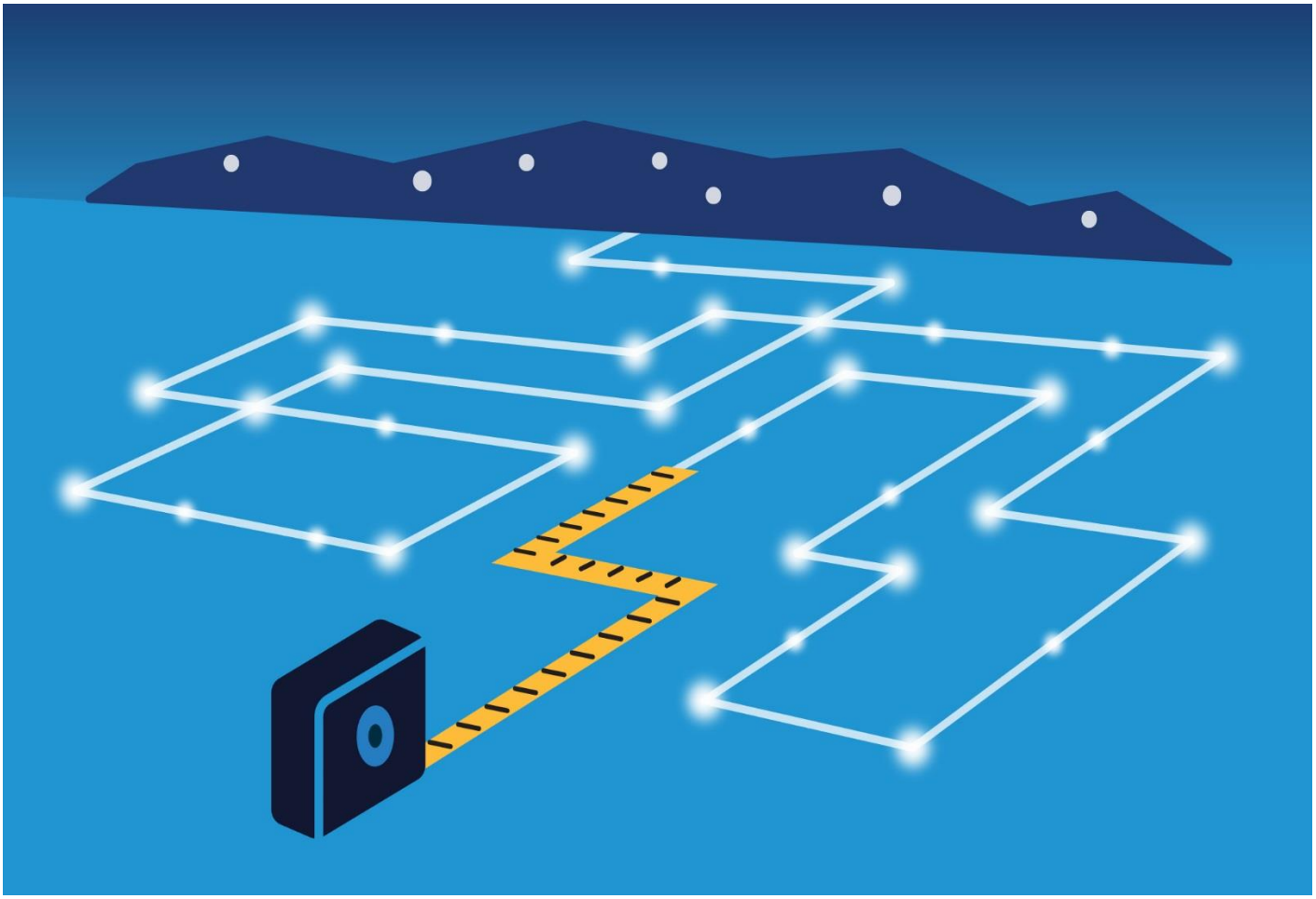
Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451



Impact and Process Evaluation of the 2013 (PY6) Ameren Illinois Company Residential Multifamily Program

Final

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NAVIGANT

MichaelsEnergy

Opinion Dynamics

Contributors

Hannah Arnold
Senior Project Manager, 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 the evaluation of the sixth program year of the Ameren Illinois Company (AIC) Residential Multifamily Program (Multifamily Program) for electric and gas energy efficiency. In Program Year 6 (PY6) (June 1, 2013, through May 31, 2014), AIC expected the Multifamily Program to account for 2% of the overall portfolio electric savings and 6% of the overall portfolio therm savings.[1] In addition, this program was part of the Illinois Power Authority (IPA)/8-103 expansion.

Implemented by Conservation Services Group (CSG), savings from the program came from a combination of three components: Common Area Lighting, Major Measures, and In-Unit, which provided a variety of energy efficiency measures, including air sealing and insulation, CFLs, faucet aerators, and showerheads. Eligible customers could participate in any combination of the program components.

The PY6 evaluation of the Multifamily Program involved both impact and process assessments. In particular, to support the evaluation, the evaluation team conducted a review of program materials and program-tracking data and interviewed program administrators and implementation staff. Our quantitative research efforts included a survey of participating property managers, as well as their tenants.

Below we present the key findings from the PY6 evaluation.

1.1 Impact Results

Overall, the PY6 Multifamily Program performed well against its internal targets, achieving 9,075 MWh in net electric savings and 100,143 therms in net gas savings. In addition, the net realization rates were generally high.

Table 1. Multifamily Program Net Impacts

Component	Ex Ante Net Impacts			Ex Post Net Impacts		
	MW	MWh	Therms	MW	MWh	Therms
In-Unit	0.58	7,550	98,905	0.60	7,487	97,457
Common Area Lighting	0.10	708	--	0.08	591	--
Major Measures	0.28	1,009	4,330	0.30	998	2,687
Total	**0.96**	**9,268**	**103,235**	**0.98**	**9,075**	**100,143**
*Net Realization Rate**				*1.02*	*0.98*	*0.97*

Note: Totals may not sum due to rounding.

* Net Realization Rate = ex post net value ÷ ex ante net value.

The PY6 impact results are based on the application of the Illinois Statewide Technical Reference Manual (TRM) for Energy Efficiency Version 2.0 (June 7, 2013), as well as deemed net-to-gross ratios (NTGRs) from PY2 (In-Unit and Common Area) and PY5 (Major Measures) to determine net savings. Outside of gross savings adjustments, the difference between ex ante and ex post net impacts result from differences in the NTGR used by the implementation and evaluation teams for major measures and common area lighting. In particular, the implementation team applied a NTGR of 0.93 for attic insulation measures and a 1.0 for air sealing

[1] Planned portfolio-level savings estimates are based on the AIC Plan 2 filing (September 20, 2011).

measures to estimate ex ante net savings, while the evaluation team used a NTGR of 0.94 for electric savings and 0.80 for gas savings to estimate ex post savings as specified for major measures in the evaluation plan.[2] Further, implementation team applied a NTGR of 1.0 for all common area lighting measures to estimate ex ante net savings, whereas the evaluation team applied a NTGR of 0.80 to energy and demand gross savings to estimate ex post net savings for the same measures.

1.2 Process Results

The Multifamily Program performed very well in PY6 in terms of both savings achieved[3] and participant satisfaction. Furthermore, participation in the In-Unit and Common Area Lighting components continued to grow, whereas participation in the Major Measures component was lower than in prior years due to a shortened implementation time frame of only 3 months.[4] Cross-component participation increased in comparison to PY4, when the evaluation team last conducted this analysis. In particular, 56 property managers (26%) participated in more than one program component in comparison to only 6 (3%) in PY4. Overall, lack of awareness of the Common Area Lighting and Major Measures components was the main barrier to cross-participation.

AIC and the implementation team also made several changes in program design and implementation during PY6. In January 2014, the program introduced specialty bulbs to address a customer need to retrofit incandescent globes, reflectors, and candelabra base bulbs with florescent lamps. The program also collaborated with AIC's Property Management Group to improve program marketing, and implemented a new inventory design and logistics strategy including the hiring of a new Field Manager to increase Technical Field Representatives' install production rate and overall program savings.

1.3 Conclusions and Recommendations

Based on the evaluation team's PY6 evaluation activities, we make the following recommendations for the program going forward.

- **Consider the development of leave-behind marketing materials to educate participants about other program components**. The property manager survey identified a lack of awareness of the Common Area Lighting and Major Measures components among property managers who received In-Unit upgrades through the program. As a result, the program should develop new strategies for educating property managers about other program components in order to encourage cross-component participation. In particular, current onsite interactions with customers as part of their participation in other program components provide a potential opportunity to share additional program information. While it may not be feasible to create new marketing collateral within the program budget, program staff should consider whether they could invest in communicating with property manager participants in this way in future program years.

[2] These NTGRs came from the PY5 evaluation and were not available to the implementation team at the beginning of PY6.

[3] As per the Monthly Portfolio Report from May 2014, the Multifamily Program achieved 129% of electric savings and 309% of gas savings (ex ante estimates of net savings compared to internal goals for the program).

[4] The program reintroduced the Major Measures program component in March 2014 to offer incentives for air sealing and attic and wall insulation, as well as programmable thermostats.

- **Make changes to the data tracking process**. The outcome of the PY6 impact evaluation led the evaluation team to make a number of recommendations related to the data tracked by CSG. These recommendations include:
  - Track kW-controlled values based on the type of occupancy sensor installed by the program.
  - Track whether exit signs replaced by program measures are fluorescent or incandescent.
  - Track the building number separately from the postal address to aid in the verification of addresses in future survey efforts.
  - Explore, and, if feasible, resolve discrepancies between the fuel type listed in the "Incentive Application" data tab and the data tabs that provide more detailed information on measures for electric customers (MF_Electric) and gas customers (MF_Gas).

2. Introduction

This report presents results from the evaluation of PY6 of the Ameren Illinois Company (AIC) Residential Multifamily Program. To support the evaluation, we conducted a review of program materials and program-tracking data and interviewed program administrators and implementation staff. Our quantitative research efforts included a telephone survey with participating property managers and an Internet survey with tenants.

2.1 Program Description

The program offers direct installation of low-cost energy efficient measures in multifamily dwelling units in addition to rebates for common area lighting retrofits, air sealing, and insulation. The program launched in 2008 and targets owners, managers, or developers of market rate multifamily housing with three or more units in AIC's service territory. The program consists of three distinct components:

- The In-Unit Direct Install component offers free compact fluorescent light bulbs (CFLs), faucet aerators, low-flow showerheads, and programmable thermostat setbacks for in-unit installation. Program field staff coordinate the installation of selected measures at no cost to the property owner.
- The Common Area Lighting component provides rebates for lighting fixture upgrades, CFLs to replace incandescent bulbs, and no-cost occupancy sensors and LED exit signs. Property managers can apply for rebates on rebated measures only after they have been installed by their own staff or by an independent contractor.

The Major Measures component, reintroduced in the last 3 months of PY6, offers incentives for air sealing, attic insulation, wall insulation, and programmable thermostats. For this component, the program used a reservation system where one contractor, Energy Masters, was limited to 60% of all available incentives with the remainder available to other contractors. However, if other contractors did not claim the remaining incentives within six weeks, the incentives became available to Energy Masters.

2.2 Research Objectives

The objective of the PY6 Multifamily Program evaluation is to estimate gross and net electric and gas savings associated with the program. In particular, the PY6 impact evaluation answers the following questions:

1. What are the estimated gross energy and demand impacts from this program?
2. What are the estimated net energy and demand impacts from this program?
3. What is the estimated net-to-gross ratio (NTGR) for the Common Area Lighting and In-Unit components?[5]

The evaluation team also explored a number of process-related research questions as part of the PY6 evaluation. The goal of the process questions is to explore changes between PY5 and PY6, as well as participation in and satisfaction with the program.

[5] The NTGR for the Major Measures component was estimated in PY5.

1. Program Design and Implementation
    a. Were there any changes in program implementation from what was specified in the PY6 implementation plan? If so, what was the rationale for these changes?
    b. What information does the implementer track for each participating property?
    c. What improvements can the program make to data-tracking processes?
2. Cross-Component Participation
    a. What barriers prevent property managers/owners from participating in multiple Multifamily Program components?
    b. How can the program increase participation across the multifamily components?
3. Participant Satisfaction
    a. How satisfied are property managers/owners with the program?

3. Evaluation Methods

Table 2 summarizes the evaluation activities that we conducted for the PY6 evaluation of the Multifamily Program.

Table 2. Summary of Multifamily Program Evaluation Activities for PY6

Activity	PY6 Impact	PY6 Process	Forward Looking	Details
Program Staff Interviews	✓			Conducted interviews with AIC and Conservation Services Group (CSG) program managers to understand changes in program design and implementation.
Review Utility Data and Materials	✓	✓		Reviewed the PY6 database, as well as marketing and outreach materials and relevant administrative program reports to assess program changes.
Property Manager/ Owner Survey		✓	✓	Conducted telephone surveys with participating property managers to collect process-related information, assess barriers to cross-component participation, and estimate NTGRs for the Common Area Lighting and In-Unit components.
Tenant Internet Survey			✓	Conducted an Internet survey with tenants to inform the development of an In-Unit NTGR.
Cross-Component Participation Analysis		✓		Reviewed program database, supplemented by information collected in the property manager surveys to provide additional insights into barriers to cross-component participation.
Impact Analysis	✓			Conducted an engineering analysis of all measures installed during PY6.

3.1 Data Collection

The team conducted the following data collection activities as part of the evaluation.

3.1.1 Program Staff Interviews

In April 2014, the evaluation team conducted two in-depth interviews with AIC and CSG program managers. The interviews provided the evaluation team with insights into data tracking, changes in program design and implementation during PY6, and customer outreach related to the program. The discussion also touched on upcoming changes for PY7.

3.1.2 Review of Program Materials and Data

The evaluation team reviewed program materials, including marketing brochures, the Multifamily Program Implementation Plan, and Monthly Administrative Meeting Reports, to complement program manager interviews and to determine programmatic changes during PY6. In addition, the team reviewed the program-tracking database to examine the type of data that is currently tracked.

3.1.3 Property Manager Survey

The evaluation team conducted quantitative telephone interviews with 33 property managers who participated in at least one component of the Multifamily Program during PY6. These interviews focused on gathering information needed to calculate a NTGR for the Common Area Lighting and In-Unit components,[6] as well as information about participant satisfaction and barriers to cross-component participation.

Sample Design

The evaluation team attempted to reach a census of project contacts through the property manager survey. However, we took a number of steps to clean and prepare the population frame for fielding. First, we identified unique project contacts based on telephone number using tracking data from March 2014. We also appended gas and electric measure records, and collapsed the data at the premise level.[7] In cases where participants completed projects at more than one address, we prioritized projects with less commonly installed measures to ensure that sufficient data were available for those measures to develop NTGRs.[8]

In total, the evaluation team identified 216 unique contacts and completed 33 interviews from July 10 to July 28, 2014.[9] Table 3 shows the number of property managers and surveys completed per program component.

Table 3. Overview of Completed Property Manager Surveys

Component	PY6 Property Manager/Owner Population	Completed Surveys
In-Unit	190	23
Common Area Lighting	79	14
Major Measures	3	1
Unique Property Managers	**216**	**33**

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 3.3.

Survey Disposition and Response Rate

Table 4 presents the final survey dispositions.

[6] Detailed information on the NTGR analysis is provided in Appendix C.

[7] Using the street address without the apartment numbers.

[8] Overall, 18 property managers had multiple premises.

[9] The average interview length was 9 minutes and 35 seconds.

Table 4. Property Manager Survey Dispositions

Disposition	N
Completed Interviews (I)	**33**
Partial	**1**
Eligible Non-Interviews	**113**
Refusal	45
Mid-Interview Terminate (R)	4
Respondent Never Available (NC)	28
Answering Device	36
Not Eligible (e)	**53**
Fax/Data Line	3
Non-Working	27
Business/Other Organization	6
Wrong Number	12
No Eligible Respondent	5
Unknown Eligibility Non-Interview (U)	**16**
Always Busy	1
No Answer	15
Total Participants in Sample	**216**

Table 5 provides the response and cooperation rates. Appendix D describes the methodology to calculate response rates in more detail.

Table 5. Property Manager Survey Response and Cooperation Rates

AAPOR Rate	Percentage
Response Rate	21%
Cooperation Rate	40%

Weighting

We developed and applied the following survey weights for the process analysis to ensure proportional representation from each program component. Unless otherwise noted, we weighted the property manager survey data as shown in Table 6.

Table 6. Property Manager Survey – Survey Weights

Component Participation	Population		Completes		Weight
	Total	%	Total	%	
In-Unit Only	134	62%	15	45%	1.36
Common Area Lighting Only	23	11%	7	21%	0.50
Major Measures Only	3	1%	1	3%	0.46
In-Unit and Common Area Lighting	56	26%	10	30%	0.86
Total	**216**		**33**		

3.1.4 Tenant Survey

We conducted an Internet survey[10] with 116 tenants residing in units that received direct install measures through the program. The main goal of the survey was to explore attribution and tenant decision making regarding in-unit CFLs. We fielded the survey with tenants between August 4 and September 10, 2014.

It is important to note that the evaluation team did not have email addresses for participating customers from the tracking database. As a result, we recruited tenants for the survey by sending them a letter offering them a $25 incentive for going online and completing the survey. Each letter contained a link to the survey, as well as a unique PIN that allowed us to track respondents. We sent the letters in two waves of 500 letters, and allowed the tenants to complete the survey over a time frame of approximately 2 weeks upon receipt of the letter.

Sample Design

We used a simple random sampling approach for the tenant survey and drew the sample from program-tracking data provided by CSG in March 2014. The tracking data included addresses of dwelling units that received In-Unit upgrades, but it did not provide tenant names or phone numbers. From this database, the team randomly selected 1,000 records and fielded the survey in two waves by splitting the sample into two equal parts and sending invitation letters in batches of 500.

Table 7. Tenant Survey Sample Design

	Tenants
Population Frame	7,080
Sample Frame	1,000
Completed Surveys	128
Surveys Included in Analysis (removing duplicate entries)	116

Note: Population frame determined by number of unique tenant addresses

As shown in Table 7, the evaluation team removed 12 records from the 128 completed surveys, because three customers completed more than one survey with identical responses.

This sample design and a coefficient of variation of 0.09 allowed the team to achieve a precision of +/- 1% at the 90% confidence level for the NTGR.

[10] We also provided tenants with the option of calling the evaluation team to complete the survey over the phone. Overall, 26% of respondents opted for the telephone.

Survey Disposition and Response Rate

Table 8 presents the final survey dispositions for the online survey.

Table 8. Tenant Survey Dispositions

Disposition	N
Completed Surveys	128
Non-Interviews/Mid-Survey Terminates	6
Ineligible Surveys/Screened Out	1
Total	**135**

As shown in Table 9, the response rate for the survey was 13%.[11]

Table 9. Tenant Survey Response Rate

Response Rate Components	N
Response Rate	13%

3.2 Analytical Methods

3.2.1 Gross Impacts

The evaluation team estimated ex post gross savings by applying savings algorithms from the Illinois Statewide Technical Reference Manual (TRM) V2.0 using information in the program-tracking database. We present the algorithms used to calculate all evaluated program savings in Appendix A, along with all input variables.

3.2.2 Net Impacts

The team calculated PY6 net impacts by applying the NTGRs outlined in Table 10. Note that the NTGRs were based on the results of prior evaluations.

Table 10. PY6 Multifamily Program NTGRs by Component

	Electric NTGR			Gas NTGR			
Component	Free-Ridership	Participant Spillover	NTGR	Free-Ridership	Participant Spillover	NTGR	Source
In-Unit	0.00	--	1.00	0.00	--	1.00	PY2
Common Area Lighting	0.20	--	0.80			N/A	PY2
Major Measures	0.06	0.00	0.94	0.20	0.00	0.80	PY5

[11] Source: AAPOR Response Rate 1.

3.2.3 Net-To-Gross

The evaluation team conducted research as part of the PY6 evaluation to update the NTGRs for the In-Unit and Common Area Lighting components of the program. These updated NTGRs will be used in the evaluation of the PY8 program.

The team provides the detailed methodology in Appendix C.

3.3 Sources and Mitigation of Error

Table 11 provides a summary of possible sources of error associated with data collection for this evaluation. We discuss each item in detail below.

Table 11. Potential Sources of Error

Research Task	Survey Errors		Non-Survey Errors
	Sampling	Non-Sampling	
Property Manager Survey	• No, Census Attempt	• Measurement error • Non-response and self-selection bias • Data processing error • External validity	• N/A
Tenant Survey	• Yes	• Measurement error • Non-response and self-selection bias • Data processing error • External validity	• N/A
Gross Savings Calculations	• N/A	• N/A	• Analysis Error
Net Savings Calculations	• N/A	• N/A	• Analysis Error

The evaluation team took a number of steps to mitigate against potential sources of error throughout the planning and implementation of the PY6 evaluation.

Survey Error

- **Sampling Error**
  - The evaluation team designed the tenant survey sample to achieve 90% confidence and ±10% relative precision. We surveyed 116 customers out of a population of 7,080 households. At the 90% confidence level, we achieved a precision of +/- 1% for the NTGR based on a coefficient of variation of 0.09.
- **Non-Sampling Error**
  - Measurement Error: We addressed both the validity and the reliability of quantitative data through multiple strategies. First, we relied on the experience of the evaluation team to create questions that, at face value, appeared to measure the idea or construct that they were 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 pretested each survey instrument, monitored both the property manager and the tenant interviews as they were being conducted, and reviewed the pretest survey data. We also used the pretests to assess whether the length of the survey was reasonable and reduced the survey length as needed.

- Non-Response Bias: Given that the response rate for the property manager survey was 21%, there was 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 to determine whether those we spoke with were significantly different from those who did not respond to the survey. Overall, we did not find any notable differences between these groups. Finally, to reduce non-response bias in the tenant survey, we also provided customers the opportunity to complete the survey over the phone instead of online.

- Data Processing Error: The team addressed processing error through interviewer training, as well as quality checks of completed survey data. Opinion Dynamics interviewers went through rigorous training before they began the interviews. 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 carried out continuous, random monitoring of all telephone interviews and validation of at least 10% of every interviewer's work.

- External Validity: We addressed external validity (the ability to generalize any findings to the population of interest) through development of an appropriate research design. For the tenant survey, we drew a random sample from 7,080 households that received In-Unit upgrades and completed sufficient surveys to achieve 90% confidence and ±10% relative precision. Given that we attempted a census of participating property managers, and that, as mentioned above, we found no evidence of a significant non-response bias, we did not need to worry about having a sample that was representative of customers who participated in the program.

Non-Survey Error

- Analysis Errors:

  - Gross Impact Calculations: We applied the TRM calculations to the participant data in the tracking database to calculate gross impacts. To minimize analytical errors, the evaluation team had all calculations reviewed by a separate team member to verify that calculations were performed accurately.

  - Net Impact Calculations**:** We applied the prospective deemed NTGR to estimate the program's net impacts. To minimize analytical errors, the evaluation team had all calculations reviewed by a separate team member to verify that calculations were performed accurately.

4. Evaluation Findings

4.1 Program Description and Participation

The Multifamily Program directly installs low-cost energy efficient measures in tenant units and offers rebates for common area lighting retrofits, air sealing, and insulation. The program was launched in 2008 and targets owners, managers, or developers of market rate multifamily housing with three or more units in AIC's service territory. The program consists of three distinct components:

- The In-Unit Direct Install component offers free CFLs, faucet aerators, low-flow showerheads, and programmable thermostat setbacks for in-unit installation. Program field staff coordinate the installation of selected measures at no cost to the property owner. Property maintenance staff install the programmable thermostats. After installation, program field staff prepare paperwork.
- The Common Area Lighting component provides rebates for lighting fixture upgrades and CFLs, as well as no-cost occupancy sensors and LED exit signs. Property managers can apply for rebates on rebated measures only after they have been installed by their own staff or by an independent contractor. To participate in the Common Area Lighting component, participants submit an application form and are responsible for completing approved upgrades within 90 days. Property maintenance staff or independent contractors can install the measures, and, upon installation, program staff verifies the installation according to program standards.
- The Major Measures component was reintroduced in March 2014 and offers incentives for air sealing, attic and wall insulation, and programmable thermostats. For this component, the program used a reservation system where one contractor, Energy Masters, was limited to 60% of all available incentives with the remainder available to other contractors. However, if other contractors did not claim the remaining incentives within six weeks, the incentives became available to Energy Masters.

Over the course of PY6, AIC saw participation in all components of the program, with the lowest levels of participation in the Major Measures component because that component was only available in the last 3 months of PY6.

Table 12. PY6 Multifamily Program Participation by Component

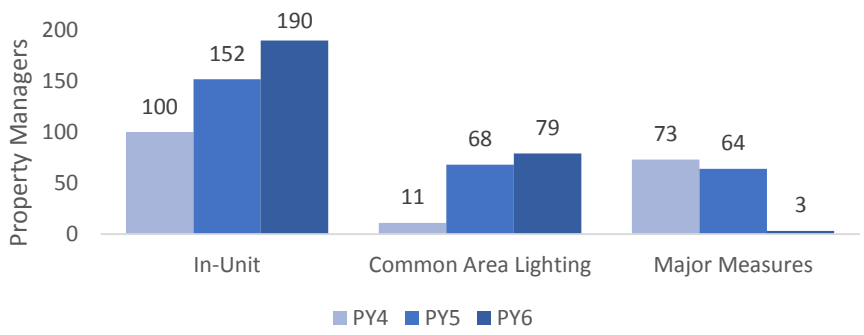
Component	Projects		Ex Ante Gross Electric Savings		Ex Ante Gross Electric Savings		Ex Ante Gross Gas Savings	
	#	%	kWh	%	kW	%	Therms	%
In-Unit	372	72%	7,550,465	81%	581	61%	98,905	96%
Common Area Lighting	108	21%	708,378	8%	100	10%	n/a	0%
Major Measures	38	7%	1,025,089	11%	280	29%	4,409	4%
Total*	**518**		**9,283,933**		**961**		**103,314**	

* Totals may not sum due to rounding.

Note: The number of projects is based on unique Project ID.

Figure 1 shows trends in participation across the components over the past 3 years. As illustrated in the figure, participation in the In-Unit and Common Area Lighting components has continued to grow over this time frame.

Figure 1. Property Manager Participation by Component from PY4 to PY6



4.2 Process Assessment

The evaluation team used data from three primary data collection activities to inform the process evaluation: The team conducted in-depth interviews with both AIC and CSG program managers, surveys with participating property managers, and surveys with tenants. In addition, we reviewed program materials and tracking data.

4.2.1 Program Design and Implementation

Program Changes

Table 13 summarizes the changes to program design and implementation in PY6.

Table 13. Program Design and Implementation Changes in PY6

Program Change	Description	Implications
Reintroduction of the Major Measures Program Component	After closing this program component due to high levels of participation by one contractor, program staff developed a reservation system for PY6 that gives 60% of all jobs to Energy Masters and keeps the remainder open for bids by other contractors.	The program can continue to offer Major Measures while managing contractor expectations and the project pipeline.
Inventory Design and Logistics Strategy	The program implemented a new inventory design and logistics strategy in February 2014.	This change increased the production rate of Technical Field Representatives and overall program savings. In particular, while this changed reduced the absolute number of retrofitted apartment units, it increased the savings per unit.

Program Change	Description	Implications
Program Measures	The program began offering specialty bulbs in January 2014 to the In-Unit and Common Area Lighting components, as property audits revealed a need to retrofit incandescent globes, reflectors, and candelabra base bulbs with florescent lamps. The program encouraged complex owners to install programmable thermostats while leaving other In-Unit direct installs with the program implementer.	The expansion of program offerings enables retrofits regardless of the base fixture. As a result, the program expected to install an additional 11,030 bulbs with an additional expense of $69,620 for the In-Unit component and $1,500 for the Common Area Lighting component. AIC expects that the program will see an increase in net savings of 605,085 kWh and 64.347 kW as a result.
Program Marketing	Program staff began collaborating with AIC's Property Management Group to obtain contact information for program outreach purposes. This group uses an online portal (LandlordDirect), as well as offline sources, to provide customer data for telemarketing efforts, including premise IDs, property management contacts, address information, and tenant information.	The program was able to enhance the available data for program marketing.

Marketing and Outreach

Program marketing was consistent with previous years, and staff leveraged mass media and in-person customer outreach. More specifically, marketing efforts included phone calls by Account Managers, in-person visits by program staff, and direct mail. Property managers and participating contractors also helped increase program awareness.

Data Tracking

The program's tracking data records several important variables for each participating property. Information includes location,[12] key property characteristics, contact information, and program participation details.[13] In addition, the database captures measure information, including measure description, quantity, incentive amount, ex ante electric and gas savings, and installation date. It also lists the project ID, which is used to link specific projects to property manager information. Project ID numbers are assigned per building in the Major Measures component, but refer to one complex for the In-Unit and Common Area Lighting components.

The evaluation team reviewed the program database to identify potential improvements to the data tracking processes. Overall, the database is comprehensive in terms of the type of data tracked and the extent to which database fields are populated. Nevertheless, the evaluation team identified a few areas where AIC and CSG could improve data tracking. The team recommends that the program consider:

[12] For In-Unit upgrades, the program records the unit number.

[13] Participation details include such variables as total electric savings, total gas savings, program category and type, project start date, incentive details, and unique project ID.

- Tracking kW-controlled values based on the type of occupancy sensor installed: The Statewide TRM provides default kW-controlled values based on the type of occupancy sensor (fixture mounted, wall mounted, etc.). However, discussions with the program implementer revealed that the requirement per sensor is 60W. This information is critical to ex post savings calculations and should be included in the program tracking data with specific wattage controlled per installed occupancy sensor to improve future evaluations.

- Tracking the existing type of exit signs: The database does not indicate whether the existing exit sign is fluorescent or incandescent. However, the baseline wattage value (specified within the Statewide TRM) varies significantly for each type of existing exit sign. After discussions with the program implementer, we learned that the rebate application indicates that all installed LED exit signs replace incandescent exit signs. Without this information, ex post savings would be calculated using the Statewide TRM default baseline wattage of 23 watts (for unknown existing exit sign type), resulting in a 191 kWh per unit savings. Upon learning that the existing exit sign type is incandescent, we applied a baseline wattage of 35 watts, resulting in an ex post per-unit savings of 301 kWh.

- Tracking building numbers in a separate field: The database tracks the site address with street name, house number, building number, and apartment number in one field. However, the tenant surveys revealed that the building numbers are not part of the postal address that tenants know. To avoid confusion in future survey efforts, it would be beneficial if the program tracked the building number separately from the postal address.

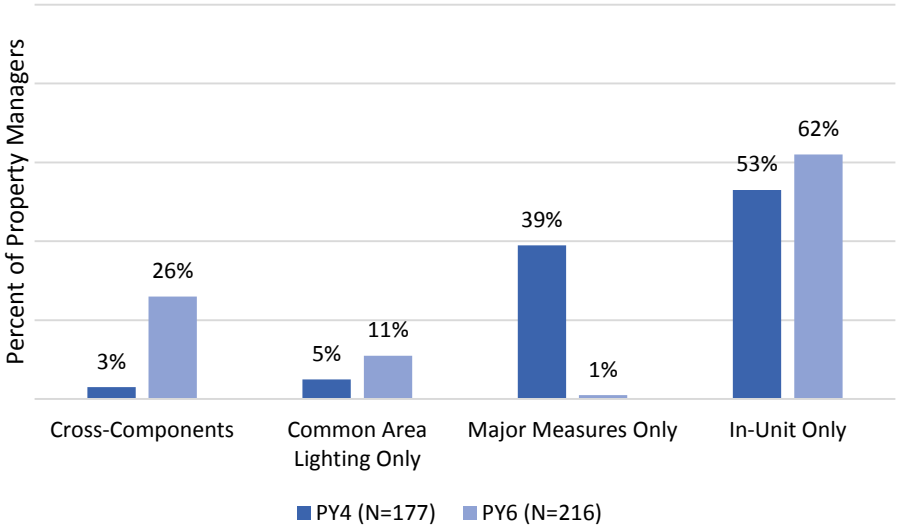
- Examining discrepancies between data tabs: Within the program-tracking database, the "MF Electric" tab includes 142 records associated with the installation of programmable thermostats, however the "Incentive Application" tab indicates gas heating for these records. Similarly, the "MF_Gas" tab includes 110 records for programmable thermostats, while the "Incentive Application" tab indicates electric heating. While the evaluation team used the data tabs for electric and gas savings versus the "Incentive Application" tab to calculate ex post savings, we recommend that program staff examine the causes of these discrepancies.

In addition to reviewing the type of data tracked by the program, the evaluation team assessed the program's tracking data based on findings from the PY5 evaluation. In particular, the team looked for evidence that the property manager contact information was not mixed with tenant-level contacts, as was found in PY5. While a review of the tracking data alone could not verify accurate tracking of contact information, the program manager survey confirmed that this problem was remedied.

4.2.2 Cross-Component Participation

There has been a significant increase in cross-component participation in PY6 compared to PY4, when the evaluation team last conducted this analysis. Only six property managers (3%) participated in more than one program component in PY4, whereas 57 property managers (26%) did so during PY6.

Figure 2. Property Manager Cross-Component Participation (PY4 and PY6)

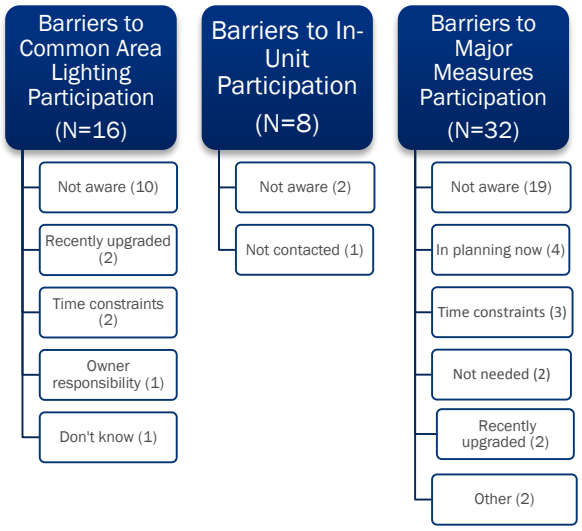


Note: Unique property managers as per program tracking data

To identify potential barriers to cross-program participation, the evaluation team asked property managers about their awareness of and reasons for not participating in other program components. Overall, the biggest barrier to joint participation in the Common Area Lighting and Major Measures components is lack of awareness. For example, the majority of property managers who did not participate in one of these components said that they were unaware that it was part of the program (10 of 16 for Common Area Lighting and 19 of 32 for Major Measures). In contrast, the majority of those property managers who did not complete In-Unit upgrades were typically aware of this program offering (6 of 8). Although with these findings, it is important to note that program staff may not market other program components to property managers if they do not have the technical potential to participate.

In addition to lack of awareness, program managers noted a number of other reasons for not participating in different program components. These factors included having recently made upgrades on their own, thinking the upgrades were unnecessary, and facing time constraints. While property managers did not directly mention it, program staff noted that if properties did not have the maintenance staff to accompany program staff during the In-Unit audit or installation of programmable thermostats, then they could not participate in the In-Unit component. This may explain why some property managers opted not to participate, even though they were aware of the program offering. Figure 3 summarizes the key barriers to participation mentioned by property managers. We asked property managers about their awareness of components in which they did not participate. Consequently, the number of responses for each program component differs in this figure.

Figure 3. Barriers to Cross-Participation



Given that many participants were unaware of the Common Area Lighting and Major Measures components, the implementer may be able to boost participation by increasing marketing and outreach related to these components. While audits already examine the potential for measures across all program components, one approach might be to provide participating property managers with materials about the Common Area Lighting and Major Measures components when conducting the In-Unit work.

4.2.3 Participant Satisfaction and Program Engagement

Property Manager Satisfaction

Satisfaction is high across all program components, as shown in Table 14. In addition, while not included in the table, the one property manager who installed Major Measures gave a satisfaction score of 10 (out of 10) for the air sealing and insulation. Of the three property managers who said that they were not very satisfied (a score of 5 or lower), two of them had problems using the programmable thermostats.

Table 14. Property Manager Satisfaction

Satisfaction with …	Mean Score*
AIC Multifamily Program Staff (n=33)	9.5
In-Unit measures (n=25)	9.5
Common Area Lighting measures (n=17)	9.4
Program overall (n=33)	9.2
AIC overall (n=33)	8.9

* Scale from 0 to 10, where 0 is “very dissatisfied” and 10 is “very satisfied.”

Ways to Learn about the Program

Consistent with the program’s outreach strategy, Table 15 shows that participants most commonly learned about the program through direct phone calls (42%). In addition, it is clear that in-person contact through

meetings and outreach from AIC representatives also play an important role in educating potential participants about the program.

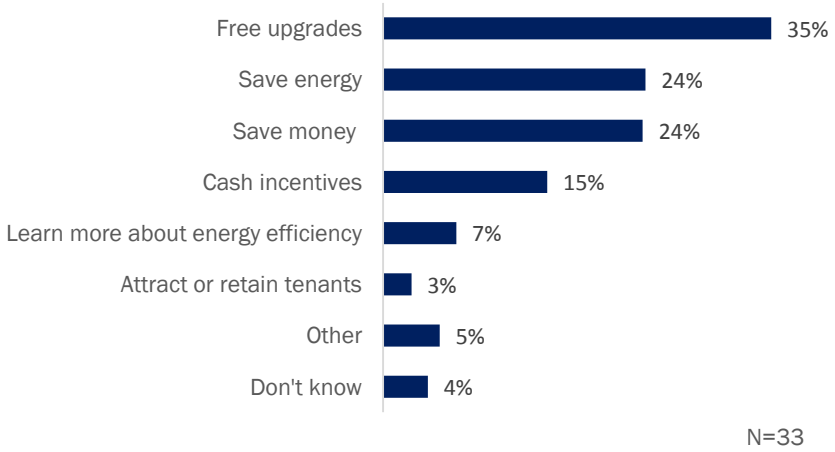
Table 15. How Participants First Heard About the Program

Ways to Learn about the Program	Percent (n=33)
Phone Call	42%
Association Meeting	13%
AIC Representative	13%
Corporate Headquarters/Managers	7%
Word of Mouth	7%
Online/Email	4%
Brochure/Flyer	3%
Contractor	1%
Other	8%
Don't know	4%

Motivation to Participate

The dominant motivators for property managers to participate in the program are free upgrades (35%), energy savings (24%), and monetary savings (24%). There are no significant differences between the motivations of those participating in different program components.

Figure 4. Reasons for Program Participation (Multiple Response)



Property Managers' Suggestions for Improvement

Almost three quarters (70%) of participating property managers had no suggestions for improving the program. Among those who offered recommendations, property managers suggested providing more or different bulbs, resolving issues with thermostats by providing instructions or better quality measures, and offering outdoor

lighting. One property manager further suggested examining insulation potential,[14] and another one said that help with the installation of measures would be beneficial.

Table 16: Participant Suggestions for Program Improvement

Suggestions	Percentage of Participants (n=33)
None	70%
Provide other types of bulbs (e.g., exterior and canned lighting)	7%
Resolve issues with thermostats (e.g., complexity, performance, quality)	7%
Provide more bulbs for replacement	4%
Other	12%

4.3 Impact Assessment

The following sections provide participation rates, measure verification rates, and gross and net impacts for PY6.

4.3.1 Participant Verification

The evaluation team verified participants and installation rates in PY6 through a review of the program-tracking database. As part of our review, we checked for errors and overall data quality. Table 17 summarizes program participation in terms of the projects and unique customers found in the database.

Table 17. Summary of Program Participation

Component	Number of Projects [a]	Number of Customers by Component
In-Unit	372	190
Common Area Lighting	108	79
Major Measures	38	3
Total	**518**	**216**

[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 install a variety of measures through the program in tenant units and common areas. They can also install building shell measures, such as air sealing and attic insulation. Table 18 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 does a good job of ensuring that projects and associated measures are documented accurately in the database.

[14] Insulation is currently available through the program, but it was not offered for all of PY6. As a result, this customer may not have had the option to install insulation when he or she participated in the program.

Table 18. Summary of Verified PY6 Multifamily Program Participation by Measure Type Based on Database Review

Component	Measure	Installed Location	Unit	# of Measures	Verification Rate
In-Unit	CFL – Low (15W)	In-Unit Interior	Lamp	49,674	100%
	Faucet Aerator (Electric WH)	In-Unit	Aerator	8,634	100%
	CFL – Medium (20W)	In-Unit Interior	Lamp	7,174	100%
	Faucet Aerator (Gas WH)	In-Unit	Aerator	5,007	100%
	Shower Head (Electric WH)	In-Unit	SH	4,839	100%
	Programmable Thermostat	In-Unit	PT	4,517	100%
	Specialty CFL – 14W Globe	In-Unit Interior	Lamp	2,991	100%
	Shower Head (Gas WH)	In-Unit	SH	2,138	100%
	CFL – High (23W)	In-Unit Interior	Lamp	1,631	100%
	Specialty CFL – 15W Reflector	In-Unit Interior	Lamp	1,618	100%
	Specialty CFL – 9W Candelabra	In-Unit Interior	Lamp	104	100%
	Specialty CFL – 5W Reflector	In-Unit Exterior	Lamp	2	100%
Common Area Lighting	13W CFL	Common Area Interior	Lamp	1,291	100%
	Linear Fluorescent T8s	Common Area Interior	Fixture	919	100%
	13W CFL	Common Area Exterior	Lamp	403	100%
	23W CFL	Common Area Exterior	Lamp	402	100%
	LED Exit Sign	Common Area Interior	Exit Sign	230	100%
	20W CFL	Common Area Exterior	Lamp	145	100%
	20W CFL	Common Area Interior	Lamp	138	100%
	Occupancy Sensor	Common Area Interior	Sensor	127	100%
	23W CFL	Common Area Interior	Lamp	61	100%
	Modular CFL Exterior	Common Area Exterior	Lamp	60	100%
	Modular CFL Interior	Common Area Interior	Lamp	52	100%
	Specialty CFL – 15W Reflector	Common Area Interior	Lamp	52	100%
Major Measures	Air Sealing	N/A	CFM	265,496	100%
	Attic Insulation	N/A	SqFt	143,497	100%

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

4.3.2 Gross Impacts

Our impact analysis activities yielded ex post gross electric and gas energy savings and peak demand savings. Table 19 presents the ex post impacts and the calculated realization rate. Overall, total gross energy and demand impacts for the PY6 Multifamily Program are 9,286 MWh, 1.01 MW, and 100,815 therms. In addition, the gross realization rates are high: 100% for electric savings, 105% for demand savings, and 98% for gas savings. An explanation of specific adjustments and calculations is included in the sections that follow.

Table 19. PY6 Gross Impacts by Program Component

Component	Ex Ante Gross Impacts			Ex Post Gross Impacts*			Realization Rate		
	MWh	MW	Therms	MWh	MW	Therms	MWh	MW	Therms
In-Unit	7,550	0.58	98,905	7,487	0.60	97,457	0.99	1.03	0.99
Common Area Lighting	708	0.10	n/a	738	0.10	n/a	1.04	0.98	n/a
Major Measures	1,025	0.28	4,409	1,061	0.32	3,358	1.04	1.13	0.76
Total	**9,284**	**0.96**	**103,314**	**9,286**	**1.01**	**100,815**	**1.00**	**1.05**	**0.98**

* The team calculated the ex post gross impacts based on application of the Illinois Statewide TRM V2.0.

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.

Table 20. PY6 Multifamily Gross Impacts by Program Component and Measure

Component	Measure	Ex Ante Gross Impacts			Ex Post Gross Impacts			Gross Realization Rate*		
		kWh	kW	Therms	kWh	kW	Therms	kWh	kW	Therms
In-Unit	Standard CFLs – Interior	2,343,875	260.0	n/a	2,412,343	251.4	n/a	1.03	0.97	n/a
	Standard CFLs – Exterior	177	0.02	n/a	177	0.02	n/a	1.00	1.00	n/a
	Specialty CFLs – Interior	236,347	24.8	n/a	252,718	24.9	n/a	1.07	1.01	n/a
	Faucet Aerator	450,349	173.5	13,018	448,414	172.7	12,973	1.00	1.00	1.00
	Shower Head	1,907,969	122.9	41,819	1,907,969	149.8	41,818	1.00	1.22	1.00
	Programmable Thermostat	2,611,748	n/a	44,067	2,464,941	0.0	42,666	0.94	n/a	0.97
Common Area Lighting	Standard CFLs – Interior	382,582	53.0	n/a	409,059	53.0	n/a	1.07	1.00	n/a
	Standard CFLs – Exterior	76,793	7.7	n/a	76,792	7.7	n/a	1.00	1.00	n/a
	Specialty CFLs – Interior	14,581	2.0	n/a	15,590	2.0	n/a	1.07	1.00	n/a
	Modular CFLs – Interior	16,675	2.5	n/a	19,332	2.5	n/a	1.16	1.00	n/a
	Modular CFLs – Exterior	14,171	2.1	n/a	4,362	0.01	n/a	0.31	0	n/a
	Linear Fluorescent T8s	119,021	17.6	n/a	119,021	17.6	n/a	1.00	1.00	n/a
	LED Exit Sign	59,646	8.1	n/a	69,195	8.1	n/a	1.16	1.00	n/a
	Occupancy Sensor	24,910	7.2	n/a	24,909	7.2	n/a	1.00	1.00	n/a
Major Measures	Air Sealing	794,527	265.5	3,280	794,324	283.5	2,736	1.00	1.07	0.83
	Attic Insulation	230,562	14.3	1,129	266,955	33.5	622	1.16	2.33	0.55
Total		**9,283,933**	**961.4**	**103,314**	**9,286,102**	**1,014.1**	**100,815**	**1.00**	**1.05**	**0.98**

Note: Numbers may not total due to rounding.

* Gross Realization Rate = ex post gross value ÷ ex ante gross value.

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 CSG about potential reasons for the differences identified in our analysis and summarize them in Table 21. We describe the basis for measure-level realization rates in more detail following Table 21.

Table 21. Explanation of Realization Rates by Measure

Component	Measure	kWh RR	kW RR	Therms RR	CDD,HDD, FLH	Pre & Post R-Value	Framing Factor	Waste Heat Factor	Other (Specified)
In-Unit	Standard CFLs – Interior	1.03	0.97	n/a				X	
	Standard CFLs – Exterior	1.00	1.00	n/a					
	Specialty CFLs – Interior	1.07	1.01	n/a				X	
	Shower Head	1.00	1.22	1.00					- Hours of Use
	Programmable Thermostat	0.94	n/a	0.97					- Deemed Heating Consumption Values
	Faucet Aerator	1.00	1.00	1.00					
Common Area Lighting	Standard CFLs – Interior	1.07	1.00	n/a				X	
	Specialty CFLs – Interior	1.07	1.00	n/a				X	
	Standard CFLs – Exterior	1.00	1.00	n/a					
	Modular CFLs – Interior	1.16	1.00	n/a				X	
	Modular CFLs – Exterior	0.31	0.00	n/a					- Ex Ante Per-Unit Value
	LED Exit Sign	1.16	1.00	n/a				X	
	Linear Fluorescent T8s	1.00	1.00	n/a					
	Occupancy Sensor	1.00	1.00	n/a					
Major Measures	Air Sealing	1.00	1.07	0.83	X				- Baseline Efficiency - Latent Multiplier - Nheat Conversion Factor
	Attic Insulation	1.16	2.33	0.55	X	X	X		- Baseline Efficiency

Inputs for lighting, low flow shower heads, and programmable thermostats have the largest impact on program level realization rates. Because lighting measures account for 35%, showerheads account for 21%, and programmable thermostats account for 28% of the kWh program savings, any differences within these measures affect the program savings significantly. We describe the differences in the ex ante and ex post savings calculations for all program measures in detail below. Note that while certain inputs may increase savings, others decrease savings. The combination of all inputs brings about the overall realization rate for a specific measure.

- **Waste Heat Factors***:* 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 factors for lighting in the calculation of ex post savings, but will include calculations with waste heat factors for the cost-effectiveness analysis[15]. The realization rate discrepancy for standard and specialty CFLs is due to the ex ante savings including waste heat factors for electric heating, which is an average 6.35% kWh penalty. Further, the average kWh penalty for LED exit signs and modular pin-based CFLs is 14%. Given that we did not include waste heat factors in the ex post analysis, the average kWh realization rate for ex post savings for standard and specialty CFLs is 1.07 and 1.16 for LED exit signs and modular interior CFLs. Had we applied the electric waste heat factors, the average kWh realization rate for ex post values would have been reduced and the realization rate would have been close to 100%.

- **Ex Ante Per-Unit Value for Modular CFLs***:* Ex ante savings for modular CFLs installed in exterior common areas are overestimated in the ex ante data by almost 70% for unknown reasons. CSG provided secondary documentation indicating that they used per unit savings values to estimate ex ante savings that match those used by the evaluation team to estimate ex post savings. However, it appears that the program misapplied these ex ante per-unit values in the program-tracking database. Despite this error, overall program savings are not significantly affected given that savings for this measure account for less than 1% of the program's reported savings.

- **Hours of Use:** For low-flow shower heads, the implementer estimated ex ante demand savings based on the hours of use for single family homes (431 hrs./yr.) instead of the hours of use for multifamily dwellings (354 hrs./yr.). For this reason, the per unit ex ante demand savings are 18% lower than the per unit ex post demand savings. Demand savings for low-flow shower heads accounts for 13% of the program's total reported kW savings; however, other measures (such as lighting) play a larger role at the program level, and therefore demand savings from low-flow shower heads has little impact on the program's overall performance.

- **Deemed Heating Consumption Values:** The Statewide TRM stipulates a deemed value for heating consumption (gas and electric) that varies by climate zone for use in estimating savings for programmable thermostats. The implementer applied heating consumption values for Springfield, IL (Climate Zone 3) for all participants to estimate ex ante calculations whereas the evaluation team used the heating consumption values for each participant based on the specific project location to estimate ex post savings. By applying the same heating consumption value to all participants, the ex ante values overstate savings by 6% for kWh and 3% for therms. Programmable thermostats make up about 28% of the electric program savings and 43% of the gas program savings. However, because the difference in heating consumption values resulted in a slight discrepancy between ex ante and ex post savings, it does not affect the program's overall realization rate.

- **CDD, HDD, and Full Load Cooling Hours (FLHclg)***:* Ex ante savings calculations used the same values for CDD, HDD, and FLHclg for all projects regardless of project location while the ex post savings used the actual location. The PY6 ex ante approach is consistent with that taken by CSG in PY5 (using inputs for Springfield for all participants). However, inputs for Springfield were not representative of the population in PY6, as more customers were in warmer areas. As a result, the per-unit savings for shell measures decreased by an average of 18% due to the change in HDDs (i.e., fewer HDD) and increased by an average of 23% due to the changes in CDDs.

- **Baseline Efficiency:** The implementer applied a weighted average of baseline cooling and heating efficiencies provided in the Statewide TRM to estimate ex ante savings. As such, the implementer used

[15] Appendix E provides the program savings with these factors included

a baseline cooling efficiency of 10.3 SEER to estimate ex ante savings for all major measure projects. In contrast, the evaluation team used the equipment efficiencies provided in the "Incentive Application" tab within the program-tracking database to calculate ex post savings for all projects. For comparison purposes, the average SEER using actual efficiency data yields a 9.3 SEER (10% 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 36%.

- **Pre and Post R-values:** 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 (a delta R-value of 38). 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-8 and the actual post R-value is R-49 for a delta R-value of 41.

- **Framing Factor (Attic Insulation):** The algorithm within the Statewide TRM Version 2 requires that the framing factor for attic insulation be divided by two. Ex ante calculations did not divide the framing factor by two, except for homes with cooling only, and as such underestimated savings. The per-unit savings for attic insulation increased by 8% when appropriately dividing the framing factor by two.

- **Latent Multiplier for Air Sealing:** 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. As described above, Springfield was not representative for the population in PY6 and the per-unit savings for air sealing measures decreased by an average of 8% when using the actual project location.

- **Nheat for Air Sealing:** The Nheat conversion factor (converting CFM50 to CFMnat) is based on the climate zone, building height, and exposure levels. The ex ante savings calculations applied a Nheat of 16.7 (assuming 1.5 stories) to all homes. The database does not include the number of stories per participant, and therefore ex post calculations used the average Nheat value for all possible stories (a value of 15.75). Because this ex post input value is higher, the per-unit savings for air sealing measures increased by an average of 5%.

4.3.3 Net Impacts

Overall, total net energy and demand impacts for the PY6 Multifamily Program are 9,075 MWh, 0.98 MW, and 100,143 therms. The net realization rate is 98% for electric savings, 102% for demand savings, and 97% for gas savings, as shown in Table 22.

Table 22. Multifamily Program Net Impacts by Program Component

Component	Ex Ante NTGR (MWh / Therm)	Ex Ante Net Impacts			Ex Post NTGR (MWh / Therm)	Ex Post Net Impacts		
		MW	MWh	Therms		MW	MWh	Therms
In-Unit	1.0 / 1.0	0.58	7,550	98,905	1.0 / 1.0	0.60	7,487	97,457
Common Area Lighting	1.0 / 1.0	0.10	708	n/a	0.80 / n/a	0.08	591	n/a
Major Measures	0.93 (insulation) 1.0 (air sealing)	0.28	1,009	4,330	0.94 / 0.80	0.30	998	2,687
Total		**0.96**	**9,268**	**103,235**		**0.98**	**9,075**	**100,143**
					Net Realization Rate	*1.02*	*0.98*	*0.97*

In determining the overall net savings associated with the Multifamily Program, the team applied the NTGRs shown in Table 23 to the gross impacts for each installed measure. Note that the source of these NTGRs is from prior evaluations.

Table 23. PY6 Multifamily Program NTGRs

Component	Electric NTGR			Gas NTGR			Source
	Free-Ridership	Participant Spillover	NTGR	Free-Ridership	Participant Spillover	NTGR	
In-Unit	0.00	--	1.00	0.00	--	1.00	PY2
Common Area Lighting	0.20	--	0.80			N/A	PY2
Major Measures	0.06	0.00	0.94	0.20	0.00	0.80	PY5

Outside of gross savings adjustments, differences in ex ante net savings and ex post net savings are due to the application of different major measures and common area lighting NTGRs. In particular, the program tracking system applied a NTGR of 0.93 for attic insulation measures and 1.0 for air sealing measures to estimate ex ante net savings, as opposed to applying a NTGR of 0.94 for electric savings and 0.80 for gas savings as specified for major measures in the evaluation plan. Further, ex ante net savings are based on a NTGR of 1.0 for all common area lighting measures, whereas the ex post net savings are based on a NTGR of 0.80 as indicated in Table 23. Table 24 provides net impacts by measure type.

Table 24. PY6 Multifamily Program Net Impacts by Component and Measure

Component	Measure	Ex Ante Net Impacts			Ex Post Net Impacts			Net Realization Rate*		
		kWh	kW	Therms	kWh	kW	Therms	kWh	kW	Therms
In-Unit	Standard CFLs – Interior	2,343,875	260.0	n/a	2,412,343	251.4	n/a	1.03	0.97	n/a
	Standard CFLs – Exterior	177	0.0	n/a	141	0.0	n/a	0.80	n/a	n/a
	Specialty CFLs – Interior	236,347	24.8	n/a	252,718	24.9	n/a	1.07	1.00	n/a
	Faucet Aerator	450,349	173.5	13,018	448,414	172.7	12,973	1.00	1.00	1.00
	Shower Head	1,907,969	122.9	41,819	1,907,969	149.8	41,818	1.00	1.22	1.00
	Programmable Thermostat	2,611,748	n/a	44,067	2,464,941	0.0	42,666	0.94	n/a	0.97
Common Area Lighting	Standard CFLs – Interior	382,582	53.0	n/a	327,247	42.4	n/a	0.86	0.80	n/a
	Standard CFLs – Exterior	76,793	7.7	n/a	61,434	6.2	n/a	0.80	0.81	n/a
	Specialty CFLs – Interior	14,581	2.0	n/a	12,472	1.6	n/a	0.86	0.80	n/a
	Modular CFLs – Interior	16,675	2.5	n/a	15,465	2.0	n/a	0.93	0.80	n/a
	Modular CFLs – Exterior	14,171	2.1	n/a	3,490	0.0	n/a	0.25	0.00	n/a
	Linear Fluorescent T8s	119,021	17.6	n/a	95,217	14.1	n/a	0.80	0.80	n/a
	LED Exit Sign	59,646	8.1	n/a	55,356	6.5	n/a	0.93	0.80	n/a

	Occupancy Sensor	24,910	7.2	n/a	19,927	5.7	n/a	0.80	0.79	n/a
Major Measures	Air Sealing	794,527	265.5	3,280	746,664	266.5	2,189	0.94	1.00	0.67
	Attic Insulation	214,423	13.3	1,050	250,938	31.5	498	1.17	2.37	0.47
Total		**9,267,793**	**960**	**103,235**	**9,074,737**	**975**	**100,143**	**0.98**	**1.02**	**0.97**

Note: Numbers may not total due to rounding.

* Net Realization Rate = ex post net value ÷ ex ante net value.

4.4 Conclusions and Recommendations

The Multifamily Program had a strong year in PY6. As part of efforts to keep the program running smoothly, AIC and CSG made several changes to the program design and implementation processes. These changes included the introduction of specialty bulbs to retrofit incandescent globes, reflector bulbs, and candelabra base bulbs. In addition, the program team reintroduced the Major Measures component with a revised reservations system to continue the provision of insulation measures to multifamily buildings. Program staff also enhanced marketing efforts through access to a larger number of multifamily properties through a collaboration with AIC's Property Management Group.

Participation in the In-Unit and Common Area Lighting components of the program also continued to grow, and, while participation in the Major Measures component was lower than in prior years due to a 3-month implementation time frame, the re-introduction of the offering provided additional energy efficiency options for eligible customers. Further, cross-component participation increased in comparison to PY4, when the evaluation team last conducted this analysis. In particular, 57 property managers (26%) participated in more than one program component in comparison to 6 (3%) in PY4. The property manager survey identified a lack of awareness of the Common Area Lighting and Major Measures components as the main barrier to cross-participation.

Property managers continue to be satisfied with the program, giving mean satisfaction scores of 8.9 or higher on a scale of 0 ("Very dissatisfied") to 10 ("Very satisfied") for all aspects of the program. In addition, cold calling continues to be an effective way to reach potential participants as illustrated by the fact that it was the most frequently mentioned source of information about the program.

Finally, the team found that overall the program-tracking database is comprehensive in terms of the type of data tracked and the extent to which database fields are populated. However, there are a number of small changes that CSG could make to improve the outcome of future impact analyses. The evaluation team is also confident that the program team resolved data tracking issues from PY5, where tenant contact information was mixed with program manager records.

Based on these findings, the evaluation team makes the following recommendations for improving the program in PY7.

- **Consider the development of leave-behind marketing materials to educate participants about other program components**. As illustrated by the property manager survey, the lack of awareness about different program components is the biggest barrier to cross-component participation. Current onsite interactions with customers during the installation process provide a potential opportunity to share additional program information. While it may not be feasible to create new marketing collateral within the current program budget, program staff should consider whether they could invest in communicating with participants in this way in future program years.

- **Make changes to the data tracking process**. The outcome of the PY6 impact evaluation led the evaluation team to make a number of recommendations related to the data tracked by CSG. These recommendations include:
  - Track kW-controlled values based on the type of occupancy sensor installed by the program.
  - Track whether exit signs replaced by program measures are fluorescent or incandescent.
  - Track the building number separately from the postal address to aid in the verification of addresses in future survey efforts.
  - Explore, and, if feasible, resolve discrepancies between the fuel type listed in the "Incentive Application" data tab and the data tabs that provide more detailed information on measures for electric customers (MF_Electric) and gas customers (MF_Gas).

4.5 Inputs for Future Planning

In PY6, the evaluation gathered data to update the Multifamily Program's In-Unit and Common Area Lighting NTGRs for application in PY8. The team developed the new NTGRs based on self-reported information from the telephone survey with property managers, as well as the Internet survey with tenants. Both surveys quantify the percentage of the gross program impacts that can reliably be attributed to the program. Appendix C provides detailed information about the methodology, as well as the results.

Table 25. Updated NTGRs for the Multifamily Program

Component	Measure	Free-Ridership	Participant Spillover	NTGR (1 – Free-Ridership + Spillover)
Common Area Lighting	All Measures	0.23	0.06	0.83
In-Unit	CFLs	0.11	0.06	0.95
	Programmable Thermostats	0.02	0.06	1.04
	Faucet Aerators	0.00	0.06	1.06
	Low-Flow Shower Heads	0.06	0.06	1.00

A. Appendix – Engineering Analysis Algorithms

In PY6, 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) V2.0 (2013)[16] to the information in the program-tracking database.

We present the algorithms used to calculate all evaluated 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 26. Baseline Wattages for Lighting Measures

Measure	EISA Adjusted*	Baseline Wattage	Resource
Standard Spiral CFL – 13W	No	60	IL TRM V2.0
Standard Spiral CFL – 15W	No	60	IL TRM V2.0
Standard Spiral CFL – 20W	Yes	53	IL TRM V2.0
Standard Spiral CFL – 23W	Yes	72	IL TRM V2.0
Specialty CFL – 9W Candelabra	No	40	IL TRM V2.0
Specialty CFL – 14W Globe	No	60	IL TRM V2.0
Specialty CFL – 15W Reflector	No	65	IL TRM V2.0
Modular (Pin-based) CFL – 18W**	No	80 (Interior) 60 (Exterior)	Actual from Database
Modular (Pin-based) CFL – 13W	No	60	Actual from Database

* The EISA schedule requires baseline adjustments to measures with incandescent baseline wattages of 100W (as of June 2012) and 75W (as of June 2013). Lighting measures with incandescent baseline wattages of 60W and 40W are scheduled for EISA adjustments beginning June 2014. This will affect the PY7 lighting estimates.

** Actual existing wattages for Modular 18W CFLs were provided by the implementer. Those installed in interior locations had baseline wattages of 80W and those installed in exterior locations had baseline wattages of 60W.

WattsEE = Wattage of installed equipment (actual wattage used)

ISR = In-service rate or the percentage of units rebated that get installed = 96.9%[17]

[16] State of Illinois: Energy Efficiency Technical Reference Manual V2.0. Effective June 1, 2013.

[17] Per value in IL TRM V2.0.

Hours = Annual operating hours

Table 27. Annual Hours of Use for Lighting Measures

Measure	Installation Location	Hours
Standard Spiral CFL – 13W	Common Area Interior	5,950
Standard Spiral CFL – 20W		
Standard Spiral CFL – 23W		
Specialty CFL – 15W Reflector		
Modular (Pin-based) CFL – 18W		
Standard Spiral CFL – 13W	Common Area Exterior	1,825
Standard Spiral CFL – 20W		
Standard Spiral CFL – 23W		
Modular (Pin-based) CFL – 13W		1,643
Modular (Pin-based) CFL – 18W		
Standard Spiral CFL – 15W	In-Unit Interior	938
Standard Spiral CFL – 20W		
Standard Spiral CFL – 23W		
Specialty CFL – 15W Reflector		
Specialty CFL – 9W Candelabra		1,328
Specialty CFL – 14W Globe		1,240
Specialty CFL – 15W Reflector	In-Unit Exterior	1,825

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 28. 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 29. Coincidence Factors for Lighting Measures

Measure	Installation Location	CF
Standard Spiral CFL – 13W	Common Area Interior	0.75
Standard Spiral CFL – 20W		
Standard Spiral CFL – 23W		
Specialty CFL – 15W Reflector		
Modular (Pin-based) CFL – 18W		

Measure	Installation Location	CF
Standard Spiral CFL – 13W	Common Area Exterior	0.184
Standard Spiral CFL – 20W		
Standard Spiral CFL – 23W		
Modular (Pin-based) CFL – 13W		0.004
Modular (Pin-based) CFL – 18W		
Standard Spiral CFL – 15W	In-Unit Interior	0.095
Standard Spiral CFL – 20W		
Standard Spiral CFL – 23W		
Specialty CFL – 15W Reflector		
Specialty CFL – 9W Candelabra		0.122
Specialty CFL – 14W Globe		0.116
Specialty CFL – 15W Reflector	In-Unit Exterior	0.184

Linear Fluorescent Lighting

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

Equation 2. Linear Fluorescent Algorithms

Energy Savings: $\Delta kWh = ((WattsBase - WattsEE) / 1000) * ISR * Hours * WHF_e$

Demand Savings: $\Delta kW = ((WattsBase - WattsEE) / 1000) * ISR * WHF_d * CF$

Where:

WattsBase = Wattage of existing equipment (actual wattage from database)

WattsEE = Wattage of installed equipment (actual wattage from database)

ISR = In-service rate or the percentage of units rebated that get installed = 100%

Hours = Annual operating hours for common area installs = 5,950 hours/year

WHF_e = Waste heat factor for energy (accounts for cooling savings from efficient lighting) = 1.34

WHF_d = Waste heat factor for demand (accounts for cooling savings from efficient lighting) = 1.57

CF = Summer Peak Coincidence Factor = 0.75

LED Exit Signs

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

Equation 3. LED Exit Sign Algorithms

Energy Savings: $\Delta kWh = ((WattsBase - WattsEE) / 1000) * Hours * WHF_e$

Demand Savings: $\Delta kW = ((WattsBase - WattsEE) / 1000) * WHF_d * CF$

Where:

WattsBase = Wattage of existing incandescent exit sign = 35W

WattsEE = Wattage of installed LED exit sign = 2W

Hours = Annual operating hours = 8,766 hours/year

WHF_e = Waste heat factor for energy (accounts for cooling savings from efficient lighting) = 1.04

WHF_d = Waste heat factor for demand (accounts for cooling savings from efficient lighting) = 1.07

CF = Summer Peak Coincidence Factor = 1.0

Occupancy Sensors

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

Equation 4. Lighting Control Occupancy Sensor Algorithms

$$\textit{Energy Savings: } \Delta kWh = kW_{controlled} * Hours * ESF * WHF_e$$

$$\textit{Demand Savings: } \Delta kW = kW_{controlled} * WHF_d * (CF_{baseline} - CF_{occupancy})$$

Where:

$kW_{controlled}$ = Total wattage controlled by each occupancy sensor = 0.06 kW[18]

Hours = Annual operating hours of light fixtures being controlled = 5,950 hours/year

ESF = Energy savings factor that represents the reduction in operating hours = 41% (Wall mounted occupancy sensors)

WHF_e = Waste heat factor for energy (accounts for cooling savings from efficient lighting) = 1.34

WHF_d = Waste heat factor for demand (accounts for cooling savings from efficient lighting) = 1.57

$CF_{baseline}$ = Summer Peak Coincidence Factor for fixtures without occupancy sensors = 0.75

$CF_{occupancy}$ = Summer Peak Coincidence Factor for fixtures controlled by occupancy sensors = 0.15

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 data for the PY6 cost-effectiveness analysis.

[18] CSG confirmed that one occupancy sensor controls four 15W CFLs for a total of 60W controlled per sensor.

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 5. Heating Penalty Algorithms for In-Unit Lighting

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

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

Where:

WattsBase = Wattage of existing equipment (see Table 26)

WattsEE = Wattage of installed equipment

ISR = In-service rate or the percentage of units rebated that get installed = 97%[19]

Hours = Annual operating hours (see Table 27)

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)

Table 30 summarizes the heating penalties for the six lighting measures installed in multifamily units offered through the program by heating equipment type.

Table 30. Heating Fuel Penalties for In-Unit (Interior) Lighting

Measure	Heating Equipment	ΔkWh	Δtherms
Standard Spiral CFL – 15W	Heat Pump (htg only)	-10.02	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		-13.54	n/a
Specialty CFL – 15W Reflector		-11.13	n/a
Standard Spiral CFL – 15W	Electric Resistance	-20.04	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		-27.08	n/a
Specialty CFL – 15W Reflector		-22.27	n/a
Standard Spiral CFL – 15W	Gas Heating	n/a	-0.98
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	-1.32
Specialty CFL – 15W Reflector		n/a	-1.09

[19] Per IL TRM V2.0.

Common Area Lighting Heating Penalties

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

Equation 6. Heating Penalty Algorithms for Common Area Lighting

*Heating Therm Savings: Δtherms = (((WattsBase – WattsEE) / 1000) * ISR * Hours * -IFTherms*

Where:

WattsBase = Wattage of existing equipment

WattsEE = Wattage of installed equipment

Table 31. Baseline and Installed Wattages for Lighting Measures

Measure	Installed Location	Baseline Wattage	Installed Wattage
Standard Spiral CFL	Common Area Interior	See Table 26	Actual
Specialty CFL	Common Area Interior	See Table 26	Actual
Modular CFL	Common Area Interior	Actual	Actual
LED Exit Sign	Common Area Interior	35W[a]	2W[a]
Linear Fluorescent T8	Common Area Interior	Actual	Actual

[a] Baseline wattage for incandescent exit sign per IL TRM is 35W. LED exit sign wattage per IL TRM is 2W.

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

Table 32. In-Service Rates for Lighting Measures

Measure	Installed Location	In-Service Rate
Standard Spiral CFL	Common Area Interior	96.9%
Specialty CFL	Common Area Interior	96.9%
Modular CFL	Common Area Interior	96.9%
LED Exit Sign	Common Area Interior	100%
Linear Fluorescent T8	Common Area Interior	100%

Hours = Annual operating hours

Table 33. Annual Hours of Use for Lighting Measures

Measure	Installed Location	Hours
Standard Spiral CFL	Common Area Interior	See Table 27
Specialty CFL	Common Area Interior	See Table 27
Modular CFL	Common Area Interior	5,950
LED Exit Sign	Common Area Interior	8,766
Linear Fluorescent T8	Common Area Interior	5,950

IFTherms = Waste heat factor that accounts for the increase in gas space heating due to the decrease in rejected heat from efficient lighting = 0.015

Table 34 summarizes the heating penalties for the lighting measures installed in common areas offered through the program.

Table 34. Heating Fuel Penalties for Common Area (Interior) Lighting

Measure	Heating Equipment	Δtherms
Standard Spiral CFL – 13W	Gas Heating[a]	-4.06
Standard Spiral CFL – 20W		-2.85
Standard Spiral CFL – 23W		-4.24
Specialty CFL – 15W Reflector		-4.32
Modular (Pin-based) CFL – 18W		-5.36
LED Exit Sign		-4.34
Linear Fluorescent T8 (40W to 32W)		-0.71
Linear Fluorescent T8 (120W to 90W)		-2.68
Linear Fluorescent T8 (60W to 30W)		-2.68
Linear Fluorescent T8 (60W to 32W)		-2.50
Linear Fluorescent T8 (40W to 28W)		-1.07

[a] Heating fuel type unknown. IL TRM assumes gas heating when heating fuel type is unknown.

Occupancy Sensor Heating Penalties

The evaluation team determined heating penalties for lighting where hours of use are reduced due to the installation of lighting controls. Occupancy sensors for this program were installed on fixtures that are located within interior common areas. Heating penalties are calculated for gas heating fuel only, as the fuel type for interior common areas is unknown. The IL TRM assumes gas heating fuel when the heating fuel type is unknown.

Equation 7. Heating Penalty Algorithms for Occupancy Sensors

$$\textit{Heating Therm Savings: } \Delta therms = \Delta kWh * - IFTherms$$

Where:

ΔkWh = Energy savings per installed occupancy sensor = 196.1 kWh

IFTherms = Waste heat factor that accounts for the increase in gas space heating due to the decrease in rejected heat from efficient lighting = 0.015

Table 35 summarizes the heating penalties for the lighting measures where occupancy sensors are installed.

Table 35. Heating Fuel Penalties for Fixtures with Occupancy Sensors

Measure	Heating Equipment	Δtherms
Occupancy Sensors	Gas Heating[a]	-2.94

[a] Heating fuel type unknown. IL TRM assumes gas heating when heating fuel type is unknown.

Water Heating Measure Algorithms

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

Equation 8. Shower Head Algorithms

Energy Savings: $\Delta kWh = \%ElectricDHW * ((GPM\_base * L\_base - GPM\_low * L\_low) * Household * SPCD * 365.25 / SPH) * EPG\_electric * ISR$

Demand Savings: $\Delta kW = \Delta kWh / Hours * CF$

Therm Savings: $\Delta Therms = \%FossilDHW * ((GPM\_base * L\_base - GPM\_low * L\_low) * Household * SPCD * 365.25 / SPH) * EPG\_gas * ISR$

Equation 9. Faucet Aerator Algorithms

Energy Savings: $\Delta kWh = \%ElectricDHW * ((GPM\_base * L\_base - GPM\_low * L\_low) * Household * 365.25 * DF / FPH) * EPG\_electric * ISR$

Demand Savings: $\Delta kW = \Delta kWh / Hours * CF$

Therm Savings: $\Delta Therms = \%FossilDHW * ((GPM\_base * L\_base - GPM\_low * L\_low) * Household * 365.25 * DF / FPH) * EPG\_gas * ISR$

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 shower head or faucet aerator

GPM_low = As-used flow rate of the low-flow shower head or faucet aerator

Table 36. GPM for Water Heating Measures

Measure	GPM_base	GPM_low
Faucet Aerator	1.20	0.94
Shower Head	2.67	1.75

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

Table 37. L_base for Water Heating Measures

Measure	Minutes
Faucet Aerator	9.85
Shower Head	8.20

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 = 0.75

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

EPG_gas = Energy per gallon of hot water supplied by gas

Table 38. EPG for Water Heating Measures

Measure	EPG_electric	EPG_gas
Faucet Aerator	0.0894	0.0045
Shower Head	0.1270	0.0063

ISR = In-service rate for multifamily units

Table 39. ISR for Water Heating Measures

Measure	ISR
Faucet Aerator*	93%
Shower Head	93%

* Unknown location of installation. Average in-service rate for kitchen and bathroom

Hours = Annual electric DHW recovery hours

Table 40. Hours for Water Heating Measures

Measure	Hours
Faucet Aerator[a]	57
Shower Head[b]	354

[a] Hours of use for multifamily with unknown location
[b] Hours of use for multifamily direct install

CF = Coincidence factor for electric load reduction

Table 41. 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 10. 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 42. Electric Heating Consumption by Climate Zone

Climate Zone	kWh	
	Electric Resistance	Heat Pump
1 (Rockford)	26,038	13,019
2 (Chicago)	24,875	12,438
3 (Springfield)	21,304	10,652
4 (Belleville)	16,434	8,217
5 (Marion)	16,726	8,363

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

Table 43. Gas Heating Consumption by Climate Zone

Climate Zone	Therms
1 (Rockford)	889
2 (Chicago)	849
3 (Springfield)	727
4 (Belleville)	561
5 (Marion)	571

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.

Equation 11. Air Sealing Algorithms

Energy Savings: $\Delta kWh = \Delta kWh\_cooling + \Delta kWh\_heating$

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

$$\Delta kWh\_heating\ (electric\ heat) = (((CFM50\_existing - CFM50\_new)/N\_heat) * 60 * 24 * HDD * 0.018) / (\eta Heat * 3{,}412)$$

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[20]

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

Table 44. 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)

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

[20] Assumed CZ2 Normal Exposure.

Table 45. 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[21]

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

Table 46. 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)

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

Table 47. 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 = 0.915

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

Attic Insulation Algorithms

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

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

Equation 12. Attic Insulation Algorithms

Energy Savings: $\Delta kWh = \Delta kWh\_cooling + \Delta kWh\_heating$

$$\Delta kWh\_cooling = (((1/R\_old - 1/R\_new) * A\_attic * (1-Framing\_factor/2)) * 24 * CDD * DUA) / (1000 * \eta Cool)$$

$$\Delta kWh\_heating\ (electric\ heat) = (((1/R\_old - 1/R\_new) * A\_attic * (1-Framing\_factor/2))) * 24 * HDD) / (\eta Heat * 3412)$$

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

Gas Savings (gas heat): $\Delta Therms = (((1/R\_old - 1/R\_new) * A\_attic * (1-Framing\_factor/2)) * 24 * HDD) / (\eta Heat * 100{,}067\ Btu/therm)$

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

Where:

R_new = Total attic assembly R-value after the installation of additional insulation (see Equation 13 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 13 for assembly R-value algorithms)

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

Framing_factor = Adjustment to account for area of framing = 0.15 (framing factor included in the assembly R-value algorithms; see Equation 13)

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

Table 48. Cooling Degree Days by Climate Zone

Climate Zone	CDD
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 of cooling system (used actual from database)

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

Table 49. Heating Degree Days by Climate Zone

Climate Zone	HDD
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)

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

Table 50. 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 = 0.915

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 13 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 13. Attic Assembly R-value Algorithms

$$\textit{Attic Assembly R-value} = ((1/\textit{R-value}_{database}) * \%\ \textit{of Assembly} + 1/\textit{R-value}_{Joist} * \textit{Framing\_Factor}/2) + (\textit{R-value}_{indoor\ air\ film} + \textit{R-value}_{plywood} + \textit{R-value}_{gypsum} + \textit{R-value}_{indoor\ air\ film})$$

Where:

$\text{R-value}_{database}$ = 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 = 0.15

Figure 5: 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	16.22
3	Joist (nominal 5.5") - southern pine	5.78		3	Joist (nominal 5.5") - southern pine	5.8	
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		18.9
	U value		0.28		U value		0.05
	% of assembly	0.925	0.075		% of assembly	0.925	0.075
	U of assembly	0.28			U of assembly	0.05	
	R of assembly	3.58			R of assembly	18.88	

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

B. Appendix – Data Collection Instruments

Ameren PY6 MF
Tenant Survey FINAL

Ameren PY6 MF
Program Manager S

C. Appendix – NTGR Results

Methodological Overview

One goal of the PY6 Multifamily Program evaluation was to develop an updated net-to-gross ratio (NTGR) for common area lighting and in-unit measures. Program net impacts are expressed as a NTGR that uses free-ridership (FR) and spillover (SO) rates as its components. FR represents the percent of savings that would have been achieved if customers had not participated in the program. SO represents additional savings that were achieved without program incentives, but would not have happened in the absence of the program.

The formula used to calculate the NTGR can be expressed as:

$$NTGR = 1 - FR + Participant\ SO$$

The evaluation team relied on the self-report method to derive both FR and SO estimates. Using the property manager and tenant surveys, the evaluation team interviewed program participants and asked a series of structured questions about the influence of the program on the decision to install energy efficient equipment. Below we present the algorithms for estimation of the NTGR based on these surveys.

Free-Ridership

The goal of most incentive-based energy efficiency programs is to influence customer decision making regarding the installation of energy using equipment or changes to a building structure. Programs can do this by changing what customers install, when they install it, and how much they install. In other words, programs influence the efficiency, timing, and quantity of customers' energy using equipment installations.

Most program savings is typically achieved by encouraging customers to install higher efficiency equipment than they would have installed on their own. Programs may also encourage early replacement of still functioning equipment that is less efficient, thus impacting the timing of the installation so that savings is realized earlier. The incentive may also make it more affordable for customers to install a greater number of high efficiency measures.

The FR algorithm outlined here combines estimates of each of these concepts:

- Program influence on the efficiency level of the installed equipment (EI)
- Program influence on the timing of the installation of high efficiency equipment (TI)
- Program influence on the quantity of the high efficiency equipment installed (QI)

Each concept takes a value between 0 and 1. The values are expressed in FR terms, with 0 meaning no FR and 1 meaning full FR.

The EI and QI scores are multiplied and then averaged with the TI score. This averaging would only apply to cases when the TI score is lower than the product of the EI and QI scores. In cases where the timing score exceeds the product of EI and QI, the FR rate is based on just the product of the EI and QI scores. This selective averaging is important so that the program is not penalized for having a smaller influence on the timing of the project than the efficiency and scope of the project. The formula to calculate FR using the selective averaging approach is expressed as:

$$IF\ EI \geq 0.50\ AND\ TI > (EI*QI),\ THEN\ FR = EI*QI$$

*IF EI≥0.50 AND TI≤(EI*QI), THEN FR=AVERAGE((EI*QI);TI)*

ALL OTHER CASES, FR=EI

Below is further detail on the how the team calculated each influence score, along with a sample survey question measuring each area of influence. Overall, the team calculated estimates of efficiency, timing, and quantity for those participants who reported having plans to install program measures at the time they learned of the program.[22]

Program Influence on Equipment Efficiency (EI)

As part of the Multifamily Program, customers can install common area measures, as well as in-unit measures. The in-unit measures are free and are evaluated using both the property manager and tenant surveys.[23] For the common area measures, the program provides incentives for the installation of select lighting measures. As such, the property manager survey contained program attribution questions related to common area CFLs, T-8s, occupancy sensors, and LED exit signs. The tenant survey covered only CFLs.

Overall, we measured program influence on equipment efficiency level by asking participants to estimate the likelihood of the installation if they had not participated in the program using a 11-point scale (where 0 is "not at all likely" and 10 is "extremely likely"). The team used this approach based on the belief that a likelihood scale is easy to answer and as such will yield reliable responses.

Survey Questions

EIA – Program Influence on Efficiency

Tenant Example:

FR1. If you had **not** received Compact Fluorescent Light (CFL) bulbs through the program, how likely is it that you would have removed all or some of the **working** incandescent light bulbs in the permanent fixtures in your household and replaced them with CFLs? Please use a scale that ranges from 0 to 10, where 0 is "not at all likely" and 10 is "extremely likely."

Property Manager Example:

NC1. If you had not received it through the program, how likely is it that you would have purchased and installed <MEASURE> in the common areas of your building? Please use a scale that ranges from 0 to 10, where 0 is "not at all likely" and 10 is "very likely."

PROGRAM INFLUENCE ON EFFICIENCY CALCULATION:

EIA = FR1 / 10 IF FR1 < 11

EIA = SYSMIS IF FR1 = 98 OR 99

[22] The team used a screening question in both surveys. The property manager example is QNC0: "At the time you learned about the program, did you already have plans to install <MEASURE> in the common areas of your property?" Those who answered no were considered non-free-riders.

[23] The tenant survey specifically covered attribution related to in-unit CFLs. All other in-unit measures were explored through the property manager survey.

Program Influence on Equipment Efficiency (EI) – CFL Adjustment

As noted above, we measure program influence on equipment efficiency level by asking participants whether they would have replaced their *working* non-energy-efficient equipment with efficient measures if it had not been for the program. For CFLs, customers who say they would not have replaced their working light bulbs with CFLs are asked if they would have replaced those bulbs with CFLs when they burned out.

For CFLs, we incorporated an adjustment factor into the efficiency score when participants were not highly likely to have replaced working light bulbs with CFLs on their own (a score of less than 8 on questions NC1 or FR1). As part of this process, we asked participants about their likelihood to replace incandescent bulbs with CFLs upon burnout and adjusted the likelihood score based on the useful life of an incandescent bulb. In particular, we gave the program partial credit for speeding up the installation of CFLs using the following assumptions:

- In-Unit Bulbs: The Illinois Statewide TRM assumes 938 hours for a residential incandescent bulb at 2.98 hours per day. Because the useful life of a residential incandescent bulb is approximately 1 year from installation and we do not know when the bulbs were installed, we assumed the average bulb was likely to burn out within 6 months. Since the program sped up the installation of CFLs by 6 months for the average in-unit bulb, we give the program half credit for these installations based on the likelihood score for these installations.
- Common Area Bulbs: The Illinois Statewide TRM assumes 5,950 hours annually for a non-residential incandescent bulb at 16.3 hours per day. Given the greater program impact of getting CFLs into non-residential sockets earlier, we give the program 96% of the likelihood score for these installations.

EIB – Program Influence on Efficiency

Tenant Example:

FR4. If you had not received Compact Fluorescent Light (CFL) bulbs through the program, how likely is it that you would have replaced any incandescent light bulbs in the permanent fixtures in your household with CFLs, **when they burned out**? Please use a scale that ranges from 0 to 10, where 0 is "not at all likely" and 10 is "extremely likely."

Property Manager Example:

NC4. If you had not received free CFLs through the program, how likely is it that you would have replaced any incandescent light bulbs in the common areas of your property with CFLs when they burned out? Please use a scale that ranges from 0 to 10, where 0 is "not at all likely" and 10 is "very likely."

ADJUSTMENT CALCULATION:

EIB = FR4 / 10

FR = EIB * 0.5 (in-unit)

FR = EI2 * 0.96 (common area)

Program Influence on Timing (TI)

Program influence on timing is measured by asking participants if the installation would have happened later if they had not participated in the program, and, if so, how much later, with the resulting score taking a value between 0 and 1.

We asked respondents who said that the program had sped up the purchase if they would have installed the equipment: at the same time, within a few months of when they installed it through the program, within a year, and more than 1 year later. As mentioned above, the timing question is conditional on at least some probability of the high efficiency installation taking place if the respondent had not participated in the program. As such, we do **NOT** ask the timing question if the following parameter is true:

- Likelihood to install high efficiency equipment is between 1 and 7 (meaning that there is not a high likelihood that a high efficiency installation would have happened if the respondent had not participated in the program)

Essentially, we are asking the timing question only of program participants who had considerable probability of installing high efficiency equipment even if they had not participated in the program (thus making timing conditional on efficiency).

Survey Questions

TI – Program Influence on Timing

Tenant Example:

FR2. If you had not received Compact Fluorescent Light (CFL) bulbs through the program, when would you have removed the working incandescent bulbs from the permanent fixtures in your unit and replaced them with CFLs? Would you say…?
1. At roughly the same time
2. Within a few months
3. Within a year
4. More than a year
8. Don't know

Property Manager Example:

NT2. If you had not received <MEASURE> through the program, when would you have installed the efficient lighting? Would you say…?
1. At roughly the same time
2. Within a few months
3. Within a year
4. (More than a year)
8. (Don't know)
9. (Refused)

PROGRAM INFLUENCE ON TIMING CALCULATION:

TI = 1 IF FR2 = 1

TI = 0.66 IF FR2 = 2

TI = 0.33 IF FR2 = 3

TI = 0 IF FR2 = 4

TI = SYSMIS IF NT2 = 98 OR 99

Program Influence on Quantity (QI)

Program influence on quantity is measured by asking participants if they would have installed a lesser quantity of program measures without the program. Given the range in quantity of the measures that participants may have installed, it was not feasible to list off the exact quantities of different types of lighting equipment installed and whether the program influenced the number of each type installed. Instead, we asked the participant to assess how the program influenced the scope or scale of the overall project.

Similar to the assessment of program influence on timing, program influence on quantity will be conditional on the probability of installing high efficiency equipment if the respondent had not participated in the program. As such, when asking the question, we emphasize to the respondents that we are referring to the high efficiency purchase and **NOT** ask the quantity question if the following parameter is true:

- Likelihood to install high efficiency equipment is between 1 and 7 (meaning that there is not a high likelihood that a high efficiency installation would have happened if the respondent had not participated in the program)

Essentially, we are asking the quantity question **ONLY** of program participants who had considerable probability of installing **HIGH EFFICIENCY** equipment even if they had not participated in the program (thus making quantity conditional on efficiency).

Survey Questions

QI – Program Influence on Quantity

Tenant Example:

FR3. How many CFLs would you have installed?
1. Fewer
2. Same amount
3. (More)
8. (Don't know)
9. (Refused)

Property Manager Example:

NA3. How many would you have installed? Would you have installed fewer or the same amount as was installed through the program?
1. Fewer
2. Same amount
3. (More)
8. (Don't know)
9. (Refused)

PROGRAM INFLUENCE ON QUANTITY CALCULATION:

QI = 0.5 IF FR3 = 1

QI = 1 IF FR3 = 2

QI = 1 IF FR3 = 3

QI = SYSMIS IF FR3 = 8 OR 9

Spillover

As part of the evaluation, we estimated both the presence and magnitude of participant SO with property manager participants. While participant SO can result from a variety of measures, survey length does not allow for estimation of SO across all possible scenarios. Given the type of respondent, as well as the type of program-rebated equipment, the evaluation team explored the SO research measures that could reasonably be expected to be influenced by program participation and would more likely be implemented without the program support.

First survey respondents were asked if they had taken any energy savings actions outside of the program. Those who did were asked how influential the program was on their decision to take energy saving actions. In cases where any energy-efficient improvements were heavily influenced by the program (a score of 8–10 on a scale from 0 to 10, where 0 indicates "no influence" and 10 indicates "greatly influenced"), respondents were asked what improvements they made, as well as a range of equipment-specific questions to allow for estimation of SO savings.

As part of the SO calculation, the evaluation team applied savings values to the measures installed outside of the program. The evaluation team estimated savings for each measure using the Statewide TRM supplemented by engineering assumptions. The evaluation team determined the program-level SO factor by dividing the estimated savings of the measures installed by survey respondents outside of the program but influenced by the program by the savings the survey respondents realized through the program.

$$SO = \frac{Respondent\ energy\ savings\ from\ spillover\ measures\ (kWh)}{Respondent\ energy\ savings\ from\ measures\ installed\ through\ the\ program\ (kWh)}$$

NTGR Results

Overall, the team found low levels of FR associated with the Multifamily Program. As shown below, the NTGRs for the Common Area Lighting and In-Unit program components range from 0.83 to 1.06. These values are in line with prior program planning values for both components, which were 0.80 and 1.00, respectively.

Table 51. Updated Multifamily NTGRS

Component	Measure	FR	Participant SO	NTGR (1 – FR + SO)
Common Area Lighting	All Measures	0.23	0.06	0.83
In-Unit	CFLs	0.11	0.06	0.95
	Programmable Thermostats	0.02	0.06	1.04
	Faucet Aerators	0.00	0.06	1.06
	Low-Flow Shower Heads	0.06	0.06	1.00

We provide additional detail on the FR and SO analyses below.

Free-Ridership

As shown in Table 52, the evaluation team found FR levels generally consistent with past planning NTGRs, which were 0.80 for Common Area Lighting measures and 1.0 for all In-Unit measures. As noted in the table, there are no precision estimates associated with the majority of these figures as they were developed based on data collection with a census of program participants. For the in-unit CFL estimate, the team reviewed results from both the property manager and tenant surveys and found almost identical levels of FR (0.11 and 0.12, respectively. The team presents an average of the two results in the table below.

Table 52. Multifamily FR Estimates

Component	FR	FR Standard Error	FR Relative Precision at 90% Confidence
Common Area Lighting	0.23	N/A	N/A
In-Unit			
CFLs	0.11	0.01*	0.02*
Programmable Thermostats	0.02	N/A	N/A
Faucet Aerators	0.00	N/A	N/A
Low-Flow Shower Heads	0.06	N/A	N/A

* Note: This precision estimate is associated with the tenant survey.

Spillover

Two property managers out of the 33 who completed the survey specified that the program influenced them to install energy efficient measures outside of the program without receiving a rebate. In order to determine the savings associated with these SO measures, the team reviewed the PY6 Multifamily Program tracking database, which contained information on the customer's heating fuel type, location, and the number of units within the multifamily facility. Based on our review of the data, the two SO cases received savings for weatherization measures, such as new windows, weather stripping, and the installation of plastic over windows. We provide the calculated SO savings per measure, as well as the overall SO percentage in Table 53. The team chose to calculate the SO rate based on total verified savings from both the In-Unit and Common Area Lighting components given that the survey respondents took part in both.

Table 1. Table 53. Total Spillover Savings per Measure

Spillover Measure	kWh	kW
New Windows	69,285	2.33
Weather Stripping/Plastic on Windows	8,312	2.46
Total Spillover Savings	**77,597**	**4.79**
Total Verified Savings	**1,330,894**	**163.48**
Spillover Rate	**5.8%**	**2.9%**

NTGR Methods for the Multifamily Program

As part of the PY6 evaluation, the team conducted NTGR research with both property managers and tenants regarding in-unit CFLs. We gathered data from both populations to explore CFL replacement practices for market-rate apartment units in AIC's territory.[24] Based on responses to the tenant survey, we found that more than three-quarters of tenants who confirmed that they resided in a building served by the Multifamily Program and were aware of the bulb installation are responsible for replacing bulbs that burn out in their units (77%). This finding indicates that, in many cases, the counterfactual for the Multifamily Program is what the tenant would install in the absence of the program. As a result, tenant surveys are likely to remain an important aspect of attribution research for this program.

While the two data collection methods used for in-unit CFLs resulted in consistent levels of FR associated with this measure (0.11 for both groups), these findings represent the first time that a comparative analysis has been done of in-unit CFL NTGRs between the two populations (property managers and tenants). Therefore, the evaluation team believes that it is too soon to determine whether one of these data collection methods could be used exclusively for this program.

[24] The ComEd Multifamily Program serves a different population, including low-income and assisted-living properties. As a result, the team felt that it was important to test whether a tenant-based NTGR approach was appropriate for this AIC program.

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).[25] 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).

[25] *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 54 presents total net 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 net program savings are reduced by 9% for kWh and 29% for therms after the application of waste heat factors.

Table 54. PY6 WNCF Net Impacts (Including Heating Penalties)

Measure	Electric Savings (kWh)	Demand Savings (kW)	Gas Savings (Therms)
Total	8,288,648	975	71,015

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 63,192 in-unit lamps and 2,870 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 V2.0 assumes gas heating when space heating fuel types are unknown. Gas heating waste heat factors were applied for all 2,870 lamps installed within common areas. The total gross heating penalty for common area lighting measures is 9,108 therms.

In-Unit Lighting

The heating fuel type is known for 97% (61,272 lamps) of the in-unit lighting measures. For the 1,920 in-unit lamps with unknown heating fuel type, we applied the values shown in Table 55.

Table 55. PY6 WNCF Known Heating Fuel Type for Lighting Measures

Heating Fuel	Heating Equipment	% of Heating Fuel Type Known
Electric	Electric Resistance	65.2
Gas	Furnace/Boiler	34.8

The total gross heating penalty for in-unit lighting measures is 786,089 kWh and 21,842 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
Senior Project Manager

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

1999 Harrison Street
Suite 1420
Oakland, CA 94612