



# IMPACT AND PROCESS EVALUATION OF AMEREN ILLINOIS COMPANY'S BEHAVIORAL MODIFICATION PROGRAM (PY5)

DRAFT FINAL

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# TABLE OF CONTENTS

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<b>1. EXECUTIVE SUMMARY .....</b>	<b>6</b>
<b>2. INTRODUCTION .....</b>	<b>9</b>
<b>3. EVALUATION METHODS .....</b>	<b>11</b>
3.1 Data Sources and Analytical Methods.....	11
3.1.1 Process Analysis.....	11
3.1.2 Impact Analysis.....	11
<b>4. RESULTS AND FINDINGS .....</b>	<b>17</b>
4.1 Process Results.....	17
4.2 Impact Results .....	18
4.2.1 Overall Adjusted Program Savings .....	18
4.2.2 Detailed Results .....	21
4.3 Inputs for Future Program Planning.....	25
4.3.1 Future Planning and Goal Setting .....	25
4.3.2 Evaluation Activities in PY6.....	26
<b>A. APPENDIX: MEAN DAILY USAGE .....</b>	<b>27</b>
<b>B. APPENDIX: BILLING ANALYSIS DATA CLEANING RESULTS .....</b>	<b>28</b>
<b>C. APPENDIX: BILLING ANALYSIS MODEL COEFFICIENTS .....</b>	<b>35</b>
<b>D. APPENDIX: CHANNELING ANALYSIS SAVINGS ADJUSTMENTS .....</b>	<b>43</b>

## TABLE OF TABLES

---

Table 1. Behavioral Modification Program Participation in PY5 .....	6
Table 2. PY5 Behavioral Modification Program Impacts .....	7
Table 3. Summary of Evaluation Methods .....	11
Table 4. Pre-Program kWh Average Daily Consumption .....	13
Table 5. Pre-Program Therm Average Daily Consumption .....	13
Table 6. Difference-of-Differences Estimator .....	16
Table 7. Behavioral Modification Program Participation in PY5 .....	18
Table 8. PY5 Behavioral Modification Program Total Savings .....	19
Table 9. Unadjusted Per-Household Savings (%) by Season – Electric .....	22
Table 10. Unadjusted Per-Household Savings (%) by Season – Gas .....	22
Table 11. Percentage of Savings by Baseline Usage – Electric .....	23
Table 12. Percentage of Savings by Baseline Usage – Gas .....	23
Table 13. Participation Lift by Cohort .....	24
Table 14. PY5 Behavioral Modification Program Impacts – Electric .....	25
Table 15. PY5 Behavioral Modification Program Impacts – Gas .....	25
Table 16. Average Daily Consumption by Cohort, Treatment v. Control, Pre- v. Post-Participation....	27
Table 17. Data Cleaning Results: Original Cohort, Electric .....	28
Table 18. Data Cleaning Results: Expansion Cohort 1, Electric .....	29
Table 19. Data Cleaning Results: Expansion Cohort 2, Electric .....	30
Table 20. Data Cleaning Results: Original Cohort, Gas .....	31
Table 21. Data Cleaning Results: Expansion Cohort 1, Gas .....	32
Table 22. Data Cleaning Results: Expansion Cohort 2, Gas .....	33
Table 23. Data Cleaning Results: Expansion Cohort 3, Gas .....	34
Table 24. Billing Analysis Model Coefficients – Electric, Original Cohort .....	35
Table 25. Billing Analysis Model Coefficients – Electric, Expansion Cohort 1 .....	35
Table 26. Billing Analysis Model Coefficients – Electric, Expansion Cohort 2 .....	36
Table 27. Billing Analysis Model Coefficients – Gas, Original Cohort .....	36

*Table of Tables*

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Table 28. Billing Analysis Model Coefficients – Gas, Expansion Cohort 1.....	37
Table 29. Billing Analysis Model Coefficients – Gas, Expansion Cohort 2.....	37
Table 30. Billing Analysis Model Coefficients – Gas, Expansion Cohort 3.....	38
Table 31. Per-Household Savings (% & kWh) by Baseline Usage – Electric.....	38
Table 32. Per-Household Savings (% & Therms) by Baseline Usage – Gas.....	39
Table 33. Billing Analysis Model Coefficients – Electric, Original Cohort.....	39
Table 34. Billing Analysis Model Coefficients – Electric, Expansion Cohort 1.....	40
Table 35. Billing Analysis Model Coefficients – Electric, Expansion Cohort 2.....	40
Table 36. Billing Analysis Model Coefficients – Gas, Original Cohort.....	41
Table 37. Billing Analysis Model Coefficients – Gas, Expansion Cohort 1.....	41
Table 38. Billing Analysis Model Coefficients – Gas, Expansion Cohort 2.....	42
Table 39. Billing Analysis Model Coefficients – Gas, Expansion Cohort 3.....	42
Table 40. Treatment and Control Group Sizes – Electric.....	43
Table 41. Treatment and Control Group Sizes – Gas.....	43
Table 42. Difference-in-Differences Estimator.....	43
Table 43. Modeled Baseline Usage.....	43
Table 44. Savings Adjustment – Electric.....	44
Table 45. Savings Adjustment – Gas.....	44

# TABLE OF FIGURES

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Figure 1. PY5 Percent Household Savings by Cohort and Year – Electric..... 19

# 1. EXECUTIVE SUMMARY

As a part of its residential portfolio, Ameren Illinois Company (AIC) administers the Behavioral Modification Program. The program began as a pilot in August 2010, and was developed to reduce the energy consumption of AIC’s residential customers through encouraging energy-efficient choices. Since then, it has expanded into a full program. The specific goals of the program are to achieve the following:

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

The program offers three different treatment types, including a Home Energy Report (HER) that is mailed to the customer’s home, an electronic copy that is emailed to the customer, and an online portal that customers can access to view their report along with additional information.

Approximately 198,000 dual fuel customers participated in the Behavioral Modification Program in PY5. To support the impact evaluation effort, these customers were divided into three cohorts. Within a cohort, most customers were dual fuel customers, and as such, appear in both electric and gas cohorts. Each cohort has participated in the program for two or three years. In addition, in November 2011 AIC added a gas-only cohort; however, ~~this cohort stopped receiving reports in April 2012, July 2012, and resumed receiving reports in April 2013. and will no longer be part of the program starting in PY6~~ (see Table 1).<sup>1</sup>

**Table 1. Behavioral Modification Program Participation in PY5**

Cohort Name	Fuel Type	Number of Customers Treated in PY5	Start Date	End Date	Program Year
Original Cohort	Electric	42,095	August 2010	NA	Y3
	Gas	42,095	August 2010	NA	Y3
Expansion Cohort 1	Electric	65,608	April 2011	NA	Y2
	Gas	65,608	April 2011	NA	Y2
Expansion Cohort 2	Electric	90,791	November 2011	NA	Y2
	Gas	90,791	November 2011	NA	Y2
Expansion Cohort 3*	Gas	15,016	November 2011	<del>July 2012</del> April 2012, resumed in April 2013	NA

**Comment [MS1]:** The gas only cohort was treated in February 2012 and March 2012 (both PY4) and not treated again until April 2013 (PY5).

**Comment [JC2]:** changed

**Comment [MS3]:** This group was treated in April of 2013.

**Comment [JC4]:** changed

\* The customers in this group are gas-only customers. This group was added in the middle of PY4 to assist the program in meeting their goals, with the intention of dropping them from treatment in PY5. This group received

<sup>1</sup> While this cohort is no longer part of the program, the evaluation team conducted a billing analysis to assess persistence in savings.

Executive Summary

reports in February and March 2012, and then did not receive any subsequent reports until April 2013. However, this group did receive one report in April 2013.

Results

In PY5, the program saved **27,998,316.18** MWh and **1,478,053,157.34** therms (Table 2). Adjusted net savings remove energy savings that resulted from customer participation in other AIC programs in PY5.

Table 2. PY5 Behavioral Modification Program Impacts

Cohort Name	Fuel Type	Modeled Annual Baseline Usage per H.H. (kWh or Therms)	Adjusted Net Savings per H.H.%	Total Participants (N)	Total Adjusted Net Program Savings: Evaluated Period (MWh or Therms)
Original Cohort	Electric	12,914	<del>1.55%</del> 4.5% 6%	42,095	<del>6,139</del> 8,241
	Gas	9,049	1.04%	42,095	<del>373,152</del> 362,576
Expansion Cohort 1	Electric	13,882	<del>1.65%</del> 4.6% 2%	65,608	<del>14,791</del> 15,557
	Gas	10,266	<del>1.30%</del> 4.2% 9%	65,608	<del>781,736</del> 843,523
Expansion Cohort 2	Electric	9,562	<del>0.92%</del> 0.8% 7%	90,791	<del>7,068</del> 7,820
	Gas	6,910	<del>0.54%</del> 0.5% 2%	90,791	<del>243,769</del> 285,645
Expansion Cohort 3	Gas	8,154	0.71%	15,016	<del>79,407</del> 84,596
Overall*	Electric	NA	NA	198,494	<del>27,998</del> 31,618
	Gas	NA	NA	213,510	<del>1,478,053</del> 1,576,341

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

Additional findings include:

- **AIC implemented the program consistently with regard to program design, and no significant changes occurred between PY4 and PY5.** Minor changes included revising language used in reports. However, the number of participants were reduced<sup>2</sup> due to attrition and implementation issues, such as removing customers with an out of state address or those customers considered to be outliers.
- ~~Per household savings in PY5 increased from PY4 for both electric and gas cohorts. This is consistent with prior evaluations and findings from programs in other jurisdictions, where participants in their second or third program year garner higher savings than the first year.~~
- **Per-household percent savings tend to increase with the level of baseline consumption.** The evaluation team compared customer savings by baseline usage, and found that as baseline

<sup>2</sup> Reduced electric participants from 246,273 to about 198,494 and reduced gas participants from 267,471 to 213,510.

*Executive Summary*

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consumption increases, the per-household percent savings for savings also tends to increase.

- **Participants continue to save even ~~with interrupted after they stop receiving treatment.~~** Expansion Cohort 3 (the gas-only cohort) stopped receiving program offerings in ~~July 2012~~ April 2012 and resumed receiving reports in April 2013. However this cohort, but continued to achieve savings in PY5 (0.71% net savings per household).
- **The program motivates customers to participate in other residential AIC programs.** All electric and gas cohorts had a higher rate of participation in PY5 in the treatment groups than the control cohorts.

**Comment [MS5]:** The gas only cohort was treated in February 2012 and March 2012 (both PY4) and not treated again until April 2013 (PY5).

**Comment [JC6]:** Changed to reflect interrupted service

## 2. INTRODUCTION

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The Behavioral Modification Program began as a pilot in August 2010 and has since expanded to a program treating more than 198,000 dual fuel customers in PY5. In PY4, administration responsibilities shifted from AIC to Conservation Services Group (CSG), with Opower remaining as the program implementer.

The program's primary tool for encouraging energy-efficient behaviors is the Home Energy Report (HER). A HER includes the following information:

- A comparison of the customer's current energy usage to past usage
- A comparison of the customer's energy usage to 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, number of occupants, etc.)

The program offers three different treatment types, including a paper report that is mailed to the customer's billing address, an electronic copy if an email address is on file, and the online portal, which customers can log onto to view their report and access additional information. In PY5, a total of about 3% of participants logged into the online portal.<sup>3</sup>

The program treated dual fuel customers during the program pilot phase, targeting households with higher-than-average energy consumption. These customers are now in their third year (Y3) of the program. In April 2011 and November 2011, AIC added two additional cohorts of customers into the program, focusing on the next tier of high-use dual fuel customers. These customers are now in their second year (Y2) of the program. In November 2011, a gas-only cohort was added; however, ~~this cohort stopped receiving reports in April 2013, and resumed receiving reports in April 2013. This cohort stopped receiving reports in July April 2013 2012, and as such will is no longer part of the program in PY6.~~ In addition, each of the cohorts experienced some amount of attrition due to customers opting-out or customers moving and closing accounts; all such customers were removed from the impact analysis.

**Comment [MS7]:** Gas only cohort did receive treatments after July 2012.

**Comment [JC8]:** changed

Reports are sent to treated customers on a monthly basis for the first three months of program treatment. After the first three months, the dual fuel customers (i.e., Original Cohort, Expansion Cohort 1, and Expansion Cohort 2) receive reports on a bimonthly basis (i.e., all dual fuel customers in our PY5 analysis received reports every other month in PY5). ~~Given that t~~ The gas-only cohort (Expansion Cohort 3) ~~stopped receiving reports in July 2012, the cohort~~ received only one report in PY5 ~~in April 2013.~~

**Comment [MS9]:** The gas only cohort received the one report in April 2013.

**Comment [JC10]:** changed

The PY5 evaluation focuses on the period from June 2012 through May 2013. Based on the PY4-PY6 AIC plan, the expected energy savings from this program are 39,993 MWh and 968,740 therms for PY5, representing 9% of electric savings and 15% of gas savings for the overall portfolio.

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<sup>3</sup> Based on numbers provided by the implementer, Opower, this represents about 2,057 customers.

*Introduction*

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The program added an additional 42,000 dual fuel customers in May 2013, which is PY6 (31,500 treatment group customers and 10,500 control group customers). These customers are not part of this evaluation, and will be evaluated during the PY6 evaluation period.

### 3. EVALUATION METHODS

In this section, we detail the evaluation activities conducted for the PY5 Behavioral Modification Program, along with the methods that were used.

#### 3.1 DATA SOURCES AND ANALYTICAL METHODS

Data sources for evaluating the Behavioral Modification Program include:

- Program-tracking databases and *ex post* savings across residential programs (see channeling analysis for more details)
- Information on key program efforts and dates gathered through stakeholder interviews
- Electric and gas billing usage data for treatment and control groups

Table 3 provides a summary of the evaluation methods used for the PY5 evaluation.

**Table 3. Summary of Evaluation Methods**

Activity	Details
Program Materials Review	Reviewed materials to assess program design, implementation, and operations.
Interviews with Program Managers and Implementers	Interviewed program managers from CSG and Opower to discuss program theory and implementation, and to collect process-related feedback.
Treatment/Control Analysis	No new cohorts were added in PY5. As such, the team compared the usage between the treatment and control groups for all the electric and gas cohorts.
Impact Evaluation Approach	Conducted a billing analysis to quantify the changes in energy use among the treatment and control group members. Also performed a channeling analysis to ensure that savings are not double-counted from participation in other AIC residential programs.

##### 3.1.1 PROCESS ANALYSIS

Process evaluation activities in PY5 were limited, as the primary evaluation task for this year was the impact analysis.

The evaluation team conducted in-depth interviews with program managers from CSG and Opower to help understand areas of success, challenges to success, and insights into the daily workings of the program. Interviews also identified program objectives and goals, and reviewed roles and responsibilities for each stakeholder group.

##### 3.1.2 IMPACT ANALYSIS

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

- Billing analysis of program savings to estimate the program energy impacts by season and overall. This analysis also includes a comparison of customer responses to the treatment by baseline energy usage.

- Channeling analysis to calculate a savings adjustment to determine what portion of net savings, as measured through the billing analysis, is captured in other program databases. This analysis helps to adjust net savings to exclude only savings captured in other residential AIC programs.

## **Billing Analysis**

Below we outline our approach to conducting the billing analysis.

### ***Data Preparation***

The data used in the billing analysis comes from two primary sources:

- Monthly billing data from July 2009 to May 2013
- Program launch date specific to each customer (treatment and control)

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

- Separated out the electric and gas monthly billing data by each of the four program cohorts (i.e., Original Cohort, Expansion Cohort 1, Expansion Cohort 2, and Expansion Cohort 3)
- Removed observations and customers within each cohort based on the following criteria:
  - Duplicate entries
  - Customers flagged as not being a part of the test group
  - Out-of-range usage data
  - Insufficient pre-treatment or post-treatment usage data
  - Very low usage data
  - Customer flagged as moving out of state
- Determined the usage on a calendar month basis for each customer based upon their read cycle
- Linked the usage with the customer-specific program start date

Depending on the cohort, the percent removed varied from 3% to 11%. For a detailed accounting of the number and percent of accounts removed due to data cleaning, please see Appendix B.

### ***Treatment / Control Analysis***

The evaluation team conducted a detailed equivalency check during the PY4 analysis, in which it was determined that the treatment and control groups for all program cohorts were equivalent. As such, the evaluation team did not conduct a full equivalency check for the PY5 analysis. However, given that some customers opted-out of the program and there has been some attrition, the evaluation team performed a comparison of usage between the treatment and control groups for all of the electric and gas cohorts. We examined the average daily fuel consumption for the 12-month period prior to when the first reports were received for treatment and control group customers. Table 4 and

Table 5 below show that all four cohorts were equivalent based on the average daily consumption in the pre-period.

**Table 4. Pre-Program kWh Average Daily Consumption**

Cohort	Treatment (Pre-Consumption) in kWh	Control (Pre-Consumption) in kWh
Original Cohort	36.09	36.08
Expansion Cohort 1	38.38	38.37
Expansion Cohort 2	25.93	25.91

**Table 5. Pre-Program Therm Average Daily Consumption**

Cohort	Treatment (Pre-Consumption) in Therms	Control (Pre-Consumption) in Therms
Original Cohort	2.57	2.57
Expansion Cohort 1	3.10	3.10
Expansion Cohort 2	1.89	1.90
Expansion Cohort 3	2.24	2.24

### Modeling Program Impacts

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

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

Because of the experimental design, we can assume that the treatment and control groups have experienced similar events with similar effects on energy use. In addition, they experience similar weather. This means that it is not important to measure or include weather in the DID models. We estimated the model by season for all electric and gas cohorts. The evaluation team calculated total program savings by summing the seasonal results. The models estimated were:

**Equation 1: Seasonal Model Estimating Equation**

$$By\ Season: ADC_{it} = \alpha_i + \beta_1 Post_t + \beta_2 Treatment_i \cdot Post_t + \epsilon_{it}$$

Where:

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

$\alpha_i$ = Household-specific intercept

$\beta_1$  = Coefficient for the change in consumption between pre and post periods

$\beta_2$  = Coefficient for the change in consumption for the treatment group in the post period compared to the pre period and to the control group. This is the basis for the net savings estimate.

This model was also used to test the effect of baseline consumption level on treatment impacts.

### Estimating Program Savings

The first step in calculating average program savings was accomplished by using the coefficients from the estimating equation (Equation 1) to estimate average daily consumption (ADC) under two conditions: 1) the control group in the treatment period and 2) the treatment group in the treatment period. The first estimate was made by evaluating Equation 1 (shown above) with the Treatment variable set to 0 (to represent the control group), and the Post variable set to 1 (to reflect the control group difference in consumption from pre- to post-periods). The second estimate was made by evaluating the Equation 1 with the Treatment variable set to 1 (to represent participation), and the Post variable remaining at 1 (again to represent the post-period). The difference between those two estimates constitutes the average daily savings per household in kWh or therms.

Program savings as a percent reduction were calculated by dividing the average daily savings estimate described above by the estimate of ADC under the conditions of non-participation.<sup>4</sup> To calculate average household savings attributable to the program for the evaluated period, the average, raw, per-household daily savings was multiplied by the average number of days in the evaluated period (i.e., the average number of days between receiving the first report and the endpoint of the post-participation billing periods). The evaluation team estimated savings using this model for each season covered by the pre- and post-periods for all electric and gas cohorts.

### Channeling Analysis

The purpose of a channeling analysis is to answer the following questions:

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

~~While no specific residential AIC programs were promoted through the Behavioral Modification Program,~~ The savings tips provided in the reports could lead to additional program participation<sup>5</sup>. If program materials were effective, we would expect to see a lift in participation in other AIC residential energy efficiency programs among program participants, or a higher rate of participation among the treatment group compared to the control. Increased participation in other AIC energy efficiency programs among the treatment participants would mean that some portion of savings from other programs may be counted by both the Behavioral Modification Program (through the billing analysis savings estimate) and other AIC programs (through deemed savings in their tracking databases).

**Comment [MS11]:** In Program Year 5 (Late January 2013 and February 2013) we used the HER tips to promote the Appliance Recycling program.

**Comment [JC12]:** Changed – added in reference to this later on

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<sup>4</sup> 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.

<sup>5</sup> AIC indicated they promoted the Appliance Recycling Program in PY5 through the HER.

### **Participation Lift Analysis**

To determine whether Behavioral Modification Program treatment generates lift in other energy efficiency programs, 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—with the databases of other residential energy efficiency programs. Other program databases cross-referenced include:<sup>6</sup>

- Appliance Recycling
- HVAC (Electric and Gas)
- Residential Lighting (online platform only)<sup>7</sup>
- Home Energy Performance (Electric and Gas)
- Moderate Income (Electric and Gas)
- Residential Efficient Products (Electric and Gas)

Through this database crossing, we determined whether each customer (both treatment and control groups) participated in any AIC energy efficiency program after they received the first Behavioral Modification Program report. The difference in treatment and control participation rates is participation lift.

### **Savings Adjustment**

The Behavioral Modification Program participants can save energy in three ways: 1) through conservation behaviors, 2) through measures installed outside of an energy efficiency program, and 3) 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 will still be counted by other programs. The objective of the savings adjustment is to remove savings already captured in other program evaluations.

To determine the net savings component of the channeling analysis, the following steps were conducted:

- **Step 1: Determine Overlap in Units:** Similar to the participation lift analysis, the evaluation team cross-referenced the database of the Behavioral Modification program, both treatment and comparison groups, with the databases of other AIC residential programs.

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<sup>6</sup> The Multifamily Program was not part of the channeling analysis due to the structure of program-tracking data. Since participation is tracked at a facility level, it is not possible to link measures to specific residential accounts. Additionally, the ENERGY STAR® New Homes Program was not part of the channeling analysis, as the rebates were given to builders of new homes. Customers at the new home, if part of the treatment group, received the Home Energy Report after they occupied their home; thus, their decision to move into an energy-efficient home was not influenced by the Behavioral Modification Program.

<sup>7</sup> This includes participation through the web store. Energy-efficient lighting sold through stores was not captured in our analysis, as the upstream lighting program component does not collect customer information.

Evaluation Methods

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- **Step 2: Evaluate Savings of Overlapping Units:** Once the overlapping units were established, the per measure (per program) evaluated deemed savings were applied to the units to get the kWh savings for both the pre- and post-program period for the treatment and comparison groups.
- **Step 3: Difference-of-Differences (DoD) Approach:** Using the DoD approach, the evaluation team used the net deemed savings to calculate the savings adjustments (see **Error! Reference source not found.**).

**Table 6. Difference-of-Differences Estimator**

	Pre	Post	Post-Pre Difference
Treatment	Y0t	Y1t	Y1t-Y0t
Comparison	Y0c	Y1c	Y1c-Y0c
<b>T-C Difference</b>	<b>Y0t-Y0c</b>	<b>Y1t-Y1c</b>	<b>(Y1t-Y1c) - (Y0t-Y0c)</b>

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

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

## 4. RESULTS AND FINDINGS

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### 4.1 PROCESS RESULTS

Process evaluation efforts in PY5 were limited, as the primary task of the evaluation was to calculate energy savings through a billing analysis.

As part of the process evaluation effort, the evaluation team reviewed the program-tracking database and available program materials, such as sample Home Energy Reports and marketing materials. We also conducted in-depth interviews with program managers from CSG and Opower.

AIC oversees the Behavioral Modification Program, and reviews and approves any program materials or changes that are made to the program during the year. CSG administers the program for AIC and holds the contract with Opower, who provides the software to produce and send out HERs and manage customer information. Similar to PY4, Opower reports to AIC on both a monthly and quarterly basis, which allows AIC to track savings in a timely manner and make changes as needed to meet program goals.

According to CSG, the program has run smoothly and there have been few challenges. In PY5, the program implemented three enhancements to the HER, as described below:

- Changed “neighbor comparison” language to “similar homes.” Program administrators made this change because many treated customers were confused by the term “neighbor,” and thought their usage was being compared to their actual neighbors, who may differ from them in many ways. “Similar homes” is a more accurate description, as the comparison is based on homes and households with similar characteristics, such as square footage, type of home, number of occupants, and other factors.
- Made opt-out language more prominent in the report, thereby making it easier for customers who do not want to participate in the program.
- Added the following question in each report: “Are we comparing you correctly?” This invited customer feedback and addressed complaints from customers who did not think they were being correctly compared. A customer is able to log onto the web portal and compare their usage to similar homes based on square footage, number of occupants, and other factors. If the customer believes that any of these factors are inappropriate for their home or household, they can call the program to make the appropriate changes.

As noted, the evaluation team reviewed the program-tracking database. Table 7 below provides details about the cohorts, including treatment start and end dates, as applicable. About 47,000 dual fuel customers and about 6,000 gas-only customers ceased receiving treatment in PY5. The evaluation team conducted the impact analysis using the customers currently receiving treatment, i.e. 198,494 electric customers and 213,510 gas customers. The customers who ceased receiving treatment were not excluded by the evaluation team but rather the implementers. As such, our impact results reflect the energy savings for those customers who are currently receiving treatment.

According to the program implementers, there are several reasons for this:

- Attrition: Customers were removed because they moved, closed their account, had an undeliverable address, or opted-out of the program.

*Results and Findings*

- No Reports Generated: Due to an implementation error, reports were not generated for some customers, and as such those customers were removed from the program.
- Out of State Addresses: Customers were removed because the address provided was an out-of-state address. Notably, the implementation contractors began checking for out-of-state addresses in PY5.
- Outliers: Customers were determined to be “outliers” if they had usage that was too extreme for a good customer experience, and were excluded from receiving reports. Outliers are homes that Opower deemed would have a bad report experience due to the vast difference in their usage compared to that of their neighbors, and therefore were excluded from the program. Notably, Opower has since updated its processes to exclude these homes prior to selection.

**Table 7. Behavioral Modification Program Participation in PY5**

Group Name	Fuel Type	Planned Number of Customers Treated in PY5	Actual Number of Customers Treated in PY5	% Attrition*	% No Generated Reports*	% Out-of-State Address*	% Outliers*
Original Group	Electric	50,001	42,095	~16%	0%	0%	0%
	Gas	50,001	42,095	~16%	0%	0%	0%
Expansion Group 1	Electric	76,355	65,608	~14%	0%	0%	0%
	Gas	76,355	65,608	~14%	0%	0%	0%
Expansion Group 2	Electric	119,917	90,791	~11%	~ 3%	~ 4%	~ 6%
	Gas	119,917	90,791	~11%	~ 3%	~ 4%	~ 6%
Expansion Group 3	Gas	21,198	15,016	0%	~29%	0%	0%
Total	Electric	246,273	198,494				
	Gas	267,471	213,510				

\* Data received from the program implementer.

## 4.2 IMPACT RESULTS

This section provides overall PY5 Behavioral Modification Program net adjusted savings. Following the presentation of results, we provide detailed results from the billing analysis and channeling analysis, which contributed to the development of a final adjusted net program savings value.

### 4.2.1 OVERALL ADJUSTED PROGRAM SAVINGS

Table 8 below provides overall program net adjusted savings. The program saved 27,99831,618 MWh and 1,478,0531,576,341 therms.

**Table 8. PY5 Behavioral Modification Program Total Savings**

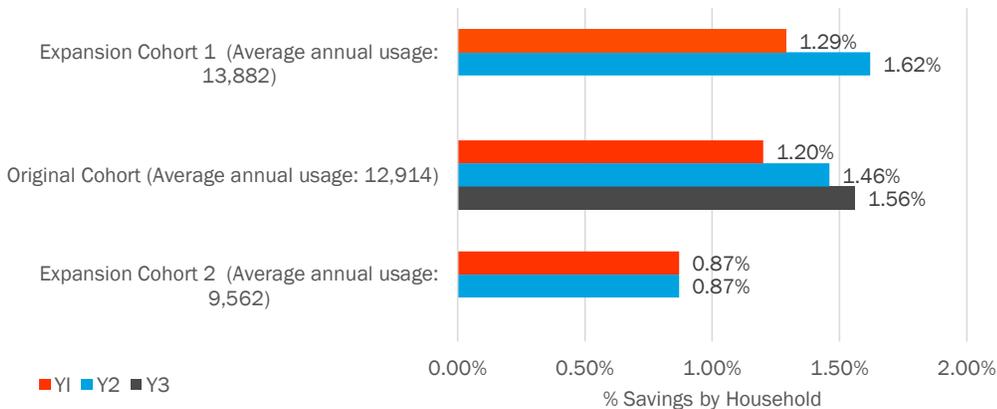
Cohort	Final Adjusted Net Program Savings (MWh)	Final Adjusted Net Program Savings (Therms)
Original Cohort	8,241,613	362,576,373
Expansion Cohort 1	15,557,479	843,523,781
Expansion Cohort 2	7,820,706	285,645,243
Expansion Cohort 3	—	84,596,794
<b>Total*</b>	<b>31,618,279</b>	<b>1,576,341,478</b>

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

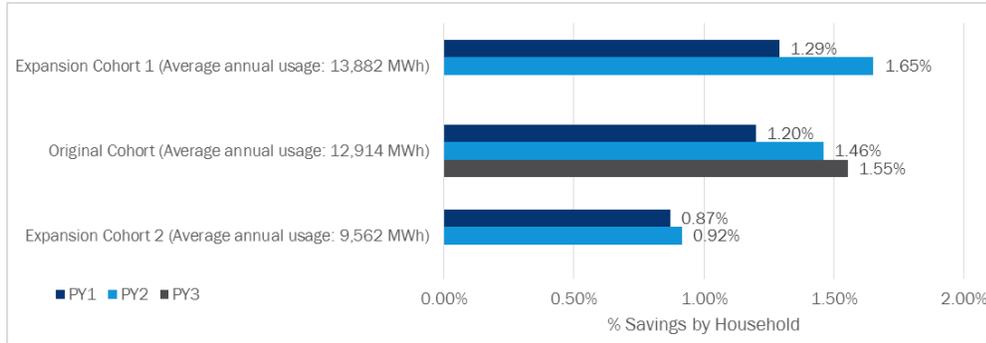
Adjusted net savings refer to modeled impacts less savings that are accounted for from participation in other residential AIC programs. Applying these adjusted savings, the evaluation team reduced electric savings by 0.004% to 0.03%, and gas savings by 0% to 0.023%, depending on the cohort. Note that in some cases, adjusted savings are 0%. These are cases where the control group participated in programs at a greater extent than the treatment group (see Section 4.2.2).

We found two key factors that correlate with program energy impacts: baseline usage, and number of years a participant has been in the program. Figure 1 and Figure 2 below provide both electric and gas percent household savings by cohort and by year. As can be seen in the figures, cohorts with higher baseline consumption tend to yield higher percent savings. Additionally, cohorts that have participated in the program for more time also tend to yield higher percent savings.

**Figure 1. PY5 Percent Household Savings by Cohort and Year – Electric**

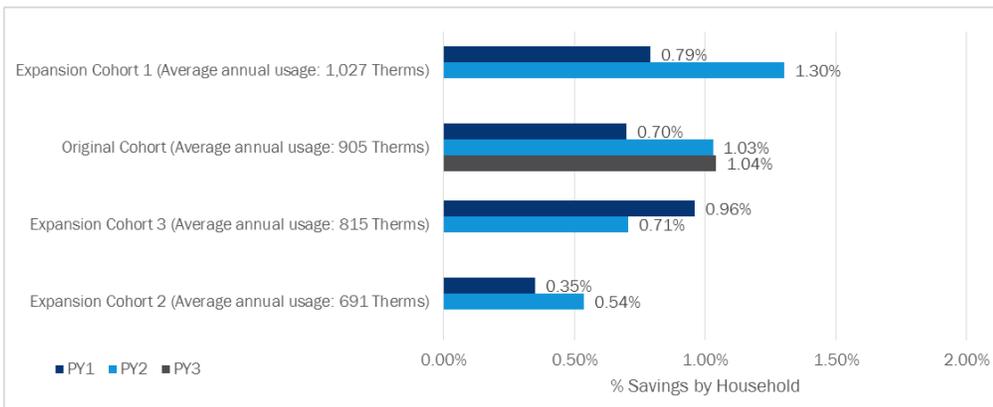
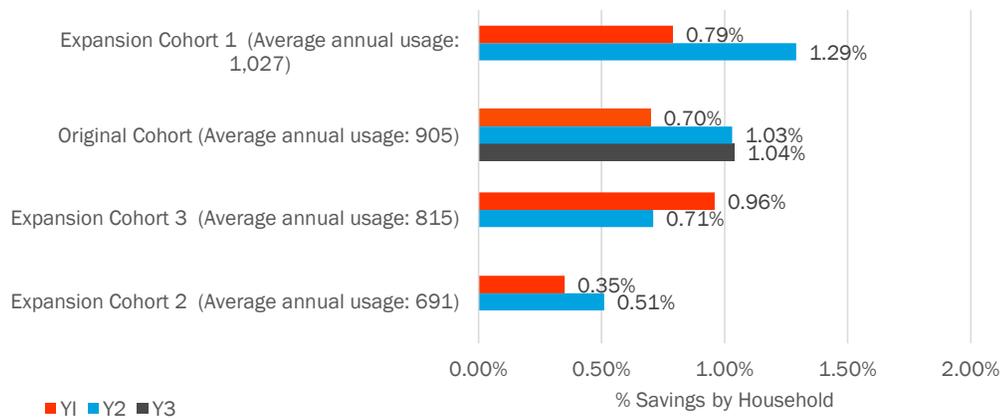


Results and Findings



\*"Average Annual Use" reflects pre-participation average annual consumption.

Figure 2. PY5 Percent Household Savings by Cohort and Year – Gas



## Results and Findings

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\*“Average Annual Use” reflects pre-participation average annual consumption.

As noted above, the rate of savings tends to increase with the level of baseline consumption consistent with findings in similar programs in other jurisdictions. Notably, because randomization occurs within cohort groups rather than across cohorts, the findings are purely observational.

Consistent with findings for similar programs in other jurisdictions, we found that electric and gas savings increased from the first to second year of participation. However, we found that for the gas Original Cohort savings appear to level-off from the second to third year of participation. A possible explanation for this leveling-off could be that gas cohorts in general tend to stabilize faster than electric cohorts do because there tend to be limited options for customers to save. This means that over time, AIC should expect to see a plateau in gas savings within existing cohorts. We anticipate reviewing this trend for Expansion Cohorts 1 and 2 in future evaluations (see Appendix D).

Notably, gas-only customers ~~who stopped receiving treatment~~ (Expansion Cohort 3) continued to garner savings despite ~~receiving only one report in April 2013~~~~no longer receiving treatment after July 2012~~. This indicates persistence of savings (i.e., the extent to which a program treatment effect continues to generate savings above the control group after treatment ~~has been discontinued~~~~was suspended for much of 2012~~). However, as expected there was a decline in these savings from previous years since treatment was not ~~longer being~~ received.

**Comment [MS13]:** Gas only cohort received treatment April 2013.

**Comment [JC14]:** Changed – but do we want to keep “persistence”

Based on this analysis, future customer targeting efforts should consider baseline consumption to support achievement of planning goals. In addition, planning assumptions should consider the number of years participants have been in the program. Future evaluation efforts will assess whether increases year-over-year continue or plateau over time.

### 4.2.2 DETAILED RESULTS

The evaluation team conducted a variety of efforts to develop adjusted net impact results for the Behavioral Modification Program. These included a comparison of baseline usage between treatment and control groups, impact modeling by season and baseline usage, participation lift analysis, and channeling analysis. We provide detailed results for each evaluation effort below.

#### Treatment / Control Analysis

The evaluation team compared baseline usage between the treatment and control groups for all of the electric and gas cohorts. We examined the average daily fuel consumption for the 12-month period prior to when the first reports were received between the treatment and control groups. Overall, we found that the treatment and control groups appear equivalent within each cohort.

#### Impact Modeling Analysis

Notably, confidence intervals and significance testing are generally provided when evaluating a sample from the participant population. Given that this evaluation is for the entire participant population, we do not provide the confidence intervals, as any savings achieved through the program reflect actual population savings and do not require significance testing.

#### Seasonal Model

The evaluation team used a seasonal model to calculate overall program savings. Table 9 below summarizes the PY5 unadjusted net savings for the three electric cohorts. This table provides net

Results and Findings

savings results, but does not deduct double-counted savings from participation in other residential AIC programs (see Appendix C for the modeled coefficients).

**Table 9. Unadjusted Per-Household Savings (%) by Season – Electric**

Cohort Name	Statistic	Overall <sup>a</sup>	Winter	Summer	Spring	Fall
Original Cohort	Average % Savings	<del>1.55%</del> 1.57%	1.46%	1.32%	1.88%	1.55%
	Average Savings per Customer	<del>196</del> 146	42	<del>65</del> 24	<del>50</del> 33	<del>40</del> 39
Expansion Cohort 1	Average % Savings	<del>1.62%</del> 1.65%	1.51%	1.74%	1.74%	1.62%
	Average Savings per Customer	<del>238</del> 230	48	93	<del>51</del> 39	46
Expansion Cohort 2	Average % Savings	<del>0.92%</del> 0.89%	1.12%	0.68%	1.14%	0.72%
	Average Savings per Customer	<del>86</del> 80	24	25	<del>23</del> 15	14

<sup>a</sup> Average savings per customer are weighted savings based upon the number of days evaluated per season.

Table 10 summarizes the PY5 unadjusted net savings for the four gas cohorts. These savings do not account for cross-program participation (see Appendix C for the modeled coefficients).

**Table 10. Unadjusted Per-Household Savings (%) by Season – Gas**

Cohort Name	Statistic	Overall <sup>a</sup>	Winter	Summer	Spring	Fall
Original Cohort	Average % Savings	1.04%	0.76%	1.07%	1.00%	1.32%
	Average Savings per Customer	<del>8.62</del> 8.9	3.5	<del>0.50</del> 2	<del>2.4</del> 1.6	2.2
Expansion Cohort 1	Average % Savings	<del>1.30%</del> 1.31%	1.14%	1.36%	1.21%	1.50%
	Average Savings per Customer	<del>12.7</del> 12.1	6.1	0.7	<del>3.2</del> 2.4	2.9
Expansion Cohort 2	Average % Savings	<del>0.54%</del> 0.53%	0.36%	0.76%	0.56%	0.46%
	Average Savings per Customer	<del>3.12</del> 3	1.3	0.3	<del>1.0</del> 0.7	0.6
Expansion Cohort 3	Average % Savings	0.71%	0.69%	0.75%	0.61%	0.77%
	Average Savings per Customer	<del>5.65</del> 3	2.9	0.3	<del>1.30</del> 0.9	1.1

<sup>a</sup> Average savings per customer are weighted savings based upon the number of days evaluated per season.

**Baseline Model**

The evaluation team also performed an analysis to determine whether customer response to the treatment varied by baseline usage. Three equal-sized groups were identified based on pre-program (baseline) usage. The percentage of savings, shown in Table 11 and Table 12 below, tends to increase with the level of baseline consumption. For example, in the electric Original Cohort, high-

usage customers contributed 65% of the overall savings, medium-usage customers contributed 24% of the overall savings, and low-usage customers contributed 11% of the overall savings. This is consistent with findings in similar programs in other jurisdictions.

**Table 11. Percentage of Savings by Baseline Usage – Electric**

Cohort Name	High Usage	Medium Usage	Low Usage
Original Cohort	65%	24%	11%
Expansion Cohort 1	55%	31%	14%
Expansion Cohort 2	59%	35%	6%

**Table 12. Percentage of Savings by Baseline Usage – Gas**

Cohort Name	High Usage	Medium Usage	Low Usage
Original Cohort	56%	35%	9%
Expansion Cohort 1	58%	24%	18%
Expansion Cohort 2	41%	42%	17%
Expansion Cohort 3	64%	18%	18%

## Channeling Analysis: Participation Lift

The evaluation team cross-referenced the databases of the Behavioral Modification Program—both treatment and control groups—with the databases of other residential AIC energy efficiency programs available to the customers who participated in the Behavioral Modification Program. The other residential AIC energy efficiency programs include the Appliance Recycling Program, the Lighting Program, the HVAC Program, the Residential Energy-Efficient Products (REEP) Program, the Home Energy Performance (HEP) Program, and the Moderate Income (MI) Program. Additional details about the methodology can be found in Section 3.1.2.

Through this database crossing, we determined that overall the treatment group customers had a higher rate of participation than the control group customers did, resulting in participation lift. Given that these are dual fuel customers, each customer was only counted once for having participated in the program (i.e., the lift analysis was not conducted by cohort and fuel type, rather just by cohort).

All cohorts had higher participation rate increases in the treatment groups than the control groups (see Table 13). In addition, the Appliance Recycling program was specifically targeted through the HERs and participation lift results show that in general, the Appliance Recycling program contributed substantially to the overall participation increase.

While the percent increase seems small, the overall effect is substantial given the size of the cohorts. As such, the Behavioral Modification Program channeled about 700 customers into other residential AIC programs. A single customer could be counted in multiple programs.

**Table 13. Participation Lift by Cohort**

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3
Appliance Recycling	0.12%	0.13%	0.22%	0.00%
Lighting (online platform only)*	0.00%	0.01%	0.01%	0.00%
HVAC	-0.10%	0.09%	0.07%	-0.14%
REEP	-0.02%	0.09%	-0.04%	0.19%
Home Energy Performance	0.12%	0.29%	0.01%	-0.05%
Moderate Income	-0.02%	0.02%	0.02%	0.00%
<b>Total**</b>	<b>0.10%</b>	<b>0.63%</b>	<b>0.27%</b>	<b>0.003%</b>

\* This includes participation in the online lighting platform only, as the upstream program does not collect customer information.

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

Notably, some treatment groups experience lower participation rates compared to control group customers (reflected in the negative percent values found in Table 13 above). A review of the Original Cohort participation lift year-over-year results indicates that these participants likely have less “low-hanging fruit” energy-saving options compared to their control group counterparts. However, the likely cause for the lower participation rates in the Expansion 2 cohort for the Residential Energy-Efficient Products and Home Energy Performance Programs and the lower participation rates in the Expansion 3 cohort for the HVAC and Home Energy Performance Programs is not clear. The evaluation team proposes exploring reasons for these differences in a participant survey in PY6. Additional participation lift analysis details can be found in Appendix C.

## Channeling Analysis: Savings Adjustment

To determine the net savings adjustment, the evaluation team applied evaluated net deemed savings values for each of the AIC programs to the treatment and control group customers who participated in AIC residential energy efficiency programs at the unit level (per measure, per program).<sup>8</sup>

Applying the adjusted savings, we reduced electric savings by 0.004002% to 0.03%, and gas savings by 0% to 0.023%, depending on cohort (see Table 14 and Table 15 below). Note that in some cases, adjusted savings are 0%. These are cases where the control group participated in programs to a greater extent than the treatment group (see Section 4.2.2).

<sup>8</sup> The evaluated net deemed savings were applied for all programs except for the Home Energy Performance program and the Moderate Income program where the ex-ante deemed savings were applied.

**Table 14. PY5 Behavioral Modification Program Impacts – Electric**

Statistic	Original Cohort	Expansion Cohort 1	Expansion Cohort 2
Net Program Savings (% per HH)	<del>1.55%</del> <del>1.57%</del>	1.65%	<del>0.92%</del> <del>0.89%</del>
Incremental Savings from Other Programs (% per HH)	0.002%	0.03%	0.02%
Final Adjusted Net Savings (% per HH)*	<del>1.55%</del> <del>1.56%</del>	1.62%	<del>0.89%</del> <del>0.87%</del>
Net Program Savings (kWh per HH)	<del>196.2</del> <del>146.0</del>	<del>238.0</del> <del>229.9</del>	<del>86.2</del> <del>79.9</del>
Incremental Savings from Other Programs (kWh per HH)	<del>0.21</del> <del>0.15</del>	<del>4.45</del> <del>4.48</del>	<del>2.20</del> <del>2.05</del>
Final Adjusted Net Savings (kWh per HH)	<del>196.0</del> <del>145.8</del>	<del>233.5</del> <del>225.4</del>	<del>84.0</del> <del>77.9</del>

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

**Table 15. PY5 Behavioral Modification Program Impacts – Gas**

Statistic	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3
Net Program Savings (% per HH)	1.04%	<del>1.30%</del> <del>1.31%</del>	<del>0.54%</del> <del>0.53%</del>	0.71%
Incremental Savings from Other Programs (% per HH)	0%*	<del>0.02%</del> <del>0.021%</del>	<del>0.02%</del> <del>0.018%</del>	0%*
Final Adjusted Net Savings (% per HH)**	<del>1.04%</del> <del>1.04%</del>	<del>1.28%</del> <del>1.29%</del>	<del>0.52%</del> <del>0.52%</del>	<del>0.71%</del> <del>0.71%</del>
Net Program Savings (Therms per HH)	<del>8.568</del> <del>8.86</del>	<del>12.74</del> <del>12.11</del>	<del>3.122</del> <del>2.78</del>	<del>5.585</del> <del>5.29</del>
Incremental Savings from Other Programs (Therms per HH)	0*	<del>0.22</del> <del>0.19</del>	<del>0.12</del> <del>0.09</del>	0*
Final Adjusted Net Savings (Therms per HH)**	<del>8.568</del> <del>8.86</del>	<del>12.52</del> <del>11.92</del>	<del>3.002</del> <del>2.68</del>	<del>5.585</del> <del>5.29</del>

\* Given that the overall savings adjustment was negative, the incremental savings adjustment was set to 0.

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

## 4.3 INPUTS FOR FUTURE PROGRAM PLANNING

In the following section, we discuss inputs for future program planning and evaluation activities in PY6.

### 4.3.1 FUTURE PLANNING AND GOAL SETTING

For future program planning purposes and goal setting, AIC might consider using the average savings estimates for kWh and therms over the evaluated period, which are ~~144~~~~159~~ kWh and ~~6.927~~~~7.38~~ therms per household. We calculated these values by dividing the total adjusted net program savings for the evaluated period by the total number of program participants for electricity and gas, respectively. Theoretically, AIC could multiply these averages by the planned number of future participants and produce estimates of the next program year’s anticipated electric and gas savings. However, AIC should consider refining these values based upon the baseline consumption of the new expansion cohort, as the average savings estimates presented above do not account for key

differences across cohorts by baseline consumption, fuel mix, and other demographic and household factors.

### **4.3.2 EVALUATION ACTIVITIES IN PY6**

The evaluation team plans to carry out similar tasks in PY6 as it did in PY5, including conducting interviews with CSG and Opower, completing an equivalency check of the treatment and control groups for future cohorts, and performing a billing analysis and channeling analysis to determine the net impacts of the program. As noted earlier, the program added an additional 42,000 dual fuel customers in PY6 (31,500 treatment group customers and 10,500 control group customers). We will evaluate this additional cohort during the PY6 evaluation period.

In PY6, we also plan to conduct a quantitative survey as the budget allows. The quantitative survey will be fielded to treatment and control cohorts to provide additional process and impact insights regarding energy-saving actions. We will field the survey to assess the following three analytical themes:

- **Gas Savings over Time:** Focusing on differences across first-, second-, and third-year gas participants to identify the types of actions taken, and determining whether they are behaviorally driven actions or actions taken that one could expect to persist over the estimated useful life of the measure installed, by participation year.
- **Channeling into Other Programs:** Exploring key differences in terms of customers who participated in other residential AIC programs to better understand why control group customers are participating in programs at higher rates than treatment groups for select programs and cohorts. Additionally, we will explore the cumulative participation in other programs over the years a participant received HER's through the Behavioral Modification program.
- **Persistence of Savings:** Measuring differences between participants who have been in the program for two or more years, and participants who stopped receiving HERs (e.g., interrupted groups in the case of Expansion Cohort 3). We will couple this analysis with a billing analysis comparing these two populations to help understand both savings estimates over time and persistence of savings.

## A. APPENDIX: MEAN DAILY USAGE

Table 16 depicts the mean daily usage for treatment and control groups, pre- and post-participation.

**Table 16. Average Daily Consumption by Cohort, Treatment v. Control, Pre- v. Post-Participation**

Behavioral Modification Program	Evaluated N*	Pre		Post		
		Mean	SD	Mean	SD	
<b>Electric Cohort (in kWh)</b>						
Original	Treatment	41,925	36.09	19.79	35.31	20.83
	Control	42,079	36.08	19.76	35.90	21.26
Expansion 1	Treatment	64,665	38.38	23.54	38.73	24.85
	Control	21,674	38.37	23.70	39.44	25.70
Expansion 2	Treatment	98,183	25.93	15.33	26.98	16.46
	Control	17,042	25.91	15.39	27.19	16.73
<b>Gas Cohorts (in Therms)</b>						
Original	Treatment	41,997	2.57	2.68	2.54	2.38
	Control	42,148	2.57	2.69	2.56	2.40
Expansion 1	Treatment	64,733	3.10	3.12	2.88	2.73
	Control	21,696	3.10	3.12	2.92	2.76
Expansion 2	Treatment	98,248	1.89	1.88	1.95	1.74
	Control	17,061	1.90	1.89	1.97	1.76
Expansion 3	Treatment	15,175	2.24	2.31	2.27	2.09
	Control	7,398	2.24	2.30	2.28	2.11

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

## B. APPENDIX: BILLING ANALYSIS DATA CLEANING RESULTS

Table 17 through Table 23 below show the results of the data cleaning effort for the billing analysis.

**Table 17. Data Cleaning Results: Original Cohort, Electric**

Original Cohort, Electric	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	87,063	43,493	43,570	1,009,982	504,556	505,426
Merging in pre-data based on PY4 analysis	86,701	43,313	43,388	3,198,539	1,598,205	1,600,334
# collapsed due to overlap in month variable	-	-	-	12,259	6,103	6,156
# after	86,701	43,313	43,388	3,186,280	1,592,102	1,594,178
# removed due to first report date occurring after opt-out date	-	-	-	7,193	7,193	-
# after	86,701	43,313	43,388	3,179,087	1,584,909	1,594,178
# removed due to duplicate usage data	-	-	-	-	-	-
# after	86,701	43,313	43,388	3,179,087	1,584,909	1,594,178
# removed due to low usage (<2 kwh)	166	84	82	5,337	2,701	2,636
# after	86,535	43,229	43,306	3,173,750	1,582,208	1,591,542
# removed due to change in address to out-of-state	905	466	439	30,066	15,614	14,452
# after	85,796	42,763	42,867	3,149,021	1,566,594	1,577,090
# removed due to too few months post-participation (<4)	1,626	838	788	44,538	23,021	21,517
# after	84,170	41,925	42,079	3,104,483	1,543,573	1,555,573
<b>Final #</b>	<b>84,170</b>	<b>41,925</b>	<b>42,079</b>	<b>3,104,483</b>	<b>1,543,573</b>	<b>1,555,573</b>
<b>% Removed</b>	<b>3%</b>	<b>4%</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>

**Table 18. Data Cleaning Results: Expansion Cohort 1, Electric**

Expansion Cohort 1, Electric	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	90,196	67,566	22,630	1,042,274	780,798	261,476
Merging in pre-data based on PY4 analysis	89,429	67,001	22,428	4,018,686	3,010,776	1,007,910
# collapsed due to overlap in month variable	-	-	-	14,747	11,019	3,728
# after	89,429	67,001	22,428	4,003,939	2,999,757	1,004,182
# removed due to first report date occurring after opt-out date	-	-	-	7,604	7,604	-
# after	89,429	67,001	22,428	3,996,335	2,992,153	1,004,182
# removed due to duplicate usage data	-	-	-	2	1	1
# after	89,429	67,001	22,428	3,996,333	2,992,152	1,004,181
# removed due to low usage (<2 kwh)	143	109	34	6,035	4,548	1,487
# after	89,286	66,892	22,394	3,990,298	2,987,604	1,002,694
# removed due to change in address to out-of-state	1,020	773	247	41,156	31,230	9,926
# after	88,266	66,119	22,147	3,949,142	2,956,374	992,768
# removed due to too few months post participation (<4)	1,927	1,454	473	71,002	53,115	17,887
# after	86,339	64,665	21,674	3,878,140	2,903,259	974,881
<b>Final #</b>	<b>86,339</b>	<b>64,665</b>	<b>21,674</b>	<b>3,878,140</b>	<b>2,903,259</b>	<b>974,881</b>
<b>% Removed</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>	<b>3%</b>	<b>4%</b>	<b>3%</b>

**Table 19. Data Cleaning Results: Expansion Cohort 2, Electric**

Expansion Cohort 2, Electric	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	129,320	110,207	19,113	1,476,103	1,257,771	218,332
Merging in pre-data based on PY4 analysis	120,131	102,353	17,778	6,027,964	5,135,752	892,212
# collapsed due to overlap in month variable	-	-	-	16,126	13,687	2,439
# after	120,131	102,353	17,778	6,011,838	5,122,065	889,773
# removed due to first report date occurring after opt-out date	-	-	-	6,047	6,047	-
# after	120,131	102,353	17,778	6,005,791	5,116,018	889,773
# removed due to duplicate usage data	-	-	-	20	16	4
# after	120,131	102,353	17,778	6,005,771	5,116,002	889,769
# removed due to low usage (<2 kwh)	162	145	17	7,485	6,765	720
# after	119,969	102,208	17,761	5,998,286	5,109,237	889,049
# removed due to change in address to out-of-state	1,412	1,198	214	64,187	54,517	9,670
# after	118,557	101,010	17,547	5,934,099	5,054,720	879,379
# removed due to too few months post participation (<4)	3,332	2,827	505	140,497	119,542	20,955
# after	115,225	98,183	17,042	5,793,602	4,935,178	858,424
<b>Final #</b>	<b>115,225</b>	<b>98,183</b>	<b>17,042</b>	<b>5,793,602</b>	<b>4,935,178</b>	<b>858,424</b>
<b>% Removed</b>	<b>11%</b>	<b>11%</b>	<b>11%</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>

Table 20. Data Cleaning Results: Original Cohort, Gas

Original Cohort, Gas	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	87,072	43,499	43,573	1,010,020	504,596	505,424
Merging in pre-data based on PY4 analysis	86,728	43,332	43,396	3,199,275	1,598,787	1,600,488
# collapsed due to overlap in month variable	-	-	-	12,314	6,154	6,160
# after	86,728	43,332	43,396	3,186,961	1,592,633	1,594,328
# removed due to first report date occurring after opt-out date	-	-	-	7,194	7,194	-
# after	86,728	43,332	43,396	3,179,767	1,585,439	1,594,328
# removed due to duplicate usage data	-	-	-	-	-	-
# after	86,728	43,332	43,396	3,179,767	1,585,439	1,594,328
# removed due to change in address to out-of-state	928	482	446	30,800	16,127	14,673
# after	85,800	42,850	42,950	3,148,967	1,569,312	1,579,655
# removed due to too few months post participation (<4)	1,655	853	802	48,327	24,852	23,475
# after	84,145	41,997	42,148	3,100,640	1,544,460	1,556,180
<b>Final #</b>	<b>84,145</b>	<b>41,997</b>	<b>42,148</b>	<b>3,100,640</b>	<b>1,544,460</b>	<b>1,556,180</b>
<b>% Removed</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>

**Table 21. Data Cleaning Results: Expansion Cohort 1, Gas**

Expansion Cohort 1, Gas	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	90,200	67,568	22,632	1,041,881	780,499	261,382
Merging in pre-data based on PY4 analysis	89,462	67,028	22,434	4,018,223	3,010,524	1,007,699
# collapsed due to overlap in month variable	-	-	-	14,623	10,954	3,669
# after	89,462	67,028	22,434	4,003,600	2,999,570	1,004,030
# removed due to first report date occurring after opt-out date	-	-	-	7,602	7,602	-
# after	89,462	67,028	22,434	3,995,998	2,991,968	1,004,030
# removed due to duplicate usage data	-	-	-	3	3	-
# after	89,462	67,028	22,434	3,995,995	2,991,965	1,004,030
# removed due to change in address to out-of-state	1,031	783	248	41,579	31,624	9,955
# after	88,431	66,245	22,186	3,954,416	2,960,341	994,075
# removed due to too few months post participation (<4)	2,002	1,512	490	73,301	55,051	18,250
# after	86,429	64,733	21,696	3,881,115	2,905,290	975,825
<b>Final #</b>	<b>86,429</b>	<b>64,733</b>	<b>21,696</b>	<b>3,881,115</b>	<b>2,905,290</b>	<b>975,825</b>
<b>% Removed</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>

**Table 22. Data Cleaning Results: Expansion Cohort 2, Gas**

Expansion Cohort 2, Gas	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	129,321	110,205	19,116	1,476,187	1,257,872	218,315
Merging in pre-data based on PY4 analysis	120,205	102,411	17,794	6,028,687	5,136,083	892,604
# collapsed due to overlap in month variable	-	-	-	16,224	13,769	2,455
# after	120,205	102,411	17,794	6,012,463	5,122,314	890,149
# removed due to first report date occurring after opt-out date	-	-	-	6,053	6,053	-
# after	120,205	102,411	17,794	6,006,410	5,116,261	890,149
# removed due to duplicate usage data	-	-	-	340	295	45
# after	120,205	102,411	17,794	6,006,070	5,115,966	890,104
# removed due to change in address to out-of-state	1,441	1,224	217	65,345	55,543	9,802
# after	118,764	101,187	17,577	5,940,725	5,060,423	880,302
# removed due to too few months post participation (<4)	3,455	2,939	516	144,383	123,100	21,283
# after	115,309	98,248	17,061	5,796,342	4,937,323	859,019
<b>Final #</b>	<b>115,309</b>	<b>98,248</b>	<b>17,061</b>	<b>5,796,342</b>	<b>4,937,323</b>	<b>859,019</b>
<b>% Removed</b>	<b>11%</b>	<b>11%</b>	<b>11%</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>

Table 23. Data Cleaning Results: Expansion Cohort 3, Gas

Expansion Cohort 3, Gas	Unique Customers			Observations		
	Total	Treatment	Control	Total	Treatment	Control
Initial #	23,796	15,997	7,799	276,332	185,793	90,539
Merging in pre-data based on PY4 analysis	23,298	15,666	7,632	1,185,139	797,000	388,139
# collapsed due to overlap in month variable	-	-	-	2,284	1,504	780
# after	23,298	15,666	7,632	1,182,855	795,496	387,359
# removed due to first report date occurring after opt-out date	-	-	-	997	997	-
# after	23,298	15,666	7,632	1,181,858	794,499	387,359
# removed due to duplicate usage data	-	-	-	142	99	43
# after	23,298	15,666	7,632	1,181,716	794,400	387,316
# removed due to change in address to out-of-state	287	202	85	13,349	9,325	4,024
# after	23,011	15,464	7,547	1,168,367	785,075	383,292
# removed due to too few months post participation (<4)	438	289	149	19,638	12,729	6,909
# after	22,573	15,175	7,398	1,148,729	772,346	376,383
<b>Final #</b>	<b>22,573</b>	<b>15,175</b>	<b>7,398</b>	<b>1,148,729</b>	<b>772,346</b>	<b>376,383</b>
<b>% Removed</b>	<b>5%</b>	<b>5%</b>	<b>5%</b>	<b>3%</b>	<b>3%</b>	<b>3%</b>

## C. APPENDIX: BILLING ANALYSIS MODEL COEFFICIENTS

Table 24 through Table 30 below show the billing analysis seasonal model coefficients for the electric and gas cohorts.

**Table 24. Billing Analysis Model Coefficients – Electric, Original Cohort**

Variable	Coefficient	Robust Standard Error	t
<b>Winter</b>			
Post	-2.24	0.06	-36.13
Post x Treatment	-0.47	0.09	-5.37
Constant	34.59	0.01	2398.27
<b>Summer</b>			
Post	4.65	0.06	81.21
Post x Treatment	-0.70	0.08	-8.67
Constant	48.64	0.01	4292.45
<b>Spring</b>			
Post	1.51	0.04	35.41
Post x Treatment	-0.55	0.06	-9.09
Constant	27.76	0.01	2782.05
<b>Fall</b>			
Post	-1.38	0.04	-33.03
Post x Treatment	-0.44	0.06	-7.42
Constant	29.90	0.01	3059.79

**Table 25. Billing Analysis Model Coefficients – Electric, Expansion Cohort 1**

Variable	Coefficient	Robust Standard Error	t
<b>Winter</b>			
Post	-2.04	0.09	-22.64
Post x Treatment	-0.54	0.10	-5.20
Constant	38.05	0.01	3335.94
<b>Summer</b>			
Post	5.57	0.09	61.81
Post x Treatment	-1.02	0.10	-9.80
Constant	52.68	0.01	4547.00
<b>Spring</b>			
Post	1.53	0.07	21.36
Post x Treatment	-0.56	0.08	-7.02
Constant	30.82	0.01	3786.25
<b>Fall</b>			
Post	-1.23	0.06	-19.49
Post x Treatment	-0.51	0.07	-6.97
Constant	32.65	0.01	4081.19

**Table 26. Billing Analysis Model Coefficients – Electric, Expansion Cohort 2**

Variable	Coefficient	Robust Standard Error	t
<b>Winter</b>			
Post	-0.27	0.08	-3.51
Post x Treatment	-0.27	0.08	-3.30
Constant	24.42	0.01	3405.53
<b>Summer</b>			
Post	3.93	0.07	54.68
Post x Treatment	-0.28	0.08	-3.56
Constant	36.79	0.01	6087.73
<b>Spring</b>			
Post	1.74	0.05	31.83
Post x Treatment	-0.25	0.06	-4.29
Constant	20.48	0.01	3982.56
<b>Fall</b>			
Post	0.11	0.05	2.23
Post x Treatment	-0.16	0.05	-3.06
Constant	21.48	0.00	5963.43

**Table 27. Billing Analysis Model Coefficients – Gas, Original Cohort**

Variable	Coefficient	Robust Standard Error	t
<b>Winter</b>			
Post	-1.03	0.01	-183.65
Post x Treatment	-0.04	0.01	-5.03
Constant	6.29	0.00	4849.62
<b>Summer</b>			
Post	-0.06	0.00	-50.50
Post x Treatment	-0.01	0.00	-3.79
Constant	0.60	0.00	2834.09
<b>Spring</b>			
Post	0.49	0.00	133.29
Post x Treatment	-0.03	0.01	-5.03
Constant	2.10	0.00	2471.99
<b>Fall</b>			
Post	-0.03	0.00	-10.76
Post x Treatment	-0.02	0.00	-5.90
Constant	1.90	0.00	2785.49

**Table 28. Billing Analysis Model Coefficients – Gas, Expansion Cohort 1**

Variable	Coefficient	Robust Standard Error	t
<b>Winter</b>			
Post	-1.11	0.01	-133.47
Post x Treatment	-0.07	0.01	-7.16
Constant	7.20	0.00	6724.85
<b>Summer</b>			
Post	-0.06	0.00	-32.91
Post x Treatment	-0.01	0.00	-3.53
Constant	0.62	0.00	2594.21
<b>Spring</b>			
Post	0.52	0.01	94.88
Post x Treatment	-0.04	0.01	-5.62
Constant	2.41	0.00	3488.92
<b>Fall</b>			
Post	0.03	0.00	7.18
Post x Treatment	-0.03	0.01	-6.37
Constant	2.10	0.00	3766.25

**Table 29. Billing Analysis Model Coefficients – Gas, Expansion Cohort 2**

Variable	Coefficient	Robust Standard Error	t
<b>Winter</b>			
Post	-0.65	0.01	-104.04
Post x Treatment	-0.01	0.01	-2.15
Constant	4.73	0.00	7777.95
<b>Summer</b>			
Post	-0.02	0.00	-20.33
Post x Treatment	-0.003	0.00	-2.59
Constant	0.41	0.00	4646.49
<b>Spring</b>			
Post	0.40	0.00	97.68
Post x Treatment	-0.01	0.00	-2.54
Constant	1.60	0.00	4087.38
<b>Fall</b>			
Post	0.07	0.00	24.46
Post x Treatment	-0.01	0.00	-2.11
Constant	1.34	0.00	6178.51

**Table 30. Billing Analysis Model Coefficients – Gas, Expansion Cohort 3**

Variable	Coefficient	Robust Standard Error	t
<b>Winter</b>			
Post	-0.90	0.01	-87.73
Post x Treatment	-0.03	0.01	-2.56
Constant	5.59	0.00	3702.52
<b>Summer</b>			
Post	-0.03	0.00	-12.43
Post x Treatment	-0.004	0.00	-1.17
Constant	0.54	0.00	1639.13
<b>Spring</b>			
Post	0.45	0.01	61.48
Post x Treatment	-0.01	0.01	-1.64
Constant	1.92	0.00	1851.68
<b>Fall</b>			
Post	0.05	0.00	10.00
Post x Treatment	-0.01	0.01	-2.08
Constant	1.54	0.00	2809.58

Table 31 below shows the savings per cohort using the baseline usage model.

**Table 31. Per-Household Savings (% & kWh) by Baseline Usage – Electric**

Cohort Name	Statistic	Overall	High Usage	Medium Usage	Low Usage
Original Cohort	Pre-Program Average Daily Baseline Usage	36	51	34	23
	Average % Savings	1.36%	2.17%	1.17%	0.75%
	Average Annual Savings per Customer	199	387	144	65
Expansion Cohort 1	Pre-Program Average Daily Baseline Usage	28	57	36	22
	Average % Savings	1.63%	1.99%	1.71%	1.18%
	Average Annual Savings per Customer	241	401	224	100
Expansion Cohort 2	Pre-Program Average Daily Baseline Usage	26	38	24	16
	Average % Savings	0.74%	1.05%	0.91%	0.25%
	Average Annual Savings per Customer	80	141	83	15

Table 32 below provides gas savings (in percentage terms) by baseline usage.

**Table 32. Per-Household Savings (% & Therms) by Baseline Usage – Gas**

Cohort Name	Statistic	Overall	High Usage	Medium Usage	Low Usage
Original Cohort	Pre-Program Average Daily Baseline Usage	2.6	3.5	2.4	1.7
	Average % Savings	0.93%	1.25%	1.13%	0.41%
	Average Annual Savings per Customer	9.2	15.4	9.8	2.5
Expansion Cohort 1	Pre-Program Average Daily Baseline Usage	3.1	4.1	2.9	2.2
	Average % Savings	1.15%	1.59%	0.94%	0.91%
	Average Annual Savings per Customer	12.5	21.6	9.1	6.8
Expansion Cohort 2	Pre-Program Average Daily Baseline Usage	1.9	2.4	1.9	1.4
	Average % Savings	0.49%	0.50%	0.63%	0.33%
	Average Annual Savings per Customer	3.5	4.3	4.4	1.7
Expansion Cohort 3	Pre-Program Average Daily Baseline Usage	2.2	3.1	2.1	1.6
	Average % Savings	0.67%	1.04%	0.42%	0.55%
	Average Annual Savings per Customer	6.0	11.4	3.2	3.2

Table 33 through Table 39 below show the billing analysis baseline usage model coefficients for the electric and gas cohorts.

**Table 33. Billing Analysis Model Coefficients – Electric, Original Cohort**

Variable	Coefficient	Robust Standard Error	t
<b>High Usage</b>			
Post	-1.84	0.09	-20.38
Post x Treatment	-1.07	0.13	-8.41
Constant	51.25	0.02	2554.78
<b>Medium Usage</b>			
Post	0.10	0.06	1.55
Post x Treatment	-0.40	0.09	-4.46
Constant	34.01	0.01	2414.16
<b>Low Usage</b>			
Post	1.15	0.05	22.49
Post x Treatment	-0.18	0.07	-2.50
Constant	22.98	0.01	2018.97

**Table 34. Billing Analysis Model Coefficients – Electric, Expansion Cohort 1**

Variable	Coefficient	Robust Standard Error	t
<b>High Usage</b>			
Post	0.01	0.14	0.10
Post x Treatment	-1.14	0.16	-7.12
Constant	57.10	0.02	3313.14
<b>Medium Usage</b>			
Post	1.43	0.10	14.90
Post x Treatment	-0.57	0.11	-5.19
Constant	35.73	0.01	3003.82
<b>Low Usage</b>			
Post	1.96	0.07	27.83
Post x Treatment	-0.28	0.08	-3.49
Constant	22.21	0.01	2438.26

**Table 35. Billing Analysis Model Coefficients – Electric, Expansion Cohort 2**

Variable	Coefficient	Robust Standard Error	t
<b>High Usage</b>			
Post	0.36	0.11	3.24
Post x Treatment	-0.40	0.12	-3.36
Constant	37.90	0.01	4027.42
<b>Medium Usage</b>			
Post	1.64	0.08	19.61
Post x Treatment	-0.24	0.09	-2.63
Constant	24.44	0.01	3437.08
<b>Low Usage</b>			
Post	1.75	0.07	26.43
Post x Treatment	-0.04	0.07	-0.61
Constant	15.47	0.01	2657.37

**Table 36. Billing Analysis Model Coefficients – Gas, Original Cohort**

Variable	Coefficient	Robust Standard Error	t
<b>High Usage</b>			
Post	-0.05	0.01	-7.99
Post x Treatment	-0.04	0.01	-5.34
Constant	3.54	0.00	2784.78
<b>Medium Usage</b>			
Post	0.00	0.00	0.26
Post x Treatment	-0.03	0.01	-5.25
Constant	2.45	0.00	2977.65
<b>Low Usage</b>			
Post	0.03	0.00	11.10
Post x Treatment	-0.01	0.00	-1.66
Constant	1.72	0.00	2552.29

**Table 37. Billing Analysis Model Coefficients – Gas, Expansion Cohort 1**

Variable	Coefficient	Robust Standard Error	t
<b>High Usage</b>			
Post	-0.26	0.01	-29.91
Post x Treatment	-0.06	0.01	-6.04
Constant	4.14	0.00	3646.53
<b>Medium Usage</b>			
Post	-0.17	0.01	-28.78
Post x Treatment	-0.03	0.01	-3.78
Constant	2.94	0.00	3907.90
<b>Low Usage</b>			
Post	-0.11	0.00	-22.94
Post x Treatment	-0.02	0.01	-3.48
Constant	2.22	0.00	3592.14

**Table 38. Billing Analysis Model Coefficients – Gas, Expansion Cohort 2**

Variable	Coefficient	Robust Standard Error	t
<b>High Usage</b>			
Post	0.06	0.01	10.53
Post x Treatment	-0.01	0.01	-1.91
Constant	2.35	0.00	4578.69
<b>Medium Usage</b>			
Post	0.07	0.00	15.90
Post x Treatment	-0.01	0.00	-2.53
Constant	1.89	0.00	4729.92
<b>Low Usage</b>			
Post	0.08	0.00	18.41
Post x Treatment	-0.005	0.00	-1.01
Constant	1.44	0.00	3666.00

**Table 39. Billing Analysis Model Coefficients – Gas, Expansion Cohort 3**

Variable	Coefficient	Robust Standard Error	t
<b>High Usage</b>			
Post	0.04	0.01	3.63
Post x Treatment	-0.03	0.01	-2.52
Constant	3.05	0.00	2250.85
<b>Medium Usage</b>			
Post	0.04	0.01	5.76
Post x Treatment	-0.01	0.01	-1.05
Constant	2.10	0.00	2343.92
<b>Low Usage</b>			
Post	0.05	0.01	8.92
Post x Treatment	-0.01	0.01	-1.26
Constant	1.58	0.00	2052.71

## D. APPENDIX: CHANNELING ANALYSIS SAVINGS ADJUSTMENTS

For the evaluation group to be able to correctly compare the treatment and control groups given the difference in cohort sizes, the control group was normalized to the treatment group size. Table 40 and Table 41 below shows the adjustments made.

**Table 40. Treatment and Control Group Sizes – Electric**

Electric	Treatment	Control	Adjustment Factor for Normalizing Control Group
Original Cohort	41,925	42,079	1.00
Expansion Cohort 1	64,665	21,674	2.98
Expansion Cohort 2	98,183	17,042	5.76

**Table 41. Treatment and Control Group Sizes – Gas**

Electric	Treatment	Control	Adjustment Factor for Normalizing Control Group
Original Cohort	41,997	42,148	1.00
Expansion Cohort 1	64,733	21,696	2.98
Expansion Cohort 2	98,248	17,061	5.76
Expansion Cohort 3	15,175	7,398	2.05

Using the difference-in-difference (DID) approach, the evaluation team applied the evaluated net deemed savings for calculating the savings adjustments (see Table 42 below).

**Table 42. Difference-in-Differences Estimator**

DID Estimator	Pre	Post	Post-Pre Difference
Treatment	Y0t	Y1t	Y1t-Y0t
Control	Y0c	Y1c	Y1c-Y0c
<b>T-C Difference</b>	<b>Y0t-Y0c</b>	<b>Y1t-Y1c</b>	<b>(Y1t-Y1c) - (Y0t-Y0c)</b>

The savings adjustment values were then divided by the modeled baseline assumptions to get the household-level adjustment values. The baseline usages values and the net adjustments per household are shown in the Table 43 through Table 45 below.

**Table 43. Modeled Baseline Usage**

Cohort	Electric (kWh/year)	Gas (therms/year)
Original Cohort	12,914	905
Expansion Cohort 1	13,882	1,027
Expansion Cohort 2	9,562	691
Expansion Cohort 3	--	815

**Table 44. Savings Adjustment – Electric**

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
<b>Electric – Original Cohort</b>			
Treatment	0.00%	0.19%	0.19%
Control	0.00%	0.18%	0.18%
T-C Difference	0.00%	0.00%	<b>0.002%</b>
<b>Electric – Expansion Cohort 1</b>			
Treatment	0.00%	0.20%	0.20%
Control	0.01%	0.17%	0.17%
T-C Difference	0.00%	0.03%	<b>0.03%</b>
<b>Electric – Expansion Cohort 2</b>			
Treatment	0.17%	0.20%	0.03%
Control	0.17%	0.17%	0.00%
T-C Difference	0.00%	0.03%	<b>0.02%</b>

**Table 45. Savings Adjustment – Gas**

Cohort	Pre-Treatment	Post-Treatment	Post-Pre Difference
<b>Gas – Original Cohort</b>			
Treatment	0.00%	0.21%	0.21%
Control	0.00%	0.24%	0.24%
T-C Difference	0.00%	-0.03%	<b>-0.03%</b>
<b>Gas – Expansion Cohort 1</b>			
Treatment	0.00%	0.22%	0.22%
Control	0.00%	0.20%	0.20%
T-C Difference	0.00%	0.02%	<b>0.02%</b>
<b>Gas – Expansion Cohort 2</b>			
Treatment	0.11%	0.24%	0.13%
Control	0.09%	0.20%	0.11%
T-C Difference	0.02%	0.04%	<b>0.02%</b>
<b>Gas – Expansion Cohort 3</b>			
Treatment	0.09%	0.30%	0.22%
Control	0.07%	0.32%	0.26%
T-C Difference	0.02%	-0.02%	<b>-0.04%</b>

~~E. Appendix: Year Over Year Net Adjusted Savings~~

~~**Electric Savings**~~

~~Figure 3 through Figure 5 below provide a comparison of year over year savings for electric cohorts. In the Original Cohort and Expansion Cohort 1, we see an increase in savings over each program year.~~

~~Figure 3. Year Over Year Savings for Original Cohort, Electric~~



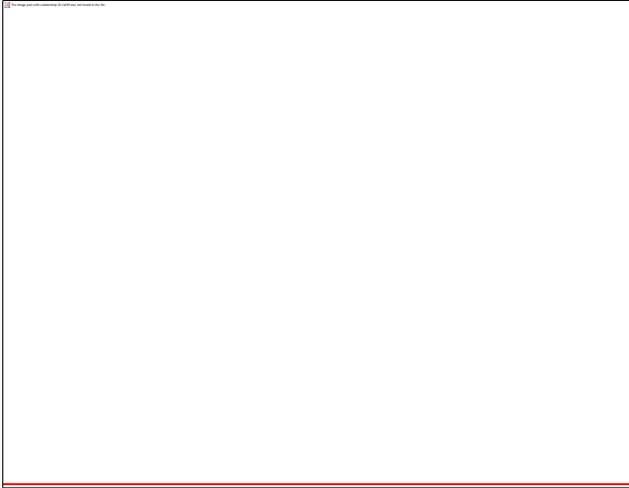
~~Expansion Cohort 1, Electric led to savings in both program years (Y1, Y2).~~

~~Figure 4. Year Over Year Savings for Expansion Cohort 1, Electric~~



~~Expansion Cohort 2, Electric led to savings in both program years (Y1, Y2).~~

~~Figure 5. Year Over Year Savings for Expansion Cohort 2, Electric~~

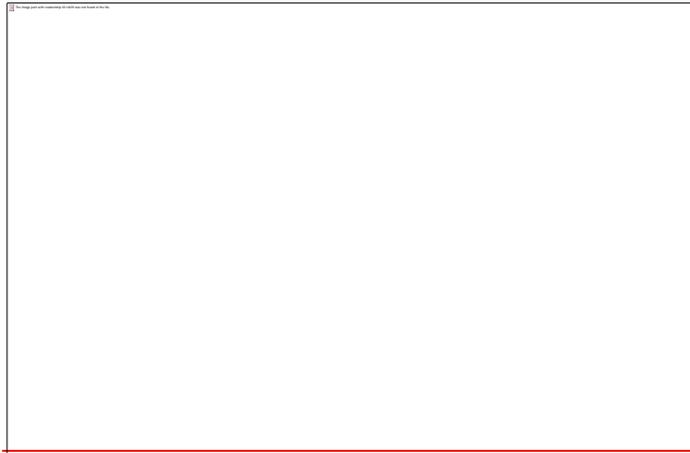


**Gas Savings**

Figure 6 through Figure 9 below provide a comparison of year over year savings for gas cohorts. In the case of gas cohorts, we find that savings increase from Year 1 to Year 2, and then decline in Year 3 (where applicable).

Original Cohort, Gas led to savings in all program years (Y1, Y2 and Y3).

Figure 6. Year Over Year Savings for Original Cohort, Gas



Expansion Cohort 1, Gas led to savings in both program years (Y1, Y2).

Figure 7. Year Over Year Savings for Expansion Cohort 1, Gas



~~Expansion Cohort 2, Gas led to savings in both program years (Y1, Y2):~~

~~Figure 8. Year Over Year Savings for Expansion Cohort 2, Gas~~



~~Expansion Cohort 3, Gas is a gas only cohort that was added into the program in November 2011. However, this cohort stopped receiving reports in July 2012 and is no longer part of the program.~~

~~Figure 9. Year Over Year Savings for Expansion Cohort 3, Gas~~

