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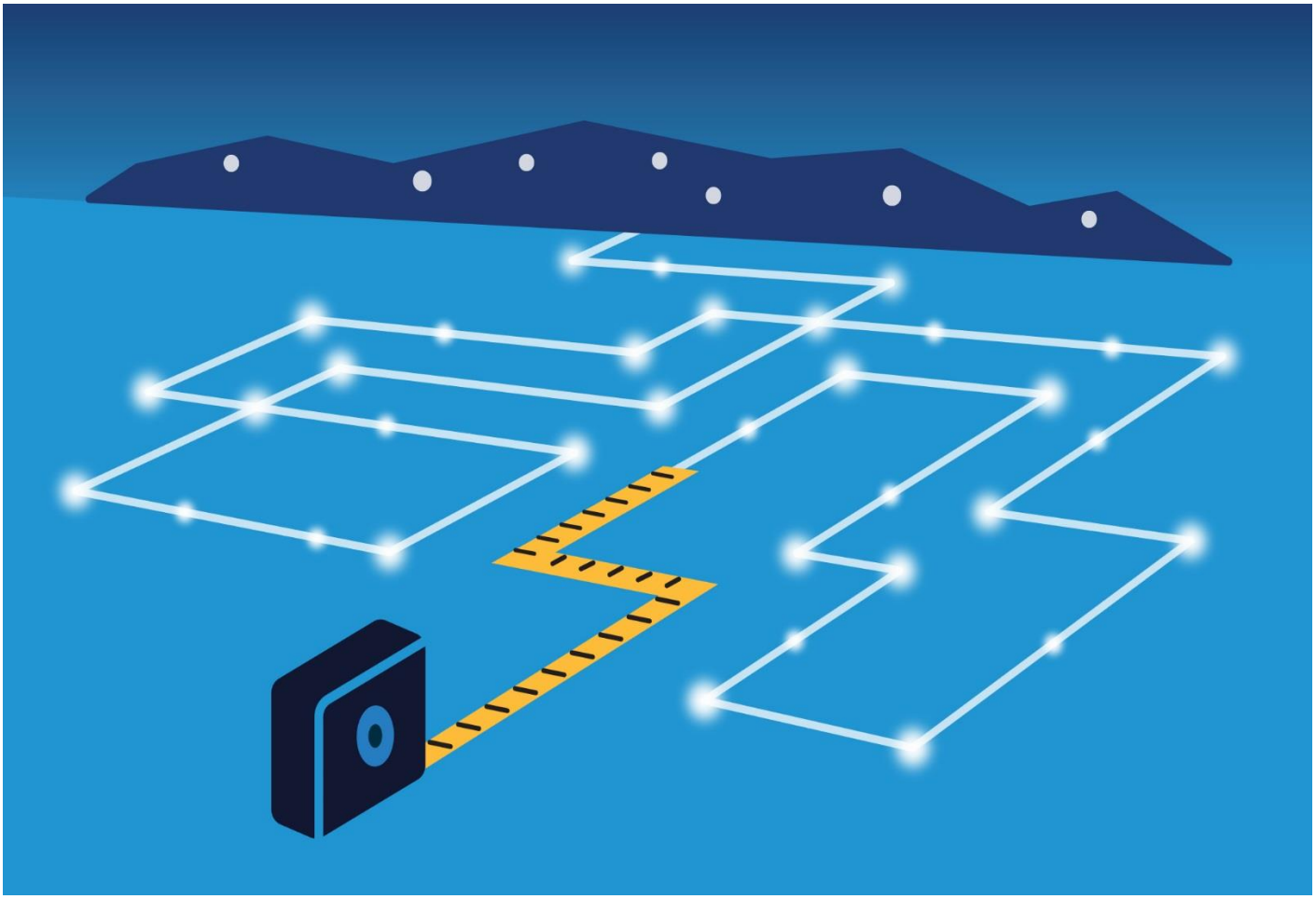

Impact and Process Evaluation of the 2013 Illinois Power Agency All-Electric Homes Program

Final

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1. Executive Summary

The All-Electric Homes (AEH) Program began in PY6 (June 2013–May 2014) as an Illinois Power Agency (IPA) program administered by Conservation Services Group (CSG). The program targets multifamily and single-family customers with electric heat and, therefore, higher-than-average electricity usage. The program requires that these customers also participate in the Home Energy Performance (HEP) Program or Moderate Income Program (for shell improvement measures) or the Multifamily Program (as eligible). The AEH Program provides these customers with access to the following:

- An audit conducted by a program technician
- Incentives of 90% off (up to a project maximum) of the cost to install a ductless mini-split heat pump (DHP) or air-source heat pump (ASHP)
- Standard and specialty CFLs, faucet aerators, and low-flow shower heads (single-family only, provided instead of the similar measures available through HEP).

Program planners forecast the program would achieve net electricity savings (at the meter) of 11,871 MWh,. However, the program achieved total ex post net savings of 9,905MWh, 83% of its goal.

To evaluate the program's savings impacts, the evaluation team calculated gross and net savings using the Illinois Statewide Technical Reference Manual (TRM) for Energy Efficiency Version 2.0 (June 7, 2013) and the filed net-to-gross ratios (NTGRs). Through a telephone survey of participants conducted midway through the program year, the team also evaluated installation and persistence rates for all measures. The process evaluation included interviews with AIC staff and staff from Conservation Services Group (CSG), the program implementer, as well as awareness and satisfaction questions included in the customer survey.

Further, the evaluation team used the telephone survey to develop a NTGR for future planning inputs, though the team did not apply the ratio to this year's savings. The team also installed meters on program ASHP and DHP units, which it will retrieve and analyze during the coming year.

1.1 Impact Results

The evaluation team calculated ex ante and ex post gross savings using participation and measures reported in the program database. To calculate ex ante gross savings, the team multiplied the ex ante unit savings provided in the tracking database by participation counts. To calculate ex post gross savings, the team applied the deemed per-unit savings values from the IPA filing for all measures, with the exception of the ASHP, for which no values were filed. Instead, the evaluation team used the applicable algorithms and methodologies from the Statewide TRM Version 2.0 for the ASHP. The evaluation team used Statewide TRM Version 2.0 instead of the Statewide TRM Version 1 because Version 1 did not provide data and algorithms to calculate the ASHP savings where the baseline equipment is electric resistance heating.

The evaluation team also conducted telephone surveys to verify installation and retention. Since the survey occurred midway through the program year, some heat pumps that were ordered had not fully been installed. We assumed that all were eventually installed. Some respondents reported more CFLs and low-flow shower heads than were listed in the tracking database; however, since we were not able to confirm that the additional installations were provided by the program, we did not credit the program for their use. Instead, we assumed 100% verification rates for all CFLs and low-flow shower heads. Survey respondents confirmed 100% verification for faucet aerators. We incorporated these verified installation rates into the ex post savings.

Table 1. Verification Rates for Measure Installation

Measure	Program Participants	Total Program Measure Count	Measure Count from Surveyed Respondents	Verified Survey Measure Count	Verified Installation Rate
ASHP – Multifamily	615	619	16	N/A	100%
ASHP – Single Family	188	193	9	N/A	100%
DHP – Multifamily	351	351	16	N/A	100%
DHP – Single Family	6	11	2	N/A	100%
Low-Flow Shower Heads	72	112	9	9	100%
CFLs/Specialty CFLs	120	1632	150	150	100%
Faucet Aerators	87	154	14	14	100%

Table 2 shows the program's PY6 first-year net savings impacts. While the total ex ante gross savings exceeded the program MWh goal, ex post net savings achieved 83% of the program MWh goal. Overall, the program realized 68% of ex ante gross MW savings and 79% of the ex ante gross MWh savings. The primary reason for the difference between the ex ante and the ex post savings for most measures was the difference in per-unit savings between the filed values and the values used in the tracking database. In addition, for the ASHP, the difference was due to the adoption of the Statewide TRM Version 2.0 algorithm to establish savings per individual unit based on its efficiency rating, capacity, and other factors to calculate ex post savings, as opposed to the assumptions provided in the tracking database.

Table 2. PY6 AEH Program PY6 Net Savings Impacts

Measure	NTGR	Ex Ante Annual Net Savings		Ex Post Annual Net Savings	
		MW	MWh	MW	MWh
ASHP – Multifamily	1.00	0.755	6,117	0.276	4,732
ASHP – Single-Family	1.00	0.301	2,539	0.127	1,483
DHP – Multifamily	1.00	0.407	3,475	0.429	3,336
DHP – Single-Family	1.00	0.016	140	0.016	138
Programmable Thermostat – Multifamily	0.88	0.000	134	0.000	89
Programmable Thermostat – Single-Family	0.88	0.000	69	0.000	34
Low-Flow Shower Heads	0.79	0.002	33	0.028	32
CFLs	0.79	0.003	23	0.025	19
Specialty CFLs	0.79	0.004	37	0.004	35
Faucet Aerators	0.79	0.002	5	0.112	7
Total*		**1.491**	**12,570**	**1.019**	**9,905**
			Net Realization Rate**	68%	79%

* Totals may not equal sum of measures due to rounding.

** Net realization rate = ex post net savings ÷ ex ante net savings.

1.2 Process Results

The process evaluation found that the program, while slow to ramp up, worked as intended by the end of the program year. In addition, although verified savings fell short of the program's savings goal, the program's participation exceeded its goals. The program demonstrated the following successes:

- The program met or exceeded participation goals for measures that drove program savings (single-family ASHP and multifamily DHP units).
- AIC and CSG agreed that sufficient demand exists to continue the program, but CSG intends to structure the program more as a whole-home opportunity in PY7, and it expects the number of HVAC installations through the program to decline.
- AIC and CSG agreed that the program ran smoothly, especially considering that it was the first year of the program's implementation. Evaluation team surveys also indicated high customer satisfaction rates.
- CSG successfully attracted trade allies to the program in PY6, though they did not serve as a primary driver of program participation. However, in the coming year, CSG expects trade allies to serve as primary marketers. As a result, CSG will need to retrain some trade allies, depending on changes made to the program design.

1.3 Conclusions and Recommendations

Overall, the evaluation team found the program performed reasonably well during its first year of implementation. The evaluation team recommends the following to improve program performance in the future:

- The implementer should use the savings values in the IPA filing and the algorithms for the ASHP units in the program database to track savings more accurately and increase the program realization rate. (Results from ongoing metering of ASHP and DHP units in multi-family properties will be available at the conclusion of the 2014–2015 program year and used to update a future version of the Statewide TRM.)
- The program can increase demand savings by enforcing the program rule that participating single-family homes have an existing air-conditioning system.

As noted in the process section above, while trade allies participated at a rate that supported the program's participation goal, they were not actively involved in marketing the program. The implementer expects trade allies to be more active in marketing the program in the coming year. Trade allies also struggled somewhat to meet the load calculation requirement of the program. AIC staff mentioned that they would like more information about the results of quality control (QC) inspections. As a result, the evaluation team recommends the following to enhance trade ally performance in the program:

- AIC/CSG should create more customer-facing educational materials for trade allies to use when discussing the program to ensure that trade allies are discussing the energy savings benefits, as well as the generous rebate levels.
- CSG should develop a system for recording the results of QC inspections and sharing those results with AIC and possibly the trade ally companies. That will enable the program to better monitor quality

as the program grows and as trade allies learn the more advanced installation procedures required for AEH, particularly load calculations.

While customers were satisfied overall, 24% reported being less than very satisfied with the performance of the installed equipment. The evaluation team did not have sufficient information to determine why customers were not very satisfied with the equipment (see Section 4.2.4 for more details). Based on these findings, the evaluation team recommends the following to improve customer experience with the program:

- AIC/CSG should develop a process for formally surveying customers about their satisfaction on an ongoing basis throughout the year, so that they can respond to issues as they arise.
- To avoid any surprises and ensure that customers are comfortable operating the equipment, AIC/CSG should encourage trade allies to prepare customers for any differences that they may experience between their new system and the previous system.

2. Introduction

This report describes the PY6 evaluation of the All-Electric Homes (AEH) Program, part of the Illinois Power Authority (IPA) procurement plan. AEH was a new program in PY6, funded by the IPA and implemented by CSG. This marks the first evaluation for the AEH Program.

The program targets energy savings in electric-resistance heated residences that have already received shell improvements (e.g., air sealing and insulation) through one of the following three AIC programs: the Home Energy Performance (HEP) Program, the Moderate Income Program, or the Multifamily Program. AEH offers generous incentives—up to 90% of the project cost for purchases of high-efficiency air-source heat pumps (ASHPs) and ductless mini-split heat pumps (DHPs)—installed by a program trade ally. Conservation Services Group (CSG) implements AEH.

To evaluate the PY6 performance of the AEH program, the evaluation team conducted:

- Program staff interviews
- Participant satisfaction phone surveys
- Measure installation verifications through phone surveys
- Analysis of program impacts using the program-tracking database and other resources

At the beginning of PY7, the evaluation team also installed meters in Multifamily Program ASHP and DHP systems. Metering results will become available during the PY7 evaluation, which will provide information for updating per-unit savings estimates for future Statewide Technical Reference Manual (TRM) Version 2.0 reviews. In particular, the meter data include total-unit energy consumption, indoor and outdoor temperatures, humidity levels, condenser performance, and fan speeds. Section 3.1.3 provides the metering study methods and analysis plan.

2.1 Program Description

AEH, an IPA program, began in PY6 (June 2013–May 2014). The program sought to increase energy savings in all-electric residences (single-family and multifamily), targeting customers with greater-than-average electricity usage, including electric heat sources. The AEH implementer (CSG) referred customers interested in AEH to other AIC programs, either the HEP program or the Moderate Income Program for single-family customers, or the Multifamily Program, depending on the customer type, to complete shell improvements to be eligible to participate in AEH.

As part of program delivery, program staff performed a no-cost energy audit or feasibility study of eligible homes and buildings to determine if a customer qualified for a heavily incentivized ASHP or DHP. Program implementation staff members offered qualifying single- and multifamily customer's high-efficiency ASHPs or DHPs at little cost. If the customer accepted the program's offer, program staff provided customers with a list of AEH program trade allies approved to install the new systems. The implementer performed quality assurance inspections on all projects to confirm completion and quality of work and to ensure customer satisfaction.

Single-family customers received an energy audit, which included installation of low-impact measures (e.g., CFLs, low-flow shower heads, and faucet aerators) at no cost. Multi-family customers received a feasibility

study that did not include low-impact measures. The program referred those customers to the Multifamily Program for installation of low-impact measures.

Table 3 summarizes measures offered through the program for each customer type.

Table 3. All-Electric Measures and Incentives, by Dwelling Type

Electric Measure	Single-Family	Multifamily	Incentive	Maximum per Unit
ASHP	✓	✓	90% up to maximum	Single-family $4,800 Multifamily $4,200
DHP	✓	✓	90% up to maximum	Single-family $16,000 Multifamily $8,000
Programmable Thermostat	✓	✓	$50/unit	Single-family $100 Multifamily $50
Low-Flow Shower Heads	✓	*	Direct Install	
CFLs	✓	*	Direct Install	
Specialty CFLs	✓	*	Direct Install	
Faucet Aerators	✓	*	Direct Install	

* Installed through the AIC Multifamily Program.

Any contractor participating in the HEP Program could install measures as long as they were both Building Performance Institute- and ENERGY STAR®-certified. In addition, the program allowed the remaining top 5% of the HVAC program contractors to participate, serving as an additional bonus to contractors already driving high participation volumes and providing incentives for other contractors to improve their program involvement.

Program planners forecast the program would achieve net savings (at the meter) of 11,871 MWh.

2.2 Research Objectives

The PY6 AEH Program evaluation sought to estimate gross and net electric savings attributable to the program. The evaluation team estimated gross energy and demand savings in accordance with Commission Orders for IPA programs. In addition, the team verified measure installation and retention, estimated the net-to-gross ratio (NTGR) for use in calculating energy and demand savings in future program years, and assessed program processes and opportunities for improvement.

The team also installed meters for a heat pump metering study, which will conclude in 2015. The study will focus on all-electric residences and the multifamily sector to inform the next version of the Statewide TRM. To date, such research has not been conducted in the all-electric and multifamily areas. Previous HVAC metering studies in the AIC territory included a significant number of homes with gas heat and did not cover the multifamily sector.

The PY6 AEH Program impact evaluation addressed the following questions:

1. What are the estimated gross energy and demand impacts from this program?
2. What are the estimated net energy and demand impacts from this program?

3. What are the estimated equivalent full-load hours (EFLH)[1] for the installed heat pumps?

As part of the PY6 evaluation, the evaluation team explored process-related research questions, examining the AEH program as a new offering. The process evaluation addressed the following research questions.

1. Program Participation
    a. How many projects were completed, and by how many different customers in each sector (single-family and multifamily)?
    b. Does customer participation meet expectations? If not, how is it different from expectations and why?
2. Program Design and Implementation
    a. What program marketing and outreach efforts did the program employ in PY6? Were they effective at driving participation in each targeted market sector?
    b. What were the lessons learned from the program's first year in operation?
    c. What did participants learn from the energy audit results?
3. Participant Experience and Satisfaction
    a. How satisfied were participants with their program experience? Are they likely to participate in other AIC programs?
4. Opportunities for Program Improvement
    a. What changes could the program make to improve the customer experience and generate greater energy savings?

[1] A Stakeholder Advisory Group (SAG) memorandum, dated February 21, 2014, from the Vermont Energy Investment Corporation TRM Team indicates that the Illinois Statewide TRM Version 2.0 places a high evaluation priority on EFLH heating for multifamily heating systems. As EFLHs are not directly metered, the evaluation team metered energy consumption and calculated savings for each hour, and then used the total metered savings to back-calculate an EFLH value (as the Statewide TRM Version 2.0 also uses this value).

3. Evaluation Methods

The evaluation team used process and impact evaluation tools to assess the PY6 AEH program. Table 4 summarizes the methods used for data collection and analysis.

Table 4. Summary of PY6 Evaluation Methods

Task	PY6 Impact	PY6 Process	Forward Looking	Details
Program Staff In-Depth Interviews		✓	✓	Interviewed AIC and CSG managers to understand goals, program history, progress to date, lessons learned, challenges, and future plans
Participant Surveys	✓	✓	✓	Surveyed 21 single-family participants and 1 multifamily property manager to verify installation, assess program satisfaction, and assess NTGR
Engineering Analysis and Database Review	✓	✓		Summarized database information to determine program participation, develop key statistics about the program, and calculate savings impacts using Statewide TRM Version 2.0 and filed IPA savings values
Site Visits/Metering			✓	In June 2014, installed meters on 40 DHP and 40 ASHP systems installed in multifamily properties; results will inform the next Statewide TRM Version 2.0 update

3.1 Data Collection

3.1.1 Program Staff Interviews

To assess the program's effectiveness and implementation, the evaluation team conducted interviews with AIC's program manager and CSG's AEH implementation manager. Stakeholder interviews addressed the program's design, operations, marketing efforts, implementation barriers, and communications. The team also inquired about data tracking and customer outreach related to the program.

3.1.2 Participant Surveys

We completed the participant surveys prior to the conclusion of the program year, given the need to provide AIC with a NTGR prior to March 1, 2014. Due to the limited size of participant population at the time of the survey (i.e., 66 single-family and 3 multifamily owners/managers), the evaluation team attempted to contact a census of participants. CSG provided the evaluation team with contact information for the multifamily building managers/owners. Survey respondents included 21 single-family participants and 1 multifamily property manager, responsible for one participating property.

A total of 193 single-family homes and 20 multifamily complexes ultimately participated. Since the limited sample of 22 might not be representative of the final program population, applicability of the results may be limited. These issues are discussed in more detail where participant survey results are discussed.

Table 5 shows the types of measures the program installed in survey respondents' homes (with CFLs the most common). Many respondents received more than one type of measure (consistent with the program's design). The multifamily property installed 16 DHP systems.

Table 5. Respondents by Measures Installed

Measure Installed	Program Measure Count	Respondents	
		Count	% of Respondents
Single-Family (n=21)			
ASHP	193	14	67%
DHP	11	2	10%
Programmable Thermostats	185	14	67%
Low-Flow Shower Heads	112	8	38%
CFLs/Specialty CFLs	1632	17	81%
Faucet Aerators	154	11	52%
Multifamily (n=1)			
DHP	351	16	100%

3.1.3 Metering Study

The evaluation team installed meters on 40 of 615 multifamily ASHP units and 40 of 351 multifamily DHP units, with each meter in a different apartment. Installed in June 2014 and planned for removal in May 2015, these data will achieve 12%–13% precision for both ASHP and DHP at the 90% confidence level. The team randomly selected complexes that participated in the 2013–2014 program year and, from those sites, randomly selected living units within each site to participate in the study.

During the update cycle in late 2015, these analysis results may be used to update a future version of the Statewide TRM for multifamily sites.

3.1.4 Sources and Mitigation of Errors

Table 6 summarizes possible error sources associated with data collection conducted for the AEH program. A discussion of the steps the evaluation team took to mitigate against potential error sources throughout planning and implementation of the PY6 evaluation follows the table.

Table 6. Possible Sources of Error

Research Task	Survey Errors		Non-Survey Errors
	Sampling Errors	Non-Sampling Errors	
Participant Survey	• Yes	• Measurement errors • Non-response and self-selection bias • Data processing errors • External validity	
Metering	• Yes	• N/A (study not complete)	• N/A (study not complete)

Gross Savings Calculations	• N/A	• N/A	• Data processing errors • Inappropriate baseline selection • Analytical errors
Net Savings Calculations	• N/A	• N/A	• Analytical errors
NTGR (Future Planning)	• Yes (based on participant survey)	• Measurement errors • Non-response and self-selection bias • Data processing errors • External validity	• Analytical errors

Survey Errors

- **Sampling Errors**

  - The evaluation team attempted to achieve a census of available participants midway through the program year. At that time, the team surveyed 21 single-family customers and 1 multifamily complex manager. By the end of the program year, total participation grew to 194 single-family homes and 22 multifamily complexes. If we assumed that the partial-year sample is representative of the full program year and that there is no non-response bias in the survey, we estimate a survey sampling error of ±17% at the 90% confidence level, at a coefficient of variation of 0.50. Actual precision of each survey question differed, depending on the variance of responses to each question. The evaluation team surveyed 1 of 20 multifamily complex managers; this did not provide statistical reliability.

    As noted above, the team completed the telephone survey part-way through implementation of the first program year. To the degree that staff and trade allies still fine-tuned program delivery, these respondents could have slightly different experiences from later participants. We compared available information about the sample and the population and found some differences in the installed measures. For instance, survey respondents received fewer high-wattage standard CFLs compared to the population, but more specialty CFLs. Whether these differences would change survey results is unknown. The representative sampling error may carry through to the NTGR calculated by the evaluation team, as this number relied on survey data.

- **Non-Sampling Errors**

  - **Measurement Errors**: The evaluation team addressed the validity and reliability of quantitative data using multiple strategies. First, the team relied on its experience to create questions that, at face value, appeared to measure the intended idea or construct. The team reviewed the questions to ensure that they did not include double-barreled questions (i.e., questions that asked about two subjects, but that had only one response) or loaded questions (i.e., slanted questions). The team also checked the overall logical flow of questions so that respondents would not be confused, which would decrease reliability.

    Key evaluation team members, along with AIC and ICC staff, had an opportunity to review all survey instruments. To confirm clear wording of questions, the team pretested each survey instrument, monitored the telephone interviews, and reviewed the pretest survey data. The team also used the pretests to assess whether the survey's length was reasonable and reduced its length as needed.

  - **Non-Response Bias**: Given that the participant survey achieved a 32% response rate, potential exists for non-response bias. However, the evaluation team attempted to mitigate possible bias by

calling each potential respondent at least four times or unless receiving a hard refusal, and by calling at different times of the day, as appropriate. As mentioned in the Sampling Errors discussion above, we compared available information about surveyed customers to the program population. Some small differences exist in the installed mix of measures; however, we found no evidence of significant differences resulting from non-response bias.

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

- **External Validity**: The evaluation team addressed external validity (i.e., the ability to generalize any findings to the population of interest, i.e., all PY6 program participants) through development of an appropriate research design. However, the fact that the survey was conducted midway through the program year could affect external validity. As discussed above, we compared available information on the survey population to the total population and found slight differences in the mix of measures installed. We found no evidence of a compromised external validity in the estimation of NTGR, measure installation rates, or program satisfaction. The evaluation team does not anticipate that using partial-year survey data for NTGR results in any different bias than already exists due to Illinois prospective application of NTGRs. Further, the installation rates were indicative that 100% installation occurred, and we have no reason to expect that it would differ for the full program under this design. Similarly, programs such as these typically have high satisfaction rates, and the early program results found this to be the case. Due to these uses of the survey results, we do not expect external validity to be a problem.

Non-Survey Errors

- **Analytical Errors**

  - **Gross Savings Calculations**: The evaluation team applied the TRM calculations to participant data in the tracking database to calculate gross impacts. To minimize analytical error, a separate team member reviewed all calculations to verify their accuracy.

  - **Net Savings Calculations:** The evaluation team applied the prospective deemed NTGR to estimate the program's net impacts. To minimize analytical errors, a separate team member reviewed all calculations to verify their accuracy.

- **Inappropriate Baseline Selection**

  - To mitigate potential inappropriate baseline selection, the evaluation team applied the TRM Version 2.0 algorithms and deemed values in place of the TRM Version 1.0. Version 1.0 assumed all ASHP units replaced a similar unit. In fact, most program units replaced old electric resistance or furnace systems.

3.2 Analytical Methods

3.2.1 Gross Impacts

The evaluation team used the program database and database per-unit savings values, supplied by the program implementer, to calculate ex ante gross savings. The following steps determined ex post gross impacts:

- The team reviewed the database data for consistency and to filter any obvious outliers. Because the team found the dataset to be very clean, this step required minimal effort.
- The team assessed installation and retention rates through the partial-year participant telephone survey.
- The team applied filed per-units savings for each measure recorded in the program database, except for ASHP units. For ASHP units, the team applied the savings algorithms included in the Statewide TRM Version 2.0. This method incorporated additional "early replacement" savings, as the program units replaced functional equipment. As directed by the Statewide TRM Version 2.0, the team assumed electric resistance as the baseline technology for the first 6 years and then ASHP as the baseline technology for the remaining 12 years of the measure life.
- The Statewide TRM Version 2.0 algorithms used for the ASHP units follow:

$$\Delta kWh = [[EFLH\_cooling * Capacity\_cooling * [1/SEER\_base - 1/SEER\_ee)]] / 1000] + [[EFLH\_heat * Capacity\_heating * [1/HSPF\_base - 1/HSPF\_ee]] / 1000]$$

$$\Delta kW = [Capacity\_cooling * [1/EER\_base - 1/EER\_ee]] / 1000] * CF$$

Where:

EFLH = equivalent full-load hours, provided in the Statewide TRM Version 2.0 by geographic area

Capacity = equipment size as provided in the tracking database

SEER = seasonal energy-efficiency rating, as provided in the tracking database for the replacement unit and in the Statewide TRM Version 2.0 for the base unit

EER = energy-efficiency rating as provided in the tracking database

HSPF = heating seasonal performance factor, provided in the Statewide TRM Version 2.0 by equipment type and size

CF = summer system peak coincidence factor, provided in the Statewide TRM Version 2.0

3.2.2 Net Impacts

The evaluation team calculated net impacts for PY6 using filed NTGRs for all measures.

3.2.3 Future Planning Inputs

The evaluation team calculated a NTGR for future planning related to the AEH program. We completed this analysis and provided the results to AIC and ICC staff via a memo dated February 27, 2014 (attached in Appendix B).

The NTGR used the following formula:

$$NTGR = 1 - [\text{free-ridership score}] + [\text{spillover}]$$

4. Evaluation Findings

4.1 Program Design and Participation

The AEH Program operated from June 1, 2013 to May 31, 2014, installing energy-efficient ASHP or DHP units in 194 single-family homes and 966 multifamily units, and performing an additional 44 audits in single-family homes that did not receive an ASHP or DHP. CSG set internal participation targets for the first year, based on the market response to the HEP and the Moderate Income programs.

The program fell slightly short of the ASHP targets and the single-family DHP target, but far exceeded the multifamily DHP and programmable thermostats targets. The single-family ASHPs and multifamily DHPs served as primary drivers of savings for the program. Therefore, the program nearly met or exceeded participation expectations for the most important measure categories. Table 7 shows measure targets and installations through the program in PY6.

Table 7. Units Installed in PY6

Electric Measure	Target		Units Installed (% of target)	
	Single-Family	Multifamily	Single-Family	Multifamily
ASHP	216	675	193 (89%)	619 (92%)
DHP	24	225	11 (46%)	351 (156%)
Programmable Thermostat	130	405	192 (148%)	494 (122%)
Low-Flow Shower Heads	not set	*	112	*
CFLs	not set	*	707	*
Specialty CFLs	not set	*	925	*
Faucet Aerators	not set	*	154	*

* Multifamily audits were performed through the Multifamily Program and direct-install measures ascribed to that program.

CSG, the AEH program implementer, submitted a program design for AEH, which the IPA included in it's procurement plan because it had a Total Resource Cost ratio above one. AIC staff also said the program offered a new approach in the face of falling participation in the more mature programs, such as the Appliance Recycling Program and the Residential Lighting Program.

Staff initially expressed concerns that the program targeted a very narrow market, given the program's slow ramp-up in the early part of the year. CSG, however, deliberately targeted the program to the southern Illinois area because of its high concentration of all-electric homes. Residents of these homes had lobbied for more electric programs in past years, when electricity prices were high. Uptake was initially slow while trade allies were recruited and trained. Participation rates sharply rose toward the end of the program year, as word of mouth from earlier participants spread. Staff and the implementer expect the existing customer base will be large enough to sustain the program for at least 2 of 3 more years.

For PY6, CSG set incentives for ASHP, DHP, and programmable thermostats at 90% of the total cost, with a maximum allowable amount set at the expected 90% cost to the customer. The incentives did not reflect the relative savings per unit installed. As shown in Table 8, DHP maximum values were higher than ASHP maximum values, and the cap for single-family DHPs was twice that of multifamily DHPs.

Some differences emerged between expected costs and actual costs, affecting the total incentive that customers could receive. According to implementer staff, the program set the cap for the ASHPs and

programmable thermostat units at the right amount, but the cap for the multifamily DHP units, which achieved a greater economy of scale than expected, proved higher than 90% of the usual project cost.

Conversely, the cap for the single-family DHPs, even at $16,000, proved too low and did not cover 90% of the cost for most homes. CSG noted that it determined the eligible HVAC measure, ASHP or DHP, according to existing heating systems. The program replaced baseboard heaters with DHP units and forced-air systems with ASHP units. CSG did not attempt to promote one technology over the other.

Table 8. Maximum Incentive Levels by Customer Type

Electric Measure	Single-Family (per Unit)		Multifamily (per Unit)	
	Maximum Incentive	Ex Post Gross Savings (kWh)	Maximum Incentive	Ex Post Gross Savings (kWh)
ASHP	$4,800	7,648	$4,200	7,644
DHP	$16,000	12,556	$8,000	9,503
Programmable Thermostat	$100	204	$50	204

One of the goals for the AEH Program included educating consumers about their energy consumption. CSG reported that the program accomplished consumer education to a certain extent through the audit, especially on the single-family side. On the multifamily side, the program primarily communicated with complex managers.

Overall, CSG made a greater effort to train the participating trade allies—rather than the end users—in the relative benefits of the ASHP and DHP systems. Trade allies received training on how units fit into a home's energy use as a whole system, not just how the units performed. This training laid the foundation for expanding the program to offer a more whole-home set of eligible measures in the coming year.

4.2 Process Assessment

4.2.1 Implementation

AIC and CSG reported smooth program implementation over the course of the year. AIC staff did not report receiving complaints from trade allies or customers.

According to CSG, its project coordinators remained in close contact with participants throughout the process. A coordinator visited every site, typically once to verify the work scope and once to verify the correct installation and proper functioning of all equipment installed. For single-family customers who had not yet received an audit, coordinators provided an audit and direct-install measures, then referred customers to the HEP or Moderate Income program to install shell measures before customers could return to the AEH program to receive the AEH HVAC measures. Multifamily customers did not receive an audit through AEH. If they had not already participated in the Multifamily Program, they were referred to that program to receive an audit, direct-install measures, and other measures available through that program, then back to the AEH program for installation of the HVAC units. Project coordinators verified that a unit participated in either the HEP or the Moderate Income Program, or the Multifamily Program, and visited the site to verify installation upon project completion. AIC staff noted that they did not receive reports of verification visit results, though they would like to have that information in the future.

CSG did not report the time frame in which they required trade allies to process rebate applications. It did note that the program requires multifamily participants to obtain three bids, which extended the project time for

these customers. CSG also reported that the installation time varied, depending on the number and size of units the customer installed. CSG estimated that projects averaged 4–6 weeks for installation and another 4–6 weeks following the verification visit for CSG to process the rebate.

Cadmus noted that the program manual restricted the program to single-family homes with a central air-conditioning system in place. However, according to the tracking database, there were three homes that received an ASHP unit that did not have a central air-conditioning system prior to the installation. This negatively affects the demand savings from the installation, since the ASHP adds air-conditioning load where none was previously used. These three ASHP units each had an average kW savings of −2.32 kW.

4.2.2 Trade Ally Outreach

AIC staff attributed the program's success to the implementer's strong outreach to trade allies. According to AIC, unusually high rebates available through the program ironically presented a marketing challenge, as trade allies and their customers hesitated to believe such a good deal was available. Therefore, the program ramped up slowly until people began telling others about positive experiences.

AIC, witnessing the success of the program, credited CSG with targeting the program to a compact area with a high number of all-electric homes, which helped facilitate marketing by trade allies and word of mouth from satisfied customers. In addition, AIC noted two very active auditors and a generally strong pool of trade allies already working with the HEP Program in the area.

CSG reported about 20–30 trade allies participated in PY6. All HEP trade allies were eligible, given their certification and experience. In addition, CSG allowed the top 5% of HVAC contractors to participate. To recruit trade allies to the AEH Program, project coordinators personally called each HEP and top HVAC trade ally.

CSG noted that, in some cases, trade allies did not expect the program's very high quality standard, which required contractors to perform additional calculations to what other programs required. According to CSG, the load calculation presented the most difficult issue for many trade allies. CSG required trade allies to complete calculations on every job, and project coordinators reviewed each of these to make sure that trade allies completed the calculations properly. A CSG representative stated: "I know there was a [learning] curve for some of the contractors. But it felt good that we were able to use the generous incentive to push contractors to go through that learning."

4.2.3 Program Marketing

CSG marketed the program through two primary channels: direct-mail outreach to HEP Program and Multifamily Program participants, and direct mail to high-use, all-electric customers, encouraging them to participate in one of the gateway programs (HEP or Multifamily) and then AEH.

AIC reported that CSG did not want to conduct mass marketing for the program due to its small size and ~~over-generous rebates~~ fixed rebate budget, which risked over-subscription. The CSG marketing approach appeared to generate sufficient demand for the program, as the program came close to participation targets set for key measures.

CSG trained the participating trade allies in the program goals, processes, and benefits to customers. Once they received this training, trade allies could perform their own outreach to potentially eligible customers. CSG cited this cascade approach as a minor program-marketing element for this year, and noted that this was a "ramp-up year" for trade allies. CSG expects trade allies to become bigger contributors to future marketing efforts.

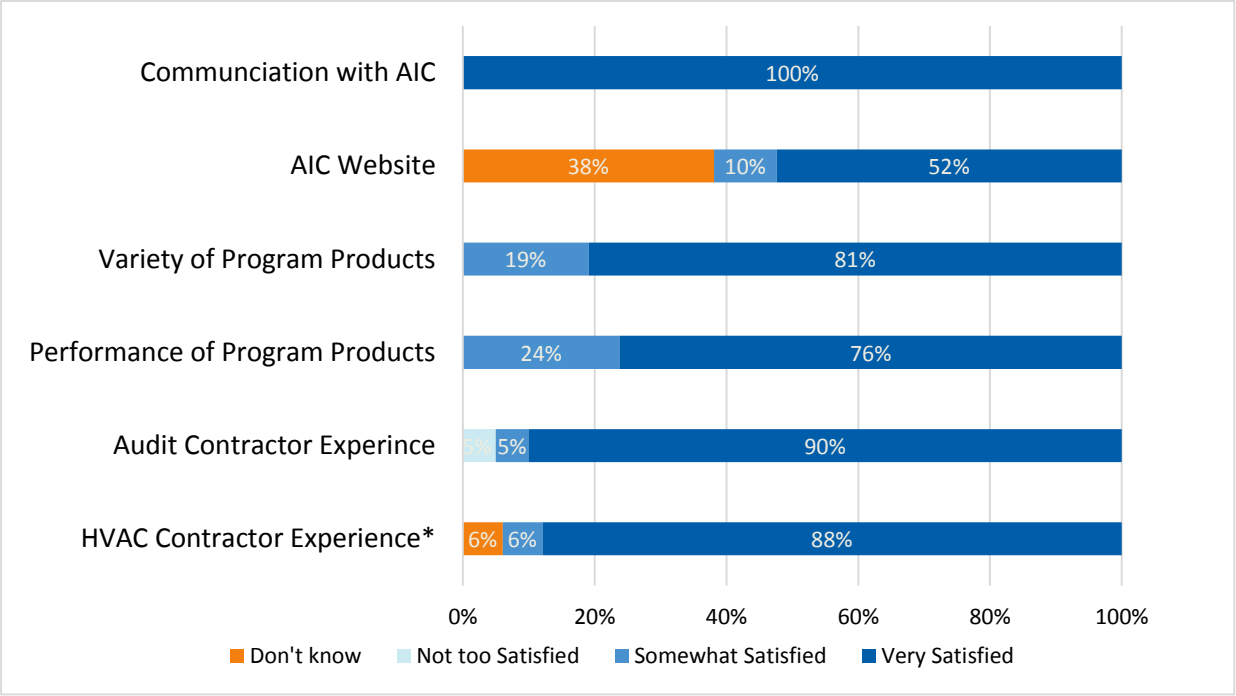
4.2.4 Customer Satisfaction

Customer satisfaction with the AEH program was reviewed in two ways:

- CSG received informal feedback through project coordinators, who reported customers were "thrilled"—especially multifamily customers. CSG expected this positive feedback, since all participants received a very customer-service-oriented experience. AIC staff noted that they did not receive reports during the year regarding customer satisfaction, but that they would like to receive them in the coming year.

- The evaluation team addressed customer satisfaction through the participant survey, which was administered part-way through the program year. The team asked participants for their feedback on communication with AIC, access to the AIC website, the variety and quality of products offered through the program, and their experiences with program contractors. Overall, participants indicated high satisfaction with the program (Figure 1). These types of programs generally yield high satisfaction rates, and we have no reason to expect that results based on a full year of participants would differ significantly. If anything, the program is likely to improve satisfaction, as program staff works out any issues or challenges associated with starting up a new program.

Figure 1. Participating Customer Satisfaction with Various Aspects of the Program (n=21)



* HVAC contractor experience was asked only of customers who received HVAC work (n=16).

Only one respondent indicated some dissatisfaction with his or her energy audit experience, stating: "On the insulation, I don't think he [the contractor] did the right thing. Our house is still very drafty and I don't think he did the foam that you're supposed to." The AEH Program did not include insulation, so the customer could

have confused the AEH Program with a different program experience.[2] The one multifamily property manager indicated high satisfaction with the program, responding "very satisfied" to each program aspect, except for AIC's website, which he said he had not used. More than one-third (38%) of respondents said that they could not rate AIC's website, suggesting that they had not used it. However, those that did rate the website said that they were either very satisfied (11 of 13) or somewhat satisfied (2 of 13).

Eight of the 21 respondents gave answers to an open-ended question regarding how they would improve the program. Though answers ranged from reducing costs to improving communications about specific improvements, no common theme emerged across the responses. Table 9 lists verbatim responses from customers.

Table 9. How Would You [the Customer] Improve the Program?

Verbatim Responses
Advertise it more so people know about it.
Make sure that the contractor is doing everything good about safety issues.
Illinois ActOnEnergy website doesn't offer the energy-efficiency equipment that the Missouri residents get. I was let down because the choices were limited. The offers there are much better.
Make it cheaper.*
Maybe having more vendors to choose from for installation of equipment.
More information on the whole operation of the system.
Originally, the audit guy from AIC came for preliminary appointment, but when he came back there was a problem he didn't and should have mentioned before. It was that the vents from the bathroom had to go out through the roof. It was really frustrating.
We were told we'd get a certificate that something was energy efficient, but afterwards we were told we couldn't because it wasn't the "right fixture." They should have told us at the time.
* AEH Program customers receive direct-install measures free. HVAC measures are incentivized at 90%, up to a cap.

Customers responded favorably when asked about their satisfaction with AIC. Nineteen of the 21 respondents said that they were "very satisfied" with their experiences as an AIC customer overall; the other two responded "somewhat satisfied." Eighteen customers said that their opinion of AIC improved based on their experience with the AEH program, two indicated that their opinions stayed the same, and one could not answer.

At least one customer was impressed with the energy savings resulting from the program. This customer volunteered a comment at the end of the survey: "I got my energy bill, $109, yesterday, and I would guess that it is 50%–75% lower as a result of participating in the program. I am very happy to see that."

4.2.5 Installation and Retention

Based on the partial-year survey results, participant surveys and document verification indicated that systems were installed as expected and that efficiency and system sizes were accurately reported. Telephone and document verification resulted in a 100% measure verification rate for all measures except CFLs and low-flow shower heads. Some participants indicated that they installed more CFLs and low-flow shower heads than were recorded in the database. Because we were unable to verify that the additional installations were program products, we assumed a 100% installation rate for both program CFLs and low-flow shower heads.

[2] Participants in the AEH program may have received building envelope improvements through another AIC program prior to the energy audit.

Due to the uncertainty and potential recall error of participant counts, we conservatively assumed that the database was correct and did not credit the program with any additional CFLs or low-flow shower heads. According to survey responses, all of the program-installed HVAC equipment remained functioning and in use. While the partial-year survey results may not fully represent this program year, high installation rates are typical of these types of programs, and we would not expect to see significant differences if we surveyed a sample from the full program year.

4.3 Impact Assessment

4.3.1 Gross Impacts

The evaluation team analyzed data from the tracking database (census) to calculate ex post annual gross savings. The following summary provides reasons for ex post annual per-unit savings differing from ex ante savings reported in the tracking database:

- Program-reported savings used values derived by the implementer, not based on the filed Statewide TRM Version 2.0 values, to determine ex ante values.
- The evaluation team calculated ex post values using the filed per-unit savings values for all measures except the ASHP.
- The evaluation team applied Statewide TRM Version 2.0 algorithms to determine the savings attributable to each ASHP unit installed, based on the technology replaced, size and capacity of the installed unit, and weather zone. To achieve the most accurate value possible, the team applied the Statewide TRM Version 2.0 algorithms, which accounted for early replacement savings.

The ex post analysis found, for 3 of the 193 single-family ASHP units installed in the program, demand (kW) savings from installing an ASHP in place of an electric resistance system were zero or negative for the first 6 months in cases where the home did not previously have a central air conditioner.

Table 10 shows gross ex ante and ex post per-unit savings. The evaluation team used the Statewide TRM Version 2.0 rather than the Statewide TRM Version 1.0, as stipulated in the evaluation work plan, to estimate ex post savings for ASHP units. The evaluation team judged this a more accurate representation of program savings. The Statewide TRM Version 1.0 does not allow adjusting baseline savings according to the type of equipment replaced, as does the Statewide TRM Version 2.0. The assumed baseline in the Statewide TRM Version 1.0 was a similar ASHP system, which did not represent conditions of the AEH program, and results in a much reduced per-unit savings estimation.

Table 10. PY6 AEH Program Gross Per-Unit Savings

Measure	Ex Ante Annual Per-Unit Gross Savings		Ex Post Annual Per-Unit Gross Savings	
	kW	kWh	kW	kWh
ASHP – Multifamily	1.220	9,882	0.446*	7,645*
ASHP – Single-Family	1.560	13,153	0.660*	7,686*
DHP – Multifamily	1.160	9,899	1.222	9,503
DHP – Single-Family	1.490	12,725	1.467	12,556
Programmable Thermostat – Multifamily	0.000	309	0.000	204
Programmable Thermostat – Single-Family	0.000	408	0.000	204

Measure	Ex Ante Annual Per-Unit Gross Savings		Ex Post Annual Per-Unit Gross Savings	
	kW	kWh	kW	kWh
Low-Flow Shower Head	0.024	368	0.321	361
CFL – 23W	0.005	44	0.033	51
CFL – 20W	0.003	30	0.029	37
CFL – 13W	0.005	42	0.047	32
Specialty CFL – Candelabra (9W)	0.004	40	0.007	55
Specialty CFL – Globe (14W)	0.006	55	0.006	47
Specialty CFL – Reflector (15W)	0.005	45	0.005	34
Faucet Aerator	0.018	42	0.923	57

* Represents the average per-unit value based on the TRM Version 2.0 algorithms.

Table 11**Error! Reference source not found.** shows average per-unit annual savings for ASHP units. The first 6 years represent an early replacement annual savings value that uses electric resistance heat as the baseline. The annual savings value for the remaining 12 years of useful ASHP life have been measured against an ASHP baseline. Using the Statewide TRM Version 2.0 to enable measuring early resistance savings substantially increased the ex post program savings for the ASHP units.

Table 11. Average ASHP Per-Unit savings for Early Replacement and Standard Baselines

Customer Type	Measure Quantity	Average Annual Per-Unit Energy Savings			
		Years 1–6 (kWh)	Years 7–18 (kWh)	Years 1–6 (kW)	Years 7–18 (kW)
Multifamily	619	7,645	851	0.446	0.215
Single-Family	193	7,686	1,037	0.660	0.304

Table 12 presents the program ex ante gross and ex post gross savings by measure.

Table 12. PY6 AEH Program Gross Savings Impacts

Measure	Ex Ante Gross Savings		Ex Post Gross Savings	
	MW	MWh	MW	MWh
ASHP – Multifamily	0.755	6,117	0.276	4,732
ASHP – Single-Family	0.301	2,539	0.127	1,483
DHP – Multifamily	0.407	3,475	0.429	3,336
DHP – Single-Family	0.016	140	0.016	138
Programmable Thermostat – Multifamily	0.000	152	0.000	101
Programmable Thermostat – Single-Family	0.000	78	0.000	39
Low-Flow Shower Head	0.003	41	0.036	40
CFL	0.003	29	0.031	24
Specialty CFL	0.005	47	0.006	44
Faucet Aerator	0.003	7	0.142	9
Total	**1.494**	**12,624**	**1.064**	**9,946**

* Totals may not equal sum of measures due to rounding.

4.3.2 Net Impacts

The evaluation team calculated net ex ante and ex post savings by applying the filed NTGRs to the measure quantity reported in the database and the ex ante and ex post savings values used for gross savings calculations. Table 13 shows the filed NTGRs by measure and net savings in MW and MWh.

Table 13. PY6 AEH Program Net Savings Impacts

Measure	NTGR	Ex Ante Annual Net Savings		Ex Post Annual Net Savings	
		MW	MWh	MW	MWh
ASHP – Multifamily	1.00	0.755	6,117	0.276	4,732
ASHP – Single-family	1.00	0.301	2,539	0.127	1,483
DHP – Multifamily	1.00	0.407	3,475	0.429	3,336
DHP – Single-family	1.00	0.016	140	0.016	138
Programmable Thermostat – Multifamily	0.88	0.000	134	0.000	89
Programmable Thermostat – Single-family	0.88	0.000	69	0.000	34
Low-Flow Shower Head	0.79	0.002	33	0.028	32
CFL	0.79	0.003	23	0.025	19
Specialty CFL	0.79	0.004	37	0.004	35
Faucet Aerator	0.79	0.002	5	0.112	7
Total*		**1.491**	**12,570**	**1.019**	**9,905**
		Net Realization Rate**		68%	79%

* Totals may not equal sum of measures due to rounding.
** Net realization rate = ex post net savings ÷ ex ante net savings.

4.3.3 Future Planning Inputs

The evaluation team calculated a NTGR for the AEH Program using telephone surveys of program participants from the first half of the program period. The team conducted this analysis and provided results to AIC and ICC staff via memo dated February 27, 2014 (Appendix B). We did not apply these NTGR values to PY6 program savings. Because NTGR results are applied prospectively, the use of partial-year participants should not create any bias not already existing from applying past program year research to future years.

Table 14 shows free-ridership (FR), spillover, the NTGR score for each measure category, and the overall NTGR by market segment.

Table 14. Free-Ridership, Spillover, NTGR, and Gross Savings by Measure Category

Category	Free-Ridership	Spillover	NTGR	Gross Savings (kWh)
Single-Family Low-Impact	27%	3%	76%	11,280
Single-Family High-Impact	1%		102%	153,630
Single-Family Overall	**3%***		**100%**	**164,910**
Multifamily High-Impact	**0%**	**0%**	**100%**	**152,050**

* Calculated using the free-ridership equation over all single-family measures.

4.4 Conclusions and Recommendations

Realization Rate

- **Conclusion 1:** The program achieved lower ex post savings than what was anticipated in the program database, largely due to the fact that the database used a different deemed value to estimate savings than the value in the IPA filing. For ASHP, the difference was due to the use of the Statewide TRM Version 2.0 algorithms in place of an assumed value in the database.
  - **Recommendation 1:** Reevaluate forecasted program savings, based on trends of equipment replaced and the size, capacity, and location of the equipment installed, and then applying the Statewide TRM Version 2.0 values. The program-tracking database already collects the necessary information, so relatively little effort should be required to monitor savings based on this system. Adjusting how the database forecasts savings can easily result in a higher realization rate in the coming year.

Program Design

- **Conclusion 2:** In three instances, the tracking database recorded ASHP units installed in homes without a central air-conditioning unit. This is in violation of the rule stated in the program manual that homes are eligible only if they have an existing air-conditioning system. These installations result in negative demand savings for the program.
  - **Recommendation 2:** The implementer should enforce program eligibility criteria for all participants.

Implementation

- **Conclusion 3:** AIC largely expressed satisfaction with the program's performance. CSG conducted a smooth program implementation, particularly for a first-year program. CSG reported that all trade allies, even well-trained and experienced HEP trade allies, struggled with the load calculation requirement. In the future, AIC has requested that CSG share QC results.
  - **Recommendation 3:** Design a tracking system for QC results with a focus on load calculations. Provide periodic reports from this system to AIC. It may be useful to share individual contractor's results with the contractor's sales manager so that they can identify if a particular installer struggles to meet this program requirement.

Customer Education

- **Conclusion 4:** One of AIC primary objectives through its demand-side management programs is to push the market toward greater adoption of energy-efficiency technologies, even outside of program incentives. A primary channel for achieving this transformation is consumer education. In PY6, little direct education of consumers occurred. CSG invested most of its effort in educating trade allies, expecting them to educate consumers further down the marketing chain. In addition, customer surveys noted little response in terms of benefits customers reported from their new systems.

  - **Recommendation 4:** Educating customers about what to expect from their new systems may help them recognize additional benefits. Develop new marketing materials designed for trade allies to use. Ensure that at least some of these materials are intended to be left with customers, and generally educate consumers on the benefits of whole-home energy-efficiency upgrades and on technology that customers may not be familiar with, such as DHP units. This will help promote AIC's objective of broad consumer education and will help ensure that trade allies do not rely exclusively on generous incentives to market the program.

Customer Satisfaction

- **Conclusion 5:** Although CSG staff did made a great deal of contact with customers, neither AIC nor CSG put a formal system in place to collect customer satisfaction data. On the evaluation team's participant surveys, 24% of customers noted that they were less than "very satisfied" with the performance of equipment installed. If the implementer had collected this type of feedback throughout the year, it could have responded more effectively.

  - **Recommendation 5:** As the program grows, particularly as new trade allies enter the program, it will become more important to track customer satisfaction more closely over the year. CSG should consider developing a very brief exit survey, perhaps in an online format that field coordinators can deliver via an iPad to customers when verifying installation or via an email link. CSG should share survey results with AIC. However, an exit survey will not collect customer satisfaction with equipment performance, as this requires customers to experience equipment for a period of time after installation. The team also recommends conducting a follow-up call, a few months after installation, to ensure that measures continue to perform.

    While the evaluation team's participant survey was not designed to capture the reason participants were less than very satisfied, we speculate the new equipment may operate or perform differently than the replaced equipment. Trade ally training to encourage talking with customers about what these differences may be (such as length of time to turn on or off, range of impact around the home, and sound levels and sound locations during operation) may improve customer satisfaction. In particular, the training should make sure trade allies are training participants effectively to operate their new equipment.

A. Appendix – Data Collection Instruments

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AEH StakeholderGuide_D

B. Appendix – PY6 NTGR Research

AEH NTG Memo 2-28-14.docx

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