.006745142

Variable	Coefficient	Standard Error
Expansion Cohort 3		
Post	-0.430170523	0.011006191
Post x Treatment	-0.028684872	0.013433813
Expansion Cohort 4		
Post	-0.380644993	0.010919599
Post x Treatment	-0.009310455	0.012621835
Expansion Cohort 5		
Post	-0.921091422	0.011500668
Post x Treatment	-0.002046324	0.012596749
Expansion Cohort 6		
Post	-0.414685217	0.006430847
Post x Treatment	-0.00863895	0.007688646

E.2 Weather-Adjusted Model Coefficients

Table 47 and Table 48 show the weather-adjusted billing analysis model coefficients for the electric and gas cohorts.

Table 47. Weather-Adjusted Model Billing Analysis Model Coefficients – Electric

Variable	Coefficient	Robust Standard Error
Original Cohort		
Post	-3.086150724	0.026263163
CDD	0.225105237	0.00027609
HDD	0.007331037	2.96378E-05
Post x Treatment	-0.378151884	0.037353663
Expansion Cohort 1		
Post	-1.507659763	0.042553528
CDD	0.249871786	0.00029445
HDD	0.009741644	3.64529E-05
Post x Treatment	-0.571568798	0.048877323
Expansion Cohort 2		
Post	0.185282465	0.032066497
CDD	0.153096864	0.000150525
HDD	0.00536148	2.07683E-05
Post x Treatment	-0.168284939	0.03455991
Expansion Cohort 4		
Post	-1.00044324	0.09342235
CDD	0.188320333	0.000463923
HDD	0.017656176	8.38042E-05
Post x Treatment	-0.788157666	0.106887129

Variable	Coefficient	Robust Standard Error
Expansion Cohort 5		
Post	-0.85113395	0.051931975
CDD	0.230944512	0.000397855
HDD	0.009153087	3.48363E-05
Post x Treatment	-0.417936402	0.056700282
Expansion Cohort 6		
Post	-0.817074025	0.043854895
CDD	0.187956988	0.000441899
HDD	0.010169172	4.28047E-05
Post x Treatment	-0.169808624	0.052280032

Table 48. Weather-Adjusted Model Billing Analysis Model Coefficients – Gas

Variable	Coefficient	Robust Standard Error
Original Cohort		
Post	-0.139721132	0.002430146
CDD	0.003872768	2.55559E-05
HDD	0.005215388	2.74238E-06
Post x Treatment	-0.014141589	0.003456096
Expansion Cohort 1		
Post	-0.08778445	0.003895015
CDD	0.004097434	2.69692E-05
HDD	0.006120448	3.33747E-06
Post x Treatment	-0.025432403	0.004473721
Expansion Cohort 2		
Post	0.017135323	0.002510881
CDD	0.002395798	1.18048E-05
HDD	0.004109084	1.62748E-06
Post x Treatment	-0.010089051	0.002706256
Expansion Cohort 3		
Post	0.018412123	0.005239051
CDD	0.003078974	3.43176E-05
HDD	0.004924225	5.1889E-06
Post x Treatment	-0.029852619	0.006302776
Expansion Cohort 4		
Post	0.007024516	0.006659836
CDD	0.002390497	3.32205E-05
HDD	0.004859235	5.97736E-06
Post x Treatment	-0.011696725	0.007622003

Variable	Coefficient	Robust Standard Error
Expansion Cohort 5		
Post	-0.114020596	0.005351076
CDD	0.005639635	4.10803E-05
HDD	0.005742918	3.59371E-06
Post x Treatment	-0.007395488	0.005842635
Expansion Cohort 6		
Post	-0.027034714	0.003502214
CDD	0.003665485	3.53527E-05
HDD	0.003525697	3.42271E-06
Post x Treatment	-0.010797591	0.00417242

E.3 Standard Weather-Year Model Coefficients

Table 49 and Table 50 show the standard weather-year model coefficients for the electric and gas cohorts.

Table 49. Standard Weather-Year Model Coefficients - Electric

Variable	Coefficient	Robust Standard Error
Original Cohort		
Post	-3.088532802	0.026274971
CDD	0.224810605	0.000302464
HDD	0.007292038	3.21956E-05
Post x Treatment	-0.541862416	0.063461679
CDD x Post x Treatment	0.001992574	0.000747647
HDD x Post x Treatment	0.000261714	8.28204E-05
Expansion Cohort 1		
Post	-1.526457826	0.042652247
CDD	0.247298938	0.000330006
HDD	0.009936836	4.26205E-05
Post x Treatment	-0.873661264	0.07024181
CDD x Post x Treatment	0.01446173	0.000731007
HDD x Post x Treatment	-0.000318743	8.32668E-05
Expansion Cohort 2		
Post	0.13452109	0.032035719
CDD	0.148098843	0.000167307
HDD	0.005631221	2.49545E-05
Post x Treatment	-1.197840392	0.043928629
CDD x Post x Treatment	0.030669122	0.000381946
HDD x Post x Treatment	0.000270233	4.59147E-05

Variable	Coefficient	Robust Standard Error
Expansion Cohort 4		
Post	-1.071420284	0.093133291
CDD	0.17969428	0.000501734
HDD	0.018824562	0.000102684
Post x Treatment	-4.499897708	0.149110434
CDD x Post x Treatment	0.096550618	0.001376228
HDD x Post x Treatment	0.001782983	0.000185303
Expansion Cohort 5		
Post	-0.82056871	0.051985159
CDD	0.233649028	0.000553427
HDD	0.009434299	4.19439E-05
Post x Treatment	0.187588056	0.076153626
CDD x Post x Treatment	-0.007212029	0.000799058
HDD x Post x Treatment	-0.000995705	7.86992E-05
Expansion Cohort 6		
Post	-0.770363595	0.043888468
CDD	0.185961377	0.00056977
HDD	0.010474188	5.04212E-05
Post x Treatment	0.378809295	0.080077826
CDD x Post x Treatment	0.001323927	0.00090282
HDD x Post x Treatment	-0.001574721	9.75412E-05

Table 50. Standard Weather-Year Model Coefficients - Gas

Variable	Coefficient	Robust Standard Error
Original Cohort		
Post	-0.140129544	0.002430306
CDD	0.003496007	2.79893E-05
HDD	0.005205461	2.97809E-06
Post x Treatment	-0.113473638	0.005869119
CDD x Post x Treatment	0.0021508	6.91527E-05
HDD x Post x Treatment	8.57299E-05	7.6583E-06
Expansion Cohort 1		
Post	-0.093345945	0.003901395
CDD	0.003584064	3.02117E-05
HDD	0.006133143	3.90044E-06
Post x Treatment	-0.114984503	0.006424093
CDD x Post x Treatment	0.002769906	6.68687E-05
HDD x Post x Treatment	1.99169E-05	7.61458E-06

Variable	Coefficient	Robust Standard Error
Expansion Cohort 2		
Post	0.012430192	0.002512783
CDD	0.002086621	1.31462E-05
HDD	0.004106308	1.95953E-06
Post x Treatment	-0.089366842	0.003446279
CDD x Post x Treatment	0.001779548	2.99855E-05
HDD x Post x Treatment	6.60803E-05	3.60256E-06
Expansion Cohort 3		
Post	0.016114427	0.005247266
CDD	0.002780179	3.71539E-05
HDD	0.004954166	5.95522E-06
Post x Treatment	-0.108251039	0.009589968
CDD x Post x Treatment	0.002493452	9.68414E-05
HDD x Post x Treatment	-7.74199E-06	1.24507E-05
Expansion Cohort 4		
Post	0.004154706	0.006672836
CDD	0.002113956	3.61109E-05
HDD	0.004889431	7.36732E-06
Post x Treatment	-0.132367822	0.010697638
CDD x Post x Treatment	0.003002732	9.90972E-05
HDD x Post x Treatment	7.06335E-05	1.32803E-05
Expansion Cohort 5		
Post	-0.104472291	0.00535307
CDD	0.005747609	5.71411E-05
HDD	0.005811903	4.3267E-06
Post x Treatment	0.137107195	0.007843177
CDD x Post x Treatment	-0.000933658	8.244E-05
HDD x Post x Treatment	-0.000300672	8.10432E-06
Expansion Cohort 6		
Post	-0.027645249	0.003506153
CDD	0.003663235	4.56873E-05
HDD	0.003520299	4.04132E-06
Post x Treatment	-0.021432155	0.006387698
CDD x Post x Treatment	5.01489E-05	7.2166E-05
HDD x Post x Treatment	2.39533E-05	7.77254E-06

E.4 Lagged Dependent Variable Model Coefficients

The LDV billing model analysis coefficients for the electric and gas cohorts are available in the evaluation binder.

E.5 Per-Year Savings

In Table 51 and Table 52, we present the billing analysis results using the weather-adjusted model (used for ex post savings claims) across program years. These provide the electric and gas percent household savings by cohort and by year.

Table 51. Per-Year Saving 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	Sixth Year in Program
Original Cohort *(Average Annual Usage: 12,453 kWh)*	1.20%	1.46%	1.56%	1.81% (1.76%*)	1.75% (1.75%[a])	2.81% (1.17%[a])
Expansion Cohort 1 *(Average Annual Usage: 14,084 kWh)*	1.29%	1.62%	1.98% (1.95%[a])	1.73% (1.70%[a])	1.62% (1.60%*)	
Expansion Cohort 2 *(Average Annual Usage: 9,478 kWh)*	0.87%	0.87%	1.2% (1.14%[a])	0.67% (0.65%[a])	0.62% (0.68%[a])	
Expansion Cohort 4 *(Average Annual Usage: 18,342 kWh)*	1.37% (1.35%*)	1.28% (1.25%*)	1.25% (1.66%[a])			
Expansion Cohort 5 *(Average Annual Usage: 12,064 kWh)*	0.66% (0.66%*)	0.86% (1.29%*)				
Expansion Cohort 6 *(Average Annual Usage: 11,017 kWh)*	0.39% (0.57%*)					

Note: Baseline consumption is from the year before the first report was sent.
[a] Provide weather-adjusted results for comparison purposes only.

Table 52. Per-Year Saving 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	Sixth Year in Program
Original Cohort *(Average Annual Usage: 879 therms)*	0.70%	1.03%	1.04%	0.91% (1.03%*)	0.95% (0.91%[a])	0.97% (0.65%[a])
Expansion Cohort 1 *(Average Annual Usage: 1,001 therms)*	0.79%	1.29%	1.12% (1.52%[a])	0.94% (0.93%[a])	1.26% (1.03%[a])	
Expansion Cohort 2 *(Average Annual Usage: 674 therms)*	0.35%	0.51%	0.72% (0.85%[a])	0.51% (0.60%*)	0.75% (0.60%[a])	
Expansion Cohort 3 *(Average Annual Usage: 791 therms)*	0.96%	0.71%	1.11% (1.25%[a])	1.67% (1.61%*)	1.48% (1.54%)	

Gas Cohorts	First Year in Program	Second Year in Program	Third Year in Program	Fourth Year in Program	Fifth Year in Program	Sixth Year in Program
Expansion Cohort 4 *(Average Annual Usage: 770 therms)*	0.37% (0.24%[a])	0.72% (0.80%[a])	0.49% (0.61%[a])			
Expansion Cohort 5 *(Average Annual Usage: 960 therms)*	0.44% (0.36%[a])	0.09% (0.34%[a])				
Expansion Cohort 6 *(Average Annual Usage: 568 therms)*	0.63% (0.79%*)					

Note: Baseline consumption is from the year before the first report was sent.
[a] Provide weather-adjusted results for comparison purposes only.

E.6 Summary of CDD and HDD

Table 53 below summarizes average pre- and post-participation period HDD and CDD for treatment and control groups for each cohort.

Table 53. Average Pre- and Post-Participation Period HDD and CDD for Treatment and Control Customers by Cohort

Period	Cohort	Average CDD (Control)	Average CDD (Treatment)	Average HDD (Control)	Average HDD (Treatment)	Difference in Average CDD	Difference in Average HDD
Pre-Participation Period	Original Cohort	29.4	31.8	460.0	459.4	-2.4	0.6
	Expansion 1	42.0	42.1	462.1	462.6	0.0	-0.5
	Expansion 2	44.5	44.5	469.8	469.7	0.0	0.1
	Expansion 3	48.4	48.5	453.3	452.7	-0.1	0.5
	Expansion 4	49.5	48.5	451.2	451.0	1.0	0.2
	Expansion 5	27.4	26.9	528.1	527.7	0.5	0.4
	Expansion 6	26.5	26.4	493.1	492.2	0.1	0.9
Post-Participation Period	Original Cohort	29.9	29.9	395.4	395.4	0.0	0.0
	Expansion 1	29.3	29.3	394.7	394.1	-0.1	0.6
	Expansion 2	29.8	29.9	391.9	391.3	-0.1	0.6
	Expansion 3	32.3	32.3	373.6	373.3	0.0	0.3
	Expansion 4	31.1	31.1	381.7	382.0	0.0	-0.3
	Expansion 5	30.6	30.7	387.5	387.4	-0.1	0.1
	Expansion 6	31.2	31.3	380.9	380.4	-0.2	0.5

Table 54 compares average monthly HDD and CDD values for the TMY3 Standard Weather-Year and the actual PY8 post-participation period.

Table 54. Average Monthly HDD and CDD for Standard Weather-Year and Actual PY8 Post-Participation Period

Month	HDD		CDD	
	TMY3	PY8 Post-Participation Period	TMY3	PY8 Post-Participation Period
1	1,270	1,119	0	0
2	1,008	876	0	0
3	752	518	0	0
4	409	352	16	7
5	146	167	21	23
6	47	19	57	69
7	16	11	102	109
8	33	27	75	75
9	105	63	24	72
10	417	289	1	5
11	775	530	0	0
12	1,105	718	0	0

E.7 Comparison with OPower Results

As part of the evaluation effort, we compared OPower's cleaned and calendarized billing dataset with our evaluation dataset. To identify why savings estimates from OPower's models might diverge from those developed by the evaluation team elsewhere in this report. We identified the following factors that may explain divergences in savings results, including data cleaning procedures, time periods included in the analysis, and model specifications.

Data Cleaning

According to interviews with and documentation provided by OPower, there are several methodological differences in OPower's data cleaning from the evaluation team's data cleaning process, such as:

- OPower uses calendarization to assign energy consumption into months. In contrast, this evaluation uses the bill midpoint to assign consumption into a particular month. Our direct comparison of consumption between these two methods shows that they are slightly different on average.
- OPower fills some missing data using imputation. This approach effects both participants and control customers. We were not able to assess the direct impact on savings because the imputed values are not marked in the OPower dataset.
- OPower keeps partial months for customers who move out, meaning that final months for customers may only reflect partial data. Our analysis removes partial last months from the analysis dataset to avoid weighting consumption from the early days of the month higher than later in the month. We still assign savings through the last day of the final bill, so the savings estimates cover the same period in both approaches.

On average, the cleaned OPower data is somewhat different from our cleaned data. Table 55 shows pre-participation period average consumption and number of customers in the billing analysis dataset for the OPower evaluation data by wave and fuel.

Table 55. Daily Consumption and Customer Counts from OPower and Evaluation Data

Data Source	Fuel	Wave	Pre-Participation Period Daily Consumption	Number of Treatment Customers	Number of Control Customers
OPower	Electric	Original Cohort	36.0	34566	35634
Evaluation	Electric	Original Cohort	34.3	35685	35829
OPower	Electric	Expansion 1	41.2	52326	17971
Evaluation	Electric	Expansion 1	40.2	53868	18089
OPower	Electric	Expansion 2	27.2	77227	13556
Evaluation	Electric	Expansion 2	27.2	79849	13835
OPower	Electric	Expansion 4	53.2	21041	7053
Evaluation	Electric	Expansion 4	52.4	22509	7528
OPower	Electric	Expansion 5	33.7	49205	9864
Evaluation	Electric	Expansion 5	34.6	53956	10812
OPower	Electric	Expansion 6	30.6	26859	11567
Evaluation	Electric	Expansion 6	31.7	34849	15230
OPower	Gas	Original Cohort	2.65	34518	35581
Evaluation	Gas	Original Cohort	2.69	35660	35811
OPower	Gas	Expansion 1	3.02	52135	17920
Evaluation	Gas	Expansion 1	2.93	53827	18079
OPower	Gas	Expansion 2	2.01	76744	13481
Evaluation	Gas	Expansion 2	2.07	79778	13827
OPower	Gas	Expansion 3	2.37	12489	6119
Evaluation	Gas	Expansion 3	2.46	12752	6161
OPower	Gas	Expansion 4	2.29	19983	6705
Evaluation	Gas	Expansion 4	2.21	22451	7507
OPower	Gas	Expansion 5	3.07	48624	9743
Evaluation	Gas	Expansion 5	2.96	53960	10811
OPower	Gas	Expansion 6	1.76	25789	11048
Evaluation	Gas	Expansion 6	2.09	34864	15236

OPower did not include weather in the dataset that they provided and the weather must be merged before the calendarization, so we are unable to compare results where weather is required.

Time Periods Included

OPower has somewhat different pre-treatment periods, which could explain some of the differences in pre-participation period consumption averages shown in Table 55. Table 56 shows the minimum and maximum pre-participation period dates across all waves. Pre-participation period start dates are close in all cases, but pre-participation end periods do not align. It appears that the pre-participation periods are defined differently, OPower appears to define the pre-participation period identically for all customers as approximately a year before the cohort was randomized for the experimental design, while this evaluation defines the pre-participation period differently for each customer—the pre-participation period continues until the month before the customer receives his or her first report.

Table 56. Pre-Participation Periods for OPower and Evaluation Datasets

Data Source	Wave	Pre-Participation Period Start	Pre-Participation Period End
OPower	Original Cohort	06/2009	06/2010
Evaluation	Original Cohort	06/2009	12/2011
OPower	Expansion 1	04/2010	04/2011
Evaluation	Expansion 1	04/2010	12/2013
OPower	Expansion 2	09/2010	10/2011
Evaluation	Expansion 2	01/2011	12/2014
OPower	Expansion 3	10/2010	10/2011
Evaluation	Expansion 3	01/2011	12/2012
OPower	Expansion 4	03/2012	05/2013
Evaluation	Expansion 4	05/2012	12/2015
OPower	Expansion 5	06/2013	08/2014
Evaluation	Expansion 5	09/2013	12/2015
OPower	Expansion 6	01/2014	03/2015
Evaluation	Expansion 6	03/2014	12/2015

Model Specification

This evaluation uses a weather-adjusted model to calculate overall savings, while OPower uses a LDV model (see Equation 3) that does not directly adjust for weather. Instead, the LDV model uses only pre-participation period seasonal consumption to adjust, indirectly, for weather and other seasonal effects in each month of the post-participation period. Each of the cohorts have a different pre-treatment period, so the LDV models will adjust differently for each, and could introduce bias if the weather in the pre-participation period is substantially different from the post-participation period. The issue of merging weather data discussed above means that we are not able to compare results from models that include weather correction. For that reason, Table 57 shows the results of a simple DID approach to estimating savings to find differences in modeled results between OPower and this evaluation. The DID savings estimates based on the OPower data have a larger range than those based on the evaluation data, but, in most cases, the savings estimates are similar.

We also examined savings using the LDV model on the OPower cleaned data, which yielded savings estimates that are usually similar and when they diverge can be either higher or lower. This means that the differences in the two datasets do not seem to yield systematic bias, but without being able to check the weather-corrected model results, we cannot say whether the differences in OPower's savings estimates and ours is related to weather. Table 57 shows a side-by-side comparison of results.

Table 57. Savings Estimates from LDV, DID, and Weather-Adjusted Models

Data Source	Fuel	Cohort	LDV Savings	DID Savings	Weather-Adjusted Savings
OPower	Electric	Original Cohort	0.51	0.53	
Evaluation	Electric	Original Cohort	0.86	0.92	0.38
OPower	Electric	Expansion 1	0.61	0.51	
Evaluation	Electric	Expansion 1	0.59	0.58	0.57
OPower	Electric	Expansion 2	0.18	0.20	
Evaluation	Electric	Expansion 2	0.18	0.16	0.17
OPower	Electric	Expansion 4	0.57	0.57	
Evaluation	Electric	Expansion 4	0.55	0.61	0.79
OPower	Electric	Expansion 5	0.34	0.35	
Evaluation	Electric	Expansion 5	0.26	0.28	0.42
OPower	Electric	Expansion 6	0.26	0.26	
Evaluation	Electric	Expansion 6	0.16	0.12	0.17
OPower	Gas	Original Cohort	0.020	0.025	
Evaluation	Gas	Original Cohort	0.021	0.021	0.014
OPower	Gas	Expansion 1	0.031	0.037	
Evaluation	Gas	Expansion 1	0.033	0.032	0.025
OPower	Gas	Expansion 2	0.014	0.015	
Evaluation	Gas	Expansion 2	0.013	0.012	0.010
OPower	Gas	Expansion 3	0.036	0.032	
Evaluation	Gas	Expansion 3	0.036	0.029	0.030
OPower	Gas	Expansion 4	0.014	0.011	
Evaluation	Gas	Expansion 4	0.008	0.008	0.012
OPower	Gas	Expansion 5	0.014	0.006	
Evaluation	Gas	Expansion 5	0.009	0.004	0.007
OPower	Gas	Expansion 6	0.006	0.012	
Evaluation	Gas	Expansion 6	0.004	0.007	0.011

Overall, the datasets from OPower and this evaluation are similar, but there are differences that can lead to variances in savings estimates, as well as one substantial difference that we could not evaluate. The differences that we were able to identify were due to somewhat different pre-treatment periods and slightly different average usage in each wave. We were not able to evaluate the difference in savings results if we were to run the weather-adjusted model that we used for estimating impacts in this evaluation. When we used a simple DID model that does not correct for weather, the savings differences were relatively small in most

cases, as were savings based on the LDV model. Overall, it is not clear if there is any single cause for these differences. We have discussed a range of possible reasons for the difference, but none of them stands out as a single likely cause.

F. Appendix – Channeling Analysis

The evaluation team compared the participation between treatment and control groups by measuring differences in participation rates. We generated the participation rates by dividing the participation count by the total population in each cohort. In other words, we normalized the participation to generate a percent participation from each cohort. In a similar fashion, we also normalized per participant savings by the per participant baseline usage in order to develop percent savings adjustments.

Using the difference-in-difference (DID) approach, the evaluation team applied the pro-rated cumulative evaluated net savings for calculating the savings adjustments (see Table 58).

Table 58. 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 AIC programs and the modeled baseline usage.

The team divided the savings adjustment values by the modeled baseline values to get the household-level adjustment values (see Table 59). We show the baseline usage values and the net adjustments per household in Table 60.

Table 59. Modeled Baseline Usage

Cohort	Electric (kWh/year)	Gas (therms/year)
Original Cohort	11,895	790
Expansion Cohort 1	13,078	897
Expansion Cohort 2	9,026	610
Expansion Cohort 3	NA	707
Expansion Cohort 4	17,318	699
Expansion Cohort 5	11,815	787
Expansion Cohort 6	10,848	498

Table 60. Savings Adjustment – Electric

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Electric – Original Cohort			
Treatment	0.000%	0.091%	0.091%
Control	0.000%	0.074%	0.074%
T-C Difference	0.000%	0.017%	0.017%
Electric – Expansion Cohort 1			
Treatment	0.001%	0.059%	0.059%
Control	0.001%	0.067%	0.067%
T-C Difference	0.000%	-0.008%	-0.008%

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
Electric – Expansion Cohort 2			
Treatment	0.041%	0.068%	0.026%
Control	0.042%	0.066%	0.024%
T-C Difference	-0.001%	0.001%	0.002%
Electric – Expansion Cohort 4			
Treatment	0.228%	0.053%	-0.176%
Control	0.223%	0.044%	-0.180%
T-C Difference	0.005%	0.009%	0.004%
Electric – Expansion Cohort 5			
Treatment	0.299%	0.192%	-0.107%
Control	0.250%	0.175%	-0.075%
T-C Difference	0.048%	0.016%	-0.032%
Electric – Expansion Cohort 6			
Treatment	0.278%	0.370%	0.092%
Control	0.290%	0.364%	0.074%
T-C Difference	-0.012%	0.006%	0.018%

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 63).

Table 61. Historical Participation Lift by Cohort and Program Year

Cohort	PY3	PY4	PY5	PY6	PY7	PY8
Original Cohort	0.008%	0.385%	0.121%	0.007%	0.350%	0.068%
Expansion 1	-	0.486%	0.449%	-0.174%	0.074%	-0.147%
Expansion 2	-	0.080%	0.175%	0.227%	0.066%	0.004%
Expansion 3 - Gas	-	0.147%	0.018%	0.136%	0.120%	0.209%
Expansion 4	-	-	-	0.573%	0.025%	-0.046%
Expansion 5	-	-	-	-	-0.016%	0.161%
Expansion 6	-	-	-	-	-	0.132%

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 an additional 6.0% of the total program participants or about 2,100 additional participants into other residential AIC programs since PY4.

Table 62. Channeled Participant Count by Cohort and Program Year

Cohort	PY3	PY4	PY5	PY6	PY7	PY8	Total
Original Cohort	4	181	53	3	135	25	**400**
Expansion 1	-	361	306	0	43	0	**710**
Expansion 2	-	93	194	230	62	4	**582**
Expansion 3 - Gas	-	27	3	21	17	28	**96**
Expansion 4	-	-	-	172	6	0	**179**

Expansion 5	-	-	-	-	0	87	87
Expansion 6	-	-	-	-	-	46	46
Total	4	662	556	426	263	189	2,100

Table 63. Historical Participation Lift by Program and Cohort

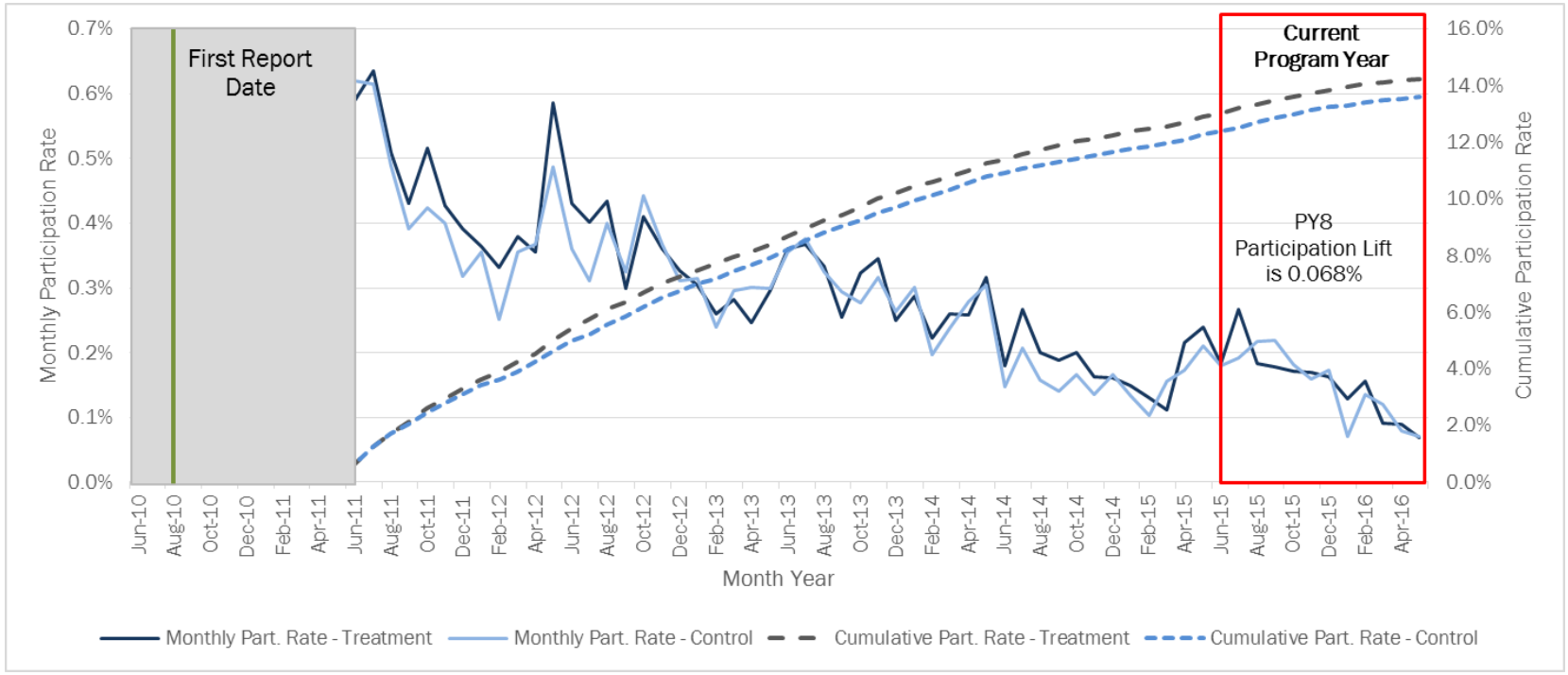
Cohort	PY3	PY4	PY5	PY6	PY7	PY8
Appliance Recycling						
Original Cohort	0.000%	0.108%	0.135%	0.020%	0.274%	0.107%
Expansion Cohort 1	-	0.248%	0.124%	0.108%	0.155%	-0.108%
Expansion Cohort 2	-	0.120%	0.147%	-0.038%	0.162%	0.075%
Expansion Cohort 3	-	0.011%	0.000%	-0.007%	-0.054%	0.008%
Expansion Cohort 4	-	-	-	0.099%	0.003%	-0.134%
Expansion Cohort 5	-	-	-	-	0.018%	-0.017%
Expansion Cohort 6	-	-	-	-	-	0.002%
Lighting (Webstore)						
Original Cohort	0.000%	0.006%	0.007%	-0.007%	0.013%	0.000%
Expansion Cohort 1	-	-0.008%	-0.007%	0.008%	-0.002%	-0.002%
Expansion Cohort 2	-	-0.013%	0.004%	0.009%	-0.002%	-0.001%
Expansion Cohort 3	-	-	-	0.000%	-0.014%	0.000%
Expansion Cohort 4	-	-	-	0.020%	0.000%	0.000%
Expansion Cohort 5	-	-	-	-	0.008%	-0.006%
Expansion Cohort 6	-	-	-	-	-	-0.005%
HVAC						
Original Cohort	0.000%	0.080%	-0.098%	0.033%	-0.031%	-0.082%
Expansion Cohort 1	-	0.100%	0.068%	-0.306%	-0.091%	-0.001%
Expansion Cohort 2	-	0.003%	0.028%	0.151%	0.047%	0.063%
Expansion Cohort 3	-	-0.060%	-0.076%	0.169%	0.052%	0.093%
Expansion Cohort 4	-	-	-	0.222%	0.002%	0.037%
Expansion Cohort 5	-	-	-	-	0.039%	0.210%
Expansion Cohort 6	-	-	-	-	-	-0.071%
REEP						
Original Cohort	0.008%	0.154%	-0.021%	-0.081%	0.000%	0.000%
Expansion Cohort 1	-	-0.041%	0.027%	0.011%	-0.032%	-0.024%
Expansion Cohort 2	-	-0.050%	-0.069%	0.095%	-0.091%	-0.112%
Expansion Cohort 3	-	0.100%	0.169%	-0.095%	0.033%	0.012%
Expansion Cohort 4	-	-	-	0.142%	0.110%	0.136%
Expansion Cohort 5	-	-	-	-	-0.102%	-0.086%
Expansion Cohort 6	-	-	-	-	-	0.005%
Home Performance						
Original Cohort	0.000%	0.086%	0.126%	0.059%	0.074%	0.081%
Expansion Cohort 1	-	0.308%	0.235%	0.018%	0.016%	0.013%
Expansion Cohort 2	-	-0.007%	0.022%	0.013%	-0.060%	-0.069%
Expansion Cohort 3	-	0.123%	-0.044%	0.049%	0.104%	0.089%

Cohort	PY3	PY4	PY5	PY6	PY7	PY8
Expansion Cohort 4	-	-	-	0.176%	-0.016%	0.016%
Expansion Cohort 5	-	-	-	-	0.046%	0.032%
Expansion Cohort 6	-	-	-	-	-	0.134%
Moderate Income/Income Qualified						
Original Cohort	0.000%	-0.008%	-0.002%	-0.002%	0.031%	-0.019%
Expansion Cohort 1	-	-0.003%	0.030%	0.002%	0.012%	-0.004%
Expansion Cohort 2	-	0.003%	0.018%	0.007%	0.015%	0.040%
Expansion Cohort 3	-	-0.006%	-0.013%	0.026%	0.007%	0.015%
Expansion Cohort 4	-	-	-	0.023%	0.016%	-0.057%
Expansion Cohort 5	-	-	-	-	-0.029%	0.030%
Expansion Cohort 6	-	-	-	-	-	0.083%

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 17 through Figure 22 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 17. 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 18. Trended Program Participation Rate: Expansion Cohort 1

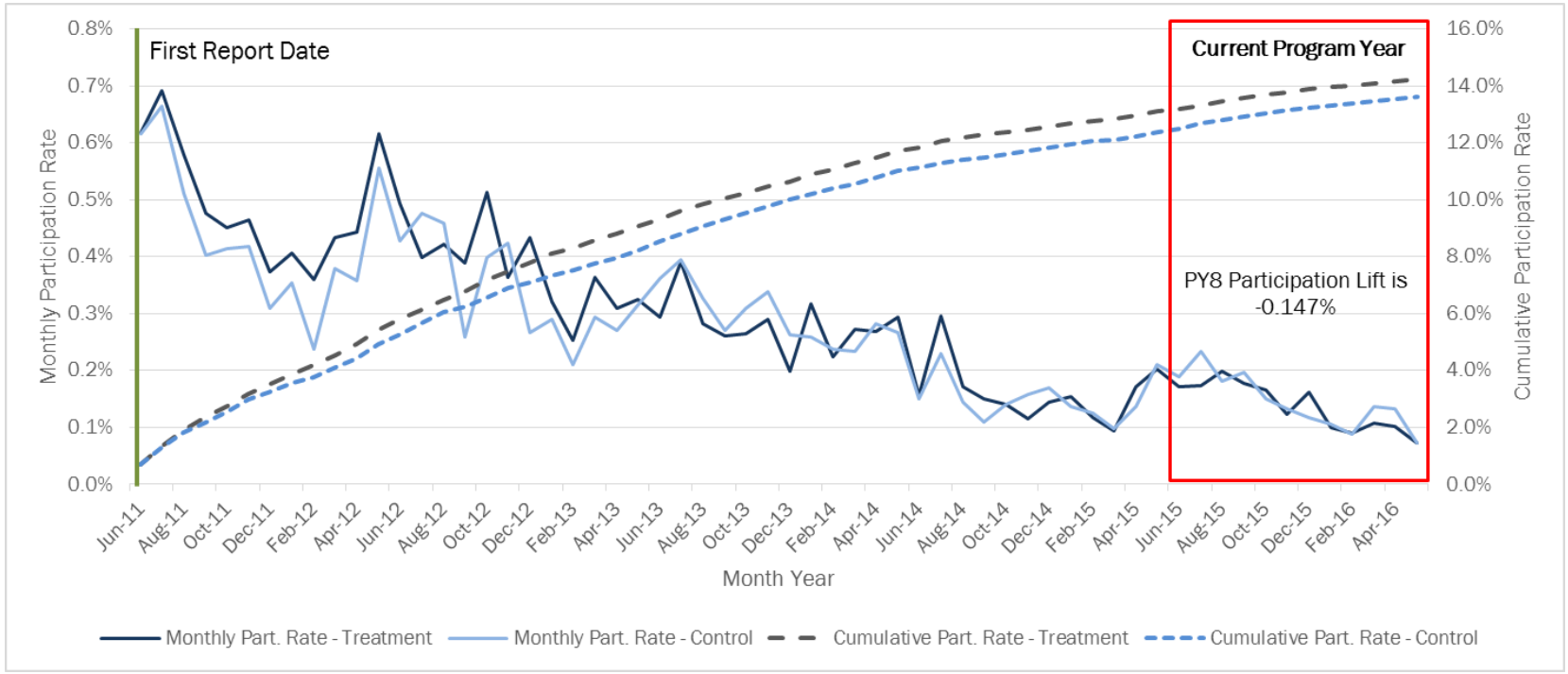


Figure 19. Trended Program Participation Rate: Expansion Cohort 2

Figure 20. Trended Program Participation Rate: Expansion Cohort 3 (Gas Only)

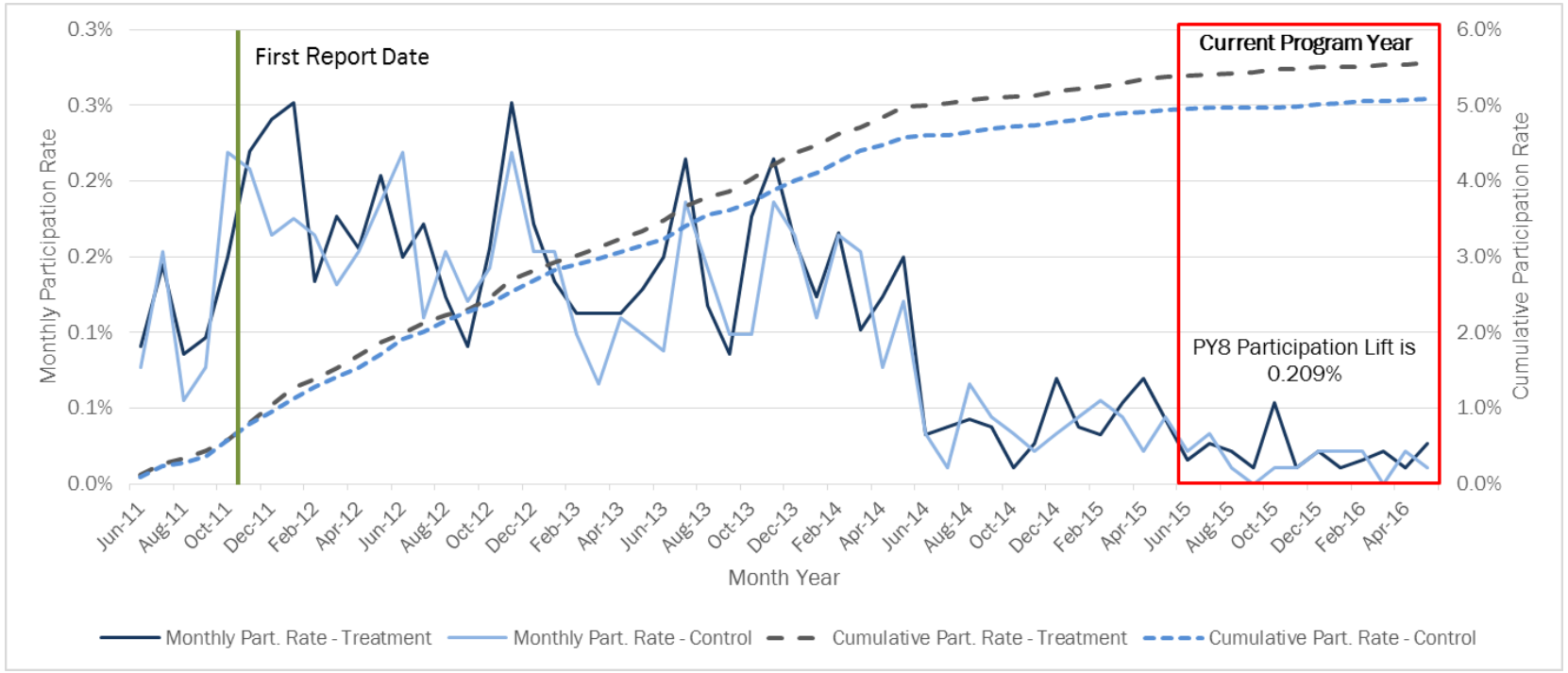


Figure 21. Trended Program Participation Rate: Expansion Cohort 4

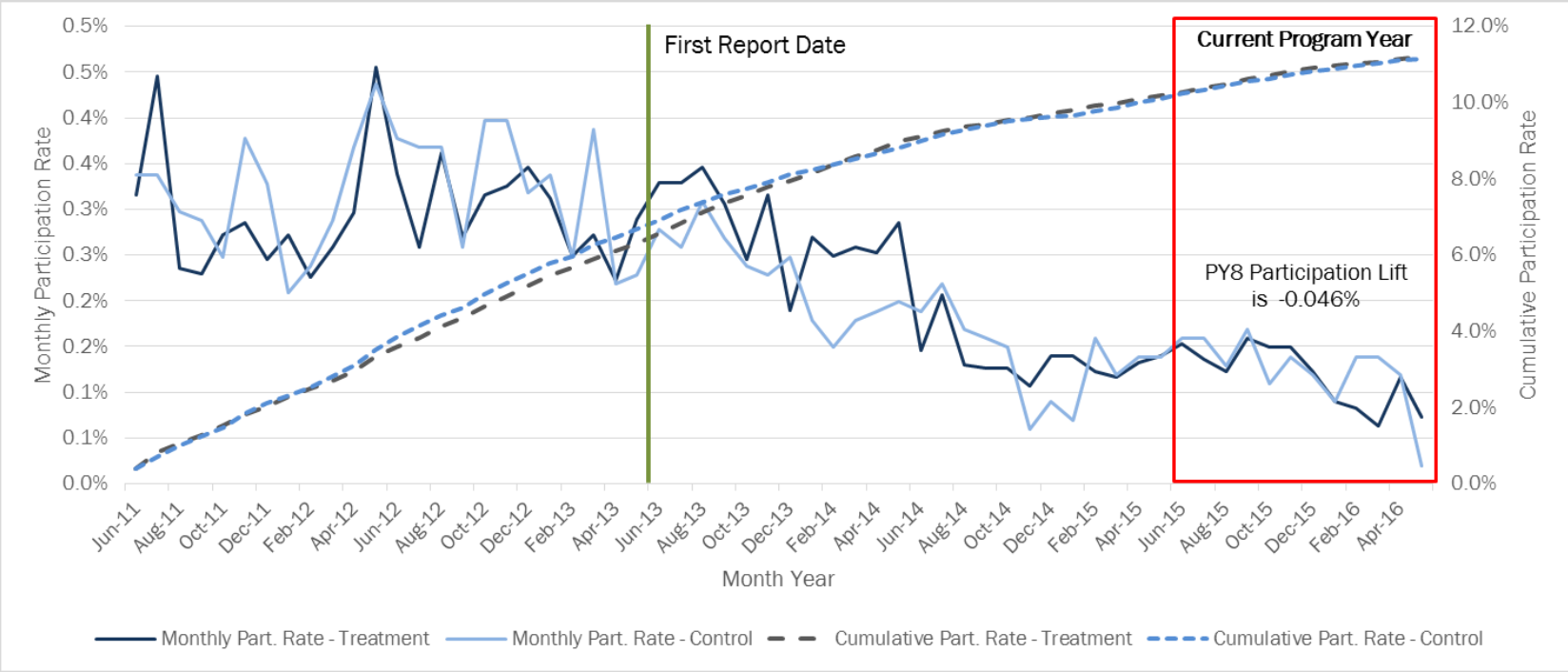


Figure 22. Trended Program Participation Rate: Expansion Cohort 5

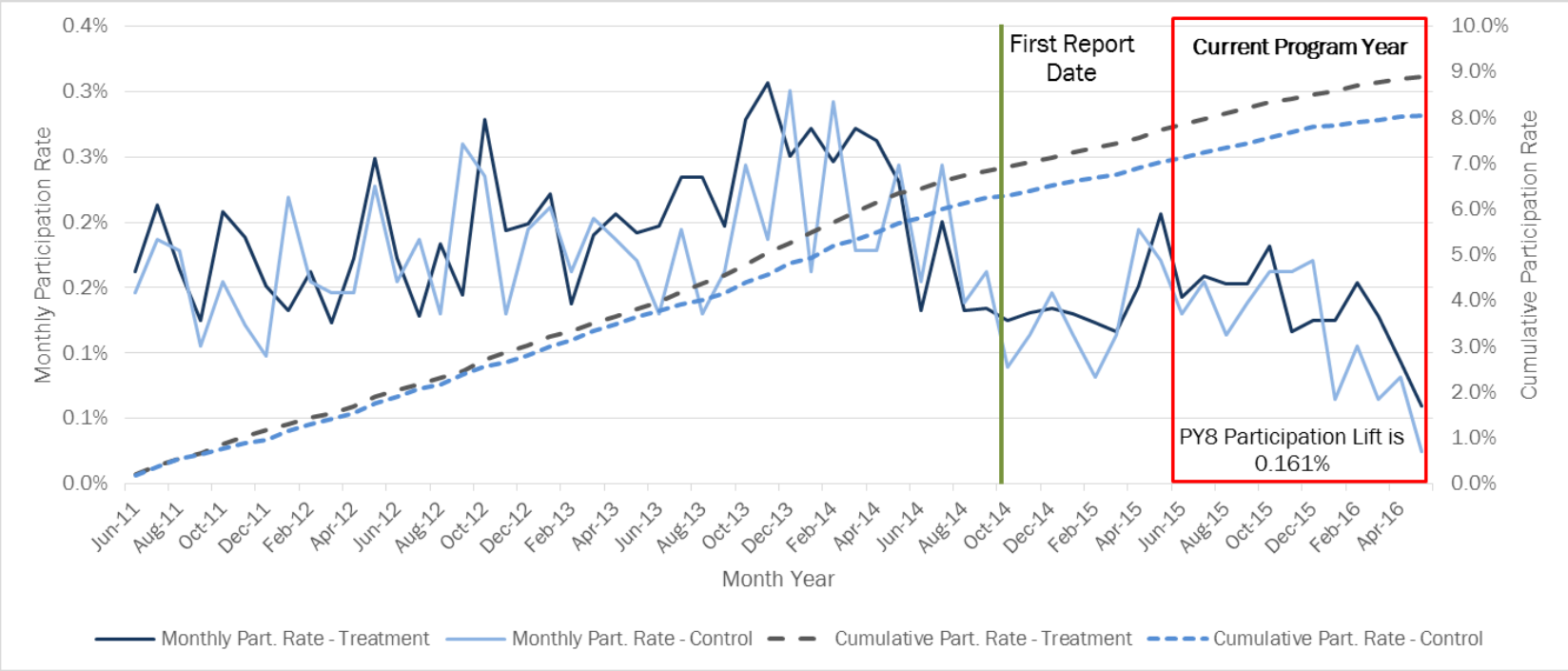
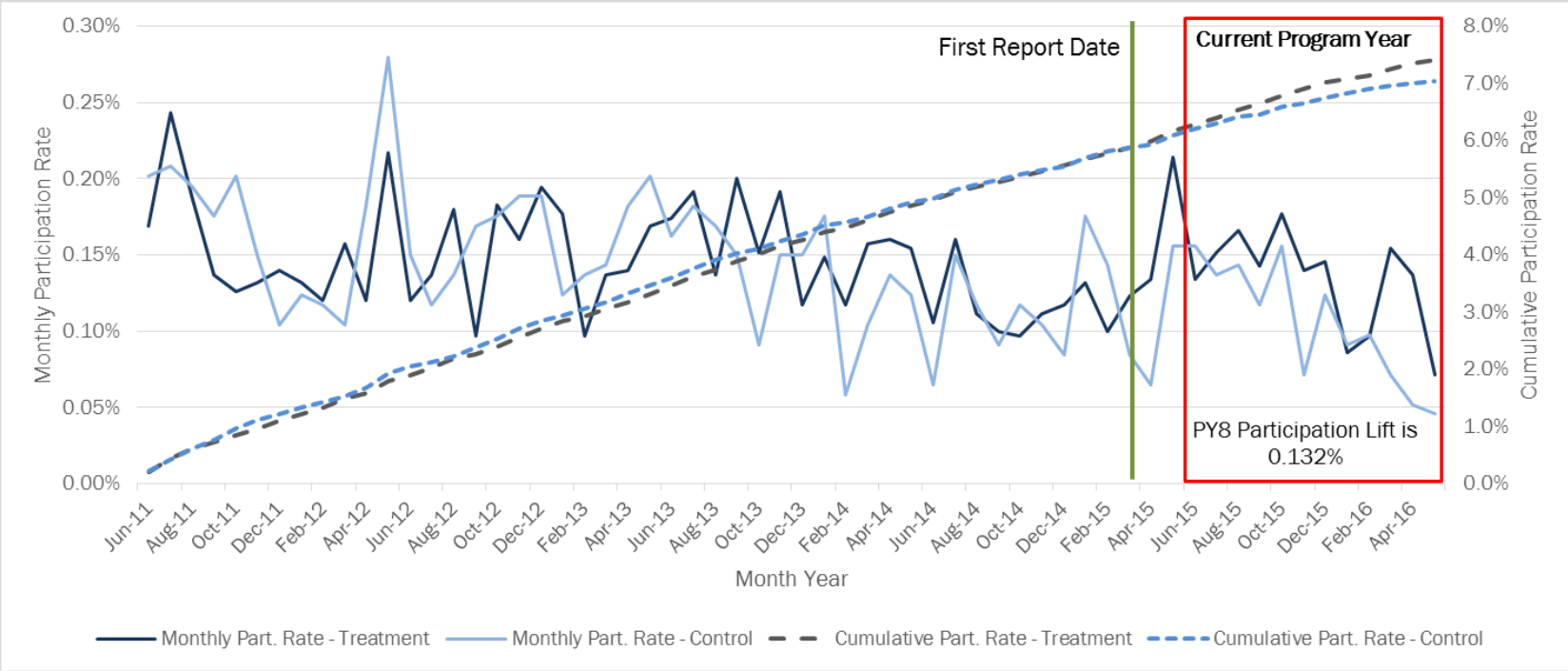


Figure 20. Trended Program Participation Rate: Expansion Cohort 6



The evaluation team compared the participation between treatment and control groups by measuring differences in participation rates. We generated the participation rates by dividing the participation count by the total population in each cohort. In other words, we normalized the participation to generate a percent participation from each cohort. In a similar fashion, we also normalized per participant savings by the per participant baseline usage in order to develop percent savings adjustments.

Using the difference-in-difference (DID) approach, the evaluation team applied the pro-rated cumulative evaluated net savings for calculating the savings adjustments (see Table 58).

Table 58. 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 AIC programs and the modeled baseline usage.

The team divided the savings adjustment values by the modeled baseline values to get the household-level adjustment values (see Table 59). We show the baseline usage values and the net adjustments per household in Table 60.

The evaluation team compared the participation between treatment and control groups by measuring differences in participation rates. We generated the participation rates by dividing the participation count by the total population in each cohort. In other words, we normalized the participation to generate a percent participation from each cohort. In a similar fashion, we also normalized per participant savings by the per participant baseline usage in order to develop percent savings adjustments.

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Table 58. 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 AIC programs and the modeled baseline usage.

The team divided the savings adjustment values by the modeled baseline values to get the household-level adjustment values (see Table 59). We show the baseline usage values and the net adjustments per household in Table 60.

The evaluation team compared the participation between treatment and control groups by measuring differences in participation rates. We generated the participation rates by dividing the participation count by the total population in each cohort. In other words, we normalized the participation to generate a percent participation from each cohort. In a similar fashion, we also normalized per participant savings by the per participant baseline usage in order to develop percent savings adjustments.

Using the difference-in-difference (DID) approach, the evaluation team applied the pro-rated cumulative evaluated net savings for calculating the savings adjustments (see Table 58).

Table 58. 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 AIC programs and the modeled baseline usage.

The team divided the savings adjustment values by the modeled baseline values to get the household-level adjustment values (see Table 59). We show the baseline usage values and the net adjustments per household in Table 60.

The evaluation team compared the participation between treatment and control groups by measuring differences in participation rates. We generated the participation rates by dividing the participation count by the total population in each cohort. In other words, we normalized the participation to generate a percent participation from each cohort. In a similar fashion, we also normalized per participant savings by the per participant baseline usage in order to develop percent savings adjustments.

Using the difference-in-difference (DID) approach, the evaluation team applied the pro-rated cumulative evaluated net savings for calculating the savings adjustments (see Table 58).

Table 58. 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 AIC programs and the modeled baseline usage.

The team divided the savings adjustment values by the modeled baseline values to get the household-level adjustment values (see Table 59). We show the baseline usage values and the net adjustments per household in Table 60.

The evaluation team compared the participation between treatment and control groups by measuring differences in participation rates. We generated the participation rates by dividing the participation count by the total population in each cohort. In other words, we normalized the participation to generate a percent participation from each cohort. In a similar fashion, we also normalized per participant savings by the per participant baseline usage in order to develop percent savings adjustments.

Using the difference-in-difference (DID) approach, the evaluation team applied the pro-rated cumulative evaluated net savings for calculating the savings adjustments (see Table 58).

Table 58. 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 AIC programs and the modeled baseline usage.

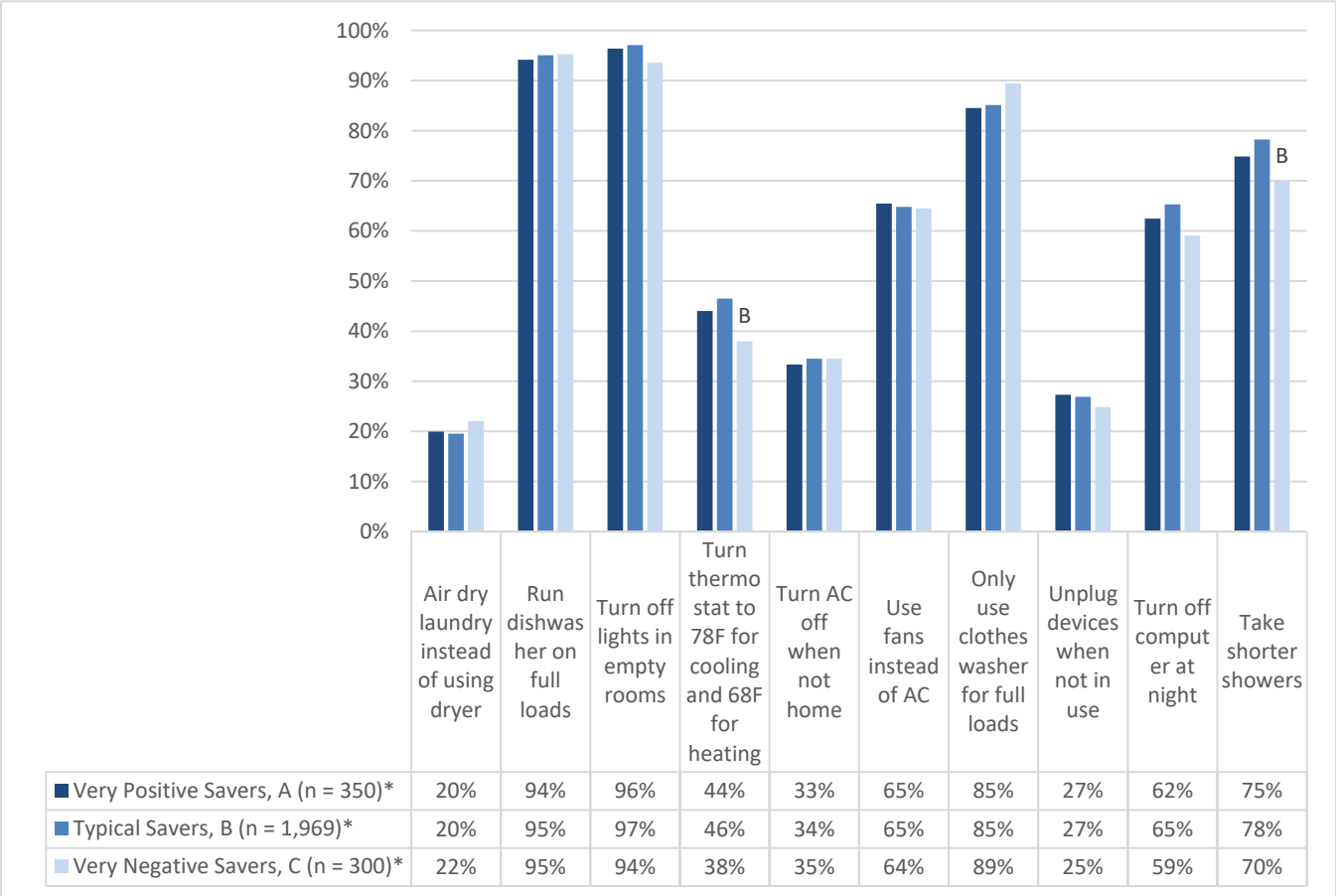
The team divided the savings adjustment values by the modeled baseline values to get the household-level adjustment values (see Table 59). We show the baseline usage values and the net adjustments per household in Table 60.

H. Appendix – Additional Survey Results

H.1 Energy-Saving Behaviors by Savings Group

There were few statistically significant differences in the frequency with which each electric (Figure 23) or gas (see binders) savings group took habitual energy-saving actions. However, there were consistent differences in the share of customers who attributed taking that action to their HERs. Specifically, "Very Negative" electric savers were much less likely than members of other groups to attribute this behavior to their HERs (Figure 24). There were no clear patterns among the gas savings groups.

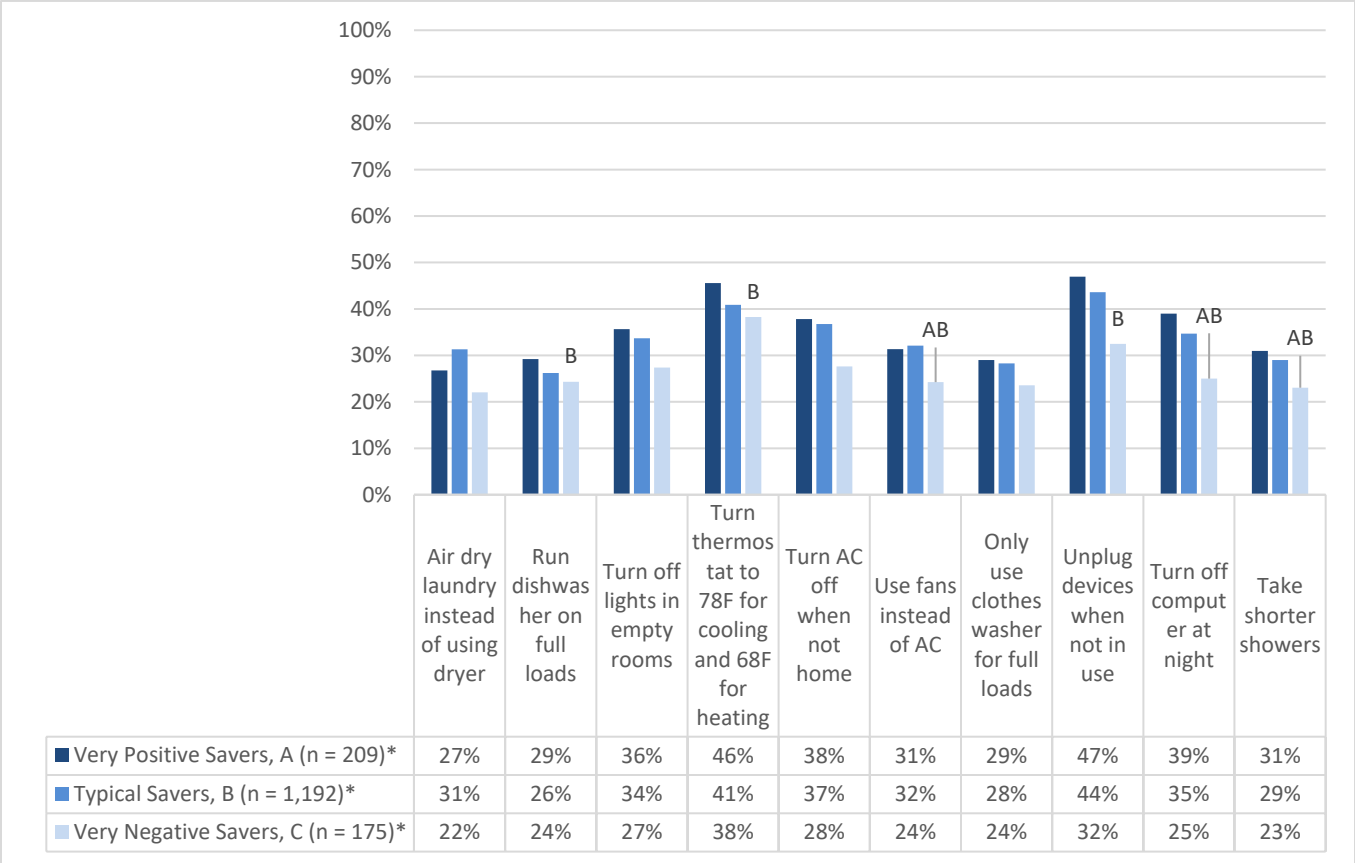
Figure 23. General Energy-Saving Behaviors by Electric Savings



	Air dry laundry instead of using dryer	Run dishwasher on full loads	Turn off lights in empty rooms	Turn thermostat to 78F for cooling and 68F for heating	Turn AC off when not home	Use fans instead of AC	Only use clothes washer for full loads	Unplug devices when not in use	Turn off computer at night	Take shorter showers
Very Positive Savers, A (n = 350)*	20%	94%	96%	44%	33%	65%	85%	27%	62%	75%
Typical Savers, B (n = 1,969)*	20%	95%	97%	46%	34%	65%	85%	27%	65%	78%
Very Negative Savers, C (n = 300)*	22%	95%	94%	38%	35%	64%	89%	25%	59%	70%

Note: Letters indicate statistical significance between savings groups at the 90% confidence level.
* Reported N's are the average across all questions in chart for each savings group. N's for individual questions are reported in the binders.

Figure 24. General Energy-Savings Behaviors Attributed to Report by Electric Savings Groups

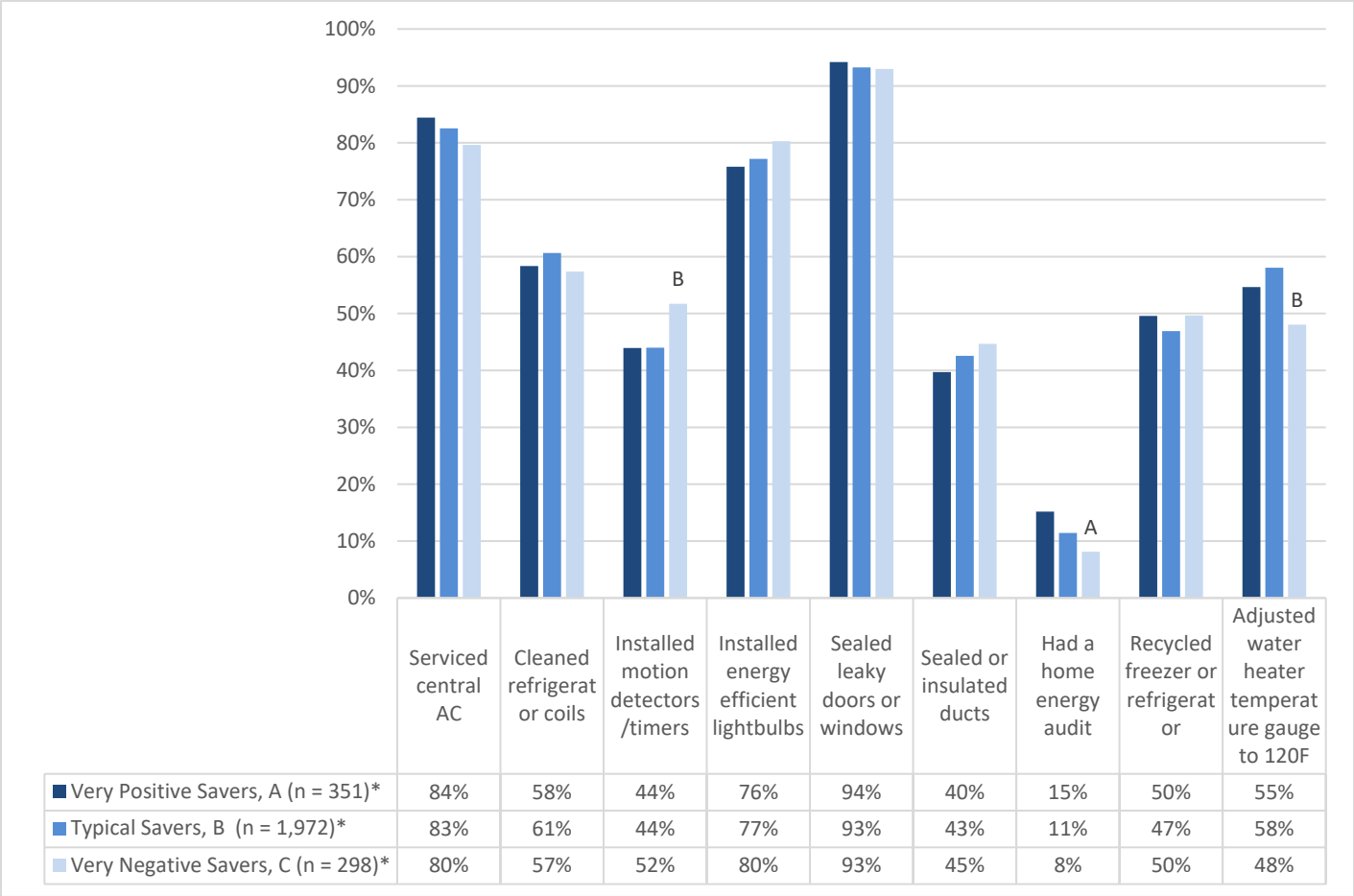


	Air dry laundry instead of using dryer	Run dishwasher on full loads	Turn off lights in empty rooms	Turn thermostat to 78F for cooling and 68F for heating	Turn AC off when not home	Use fans instead of AC	Only use clothes washer for full loads	Unplug devices when not in use	Turn off computer at night	Take shorter showers
Very Positive Savers, A (n = 209)*	27%	29%	36%	46%	38%	31%	29%	47%	39%	31%
Typical Savers, B (n = 1,192)*	31%	26%	34%	41%	37%	32%	28%	44%	35%	29%
Very Negative Savers, C (n = 175)*	22%	24%	27%	38%	28%	24%	24%	32%	25%	23%

Note: Letters indicate statistical significance between savings groups at the 90% confidence level.
* Reported N's are the average across all questions in chart for each savings group. N's for individual questions are reported in the binders.

The same pattern holds for one-time energy-saving actions, such as getting a home energy audit, upgrading insulation or lighting, or replacing or recycling major appliances. While there are generally no differences in the overall rates of different activities for the electric savings groups (Figure 25), more "Very Positive" savers and "Typical" savers attribute their actions to their HERs than do "Very Negative" savers (Figure 26). There are again no clear patterns in the gas savings groups.

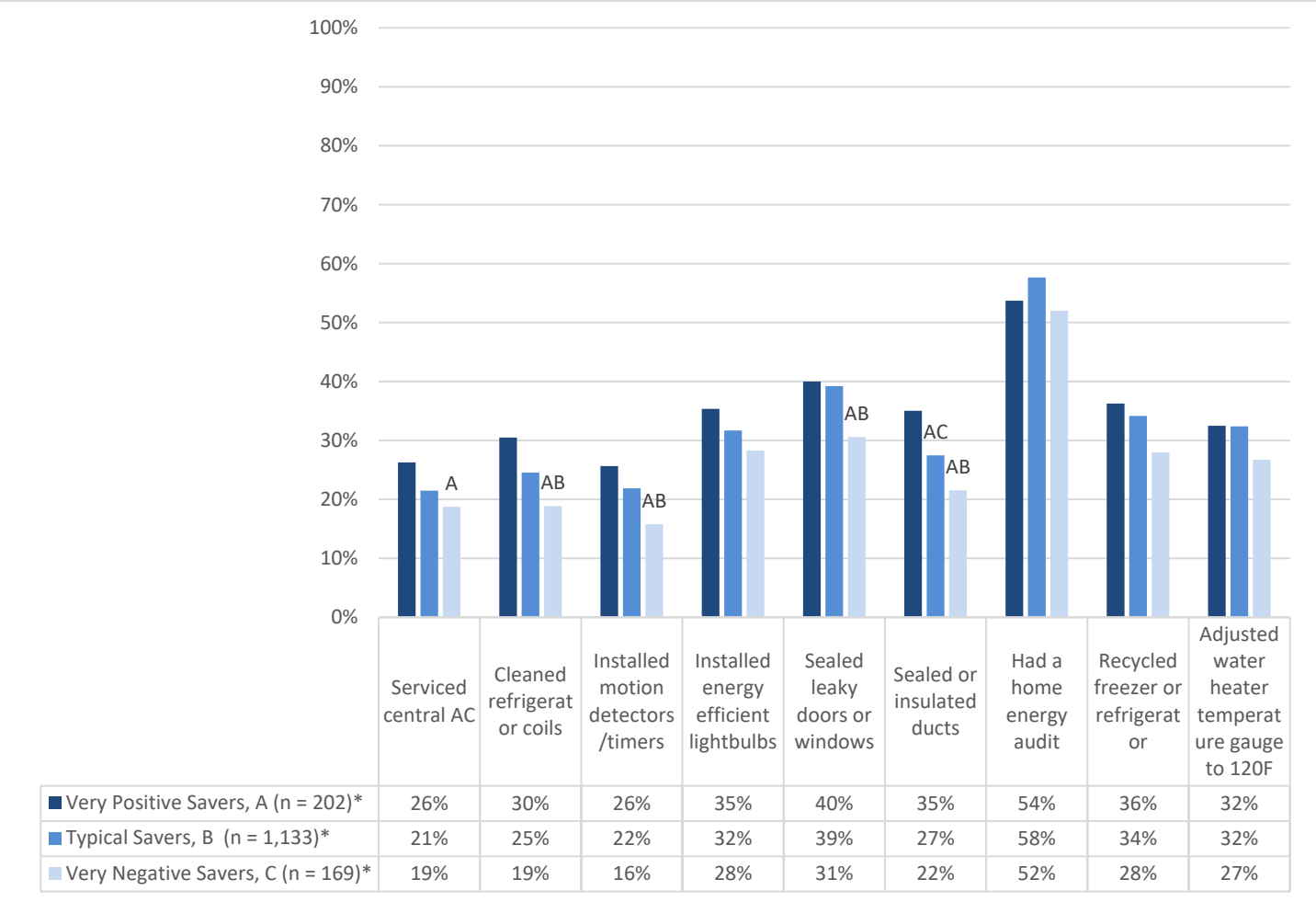
Figure 25. Intensive Saving Actions by Electric Savings Group



	Serviced central AC	Cleaned refrigerator coils	Installed motion detectors /timers	Installed energy efficient lightbulbs	Sealed leaky doors or windows	Sealed or insulated ducts	Had a home energy audit	Recycled freezer or refrigerator	Adjusted water heater temperature gauge to 120F
Very Positive Savers, A (n = 351)*	84%	58%	44%	76%	94%	40%	15%	50%	55%
Typical Savers, B (n = 1,972)*	83%	61%	44%	77%	93%	43%	11%	47%	58%
Very Negative Savers, C (n = 298)*	80%	57%	52%	80%	93%	45%	8%	50%	48%

Note: Letters indicate statistical significance between savings groups at the 90% confidence level.
* Reported N's are the average across all questions in chart for each savings group. N's for individual questions are reported in the binders.

Figure 26. Intensive Energy-Saving Actions Attributed to Report by Electric Savings Group



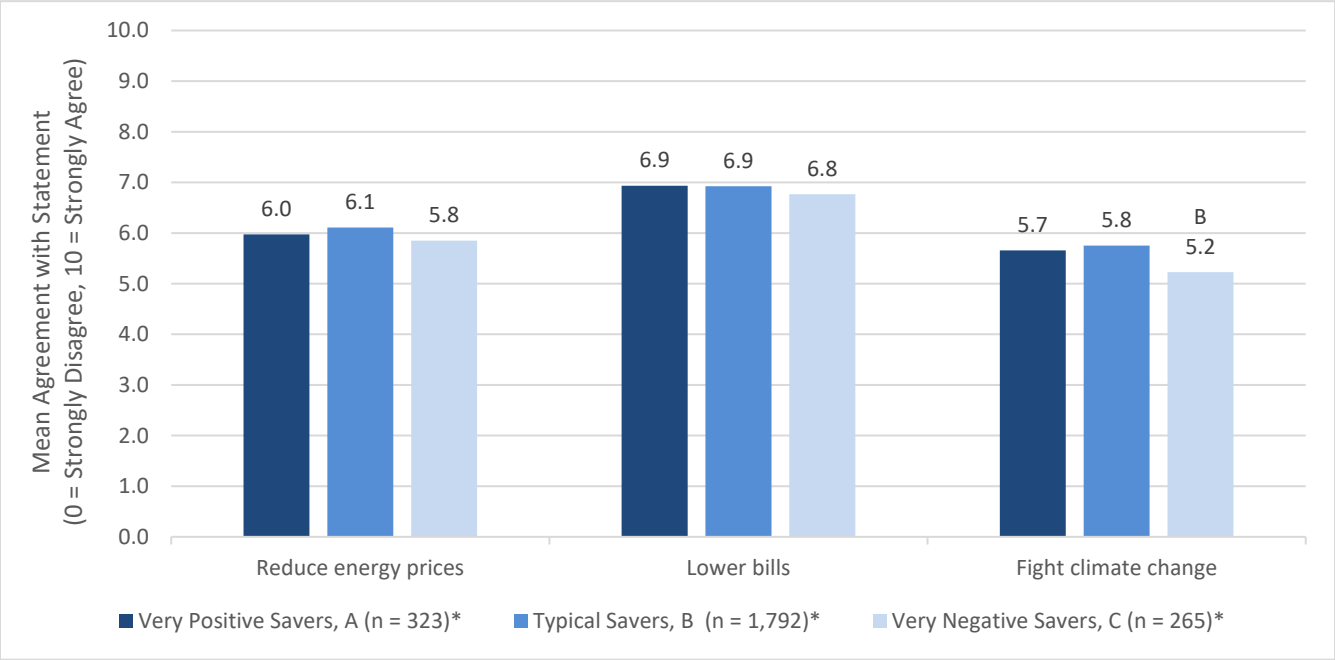
	Serviced central AC	Cleaned refrigerator coils	Installed motion detectors /timers	Installed energy efficient lightbulbs	Sealed leaky doors or windows	Sealed or insulated ducts	Had a home energy audit	Recycled freezer or refrigerator	Adjusted water heater temperature gauge to 120F
Very Positive Savers, A (n = 202)*	26%	30%	26%	35%	40%	35%	54%	36%	32%
Typical Savers, B (n = 1,133)*	21%	25%	22%	32%	39%	27%	58%	34%	32%
Very Negative Savers, C (n = 169)*	19%	19%	16%	28%	31%	22%	52%	28%	27%

Note: Letters indicate statistical significance between savings groups at the 90% confidence level.
* Reported N's are the average across all questions in chart for each savings group. N's for individual questions are reported in the binders.

H.2 Energy Savings Attitudes by Savings Groups

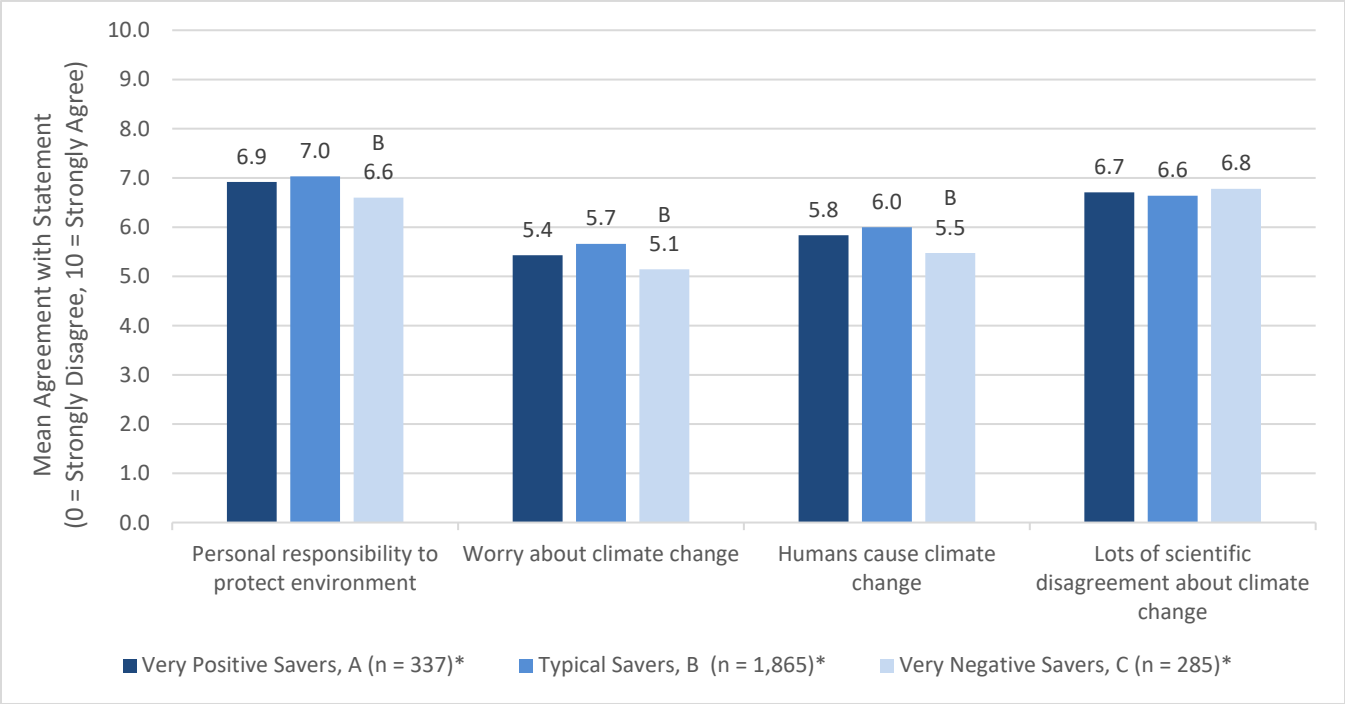
We found that, compared to other groups, "Very Negative" electric savers were less interested in the environmental implications of participation in AIC programs (Figure 27), felt less responsibility to protect the environment (Figure 28), were less concerned about climate change (ibid), and were less convinced that climate change is the result of human activities (ibid) than "Typical" savers. Interestingly, "Very Negative" savers were also less inclined to avoid arguments or to like to be a part of social trends than other savings groups (Figure 29). As usual, no clear patterns emerged among gas customers.

Figure 27. Electric Savings Groups: "By participating in an AIC program, I could…"



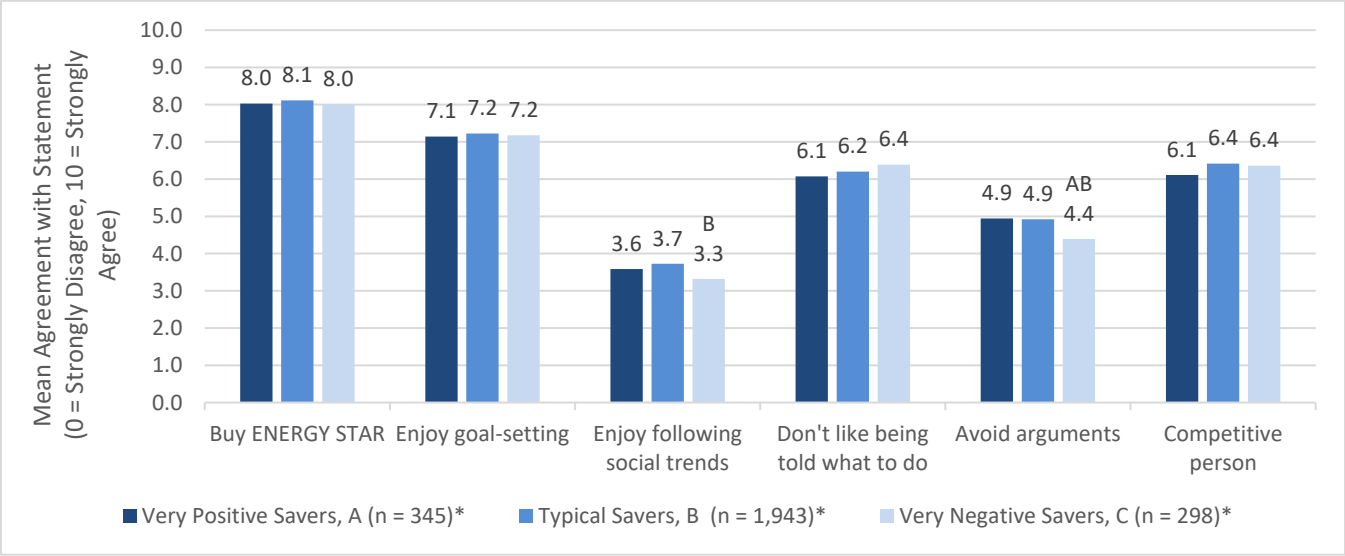
Note: Letters indicate statistical significance between savings groups at the 90% confidence level.
* Reported N's are the average across all questions in chart for each savings group. N's for individual questions are reported in the binders.

Figure 28. Environmental Attitudes by Electric Savings Group



Note: Letters indicate statistical significance between savings groups at the 90% confidence level.
* Reported N's are the average across all questions in chart for each savings group. N's for individual questions are reported in the binders.

Figure 29. Social Attitudes by Electric Savings Group



Note: Letters indicate statistical significance between savings groups at the 90% confidence level.
* Reported N's are the average across all questions in chart for each savings group. N's for individual questions are reported in the binders.

H.3 Description of AIC Segmentation Groups

Residential Program Key Segments

We will target our efforts based on geographic areas and use the data from the following key residential groups in our segmentation (identified by Shelton Research):

cautious conservatives

- 90% say energy conservation is important (vs. 81% overall).
- Top motivator/driver: to save money (62%).
- Highest average number of energy efficiency behaviors/habits: 7.2 (vs. 5.5 overall).
- Preferred messaging direction: control costs and avoid waste
- Key offerings, based on past participation, include Appliance Recycling, Home Efficiency Income-Qualified and Heating & Cooling.

concerned parents

- 76% say energy conservation is important (vs. 81% overall).
- Top motivators/drivers: to waste less money (26%) and to be responsible/not waste (19%).
- Average number of energy-efficiency behaviors/habits: 5.5.
- Preferred messaging direction: information/control and avoid waste.
- Key offerings, based on past participation, include Appliance Recycling, Home Efficiency Income-Qualified, and Multifamily.

working class realists

- Below average rating of energy conservation importance (71% vs. 81% overall).
- Top motivator/driver: to save money (79%).
- Below average number of energy efficiency behaviors/habits: 3.3.
- Preferred messaging direction: info/control and avoid waste save money.
- Key offerings, based on past participation, include Multifamily; however, have historically had solid participation in all programs.

- 93% say that energy conservation is important (vs. 81% overall).
- Top motivators/drivers: to save money (43%) and to protect the environment/save natural resources (23%).
- Above average number of energy efficiency behaviors/habits: 6.4 (vs. 5.5 overall).
- Preferred messaging direction: information/control and reducing environmental impact.
- Compared to other segments, this group has historically had the lowest participation in nearly all programs (may have already done energy efficiency improvements without receiving incentives).

I. Appendix – Assessment of Non-Response Bias

I.1 Equivalency of Sample Frame and Population

The evaluation team compared the demographic, housing, and psychographic characteristics of customers with and without email to assess the appropriateness of a web-based survey. Table 64 summarizes our findings. Customers with email addresses on file tend to be younger, more highly educated, more likely to be female, more likely to have children, less likely to have lived in the home a long time, less likely to own a home, and less likely to have an older home than those without an email address. These findings are consistent with general differences between populations with and without email addresses. Although these differences mean that our survey results are not generalizable to AIC's non-email population, a telephone-based survey would involve its own demographic biases and would likely have suffered from very low response rates.[27]

Table 64. Demographic Characteristics of Email and Non-Email Customers (Sample Frame)

Category		No Email (n=207,857)	Has Email (n=200,950)
Household	Homeowner listed as deceased*	0.60%	0.22%
Demographics			
Age	Under 35	8.1%	20.7%
	35-54	32.1%	47.7%
	55+	59.8%	31.5%
Household size	Avg. number of Adults**	2.40	2.53
Children in household	At least 1 child <18 years.	21.1%	34.1%
Education of respondent	Less than High School Diploma	11.0%	8.1%
	High School Diploma	40.9%	30.2%
	Some College	25.3%	33.0%
	Bachelor Degree	13.6%	18.0%
	Graduate Degree	9.1%	10.7%
Household Income	Under $50K	44.2%	34.3%
	$50-$100K	37.4%	44.2%
	$100-$200K	15.6%	18.5%
	$200K or higher	2.8%	3.0%
Occupation	Blue Collar	19.6%	23.3%
	Farm Related	0.7%	0.6%
	Other	7.9%	12.0%
	Professional/Technical	24.8%	31.4%
	Retired	26.8%	9.1%
	Sales/Service	20.1%	23.5%
Gender	Female	38.1%	44.3%

[27] See Curtin, Presser & Singer (2005). "Changes in telephone survey nonresponse over the past quarter century." *Public Opinion Quarterly, 69* (1), 87-98.

Category		No Email (n=207,857)	Has Email (n=200,950)
Housing			
Homeownership	Own	87.2%	82.7%
Housing Type	Single-family detached	90.3%	91.6%
Home Size	Home square footage of 100-5,999	98.8%	98.7%
	Home square footage of 6,000-9,999	1.1%	1.3%
	Home square footage of over 10,000	0.1%	0.1%
Age of House	Before 1960	24.5%	26.2%
	1960-1989	46.3%	40.9%
	1990 or later	29.2%	32.8%
Length of Residence	0-9 Years	52.9%	72.0%
	10-20 Years	24.8%	17.9%
	21 Years or Higher	22.2%	10.1%
Psychographic			
Social Causes	Internet Online Subscriber	54.5%	66.4%
	Health	14.0%	10.6%
	Religious	12.2%	8.9%
	Veterans	10.8%	6.4%
	Animal Welfare	7.7%	6.3%
	Political – Conservative	3.1%	2.2%
	Political – Liberal	1.4%	1.2%
	Children	10.5%	8.9%
	Volunteer Work	0.4%	0.3%
	Other Social Cause	16.5%	12.7%

* Indicated where "number of adults in household" variable is equal to zero.
** Note: Does not count households where homeowner listed as deceased (number of adults in home = 0).

I.2 Equivalency of Treatment and Control Group Respondents

The evaluation team also investigated potential non-response bias in the survey by comparing the characteristics of treatment and control customers who responded to the survey. Table 65 summarizes our findings. Treatment customers in the survey were less likely to own a home and less likely to support health-related, religious, or politically conservative social causes than control customers. They also had a slightly lower average household size, slightly older houses, and a slightly different distribution of jobs than control group respondents.

Table 65. Demographic and Housing Characteristics of Survey Respondents

Category		Control (n=1,522)	Treatment (n=3,416)
Household	Homeowner listed as deceased*	0.20%	0.41%
Demographics			
Age	Under 35	8.6%	10.6%
	35-54	43.5%	42.5%
	55+	47.9%	46.9%
Household size+	Avg. number of Adults**	2.80	2.70
Children in household	At least 1 child <18 years.	32.3%	30.0%
Education of respondent	Less than High School Diploma	5.1%	6.2%
	High School Diploma	28.6%	27.9%
	Some College	29.8%	30.5%
	Bachelor Degree	23.1%	21.4%
	Graduate Degree	13.4%	13.8%
Household Income	Under $50K	25.3%	26.4%
	$50-$100K	47.0%	47.9%
	$100-$200K	23.0%	21.8%
	$200K or higher	4.7%	3.8%
Occupation	Blue Collar	18.5%	17.9%
	Farm Related	1.1%	0.6%
	Other	5.9%	7.5%
	Professional/Technical	40.5%	38.4%
	Retired	13.2%	14.3%
	Sales/Service	20.6%	21.3%
Gender	Female	36.1%	38.2%
Housing			
Homeownership+	Own	91.2%	88.8%
Housing Type	Single-family detached	92.1%	92.6%
Home Size	Home square footage of 100-5,999	98.2%	97.6%
	Home square footage of 6,000-9,999	1.6%	2.4%
	Home square footage of over 10,000	0.1%	0.0%
Age of House	Before 1960	23.5%	22.1%
	1960-1989	44.2%	42.5%
	1990 or later	32.3%	35.4%
Length of Residence	0-9 Years	61.3%	63.1%
	10-20 Years	23.9%	21.0%
	21 Years or Higher	14.8%	15.9%

Category		Control (n=1,522)	Treatment (n=3,416)
Psychographic			
Social Causes	Internet Online Subscriber	78.6%	76.7%
	Health+	16.9%	14.6%
	Religious+	16.4%	14.5%
	Veterans	10.1%	9.4%
	Animal Welfare	9.1%	9.1%
	Political – Conservative+	4.2%	3.2%
	Political – Liberal	2.2%	1.9%
	Children	12.7%	11.9%
	Volunteer Work	0.8%	0.4%
	Other Social Cause	21.3%	19.3%

* Indicated where "number of adults in household" variable is equal to zero.
** Note: Does not count households where homeowner listed as deceased (number of adults in home = 0).
+ Indicates a statistically significant difference between treatment and control groups at the 90% confidence level.

I.3 Equivalency of Treatment and Control Group Respondents and Non-Respondents

Next, the evaluation team compared the characteristics of survey respondents and non-respondents within the treatment and control groups. Table 66 and Table 67 present the results. In both the treatment and the control groups, respondents tended to be older, less likely to have children, more highly educated, wealthier, less likely to have blue-collar jobs, more likely to be professional or technical, and more likely to be involved in supporting various social causes than non-respondents. Consistent with the demographic differences, respondents were more likely to own a home and tended to have lived in their current residences longer than non-respondents.

Table 66. Demographic and Housing Characteristics of Treatment Group Respondents and Non-Respondents

Category		Treatment Group Survey Non-Respondents (n =44,958)	Treatment Group Survey Respondents (n = 3,416)
Household	Homeowner listed as deceased*	0.21%	0.41%
Demographics			
Age	Under 35	22.5%	10.6%
	35-54	47.6%	42.5%
	55+	29.9%	46.9%
Household size	Avg. number of Adults**	2.49	2.70
Children in household	At least 1 child <18 years.	34.0%	30.0%
Education of respondent	Less than High School Diploma	8.6%	6.2%
	High School Diploma	30.3%	27.9%
	Some College	33.3%	30.5%
	Bachelor Degree	17.6%	21.4%

Category		Treatment Group Survey Non-Respondents (n =44,958)	Treatment Group Survey Respondents (n = 3,416)
	Graduate Degree	10.2%	13.8%
Household Income	Under $50K	35.9%	26.4%
	$50-$100K	43.5%	47.9%
	$100-$200K	17.9%	21.8%
	$200K or higher	2.8%	3.8%
Occupation	Blue Collar	23.9%	17.9%
	Farm Related	0.7%	0.6%
	Other	12.6%	7.5%
	Professional/Technical	30.2%	38.4%
	Retired	8.8%	14.3%
	Sales/Service	23.8%	21.3%
Gender	Female	45.1%	38.2%
Housing			
Homeownership	Own	81.2%	88.8%
Housing Type	Single-family detached	91.3%	92.6%
Home Size	Home square footage of 100-5,999	98.7%	97.6%
	Home square footage of 6,000-9,999	1.2%	2.4%
	Home square footage of over 10,000	0.0%	0.0%
Age of House	Before 1960	26.6%	22.1%
	1960-1989	40.7%	42.5%
	1990 or later	32.7%	35.4%
Length of Residence	0-9 Years	72.9%	63.1%
	10-20 Years	17.5%	21.0%
	21 Years or Higher	9.6%	15.9%
Psychographic			
Social Causes	Internet Online Subscriber	64.9%	76.7%
	Health	10.1%	14.6%
	Religious	8.2%	14.5%
	Veterans	6.1%	9.4%
	Animal Welfare	6.0%	9.1%
	Political – Conservative	2.1%	3.2%
	Political – Liberal	1.1%	1.9%
	Children	8.5%	11.9%
	Volunteer Work	0.3%	0.4%
	Other Social Cause	12.1%	19.3%

* Indicated where "number of adults in household" variable is equal to zero.
** Note: Does not count households where homeowner listed as deceased (number of adults in home = 0).

Table 67. Demographic and Housing Characteristics of Control Group Respondents and Non-Respondents

Category		Control Group Survey Non-Respondents (n = 16,424)	Control Group Survey Respondents (n = 1,152)
Household	Homeowner listed as deceased*	0.27%	0.20%
Demographics			
Age	Under 35	19.5%	8.6%
	35-54	49.6%	43.5%
	55+	30.9%	47.9%
Household size	Avg. number of Adults**	2.58	2.80
Children in household	At least 1 child <18 years.	35.5%	32.3%
Education of respondent	Less than High School Diploma	8.2%	5.1%
	High School Diploma	30.3%	28.6%
	Some College	32.5%	29.8%
	Bachelor Degree	17.9%	23.1%
	Graduate Degree	11.1%	13.4%
Household Income	Under $50K	33.6%	25.3%
	$50-$100K	44.4%	47.0%
	$100-$200K	18.8%	23.0%
	$200K or higher	3.2%	4.7%
Occupation	Blue Collar	23.4%	18.5%
	Farm Related	0.6%	1.1%
	Other	10.5%	5.9%
	Professional/Technical	32.4%	40.5%
	Retired	9.2%	13.2%
	Sales/Service	24.0%	20.6%
Gender	Female	43.8%	36.1%
Housing			
Homeownership	Own	83.8%	91.2%
Housing Type	Single-family detached	91.5%	92.1%
Home Size	Home square footage of 100-5,999	98.7%	98.2%
	Home square footage of 6,000-9,999	1.3%	1.6%
	Home square footage of over 10,000	0.1%	0.1%
Age of House	Before 1960	26.0%	23.5%
	1960-1989	41.9%	44.2%
	1990 or later	32.2%	32.3%
Length of Residence	0-9 Years	73.1%	61.3%
	10-20 Years	17.2%	23.9%
	21 Years or Higher	9.7%	14.8%

Category		Control Group Survey Non-Respondents (n = 16,424)	Control Group Survey Respondents (n = 1,152)
Psychographic			
Social Causes	Internet Online Subscriber	66.8%	78.6%
	Health	10.5%	16.9%
	Religious	8.6%	16.4%
	Veterans	6.2%	10.1%
	Animal Welfare	6.3%	9.1%
	Political – Conservative	2.0%	4.2%
	Political – Liberal	1.0%	2.2%
	Children	9.4%	12.7%
	Volunteer Work	0.3%	0.8%
	Other Social Cause	12.1%	21.3%

* Indicated where "number of adults in household" variable is equal to zero.
** Note: Does not count households where homeowner listed as deceased (number of adults in home = 0).

I.4 Equivalency of Savings Group Respondents and Non-Respondents

The evaluation team also assessed whether non-response bias could be influencing the results of the savings group analysis. To do this, we first compared the demographic, housing, and psychographic characteristics of respondents and non-respondents within each savings group. We did find differences, particularly with respect to age and income. Respondents tended to be older and wealthier than non-respondents. All comparison tables are available in the binders.

We took several steps to determine whether we should weight the data to correct for these differences. First, we examined the correlations between each of the demographic, housing, and psychographic variables and our savings group analysis outcome variables of interest. If there is low correlation between outcome variables and potential weighting variables, there is little reason to weight.[28] Most of the correlations were very low (less than an absolute value of 0.05), but several were in the 0.15–0.20 range. All correlations are reported in the binders.

We next created a set of post-stratification weights based on the most highly correlated variables (age and income) and examined the correlation between the weights and our outcome variables of interest. The correlations were again generally low, with only a handful in the 0.15–0.20 range. These correlations are reported in the binders.

Finally, we analyzed responses to the most highly correlated survey questions with and without weights and compared the results. Table 68 and Table 69 summarize this analysis. The results changed only in minor and substantively unimportant ways. As a result, we decided not to weight the data.

[28] In fact, weighting would be counterproductive in such an instance.

Table 68. Electric Savings Groups: Comparison of Weighted and Unweighted Survey Results

Question	Savings Group	Weighted		Unweighted	
		Mean	90% Confidence Interval	Mean	90% Confidence Interval
How satisfied are you with Ameren overall?	Very Positive	7.0	(6.7 – 7.3)	7.1	(6.9 – 7.3)
	Typical	7.3	(7.2 – 7.4)	7.4	(7.3 – 7.5)
	Very Negative	6.3	(6.0 – 6.7)	6.6	(6.4 – 6.9)
How satisfied are you with the Home Energy Report program?	Very Positive	6.3	(5.9 – 6.6)	6.3	(6.1 – 6.6)
	Typical	6.6	(6.5 – 6.7)	6.6	(6.5 – 6.7)
	Very Negative	5.6	(5.3 – 6.0)	5.7	(5.5 – 6.0)
How satisfied are you with Ameren's energy efficiency programs?	Very Positive	6.1	(5.7 – 6.5)	6.3	(6.0 – 6.5)
	Typical	6.5	(6.3 – 6.6)	6.6	(6.5 – 6.7)
	Very Negative	5.5	(5.1 – 6.0)	5.8	(5.5 – 6.0)
How satisfied are you with Ameren's website?	Very Positive	6.9	(6.5 – 7.3)	7.0	(6.8 – 7.2)
	Typical	7.1	(7.0 – 7.2)	7.1	(7.1 – 7.2)
	Very Negative	6.6	(6.3 – 6.9)	6.7	(6.4 – 6.9)

Table 69. Gas Savings Groups: Comparison of Weighted and Unweighted Survey Results

Question	Savings Group	Weighted		Unweighted	
		Mean	90% Confidence Interval	Mean	90% Confidence Interval
How satisfied are you with Ameren overall?	Very Positive	7.1	(6.8 – 7.4)	7.3	(7.1 – 7.5)
	Typical	7.2	(7.1 – 7.3)	7.3	(7.2 – 7.4)
	Very Negative	7.0	(6.7 – 7.4)	7.2	(6.9 – 7.4)
How satisfied are you with the Home Energy Report program?	Very Positive	6.7	(6.3 – 7.0)	6.8	(6.5 – 7.0)
	Typical	6.4	(6.3 – 6.6)	6.5	(6.4 – 6.6)
	Very Negative	6.1	(5.7 – 6.6)	6.3	(6.0 – 6.6)
How satisfied are you with Ameren's energy efficiency programs?	Very Positive	6.5	(6.1 – 6.9)	6.7	(6.5 – 6.9)
	Typical	6.3	(6.2 – 6.5)	6.5	(6.4 – 6.6)
	Very Negative	6.2	(5.7 – 6.6)	6.2	(6.0 – 6.5)
How satisfied are you with Ameren's website?	Very Positive	6.9	(6.6 – 7.3)	7.1	(6.9 – 7.3)
	Typical	7.0	(6.9 – 7.2)	7.1	(7.0 – 7.2)
	Very Negative	7.0	(6.6 – 7.4)	7.1	(6.8 – 7.3)

I.5 Reports Used in Survey Experiment

The evaluation team created a survey experiment to see whether members of different savings groups responded differently to different intervention strategies. Specifically, we compared two motivational strategies (social norming and goal-setting) and two messaging strategies (praise and critique). We used a two-by-two experimental design with four reports to isolate the impact of each feature. We created the four

report images using standard and target rank reports from OPower with identifying information removed. Table 70 summarizes the reports associated with each strategy. The report images are provided below.

Table 70. Intervention Strategies and Corresponding Report Images

Social norming + praise → Standard Report - Positive	Goal-setting + praise → Target Rank Report - Positive
Social norming + critique → Standard Report - Negative	Goal-setting + critique → Target Rank Report – Negative.

Figure 30. Standard Report - Positive

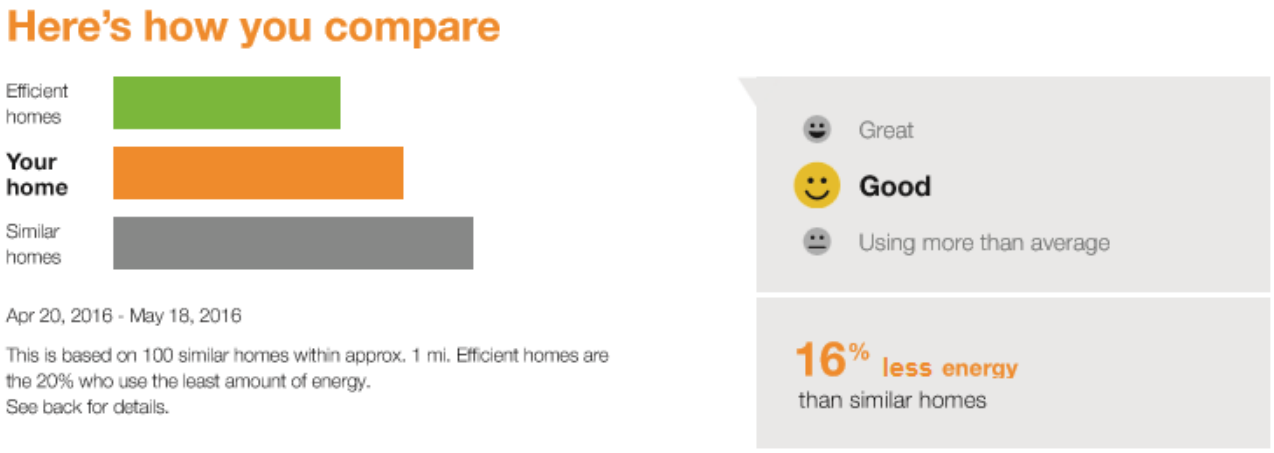


Figure 31. Standard Report - Negative

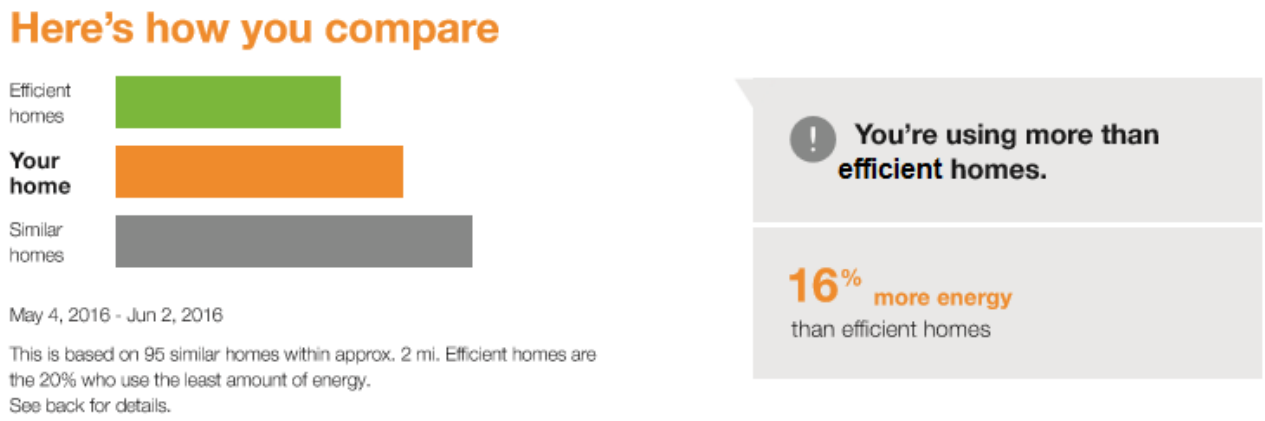


Figure 32. Target Rank - Positive

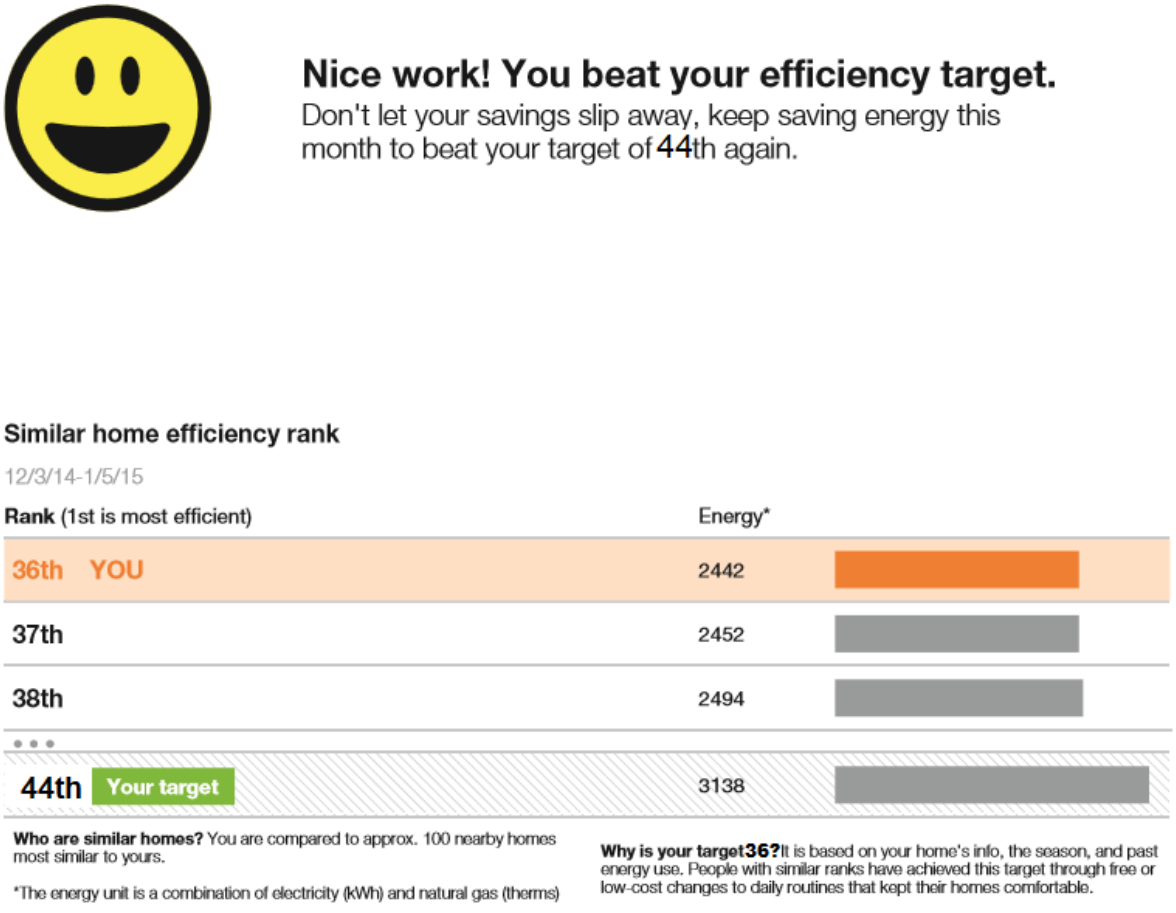
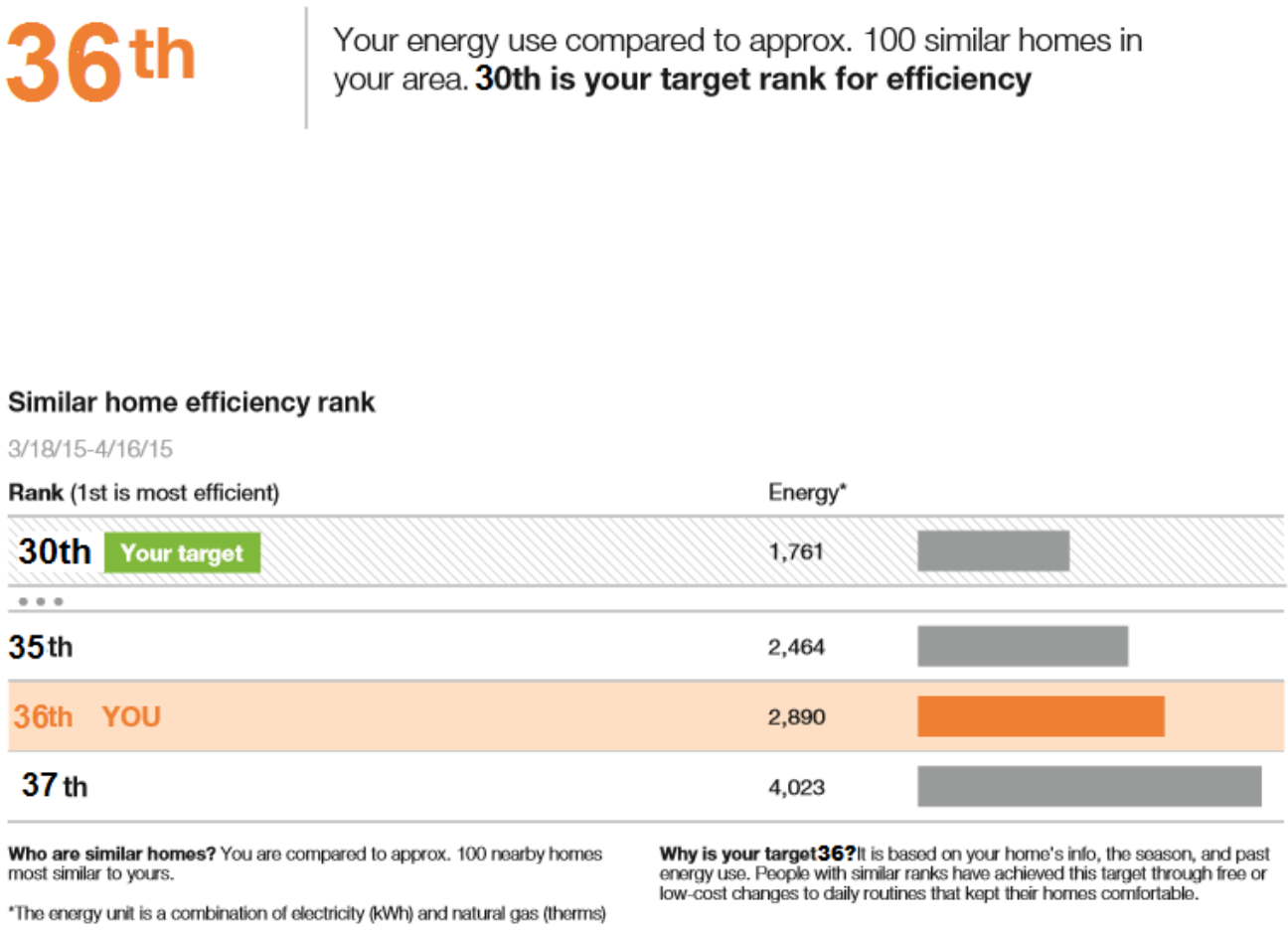


Figure 33. Target Rank - Negative



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