



Opinion **Dynamics**

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451



Impact and Process Evaluation of 2016 (PY9) Illinois Power Agency Behavioral Modification Program

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Contributors

Hannah Howard
Managing Director, Opinion Dynamics

Olivia Patterson
Senior Director, Data Science, Opinion Dynamics

Stefanie Wayland
Senior Director, Data Science, Opinion Dynamics

Aaiysha Khursheed, Ph.D.
Principal Consultant, Opinion Dynamics

Zach Ross
Principal Consultant, Opinion Dynamics

Kai Zhou
Managing Consultant, Data Science, Opinion Dynamics

Eric Ziemba
Consultant, Data Science, Opinion Dynamics

Drew Blumenthal
Consultant, Data Science, Opinion Dynamics

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1. Executive Summary

This report presents results from the Behavioral Modification Program implemented by Oracle from June 2016 to May 2017 (also referred to as Program Year 9 [PY9]). The Behavioral Modification Program has been offered by Ameren Illinois Company (AIC) since August 2010. PY9 is the second year that the electric portion of the program was offered through the Illinois Power Agency (IPA) procurement plan process. Launched in August 2010, the program seeks to:

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

The Behavioral Modification Program began in PY3 and until the end of PY7, AIC oversaw a single dual-fuel program, as well as reviewed and approved any program materials or changes that were made during the program year. Since PY8, AIC has administered the program for gas customers, while the electric portion of the program has been offered through the IPA procurement process. Thus, this report focuses on the PY9 IPA electric savings.

In PY9, the program offered three forms of treatment: (1) a hard-copy printed home energy report (HER) mailed four times a year to the customer's billing address; (2) an electronic HER (eHER) sent once per billing cycle to all customers with email addresses (generally once a month); and (3) an online portal, which customers can log onto to view the same report and access additional information.

The Behavioral Modification Program reached just about a third of AIC's approximately 1 million residential customers in PY9. A total of 308,906 participants received reports in PY9 (including both dual-fuel and gas-only customers). Excluding the gas only cohort, 296,891 electric customers received reports. Oracle added a new cohort of just over 46,000 dual-fuel customers in September 2016 (Expansion Cohort 7). As a result, the number of income-qualified customers who received HERs with the Home Energy Program Income-Qualified (HEPIQ) marketing module increased demonstrating AIC staff commitment to expand services for income qualified customers.

Program Impacts

In PY9, the program achieved adjusted net savings of 35,157 MWh (see Table 1). Adjusted net savings remove the energy savings that resulted from customer participation in other AIC programs.

Table 1. PY9 Behavioral Modification Program Net Electric Impacts

Cohort	Number of Customers Treated in PY9	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (kWh per household)	Unadjusted Net Program Savings (kWh) ^b	PY9 Savings Uplift (kWh)	Legacy Savings Uplift (kWh)	Adjusted Net Program Savings (kWh)
Original Cohort	33,406	1.43%	178.88	5,792,155	0	142,000	5,650,155
Expansion Cohort 1	50,266	1.60%	222.09	10,799,689	0	244,168	10,555,521
Expansion Cohort 2	73,636	0.97%	92.91	6,584,874	127,912	2,893	6,454,068
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	20,329	1.02%	183.81	3,565,756	0	125,143	3,440,613
Expansion Cohort 5	45,359	0.87%	109.08	4,604,843	0	8,750	4,596,093
Expansion Cohort 6	27,716	0.84%	93.32	2,373,271	0	18,264	2,355,007
Expansion Cohort 7	46,179	0.58%	63.95	2,190,837	85,758	N/A	2,105,079
Total^c	296,891		120.96	35,911,425	213,671	541,218	35,156,536

^a The number of customers in PY9 refers to the number of customers to which AIC/IPA intended to provide HERs and who had an experiment start date

^b Pro-rated for participants whose accounts closed during PY9

^c Totals may not be exact due to rounding

Key Findings and Recommendations

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 net reduction of 35,157 MWh. Program participants achieved 118.42 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 electric program participants.
 - **Recommendation:** Depending on the selected cohorts for future program years, AIC can use the average savings estimates for kWh over the evaluated period to inform future participant selection. Theoretically, AIC could multiply these averages by the selected future participant type and produce estimates of the next program year's anticipated electricity and gas savings. These projections of savings provide information about the types of participants to select to include in future program years.
- **Key Finding #2: All cohorts show equivalency in terms of average daily consumption in the pre-participation period.** In addition, we demonstrated equivalency between the treatment and control groups of Expansion Cohort 7 using household, demographic, and psychographic data.
 - **Recommendation:** We recommend that the vendor continue to monitor the equivalency of the treatment and control groups of each cohort to ensure they remain so.
- **Key Finding #3: For the second year in a row, technical issues resulted in reductions to report frequency for many customers.** There were widespread issues with missing monthly billing reads in October 2016 that reduced the frequency of reports for approximately 31,000 customers. Because these billing reads were missing, these customers were mistakenly moved to program opt-out status. In addition, when Oracle converted to its Agile EE platform, the staff discovered 7,600 treatment

customers had not been receiving reports since 2012 or 2013, depending upon the customer. Both issues were addressed and the customers were included back in the program.

- **Recommendation:** Investigate the reoccurring missing reads issue as it affects program delivery and evaluation. The missing billing reads occurred in the fall just as it had in PY8. AIC should perform systematic checks to ensure that the billing data provided to Oracle goes through a thorough quality assurance/quality control (QA/QC) process to prevent this issue from occurring again.

- **Key Finding #4: Oracle's use of exclusion criteria that allow for the inclusion of customers with only 90 days of pre-period billing information may contribute to high program attrition rates, as well as volatility in estimating energy savings associated with the program.** As documented in this report, later cohorts with lower required pre-period billing information have higher attrition rates, and results across statistical models vary and in some cases become negative. Fewer pre-period billing records lead to fewer customers that can be incorporated within a statistical model, leading to more uncertainty in savings estimates.

- **Recommendation:** We recommend expanding the number of required pre-participation billing months for any new cohorts to a minimum of nine months.

2. Evaluation Approach

The PY9 evaluation of the Behavioral Modification Program included an impact analysis, as well as a review of program processes and design changes. To evaluate impacts, the evaluation team conducted an equivalency assessment between treatment and control groups, a billing analysis, and a channeling analysis. We reviewed program materials and program-tracking data, and conducted interviews with program implementation staff to assess the successes and challenges encountered during the PY9 year and to gain contextual information about the savings generated from the delivery of HERs to targeted customers. We also discussed whether the program implementation differed from previous years.

2.1 Research Objectives

The evaluation team sought to answer the following research questions as part of the PY9 program evaluation.

Impact Questions

- Were the new treatment and control groups equivalent and has equivalency been maintained for previous cohorts?
- What were the estimated electric energy savings from this program for all cohorts in PY9?
- Did the program achieve savings year-over-year for each of the cohorts?
- 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?

Program Process Questions

- How has the program changed since PY8?
- What notable successes occurred and challenges were faced with program implementation?
- Were there any changes in the quantity or frequency of hard copy and/or electronic HERs delivery to customers?

2.2 Evaluation Tasks

Table 2 below summarizes the PY9 evaluation activities conducted for the Behavioral Modification Program and the sections below provide additional details about each of them.

Table 2. Summary of Behavioral Modification Program Evaluation Activities for PY9

Activity	Impact	Process	Forward Looking	Details
Program Staff Interviews	✓	✓	✓	Interviewed program managers from AIC and Oracle to discuss changes in program operations since PY8 as well as program successes and challenges faced during PY9.
Review of Utility Data and Program Materials	✓	✓		Reviewed data to determine if it was adequate to conduct the net impact analysis and reviewed materials to assess program design, implementation, and operations.
Equivalency Analysis	✓		✓	For Expansion Cohort 7, compared treatment and control groups' energy usage and key demographic, household, and psychographic data to assess whether they are equivalent. For all previous cohorts, we checked treatment and control groups' energy usage to ensure continued equivalency.
Billing Analysis	✓			Conducted billing analysis to quantify the changes in energy use among the treatment and control groups.
Channeling Analysis	✓		✓	Performed a channeling analysis to ensure we did not double-count savings from participation in other AIC residential programs.

2.2.1 Program Staff Interviews

We conducted two telephone interviews with key program staff from AIC and Oracle. The interviews provided us with a comprehensive understanding of the program and its implementation, including insights into the daily operation of the program, program changes in PY9, and areas of success and challenges.

2.2.2 Program Materials Review

The evaluation team reviewed the program-tracking database and other program materials, including Oracle's PY9 implementation plan and web use metrics. This review allowed us to determine if there were any gaps present in the data, particularly around information required for the impact analysis. Table 3 provides a description of the data we reviewed, as well as their sources.

Table 3. PY9 Behavioral Modification Program Evaluation Data Reviewed by Source

Data Source	Data Details
Behavioral Modification Program Information	PY9 program energy savings goals, budget and expenditures, opt-out 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 billing data from July 2009 to May 2017

Data Source	Data Details
Customer Information	Customer account information, Experian data (including demographic data, housing characteristics, and psychographic data)
AIC Program-Tracking Databases	For all AIC residential programs from June 2009 to May 2017 (PY4–PY9)
Weather Data	Heating degree days (HDD) and cooling degree days (CDD) for specific weather stations in AIC service territory

2.2.3 Impact Analysis

We carried out an equivalency analysis, a billing analysis, and a channeling analysis to arrive at PY9 ex post net energy savings for the Behavioral Modification Program. We present the details of each method below.

Equivalency Analysis

The equivalency analysis includes a comparison of baseline household energy consumption and household characteristics for new cohorts. Through a review of these data, we determine whether there were key differences between the treatment and control groups. Confirming the comparability of the treatment and control groups strengthens the internal validity and defensibility of the research design.

The evaluation team used two methods to identify systematic differences between the treatment and control groups for Expansion Cohort 7. 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 2015 billing period. Second, the evaluation team examined the demographic, housing, and psychographic data purchased from Experian, comparing treatment to control customers. These observable characteristics may reflect other characteristics, such as attitudes and beliefs.

Below, we list variables used in the equivalency check for Expansion Cohort 7:

- Demographic Characteristics
 - Age
 - Dwelling type
 - Education
 - Homeowner/renter distribution
 - Estimated household income
 - Number of adults in household
 - Occupation group
 - Number of children in household
- 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 of internet services)

Equivalency analyses conducted in previous evaluations showed the treatment and control groups were equivalent for the Original Cohort and Expansion Cohorts 1 through 6. Because there has been some attrition, the evaluation team compared energy 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.

Billing Analysis

We determined program impacts using a billing analysis that leveraged a randomized control trial (RCT) 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 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 2017 from AIC;
- Program launch date specific to each customer (treatment and control) from Oracle; and
- Weather data (HDD and CDD) from National Oceanic and Atmospheric Administration (NOAA). The data came from 46 weather stations across the state and are appended at the zip code level.

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 more than 90 days
 - Dropped first and last billing periods with more than 60 days
 - Dropped first and last billing periods with less than 10 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:

- Moved out before RCT started
 - First report date occurring after inactive date
 - Out-of-range usage data
 - Very low usage data
 - No post-participation period data
 - Insufficient pre-participation period data
- Determined the monthly usage for each customer based on their read cycle (each usage record has a start date and a duration; based on these two variables, the team identified the appropriate month for each read cycle).
- Matched weather data by customer to the geographically closest weather station.

Depending on the cohort, data cleaning removed between <1% to 32% of customers in the electric and gas analyses. The majority of these drops, especially for more recent cohorts, are due to insufficient pre-participation period billing data. We provide the accounting of the number and percentage of accounts removed due to these activities in Appendix B of this report.

Modeling Program Impacts

The impact analysis relied on a statistical analysis of monthly electric 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 team used an intent-to-treat (ITT) approach in PY9,¹ and in implementing this approach, we estimated savings using a difference-in-differences (DID) model. The DID refers to the model's implicit comparison of consumption before and after treatment of both treatment and control group customers. The model includes customer-specific intercepts (i.e., fixed effects) to capture unobserved differences between customers that do not change over time and affect customers' energy use.

As part of the impact analysis, we use three different models to aid in comparisons to previous evaluations:

1. An overall model (Equation 1), that incorporates the post-participation period only. This is the lagged dependent variable (LDV) model, which is consistent with program implementer modeling and does a better job of modeling program impacts given Oracle's exclusion criteria of only 90 days pre-period data.
2. An overall model with the addition of weather adjustments (Equation 2), which allows direct year-to-year savings comparison.
3. A simple overall model (Equation 3), which is consistent with previous years' evaluations.

¹ ITT estimates the impacts of the program for a group of customers the program intended to treat, (i.e., customers AIC intended to receive HERs or eHERs). In previous years, we used the average treatment effect of the treated (ATT), which estimates the impacts of the program for the group of customers that received HERs and/or eHERs. These approaches differ in the number of customers used in the analysis.

We provide impact estimates for the program using the first model. We use the second model to assess savings year over year. We use the third model to provide results using the most basic model specification. Our model specifications are as follows:

Model 1: Post-Participation Period Only Model

For reporting purposes, and to enable comparisons to program implementer-supported models (i.e., Oracle, the program implementer’s estimates), we estimated a LDV model. A LDV model differs from the linear fixed effects regression (LFER) model in that only usage from the post-participation period is used in estimating the model. Information from the pre-participation period is used only to calculate 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 ITT effect. We employed the following estimating equation:

Equation 1. Post-Participation Period Only Model Estimating Equation

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

Where:

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

α_i = Household-specific intercept

β_1 = Coefficient for the change in consumption for the treatment group

β_2 = Coefficient for the average daily usage across household i available pretreatment meter reads

β_3 = Coefficient for the average daily usage over the months of December through March across household i available pretreatment meter reads

β_4 = Coefficient for the average daily usage over the months of June through 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

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

$PreUsage$ = 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 through March

$PreSummer_i$ = Average daily usage for household i over the pre-participation months of June through September

$MonthYear_t$ = Vector of month-year dummies

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. 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:

$ADC_{it}, \alpha_i, Treatment_i$ and ε_{it} are defined as above in Model 1

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

$Post_t$ = Variable to represent the pre- and post-participation periods (0 = pre-participation period, 1 = post participation period²)

HDD_{it} = Sum of HDD (base 65 °F)

CDD_{it} = Sum of CDD (base 75 °F)

² We defined the pre-period as the 12 months before the customer's first report. The month in which a customer receives their first report is neither pre-period nor post-period. The post-period is the time period after the month in which the customer received their first report. For the purposes of this evaluation, we focused specifically on the PY9 post-period and dropped post-period data outside of the program year window (June 2016 through May 2017).

Model 3: Original Model

Equation 3. Original Model Estimating Equation

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

Where:

ADC_{it} , α_i , $Treatment_i$ and ε_{it} are defined as above in Model 1

β_1 , β_2 and $Post_t$ are defined as above in Model 2

Estimating Program Savings

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

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.³ 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 the date Expansion Cohort 7 was added to the program [June 8, 2017] and the endpoint of the post-participation billing periods).

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.

Participation Lift and Channeling Analysis

The evaluation team conducted the participation lift and channeling analysis (also known as program uplift analysis) to answer the following research questions:

1. Does the program treatment have an effect on participation in other AIC residential energy efficiency programs (also known as “participation lift”)?
2. What portion of savings achieved by customers in the Behavioral Modification treatment group is counted as savings by other AIC residential energy efficiency programs (savings adjustment)?

The evaluation team assumes that customers in the treatment and control groups receive the same treatment from AIC for other energy efficiency programs (i.e., they encounter the same marketing and incentives). Because the Oracle program design for the Behavioral Modification Program randomly assigns customers to the treatment and control groups, any difference between the groups when it comes to participation in other

³ 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.

AIC offerings can be attributed to the Program. As such, we conducted a participation lift analysis to calculate increased participation in AIC's other residential energy efficiency programs due to the Behavioral Modification Program.

Additionally, to ensure that we do not double count savings across programs, the evaluation team calculates a savings adjustment that removes savings captured in the Behavioral Modification consumption analysis that are claimed by other programs. Applying this savings adjustment to the result of the Behavioral Modification consumption analysis produces adjusted net savings.

PY9 Participation Lift Analysis

To determine whether the Behavioral Modification Program treatment generated participation lift in PY9 (e.g., an increase in participation in other energy efficiency programs in PY9 as a result of the Behavioral Modification Program), we calculated whether more treatment than control group members participated in other AIC residential energy efficiency programs after receiving HERs compared to program participation before receiving HERs. We cross-referenced the Behavioral Modification Program database—both treatment and control groups (for all program cohorts)—with the databases of other residential energy efficiency programs in PY9, including:⁴

- Appliance Recycling
- HVAC
- Home Efficiency Income Qualified⁵
- Moderate Income Kits

The participation lift analysis calculates the number of program participants who participated in both the Behavioral Modification Program **and** other energy efficiency programs in PY9. To ensure the participation lift is attributable solely to the Behavioral Modification Program, we calculate participation lift using a difference-

⁴ We did not include a number of programs that touched residential customers during PY9 in this analysis for various reasons:

We did not include the Home Efficiency Standard Program for PY9 in the channeling analysis due to the structure of the program-tracking data. Since this data did not have a valid variable for identifying unique customers, our team was not able to link projects to specific residential accounts. A small number of customers participated in this program in PY9 (approximately 70 participants).

The Multifamily Program was not included in the channeling analysis due to the structure of program-tracking data. Since participation is tracked at a multifamily property 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.

We did not include the CFL Distribution Program because it chooses customers randomly, and thus whether or not customers obtain CFLs cannot be influenced by the Behavioral Modification Program.

We excluded the School Kits Program as program data is tracked at a school level and our team was unable to link measures to specific residential accounts.

Finally, we excluded the Rural Kits program; due to its opt-out design, we assume that treatment and control group customers have the same level of participation in this program.

⁵ In prior years, this program was known as the "Moderate Income" offering.

in-differences estimator (where possible).⁶ To do so, we identify the total number of treatment and control group customers who participated in an AIC energy efficiency program in PY9, as well as the total count of treatment and control group customers who participated in an AIC energy efficiency program prior to receiving HERs. The difference in these calculations is the net participation due to the Behavioral Modification Program (see Table 4). To ensure that our analysis represents only savings that can be definitively attributed to the effects of the Behavioral Modification Program, we test participation lift for statistical significance at a 95% level of confidence, and consider only statistically significant uplift to have been caused by the Program.

Table 4. Difference-in-Differences Estimator

	Pre-Participation	Post-Participation	Difference
Treatment (t)	Y_{0t}	Y_{1t}	$Y_{1t} - Y_{0t}$
Control (c)	Y_{0c}	Y_{1c}	$Y_{1c} - Y_{0c}$
T-C Difference	$Y_{0t} - Y_{0c}$	$Y_{1t} - Y_{1c}$	$(Y_{1t} - Y_{0t}) - (Y_{1c} - Y_{0c})$

Note: Y represents percent participation in other residential AIC programs.

Savings Adjustment

Behavioral Modification Program participants can save energy in three ways: (1) through conservation (e.g., turning off lights when leaving a room or other behavioral practices unrelated to installing equipment), (2) through measures installed outside of an energy efficiency program, and (3) through measures installed as part of other AIC energy efficiency programs. Although savings achieved from measures installed through other energy efficiency programs may not have occurred in the absence of the Behavioral Modification Program (e.g., if the Program induces participation in these programs), these savings would nevertheless be counted by the other programs. The objective of the savings adjustment is to remove savings already captured in other program evaluations and thereby avoid double-counting. This analysis quantifies the energy savings attributable to participation lift to ensure that AIC does not count savings twice (once in the Behavioral Modification Program estimate of savings and again in the savings for other energy efficiency programs).

This analysis requires calculating energy savings associated with measures installed in PY9 (known as “Annual Uplift”), as well savings associated with measures installed in prior program years (known as “Legacy Uplift”).⁷

Annual Uplift Savings Adjustment

To compute this savings adjustment for PY9, we multiply the net PY9 participation uplift due to the Behavioral Modification by the median first year ex post net savings per treatment group customer participating in another AIC residential program in PY9. We considered the same programs in our annual uplift savings adjustment as considered in the PY9 participation lift analysis.

⁶ In many cases, we are unable to calculate a Difference-in-Differences estimator due to lack of pre- period data. In these cases, we calculate a post-only differences estimator, in the following form: $Y_{1t} - Y_{1c}$.

⁷ Legacy Uplift occurs when measures are installed with estimated useful life greater than one year.

Legacy Uplift Savings Adjustment

The Behavioral Modification Program consumption analysis captures savings within the model for each year of a given measure’s estimated useful life. To ensure that AIC does not inappropriately attribute savings to the Behavioral Modification Program that are associated with other programs and to accurately reflect the evaluation paradigm in Illinois, we also net out the savings from equipment rebated through other energy efficiency programs in past years for each year of the estimated useful life of the measure.

We considered the following programs in our legacy uplift savings adjustment:

Table 5. Programs Included in Legacy Uplift Savings Adjustment

Program	Years Included				
	PY4	PY5	PY6	PY7	PY8
Residential Lighting (Online Store Component Only)	✓	✓	✓	✓	
Appliance Recycling	✓	✓	✓	✓	✓
Home Efficiency Income Qualified	✓	✓	✓	✓	✓
Home Efficiency Standard	✓	✓	✓	✓	✓
HVAC	✓	✓	✓	✓	✓
Moderate Income Kits					✓
Residential Efficient Products	✓	✓	✓		

We include discontinued programs (e.g. Residential Efficient Products) as energy savings from this program’s past activity still persist in following years.

Savings are calculated in the same manner as the annual adjustment for PY9, with one adjustment. We multiply the net participation uplift due to the Behavioral Modification for each of the past years by the median first year ex post net savings per treatment group customer participating in another AIC residential program in for that year. However, when a measure has reached the end of its effective useful life by PY9, we exclude it from our analysis (e.g., if a measure installed in PY4 has only a three-year effective useful life, it is not considered in the median first year ex post net savings value for PY4 customers).

Note that these adjusted savings could be attributed to the Behavioral Modification Program and to other residential AIC programs, because they would not occur unless both programs were operating, but for accounting purposes, only one program can claim these savings.

2.3 Sources and Mitigation of Error

There are five potential sources of error that affect billing analyses. We document these, and the steps taken to mitigate them, below.

Table 6. Possible Sources of Error

Research Task	Survey Error		Non-Survey Error
	Sampling Error	Non-Sampling Survey Error	
Treatment/Control Surveys	<ul style="list-style-type: none"> • Sample frame error • Sampling error 	<ul style="list-style-type: none"> • Measurement error • Non-response error 	N/A
Multilevel Modeling	N/A	N/A	<ul style="list-style-type: none"> • Model specification error • Measurement error

Billing Analysis	N/A	N/A	<ul style="list-style-type: none"> • Model specification error • Measurement error • Multi-collinearity • Heteroskedasticity • Serial correlation
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■ Non-Survey Errors

- **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 Errors:** Measurement error can come from variables such as weather data, which are commonly included in the billing analysis models. If an inefficient base temperature is chosen for calculating degree-days or if an incorrect climate zone weather station is chosen, the model results could be subject to measurement error. We addressed this type of error by very carefully choosing the closest weather station for each customer in the model. Specifying an incorrect time period (either pre-treatment or post-treatment) can also lead to measurement error. To the extent that the data received from the program implementer are correct, this should not be a problem; however, little can be done if there is an error in the source data.
- **Multi-collinearity:** This type of modeling error can both bias the model results and produce very large variances in the results. The team dealt with this type of error by using model diagnostics such as 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 contains detailed findings from the PY9 evaluation of the Behavioral Modification Program.

3.1 Program Design and Implementation

3.1.1 Program Description

The Behavioral Modification Program began in PY3 and, until the end of PY7, AIC oversaw a single dual-fuel program as well as reviewed and approved any program materials or changes that were made during the program year. Since PY8, AIC has administered the program for gas customers, while the electric portion of the program has been adopted through the IPA procurement process. Oracle implements both the electric and gas portions of the program while Leidos provides additional oversight for the AIC gas program. The IPA holds a contract with Oracle, which provides the software to produce and distribute HERs and manage customer information. PY9 is the last year that the electric portion of the program will be administered through the IPA procurement process.

The program's primary tool for encouraging energy-efficient behaviors is the HER. In PY9, the program offered three treatment types: (1) a hard copy printed HER mailed four times a year to the customer's billing address; (2) an eHER sent once per billing cycle to all customers with email addresses (generally once a month); and (3) an online portal, which customers can log onto to view the same report and access additional information. The HERs include 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, and
- 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 terms of report frequency, the Original Cohort and all Expansion Cohorts except for 3 (gas-only) and 7 (the newest expansion cohort of approximately 46,000 customers) received four HERs at evenly spaced intervals through the year.⁸ Expansion Cohort 3, made up of gas-only customers, received four reports at a different cadence, with no reports sent during the summer months.⁹ Expansion Cohort 7 received two back-to-back reports in September and October, a third in January, and a final one for PY9 in May. Overall, dual-fuel cohorts tend to receive HERs on a roughly quarterly basis while the gas-only cohort receives them during the colder months of the year.

3.1.2 Program Changes

Based on interviews with AIC program staff and implementers, there were limited changes made to the program in PY9. Overall, changes in program implementation and processes can be grouped into the following

⁸ The original cohort and all dual-fuel Expansion Cohorts except for 7 were sent reports in July, October, February, and May.

⁹ Gas-only customers received HERs in late September/early October, late October/early November, January, and March.

categories: (1) introduction of Oracle's new energy efficiency platform, Agile EE; (2) report frequency; and (3) campaigns.

Agile EE is Oracle's new energy efficiency platform and was used to implement the Behavioral Modification Program in PY9.

- Agile EE includes newly designed HERs and a new suite of self-service online tools available to both AIC customers and program participants.
- In addition to the adoption of Agile EE, AIC program staff made updates to the tip library and images used to promote campaigns in the HERs.

Technical issues resulted in reductions in report frequency for approximately 40,000 participants. Specifically, missing billing reads¹⁰ and Oracle's transition to Agile EE led to customers being flagged as having opted-out of receiving reports.

- The program experienced issues with missing billing reads, which led to a reduction in the number of reports delivered to customers for a second year in a row. In particular, AIC experienced approximately 88,600 missing customer bill reads in October 2016 and, of these missing bill reads, approximately 31,000 of the affected customers were part of the treatment group (e.g., customers who received reports). Due to the missing bill reads, these customers defaulted to an opt-out status and therefore received no additional HERs or eHERs beyond October 2016. According to the AIC program manager, these customers need to be reinstated into the program for them to receive HERs and eHERs again. As of the end of June 2017, AIC provided Oracle with the missing billing data. Oracle staff investigated which customers did not receive HERs due to the missing billing reads and has incorporated them back into the treatment group so they will receive reports moving forward.
- When Oracle converted over to Agile EE, its staff discovered approximately 7,600 treated customer accounts that had been excluded because they were assigned to two modules¹¹ (thereby making them ineligible to receive reports). According to the AIC program manager, these customers were not marked as opting out of the program, but rather they fell out of circulation. Oracle's records show that these customers have not received a print report since 2012 or 2013. As such, AIC and Oracle have agreed to include a "Welcome Back" module in their first print report that was sent to customers in August 2017.

In addition to reductions in report delivery for several customers, there were changes in terms of the number of participants in the program, as well as changes to specific campaigns.

- The number of income-qualified customers receiving HERs that include the Home Efficiency Income-Qualified Program (HEIQ) marketing module increased when the program added customers through Expansion Cohort 7. AIC initially launched this initiative to expand services for income qualified customers and adding more qualified customers in this latest cohort shows it continues to pursue its efforts. In the previous program year, Leidos used zip codes to identify customers who would likely be eligible for income-qualified programs and these customers received tailored messaging through HERs

¹⁰ Missing bill reads occur when specific customer meters do not provide bills for a month, leading to gaps in billing history provided to Oracle. As a result, Oracle flagged these customers as having opted-out of the program.

¹¹ Modules refer to different cohort types. In this case, it refers to a dual-fuel and gas-only cohort types.

regarding the program. Since more customers located in these zip codes were added to the program in PY9, additional customers qualified to receive HERs with the HEIQ marketing module.

- The Behavioral Modification program staff discontinued the “target rank campaign” in PY9, which provided customized short-term goals to high-energy users from Expansion Cohort 1 (approximately 17,000 customers) to encourage HER recipients to improve their energy efficiency rank. This was done through positive feedback for incremental improvements in reducing energy use and dynamic rank tracking that allowed customers to follow their progress from report to report.

PY9 also saw updates to content and format of HERs regarding campaigns.

- Reports included information promoting rebates for smart thermostats and programmable thermostats available through AIC’s HVAC program. In addition, HERs sent to income-qualified customers included a call to action for customers to sign onto ActOnEnergy.com to familiarize themselves with rebates for energy efficient equipment, as well as tips on saving energy. HERs sent to gas-only customers in September 2016 included an information campaign about how to keep homes warm during the winter and tips on how to reduce water heating bills, as these are the months during which gas-only customers receive most of their print reports.

3.1.3 Program Participation

The Behavioral Modification Program reached just about a third of AIC’s approximately 1 million residential electric customers in PY9. Of these electric customers, 296,891 participants received reports in PY9 (including both dual-fuel and gas-only customers). Note this number excludes customers who opted out of the program, moved out of the AIC service territory, and/or did not receive a report for other reasons in PY9, as described above.

The Original Cohort customers are now in their seventh year with the program and seven additional cohorts were added to the program over the six years that followed the introduction of the program. All cohorts are dual-fuel customers, except for Expansion Cohort 3, which is gas-only.

The program added just over 46,000 dual-fuel customers to the program as Expansion Cohort 7 to address program attrition resulting from opt-outs and move-outs from the overall pool of participants. The program implementer noted that staff used exclusion criteria to identify the set of customers they could include in Expansion Cohort 7. As part of this process, they begin with the customer population and remove customers who do not want to receive reports (opt-outs), customers in prior cohorts, customers without deliverable mailing addresses, and those with medical exclusion codes. As the program includes more customers in additional cohorts and as customers opt-out over time, the set of customers from which new cohorts can be identified shrinks. Table 7 provides a breakdown by cohort of all treatment customers who received reports for at least one month in PY9.

Table 7. Behavioral Modification Program Participation in PY9

Cohort Name	Fuel Type	Number of Electric Treated Customers in PY9	Start Date	Program Year
Original Cohort	Dual-Fuel	33,406	August 2010	7th year in the program
Expansion Cohort 1	Dual-Fuel	50,266	April 2011	6th year in the program
Expansion Cohort 2	Dual-Fuel	73,636	November 2011	6th year in the program
Expansion Cohort 3	Gas-Only	N/A	November 2011	6th year in the program
Expansion Cohort 4	Dual-Fuel	20,329	June 2013	4th year in the program
Expansion Cohort 5	Dual-Fuel	45,359	September 2014	3rd year in the program
Expansion Cohort 6	Dual-Fuel	27,716	April 2015	3rd year in the program
Expansion Cohort 7	Dual-Fuel	46,179	September 2016	1st year in the program
	Total	296,891		

As expected, each cohort experienced some attrition as customers opted out of receiving reports, moved and closed their accounts, or never received a report in PY9 because of missing billing reads. We base the attrition rates shown in Table 8 on numbers provided in Oracle’s program tracking database.¹² We also include earlier program year attrition rates to provide context.

Table 8. Behavioral Modification Program Attrition Rates in PY9

Cohort Name	PY3	PY4	PY5	PY6	PY7	PY8	PY9
Original Cohort	6.64%	7.30%	7.24%	6.70%	6.46%	6.23%	5.86%
Expansion Cohort 1	2.22%	9.68%	8.26%	7.61%	7.02%	6.58%	6.23%
Expansion Cohort 2		7.79%	9.77%	8.59%	8.02%	7.57%	7.17%
Expansion Cohort 3		24.03%	6.59%	7.10%	6.77%	6.35%	6.24%
Expansion Cohort 4				16.72%	12.29%	9.46%	8.31%
Expansion Cohort 5					14.03%	15.74%	12.63%
Expansion Cohort 6					6.69% (April and May Only)	20.96%	14.77%
Expansion Cohort 7							20.74%

Note: The attrition rates do not include those customers who were dropped when moving to the Agile EE platform.

The table shows a higher rate of attrition in the first year of receiving reports. This is partially due to how the evaluation team assigns attrition to program years based on the program data. Customers who never received a report do not have a specified program date on which they left the program. Because of this, we calculate the attrition rates for each cohort by assuming the customers who never received a report left the program in

¹² We compared the attrition rates we calculated using AIC’s program tracking database to the attrition rates we calculated using monthly participant data by cohort provided by Oracle. The attrition rates align, only differing on average by 0.1%.

each cohort’s inaugural program year. For example, the customers in the Original Cohort that never received a report are placed in the attrition rate calculation in PY3 (the first year of that cohort). Thus, the attrition rates for the inaugural program year of each cohort are slightly inflated since they include the total number of customers that never received a report for each cohort.

Table 8 also illustrates that later cohorts tend to have higher attrition rates than earlier cohorts. This is primarily driven by higher move-out rates rather than opt-out rates, and one potential explanation is that the type of customer selected for these later cohorts (which billing data cleaning suggests often have less than nine months of pre-period billing history) are more transient than customers who have a longer history of billing records.

Finally, the evaluation team looked at participation in terms of customer engagement with program provided web tools by assessing Oracle web metrics related to customer use of AIC’s web tools that allow access to eHERs online. First time logins represent customers who created an account or first visited the Oracle website. Return logins refer to customers who have visited the site on at least two occasions. Based on this data (Table 9), the number of site visits was at its peak in PY4, remained relatively steady through PY5, and has fallen dramatically since. Based on interviews with Oracle staff, this is likely due to AIC’s use of an additional website provider and associated decline in advertising of the Oracle web tool compared to earlier program years. The number of total logins sums the number of first time and return logins, which are also presented in the table below.

Table 9. Behavioral Modification Program Web Metrics

Web Metrics	PY4	PY5	PY6	PY7	PY8	PY9
First Time	1,278	1,064	367	107	181	310
Return Logins	1,657	1,487	942	439	496	410
Total Logins	2,935	2,551	1,309	546	677	728

Note: Oracle provided web metrics beginning with PY4, which is why PY3 information is not included.

3.2 Impact Assessment

The evaluation team undertook a variety of efforts to develop adjusted net impact results for the Behavioral Modification Program. These include a comparison of the equivalency between treatment and control groups, impact modeling, and channeling analysis. We provide detailed results for each effort below.

3.2.1 Equivalency Analysis

The evaluation team performed an equivalency analysis between the Expansion Cohort 7 treatment and control groups to assess how similar they were at the start of the program. As part of this process, we examined both energy usage and key demographic, housing, and psychographic characteristics. In both cases, we found the treatment and comparison households are similar:

- For electric consumption, ADC in the year before the start of the program was 31.70 kWh/day in the control group and 31.67 kWh/day in the treatment group. For gas consumption, in the year before the start of the program, ADC was 1.63 therms/day for households in both the control group and treatment group.

- The team found that the treatment and comparison households are similar across all demographics, housing, and psychographic characteristics studied. In every category, the treatment and control groups differed by less than 1% on the key demographic and psychographic comparisons.

Beyond Expansion Cohort 7, we examined equivalency of treatment and control groups of all previous cohorts based on energy usage and found that all of these are equivalent as well. Results showing the equivalency of the treatment and control groups for all cohorts are in Appendix A.

3.2.2 Model Results

The team fit several statistical models to estimate impacts from the program. This section provides findings from each of these models. The first model below presents the unadjusted net savings to which we apply the channeling analysis and derive the final net impact savings above in Table 15. The results using the second model (Equation 2), allows for comparison of results across years, as the results are weather-adjusted. The results from the original model shown in Equation 3 are presented as we use these results to compare the per year savings of the program since the program was launched with the Original Cohort.

Post-Participation Period Only Model Results (Equation 1)

Table 10 presents the PY9 unadjusted net electric savings for the seven dual-fuel cohorts. The table shows net savings but does not deduct double-counted savings from participation in other AIC residential programs. These results reflect estimated savings from the post-participation period only model or LDV model. This model is the same used by the implementation contractor, Oracle, 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.

Table 10. PY9 Unadjusted Per-Household Net Electric Savings – Lagged Dependent Model

Cohort	Number of Customers Treated in PY9 ^a	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (kWh per household)	Unadjusted Net Program Savings (kWh) ^b
Original Cohort	33,406	1.43%	178.9	5,792,155
Expansion Cohort 1	50,266	1.60%	222.1	10,799,689
Expansion Cohort 2	73,636	0.97%	92.9	6,584,874
Expansion Cohort 3	N/A	N/A	N/A	N/A
Expansion Cohort 4	20,329	1.02%	183.8	3,565,756
Expansion Cohort 5	45,359	0.87%	109.1	4,604,843
Expansion Cohort 6	27,716	0.84%	93.3	2,373,271
Expansion Cohort 7	46,179	0.58%	63.9	2,190,837
Total^c	296,891		121.0	35,911,425

^a The number of customers in PY9 refers to the number of customers to which AIC/IPA intended to provide HERs and who had an experiment start date

^b Pro-rated for participants whose accounts closed during PY9

^c Totals may not be exact due to rounding

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

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

experienced by the analyzed population. The evaluation team notes that average percent electric savings for all cohorts except Cohort 6 and 7 are equal to or greater than 1% (see Table 11).

Table 11. PY9 Unadjusted Per-Household Net Electric Savings – Weather-Adjusted Model

Cohort	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (kWh per household)
Original Cohort	1.49%	180.7
Expansion Cohort 1	1.61%	214.4
Expansion Cohort 2	1.00%	94.3
Expansion Cohort 3	N/A	N/A
Expansion Cohort 4	1.24%	217.4
Expansion Cohort 5	1.00%	123.8
Expansion Cohort 6	0.65%	71.8
Expansion Cohort 7	0.47%	55.4

Original Model (Equation 3)

Table 12 summarizes results from the original model. Similar to the weather adjusted model, average percent electric savings is larger for all cohorts except Cohorts 6 and 7; however, not all percent savings are equal to or greater than 1% for the Original Cohort and Cohorts 1 through 5.

Table 12. PY9 Unadjusted Per-Household Net Electric Savings – Original Model

Cohort	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (kWh per household)
Original Cohort	1.51%	183.5
Expansion Cohort 1	1.67%	223.8
Expansion Cohort 2	0.95%	89.9
Expansion Cohort 3	N/A	N/A
Expansion Cohort 4	1.23%	216.7
Expansion Cohort 5	0.90%	111.2
Expansion Cohort 6	0.58%	64.7
Expansion Cohort 7	0.62%	64.8

Per-Year Savings

In Figure 1 below, we present the billing analysis results across program years based on the original model (Equation 3).¹³ These provide the electric percent household savings by cohort and by year. These include the

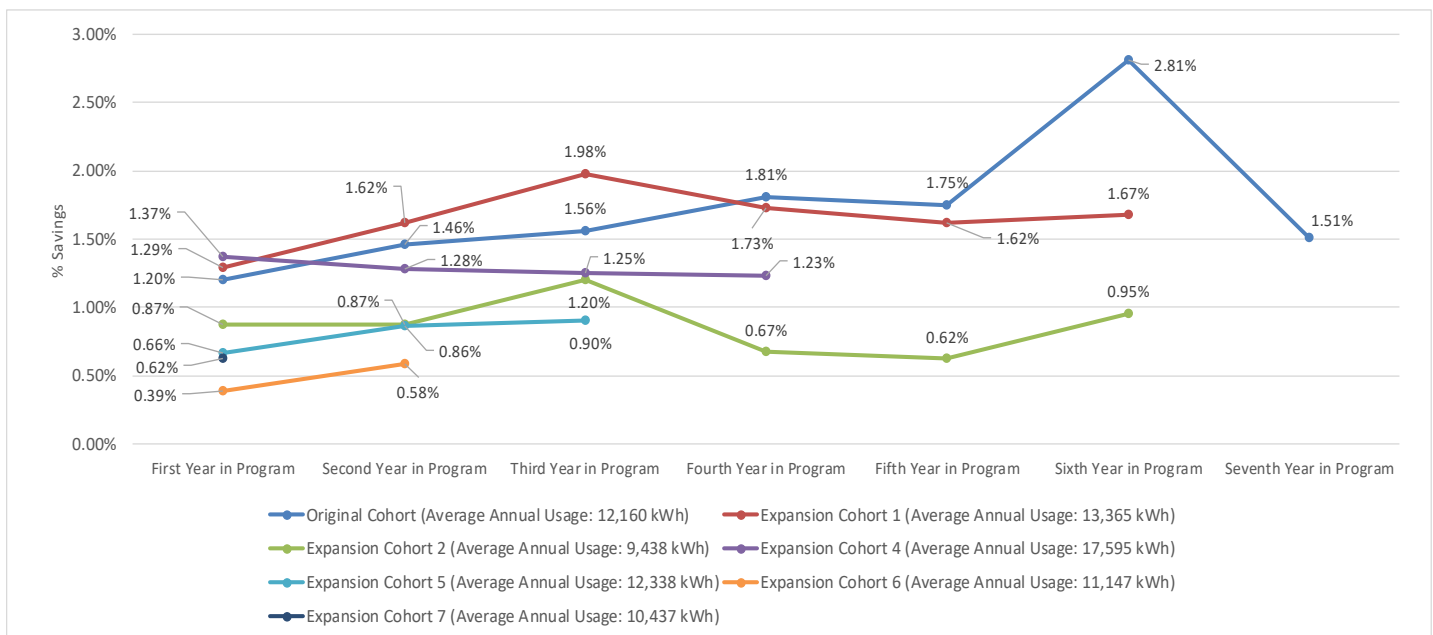
¹³ We use the original model results for PY9 to make comparisons across years because we have estimated savings for each evaluation year using this model and do not necessarily have LDV modeling results for each year.

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 the accompanying evaluation binders of results. As with earlier evaluations, we find that pre-participation period consumption correlates with increased energy savings by cohort.

For dual-fuel cohorts, we see a varied picture across pre-participation period consumption, as well as savings year over year. Virtually all cohorts showed that savings that have plateaued or slightly increased except for the Original Cohort, which showed decreased savings in the seventh year.

Figure 1. Year-Over-Year Savings – Electric (Original Model)



Since PY7, the evaluation team has estimated impacts using a weather adjusted model as it allows us to assess the changes in energy savings year over year, that are not due to extreme changes in weather. As a result, Table 13 provides the percent household savings for the last three years for each cohort. As can be seen, the Original Cohort and Expansion Cohorts 1 and 4 yield the highest savings over the most recent years of the program.

Table 13. Weather Adjusted Percent Electric Savings – PY7-PY9

Electric Cohorts	PY7	PY8	PY9
Original Cohort (Average Annual Usage: 12,160 kWh)	1.75%	1.17%	1.49%
Expansion Cohort 1 (Average Annual Usage: 13,365 kWh)	1.70%	1.60%	1.61%
Expansion Cohort 2 (Average Annual Usage: 9,438 kWh)	0.65%	0.68%	1.00%
Expansion Cohort 4 (Average Annual Usage: 17,595 kWh)	1.25%	1.66%	1.24%
Expansion Cohort 5 (Average Annual Usage: 12,338 kWh)	0.66%	1.29%	1.00%
Expansion Cohort 6 (Average Annual Usage: 11,147 kWh)		0.57%	0.65%
Expansion Cohort 7 (Average Annual Usage: 10,437 kWh)			0.47%

3.2.3 Channeling Analysis

The savings analysis for the Behavioral Modification Program considers energy savings that resulted from energy-efficient actions taken through other AIC residential energy efficiency programs. While a base rate of participation in these programs would be expected in both the treatment and control groups, it is possible that the Behavioral Modification Program resulted in an increase, or “uplift,” in participation in other AIC residential energy efficiency programs among the members of the treatment group by channeling treated customers to those programs.

To ensure that we do not double count savings across programs, we calculate a savings adjustment that removes savings that result from this uplift. To calculate this adjustment, we first calculate the participation uplift resulting from the Behavioral Modification Program, and then apply a median savings value per uplifted participant to this uplift to calculate savings uplift. We then deduct these savings from our original estimate of program savings. We also include “legacy uplift,” deducting savings from measures installed in prior program years.

Table 14 presents the results from our uplift analysis. Detailed cohort-level participation lift calculations are provided in Appendix D. We deduct approximately 2.1% of unadjusted program savings due to this analysis, of which the majority (1.5%) are due to legacy measures installed in prior program years.

Table 14. PY9 Behavioral Modification Program Impacts – Electric

Cohort	Unadjusted Program Savings (kWh)	PY9 Savings Uplift		Legacy Savings Uplift		Total Savings Uplift	
		kWh	%	kWh	%	kWh	%
Original Cohort	5,792,155	0	0.0%	142,000	2.5%	142,000	2.5%
Expansion Cohort 1	10,799,689	0	0.0%	244,168	2.3%	244,168	2.3%
Expansion Cohort 2	6,584,874	127,912	1.9%	2,893	>0.1%	130,806	2.0%
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	3,565,756	0	0.0%	125,143	3.5%	125,143	3.5%
Expansion Cohort 5	4,604,843	0	0.0%	8,750	0.2%	8,750	0.2%
Expansion Cohort 6	2,373,271	0	0.0%	18,264	0.8%	18,264	0.8%
Expansion Cohort 7	2,190,837	85,758	3.9%	N/A	0.0%	85,758	3.9%
Total	35,911,425	213,671	0.6%	541,218	1.5%	754,889	2.1%

3.2.4 Net Impacts

This section presents PY9 Behavioral Modification Program adjusted net savings. The program achieved 35,157 MWh in adjusted net savings (Table 15). Adjusted net savings refer to modeled impacts using Equation 1, less savings accounted for from participation in other AIC residential programs (as discussed in Section 3.2.3). These findings confirm that the Behavioral Modification Program reduces energy consumption.

Table 15. PY9 Behavioral Modification Program Total Electric Savings

Cohort	Unadjusted Program Savings (kWh)	PY9 Savings Uplift (kWh)	Legacy Savings Uplift (kWh)	Final Adjusted Net Program Savings (kWh)
Original Cohort	5,792,155	0	142,000	5,650,155
Expansion Cohort 1	10,799,689	0	244,168	10,555,521
Expansion Cohort 2	6,584,874	127,912	2,893	6,454,068
Expansion Cohort 3	N/A	N/A	N/A	N/A
Expansion Cohort 4	3,565,756	0	125,143	3,440,613
Expansion Cohort 5	4,604,843	0	8,750	4,596,093
Expansion Cohort 6	2,373,271	0	18,264	2,355,007
Expansion Cohort 7	2,190,837	85,758	N/A	2,105,079
Total	35,911,425	213,671	541,218	35,156,536

4. Key Findings and Recommendations

The Behavioral Modification Program achieved its stated electric goals to reduce energy consumption and educate customers about energy savings measures and behaviors. PY9 implemented no major implementation changes. Program staff added a new cohort of approximately 46,000 dual-fuel customers in September 2016 and continued to offer its income-qualified customer module initiative to support the Home Efficiency Income Qualified Program.

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 net reduction of 35,157 MWh. Program participants achieved 118.42 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 electric program participants.
 - **Recommendation:** Depending on the selected cohorts for future program years, AIC can use the average savings estimates for kWh over the evaluated period to inform future participant selection. Theoretically, AIC could multiply these averages by the selected future participant type and produce estimates of the next program year's anticipated electricity and gas savings. These projections of savings provide information about the types of participants to select to include in future years.
- **Key Finding #2: Our evaluation showed equivalency in terms of average daily consumption in the pre-participation period for all cohorts.** In addition, we demonstrated equivalency between the treatment and control groups of Expansion Cohort 7 using household, demographic, and psychographic data.
 - **Recommendation:** We recommend that the vendor continue to monitor the equivalency of the treatment and control groups of each cohort to ensure they remain so.
- **Key Finding #3: For the second year in a row, technical issues resulted in reductions to report frequency for many customers.** There were widespread issues with missing monthly billing reads in October 2016 that reduced the frequency of reports for approximately 31,000 customers. Because these billing reads were missing, these customers were mistakenly moved to program opt-out status. In addition, when Oracle converted to its Agile EE platform, the staff discovered 7,600 treatment customers had not been receiving reports since 2012 or 2013, depending upon the customer. Both issues were addressed and the customers were included back in the program.
 - **Recommendation:** Investigate the reoccurring missing reads issue as it affects program delivery and evaluation. The missing billing reads occurred in the fall just as it had in PY8. AIC should perform systematic checks to ensure that the billing data provided to Oracle goes through a thorough assurance/quality control QA/QC process to prevent this issue from occurring again.
- **Key Finding #4: The exclusion criteria of including customers with 90 days of pre-period billing information may contribute to high attrition rates, as well as volatility in estimating energy savings associated with the program.** As documented in this report, later cohorts with lower required pre-period billing information have higher attrition rates, and results across statistical models vary and in some cases become negative. Fewer pre-period billing records lead to fewer customers that can be incorporated within a statistical model, leading to more uncertainty in savings estimates.

- **Recommendation:** We recommend expanding the number of required pre-participation billing months for any new cohorts to a minimum of nine months.

Appendix A. Equivalency Analysis Results

We examined the average daily fuel consumption for the 12 pre-participation period months for treatment and control group customers used for modeling to ensure that attrition from the program did not bias findings in PY9. Table 16 shows that all cohorts were generally equivalent based on ADC in the pre-participation period.

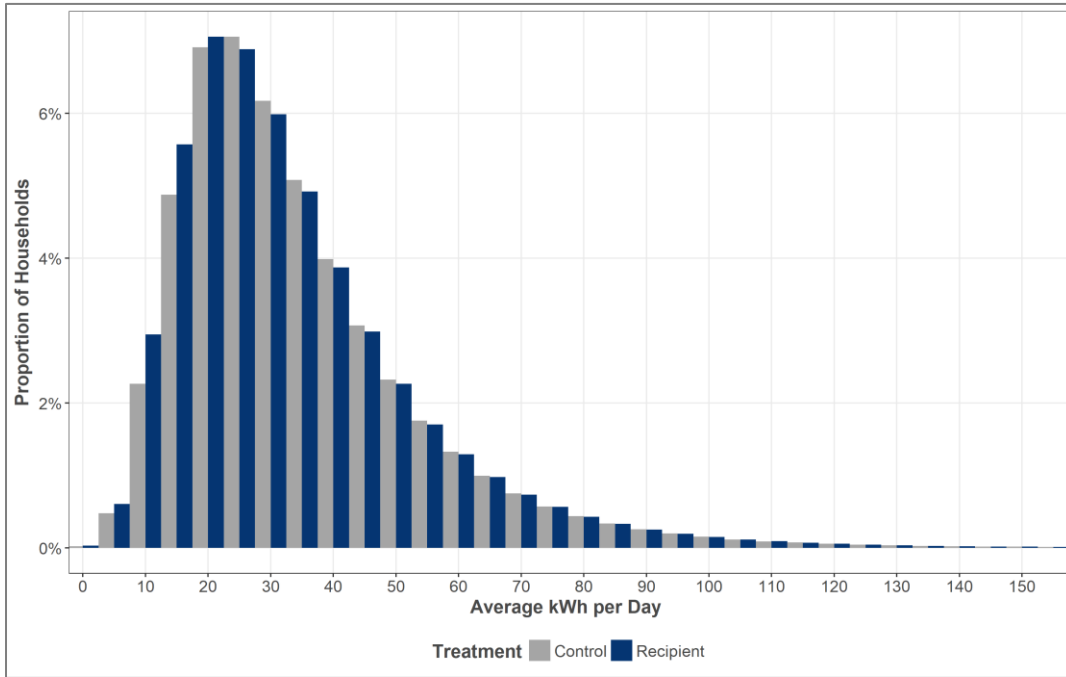
Table 16. Pre-Participation kWh Average Daily Consumption

Cohort	Treatment (Pre-Participation) Consumption in kWh	Control (Pre-Participation) Consumption in kWh
Original Cohort	34.40	34.36
Expansion Cohort 1	39.76	39.80
Expansion Cohort 2	26.68	26.66
Expansion Cohort 4	51.49	51.27
Expansion Cohort 5	34.92	34.93
Expansion Cohort 6	30.43	30.61
Expansion Cohort 7	31.19	31.24

We found Expansion Cohort 7 to be equivalent in terms of electric usage. For electric customers, ADC in the year before the start of the program was 31.19 kWh/day in the control group and 31.24 kWh/day in the treatment group.

Figure 2 presents the pre-participation period electric consumption for both treatment and control groups for all cohorts and exhibits equivalency.

Figure 2. Pre-Participation Period Electric Consumption, Treatment vs Control, All Waves



The evaluation team obtained secondary data for demographic, housing, and psychographic characteristics for the Expansion Cohort 7 treatment and control groups. Table 17 summarizes key characteristics of the treatment and control group members.

Table 17. Expansion Cohort 7: Key Demographic, Housing, and Psychographic Comparisons

Category		Treatment (n=46,133)	Control (n=18,540)
Demographics			
Age	Under 35	30.0%	30.2%
	35-54	30.1%	29.5%
	55+	23.4%	22.6%
	N/A	17.5%	17.7%
Household size	Avg. number of Adults ^b	1.95	1.96
Children in household	At least 1 child <18 years.	21.9%	22.2%
Education of respondent	Less than High School Diploma	10.6%	10.5%
	High School Diploma	32.9%	32.9%
	Some College	35.4%	35.2%
	Bachelor Degree	12.7%	12.9%
	Graduate Degree	7.5%	7.6%
	N/A	1%	0.9%

Category		Treatment (n=46,133)	Control (n=18,540)
Household Income	Under \$50K	53.4%	52.8%
	\$50-\$100K	30.0%	29.4%
	\$100-\$200K	14.0%	14.8%
	\$200K or higher	2.7%	2.7%
	N/A	0.3%	0.3%
Occupation	Sales/Service	12.6%	12.5%
	Professional/Technical	23.2%	23.4%
	Blue Collar	25.8%	25.7%
	Retired	9.2%	8.5%
	Other	28.1%	28.8%
	N/A	0.1%	0.9%
Gender	Female	48.5%	48.6%
Housing			
Homeownership	Own	54.9%	54.9%
Home Size	Home square footage of 100-5,999	83.1%	82.7%
	Home square footage of 6,000-9,999	0.4%	0.5%
	Home square footage of over 10,000	0.03%	0.04%
	N/A	16.5%	16.8%
Age of House	Before 1960	63.0%	62.3%
	1960-1989	11.6%	11.2%
	1990 or later	8.7%	9.4%
	N/A	16.8%	17.1%
Length of Residence	0-9 Years	69.9%	71.1%
	10-20 Years	18.5%	17.7%
	21 Years or Higher	11.6%	11.2%
Psychographic			
	Health	8.3%	8.0%
	Religious	6.0%	6.2%
	Veterans	5.3%	5.1%
	Animal Welfare	4.8%	4.7%
	Political - Conservative	1.5%	1.4%
	Political - Liberal	0.79%	0.73%
	Children	7.5%	7.1%
	Other Social Cause	10.8%	10.7%

Appendix B. Billing Analysis Data Cleaning Results

This appendix shows 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. The primary driver leading to removal of customers for the analysis is insufficient pre-period billing data.

Table 18. Cohort Level Data Cleaning Results for Treatment and Control Groups, Electric

Cohort	Metric	Unique Customers		Observations	
		Treatment	Control	Treatment	Control
Original Cohort	Initial #	49,694	49,688	3,976,624	3,985,749
	Final #	49,279	49,265	3,970,754	3,979,900
	% Remaining	99.16%	99.15%	99.85%	99.85%
Expansion Cohort 1	Initial #	75,688	25,202	5,333,469	1,783,833
	Final #	73,854	24,589	5,309,395	1,775,784
	% Remaining	97.58%	97.57%	99.55%	99.55%
Expansion Cohort 2	Initial #	112,668	19,583	7,304,591	1,268,110
	Final #	106,744	18,476	7,156,798	1,240,151
	% Remaining	94.74%	94.35%	97.98%	97.80%
Expansion Cohort 4	Initial #	31,485	10,497	1,534,186	512,007
	Final #	26,959	9,024	1,421,658	475,775
	% Remaining	85.62%	85.97%	92.67%	92.92%
Expansion Cohort 5	Initial #	62,988	12,597	2,467,487	492,054
	Final #	54,959	10,997	2,261,506	450,839
	% Remaining	87.25%	87.30%	91.65%	91.62%
Expansion Cohort 6	Initial #	37,795	16,500	1,198,779	523,248
	Final #	26,164	11,394	941,459	410,141
	% Remaining	69.23%	69.05%	78.53%	78.38%
Expansion Cohort 7	Initial #	46,183	18,490	932,393	373,143
	Final #	30,371	12,176	715,118	286,408
	% Remaining	65.76%	65.85%	76.70%	76.76%

Table 19. Cohort Level Data Cleaning Results for Treatment and Control Groups, Gas

Cohort	Metric	Unique Customers		Observations	
		Treatment	Control	Treatment	Control
Original Cohort	Initial #	49,694	49,688	3,974,091	3,983,586
	Final #	49,283	49,266	3,968,334	3,977,673
	% Remaining	99.17%	99.15%	99.86%	99.85%
Expansion Cohort 1	Initial #	75,688	25,202	5,328,093	1,782,381
	Final #	73,854	24,581	5,303,390	1,773,783
	% Remaining	97.58%	97.54%	99.54%	99.52%
Expansion Cohort 2	Initial #	112,668	19,583	7,297,752	1,267,389
	Final #	106,601	18,454	7,142,958	1,238,076
	% Remaining	94.62%	94.23%	97.88%	97.69%
Expansion Cohort 3	Initial #	20,632	10,108	1,193,270	579,465
	Final #	16,713	8,082	1,138,712	551,244
	% Remaining	81.01%	79.96%	95.43%	95.13%
Expansion Cohort 4	Initial #	31,484	10,494	1,529,574	510,410
	Final #	26,151	8,786	1,378,318	462,539
	% Remaining	83.06%	83.72%	90.11%	90.62%
Expansion Cohort 5	Initial #	62,988	12,597	2,465,275	491,657
	Final #	54,765	10,961	2,252,026	449,186
	% Remaining	86.95%	87.01%	91.35%	91.36%
Expansion Cohort 6	Initial #	37,796	16,500	1,196,099	522,019
	Final #	25,703	11,169	925,073	401,924
	% Remaining	68.00%	67.69%	77.34%	76.99%
Expansion Cohort 7	Initial #	46,183	18,490	930,777	372,515
	Final #	30,029	12,039	706,741	283,131
	% Remaining	65.02%	65.11%	75.93%	76.01%

Appendix C. Billing Analysis Model Coefficients

Below we provide the billing analysis model coefficients and per-year savings results using Equation 1. For reporting purposes and to enable comparisons to program implementer-supported models (i.e., Oracle, 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 is used in estimating the model. Information from the pre-participation period is used only to calculate 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 intent-to-treat (ITT) effect. We employed the following estimating equation: For reporting purposes, and to enable comparisons to program implementer-supported models (i.e., Oracle, the program implementer’s estimates), we estimated a LDV model. A LDV model differs from the linear fixed effects regression (LFER) model in that only usage from the post-participation period is used in estimating the model. Information from the pre-participation period is used only to calculate 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 ITT effect. We employed the following estimating equation:

Equation 1. We include both electric and gas model coefficients to contextualize our results.

A.1 Lagged Dependent Variable Model Coefficients

Table 20 and Table 21 show the Equation 3 LDV billing analysis model coefficients for the electric and gas cohorts.

Table 20. LDV Model Billing Analysis Model Coefficients – Electric

Cohort	Coefficient	Robust Standard Error
Original Cohort		
treat	-0.49007334	0.030025204
pre_adc	1.621325721	0.023990833
pre_adc_summ	-0.318031614	0.01210016
pre_adc_win	-0.507523293	0.009851715
Expansion Cohort 1		
treat	-0.608456366	0.038299038
pre_adc	1.600988776	0.017664941
pre_adc_summ	-0.247597208	0.007837118
pre_adc_win	-0.503266066	0.007939905

Cohort	Coefficient	Robust Standard Error
Expansion Cohort 2		
treat	-0.254552033	0.028599225
pre_adc	1.583041785	0.01732745
pre_adc_summ	-0.223997465	0.0077552
pre_adc_win	-0.510347709	0.007884863
Expansion Cohort 3		
N/A		
Expansion Cohort 4		
treat	-0.503602725	0.072203283
pre_adc	1.584894035	0.029193341
pre_adc_summ	-0.150657258	0.012183101
pre_adc_win	-0.599409409	0.013210999
Expansion Cohort 5		
treat	-0.298853467	0.043454342
pre_adc	1.2322131	0.024453378
pre_adc_summ	-0.055501262	0.013017294
pre_adc_win	-0.38548325	0.009780871
Expansion Cohort 6		
treat	-0.255661283	0.038145192
pre_adc	1.298792789	0.029194675
pre_adc_summ	0.014143684	0.012445514
pre_adc_win	-0.548506342	0.014624842
Expansion Cohort 7		
treat	-0.175199982	0.035208584
pre_adc	1.111977303	0.016850389
pre_adc_summ	0.073849622	0.008104437
pre_adc_win	-0.30808343	0.007551481

Table 21. Original Model Billing Analysis Model Coefficients – Gas

Cohort	Coefficient	Robust Standard Error
Original Cohort		
treat	-0.019206038	0.001860718
pre_adc	0.131377159	0.017638497
pre_adc_summ	0.332502618	0.013385702

Cohort	Coefficient	Robust Standard Error
pre_adc_win	-0.001100411	0.00634472
Expansion Cohort 1		
treat	-0.031165389	0.002502067
pre_adc	0.224178283	0.015448784
pre_adc_summ	0.414580288	0.012735767
pre_adc_win	-0.040214949	0.005668049
Expansion Cohort 2		
treat	-0.011448311	0.001749051
pre_adc	0.238573432	0.014670407
pre_adc_summ	0.422964157	0.013261578
pre_adc_win	-0.041299843	0.005303148
Expansion Cohort 3		
treat	-0.040890457	0.003658752
pre_adc	0.371706808	0.033226031
pre_adc_summ	0.286123947	0.023961396
pre_adc_win	-0.089496681	0.01202031
Expansion Cohort 4		
treat	-0.01583242	0.003859176
pre_adc	0.38510153	0.024644579
pre_adc_summ	0.421537405	0.017299336
pre_adc_win	-0.119723655	0.010619617
Expansion Cohort 5		
treat	-0.01821726	0.003020121
pre_adc	0.118945358	0.011865671
pre_adc_summ	0.606249855	0.013288526
pre_adc_win	-0.009879831	0.004465524
Expansion Cohort 6		
treat	-0.006387339	0.002088178
pre_adc	0.065028127	0.020369706
pre_adc_summ	0.709642683	0.016997906
pre_adc_win	0.00183656	0.009713517
Expansion Cohort 7		
treat	-0.016276022	0.002810625
pre_adc	0.087488588	0.015148087
pre_adc_summ	0.716350317	0.01454354

Billing Analysis Model Coefficients

Cohort	Coefficient	Robust Standard Error
pre_adc_win	0.00760925	0.006139766

Appendix D. Participation Lift and Channeling Analysis

PY9 Annual Uplift

To determine whether the Behavioral Modification Program treatment generated participation lift in PY9 (e.g., an increase in participation in other energy efficiency programs in PY9 as a result of the Behavioral Modification Program), we calculated whether more treatment than control group members participated in other AIC residential energy efficiency programs after receiving HERs compared to program participation before receiving HERs. We cross-referenced the Behavioral Modification Program database—both treatment and control groups (for all program cohorts)—with the databases of other residential energy efficiency programs in PY9, including:

- Appliance Recycling (ARP)
- HVAC
- Home Efficiency Income Qualified (HEIQ)
- Moderate Income Kits (MICK)

The participation lift analysis calculates the number of program participants who participated in both the Behavioral Modification Program **and** other energy efficiency programs in PY9. To ensure the participation lift is attributable solely to the Behavioral Modification Program, we calculate participation lift using a Difference-in-Differences estimator (where possible). To do so, we identify the total number of treatment and control group customers who participated in an AIC energy efficiency program in PY9, as well as the total count of treatment and control group customers who participated in an AIC energy efficiency program prior to receiving HERs. The difference in these calculations is the net participation due to the Behavioral Modification Program.

Table 22 presents the result of our participation lift analysis for PY9. Generally, we see that the treatment group had a higher rate of overall program participation than the control group, although on a program-by-program basis the effects are less consistent. However, most of these effects appear to be statistically insignificant. 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).

Table 22. PY9 Participation Lift Rate by Cohort and Program

Program Name	Original Cohort	Expansion Cohort 1	Expansion Cohort 2	Expansion Cohort 3 - Gas	Expansion Cohort 4	Expansion Cohort 5	Expansion Cohort 6	Expansion Cohort 7
ARP	0.00%	0.01%	0.02%	N/A	-0.07%	-0.06%	0.05%	0.08%
HEIQ	-0.03%	-0.04%	0.10%*	N/A	0.09%	-0.03%	0.08%	0.06%*
HVAC	0.05%	0.07%	0.13%	N/A	0.41%	0.02%	-0.22%	0.14%*
MICK	-0.24%	-0.03%	-0.09%	N/A	-0.20%	-0.38%	0.16%	-0.07%

* Positive, statistically significant difference

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While the percentage increase seems small, the overall effect is substantial given the size of the cohorts. The Behavioral Modification Program channeled about 168 customers into other AIC residential programs in PY9.¹⁴

Table 23 through Table 29 present estimated program savings due to participation uplift in other EE programs during PY9. We include estimates of annual savings uplift for the following programs:

- ARP
- HEIQ
- HVAC
- MICK

We present all estimates of both positive and negative uplift for context, but only statistically significant estimates of positive uplift are used to adjust program savings (Table 30 presents the results used to adjust program savings). To compute these estimates, we multiply the net PY9 participation uplift due to the Behavioral Modification Program by the median first year ex post net savings per treatment group customer participating in another AIC residential program in PY9. Note that we do not present results for Expansion Cohort 3, which is gas-only.

We typically use a difference-in-differences estimator to assess uplift. In a number of cases (notably the first four program waves, as well as the Moderate Income Kits Program in all waves except Expansion Cohort 7), pre-period data is not available for participation. In these cases, we use a post-only difference (POD) estimator to determine uplift, marked prominently in the tables below.

Table 23. PY9 Annual Uplift Adjustment for Original Cohort

PY9, Original Cohort	Program			
	ARP	HEIQ	HVAC	MICK
Median kWh savings per participant	490.0	1,545.9	557.1	124.5
Treatment group customers	33,406			
Treatment group rate of PY9 participation	0.33%	0.21%	0.71%	1.82%
Change in rate of treatment group participation from pre-program year	<i>POD used</i>			
Control group customers	33,619			
Control group rate of PY9 participation	0.33%	0.24%	0.66%	2.05%
Change in rate of control group participation from pre-program year	<i>POD used</i>			
Post-only difference statistic	0.00%	-0.03%	0.05%	-0.24%
Positive and statistically significant?	No	No	No	No
Participant uplift	1	-9	17	-79
Total savings attributable to other programs (kWh)	344.6	-14,675.3	9,696.3	-9,791.0

¹⁴ Please note that this number is additive across programs. E.g., a customer channeled into both ARP and HVAC is counted twice.

Table 24. PY9 Annual Uplift Adjustment for Expansion Cohort 1

PY9, Expansion Cohort 1	Program			
	ARP	HEIQ	HVAC	MICK
Median kWh savings per participant	490.0	1,439.3	557.1	124.5
Treatment group customers	50,266			
Treatment group rate of PY9 participation	0.28%	0.12%	0.63%	1.23%
Change in rate of treatment group participation from pre-program year	<i>POD used</i>			
Control group customers	16,853			
Control group rate of PY9 participation	0.27%	0.17%	0.56%	1.26%
Change in rate of control group participation from pre-program year	<i>POD used</i>			
Post-only difference statistic	0.01%	-0.04%	0.07%	-0.03%
Positive and statistically significant?	No	No	No	No
Participant uplift	4	-22	35	-15
Total savings attributable to other programs (kWh)	1,861.9	-30,963.4	19,293.1	-1,907.0

Table 25. PY9 Annual Uplift Adjustment for Expansion Cohort 2

PY9, Expansion Cohort 2	Program			
	ARP	HEIQ	HVAC	MICK
Median kWh savings per participant	490.0	1,716.4	557.1	124.5
Treatment group customers	73,636			
Treatment group rate of PY9 participation	0.27%	0.22%	0.51%	1.79%
Change in rate of treatment group participation from pre-program year	<i>POD used</i>			
Control group customers	12,773			
Control group rate of PY9 participation	0.25%	0.12%	0.38%	1.87%
Change in rate of control group participation from pre-program year	<i>POD used</i>			
Post-only difference statistic	0.02%	0.10%	0.13%	-0.09%
Positive and statistically significant?	No	Yes	No	No
Participant uplift	15	75	94	-63
Total savings attributable to other programs (kWh)	7,115.2	127,912.4	52,093.5	-7,823.5

Table 26. PY9 Annual Uplift Adjustment for Expansion Cohort 4

PY9, Expansion Cohort 4	Program			
	ARP	HEIQ	HVAC	MICK
Median kWh savings per participant	490.0	1,930.8	557.1	124.5
Treatment group customers	20,329			
Treatment group rate of PY9 participation	0.33%	0.24%	0.69%	1.33%
Change in rate of treatment group participation from pre-program year	-0.87%	0.19%	-0.46%	<i>POD used</i>
Control group customers	6,783			
Control group rate of PY9 participation	0.29%	0.19%	0.50%	1.53%
Change in rate of control group participation from pre-program year	-0.80%	0.10%	-0.87%	<i>POD used</i>
Post-only difference statistic	-0.07%	0.09%	0.41%	-0.20%
Positive and statistically significant?	No	No	No	No
Participant uplift	-14	18	83	-41
Total savings attributable to other programs (kWh)	-6,938.0	34,793.7	46,138.4	-5,067.2

Table 27. PY9 Annual Uplift Adjustment for Expansion Cohort 5

PY9, Expansion Cohort 5	Program			
	ARP	HEIQ	HVAC	MICK
Median kWh savings per participant	490.0	1,317.5	557.1	124.5
Treatment group customers	45,359			
Treatment group rate of PY9 participation	0.18%	0.25%	0.54%	1.09%
Change in rate of treatment group participation from pre-program year	-0.60%	0.20%	-0.74%	<i>POD used</i>
Control group customers	8,976			
Control group rate of PY9 participation	0.22%	0.30%	0.42%	1.47%
Change in rate of control group participation from pre-program year	-0.53%	0.23%	-0.76%	<i>POD used</i>
Post-only difference statistic	-0.06%	-0.03%	0.02%	-0.38%
Positive and statistically significant?	No	No	No	No
Participant uplift	-28	-15	10	-171
Total savings attributable to other programs (kWh)	-13,934.9	-19,921.5	5,363.7	-21,298.8

Table 28. PY9 Annual Uplift Adjustment for Expansion Cohort 6

PY9, Expansion Cohort 6	Program			
	ARP	HEIQ	HVAC	MICK
Median kWh savings per participant	490.0	1,707.7	557.1	124.5
Treatment group customers	27,716			
Treatment group rate of PY9 participation	0.24%	0.25%	0.44%	1.23%
Change in rate of treatment group participation from pre-program year	-0.30%	0.22%	-0.32%	<i>POD used</i>
Control group customers	12,056			
Control group rate of PY9 participation	0.17%	0.15%	0.55%	1.07%
Change in rate of control group participation from pre-program year	-0.35%	0.14%	-0.11%	<i>POD used</i>
Post-only difference statistic	0.05%	0.08%	-0.22%	0.16%
Positive and statistically significant?	No	No	No	No
Participant uplift	14	23	-60	44
Total savings attributable to other programs (kWh)	6,642.1	39,136.9	-33,486.5	5,533.4

Table 29. PY9 Annual Uplift Adjustment for Expansion Cohort 7

PY9, Expansion Cohort 7	Program			
	ARP	HEIQ	HVAC	MICK
Median kWh savings per participant	490.0	1,678.0	557.1	124.5
Treatment group customers	46,179			
Treatment group rate of PY9 participation	0.18%	0.21%	0.50%	0.46%
Change in rate of treatment group participation from pre-program year	-0.24%	0.10%	0.22%	-0.15%
Control group customers	18,490			
Control group rate of PY9 participation	0.19%	0.16%	0.42%	0.49%
Change in rate of control group participation from pre-program year	-0.32%	0.03%	0.08%	-0.09%
Post-only difference statistic	0.08%	0.06%	0.14%	-0.07%
Positive and statistically significant?	No	Yes	Yes	No
Participant uplift	37	30	64	-31
Total savings attributable to other programs (kWh)	18,056.9	50,364.7	35,393.6	-3,865.1

Table 30 summarizes the total PY9 annual uplift savings by cohort.

Table 30. Total PY9 Annual Uplift Adjustment

Cohort	Savings Attributable to Other PY9 Programs (kWh)				Total Savings Attributable to PY9 Programs (kWh)
	ARP	HEIQ	HVAC	MICK	
Original Cohort	—	—	—	—	0
Expansion Cohort 1	—	—	—	—	0
Expansion Cohort 2	—	127,912	—	—	127,912
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	—	—	—	—	0
Expansion Cohort 5	—	—	—	—	0
Expansion Cohort 6	—	—	—	—	0
Expansion Cohort 7	—	50,365	35,394	—	85,758
Total	0	178,277	35,394	0	213,671

Legacy Uplift

The Behavioral Modification Program consumption analysis captures savings within the model for each year of a given measure’s estimated useful life. To ensure that AIC does not inappropriately attribute savings to the Behavioral Modification Program that are associated with other programs and to accurately reflect the evaluation paradigm in Illinois, we also net out the savings from equipment rebated through other energy efficiency programs in past years for each year of the estimated useful life of the measure.

Savings are calculated in the same manner as the annual adjustment for PY9, with one adjustment. We multiply the net participation uplift due to the Behavioral Modification Program for each of the past years analyzed by the median first year ex post net savings per treatment group customer participating in another AIC residential program in for that year. However, when a measure has reached the end of its effective useful life by PY9, we exclude it from our analysis (e.g., if a measure installed in PY4 has only a three-year effective useful life, it is not considered in the median first year ex post net savings value for PY4 customers).

Table 31 presents the programs considered in our legacy uplift savings adjustment. We include discontinued programs (e.g. Residential Efficient Products) as energy savings from this program’s past activity still persist in following years.

Table 31. Programs Included in Legacy Uplift Savings Adjustment

Program	Years Included				
	PY4	PY5	PY6	PY7	PY8
Residential Lighting (Online Store Component Only) (OLS)	✓	✓	✓	✓	
ARP	✓	✓	✓	✓	✓
HEIQ	✓	✓	✓	✓	✓
Home Efficiency Standard (HES)	✓	✓	✓	✓	✓
HVAC	✓	✓	✓	✓	✓
MICK					✓
Residential Efficient Products (REEP)	✓	✓	✓		

Table 32 through Table 36 present legacy uplift savings from PY4 through PY8 that we deduct from PY9 Behavioral Modification Program savings.

Table 32. PY4 Legacy Uplift kWh Savings

Cohort	Savings Attributable to PY4 Programs (kWh)							Total Savings Attributable to PY4 Programs (kWh)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
Original Cohort	—	—	—	—	N/A	—	—	0
Expansion Cohort 1	109,969	—	48,208	—	N/A	—	—	158,176
Expansion Cohort 2	—	—	—	—	N/A	—	—	0
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	109,969	0	48,208	0	0	0	0	158,176

Table 33. PY5 Legacy Uplift kWh Savings

Cohort	Savings Attributable to PY5 Programs (kWh)							Total Savings Attributable to PY5 Programs (kWh)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
Original Cohort	—	—	25,155	—	N/A	—	—	25,155
Expansion Cohort 1	—	—	85,992	—	N/A	—	—	85,992
Expansion Cohort 2	—	—	—	—	N/A	—	—	0
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0	0	111,147	0	0	0	0	111,147

Table 34. PY6 Legacy Uplift kWh Savings

Cohort	Savings Attributable to PY6 Programs (kWh)							Total Savings Attributable to PY6 Programs (kWh)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
Original Cohort	—	—	—	—	N/A	—	—	0
Expansion Cohort 1	—	—	—	—	N/A	—	—	0
Expansion Cohort 2	—	—	—	—	N/A	—	2,893	2,893
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	—	—	32,818	80,947	N/A	—	—	113,765
Expansion Cohort 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0	0	32,818	80,947	0	0	2,893	116,658

Table 35. PY7 Legacy Uplift kWh Savings

Cohort	Savings Attributable to PY7 Programs (kWh)							Total Savings Attributable to PY7 Programs (kWh)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
Original Cohort	74,692	—	26,265	—	N/A	—	N/A	100,957
Expansion Cohort 1	—	—	—	—	N/A	—	N/A	0
Expansion Cohort 2	—	—	—	—	N/A	—	N/A	0
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	—	—	—	—	N/A	—	N/A	0
Expansion Cohort 5	—	—	—	—	N/A	—	N/A	0
Expansion Cohort 6	—	—	—	—	N/A	—	N/A	0
Expansion Cohort 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	74,692	0	26,265	0	0	0	0	100,957

Table 36. PY8 Legacy Uplift kWh Savings

Cohort	Savings Attributable to PY8 Programs (kWh)							Total Savings Attributable to PY8 Programs (kWh)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
Original Cohort	—	—	15,889	—	—	N/A	N/A	15,889
Expansion Cohort 1	—	—	—	—	—	N/A	N/A	0
Expansion Cohort 2	—	—	—	—	—	N/A	N/A	0
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	—	—	11,378	—	—	N/A	N/A	11,378
Expansion Cohort 5	—	—	8,750	—	—	N/A	N/A	8,750
Expansion Cohort 6	—	—	18,264	—	—	N/A	N/A	18,264
Expansion Cohort 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0	0	54,281	0	0	0	0	54,281

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Table 37 summarizes total legacy uplift savings from PY4 through PY8 by cohort.

Table 37. Total Legacy Uplift kWh Savings (PY4-PY8)

Cohort	Savings Attributable to PY4-PY8 Programs (kWh)							Total Savings Attributable to PY4-PY8 Programs (kWh)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
Original Cohort	74,692	0	67,308	0	0	0	0	142,000
Expansion Cohort 1	109,969	0	134,199	0	0	0	0	244,168
Expansion Cohort 2	0	0	0	0	0	0	2,893	2,893
Expansion Cohort 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion Cohort 4	0	0	44,196	80,947	0	0	0	125,143
Expansion Cohort 5	0	0	8,750	0	0	0	0	8,750
Expansion Cohort 6	0	0	18,264	0	0	0	0	18,264
Expansion Cohort 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	184,661	0	272,718	80,947	0	0	2,893	541,218

For more information, please contact:

Hannah Howard
Managing Director

510 444 5050 tel
510 444 5222 fax
hhoward@opiniondynamics.com

1 Kaiser Plaza, Suite 445
Oakland, CA 94612



Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

San Francisco Bay

510 444 5050 tel
510 444 5222 fax

1 Kaiser Plaza, Suite 445
Oakland, CA 94612