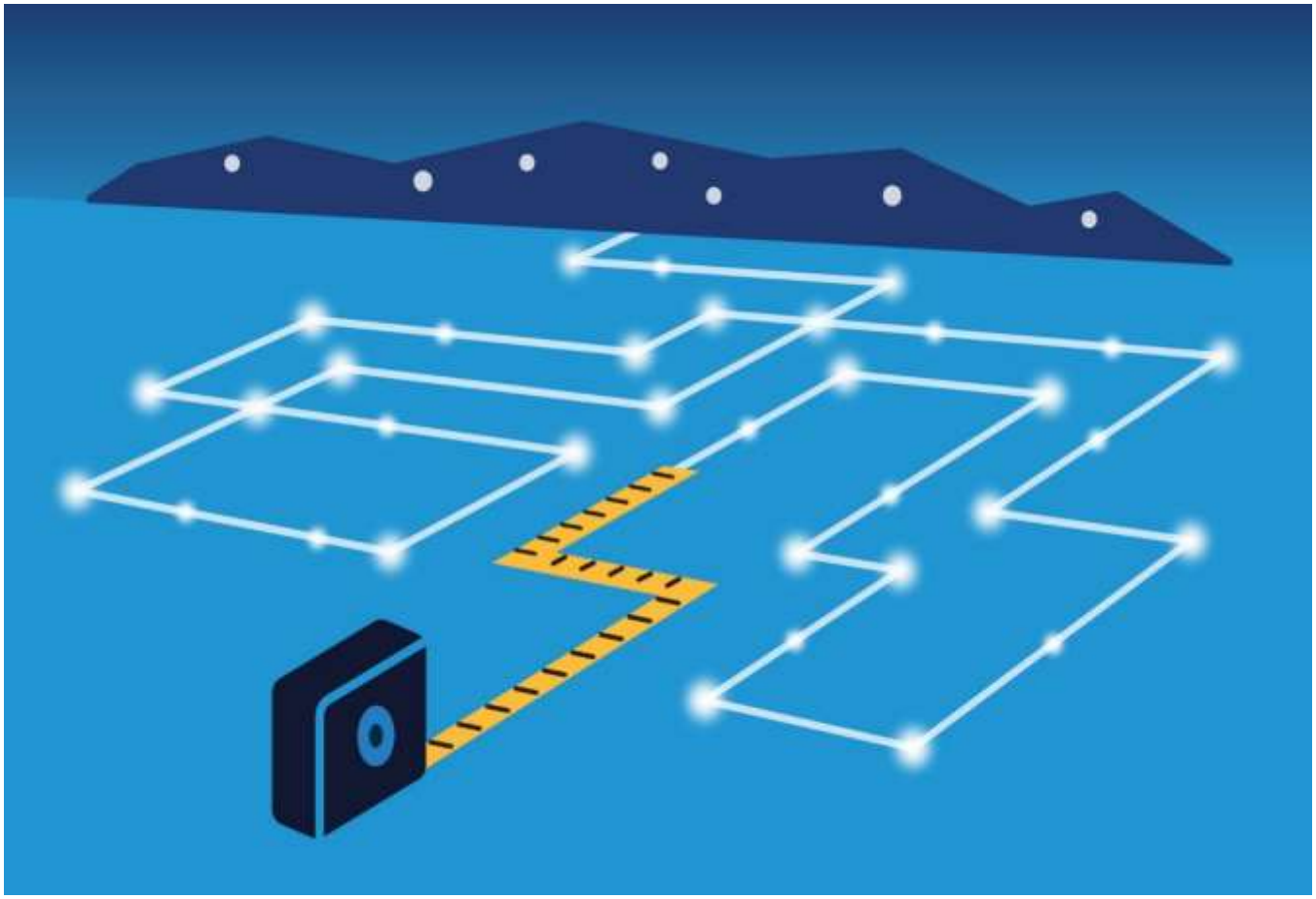
Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451



Evaluation of the 2014 (PY7) Ameren Illinois Company Residential Multifamily Program

Final

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CADMUS

NAVIGANT

MichaelsEnergy

Contributors

Rick G. Winch
Vice President, Opinion Dynamics

Hannah Arnold
Managing Director, Opinion Dynamics

Ute Zischka
Project Analyst, Opinion Dynamics

Mallorie Gattie
Energy Engineer, Opinion Dynamics

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1. Executive Summary

This report presents results from program year seven (PY7) of the Ameren Illinois Company (AIC) Multifamily Program, which was implemented from June 2014 to May 2015 by implementation contractors Leidos and CLEAResult (formerly Conservation Services Group). During PY7, multifamily program offerings in AIC service territory were split between the AIC Multifamily Program and another multifamily program sponsored by the Illinois Power Agency (IPA). While there was no change in program offerings from the customer perspective, the AIC Multifamily Program focused largely on implementing in-unit and common area direct installation projects while the IPA Multifamily Program completed the majority of major measure projects.[1]

Measures offered through the direct installation component of the program include in-unit CFLs, faucet aerators, low-flow showerheads, programmable thermostats and common area lighting upgrades. While major measures (also referred to as shell measures) include air sealing and insulation. Program delivery also differs somewhat by program component. In general, the program implementer conducts outreach and recruitment of participants for the direct installation component of the program whereas for shell measures, program allies are responsible for generating leads and bringing customers into the program.

Aside from the addition of and coordination with the IPA Multifamily Program offering, the PY7 AIC Multifamily Program functioned much the same as in prior program years. Overall, AIC expected the program to contribute 2.4% of the overall PY7 portfolio's electric savings and 2.2% of the portfolio's gas savings.

Below we present the key findings from the PY7 Multifamily Program evaluation.

Program Impacts

Table 1 summarizes the net electricity, demand and gas savings from the PY7 Multifamily Program, which are 8,306 MWh, 1.72 MW and 239,163 therms. The evaluation team verified all program measures through a database review process, and applied the same net-to-gross ratios (NTGR) as the implementation team. As such, differences between ex ante and ex post gross savings calculations are generally driven by variances in savings for lighting, programmable thermostats and low-flow showerheads, which account for between 14% and 46% of program savings.

Table 1. PY7 Net Multifamily Program Impacts

	Ex Ante Gross	Gross Realization Rate	Ex Post Gross	NTGR [a]	Ex Post Net
Energy Savings (MWh)					
Total MWh	9,453	0.98	9,232	0.90	8,306
Demand Savings (MW)					
Total MW	1.63	1.15	1.88	0.91	1.72
Gas Savings (Therm)					
Total Therms	318,372	0.89	282,248	0.85	239,163

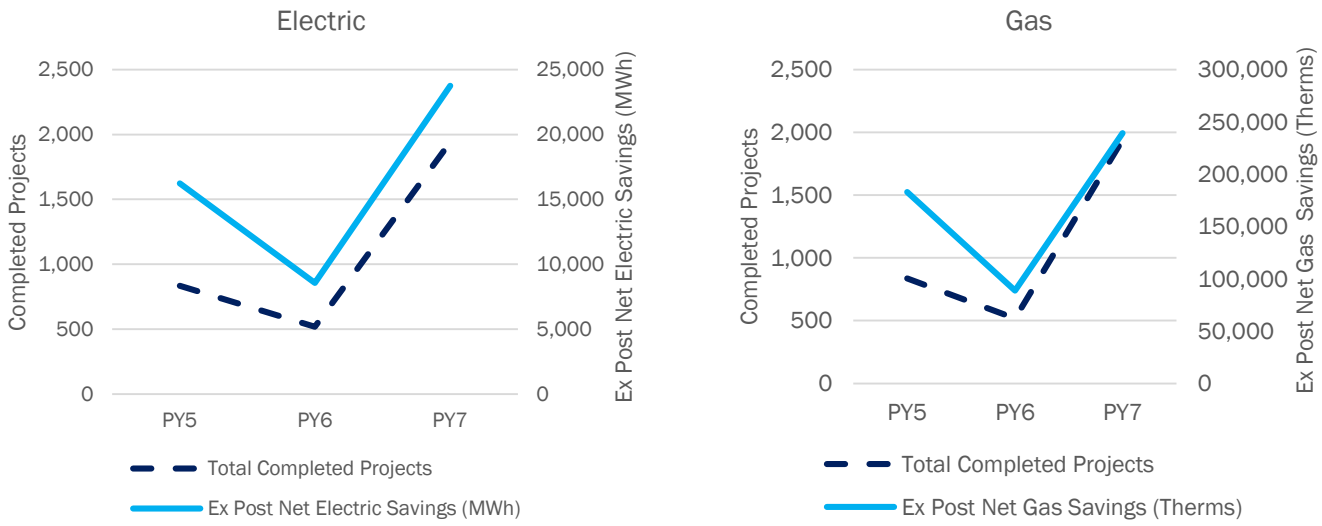
[a] The NTGRs presented here are program-level values developed based on SAG approved measure-level NTGRs.

[1] The evaluation team provides results from the evaluation of the IPA Multifamily Program in a separate report.

Program Participation

Program staff achieved the PY7 AIC Multifamily Program savings presented above through implementation of 997 projects with 189 property managers/owners (128 participating in the AIC program alone and 61 participating in both AIC and IPA programs). When considered in conjunction with activity in the electric-only IPA Multifamily Program, a dramatic increase in savings for this sector is evident.

Figure 1. AIC and IPA Multifamily Program Activity from PY5 – PY7



Note: The IPA Multifamily Program began in PY7.

Key Findings and Recommendations

While program design changed somewhat given the movement of most major measures projects to the IPA Multifamily Program, the AIC Multifamily Program generally operated smoothly and effectively in PY7. As noted in detail below, research with participating customers and program allies points to high levels of satisfaction, while discussions with non-participants and a review of secondary data provide insight on how the program can identify decision-makers and target properties going forward.

The following are the key findings and recommendations from the PY7 evaluation.

- **Key Finding #1**: Participating property managers are highly satisfied with the program and those with additional properties are likely to participate in the future. Contractors also appear to be happy with the program, noting that communications between program staff and trade allies have improved over time.
  - **Recommendation**: The ownership and management of multifamily properties appears to be highly concentrated, meaning a relatively small percentage of property management firms oversee a high percentage of all multifamily buildings. As a result, it is imperative to ensure that current participants have positive program experiences. A consistent commitment to QA/QC and a timely resolution of outstanding issues/problems should continue to be used to ensure current participants continue to participate in the future.

- **Key Finding #2**: The vast majority of participating property managers are aware of all three program components (i.e., in-unit direct install, common area direct install, major measures), suggesting that all parties involved in the multifamily program are doing a good job making sure participating property managers are aware of ALL program possibilities. About one-half of nonparticipating property managers are aware of the program.

  - **Recommendation**: Continue to emphasize that all parties involved in the multifamily program promote all three program components. Awareness of the various program components, among participating property managers, appears to be high. Therefore, the future goal is to maintain present awareness levels by continuing to focus on cross-component marketing.

  - **Recommendation**: Additional outreach, across multiple communication channels, may be needed to increase awareness among nonparticipating property managers. Industry events and associations, including associated publications, may be a good way of reaching these individuals. Outreach should also include contractors and equipment manufacturers as both groups are common sources of information for nonparticipating property managers. Communications should emphasize the program's ability to help property managers reduce operating costs.

- **Key Finding #3**: Building owners plays a critical role in approving building and efficiency upgrades and are particularly motivated to reduce building operating costs.

  - **Recommendation:** It is important to develop strategies to engage building owners, as the central decision maker, in conversations about potential energy efficiency projects. Associated with this, property managers should be provided with information that will support them in pitching energy efficiency upgrades to building owners.

2. Evaluation Approach

The PY7 evaluation of the Multifamily Program involved both process and impact assessments. To support the process evaluation, we conducted a review of program materials and program-tracking data, interviews with program implementation staff, and interviews with program allies and participants. We also conducted a survey with non-participating property managers/owners and analyzed secondary data to characterize the multifamily market in AIC service territory. To evaluate gross impacts, the evaluation team reviewed the PY7 program tracking data and applied the Illinois Statewide Technical Reference Manual for Energy Efficiency Version 3.0 (IL-TRM 3.0). To calculate net impacts, the team applied NTGRs recommended to the Stakeholder Advisory Group (SAG) to the gross impacts.

In general, the team coordinated evaluation activities across the AIC and IPA programs.

2.1 Research Objectives

The evaluation team sought to answer the following research questions as part of the PY7 Multifamily evaluation:

2.1.1 Impact Questions

- What are the estimated gross energy and demand impacts from this program?
- What are the estimated net energy and demand impacts from this program?

2.1.2 Process Questions

- Program Participation
  - How many projects were completed? By how many different customers? What types of projects?
  - Does customer participation meet expectations? If not, how different is it and why?
  - How many customers participate in more than one component?
- Program Design and Implementation
  - Has the program changed compared to PY6? If so, how, why, and was this an advantageous change?
  - What implementation challenges have occurred in PY7, and how has the program overcome them?
- Opportunities for Program Improvement
  - What changes could the program make to improve the customer experience and generate greater energy savings?
- Market Characterization
  - What is the size of the multifamily market in AIC service territory?
  - What are the characteristics of multifamily buildings in AIC service territory?

- How do property managers and owners make decisions about building improvements?

2.2 Evaluation Tasks

Table 2 summarizes the evaluation activities that we conducted for the PY7 evaluation of the Multifamily Program.

Table 2. Summary of PY7 Multifamily Program Evaluation Activities

Activity	PY7 Process	PY7 Impact	Forward Looking	Details
Program Staff Interviews	✓			Conducted interviews with AIC and CLEAResult program managers to understand changes in program design and implementation.
Review Program-Tracking Data and Materials	✓	✓		Reviewed the PY7 database, relevant administrative program reports, as well as marketing and outreach materials to document program design and changes.
Program Ally Interviews*	✓			Conducted interviews with program allies to collect information about their role in program marketing and implementation, and to gain their perspectives on potential barriers to participation.
Participating Property Manager/ Owner Survey	✓		✓	Conducted telephone surveys with participating property managers/owners to collect process-related information, and help characterize the multifamily market in AIC service territory.
Non-participating Property Manager/ Owner Survey	✓		✓	Conducted telephone surveys with property managers/owners to help characterize the multifamily market in AIC service territory and identify barriers to participation in the Multifamily program.
Secondary Data Review and Analysis			✓	Reviewed AIC Residential Customer data and publicly available Census data to assess the size and characteristics of the multifamily market in the AIC service territory.
Impact Analysis		✓		Conducted an engineering analysis of all measures installed during PY7.

Note: Conducted in conjunction with the IPA Multifamily Program.

We summarize each of these activities in detail below.

2.2.1 Program Staff Interviews

In May 2015, the evaluation team conducted two in-depth interviews with AIC and CLEAResult program managers. The interviews provided the evaluation team with insights about changes, during PY7, in 1) program design and implementation, 2) data tracking, and 3) customer outreach.

2.2.2 Review of Program Materials and Data

In addition to program staff interviews, the evaluation team reviewed program materials including program flyers, the Multifamily Program Implementation Plan, and Monthly Administrative Meeting Reports. The team

also reviewed the program-tracking database to examine the type of data that is tracked, and to obtain data for both the process and impact analysis.

2.2.3 Program Ally Interviews

The evaluation team conducted in-depth interviews with participating program allies. The interviews collected information about the role of program allies in marketing and implementation, and their perspectives on barriers to program participation. Opinion Dynamics used the data from the interviews to inform the process evaluation.

Overall, we spoke with four of nine program allies who installed shell measures such as insulation or air sealing through the program. Three of the program allies with whom we spoke completed projects within both AIC's energy efficiency portfolio (referred to as 8-103/8-104 and AIC) and IPA programs. Further, the four companies we spoke to represent the majority (91%) of all projects completed during PY7.

2.2.4 Participating Property Manager/Owner Survey

The evaluation team conducted quantitative telephone interviews with 70 property managers/owners who participated in the Multifamily Program during PY7. These interviews explored the company and building characteristics of program participants, as well as the decision-making process related to energy efficiency upgrades among other topics. The participant population for this survey included property managers/owners who received direct installation (in-unit or common area) and major measures through the program. As a result, the survey findings are presented in this report, as well as the IPA Multifamily Program report.

Sample Design

Given the size of the participant population, the evaluation team did not conduct sampling for this survey effort. Instead, we conducted a census attempt and called all of the participants in the program (both the 8-103/8-104 and IPA components). In total, the evaluation team identified 248 unique contacts and completed 70 interviews. We fielded the survey from August 18 to September 16, 2015.

Table 3 shows the population of property managers/owners and number of completed surveys.

Table 3. Overview of Completed Participating Property Manager/Owner Surveys

Component	PY7 Participating Property Manager/ Owner Population	Completed Surveys
8-103/8-104 Only	128	29
IPA Only	59	16
Both	61	25
Unique Property Managers	**248**	**70**

As noted above, we attempted to reach a census of property managers and therefore, there is no sampling error associated with the survey results. However, we identify and comment on other sources of potential error in Section 2.3.

Survey Disposition and Response Rate

Table 4 presents the final survey dispositions for the participating property manager/owner survey. Note that the total records in the sample differ from the 248 unique property manager/owners listed above given the initial presence of both tenants and property managers/owners in the program-tracking data. While the implementer corrected this issue, it lead to a greater amount of sample being loaded.

Table 4. Participating Property Manager/Owner Survey Dispositions

Disposition	N
Completed Interviews (I)	**70**
Partial	**2**
Eligible Non-Interviews	**169**
Refusal	53
Mid-Interview Terminate (R)	3
Respondent Never Available (NC)	57
Answering Device	55
Language Problem (NC)	1
Not Eligible (e)	**60**
Fax/Data Line	4
Non-Working	35
No eligible respondent	3
Wrong number	18
Unknown Eligibility Non-Interview (U)	**374**
Not attempted or worked	349
Call blocking	1
Always busy	3
No Answer	21
Total Records in Sample	**675**

Table 5 provides the response and cooperation rates. Note that ineligible respondents in the original sample (i.e., tenants) are not included in the calculation of the response or cooperation rates. Appendix D describes the methodology to calculate response rates in more detail.

Table 5. Participating Property Manager/Owner Survey Response and Cooperation Rates

AAPOR Rate	Percentage
Response Rate #1	27%
Cooperation Rate #3	55%

2.2.5 Non-Participating Property Manager/Owner Survey

The evaluation team also conducted quantitative telephone interviews with property managers/owners who had not participated in the Multifamily Program. The interviews explored company and building characteristics, property-managers' and owners' decision-making process related to energy efficiency upgrades, as well as barriers to participation in the Multifamily Program. In general, the team designed the survey to inform the market characterization effort.

Sample Design

The evaluation team did not conduct sampling for the non-participating property manager/owner survey. Similar to the participant survey, we conducted a census attempt by calling all contacts within our population frame. However, the evaluation team faced significant challenges in determining the size of the non-participant population, as well as accessing data on members of this population. As a result, the team ultimately used the only viable data source available, an existing list from AIC containing property managers and building owners in the multifamily sector. AIC developed this list based on information about customers utilizing account management processes with their tenants, as well as those who opted-in to the utility's property manager portal.

It is important to note that before determining that the AIC list represented the only viable sample source, the evaluation team explored a number of other data sources. However, none provided the contacts or property information needed for completing the non-participating property manager survey. The data sources that the team assessed include:

- AIC Customer Data: We could not use AIC's customer database because it did not contain a flag for multifamily properties. In addition, the database generally contains information at the tenant level and not the owner/operator level.
- Hoovers (a D&B Company): We explored purchasing data from Hoovers to support the survey effort. Within Hoovers, the team can filter by property management SIC or NAICS codes, as well as industry codes to try to hone in on the appropriate group of respondents. However, once the team filtered down to the appropriate categories, we found only a handful of potential records that did not appear to be appropriate.
- Illinois Property Management Associations: The evaluation team conducted an extensive Internet search to try to identify property management associations with information about this population.[2] However, associations do not provide both contact information and addresses of multifamily properties.

Based on the AIC list, the evaluation team identified 413 unique contacts defined by phone number, and completed 20 interviews from August 26 to September 11, 2015. The evaluation team took a number of steps to prepare data from the AIC list for fielding the non-participating property manager survey. First, we collapsed the 5,229 records to 883 unique phone numbers. If one phone number appeared more than once (for example, with different properties), we randomly selected the site we would ask about during the survey. We

[2] For example, we reviewed information from the Illinois Rental Property Owners Association, the Association of Condominium, Townhouse and Homeowners Associations, the Apartment Building Owners and Managers Association, and the National Multifamily Housing Council.

then removed records with duplicate contact information and phone numbers of Multifamily Program participants. This yielded an approximate population of 860 property managers or owners who had not previously participated in the Multifamily Program. To establish the sample frame, we further removed records with no or invalid property addresses as the survey included site-specific questions.

Table 6 provides a summary of the survey population, the sample frame and completed surveys.

Table 6. Summary of Completed Non-Participating Property Manager/Owner Surveys

Target Population	Population (Approximated)	Sample Frame	Completed Surveys
Non-Participating Property Manager/Owners	860	413	20

Note that because we lack information about the true non-participating property manager population, it is difficult to determine if the sample frame is representative of the all property managers or owners in AIC service territory who have not previously participated in the Multifamily Program. Therefore, we use information from the non-participating property manager survey cautiously and primarily to enhance the information provided by participating property managers. We also identify and comment on sources of potential error in Section 2.3.

Survey Disposition and Response Rate

Table 7 presents the final survey dispositions for the non-participating property manager/owner survey.

Table 7. Non-Participating Property Manager/Owner Survey Dispositions

Disposition	N
Completed Interviews (I)	**20**
Partial	**3**
Eligible Non-Interviews	**222**
Refusal	120
Mid-Interview Terminate (R)	0
Respondent Never Available (NC)	71
Answering Device	31
Language Problem (NC)	0
Not Eligible (e)	**139**
Fax/Data Line	0
Non-Working	38
Duplicate Number	0
Wrong number	52
No eligible respondent available	47
Other organization	2
Unknown Eligibility Non-Interview (U)	**29**
Always busy	1
No Answer	28
Total Non-Participants in Sample	**413**

Table 8 provides the response and cooperation rates. Appendix D describes the methodology to calculate response rates in more detail.

Table 8. Non-Participating Property Manager/Owner Survey Response and Cooperation Rates

AAPOR Rate	Percentage
Response Rate #1	8%
Cooperation Rate #3	14%

2.2.6 Secondary Data Review and Analysis

The evaluation team identified and analyzed secondary data to support the market characterization. The principal source of secondary information is the 2009-2013 American Community Survey (Census data), though we also draw on AIC customer data. The Census data provides information on the number of units in multifamily structures, the year those units were built, as well as important socio-demographic data on building occupants. Through a series of analysis steps, AIC customer data was used to estimate the number of multifamily buildings within AIC's service territory as well as their size (number of units) and location. A full discussion of the analysis applied to both Census data and AIC customer data can be found in the Appendix B (Market Characterization).

2.2.7 Impact Analysis

The evaluation included both gross and net impact analyses as described below.

Gross Impact Analysis Approach

To estimate PY7 ex post gross savings for the Multifamily Program, we conducted an engineering review of the program-tracking database and applied values from the IL-TRM V3.0. We present the algorithms used to calculate all evaluated program savings in Appendix C, along with all input variables.

Net Impact Analysis Approach

The evaluation team calculated PY7 net impacts by applying the NTGRs outlined in Table 9. The source of these values is the team's final PY7 NTGR recommendation to the SAG.

Table 9. PY7 Multifamily Program NTGRs by Component

Component	Measure	Electric NTGR			Gas NTGR		
		Free-Ridership	Participant Spillover	NTGR	Free-Ridership	Participant Spillover	NTGR
Direct Installation [a]	CFL	0.19	--	0.81	0.00	--	N/A
	Aerator	0.06	--	0.94	0.06	--	0.94
	Shower Head	0.07	--	0.93	0.07	--	0.93
	Thermostat	0.00	--	1.00	0.00	--	1.00
	Common Area Lighting Measures	0.20	--	0.80	0.00	--	N/A

Major Measures	Air Sealing	0.04	--	0.96	0.19	--	0.81
	Attic Insulation	0.12	--	0.88	0.25	--	0.75

Source: Final PY7 NTGR Recommendations to the SAG

[a] Formerly divided into In-Unit and Common Area Lighting

2.3 Sources and Mitigation of Error

Table 10 provides a summary of possible sources of error associated with the research activities conducted for this evaluation. We discuss each item in detail below.

Table 10. Potential Sources of Error

Research Task	Survey Error		Non-Survey Error
	Sampling	Non-Sampling	
Participating Property Manager/Owner Survey	▪ No sampling error since it was an attempted census	▪ Measurement error ▪ Non-response and self-selection bias ▪ Data processing error ▪ External validity	▪ N/A
Non-participating Property Manager/Owner Survey	▪ No sampling error since it was an attempted census	▪ Sample frame error ▪ Measurement error ▪ Non-response and self-selection bias ▪ Data processing error	▪ N/A
Secondary Data Review	▪ N/A	▪ N/A	▪ Data processing error
Impact Analysis	▪ N/A	▪ N/A	▪ Data processing error

The evaluation team took a number of steps to mitigate against potential sources of error throughout the planning and implementation of the PY7 evaluation.

Survey Error

- Non-Sampling Error:
  - **Measurement Error**: We addressed both the validity and reliability of quantitative data through multiple strategies. First, we relied upon the experience of the evaluation team to create questions that, at face value, appear to measure the idea or construct that they are intended to measure. We reviewed the questions to ensure that we did not ask double-barreled questions (i.e., questions that ask about two subjects, but with only one response) or loaded questions (i.e., questions that are slanted one way or the other). We also checked the overall logical flow of the questions so as not to confuse respondents, which would decrease reliability.

    Key members of the evaluation team, as well as AIC and ICC Staff had the opportunity to review all survey instruments. In addition, to determine if the wording of the questions was clear and unambiguous, we pre-tested each survey instrument, monitored both the participating and non-participating property manager interviews as they were being conducted, and reviewed the pre-test survey data. We also used the pre-tests to assess whether the length of the survey was reasonable and reduced survey length as needed.

- **Non-Response Bias**: Given the response rate of 13% for the participating property manager/owner survey and 8% for the non-participating property manager/owner survey, there is the potential for non-response bias. However, we attempted to mitigate possible bias by calling each potential respondent at least eight times at different times of the day (unless a refusal was received or the phone number was deemed ineligible). In addition, we reviewed population-level data for the property managers/owners where available to determine whether those we spoke with were significantly different from those who did not respond to the survey.

  Based on this assessment, we found that the share of property managers/owners who received shell measures was identical between survey respondents and the participant population (both 50%). However, participants who completed in-unit or common area direct install projects were under-represented in the survey. Only 13% of survey respondents completed common area projects compared to 29% in the participant population, and 37% of the survey respondents received direct install measures for rental units, compared to 58% in the population. In determining whether to weight survey responses due to differences between the survey respondents and the population, the team reviewed prior survey results that included testing for significant differences across participants in different program components. Given that there have historically been very few if any differences between these groups, a decision was made to present unweighted results.

  For the non-participant survey, while there is the potential for non-response bias, the team had no population-level data to review to determine its extent. However, we did speak with a high share of respondents who own smaller properties, which suggests that larger firms may not have responded to our interview request, likely due to gatekeeper refusals.

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

- **Sample Frame Error**: This type of error occurs when the sample frame is not a perfect representation of the population, which may be the case for the non-participating property manager/owner survey due to the difficulty in forming the sample frame (i.e., the population of all non-participating property managers). This reduces our ability to generalize any findings to the target population of interest. As a result, we note within the methodology section that the results from this survey are largely used in conjunction with the participant survey, as well as to verify trends seen in the secondary data analysis.

Non-Survey Error

- **Data Processing Error**:

  - **Gross Impact Calculations**: We applied the TRM calculations to the participant data in the tracking database to calculate gross impacts. To minimize data processing error, the evaluation team had all calculations reviewed by a separate team member to verify accurate calculations.

  - **Net Impact Calculations:** We applied the prospective deemed NTGRs to estimate the program's net impacts. To minimize data processing error, the evaluation team had all calculations reviewed by a separate team member to verify accurate calculations.

3. Detailed Evaluation Findings

3.1 Program Description

The AIC Multifamily Program offers incentives and services that promote energy savings and lower operating costs in market rate multifamily properties. In PY7, delivery of Multifamily Program offerings was split between AIC's energy efficiency portfolio (referred to as 8-103/8-104) and the Illinois Power Agency (IPA). The AIC program, implemented by Leidos and CLEAResult largely focused on the delivery of direct-install measures such as in-unit CFLs, faucet aerators, low-flow showerheads, programmable thermostats and common area lighting upgrades. However, the program also provided some shell measures such as air sealing and insulation although the majority were provided through the IPA program.

Delivery of the Multifamily Program focuses on establishing relationships with property managers and owners eligible to participate. In general, the program implementer conducts outreach and recruitment of participants for the direct-install component of the program whereas for shell measures program allies are responsible for generating leads and bringing customers into the program. Marketing efforts largely include outreach via phone calls to customers who have previously participated in the program, and in-person visits by program staff to new customers that may be eligible. To raise awareness of the program among property managers/owners more broadly, the program implementer also attends trade shows and industry events.

Account managers are the key implementation staff involved in the AIC program, and as part of the enrollment process they perform audits at customer properties to identify installation opportunities across both direct-installation and shell measures. For the AIC program, they are also responsible for installing measures in tenant units and common areas with the exception of programmable thermostats, which the implementer provides to participating customers for installation by their own staff. Program allies perform all shell measures installation activities.

3.2 Program Design and Implementation

According to program staff, implementation of the Multifamily Program went smoothly and generally according to plan in PY7. However, the program staff did make minor implementation changes to address various issues that arose over the course of the program year.

3.2.1 Program Design Changes

The implementer made few adjustments to program delivery in PY7 related to common area lighting and shell measures. First, the program began to cover the full cost of select common area lighting measures - occupancy sensors, exit signs, T-8 lamps or T-12 lamps – that had previously been rebated. Second, the program implementer brought a QA/QC inspector on board in October 2014 to improve oversight of major measures projects.[3] The program aims to inspect at least 10% of project reservations, but program staff noted that the inspection rate is currently close to 25%.

The third programmatic change made by the implementer allowed for the ongoing tracking of budget allocations to shell measure projects. In particular, the program continued implementation of a reservation

[3] Previously, account managers performed this work.

system started at the end of PY6 when the major measures program component re-opened for two months. This system allows program staff to better monitor budget expenditures and associated program ally activities.

3.3 Program Participation and Experience

3.3.1 PY7 Participation

Over the course of PY7, AIC completed 997 projects (based on unique project ID) through the program. As shown in Table 11, the majority of these projects included direct installations in tenant units and building shell upgrades. As indicated by the low percentage of projects and savings, program staff noted that finding opportunities for common area upgrades remains challenging.

Table 11. PY7 AIC Multifamily Program Participation and Projected Savings by Component

Project Type	Projects		Ex Ante Gross Electric Savings		Ex Ante Gross Demand Savings		Ex Ante Gross Gas Savings	
	#	%	kWh	%	kW	%	Therms	%
Direct Install – In-Unit	454	46%	8,074,087	85%	760	46%	83,803	26%
Direct Install - Common Area Lighting	69	7%	421,128	4%	59	4%	n/a	0%
Major Measures	474	48%	957,556	10%	816	50%	234,570	74%
Total[a]	**997**		**9,452,771**		**1,635**		**318,372**	

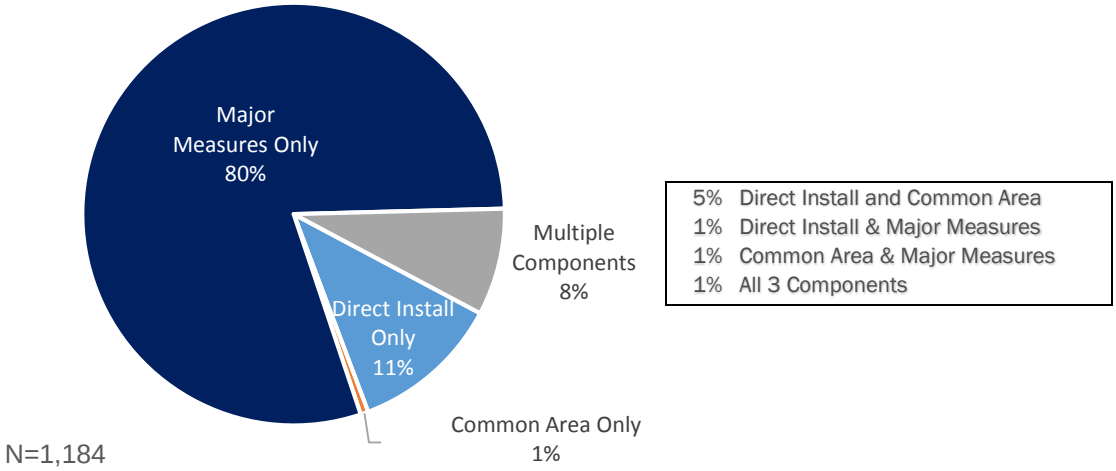
[a] Totals may not sum to 100% due to rounding.

Note: The number of projects is based on unique Project ID. In some cases, there are multiple projects completed at a given property.

To fully assess uptake of different project types, the team also looked at participation across both the AIC and IPA programs. Across both of these programs, program staff completed 1,940 projects in 1,184 multifamily buildings.[4] As shown in Figure 2, the majority of these buildings (80%) only performed shell measure upgrades, the majority of which came through the IPA program. Further, only a few buildings participated in more than one component although program allies indicated they generally make property managers aware of other program offerings when appropriate.

[4] Defined by unique street address

Figure 2. Multifamily Building Upgrades Across AIC and IPA Programs



3.3.2 Trends in Participation

Figure 3 plots the number of projects completed through the Multifamily Programs (AIC and IPA), as well as the *ex post* net savings from PY5 to PY7. As shown, the number of projects completed through the program has doubled over the past three years from 835 projects in PY5 to 1,940 projects in PY7. Electric savings also increased significantly from 15,754 MWh to 22,851 MWh (45% increase) due to the addition of the IPA program offering, which is electric only.

Figure 3. Multifamily Program Participation and Savings PY5-PY7 (AIC and IPA Programs)

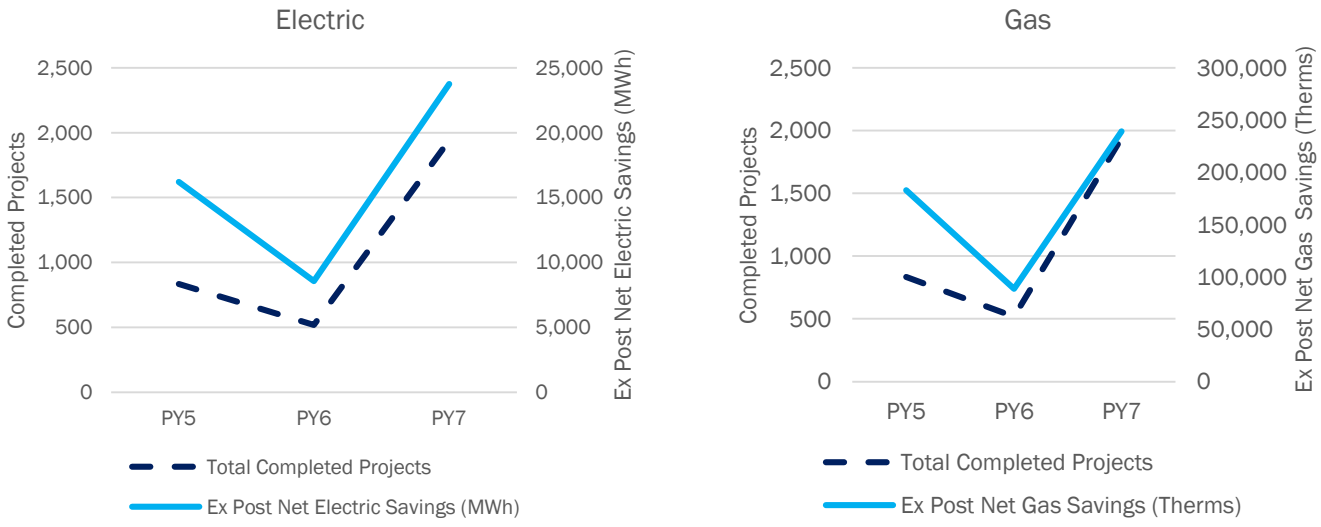
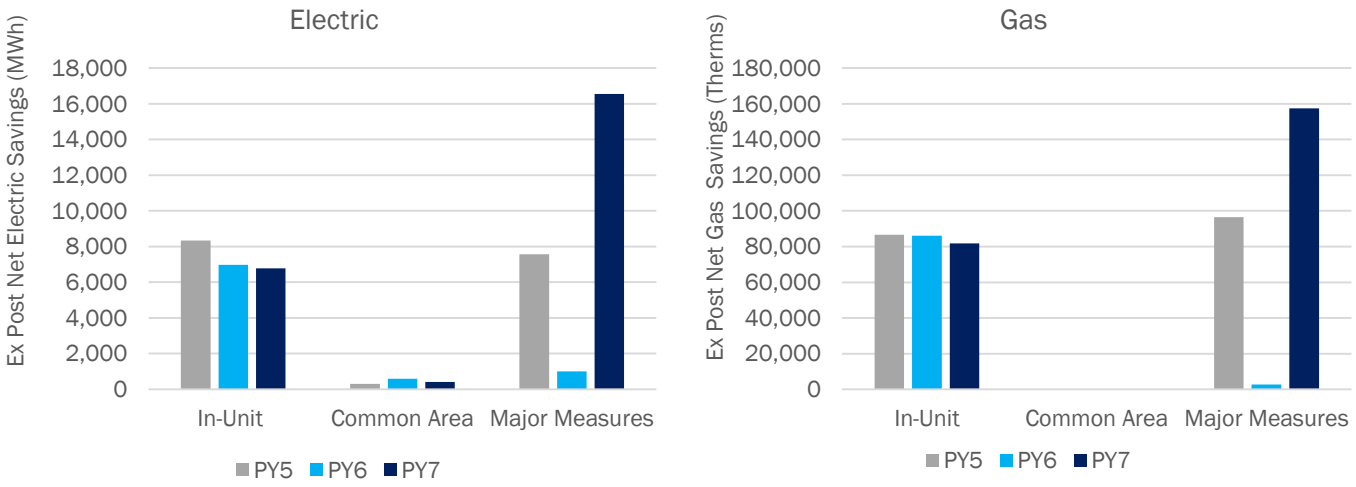


Figure 4 shows savings achieved by project type across both programs, and indicates that the removal of shell or major measures in PY6 drove the decline in savings that year. It also shows that in part through use of the

IPA program as a delivery mechanism for shell or major measures, program sponsors are achieving greater savings through that component than in any of the prior program years.

Figure 4. Savings by Project Type from PY5-PY7 (AIC and IPA Programs)



3.3.3 Participant Satisfaction and Program Engagement

Overall, the evaluation team found that participants are highly satisfied with the program, and will likely participate again with other properties. Similarly, participants report very few issues associated with participation, and those mentioned largely relate to their work with program contractors.

Customer Entry into the Program

Consistent with the program's outreach strategy and findings from the PY6 program evaluation, Table 12 shows that participating property managers most commonly learned about the program through implementer staff (29%) or AIC representatives (19%). Likewise, these results show that very few participants learn about the program from information sources outside of those prioritized by program staff.

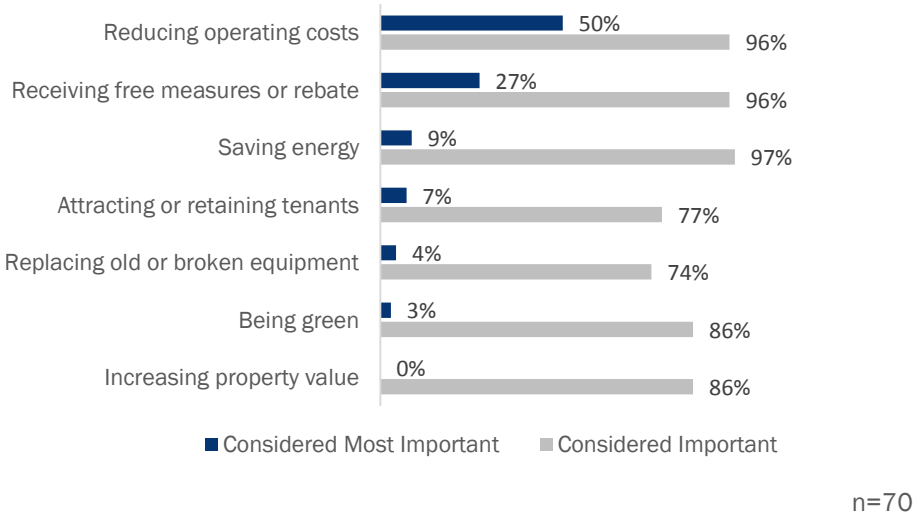
Table 12. How Participants Heard About the Program (Multiple Response)

Ways to learn about the program	Percent (n=70)
Multifamily Program staff (phone call or visit)	29%
AIC	19%
Word-of-mouth / colleague	14%
Mailing/Brochure/Flyer	10%
Contractor	10%
Associations	7%
Participated before	4%
Website	4%
Email	3%

Ways to learn about the program	Percent (n=70)
Don't know	4%

To understand what drives customers to participate in the Multifamily Program, the evaluation team also asked participating property managers/owners whether a number of specific factors were important in motivating them, and followed up with a question about what factor was most important. As shown in Figure 5, although property managers/owners generally consider all of the factors we asked about as important, half of the participating property managers/owners reported that reducing operating costs was the most important in motivating them to participate.

Figure 5. Factors Important in Motivating Participation



n=70

Property Manager Satisfaction and Recommendations for Improvement

The evaluation team also explored property managers' and owners' satisfaction with the program, and asked about challenges in the participation process and suggestions for program improvement. As shown in Table 13, program satisfaction remains high across almost all of aspects asked about.

Table 13. Property Manager Satisfaction with the Program

Satisfaction with ...	Mean Score
Program overall (n=70)	9.4
Quality of the Direct Install and Common Area Work (n=34)	9.3
Performance of the equipment (n=69)	9.2
AIC overall (n=70)	9.1
Quality of Insulation Work (n=35)	8.6

Note: Scale from 0 to 10, where 0 is "Very dissatisfied" and 10 is "Very satisfied."

Further, very few property managers/owners (8 of 70) experienced challenges during their participation in the program. Among those who did report issues with their participation, five out of eight noted problems with their contractors who performed shell measure upgrades. The challenges identified include:

- Issues with the contractor's work, including audit errors, equipment failure, and the contractor leaving behind an uncleaned work site (3)
- Communication issues with the contractor (2)
- Longer project timeline than anticipated (2)
- No follow-up regarding common area upgrades after direct install upgrades in rental units (1)

While these comments are rare, responses to a question about how the Multifamily Program could be improved elicited responses related to the issues identified here. In particular, as shown in Table 14, respondents voiced a desire for greater contractor options and improved communications. However, it is clear that the majority of participants (60%) do not have suggestions for program improvement suggesting that implementation is generally meeting the needs of customers.

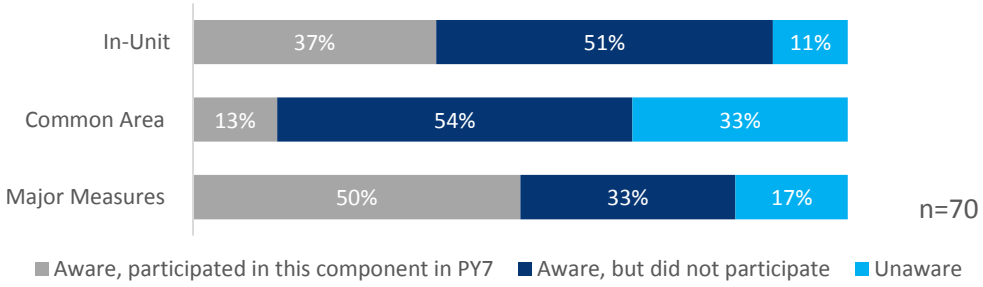
Table 14. Participant Suggestions for Program Improvement (Multiple Response)

Suggestions	Percent (n=70)
None	60%
More education on equipment and rebates	7%
Expand contractor options	7%
Improve installation schedules	6%
Expand measure mix	6%
Improve communication	6%
Other	10%

Awareness of and Participation in Other Program Components

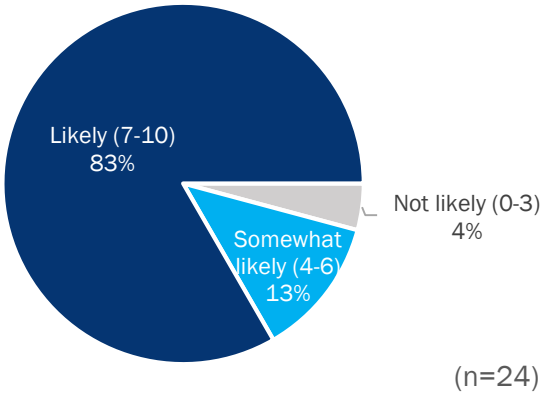
To explore potential participation across program components, the evaluation team asked property managers about their awareness of different program offerings. Figure 6 shows that only a small number of program participants had not heard of direct install upgrades in rental units (11%) or major measure upgrades (17%), however, one-third (33%) is not aware of opportunities to install common area lighting through the program.

Figure 6. Awareness of Multifamily Program Components among Participants



The evaluation team also found the potential for repeat participation at other customer facilities. In particular, one-third (34%) of the participating property managers/owners reported that they manage other multifamily properties that have not previously received Multifamily Program measures. The majority of them indicated that they would likely participate in the Multifamily Program with their other properties in the future (Figure 7).

Figure 7. Participant's Likelihood to Participate at Other Properties



To identify any barriers to participation with other properties, the evaluation team also asked respondents who indicated that they had not participated at all of their multifamily properties over the past five years (24 respondents) why they had not done so. Not all offered an explanation, but those who did indicated that other properties were not eligible (8), that the project was not feasible (3), that the timing did not work (2), or that they only recently acquired the other properties (2). One respondent also reported that the program had no more funds available, and another one could not participate because the company lacked staff to install the measures.

Multifamily Program Awareness among Non-Participating Property Managers

The evaluation team leveraged the non-participating property manager/owner survey to explore awareness of the Multifamily Program among other property managers/owners in AIC service territory. Close to half of those we spoke with (8 of 20) reported that they were aware of the program.[5] These customers said they learned about the program from various sources, including word-of-mouth (3 respondents), a phone call from AIC, a brochure, a contractor, or the internet (mentioned by one respondent each). Only one of them reported that, due to other priorities, they are unlikely to participate in the program next year.

3.4 Program Ally Satisfaction and Engagement

The program implementers worked with nine program allies to provide building shell upgrades through both the AIC and IPA programs. The program allies generated leads, conducted site visits to identify energy savings

[5] In contrast, interviews with program allies suggest that few property managers/owners are aware of the program. As noted in the methodology section of the report, data from the non-participant survey is intended to provide directional information, but may not be representative of the full population.

potential, and completed measure installations and paperwork on behalf of the program. Overall, two of the contractors who participate in both AIC and the IPA programs completed 85% of all PY7 building shell projects.

As noted in the Evaluation Tasks section of the report, the evaluation team interviewed four of nine program allies who represent over 90% of all building shell projects funded by the program. This section summarizes the findings from the four in-depth interviews.

Program Ally Involvement in the Multifamily Sector

- **Prior Involvement in the Multifamily Sector**: Before participating in the program, contractor involvement in the multifamily sector was limited. In particular, all four contractors reported providing very few or no services to the multifamily sector in AIC service territory. While two of the contractors explained they still mainly focus on single-family homes, the other two contractors indicated that the majority of their work in AIC service territory is now related to the Multifamily Program because their business model is geared towards program participation.[6]

- **Location of Program Projects:** The two contractors who completed the majority of Multifamily Program building shell projects served all of AIC's service territory. The other contractors with whom we spoke focused on buildings in the north or south of the service territory.

Program Marketing

- **Participant Identification and Outreach**: Program allies used a mix of strategies to identify prospective program participants. One contractor conducted outreach through industry associations and events, while others used online searches, drive-bys and cold calling. In addition, one contractor indicated taking a more passive approach and waiting for customers to approach them. All contractors suggested that awareness of the Multifamily Program is low among property managers/owners. Nevertheless, they felt that the level of marketing done by the program was appropriate given that allies exhaust any funds for major measure upgrades quickly.

- **Referrals to Other Programs**: All the program allies with whom we spoke indicated that they regularly refer customers to the program's direct install component, as well as other AIC program offerings where appropriate. The other programs that contractors mentioned referring customers to include the All Electric Homes Program and the Home Efficiency Standard Program.

Program Processes

- **Training**: The Program facilitated a kick-off meeting at the beginning of PY7, as well as quarterly meetings to discuss program changes or challenges, which program allies described as useful. Program allies generally felt that they do not need any additional training because the implementer is responsive to any issues that may arise throughout the year.

- **Reservation System:** Allies described the reservation system as useful, fair and easy to navigate, but raised three related issues. One contractor explained that the reservation system resulted in a heavier workload during the first half of the program year and subsequent difficulties in managing staffing

[6] A review of the program database showed that these two contractors completed more than 80% of all Multifamily building shell projects.

thereafter. Another contractor noted that the reservation system led to a slower project turnaround as it took approximately 10-15 days to receive a reservation number. Finally, one contractor indicated that some allies were unable to complete projects for their reserved funds. It is important to note that to avoid potential shortfalls in savings despite a filled project pipeline, CLEAResult has now set an expiration date on reserved funds, which requires program allies to complete projects in a set timeframe.

- **Ease of Customer Participation**: Program allies described program participation for property managers/owners as relatively easy. They reported that property managers were most concerned about accessing tenant units and allocating their staff to accompany program allies working within these units. However, despite these comments, the participating property manager/owner survey did not confirm these concerns.

Program Ally Satisfaction & Recommendations

- **Satisfaction with the Program**: Program allies are satisfied with their participation in the program, and gave satisfaction scores between 8 and 9 on a 10 point scale, where zero is not at all satisfied and 10 is extremely satisfied. In general, they highlighted that communication between program staff and allies had improved in comparison to earlier program years, and that the introduction of the reservation system was generally helpful.

- **Recommendations for Improvement:** Although program allies described the program processes and requirements as easy and appropriate, they raised the following issues and associated recommendations to improve the program:

  - Two contractors indicated that participation would be easier for them if the paperwork was revised to fit more projects on a single form and if digital forms were available.

  - One contractor noted that incentive payments to program allies took approximately six weeks and that faster payment would be helpful.

3.5 Market Characterization

The market characterization study draws upon multiple primary and secondary data sources. The principal source of secondary information is the 2009-2013 American Community Survey (Census data), though we also draw on AIC customer data. The Census data provides information on the number of units in multifamily structures, the year those units were built, as well as important socio-demographic data on building occupants. The principal source of primary data is surveys of participating and non-participating property managers. These surveys provide valuable information about building ownership structure, how buildings are managed, and how key decisions are made. Key findings from the market characterization study, as summarized below, fall into four main categories. The complete market characterization study, with accompanying tables and graphics, can be found in Appendix B.

Number and Location of Multifamily Buildings

- There are approximately 156,103 multifamily housing units in AIC's service area. These units are located in approximately 15,167 buildings, almost 80% of which contain nine or fewer units.

- Renters occupy 150,001 (96.1%) of the 156,103 units in 3+ unit buildings, meaning that very few units within multifamily buildings in AIC's service area are owner occupied.

- The majority of multifamily buildings are located in the very largest urban areas, including Peoria, Bloomington/Normal, Champaign, Springfield, and St. Louis. Not surprisingly, nearly all of the very largest buildings (i.e., those with 20+ units) are also located in these metropolitan areas.
- Buildings eligible to participate in the program (3+ units and market rate) tend to be both located on the outskirts of major metropolitan areas (i.e., the suburbs) and in communities that are more rural. They also tend to be smaller (i.e., contain nine or fewer units).

Characteristics of Units within Multifamily Buildings

- Roughly 75% of multifamily housing units in AIC's service area (here defined as 2+ units)[7] were built after 1959.
- According to participating property managers, electricity is the most common space heating (74%) and water heating (67%) fuel type in participating multifamily buildings within AIC's service area.
- Participating property managers also report that the vast majority of the participating multifamily units within AIC's service area have either room or central air conditioning (85%) and nearly all tenants pay their own electricity (93%) and gas (89%) bills.

Characteristics of Building Occupants

- Occupants of multifamily dwellings are significantly younger than occupants of single-family homes. Compared to single-family dwellers, they are also more transient, more likely to be single or two-person households, and more likely to have incomes below $50,000 annually.

Characteristics of Multifamily Property Management Firms

- Two-thirds (67%) of all multifamily units operated by survey respondents' companies are managed by a small group of companies (12%) —suggesting a high concentration of the market.
- Property managers are most likely to consult with contractors and internal staff when making building improvement decisions. The property owner, however, is the ultimate decision maker in the vast majority of situations, with upfront costs and budget considerations as key inputs.
- Energy efficiency is a strong consideration in the decision-making process most of the time. However, relatively few firms have an energy policy or a staff member responsible for managing energy use.

3.6 Impact Evaluation

The following sections provide participation rates, verified measure counts, and gross and net impacts for PY7.

[7] Multifamily is defined here as 2+ units because this is the way building age is reported within the Census data and the Census data are provided in a manner that does not allow one to create alternative groupings (i.e., more granular data is not available).

3.6.1 Participation and Measure Verification

The evaluation team reviewed the program-tracking database to verify the number of PY7 projects, participants and measures. As part of our review, we checked for errors and overall data quality. Table 15 summarizes program participation in terms of the projects and unique customers found in the database.

Table 15. Summary of Multifamily Program Participation

Project Type	Number of Projects [a]	Number of Customers
In-Unit	454	143
Common Area	69	72
Major Measures	474	123
Total	**997**	**248**

[a] For the In-Unit and Common Area Lighting components, one building complex is considered a project, whereas for the Major Measures component, one building is considered a project.

As noted throughout the report, participating property managers/owners install a variety of measures through the AIC program in tenant units and common areas. They can also install building shell measures, such as air sealing and attic insulation. Table 16 provides an overview of the measures installed based on the team's review of the program-tracking database. These findings indicate that the program's data-tracking process accurately documents projects and associated measures.

Table 16. Summary of Verified Measures

Project Type	Measure	Installed Location	Unit	# of Measures	Verification Rate
In-Unit	CFL – Low	In-Unit Interior	Lamp	38,293	1.0
	Specialty CFL - 14W globe	In-Unit Interior	Lamp	35,009	1.0
	Specialty CFL - 9W candelabra	In-Unit Interior	Lamp	13,325	1.0
	Faucet Aerator (Electric WH)	In-Unit	Aerator	8,426	1.0
	CFL – Medium	In-Unit Interior	Lamp	7,067	1.0
	Programmable Thermostat	In-Unit	PT	5,467	1.0
	Showerhead (Electric WH)	In-Unit	SH	4,528	1.0
	Specialty CFL - 15W reflector	In-Unit Interior	Lamp	3,872	1.0
	Faucet Aerator (Gas WH)	In-Unit	Aerator	3,853	1.0
	Showerhead (Gas WH)	In-Unit	SH	1,703	1.0
	CFL – High	In-Unit Interior	Lamp	548	1.0
Common Area	13 watt CFL	Common Area Interior	Lamp	727	1.0
	Specialty CFL - 15W reflector	Common Area Interior	Lamp	518	1.0
	Specialty CFL - 9W candelabra	Common Area Interior	Lamp	371	1.0
	20 watt CFL	Common Area Interior	Lamp	115	1.0
	23 watt CFL	Common Area Interior	Lamp	98	1.0
	Specialty CFL - 14W globe	Common Area Interior	Lamp	86	1.0
	20 watt CFL	Common Area Exterior	Lamp	60	1.0
	Specialty CFL - 15W reflector	Common Area Exterior	Lamp	39	1.0
	23 watt CFL	Common Area Exterior	Lamp	19	1.0

Project Type	Measure	Installed Location	Unit	# of Measures	Verification Rate
	13 watt CFL	Common Area Exterior	Lamp	14	1.0
Major Measures	Air Sealing	N/A	CFM	2,391,744	1.0
	Attic Insulation	N/A	SqFt	1,464,787	1.0
			Total	3,980,669	**1.0**

Note: Verification rate = number of verified measures ÷ number of reported measures.

3.6.2 Ex Post Gross Impact Results

Overall, total ex post first-year annual gross energy and demand impacts for the PY7 Multifamily Program are 9,232 MWh, 1.88 MW, and 282,248 therms. In addition, the gross realization rates are 98% for electric kWh savings, 115% for demand savings, and 89% for gas savings. Table 17 presents the first year annual ex post gross impacts and the calculated gross realization rate.

Overall, the program achieved similar levels of electric energy savings as the PY6 Multifamily Program, but doubled the gas savings. Further, the program included an order of magnitude increase in the number of major measures projects in PY7 over PY6 (474 versus 38, respectively). Since these measures garner gas savings, the increase seen this year is not surprising.

Table 17. PY7 Multifamily First-Year Annual Gross Impacts, by Project Type

Project Type	Ex Ante Gross Impacts			Ex Post Gross Impacts[a]			Gross Realization Rate		
	MWh	MW	Therms	MWh	MW	Therms	MWh	MW	Therms
In-Unit	8,074	0.76	83,803	7,558	0.79	84,172	0.94	1.04	1.00
Common Area	421	0.06	N/A	440	0.06	N/A	1.04	0.97	n/a
Major Measures	958	0.82	234,570	1,234	1.04	198,076	1.29	1.28	0.84
Total	**9,453**	**1.63**	**318,372**	**9,232**	**1.88**	**282,248**	**0.98**	**1.15**	**0.89**

[a] The team calculated the ex post gross impacts based on application of the Illinois Statewide TRM V3.0.
Note: Numbers may not total due to rounding.

The following tables detail gross impacts by measure for the in-unit, common area lighting, and major measure components. As illustrated, a couple of program measures make large contributions to program savings. As a result, differences within these measures can affect the program's savings significantly. Within the Multifamily Program, lighting measures account for 46% of the kWh program savings, while shower heads account for 14%, and programmable thermostats account for 24%.

Table 18. PY7 Multifamily First-Year Annual Gross Impacts, by Project Type and Measure

Component	Measure Category	Ex Ante Gross Impacts			Ex Post Gross Impacts			Gross Realization Rate[a]		
		kWh	kW	Therms	kWh	kW	Therms	kWh	kW	Therms
In-Unit	Specialty CFLs	2,629,978	264.9	n/a	2,110,432	265.0	n/a	0.80	1.00	n/a
	Programmable Thermostat	2,290,734	n/a	47,435	2,293,162	n/a	47,756	1.00	n/a	1.01
	Standard CFLs	1,331,793	138.6	n/a	1,331,759	138.8	n/a	1.00	1.00	n/a
	Shower Head	1,278,526	117.7	23,961	1,276,770	143.1	23,965	1.00	1.22	1.00
	Faucet Aerator	543,056	239.0	12,407	545,555	240.0	12,450	1.00	1.00	1.00
Common Area (Interior)	Specialty CFLs	237,313	32.2	n/a	247,984	32.2	n/a	1.04	1.00	n/a
	Standard CFLs	174,477	23.6	n/a	182,326	23.6	n/a	1.04	1.00	n/a
Common Area (Exterior)	Standard CFLs	5,891	2.4	n/a	5,891	0.6	n/a	1.00	0.25	n/a
	Specialty CFLs	3,448	0.3	n/a	3,448	0.3	n/a	1.00	1.00	n/a
Major Measures	Air Sealing	850,598	746.9	176,076	1,082,510	936.3	147,644	1.27	1.25	0.84
	Attic Insulation	106,957	69.2	58,494	151,907	104.5	50,433	1.42	1.51	0.86
Total		**9,452,771**	**1,634.8**	**318,372**	**9,231,743**	**1,884.5**	**282,248**	**0.98**	**1.15**	**0.89**

[a] Gross Realization Rate = ex post gross value ÷ ex ante gross value.

Note: Numbers may not total due to rounding.

There are a number of reasons for the differences between ex post and ex ante gross savings. To ensure that the team fully captured the reasons for any key discrepancies, we spoke with CLEAResult about potential reasons for the differences identified in our analysis and summarize them in Table 19. We describe the basis for measure-level realization rates in more detail following the table.

Table 19. Explanation of Gross Realization Rate Differences, by Measure

Project Type	Measure	Gross Realization Rate			Source of Discrepancy				
		kWh RR	kW RR	Therms RR	CDD,HDD, FLH	Pre & Post R-Value	Waste Heat Factor	HVAC Efficiency	Other (Specified)
In-Unit	Specialty CFLs	0.80	1.00	N/A			X		- Hours of Use
	Programmable Thermostat	1.00	N/A	1.01					- Deemed Heating Consumption
	Standard CFLs	1.00	1.00	N/A					
	Shower Head	1.00	1.22	1.00					- Hours of Use
	Faucet Aerator	1.00	1.00	1.00					
Common Area (Interior)	Specialty CFLs	1.04	1.00	N/A			X		
	Standard CFLs	1.04	1.00	N/A			X		
Common Area (Exterior)	Standard CFLs	1.00	0.25	N/A					- Coincidence Factor
	Specialty CFLs	1.00	1.00	N/A					
Major Measures	Air Sealing	1.27	1.25	0.84	X			X	- Latent Multiplier
	Attic Insulation	1.42	1.51	0.86	X	X		X	

We describe the key differences between ex ante and ex post savings calculations for specific measures in detail below. Note that while certain inputs may increase savings, others decrease savings. The combination of all inputs results in the overall realization rate for a specific measure.

- In-Unit Specialty CFLs
  - **Waste Heat Factors:** The ex ante energy savings included the waste heat factor penalty for all interior common area CFLs and interior in-unit specialty CFLs, which lowered savings. However, consistent with past evaluations, and per agreements between ICC staff and AIC regarding the treatment of waste heat factors, we did not include waste heat factor penalties for lighting in the calculation of ex post savings. Therefore, ex post savings were higher than ex ante.
  - **Hours of Use:** Ex ante savings applied hours of use (1,240 hrs. /yr.) for in-unit specialty globe CFLs based on the hours of use provided in an older version of the IL TRM V3.0.[8] Ex post savings applied the hours of use (847 hrs. /yr.) from a more recent version of the IL TRM V3.0. As a result, ex ante per-unit savings for in-unit specialty globe CFLs overestimate savings by 29%. Specialty globe CFLs account for 20% of the program's total reported energy savings and therefore play a larger role in the overall program realization rate.

[8] The ex ante hours of use (1,240 hours per year) for specialty globe CFLs is from the IL TRM dated January 3, 2014. Ex post hours of use (847 hours per year) is from the IL TRM dated February 24, 2014.

- **Shower Heads:**
  - **Hours of Use:** The ex ante demand savings for low-flow shower heads include the hours of use for single family homes (302 hrs./yr.) instead of the hours of use for multifamily dwellings (248 hrs./yr.). For this reason, the per-measure ex ante demand savings are 22% lower than the per-measure ex post demand savings. Demand savings for low-flow shower heads accounts for 7% of the program's total reported kW savings, and therefore has a low impact on the program's overall performance.
- **Exterior Common Area Standard CFLs:**
  - **Coincidence Factor:** Ex ante demand savings for standard CFLs in common area exterior locations incorrectly includes a coincidence factor that is representative of interior installation (CF 0.75). Ex post savings calculations apply a coincidence factor that is specific for exterior installation (CF 0.184). For this reason, the per-measure ex ante demand savings are 75% greater than the per-measure ex post demand savings. However, demand savings for standard common area CFLs in exterior locations accounts for 0.1% of the program's total reported demand savings and therefore have little impact on the program's overall performance.
- **Air Sealing and Insulations:**
  - **CDD, HDD, and Full Load Cooling Hours (FLHclg):** Ex ante savings calculations for the major measures (i.e., air sealing and attic insulation) used the same CDD, HDD, and FLHclg values for all projects regardless of project location while the ex post savings used the actual location. Inputs for Springfield were not representative of the population in PY7, as more customers were in warmer areas. As a result, the per-unit savings for shell measures decreased by an average of 4% due to the change in HDDs (i.e., fewer HDD) and increased by an average of 8% due to the changes in CDDs.
  - **HVAC Cooling Efficiency:** All ex ante savings from major measure projects applied a weighted average cooling efficiency of 11.05 SEER. When available, the evaluation team used the actual equipment efficiencies provided in the "Incentive Application" tab within the program-tracking database to calculate ex post savings. When the actual efficiency was unknown, or outside reasonable range, we applied a 10 SEER for those manufactured prior to 2006 and 13 SEER for those manufactured after 2006. If the actual efficiency and manufactured year was unknown, we applied an average SEER value using the actual SEER data from the "Incentive Application" tab for those with central cooling (based on 206 participants). For comparison purposes, the average SEER using this approach yields a 9.3 SEER (16% less than the applied ex ante SEER value). As a result, the per-unit ex post savings for major measures increases by an average of 25%.
  - **HVAC Heating Efficiency:** All ex ante savings from major measure projects applied a heating efficiency of 0.70 AFUE for participants with gas heating. When available, the evaluation team used the actual equipment efficiencies provided in the "Incentive Application" tab within the program-tracking database to calculate ex post savings. When the actual efficiency was unknown, or outside reasonable range, we applied an average AFUE value using the actual AFUE data from the "Incentive Application" tab for those with furnaces (based on 354 participants). For comparison purposes, the average AFUE using this approach yields a 0.82 AFUE (17 % greater than the applied ex ante AFUE value). As a result, the per-unit ex post savings for major measures decreases by an average of 12%.

- **Latent Multiplier:** The latent multiplier accounts for latent cooling demand for air sealing measures and is dependent on project location. The ex ante savings calculations use the same latent multiplier for all projects regardless of project location (the value for Springfield). The ex post calculations applied the latent multiplier using the actual project location. The per-unit savings for air sealing measures decreased by an average of 3% when using the actual project location.

- **Pre and Post R-values:** For attic insulation measures, ex ante savings calculations assign the same pre (R-12) and post (R-50) R-values for all participants irrespective of the actual pre-existing and installed R-values. Ex post savings used the actual pre and post R-values included within the database to calculate savings per participant. Within the ex post calculations, there is a wider delta R-value, leading to larger savings. Specifically, the average pre R-value using actual data is R-9 and the actual post R-value is R-49 for a delta R-value of 40. The per-unit kWh savings for attic insulation measures increased by an average of 3% and by 7% for per-unit therm savings when using actual pre and post R-value data.

3.6.3 Net Impacts

Applying the NTGR values from Table 9, total net energy and demand impacts for the PY7 Multifamily Program are 8,306 MWh, 1.72 MW, and 239,163 therms. The net realization rate is 98% for electric savings, 115% for demand savings, and 89% for gas savings, as shown in Table 20.

Table 20. Multifamily Program Net Impacts by Program Component

Component	Ex Ante Net Impacts			Ex Post Net Impacts		
	MWh	MW	Therms	MWh	MW	Therms
In-Unit	7,199	0.66	81,381	6,782	0.69	81,747
Common Area Lighting	337	0.05	n/a	352	0.05	n/a
Major Measures	911	0.78	186,492	1,173	0.99	157,416
Total	**8,447**	**1.49**	**267,873**	**8,306**	**1.72**	**239,163**
			Net Realization Rate [a]	*0.98*	*1.15*	*0.89*

[a] Net Realization Rate = ex post net value ÷ ex ante net value.

The *ex ante* and *ex post* net savings calculations applied the same NTGRs (Table 9) and only differ due to the gross savings adjustments explained above. Table 21 provides net impacts by measure type.

Table 21. PY7 Multifamily Program Net Impacts by Project Type and Measure

Project Type	Measure	Ex Ante Net Impacts			Ex Post Net Impacts			Net Realization Rate[a]		
		kWh	kW	Therms	kWh	kW	Therms	kWh	kW	Therms
In-Unit	Programmable Thermostat	2,290,734	n/a	47,435	2,293,162	n/a	47,756	1.00	n/a	1.01
	Specialty CFLs	2,130,282	214.6	n/a	1,709,450	214.7	n/a	0.80	1.00	n/a
	Shower Head	1,189,029	109.4	22,284	1,187,396	133.1	22,288	1.00	1.22	1.00
	Standard CFLs	1,078,752	112.2	n/a	1,078,725	112.4	n/a	1.00	1.00	n/a
	Faucet Aerator	510,472	224.6	11,662	512,822	225.6	11,703	1.00	1.00	1.00
Common Area Lighting (Interior)	Specialty CFLs	189,850	25.7	n/a	198,387	25.7	n/a	1.04	1.00	n/a
	Standard CFLs	139,581	18.9	n/a	145,860	18.9	n/a	1.04	1.00	n/a
Common Area Lighting (Exterior)	Standard CFLs	4,713	1.9	n/a	4,712	0.5	n/a	1.00	0.25	n/a
	Specialty CFLs	2,759	0.3	n/a	2,759	0.3	n/a	1.00	1.00	n/a
Major Measures	Air Sealing	816,574	717.0	142,621	1,039,210	898.8	119,591	1.27	1.25	0.84
	Attic Insulation	94,122	60.9	43,870	133,678	92.0	37,825	1.42	1.51	0.86
Total		**8,446,870**	**1,485.6**	**267,873**	**8,306,161**	**1,722.0**	**239,163**	**0.98**	**1.16**	**0.89**

[a] Net Realization Rate = ex post net value ÷ ex ante net value.
Note: Numbers may not total due to rounding.

4. Key Findings and Recommendations

PY7 evaluation activities addressed both impact and process issues. The impact work consisted of an analysis of the program database, related engineering work, and the application of NTGRs as approved through the SAG. The process work consisted of surveying both participating (70) and nonparticipating (20) property managers, program and implementation staff, and key trade allies. Finally, based largely on Census data and AIC customer data, the evaluation team completed a market characterization study. From these evaluation activities, we highlight the following findings and recommendations.

Multifamily Market Characterization

- There are approximately 156,103 multifamily housing units in AIC's service area. These units are located in approximately 15,167 buildings, almost 80% of which contain nine or fewer units.
- Eligible multifamily properties (i.e., 3+ units and market rate) tend to be located on the outskirts of major metropolitan areas (i.e., the suburbs) or in communities that are more rural. They also tend to be smaller (i.e., contain 9 or few units).
- Occupants of multifamily buildings, compared to their single-family counterparts, tend to be younger, more transient, more likely to be single- or two-person households, and have lower incomes.

Program Implementation

A number of key changes took place in PY7 that had positive impacts on the program. The program began to cover the full cost of select common area lighting measures, brought a QA/QC inspector on board, and systematically tracked budget expenditures and associated trade ally activities (particularly for major measures). In addition, research with participants and non-participants provided insight into program delivery and outreach.

- **Key Finding #1**: Participating property managers are highly satisfied with the program and those with additional properties are likely to participate in the future. Contractors also appear to be happy with the program, noting that communications between program staff and trade allies have improved over time.
  - **Recommendation**: The management of multifamily properties appears to be highly concentrated, meaning a relatively small percentage of property management firms oversee a high percentage of all multifamily buildings. As a result, it is imperative to ensure that current participants have positive program experiences. A consistent commitment to QA/QC and a timely resolution of outstanding issues/problems should continue to be used to ensure current participants continue to participate in the future.
- **Key Finding #2**: The vast majority of participating property managers are aware of all three program components (i.e., in-unit direct install, common area direct install, major measures), suggesting that all parties involved in the multifamily program are doing a good job making sure participating property managers are aware of all program possibilities. About one-half of nonparticipating property managers are aware of the program. However, it is possible that awareness is lower as program allies suggest that few property managers and owners are aware of the program.

- **Recommendation**: Continue to emphasize that all parties involved in the multifamily program promote all three program components. Awareness of the various program components, among participating property managers, appears to be high. Therefore, the future goal is to maintain present awareness levels by continuing to focus on cross-component marketing.

- **Recommendation**: Additional outreach, across multiple communication channels, may be needed to increase awareness among nonparticipating property managers. Industry events and associations, including associated publications, may be a good way of reaching these individuals. Outreach should also include contractors and equipment manufacturers as both groups are common sources of information for nonparticipating property managers. Communications should emphasize the program's ability to help property managers reduce operating costs.

- **Key Finding #3**: Building owners plays a critical role in approving building and efficiency upgrades and are particularly motivated to reduce building operating costs.

  - **Recommendation:** It is important to develop strategies to engage building owners, as the central decision maker, in conversations about potential energy efficiency projects. Associated with this, property managers should be provided with information that will support them in proposing energy efficiency upgrades to building owners.

A. Appendix - Market Characterization: Detailed Findings

Provided under a separate cover.

B. Appendix - Data Collection Instruments

Participating Property Manager Sı

Non-Participant Property Manager Sı

Program Ally IDI Guide

C. Appendix - Engineering Analysis Algorithms

In PY7, the impact evaluation efforts estimated gross impact savings for the Residential Multifamily Program by applying savings algorithms from the Illinois Statewide Technical Reference Manual (TRM) V3.0 (2014)[9] to the information in the program-tracking database.

We present the algorithms used to calculate all evaluation program savings below, along with all input variables.

Lighting Algorithms

Compact Fluorescent Lighting (CFLs)

The evaluation team determined ex post lighting savings using the algorithms below.

Equation 1. CFL Algorithms

Energy Savings: $\Delta kWh = ((WattsBase - WattsEE) / 1{,}000) * ISR * Hours * WHF_e$

Demand Savings: $\Delta kW = ((WattsBase - WattsEE) / 1{,}000) * ISR * WHF_d * CF$

Where:

WattsBase = Wattage of existing equipment

Table 22. Baseline Wattages for Lighting Measures

Measure	EISA Adjusted[a]	Baseline Wattage	Resource
Standard Spiral CFL – 13W	Yes	43	IL TRM V3.0
Standard Spiral CFL – 20W	Yes	53	IL TRM V3.0
Standard Spiral CFL – 23W	Yes	72	IL TRM V3.0
Specialty CFL – 9W Candelabra	No	40	IL TRM V3.0
Specialty CFL – 14W Globe	No	60	IL TRM V3.0
Specialty CFL – 15W Reflector	No	65	IL TRM V3.0

[a] The EISA schedule requires baseline adjustments to measures with incandescent baseline wattages of 100W (as of June 2012), 75W (as of June 2013), and 60W (as of June 2014).

WattsEE = Wattage of installed equipment (actual wattage used)

ISR = In-service rate or the percentage of units rebated that get installed = 96.9%[10]

Hours = Annual operating hours (see Table 23)

Table 23. Annual Hours of Use for Lighting Measures

Installation Location	Measure	Hours
	Standard Spiral CFL – 13W	5,950

[9] Illinois Statewide Technical Reference Manual for Energy Efficiency V3.0. Effective June 1, 2014. February 24, 2014.

[10] Per value in IL TRM V3.0.

Installation Location	Measure	Hours
Common Area Interior	Standard Spiral CFL – 20W	
	Standard Spiral CFL – 23W	
	Specialty CFL – 9W Candelabra	
	Specialty CFL – 14W Globe	
	Specialty CFL – 15W Reflector	
Common Area Exterior	Standard Spiral CFL – 13W	1,825
	Standard Spiral CFL – 20W	
	Standard Spiral CFL – 23W	
	Specialty CFL – 15W Reflector	1,643
In-Unit Interior	Standard Spiral CFL – 13W	938
	Standard Spiral CFL – 20W	
	Standard Spiral CFL – 23W	
	Specialty CFL – 9W Candelabra	1,328
	Specialty CFL – 14W Globe	847
	Specialty CFL – 15W Reflector	938

WHF_e = Waste heat factor for energy (accounts for cooling savings from efficient lighting)

WHF_d = Waste heat factor for demand (accounts for cooling savings from efficient lighting)

Table 24. Energy and Demand Waste Heat Factors

Installation Location	WHF_e	WHF_d
Interior	1.04	1.07
Exterior	1.00	1.00

CF = Summer Peak Coincidence Factor

Table 25. Coincidence Factors for Lighting Measures

Installation Location	Measure	CF
Common Area Interior	Standard Spiral CFL – 13W	0.75
	Standard Spiral CFL – 20W	
	Standard Spiral CFL – 23W	
	Specialty CFL – 9W Candelabra	
	Specialty CFL – 14W Globe	
	Specialty CFL – 15W Reflector	
Common Area Exterior	Standard Spiral CFL – 13W	0.184
	Standard Spiral CFL – 20W	
	Standard Spiral CFL – 23W	
	Specialty CFL – 15W Reflector	
In-Unit Interior	Standard Spiral CFL – 13W	0.095
	Standard Spiral CFL – 20W	
	Standard Spiral CFL – 23W	

Installation Location	Measure	CF
	Specialty CFL – 9W Candelabra	0.122
	Specialty CFL – 14W Globe	0.116
	Specialty CFL – 15W Reflector	0.095

Lighting Measures Heating Penalty

The evaluation team determined heating penalties using the algorithms below. Based on the agreement between the ICC and AIC, we do not include heating penalties in the ex post energy savings, but will include this in the data for the PY7 cost-effectiveness analysis.

In-Unit Heating Penalties

The evaluation team determined heating penalties for different heating fuel types for lighting installed in multifamily units using the algorithms below.

Equation 2. Heating Penalty Algorithms for In-Unit Lighting

Electric Heating Penalty: $\Delta kWh = -(((WattsBase - WattsEE) / 1000) * ISR * Hours * HF) / \eta Heat$

Gas Heating Penalty: $\Delta therms = -(((WattsBase - WattsEE) / 1000) * ISR * Hours * HF * 0.03412) / \eta Heat$

Where:

WattsBase = Wattage of existing equipment (see Table 22)

WattsEE = Wattage of installed equipment

ISR = In-service rate or the percentage of units rebated that get installed = 96.9%

Hours = Annual operating hours (see Table 23)

HF = Heating factor = 0.49

ηHeat = Efficiency of heating equipment (assumed COP 2.0 for heat pumps, 1.0 COP for electric resistance heating, and AFUE 0.7 for gas heating per IL TRM V3.0)

Table 26 summarizes the heating penalties for the six lighting measures installed in multifamily units offered through the program by heating equipment type.

Table 26. Heating Fuel Penalties for In-Unit (Interior) Lighting

Heating Equipment	Measure	ΔkWh	Δtherms
Heat Pump (htg only)	Standard Spiral CFL – 13W	-6.68	n/a
	Standard Spiral CFL – 20W	-7.35	n/a
	Standard Spiral CFL – 23W	-10.91	n/a
	Specialty CFL – 9W Candelabra	-9.77	n/a
	Specialty CFL – 14W Globe	-9.25	n/a
	Specialty CFL – 15W Reflector	-11.13	n/a
Electric Resistance	Standard Spiral CFL – 13W	-13.36	n/a
	Standard Spiral CFL – 20W	-14.70	n/a
	Standard Spiral CFL – 23W	-21.82	n/a
	Specialty CFL – 9W Candelabra	-19.55	n/a
	Specialty CFL – 14W Globe	-18.50	n/a
	Specialty CFL – 15W Reflector	-22.27	n/a
Gas Heating	Standard Spiral CFL – 13W	n/a	-0.65
	Standard Spiral CFL – 20W	n/a	-0.72
	Standard Spiral CFL – 23W	n/a	-1.06
	Specialty CFL – 9W Candelabra	n/a	-0.95
	Specialty CFL – 14W Globe	n/a	-0.90
	Specialty CFL – 15W Reflector	n/a	-1.09

Common Area Lighting Heating Penalties

The fuel type for interior common areas is unknown. The IL TRM assumes gas heating when the heating fuel type is unknown. The evaluation team determined gas heating penalties for lighting installed in common areas using the algorithms below.

Equation 3. Heating Penalty Algorithms for Common Area Lighting

*Gas Heating Penalty: Δtherms = - (((WattsBase – WattsEE) / 1000) * ISR * Hours * HF * 0.03412) / ηHeat*

Where:

WattsBase = Wattage of existing equipment (see Table 22)

WattsEE = Wattage of installed equipment

ISR = In-service rate or the percentage of units rebated that get installed = 96.9%

Hours = Annual operating hours (see Table 23)

HF = Heating factor = 0.49

ηHeat = Efficiency of heating equipment (assumed AFUE 0.7 for gas heating per IL TRM V3.0)

Table 27 summarizes the heating penalties for the lighting measures installed in common areas offered through the program.

Table 27. Heating Fuel Penalties for Common Area (Interior) Lighting

Heating Equipment	Measure	Δtherms
Gas Heating[a]	Standard Spiral CFL – 13W	-4.13
	Standard Spiral CFL – 20W	-4.54
	Standard Spiral CFL – 23W	-6.75
	Specialty CFL – 9W Candelabra	-4.27
	Specialty CFL – 14W Globe	-6.33
	Specialty CFL – 15W Reflector	-6.89

[a] IL TRM assumes gas heating when heating fuel type is unknown. All common area lighting had an unknown heating type and so applied gas heating.

Water Heating Conservation Measure Algorithms

The evaluation team determined ex post water heating conservation measure savings using the algorithms below.

Equation 4. Low-flow Showerhead Algorithms

*Energy Savings: ΔkWh = %ElectricDHW * ((GPM_base * L_base – GPM_low * L_low) * Household * SPCD * 365.25 / SPH) * EPG_electric * ISR*

*Demand Savings: ΔkW = ΔkWh/ Hours * CF*

*Therm Savings: ΔTherms = %FossilDHW * ((GPM_base * L_base – GPM_low * L_low) * Household * SPCD * 365.25 / SPH) * EPG_gas * ISR*

Equation 5. Low-flow Faucet Aerator Algorithms

*Energy Savings: ΔkWh = %ElectricDHW * ((GPM_base * L_base – GPM_low * L_low) * Household * 365.25 * DF / FPH) * EPG_electric * ISR*

*Demand Savings: ΔkW = ΔkWh/ Hours * CF*

*Therm Savings: ΔTherms = %FossilDHW * ((GPM_base * L_base – GPM_low * L_low) * Household * 365.25 *DF / FPH) * EPG_gas * ISR*

Where:

%ElectricDHW = 100% if electric water heater, 0% if gas water heater

%GasDHW = 100% if gas water heater, 0% if electric water heater

GPM_base = Flow rate of the baseline showerhead or faucet aerator (see Table 28)

GPM_low = As-used flow rate of the low-flow showerhead or faucet aerator (see Table 28)

Table 28. GPM for Water Heating Measures

Measure	GPM_base	GPM_low
Faucet Aerator	1.39	0.94
Shower Head	2.67	1.75

L_base = Average baseline length faucet use per capita for all faucets in minutes

Table 29. L_base for Water Heating Measures

Measure	Minutes
Faucet Aerator	6.9
Shower Head	7.8

L_low = Average retrofit length faucet use per capita for all faucets in minutes (same as L_base)

Household = Average number of people in household for multifamily units = 2.10

SPCD = Showers per capita per day = 0.60

SPH = Shower heads per household for multifamily units = 1.30

DF = Drain factor = 0.795 (unknown location)

FPH = Faucets per household for multifamily units = 2.50

EPG_electric = Energy per gallon of hot water supplied by electric (see Table 30)

EPG_gas = Energy per gallon of hot water supplied by gas (see Table 30)

Table 30. EPG for Water Heating Measures

Measure	EPG_electric	EPG_gas
Faucet Aerator	0.0919	0.0046
Shower Head	0.1168	0.0058

ISR = In-service rate for multifamily units

Table 31. ISR for Water Heating Measures

Measure	ISR
Faucet Aerator[a]	93%
Shower Head	95%

[a] Unknown location of installation. Average in-service rate for kitchen and bathroom

Hours = Annual electric DHW recovery hours

Table 32. Hours for Water Heating Measures

Measure	Hours
Faucet Aerator[a]	50
Shower Head	248

[a] Hours of use for multifamily with unknown location

CF = Coincidence factor for electric load reduction

Table 33. CF for Water Heating Measures

Measure	CF
Faucet Aerator	0.0220
Shower Head	0.0278

Programmable Thermostat Algorithms

The evaluation team calculated the ex post programmable thermostat savings using the algorithms below.

Equation 6. Programmable Thermostat Algorithms

$$\Delta kWh\_heating\ (electric\ heat) = \%ElectricHeat * Elec\_Heating\_Consumption * Heating\_Reduction * HF * Eff\_ISR$$

$$Gas\ Savings\ (gas\ heat):\ \Delta Therms = \%FossilHeat * Gas\_Heating\_Consumption * Heating\_Reduction * HF * Eff\_ISR$$

$$\Delta kWh\_heating\ (gas\ heat\ furnace\ fan\ run\ time\ reduction) = \Delta Therms * F_e * 29.3$$

Where:

%ElectricHeat = 100% if electric space heating fuel, 0% if gas space heating fuel

%FossilHeat = 100% if gas space heating fuel, 0% if electric space heating fuel

Elec_Heating_Consumption = Estimated annual household heating consumption for electrically heated homes (applied per participant based on project location)

Table 34. Electric Heating Consumption by Climate Zone

Climate Zone	kWh	
	Electric Resistance	Heat Pump
1 (Rockford)	21,741	12,789
2 (Chicago)	20,771	12,218
3 (Springfield)	17,789	10,464
4 (Belleville)	13,722	8,072
5 (Marion)	13,966	8,215

Gas_Heating_Consumption = Estimated annual household heating consumption for gas-heated homes (applied per participant based on project location)

Table 35. Gas Heating Consumption by Climate Zone

Climate Zone	Therms
1 (Rockford)	1,052
2 (Chicago)	1,005
3 (Springfield)	861
4 (Belleville)	664
5 (Marion)	676

Heating_Reduction = Reduction in heating energy consumption due to installing programmable thermostat = 6.2%

HF = Household factor to adjust heating consumption for multifamily homes = 65%

Eff_ISR = Percentage of thermostats installed and effectively programmed = 100% (Direct Install)

F_e = Furnace fan energy consumption as a percentage of annual fuel consumption = 3.14%

Air Sealing Algorithms

The evaluation determined ex post air sealing savings using the algorithms below. Since the program-tracking database does not include air sealing for those with electric heating, we did not include air sealing savings algorithms for electric heating.

Equation 7. Air Sealing Algorithms

$$\Delta kWh\_cooling = [((CFM50\_existing - CFM50\_new)/N\_cool) * 60 * 24 * CDD * DUA * 0.018) / (1000 * \eta Cool)] * LM$$

$$Demand\ Savings: \Delta kW = (\Delta kWh\_cooling / FLH\_cooling) * CF$$

$$Gas\ Savings\ (gas\ heat): \Delta Therms = (((CFM50\_existing - CFM50\_new)/N\_heat) * 60 * 24 * HDD * 0.018) / (\eta Heat * 100{,}000)$$

$$\Delta kWh\_heating\ (gas\ heat\ furnace\ fan\ run\ time\ reduction) = \Delta Therms * F_e * 29.3$$

Where:

CFM_existing = Infiltration at 50 Pascals as measured by blower door before air sealing

CFM_new = Infiltration at 50 Pascals as measured by blower door after air sealing

N_Cool = Conversion factor from leakage at 50 Pascal to leakage at natural conditions = 18.5[11]

CDD = Cooling Degree Days (applied per participant based on location)

Table 36. Cooling Degree Days by Climate Zone

Climate Zone	CDD 65
1 (Rockford)	820
2 (Chicago)	842
3 (Springfield)	1,108
4 (Belleville)	1,570
5 (Marion)	1,370

DUA = Discretionary Use Adjustment = 0.75

ηCool = Seasonal Energy Efficiency Ratio (SEER) of cooling system (used actual from database when available)

[11] Assumed CZ2 Normal Exposure.

Table 37. Cooling Efficiency Assumptions for Air Sealing

Information Provided	Number of Households (N= 388)	Manufactured Year	ηCool (SEER)
Actual SEER	193	n/a	Actual
Manufactured Year	177	Before 2006	10.0
Manufactured Year	8	After 2006	13.0
None[a]	10	n/a	8.4

[a] For those where the actual SEER and manufactured year is unknown we determined the average existing cooling efficiency using the actual SEER for all participants with central cooling (n=206).

LM = Latent Multiplier to account for latent cooling demand (applied per participant based on project location)

Table 38. Latent Multiplier by Climate Zone

Climate Zone	Latent Multiplier
1 (Rockford)	8.5
2 (Chicago)	6.2
3 (Springfield)	6.6
4 (Belleville)	5.8
5 (Marion)	6.6

N_heat = Conversion factor from leakage at 50 Pascal to leakage at natural conditions = 15.75[12]

HDD = Heating Degree Days (applied per participant based on project location)

Table 39. Heating Degree Days by Climate Zone

Climate Zone	HDD 65
1 (Rockford)	6,569
2 (Chicago)	6,339
3 (Springfield)	5,497
4 (Belleville)	4,379
5 (Marion)	4,476

ηHeat = Efficiency of heating system (used actual from database when available)

Table 40. Gas Heating Efficiency Assumptions for Air Sealing

Information Provided	Number of Households (N= 474)	ηHeat (AFUE)
Actual AFUE	419	Actual
None[a]	55	0.82

[12] Applied average of 1, 1.5, 2, and 3-story homes for homes with normal exposure in CZ2.

[a] For those where the actual AFUE and manufactured year is unknown we determined the average existing heating efficiency using the actual AFUE for all participants with furnaces (n=354).

FLH_cooling = Full Load Hours of air conditioning (applied per participant based on project location)

Table 41. FLH_cooling by Climate Zone

Climate Zone	FLH_cooling
1 (Rockford)	467
2 (Chicago)	506
3 (Springfield)	663
4 (Belleville)	940
5 (Marion)	820

CF = Coincidence Factor = 0.68

F_e = Furnace fan energy consumption as a percentage of annual fuel consumption = 3.14%

Attic Insulation Algorithms

The evaluation determined ex post attic insulation savings using the algorithms below. Since the program-tracking database does not include attic insulation for those with electric heating, we did not include attic insulation savings algorithms for electric heating.

Equation 8. Attic Insulation Algorithms

$$\Delta kWh\_cooling = (((1/R\_old - 1/R\_new) * A\_attic * (1\text{-}Framing\_factor)) * 24 * CDD * DUA) / (1000 * \eta Cool)$$

$$Demand\ Savings: \Delta kW = (\Delta kWh\_cooling / FLH\_cooling) * CF$$

$$Gas\ Savings\ (gas\ heat): \Delta Therms = (((1/R\_old - 1/R\_new) * A\_attic * (1\text{-}Framing\_factor) * ADJattic) * 24 * HDD) / (\eta Heat * 100{,}067\ Btu/therm)$$

$$\Delta kWh\_heating\ (gas\ heat\ furnace\ fan\ run\ time\ reduction) = \Delta Therms * F_e * 29.3$$

Where:

R_new = Total attic assembly R-value after the installation of additional insulation (see Equation 9 for assembly R-value algorithms)

R_old = R-value of existing attic assembly and any existing insulation with a minimum of R-5 (see Equation 9 for assembly R-value algorithms)

A_attic = Total area of insulated attic (sq.ft.)

Framing_factor = Adjustment to account for area of framing = 0.07 (framing factor included in the assembly R-value algorithms; see Equation 9)

ADJattic = Adjustment for attic insulation to account for prescriptive engineering algorithms over claiming savings = 74%

CDD = Cooling Degree Days (applied per participant based on project location)

Table 42. Cooling Degree Days by Climate Zone

Climate Zone	CDD 65
1 (Rockford)	820
2 (Chicago)	842
3 (Springfield)	1,108
4 (Belleville)	1,570
5 (Marion)	1,370

DUA = Discretionary Use Adjustment = 0.75

ηCool = Seasonal Energy Efficiency Ratio (SEER) of cooling system (used actual from database when available)

Table 43. Cooling Efficiency Assumptions for Attic Insulation

Information Provided	Number of Households (N= 273)	Manufactured Year	ηCool (SEER)
Actual SEER	172	n/a	Actual
Manufactured Year	88	Before 2006	10.0
Manufactured Year	7	After 2006	13.0
None[a]	6	n/a	8.4

[a] For those where the actual SEER and manufactured year is unknown we determined the average existing cooling efficiency using the actual SEER for all participants with central cooling (n=206).

HDD = Heating Degree Days (applied per participant based on project location)

Table 44. Heating Degree Days by Climate Zone

Climate Zone	HDD 60
1 (Rockford)	5,352
2 (Chicago)	5,113
3 (Springfield)	4,379
4 (Belleville)	3,378
5 (Marion)	3,438

ηHeat = Efficiency of heating system (used actual from database when available)

Table 45. Gas Heating Efficiency Assumptions for Attic Insulation

Information Provided	Number of Households (N= 359)	ηHeat (AFUE)
Actual AFUE	313	Actual
None	46	0.82

[a] For those where the actual AFUE and manufactured year is unknown we determined the average existing heating efficiency using the actual AFUE for all participants with furnaces (n=354).

FLH_cooling = Full Load Hours of air conditioning (applied per participant based on project location)

Table 46. FLH_cooling by Climate Zone

Climate Zone	FLH_cooling
1 (Rockford)	467
2 (Chicago)	506
3 (Springfield)	663
4 (Belleville)	940
5 (Marion)	820

CF = Coincidence Factor = 0.68

F_e = Furnace fan energy consumption as a percentage of annual fuel consumption = 3.14%

Because the R-values in these algorithms are stated to be assembly R-values, our engineering calculations deviated somewhat from the TRM as follows:

- We determined the assembly value using the ASHRAE Isothermal Planes method (page 27.3, ASHRAE Fundamentals, 2013).
- This method includes the IL TRM framing factor within the calculations as shown below.
- Equation 9 was not applied to calculate assembly R-values for pre-existing attic insulation for those with R-values less than 5. These cases were assigned an assembly R-value of 5 for attic insulation.

The following algorithms were used to calculate the assembly R-values for attic insulation:

Equation 9. Attic Assembly R-value Algorithms

$$\textit{Attic Assembly R-value} = ((1/\textit{R-value}_{database}) * \%\ \textit{of Assembly} + 1/\textit{R-value}_{Joist} * \textit{Framing\_Factor}) + (\textit{R-value}_{indoor\ air\ film} + \textit{R-value}_{plywood} + \textit{R-value}_{gypsum} + \textit{R-value}_{indoor\ air\ film})$$

Where:

$R\text{-value}_{database}$ = Pre or post insulation R-value found in the database (for R-values that are greater than 5)

Framing_factor = Adjustment to account for area of framing = 0.07

Figure 8. Engineering Factors Used within Attic Insulation Calculations

No Insulation				With Insulation			
N	Element	R	R	N	Element	R	R
1	indoor air film, still air		0.68	1	indoor air film, still air		0.68
2	air[a]	0.86	0.92	2	mineral fiber batt insulation	19	16.45
3	Joist (nominal 5.5") - southern pine	5.78		3	Joist (nominal 5.5") - southern pine	5.78	
4	plywood, 5/8", douglas fir		0.85	4	plywood, 5/8", douglas fir		0.85
5	gypsum wallboard, 0.5 inch		0.45	5	gypsum wallboard, 0.5 inch		0.45
6	indoor air film, still air		0.68	6	indoor air film, still air		0.68
	R value		3.6		R value		19.1
	U value		0.28		U value		0.05
	% of assembly	0.925	0.07		% of assembly	0.925	0.07
	U of assembly	0.28			U of assembly	0.05	
	R of assembly	3.58			R of assembly	19.11	

[a]horizontal position, up heat flow, 50 degree mean with 30 degree difference, emissivity of 0.82 for building materials, 5.5" air space

D. Appendix - Response Rate Methodology

Given that survey response rates are calculated and presented for all of the program surveys, below we present a definition and explanation of how we calculated the rate. The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).[13] For various reasons, we were unable to determine the eligibility of all sample units through the survey process, and chose to use AAPOR Response Rate 3 (RR3). RR3 includes an estimate of eligibility for these unknown sample units. The formulas used to calculate RR3 are presented below. The definitions of the letters used in the formulas are displayed in the Survey Disposition tables in the Methodology section of the report.

$$E = (I + R + NC) / (I + R + NC + e)$$

$$RR3 = I / ((I + R + NC) + (E*U))$$

We also calculated a cooperation rate, which is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of participants who completed an interview out of all of the participants with whom we actually spoke. We used AAPOR Cooperation Rate 1 (COOP1), which is calculated as:

$$COOP1 = I / (I + R)$$

The approach to calculating response rates differs slightly for Internet-based surveys. In these instances, the survey response rate is the number of completed surveys divided by the total number of potentially eligible respondents in the sample. The quality of the email list is a key factor in determining the eligibility of participants who do not respond to the email but also do not bounce back. This calculation assumes a high-quality list in which all respondents are eligible except those who reply with an accepted reason why they are not eligible (e.g., employee of client).

[13] *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2011. http://www.aapor.org/AM/Template.cfm?Section=Standard_Definitions2&Template=/CM/ContentDisplay.cfm&ContentID=3156.

E. Appendix - Cost-Effectiveness Inputs

Table 47 presents total gross impacts for AIC cost-effectiveness calculations. These values differ from those included in the main report due to the inclusion of heating penalties for lighting measures. This approach was taken based on discussions with AIC and past agreement between AIC and ICC staff that heating penalties would not be included in savings calculations for goal attainment. Overall, total gross program savings are reduced by 11% for kWh and 13% for therms after the application of waste heat factors.

Table 47. PY7 Multifamily Program Gross Impacts (Including Heating Penalties)

	kWh	kW	Therms
Gross Savings	9,231,743	1,885	282,248
Heating Penalty	1,017,823	n/a	36,026
Total Gross Savings with Heating Penalty	8,213,920	1,885	246,222

Lighting Heating Penalty

The inclusion of waste heat factors for lighting is based on the concept that heating loads are increased to supplement the reduction in heat that was once provided by the existing lamp type. The heating penalty was applied to 98,114 in-unit lamps and 1,915 interior common area lamps based on the specific heating fuel type (if known) and installed lamp type.

Common Area Lighting

The heating fuel type for all common area lighting is unknown. The Illinois Statewide TRM V3.0 assumes gas heating when space heating fuel types are unknown. We applied gas heating waste heat factors to all 1,915 lamps installed within common areas. The total gross heating penalty for common area lighting measures is 9,882 therms.

In-Unit Lighting

We applied the appropriate waste heat factor to all 98,114 in-unit lamps based on the heating fuel type specified in the program-tracking database. The program-tracking database provided heating fuel types for all in-unit lighting measures. The total gross heating penalty for in-unit lighting measures is 1,017,823 kWh and 26,144 therms.

The evaluation team will provide AIC with measure-specific gross impacts that include waste heat factors as part of the provision of inputs for cost-effectiveness calculations.

For more information, please contact:

Hannah Arnold
Managing Director

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

1999 Harrison Street, Suite 1420
Oakland, CA 94612