



Ameren Illinois Company 2018 Residential Program Impact Evaluation Report

Final

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1. Executive Summary

This report presents impact evaluation results from Ameren Illinois Company's (AIC) 2018 Residential Electric and Natural Gas Energy Efficiency Program. The Residential Program is part of AIC's overall portfolio of residential and non-residential energy efficiency programs implemented during the 2018 calendar year. The overarching objective of the 2018 impact evaluation is to determine the gross and net electric energy, electric demand, and natural gas impacts associated with the Program.

The Residential Program is made up of eight main initiatives, which the evaluation team assessed as part of the 2018 evaluation:

- Retail Products
- Income Qualified
- Public Housing
- Behavioral Modification
- Heating and Cooling (HVAC)
- Appliance Recycling
- Multifamily
- Direct Distribution of Efficient Products (Direct Distribution)

In addition, the 2018 impact evaluation includes an assessment of impacts from two efforts that we do not expect to be implemented in future years:

- Smart Savers
- DCEO New Construction Commitments (DCEO NC Commitments)

1.1 Background

This is the first year of the four-year 2018 Plan period, during which AIC will operate its energy efficiency programs in accordance with Illinois Senate Bill 2814 (the Future Energy Jobs Act [FEJA]) for the first time. Passage of FEJA has led to a number of significant changes in energy efficiency program delivery in Illinois including the following:

- **Discontinuation of energy efficiency programs funded through the Illinois Power Agency (IPA):** Energy efficiency programs adopted through the IPA procurement plan process and previously available to AIC customers, including several residential programs, ended on May 31, 2017.
- **Discontinuation of energy efficiency programs offered through the Illinois Department of Commerce and Economic Opportunity (DCEO):** Prior to the Transition Period (June 1, 2017 to December 31, 2017), public housing facilities were ineligible for AIC energy efficiency programs and instead were served by programs offered through the DCEO. As of June 1, 2017, these customers became eligible for AIC programs and the Transition Period allowed AIC to begin to integrate these customers into its programs and beginning in 2018, public housing facilities served by AIC are fully eligible for the AIC Residential Program in the same manner as other AIC customers.

- **Shift to Cumulative Persisting Annual Savings (CPAS):** Beginning in 2018, electric energy savings goals for Illinois utilities are primarily defined based on persisting savings as a percentage of sales. As such, annual evaluations of AIC's electric programs, including this one, present both annual, as well as persisting savings over the life of delivered measures. As a result, AIC and its implementer have also sought to deliver programs that achieve savings that persist for a longer period of time savings.
- **Calculation of Weighted Average Measure Life (WAML):** FEJA replaces the existing funding mechanism for electric energy efficiency in Illinois by allowing AIC to create a regulatory asset and amortize and recover the total expenditures of that regulatory asset "over a period that is equal to the weighted average of the measure lives implemented for that year that are reflected in the regulatory asset."¹ Therefore, we present WAML for AIC's electric Residential Program in this report in accordance with the guidelines for calculation presented in the Illinois Stakeholder Advisory Group's (SAG) WAML Report.²

1.2 Program Savings

Within the following sections, the evaluation team presents Annual Savings (annualized 2018 energy savings), and CPAS. As discussed in greater detail within the forthcoming 2018 AIC Integrated Impact Evaluation Report, AIC's performance against its Applicable Annual Incremental Goal (AAIG)³ is determined based on both types of program savings.

1.2.1 Annual Savings

The 2018 Residential Program achieved 154,983 MWh, 21.43 MW, and 1,847,931 therms in verified net savings. These savings are reported after accounting for the FEJA-allowed "conversion" of gas savings to electric energy savings for the purpose of goal attainment. Table 1, Table 2, and Table 3 present ex ante gross, verified gross, and verified net electric energy, electric demand, and gas savings by initiative for the 2018 Residential Program.

Table 1. 2018 Residential Program Electric Energy Annual Savings Summary

Initiative/Effort	Ex Ante Gross MWh	Gross Realization Rate	Verified Gross MWh	Net-to-Gross Ratio (NTGR)	Verified Net MWh
Retail Products	141,201	105%	148,825	0.713	106,060
Income Qualified	11,615	100%	11,576	1.000	11,576
Public Housing	1,742	96%	1,675	1.000	1,675
Behavioral Modification	6,729	99%	6,680	N/A	6,680
HVAC	6,718	104%	6,955	0.752	5,230
Appliance Recycling	5,108	104%	5,321	0.538	2,862
Multifamily	2,558	99%	2,539	0.924	2,345
Direct Distribution	1,485	117%	1,740	0.926	1,612
Smart Savers	2,560	103%	2,631	1.000	2,631
DCEO NC Commitments	1,011	82%	826	1.000	826
<i>Residential Program Subtotal</i>	<i>180,726</i>	<i>104%</i>	<i>188,769</i>	<i>0.750</i>	<i>141,497</i>

¹ Weighted Average Measure Life Report. Illinois Energy Efficiency Stakeholder Advisory Group. February 20, 2018.

² Ibid.

³ AAIG is defined as the difference between the cumulative persisting goal for the year being evaluated and the cumulative persisting goal for the previous year. Further explanation is provided in the 2018 AIC Integrated Impact Evaluation Report.

Initiative/Effort	Ex Ante Gross MWh	Gross Realization Rate	Verified Gross MWh	Net-to-Gross Ratio (NTGR)	Verified Net MWh
Income Qualified (gas conversion)	N/A	N/A	N/A	N/A	12,571
Smart Savers (gas conversion)	N/A	N/A	N/A	N/A	915
Residential Program Total					154,983

Table 2. 2018 Residential Program Electric Demand Annual Savings Summary

Initiative/Effort	Ex Ante Gross MW	Gross Realization Rate ^a	Verified Gross MW	NTGR	Verified Net MW
Retail Products	19.92	94%	18.77	0.722	13.54
Income Qualified	3.62	89%	3.21	1.000	3.21
Public Housing	0.24	89%	0.21	1.000	0.21
Behavioral Modification	N/A	N/A	1.15	N/A	1.15
HVAC	2.25	110%	2.48	0.748	1.85
Appliance Recycling	0.62	105%	0.65	0.537	0.35
Multifamily	0.27	117%	0.31	0.930	0.29
Direct Distribution	0.18	132%	0.23	0.952	0.22
Smart Savers	0.36	155%	0.56	1.000	0.56
DCEO NC Commitments	0.04	141%	0.05	1.000	0.05
Residential Program Total	27.49	96%	27.61	0.776	21.43

^a Because the implementer did not provide ex ante demand savings, we do not include the Behavioral Modification Initiative in calculations of gross realization rate for demand.

Table 3. 2018 Residential Program Gas Annual Savings Summary

Initiative/Effort	Ex Ante Gross Therms	Gross Realization Rate	Verified Gross Therms	NTGR	Verified Net Therms
Retail Products	682,501	75%	510,661	1.000	510,661
Income Qualified	1,208,020	96%	1,155,691	1.000	1,155,691
Public Housing	41,235	102%	42,243	1.000	42,243
Behavioral Modification	177,590	120%	212,435	N/A	212,435
HVAC	57,136	115%	65,737	0.930	61,151
Appliance Recycling	0	N/A	0	N/A	0
Multifamily	37,383	100%	37,480	1.000	37,480
Direct Distribution	54,877	36%	19,543	1.038	20,294
Smart Savers	247,233	99%	245,238	1.000	245,238
DCEO NC Commitments	24,878	92%	22,851	1.000	22,851
<i>Residential Program Subtotal</i>	<i>2,530,853</i>	<i>91%</i>	<i>2,311,881</i>	<i>0.998</i>	<i>2,308,045</i>
Income Qualified (gas conversion)	N/A	N/A	N/A	N/A	(428,888)
Smart Savers (gas conversion)	N/A	N/A	N/A	N/A	(31,226)
Residential Program Total					1,847,931

1.2.2 Cumulative Persisting Annual Savings

Table 4 summarizes CPAS and WAML for the 2018 Residential Program at the initiative level. For additional detail related to CPAS and measure life, please see the individual initiative chapters in Section 3 and the overall CPAS spreadsheet, provided with this report.

Table 4. 2018 Residential Program CPAS and WAML

Initiative/Effort	WAML	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh) ^a
				2018	2019	2020	2021	...	2030	...	
Retail Products	10.3	148,825	0.713	106,060	106,060	105,893	55,309	...	8,657	...	730,126
Income Qualified	15.0	11,576	1.000	11,576	11,576	11,576	9,240	...	4,958	...	141,894
Income Qualified (gas conversion)	19.8	12,571	1.000	12,571	12,571	12,571	12,571	...	5,856	...	171,615
Public Housing	12.1	1,675	1.000	1,675	1,675	1,675	1,153	...	359	...	16,707
Behavior Modification	5.0	6,680	N/A	6,680	4,932	3,048	1,615	...	0	...	16,997
HVAC	18.3	6,955	0.752	5,230	5,230	5,230	5,230	...	3,107	...	73,210
Appliance Recycling	8.0	5,321	0.538	2,862	2,862	2,862	2,862	...	0	...	22,893
Multifamily	9.6	2,539	0.924	2,345	2,345	2,345	2,104	...	7	...	21,007
Direct Distribution of Efficient Products	8.4	1,740	0.946	1,612	1,612	1,549	1,132	...	0	...	10,968
Smart Savers	10.0	2,631	1.000	2,631	2,631	2,631	2,631	...	0	...	26,313
Smart Savers (gas conversion)	10.0	915	1.000	915	915	915	915	...	0	...	9,152
DCEO New Construction Commitments	18.8	826	1.000	826	826	826	826	...	715	...	15,514
2018 CPAS		202,255	0.766	154,983	153,235	151,122	95,589	...	23,659	...	1,256,396
Expired 2018 CPAS				0	1,748	3,862	59,394	...	131,324	...	
WAML	11.2										

^a Lifetime savings are inclusive of all savings for the entire life of all measures. During 2018, the longest-lived measures installed through the Residential Program had a measure life of 25 years. Therefore, some CPAS exist through 2042.

2. Evaluation Approach

The following section of the report describes the evaluation approach taken for the 2018 Residential Program impact evaluation. As part of the evaluation process, the evaluation team applied versions of the Illinois Energy Efficiency Policy Manual and the Illinois Technical Reference Manual (IL-TRM) applicable to the 2018 program year (Version 1.1 and Version 6.0, respectively) wherever relevant.⁴ Appendix A of this report provides more detailed initiative-specific methodology where appropriate.

2.1 Research Objectives and Evaluation Activities

The overarching research objectives for the impact evaluation of AIC's 2018 Residential Program are as follows:

- What were the estimated gross energy and demand impacts from the Program?
- What were the estimated net energy and demand impacts from the Program?

The evaluation team met these objectives by conducting the impact evaluation activities outlined in Table 5. As shown, for most initiatives, the impact evaluation primarily consisted of applying savings algorithms from the Illinois Technical Reference Manual (IL-TRM) V6.0 to final initiative tracking databases to estimate verified gross savings. For select initiatives and measures, the team employed engineering desk reviews and consumption analysis to estimate impacts. In addition, we reviewed initiative materials and interviewed all initiative managers.

Table 5. 2018 Residential Program Impact Evaluation Activities

Initiative	Gross Impacts		Net Impacts	
	IL-TRM Application Review	Engineering Desk Reviews	Consumption Analysis	Application of SAG-Approved NTGRs
Retail Products	✓			✓
Income Qualified	✓			✓
Public Housing	✓			✓
Behavioral Modification			✓	
HVAC	✓			✓
Appliance Recycling	✓			✓
Multifamily	✓			✓
Direct Distribution	✓			✓
Smart Savers	✓			
DCEO NC Commitments		✓		✓

The following sections provide further detail on the verified gross and net impact evaluation activities.

⁴ In future years, the evaluation team will apply updated versions of these manuals to the evaluation of this program as required by law, ICC orders and changes to the manuals themselves.

2.2 Verified Gross Impact Analysis Approach

2.2.1 Application of IL-TRM V6.0

To determine verified gross impacts associated with the majority of measures delivered through the Residential Program, we reviewed the content of the initiative tracking database to identify database errors and duplicate records, and to ensure that the implementer correctly applied savings algorithms and assumptions stated in the IL-TRM V6.0 and the IL-TRM V6.0 errata document. In particular, we applied the algorithms and assumptions provided in the IL-TRM V6.0, while using project-specific data from the initiative tracking databases where appropriate. As part of this process, we also verified measure installations through analysis of initiative tracking databases, as well as through the review of supporting project documentation.

We resolved any discrepancies found in the databases and provide details related to any gross savings adjustments in the initiative-specific sections of this report.

In accordance with Illinois policy, the evaluation team omitted heating penalties from savings reported in the body of this report. Appendix B presents detail on heating penalties for cost-effectiveness purposes.

2.2.2 Application of Custom Impact Methods

The DCEO NC Commitments were not suitable for gross impact analysis using the IL-TRM. This effort required custom energy savings calculations to determine gross impacts. Further details regarding the custom impact methods applied for this effort are presented in Appendix A.

2.3 Verified Net Impact Analysis Approach

To determine verified net savings for the 2018 Residential Program, we primarily applied SAG-approved net-to-gross ratios (NTGRs) to verified gross savings. There are two exceptions to this approach.

- One exception to this approach is the Behavioral Modification Initiative, which is implemented as a randomized controlled trial (RCT) and is evaluated using a consumption analysis approach that directly estimates net savings. Further details around the methods employed for the evaluation of this initiative are presented in Appendix A.
- In addition, the evaluation team did not apply a NTGR to savings achieved from the installation of advanced thermostats. By SAG agreement, savings achieved by these measures are considered to be net and therefore not subject to adjustment with an NTGR.

2.4 Sources and Mitigation of Error

The evaluation team took steps to mitigate potential sources of error throughout the planning and implementation of the 2018 evaluation. In particular, we took the following actions to address potential sources of non-survey related error.⁵

- **Analysis Error:** For prescriptive gross impact calculations, we applied IL-TRM V6.0 calculations to the participant data in the tracking database to calculate gross impacts. To minimize data analysis error, a separate team member reviewed all calculations to verify their accuracy. For net impact calculations, we applied SAG-approved NTGRs to estimated gross impacts to derive net impacts where appropriate. To minimize analytical errors, all calculations were reviewed by a separate team member to verify their accuracy.

For the Behavioral Modification Initiative, we also worked to address the following types of error:

- **Model Specification Error:** The most difficult type of modeling error, in terms of bias and the ability to mitigate it, is specification error. In this type of error, variables that predict model outcomes are included when they should not be or left out when they should be included, possibly producing biased estimates. The team addressed this type of error by using a fixed-effects model, which adjusts for constant differences from one household to the next using customer-specific intercepts. Over time, treatment and control groups in a randomized experiment can drift apart due to attrition, causing imbalance between the groups that must be addressed in the model specification. When there is imbalance in consumption, weather, or other factors between treatment and control groups, model specification error can become much more pronounced. For this reason, the team also included models that control for weather conditions to account for differences in temperatures experienced by treatment and control populations.
- **Measurement Errors:** Measurement error can come from variables such as weather data, which are commonly included in the billing analysis models. If an inefficient base temperature is chosen for calculating degree-days or if an incorrect climate zone weather station is chosen, the model results could be subject to measurement error. We addressed this type of error by very carefully choosing the closest weather station for each customer in the model. Specifying an incorrect time period (either pre-treatment or post-treatment) can also lead to measurement error. To the extent that the data received from the implementer are correct, this should not be a problem; however, little can be done if there is an error in the source data.
- **Multi-collinearity:** This type of modeling error can both bias the model results and produce very large variances in the results. The team dealt with this type of error by using model diagnostics such as variance inflation factor (VIF), though the relatively simple models used in the impact analysis have essentially no chance of problems with multi-collinearity.
- **Heteroskedasticity:** This type of modeling error can result in imprecise model results due to variance changing across customers with different levels of consumption. The team addressed this type of error by using robust standard errors. Most statistical packages offer a robust standard error option and make conservative assumptions in calculating the errors, which has the effect of making significance tests conservative as well.

⁵ There is no sampling error or measurement error associated with any Residential Program evaluation activity because we did not conduct any sampling-based evaluation activities for the 2018 evaluation.

- **Serial Correlation:** This type of modeling error can result in imprecise model results (due to multiple observations being highly correlated within the customer). The team addressed this type of error by clustering the errors by customer and using robust error estimation.

3. Initiative-Level Results

Within the following sections, we present the results of the impact evaluation of the 2018 Residential Program initiatives. Each sub-section presents a summary of the initiative's design, participation, and associated electric and natural gas impacts. Additional details on the impact analysis methodology used for these evaluations are presented in Appendix A.

3.1 Retail Products

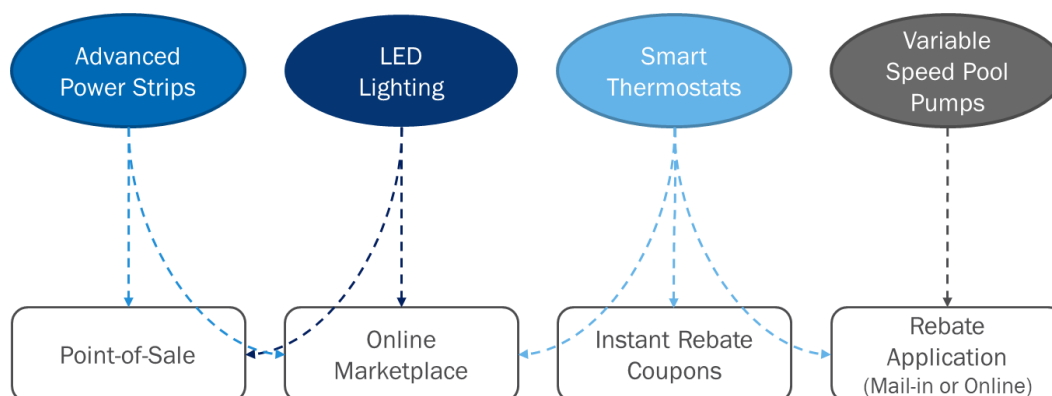
3.1.1 Initiative Description

The AIC Retail Products Initiative builds on AIC's prior Residential Lighting Program, which for nine years, aimed to transform the residential lighting market in AIC territory by increasing customers' awareness and use of ENERGY STAR® (ES) lighting. The 2018 Retail Products Initiative, implemented by CLEAResult, continues to partner with lighting retailers and manufacturers to sell LED lighting products, and also incorporates rebates for advanced thermostats, advanced power strips, and variable-speed pool pumps. These discounts encourage customers who are reluctant to pay full price for these energy-efficient products to forego cheaper but less efficient alternatives. As the Initiative continues in future years, AIC will consider adding other products to the offering.

Summary of Key Implementation Changes in 2018

The most significant changes to the Initiative in 2018 included expansion of initiative offerings to mail-in or online application-based rebates for variable-speed pool pumps and point-of-sale discounts on advanced power strips. In 2018, AIC also enhanced initiative delivery by offering an online marketplace, through which AIC customers could shop for and purchase discounted advanced thermostats, advanced power strips, and LEDs. Additionally, AIC began offering instant rebate coupons that customers could obtain online and use to receive discounts on advanced thermostats at point-of-purchase. Implementation of the retail lighting portion of the Initiative was largely similar to previous years and included discounts across a range of ES LED products at a wide range of retail locations. The point-of-sale advanced power strip discounts were offered only at discount store locations through a single retail partner. Figure 1 illustrates the various initiative delivery channels by enduse.

Figure 1. Overview of Retail Products Initiative Delivery Channels by Enduse



As in previous years, the Initiative conducted marketing and educational efforts at participating retailers and provided training and support to retailer staff, but 2018 saw the addition of marketing to pool pump retailers to engage them and their customers in the new variable-speed pool pump offering.

3.1.2 Participation Summary

LED lighting remained the primary enduse for the Retail Products Initiative in 2018, accounting for 99% of all initiative product sales. Standard LEDs dominated the lighting product category (82% of all products sold), followed by reflector LEDs (11% of all products sold). Specialty LEDs accounted for a small percentage of LED sales (6% of all products sold). Advanced thermostats, advanced power strips, and variable-speed pool pumps collectively accounted for just 1% of sales, as might be expected due to higher per-unit prices and the simple fact that any given home has more light bulbs than thermostats, pool pumps, or power strips. Table 6 presents participation in the Retail Products Initiative during 2018.

Table 6. 2018 Retail Products Initiative Participation Summary

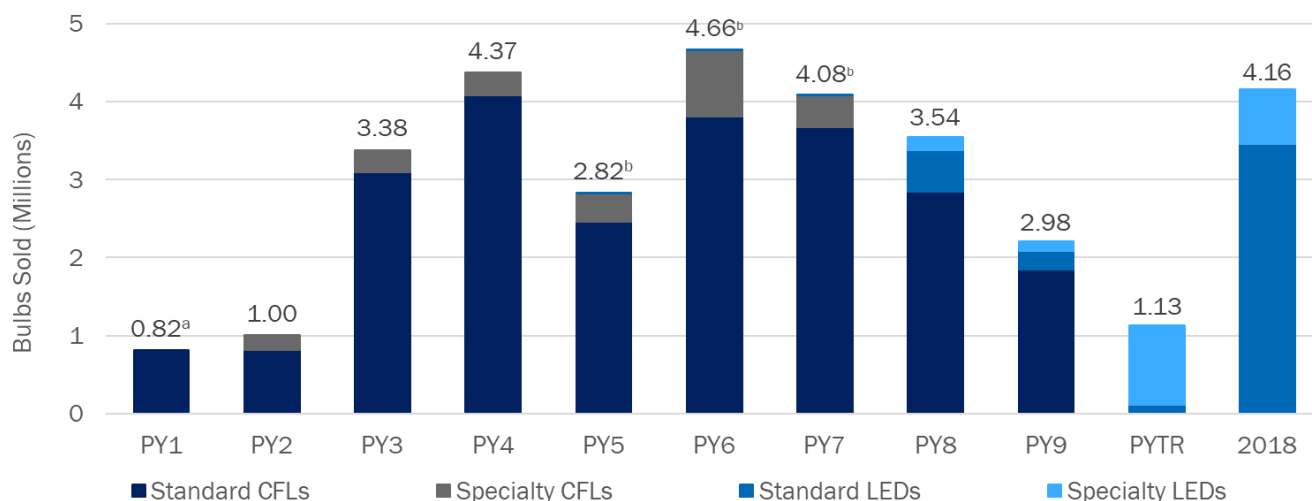
Measure	Product Type	Product Quantity	Share of Sales
Standard LEDs	A-line	3,457,548	82%
Specialty LEDs (Reflector)	BR	384,202	9%
	R	16,998	<1%
	PAR/MR	58,033	1%
Specialty LEDs (Other)	Decorative	193,901	5%
	Globe	45,194	1%
	3-way	4,685	<1%
Advanced power strips		25,803	1%
Advanced thermostats ^a		14,403	<1%
Variable-speed pool pumps		206	<1%
Total		4,200,973	100%

^a Excludes records from tracking data with purchase dates outside of 2018. In cases where purchase date was missing, submittal date was referenced instead.

Historic Product Sales

The Retail Products Initiative discounted 4,160,561 LED light bulbs during 2018, adding to nearly a decade of AIC-driven efficient lighting sales. Since 2009, AIC has offered discounts on over 32 million energy efficient lighting products. Figure 2 shows efficient lighting sales from Program Year (PY) 1⁶ through 2018.

Figure 2. History of Lighting Products Sold (PY1-2018)



^a We do not have a record of the number of CFLs sold by shape for PY1.

^b LEDs were sold, but the quantity is too small for the bar to be clearly visible.

Advanced thermostat sales increased dramatically from the 1,916 sold during the seven-month Transition Period to the 14,403 sold in 2018. As previously noted, variable-speed pool pumps and advanced power strips were new additions to the Initiative in 2018.

Sales by Delivery Channel

Virtually all LEDs (more than 99%) and advanced power strips (98%) were discounted at point-of-sale. The remainder were sold through the online marketplace. Instant rebates accounted for 43% of advanced thermostat sales, while rebate applications (including paper and online applications) made up another 42% of advanced thermostat sales. Online applications for advanced thermostat rebates considerably outnumbered paper-based ones, as was the case for variable-speed pool pump rebates. Table 7 provides a breakdown of the share of product sales by product category and rebate channel.

⁶ PY1 ran from June 1, 2008 through May 31, 2009.

Table 7. 2018 Retail Products Initiative Sales by Delivery Channel

Rebate Channel	LED Lighting (n=4,160,591)	Advanced Power Strips (n=25,803)	Advanced Thermostats (n=14,403)	Variable-Speed Pool Pumps (n=206)
Point of sale	100%	98%	N/A	N/A
Online store	0%	2%	15%	N/A
Online rebate	N/A	N/A	34%	70%
Mail-in rebate	N/A	N/A	8%	30%
Instant rebate	N/A	N/A	43%	N/A
Total	100%	100%	100%	100%

Lighting Retail Channel Coverage

Over the course of 2018, AIC offered discounted LEDs across 54 retailers at 724 storefronts. Big box, club, and DIY stores sold the vast majority of discounted LEDs (85% of all LED sales). While big box and DIY stores were similarly large contributors to LED sales in prior years, club stores contributed more than twice the share of LED sales in 2018 than in the Transition Period (29% up from 14%). Table 8 provides a breakdown of lighting sales by retail channel.

Table 8. 2018 Retail Products Initiative LED Sales by Retail Channel

Retail Channel	LED Sales	Share of LED Sales
Big box	1,255,326	30%
DIY	1,197,779	29%
Club	1,061,123	26%
Discount	339,191	8%
Hardware	231,188	6%
Grocery	49,817	1%
Pharmacy	18,766	<1%
Other	4,785	<1%
Online	2,586	<1%
Total	4,160,561	100%

3.1.3 Initiative Annual Savings Summary

Table 9 presents the Retail Products Initiative annual savings achieved in 2018. Overall, the Retail Products Initiative achieved 106,060 MWh in verified net electric energy savings, 13.541 MW in verified net electric demand savings, and 510,661 therms in verified net gas savings.

Table 9. 2018 Retail Products Initiative Total Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	141,201	19.921	682,501
Gross Realization Rate	105%	94%	75%
Verified Gross Savings ^a	148,825	18.766	510,661
NTGR	0.713	0.722	1.000
Verified Net Savings	106,060	13.541	510,661

^a Includes lighting carryover savings from previous two years.

3.1.4 Initiative Savings Detail

The vast majority of electric energy savings achieved through the 2018 Retail Products Initiative are attributable to LEDs (94% of gross and 92% of net, including carryover). Advanced thermostats make up another 4% of gross and 5% of net energy savings, while advanced power strips contribute 2% of gross and net energy savings and variable-speed pool pumps account for less than 1%. Table 10 provides a summary of electric energy savings by enduse.

Table 10. 2018 Retail Products Initiative Electric Energy Savings by Enduse

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
Lighting (first-year)	131,436	100%	131,535	0.700	92,075
Lighting (carryover) ^a	N/A	N/A	8,514	0.622	5,297
Advanced power strips	2,658	100%	2,658	0.997	2,650
Advanced thermostats	6,711	85%	5,722	N/A	5,722
Variable-speed pool pumps	396	100%	396	0.800	317
Total	141,201	105%	148,825	0.713	106,060

^a Carryover includes savings from bulbs purchased in 2016 and 2017, but not installed until 2018.

As with electric energy savings, LEDs account for the vast majority of the Initiative's electric demand savings (90% of gross and 87% of net, including carryover). Advanced thermostats make up another 7% of gross and 9% of net demand savings. Advanced power strips contribute 2% to both gross and net demand savings, while variable-speed pool pumps account for the remaining 1% of gross and 2% of net demand savings. Table 11 provides a summary of electric demand savings by measure.

Table 11. 2018 Retail Products Initiative Electric Demand Savings by Measure

Measure Category (Purchase / Install)	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
Lighting (first-year)	18.347	87%	15.960	0.700	11.172
Lighting (carryover) ^a	N/A	N/A	1.017	0.622	0.633
Advanced power strips	0.299	100%	0.298	0.997	0.297
Advanced thermostats	1.012	121%	1.229	N/A	1.229
Variable-speed pool pumps	0.262	100%	0.262	0.800	0.209
Total	19.921	94%	18.766	0.722	13.541

^a Carryover includes savings from bulbs purchased in 2016 and 2017 but not installed until 2018.

Advanced thermostats were the only product with gas savings in the Retail Products Initiative as shown in Table 12.

Table 12. 2018 Retail Products Initiative Gas Savings by Measure

Measure Category (Purchase / Install)	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Advanced thermostats	682,501	75%	510,661	N/A	510,661

For lighting measures, ex ante energy savings nearly exactly match verified gross savings, with minor discrepancies attributable to occasional inconsistencies in how savings parameters were applied.

For advanced thermostats, the primary contributors to differences between ex ante and verified savings are removal of savings claimed for a second advanced thermostat at a single service location, removal of electric savings claimed for customers with no electric account number, and removal of gas savings claimed for customers with no gas account number. In addition, some of the ex ante electric energy savings parameters dependent on geographic location were not assigned to the appropriate climate zone. Finally, ex ante electric demand savings applied the Pennsylvania – Jersey – Maryland (PJM) peak coincidence factor rather than the Summer System peak coincidence factor,⁷ resulting in a higher gross realization rate for demand savings.

Ex ante savings calculations for advanced power strips and variable-speed pool pumps were perfectly aligned, resulting in a 100% gross realization rate.

⁷ AIC is not part of PJM and therefore application of this coincidence factor in its territory is inappropriate.

3.1.5 Cumulative Persisting Annual Savings

Table 13 presents CPAS and WAML for the 2018 Retail Products Initiative. The measure-specific and total verified gross savings for the Retail Products Initiative are summarized, and CPAS in each year of the 2018-2021 Plan are presented.⁸ The WAML for the Initiative is 10.3 years.

Table 13. 2018 Retail Products Initiative CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
PY8 Standard LED - Residential ^a	10.0	80	0.730	59	59	59	18	...	0	...	305
PY8 Standard LED - Commercial ^a	13.8	15	0.730	11	11	11	3	...	3	...	68
PY8 Reflector LED - Residential ^a	10.0	24	0.730	17	17	17	17	...	0	...	173
PY8 Reflector LED - Commercial ^a	13.8	4	0.730	3	3	3	3	...	3	...	41
PY8 Specialty LED - Residential ^a	10.0	15	0.730	11	11	11	11	...	0	...	110
PY8 Specialty LED - Commercial ^a	13.8	2	0.730	2	2	2	2	...	2	...	22
PY8 Standard CFL - Residential ^a	3.0	3,300	0.630	2,079	2,079	2,079	0	...	0	...	6,236
PY8 Standard CFL - Commercial ^a	2.8	822	0.630	518	518	414	0	...	0	...	1,449
PY9 Standard LED - Residential ^a	10.0	730	0.580	424	424	424	139	...	0	...	2,247
PY9 Standard LED - Commercial ^a	13.8	130	0.580	75	75	75	25	...	25	...	493
PY9 Reflector LED - Residential ^a	10.0	155	0.600	93	93	93	93	...	0	...	929
PY9 Reflector LED - Commercial ^a	13.8	26	0.600	16	16	16	16	...	16	...	216
PY9 Specialty LED - Residential ^a	10.0	69	0.580	40	40	40	37	...	0	...	380
PY9 Specialty LED - Commercial ^a	13.8	10	0.580	6	6	6	5	...	5	...	77
PY9 Standard CFL - Residential ^a	3.0	2,315	0.630	1,458	1,458	1,458	0	...	0	...	4,375
PY9 Standard CFL - Commercial ^a	2.8	577	0.630	364	364	291	0	...	0	...	1,018
PYTR Standard LED - Residential ^a	10.0	448	0.580	260	260	260	88	...	0	...	1,393
PYTR Standard LED - Commercial ^a	13.8	78	0.580	45	45	45	15	...	15	...	299
PYTR Reflector LED - Residential ^a	10.0	87	0.600	52	52	52	52	...	0	...	520
PYTR Reflector LED - Commercial ^a	13.8	14	0.600	9	9	9	9	...	9	...	118
PYTR Specialty LED - Residential ^a	10.0	48	0.580	28	28	28	27	...	0	...	270
PYTR Specialty LED - Commercial ^a	13.8	7	0.580	4	4	4	4	...	4	...	50

⁸ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

Initiative-Level Results

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
2018 Standard LED - Residential	10.0	83,004	0.700	58,103	58,103	58,103	19,403	...	0	...	310,128
2018 Standard LED - Commercial	13.8	20,393	0.700	14,275	14,275	14,275	4,767	...	4,767	...	94,309
2018 Reflector LED - Residential	10.0	20,210	0.700	14,147	14,147	14,147	14,147	...	0	...	141,469
2018 Reflector LED - Commercial	13.8	4,538	0.700	3,177	3,177	3,177	3,177	...	3,177	...	43,841
2018 Specialty LED - Residential	10.0	8,613	0.700	6,029	6,029	6,029	5,898	...	0	...	59,375
2018 Specialty LED - Commercial	13.8	1,587	0.700	1,111	1,111	1,111	1,080	...	1,080	...	14,999
Advanced Power Strips	7.0	2,658	0.997	2,650	2,650	2,650	2,650	...	0	...	18,549
Advanced Thermostats	10.0	5,722	N/A	5,722	5,722	5,722	5,722	...	0	...	57,221
Variable-Speed Pool Pumps	10.0	396	0.800	396	396	396	396	...	0	...	3,959
2018 CPAS		156,077	0.713	111,182	111,182	111,005	57,803	...	9,105	...	764,638
Expired 2018 CPAS				0	0	176	53,379	...	102,077	...	
WAML	10.3										

^a Carryover measure purchased in a prior year but installed in 2018.

3.1.6 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Retail Products Initiative moving forward:

- **Key Finding #1:** Although most ex ante assumptions were correctly applied based on the IL-TRM V6.0, savings parameters were not tracked consistently for all measures and types of savings.
 - **Recommendation:** Maintain a record of ex ante savings assumptions and per-unit values for each product incentivized through the Retail Products Initiative. This should draw attention to any unintended discrepancies and help ensure consistency between ex ante and verified savings. A clear record of ex ante savings parameters has the added benefit of ensuring evaluators can draw informed conclusions when seeking to explain any differences found.
- **Key Finding #2:** Initiative tracking data did not consistently identify repeat participants who received rebates for multiple advanced thermostats. Ex ante savings consequently double-credited some participants with savings from multiple products installed at a single location.
 - **Recommendation:** Update ex ante savings formulas to avoid claiming savings for a second thermostat installed at a single service address. Also monitor for repeat participants who list a single account number on one application, but both electric and gas accounts on another. In these cases, both electric and gas savings should be claimed for one thermostat and no savings should be claimed for the other.
- **Key Finding #3:** Advanced thermostat ex ante savings did not always account for the fuel type supplied by AIC – savings were sometimes claimed for electricity or gas not provided by AIC or vice versa.
 - **Recommendation:** Update ex ante savings formulas to consistently claim all electric heating and cooling savings for AIC electric customers only and all gas heating savings for AIC gas customers only.
- **Key Finding #4:** Advanced thermostat ex ante energy savings assigned a single value for full-load cooling hours (FLH) and electric heating consumption to all participants regardless of geographic location.
 - **Recommendation:** Incorporate a climate zone look-up by ZIP code for these parameters into ex ante calculations. This will ensure alignment with the IL-TRM, and consistency between ex ante and verified savings.
- **Key Finding #5:** Advanced thermostat ex ante demand savings often used the PJM peak coincidence factor of 0.233 rather than the Summer System peak coincidence factor of 0.34.
 - **Recommendation:** Always use the Summer System peak coincidence factor of 0.34 to calculate ex ante demand savings for advanced thermostats distributed through AIC initiatives.
- **Key Finding #6:** Participation dates were well-documented in most cases, but not fully populated for all measures and delivery channels. Closeout data provided by the implementer also included some measures sold outside of the evaluation period.
 - **Recommendation:** Include a standardized participation date field for all distributed measures and ensure it is fully populated and can be used to accurately identify the evaluation period in which the measure is assigned. If possible, also limit the end-of-year closeout data extract to exclude participation from outside of the evaluation period to help avoid confusion regarding final measure counts.

3.2 Income Qualified

3.2.1 Initiative Description

The Income Qualified (IQ) Initiative is a home energy diagnostic and whole-house retrofit program that serves single family and multifamily AIC electric and/or gas customers with total annual household income between 0% and 300% of federal poverty guidelines for household size. The IQ Initiative implementers and program allies conduct energy audits in participating households and offers energy efficient direct install measures such as LEDs, showerheads, faucet aerators, advanced power strips, pipe insulation, and programmable/advanced thermostats to qualifying residential customers at no cost. Customers may also receive building shell measures such as air sealing and insulation, and HVAC measures such as central air conditioner replacements, boilers, and heat pumps. In addition, the IQ Initiative distributes energy efficiency kits by mail or during community events.

Leidos oversees the implementation of the IQ Initiative in coordination with three implementation partners, Illinois Community Action Agencies (CAAs), and program allies. CMC Energy is the implementation lead for MF properties, Walker-Miller is the lead for low-to-moderate income SF properties who do not participate in the Illinois Home Weatherization Assistance Program (IHWAP), and Resource Innovations oversees the CAAs that serve low-income SF properties that also participate in the IHWAP program.⁹ Table 14 below briefly describes each implementation partner's role.

Table 14. 2018 IQ Initiative - Key Implementation Partners and Roles

Partner	MF Low Income	SF Moderate-to-Low Income (without IHWAP)	SF Low Income (with IHWAP)
Leidos	Overall implementation lead; Manages property leads		
	Marketing lead; Performs technical review of projects		
CMC Energy	Marketing, energy audits, DI	None	None
Walker-Miller	None	Marketing; energy audits DI; Submits incentive application (when not a program ally lead ^a)	None
Resource Innovations	None	None	Oversees CAAs; Marketing; Reviews and QC's CAA incentive applications; Pays CAAs
CAAs	None	None	Marketing; Determines customer eligibility; Energy audits; DI, Shell retrofit installations; QC inspection of all participant homes
Program Allies	Shell and HVAC and Programmable or Advanced Thermostats	Marketing; Energy audits, DI, shell and HVAC installations; Submits incentive application (when a program ally lead ^a)	None ^b

^a For SF Moderate Income, program allies can either perform just the shell and HVAC retrofits or perform the whole suite of services depending on if the program ally delivered the lead.

^b Some CAAs complete projects on their own, while smaller CAAs may bid out project work to certified contractors.

⁹ Low income customers are defined as those less than 200% of federal poverty guidelines. Moderate income customers are defined as those between 200% and 300% of federal poverty guidelines.

Summary of Key Implementation Changes

AIC offered the IQ Initiative in its present form for the first time in 2018, and while it will evolve over time, there were no significant changes to initiative design during the evaluation period. As compared to prior years of AIC implementing similar programs, one major difference in the 2018 program year is that AIC was not able to offer on-bill financing to its customers, which impacted the incentive structure of the Initiative.

Key 2018 Events

During the 2018 program year; CAAs were unable to complete projects at a level consistent with the Initiative's implementation plan. This occurred because CAAs experienced delays in receiving federal and state funding for the Illinois Home Weatherization Assistance Program (IHWAP), as well as delays in contracting between AIC and the CAAs. Ultimately, only twelve out of the 25 CAAs who signed participation agreements completed projects in 2018.

Participation Summary

Table 6 presents IQ Initiative participation during 2018 for single family customers. For context, the implementers initially planned to serve 5,000 single family homes. Among these 5,000, the implementers planned to provide 3,700 households with shell and HVAC retrofits – 1,700 low income households and 2,000 moderate income households. There was no specific goal in the implementation plan for audits. Overall, the Initiative reached fewer single family homes than initially planned (significantly fewer through the CAA channel). According to Leidos, this difference reflects the impact of the state/federal funding and AIC contract delays mentioned earlier.

Additionally, a review of initiative tracking data and supplemental data from Community Events indicate that 867 participants received energy efficiency kits by mail and an estimated 6,418 participant received Energy Saving Kits during a community event. This exceeded the implementation plan goal of 4,800 kits.

Table 15. 2018 IQ Initiative Participation Summary – Single Family

Participation	Channel Type		Total ^a
	Non-CAA	CAA	
Number of single family homes	3,073	147	3,220
Number of completed projects	4,497	147	4,644
Audit with direct install projects completed	2,641	134	2,775
Shell and HVAC retrofit projects completed	2,569	145	2,714
Energy efficiency kits distributed ^b			7,285

^a Totals are based on number of unique properties as represented by electric or gas account number. The number of unique projects is based on the "Opportunity Name" found in the initiative tracking database.

^b This represents the total number of participants that received energy efficiency kits by mail or during a community event.

Table 16 presents IQ Initiative participation during 2018 for multifamily properties.

Table 16. 2018 IQ Initiative Participation Summary – Multifamily

Participation	Total ^a
Multifamily properties	59
Projects	59
Audits with direct install completed	35
Shell and HVAC retrofits completed	24

^a Totals are based on number of unique properties as represented by electric or gas account numbers. The number of projects is based on the on “Opportunity Name” found in the initiative tracking database.

3.2.2 Initiative Annual Savings Summary

The 2018 IQ Initiative achieved 11,576 MWh, 3.207 MW, and 1,155,691 therms in verified net savings.¹⁰ Table 9 presents IQ Initiative annual savings achieved in 2018.

Table 17. 2018 IQ Initiative Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	11,615	3.622	1,208,020
Gross Realization Rate	100%	89%	96%
Verified Gross Savings	11,576	3.207	1,155,691
NTGR	1.000	1.000	1.000
Verified Net Savings	11,576	3.207	1,155,691

3.2.3 Initiative Savings Detail

The IQ Initiative distributed measures through four channels. The channels, as shown in Table 18, are single family (CAA), single family (Non-CAA), multifamily, and kits.

Table 18. 2018 IQ Initiative Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
Single Family (CAA)					
Bathroom Exhaust Fan	139	90%	125	1.000	125
Air Sealing	109	62%	68	1.000	68
Insulation	86	89%	77	1.000	77
Lighting	77	96%	74	1.000	74
Showerhead	12	100%	12	1.000	12
Faucet Aerator	0.5	100%	0.5	1.000	0
<i>Subtotal</i>	<i>424</i>	<i>84%</i>	<i>357</i>	<i>1.000</i>	<i>357</i>

¹⁰ For purposes of goal attainment, as allowed by FEJA, some 2018 IQ Initiative gas savings are eventually converted to electric energy savings. This section’s presentation of annual savings achieved *does not* consider this conversion. For further detail on that conversion, see the Executive Summary of this report, the forthcoming 2018 AIC Integrated Impact Evaluation Report, and Section 3.4.4, which presents CPAS from converted IQ Initiative gas savings.

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
Single Family (Non-CAA)					
Insulation	1,778	80%	1,416	1.000	1,416
Lighting	1,407	100%	1,406	1.000	1,406
BPM Motor	1,143	100%	1,143	1.000	1,143
Central Air Conditioner (CAC)	1,113	125%	1,391	1.000	1,391
Air Source Heat Pump	1,066	97%	1,032	1.000	1,032
Air Sealing	793	94%	747	1.000	747
Advanced Thermostat	565	92%	520	N/A	520
Duct Sealing	189	83%	158	1.000	158
Advanced Power Strip	144	100%	144	1.000	144
Ductless Heat Pump	105	38%	40	1.000	40
Showerhead	48	38%	18	1.000	18
Faucet Aerator	16	34%	5	1.000	5
Bathroom Exhaust Fan	11	103%	11	1.000	10.8
Programmable Thermostat	5	100%	5	1.000	5
Hot Water Pipe Insulation	0.5	90%	0.4	1.000	0.4
<i>Subtotal</i>	8,382	96%	8,038	1.000	8,038
Multifamily					
Advanced Thermostat	195	102%	200	N/A	200
Lighting	147	100%	147	1.000	147
Showerhead	48	100%	48	1.000	48
Advanced Power Strip	45	100%	45	1.000	45
Hot Water Pipe Insulation	22	100%	22	1.000	22
Faucet Aerator	21	100%	21	1.000	21
Duct Sealing	13	152%	19	1.000	19
Insulation	0.34	108%	0.37	1.000	0
Air Sealing	0.12	120%	0.15	1.000	0
<i>Subtotal</i>	491	102%	502	1.000	502
Energy Efficiency Kits					
Lighting	1,593	113%	1,793	1.000	1,793
Advanced Power Strip	510	112%	572	1.000	572
Showerhead	111	171%	189	1.000	189
Faucet Aerator	62	172%	107	1.000	107
Water Heater Temperature Card	23	0%	0	1.000	0
Advanced Thermostat	19	93%	18	N/A	18
Restrictor Shower Valve	0	N/A	1	1.000	1
<i>Subtotal</i>	2,318	116%	2,680	1.000	2,680
Total	11,615	100%	11,576	1.000	11,576

Table 19. 2018 IQ Initiative Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
Single Family (CAA)					
Air Sealing	0.043	73%	0.032	1.000	0.032
Insulation	0.032	90%	0.028	1.000	0.028
Bathroom Exhaust Fan	0.019	77%	0.014	1.000	0.014
Lighting	0.008	94%	0.007	1.000	0.007
Showerhead	0.001	100%	0.001	1.000	0.001
Faucet Aerator	0.001	100%	0.001	1.000	0.001
<i>Subtotal</i>	<i>0.103</i>	<i>81%</i>	<i>0.083</i>	<i>1.000</i>	<i>0.083</i>
Single Family (Non-CAA)					
Insulation	1.118	44%	0.497	1.000	0.497
Central Air Conditioner (CAC)	0.806	125%	1.010	1.000	1.010
Air Sealing	0.382	97%	0.370	1.000	0.370
BPM Motor	0.353	100%	0.354	1.000	0.354
Advanced Thermostat	0.155	89%	0.138	N/A	0.138
Lighting	0.144	100%	0.144	1.000	0.144
Air Source Heat Pump	0.130	89%	0.115	1.000	0.115
Duct Sealing	0.081	93%	0.075	1.000	0.075
Advanced Power Strip	0.016	100%	0.016	1.000	0.016
Faucet Aerator	0.003	100%	0.003	1.000	0.003
Showerhead	0.002	100%	0.002	1.000	0.002
Bathroom Exhaust Fan	0.001	99%	0.001	1.000	0.001
Hot Water Pipe Insulation	0.000	100%	0.000	1.000	0.000
Ductless Heat Pump	0.000	N/A	0.033	1.000	0.033
<i>Subtotal</i>	<i>3.191</i>	<i>86%</i>	<i>2.759</i>	<i>1.000</i>	<i>2.759</i>
Multifamily					
Advanced Thermostat	0.021	117%	0.025	N/A	0.025
Lighting	0.015	100%	0.015	1.000	0.015
Duct Sealing	0.008	53%	0.004	1.000	0.004
Faucet Aerator	0.007	100%	0.007	1.000	0.007
Showerhead	0.005	100%	0.005	1.000	0.005
Advanced Power Strip	0.005	100%	0.005	1.000	0.005
Hot Water Pipe Insulation	0.002	100%	0.002	1.000	0.002
Insulation	0.0002	239%	0.0005	1.000	0.0005
Air Sealing	0.0001	140%	0.0001	1.000	0.0001
<i>Subtotal</i>	<i>0.065</i>	<i>100%</i>	<i>0.065</i>	<i>1.000</i>	<i>0.065</i>

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
Energy Efficiency Kits					
Lighting	0.159	106%	0.168	1.000	0.168
Advanced Power Strip	0.057	112%	0.064	1.000	0.064
Faucet Aerator	0.024	171%	0.042	1.000	0.042
Showerhead	0.012	175%	0.021	1.000	0.021
Advanced Thermostat	0.008	66%	0.005	N/A	0.005
Water Heater Temperature Card	0.003	0%	0.000	1.000	0.000
Restrictor Shower Valve	0.000	N/A	0.00005	1.000	0.00005
<i>Subtotal</i>	<i>0.263</i>	<i>114%</i>	<i>0.300</i>	<i>1.000</i>	<i>0.300</i>
Total	3.622	89%	3.207	1.000	3.207

Table 20. 2018 IQ Initiative Gas Savings by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Single Family (CAA)					
Insulation	19,130	94%	18,050	1.000	18,050
Air Sealing	12,884	110%	14,173	1.000	14,173
Showerhead	492	100%	492	1.000	492
Faucet Aerator	33	102%	33	1.000	33
<i>Subtotal</i>	<i>32,539</i>	<i>101%</i>	<i>32,747</i>	<i>1.000</i>	<i>32,747</i>
Single Family (Non-CAA)					
Furnace	487,495	96%	468,998	1.000	468,998
Insulation	379,491	78%	297,523	1.000	297,523
Air Sealing	130,279	98%	127,331	1.000	127,331
Advanced Thermostat	94,995	98%	93,414	N/A	93,414
Boiler	19,677	88%	17,239	1.000	17,239
Showerhead	3,806	127%	4,831	1.000	4,831
Programmable Thermostat	2,653	100%	2,653	1.000	2,653
Duct Sealing	1,221	2,605%	31,819	1.000	31,819
Faucet Aerator	1,146	131%	1,500	1.000	1,500
Hot Water Pipe Insulation	16	111%	18	1.000	18
<i>Subtotal</i>	<i>1,120,779</i>	<i>93%</i>	<i>1,045,325</i>	<i>1.000</i>	<i>1,045,325</i>
Multifamily					
Advanced Thermostat	3,603	100%	3,603	N/A	3,603
Faucet Aerator	245	105%	258	1.000	258
Hot Water Pipe Insulation	158	100%	158	1.000	158
Insulation	145	80%	116	1.000	116
Showerhead	72	100%	72	1.000	72
Air Sealing	33	100%	33	1.000	33
<i>Subtotal</i>	<i>4,255</i>	<i>100%</i>	<i>4,239</i>	<i>1.000</i>	<i>4,239</i>

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Energy Efficiency Kits					
Showerhead	25,736	171%	43,984	1.000	43,984
Faucet Aerator	14,265	172%	24,579	1.000	24,579
Water Heater Temperature Card	6,035	0%	0	1.000	0
Advanced Thermostat	4,269	109%	4,666	N/A	4,666
Restrictor Shower Valve	144	106%	152	1.000	152
<i>Subtotal</i>	<i>50,448</i>	<i>145%</i>	<i>73,380</i>	<i>1.000</i>	<i>73,380</i>
Total	1,208,020	96%	1,155,691	1.000	1,155,691

The resulting electric energy and demand realization rates are driven by differences between ex ante and verified savings calculations for eight measure categories that contribute the most to overall savings.¹¹ We describe these differences between the ex ante and verified savings calculations in detail below. In particular, the evaluation team found that the ex ante savings did not incorporate the intended input assumptions for faucet aerators, showerheads, bathroom exhaust fans, and insulation measures. Had ex ante savings applied the inputs identified in the initiative tracking database for these measures, the realization rates (at the measure level) would be 1.0.

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. The following differences between ex ante and verified savings calculations contribute to the overall resulting energy and gas realization rates:

- **Gas Furnace Differences:** Gas furnace installs account for 40% of overall ex ante gas savings.
 - **Existing Equipment Efficiency:** The IL-TRM advises to apply the actual existing efficiency for early retirement gas furnaces when known, otherwise apply the default value provided in the IL-TRM V6.0. The evaluation team applied the actual existing AFUE efficiency provided in initiative tracking data, where the implementation team applied the IL-TRM default value.
- **LED Lighting Differences:** LED lighting accounts for 28% of overall ex ante energy savings.
 - **Hours of Use:** The implementation team applied the hours of use value for “unknown” installed location for CAA channel lighting measures. The evaluation team applied the hours of use from the IL-TRM V6.0 that aligns with the installed location (e.g., interior, exterior) documented in the initiative tracking data.
 - **Mailed Kits:** Realization rates are larger than 1.00 for LED lighting in the kit channel because the implementation team did not track the mailed kit LED measures in the final initiative tracking database. The evaluation team calculated verified energy and demand savings associated with the mailed kit LEDs, therefore increasing realization rates.
- **Insulation Differences:** Insulation measures account for 16% of overall ex ante energy savings and 29% of overall ex ante therm savings. Insulation generally has the lowest realization rates across each IQ channel.

¹¹ LED lighting, brushless permanent magnet blower motors (BPM Motors), central air conditioners, air source heat pumps (ASHP), gas furnaces, advanced thermostats, insulation, and air sealing account for 87% and 93% of the total ex ante electric and gas energy savings, respectively.

- **HVAC Efficiency:** The IL-TRM advises to apply the actual efficiencies when known, otherwise apply the default values provided in the IL-TRM V6.0. The evaluation team applied the actual HVAC efficiencies provided in initiative tracking data, where the implementation team applied the IL-TRM default values.
- **Misaligned Heating & Cooling Type:** The initiative tracking data product names do not align with the primary heating or cooling fields for measures installed through all channels. The issue was most common with the CAA channel, where the misalignment occurred for 8% of all insulation projects. The implementation team calculated ex ante savings based on the HVAC types identified in the product name. However, later advised, the evaluation team calculate verified savings based on the primary heating and cooling type fields, as they most accurately represent the homes.
- **Window AC:** The implementation team inconsistently claims energy and demand savings for projects without central cooling (e.g., window AC). The evaluation team excludes cooling savings for homes without central cooling.
- **Central Air Conditioning Differences:** Central AC (CAC) installs account for 10% of overall ex ante energy savings.
 - **Existing Equipment Efficiency:** The IL-TRM advises to apply the actual existing efficiencies for early retirement CACs when known, otherwise apply the default values provided in the IL-TRM V6.0. The evaluation team applied the actual existing SEER and EER efficiencies provided in initiative tracking data, where the implementation team applied the IL-TRM default values.
- **Air Source Heat Pump Differences:** Air source heat pump (ASHP) installs account for 9% of overall ex ante energy savings.
 - **Existing Equipment Efficiency:** The IL-TRM advises to apply the actual existing efficiencies for early retirement ASHPs when known, otherwise apply the default values provided in the IL-TRM V6.0. The evaluation team applied the actual existing SEER, EER, and HSPF efficiencies provided in initiative tracking data, where the implementation team applied the IL-TRM default values.
- **Air Sealing Differences:** Air sealing accounts for 8% of overall ex ante energy savings and 12% of ex ante therm savings.
 - **Number of Stories:** The evaluation team relies on the number of stories provided in the initiative tracking data, where available, otherwise defaults to 1.5 stories. The implementation team assumes 1.5 stories for all projects.
 - **HVAC Efficiency:** The evaluation team applies the actual cooling and heating efficiencies provided in the initiative tracking data. Where data is not available, the evaluation team applied the IL-TRM V6.0 default efficiencies based on HVAC equipment age. The implementation team applied the IL-TRM V6.0 default efficiencies.
- **Advanced Thermostat Differences:** Advanced thermostat installs account for 7% of overall ex ante energy savings and 9% of ex ante therm savings.
 - **Misaligned Heating & Cooling Type:** The initiative tracking data product names do not align with the primary heating or cooling fields for measures installed through all channels. The issue was most common with the non-CAA single family channel, where the misalignment occurred for 8% of advanced thermostats. The implementation team calculated ex ante savings based on the HVAC types identified in the product name. However, the evaluation team calculated verified savings based on the primary heating and cooling type fields, as they most accurately represent the homes treated.

- **Full Load Hours:** The implementation team applied the single family full load cooling hours for all projects, regardless of housing type. Alternatively, the evaluation team applied full load cooling hours consistent with each project's housing type (single or multifamily).
- **Advanced Power Strip Differences:** Advanced power strip installs account for 6% of overall ex ante energy savings.
- **Mailed Kits:** Realization rates are greater than 100% for advanced power strips in the kit channel because the implementation team did not include the advanced power strips in the final initiative tracking database. The evaluation team calculated verified energy and demand savings associated with the mailed kit advanced power strips, therefore increasing realization rates.

3.2.4 Cumulative Persisting Annual Savings

Table 21 through Table 25 present CPAS and WAML for the 2018 IQ Initiative by channel (without converted gas savings).¹² Table 26 presents CPAS converted from 2018 IQ Initiative gas savings and the associated WAML. Measure-specific and total verified gross savings for the IQ Initiative are summarized, and CPAS in each year of the 2018-2021 Plan are presented.¹³ The WAML for the Initiative (not including converted gas savings) is 15.0 years. The WAML for converted gas savings is 19.8 years.

Table 21. 2018 IQ Initiative CPAS and WAML Without Gas Conversion

Channel	WAML	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
SF CAA	17.3	357	1.000	357	357	357	315	...	270	...	5,891
SF Non-CAA	17.1	8,038	1.000	8,038	8,038	8,038	7,212	...	4,647	...	116,143
Multifamily	10.3	502	1.000	502	502	502	421	...	41	...	4,582
Kits	9.3	2,680	1.000	2,680	2,680	2,680	2,124	...	0	...	21,082
2018 CPAS		11,576	1.000	11,576	11,576	11,576	10,072	...	4,958	...	147,697
Expired 2018 CPAS				0	0	0	1,504	...	6,618	...	
WAML	15.0										

¹² Please note that NTGRs are omitted from Tables 22 through 26 for presentation purposes. All IQ measures had NTGRs of 1.000 applied.

¹³ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

Table 22. 2018 IQ Initiative CPAS and WAML – Single Family CAA

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
			2018	2019	2020	2021	...	2030	...	
Bathroom Exhaust Fan	19.0	125	125	125	125	125	...	125	...	2,382
LED	10.0	72	72	72	72	30	...	0	...	428
Air Sealing	15.0	68	68	68	68	68	...	68	...	1,016
Attic Insulation	25.0	64	64	64	64	64	...	64	...	1,609
Showerhead	10.0	12	12	12	12	12	...	0	...	125
Wall Insulation	25.0	9	9	9	9	9	...	9	...	222
Floor Insulation	25.0	3	3	3	3	3	...	3	...	82
LED Specialty	10.0	2	2	2	2	2	...	0	...	23
Faucet Aerator	9.0	0.5	0.5	0.5	0.5	0.5	...	0.0	...	4
2018 CPAS		357	357	357	357	315	...	270	...	5,891
Expired 2018 CPAS			0	0	0	41	...	87	...	
WAML	17.3									

Table 23. 2018 IQ Initiative CPAS and WAML – Single Family Non-CAA

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
			2018	2019	2020	2021	...	2030	...	
Central AC (ER)	18.0	1,385	1,385	1,385	1,385	1,385	...	437	...	13,561
BPM	20.0	1,143	1,143	1,143	1,143	1,143	...	1,143	...	22,868
ASHP (ER)	18.0	1,028	1,028	1,028	1,028	1,028	...	783	...	15,561
LED	10.0	881	881	881	881	203	...	0	...	4,063
Air Sealing	15.0	747	747	747	747	747	...	747	...	11,211
Attic Insulation	25.0	999	999	999	999	999	...	999	...	24,980
Advanced Thermostat	10.0	520	520	520	520	520	...	0	...	5,204
LED Specialty	10.0	496	496	496	496	496	...	0	...	4,959
Crawl Space Insulation	25.0	212	212	212	212	212	...	212	...	5,299
Duct Sealing	20.0	158	144	144	144	144	...	144	...	2,887
Power Strip	7.0	144	140	140	140	140	...	0	...	981
Wall Insulation	25.0	140	65	65	65	65	...	65	...	1,624
Rim Joist Insulation	25.0	65	29	29	29	29	...	29	...	725
Ductless Heat Pump	18.0	40	5	5	5	5	...	37	...	477

Initiative-Level Results

LED Exterior	6.1	29	158	158	158	10	...	0	...	505
Showerhead	10.0	18	18	18	18	18	...	0	...	180
Bathroom Exhaust Fan	19.0	11	40	40	40	40	...	40	...	756
Faucet Aerator	9.0	5	11	11	11	11	...	0	...	97
Central AC (TOS)	18.0	5	5	5	5	5	...	5	...	96
Programmable Thermostat	5.0	5	5	5	5	5	...	0	...	27
ASHP (TOS)	18.0	4	4	4	4	4	...	4	...	74
Pipe Insulation	15.0	0.4	0.4	0.4	0.4	0.4	...	0.4	...	7
2018 CPAS		8,038	8,038	8,038	8,038	7,212	...	4,647	...	116,143
Expired 2018 CPAS			0	0	0	825	...	3,390	...	
WAML	17.1									

Table 24. 2018 IQ Initiative CPAS and WAML – Multifamily

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
			2018	2019	2020	2021	...	2030	...	
Advanced Thermostat	10.0	200	200	200	200	200	...	0	...	1,998
LED	10.0	102	102	102	102	22	...	0	...	463
Showerhead	10.0	48	48	48	48	48	...	0	...	478
Power Strip	7.0	45	45	45	45	45	...	0	...	316
LED Specialty	10.0	43	43	43	43	43	...	0	...	432
Hot Water Pipe Insulation	15.0	22	22	22	22	22	...	22	...	326
Faucet Aerator	9.0	21	21	21	21	21	...	0	...	190
Duct Sealing	20.0	19	19	19	19	19	...	19	...	382
LED Exterior	6.1	1.3	1.3	1.3	1.3	0.3	...	0.0	...	4
Attic Insulation	25.0	0.4	0.4	0.4	0.4	0.4	...	0.4	...	9
Air Sealing	15.0	0.1	0.1	0.1	0.1	0.1	...	0.1	...	2
2018 CPAS		502	502	502	502	421	...	41	...	4,601
Expired 2018 CPAS			0	0	0	81	...	460	...	
WAML	10.3									

Table 25. 2018 IQ Initiative CPAS and WAML – Kits

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
			2018	2019	2020	2021	...	2030	...	
LED	10.0	1,793	1,793	1,793	1,793	1,237	...	0	...	14,039
Power Strip	7.0	572	572	572	572	572	...	0	...	4,005
Showerhead	10.0	189	189	189	189	189	...	0	...	1,892
Faucet Aerator	9.0	107	107	107	107	107	...	0	...	961
Advanced Thermostat	10.0	18	18	18	18	18	...	0	...	178
Shower Restrictor Valve	10.0	1	1	1	1	1	...	0	...	7
2018 CPAS		2,680	2,680	2,680	2,680	2,124	...	0	...	21,082
Expired 2018 CPAS			0	0	0	556	...	2,680	...	
WAML	9.3									

Table 26. 2018 IQ Initiative CPAS and WAML – Gas Conversion

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
			2018	2019	2020	2021	...	2030	...	
Advanced Thermostat	10.0	1,200	1,200	1,200	1,200	1,200	...	0	...	11,998
Air Sealing	15.0	1,446	1,446	1,446	1,446	1,446	...	1,446	...	21,683
Attic Insulation	25.0	2,065	2,065	2,065	2,065	2,065	...	2,065	...	51,622
Boiler (ER)	25.0	161	161	161	161	161	...	41	...	1,982
Crawl Space Insulation	25.0	534	534	534	534	534	...	534	...	13,360
Duct Insulation	20.0	326	326	326	326	326	...	326	...	6,528
Furnace	20.0	61	61	61	61	61	...	61	...	1,214
Furnace (ER)	20.0	6,139	6,139	6,139	6,139	6,139	...	744	...	47,256
Rim Joist Insulation	25.0	194	194	194	194	194	...	194	...	4,847
Wall Insulation	25.0	445	445	445	445	445	...	445	...	11,124
2018 CPAS		12,571	12,571	12,571	12,571	12,571	...	5,102	...	171,615
Expired 2018 CPAS			0	0	0	0	...	6,715	...	
WAML	19.8									

3.2.5 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the IQ Initiative moving forward:

- **Key Finding #1:** Upon reviewing the initiative tracking data, the evaluation team found that records for new participant segments such as multifamily participants and energy saving kit participants were aggregated into single projects that either represent properties for multifamily participants or a number of energy efficiency kit recipients per event or energy saving kit mailing effort. While the implementation staff was able to provide supplemental files that help identify individual participants, it would be more reliable for evaluation and verification purposes if multifamily tenants and energy saving kit recipients were tracked individually in the initiative tracking data if possible.
 - **Recommendation:** The evaluation team recommends tracking all initiative participants individually in the initiative tracking database as tracking participants individually allows the evaluation team to more accurately evaluate and verify participation. It also allows for more reliable data collection when gathering data for in-service rate analysis or participant experience and satisfaction.
- **Key Finding #2:** The evaluation team requested 2018 IQ Initiative tracking data three times. Preliminary requests were used to conduct analysis on completed projects and perform process evaluation activities concurrently with initiative implementation. The evaluation team reviewed each data extract and found that the data, including field names, number of records, and participant flags, were inconsistent across data sets. This required additional data review and analysis each time and placed an additional burden on implementation staff to answer the evaluation team's questions.
 - **Recommendation:** The evaluation team recommends standardizing initiative tracking data shared with evaluation team throughout the year to minimize confusion, reduce the burden on implementation partners associated with data requests, and to allow for a more streamlined and efficient approach to impact analysis.
- **Key Finding #3:** Ex ante savings calculations rely on IL-TRM defaults even when the TRM specifies to use actual values (when known).
 - **Recommendation:** Revise ex ante savings calculations such that they prioritize actual values where the TRM specifies.
- **Key Finding #4:** The initiative tracking data product names do not align with the primary heating or cooling fields for measures installed through all channels.
 - **Recommendation:** Ensure all data fields are consistent within each project line item in the initiative tracking data.
- **Key Finding #5:** Ex ante input assumptions identified in the initiative tracking data were not used when calculating ex ante savings for faucet aerators, showerheads, bathroom exhaust fans, and insulation measures.
 - **Recommendation:** Ensure savings calculations incorporate the intended input assumptions.

3.3 Public Housing

3.3.1 Initiative Description

The Public Housing Initiative offers home energy diagnostic services and whole-house retrofits to multifamily properties owned by government entities (i.e., federal, state, and municipal housing authorities). The Initiative serves communities where the average household income is at or below 300% of federal poverty guidelines. Multifamily properties within AIC territory that are owned or managed by public housing authorities (PHAs) are eligible to participate in the Initiative.

Leidos is the overall implementer of the Initiative, in partnership with CMC Energy and program allies. CMC Energy leads the day-to-day implementation of the program and coordinates participation logistics with PHA staff. Program allies complete eligible envelope upgrades. CMC Energy develops a statement of work based on the results of an energy audit and installs direct install measures such as LEDs, low-flow faucet aerators and showerheads, pipe wrap, programmable or advanced thermostats, and advanced power strips at no cost to the PHA. Participants can install envelope measures, such as air sealing and insulation, either independently or in addition to direct install measures.¹⁴ This requires participants to submit an independent application. The property then goes through a pre-inspection by Leidos staff to ensure that the property needs envelope measures and that similar measures are not already installed. Program allies complete the envelope upgrades once the property passes pre-inspection.

Summary of Key Implementation Changes in 2018

Prior to the Transition Period, the Illinois DCEO administered a statewide Public Housing Program. As such, the 2018 Public Housing Initiative is new to the AIC Residential Program and was not assessed relative to previous years' implementation or performance.

3.3.2 Participation Summary

The Public Housing Initiative served 292 participants in 2018 who completed either direct installation projects, envelope upgrades, or both. In this case, a participant is defined as a unique PHA property. In total, the Initiative provided 32,336 measures, in addition to attic insulation, pipe wrap, and air sealing. Table 6 presents Public Housing participation details for 2018, and Figure 3 presents direct installation measure counts by type.

Table 27. 2018 Public Housing Initiative Participation Summary

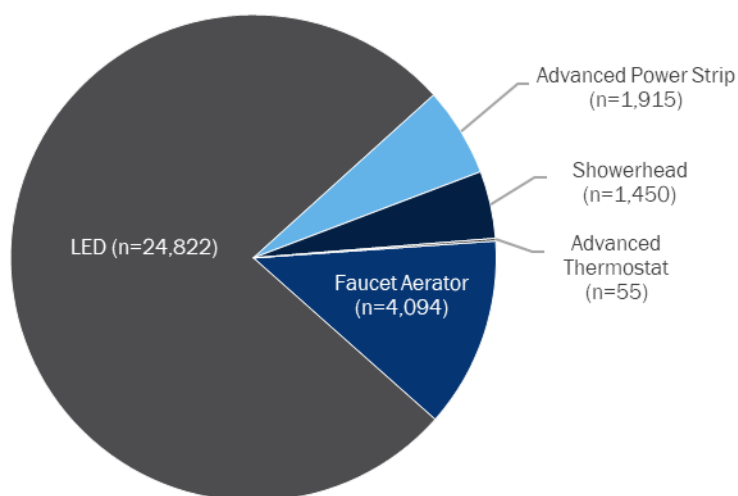
Participation	Direct Installations	Envelope Upgrades	Total
Unique Participants ^a	—	—	292
Project Count	138	200	340
Measure Count ^b	32,538	206	32,336

^a Participants could complete direct installations, envelope upgrades, or both.

^b For measures quantified in feet, such as attic insulation, air sealing and pipe wrap, we counted the number of discrete installations.

¹⁴ In 2018, the PH Initiative only offers air sealing and insulation as envelope measures. According to initiative staff, participants interested in larger energy efficient upgrades, such as HVAC equipment, are referred to the AIC Business Program (i.e., the Standard and Custom Initiatives).

Figure 3. Public Housing Direct Installation Measure Count by Type



3.3.3 Initiative Annual Savings Summary

Table 9 presents Public Housing Initiative annual savings achieved in 2018.

Table 28. 2018 Public Housing Initiative Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	1,742	0.24	41,235
Gross Realization Rate	96%	89%	102
Verified Gross Savings	1,675	0.21	42,243
NTGR	1.000	1.000	1.000
Verified Net Savings	1,675	0.21	42,243

3.3.4 Initiative Savings Detail

The Public Housing Initiative distributed 15 distinct energy-saving measures. In-unit, A-type LEDs, as well as showerheads and attic insulation contributed to nearly two-thirds of the Initiative's total verified net savings. The Initiative achieved 1,675 MWh, 0.21 MW, and 42,243 therms in verified net savings while achieving 96%, 89%, and 102% realization rates for electric energy, electric demand, and gas respectively. Table 29, Table 30, and Table 31 summarize the ex ante and verified electric energy, electric demand, and gas savings for measures delivered through the Initiative.

Table 29. 2018 Public Housing Initiative Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
LED - In-Unit (A-Type)	614	100%	614	1.000	614
LED- In-Unit (Candelabra)	12	100%	12	1.000	12
LED - In-Unit (Globe)	9	100%	9	1.000	9
LED - In-Unit (Reflector)	6	100%	6	1.000	6

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
LED - Common Area (A-Type)	106	100%	106	1.000	106
LED - Common Area (Reflector)	10	100%	10	1.000	10
LED - Common Area (Globe)	0	100%	0	1.000	0
LED - Exterior (A-Type)	3	100%	3	1.000	3
Faucet Aerator	133	100%	132	1.000	132
Showerhead	252	98%	246	1.000	246
Pipe Insulation	28	100%	28	1.000	28
Advanced Thermostat	19	78%	15	N/A	15
Advanced Power Strip - Tier 1	162	100%	162	1.000	162
Air Sealing	95	84%	80	1.000	80
Attic Insulation	291	86%	250	1.000	250
Total	1,742	96%	1,675	1.000	1,675

Table 30. 2018 Public Housing Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
LED - In-Unit (A-Type)	0.06	100%	0.06	1.000	0.06
LED - In-Unit (Candelabra)	0.00	100%	0.00	1.000	0.00
LED - In-Unit (Globe)	0.00	100%	0.00	1.000	0.00
LED - In-Unit (Reflector)	0.00	100%	0.00	1.000	0.00
LED - Common Area (A-Type)	0.01	100%	0.01	1.000	0.01
LED - Common Area (Reflector)	0.00	100%	0.00	1.000	0.00
LED - Common Area (Globe)	0.00	100%	0.00	1.000	0.00
LED - Exterior (A-Type)	0.00	N/A	N/A	N/A	N/A
Faucet Aerator	0.05	99%	0.05	1.000	0.05
Showerhead	0.03	98%	0.03	1.000	0.03
Pipe Insulation	0.00	100%	0.00	1.000	0.00
Advanced Thermostat	0.01	83%	0.01	N/A	0.01
Advanced Power Strip - Tier 1	0.02	100%	0.02	1.000	0.02
Air Sealing	0.02	55%	0.01	1.000	0.01
Attic Insulation	0.03	56%	0.02	1.000	0.02
Total	0.24	89%	0.21	1.000	0.21

Table 31. 2018 Public Housing Gas Savings by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Faucet Aerator	8,468	105%	8,883	1.000	8,883
Showerhead	13,596	101%	13,670	1.000	13,670
Pipe Insulation	797	100%	797	1.000	797
Advanced Thermostat	1,757	100%	1,757	N/A	1,757

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Air Sealing	6,174	100%	6,188	1.000	6,188
Attic Insulation	10,442	105%	10,947	1.000	10,947
Total	41,235	102%	42,243	1.000	42,243

The resulting gross realization rates were driven by differences between ex ante and verified savings calculations for a number of measures. For faucet aerators and showerheads, the evaluation team identified only minor differences in savings calculations, resulting in realization rates near 100%. While the evaluation team did note significant variances between ex ante and verified electric savings for advanced thermostats, these measures accounted for only 1% and 5% of ex ante initiative electric energy and demand savings, respectively, and therefore had a minimal impact on overall realization rates.

The following differences between ex ante and verified savings calculations contributed to the overall resulting energy and gas realization rates:

■ Attic Insulation Differences

- **Cooling Savings:** The implementation team included cooling savings for approximately half of the records that did not indicate central cooling was present. This discrepancy occurred in 100 of the 187 records.
- **Full Load Cooling Hours:** The implementation team applied the full load cooling hours for single family homes instead of the values for multifamily homes provided in the IL-TRM V6.0.
- **Heat Pump Heating Efficiency:** The implementation team used a heating efficiency (COP) value of 1.78. Since actual efficiency and age data is not available, the evaluation team determined it appropriate to use a value of 1.92, which is the IL-TRM V6.0 specified value for a heat pump manufactured between 2006 and 2014.
- **Gas Furnace Therm Savings:** For all five of the measures with the label, 'PH Attic Ins R19 to R49 Gas Heat w/wo CAC (PY18),' the implementation team did not calculate therm savings, and incorrectly included electric heating savings.
- **Gas Furnace Heating Efficiency:** The implementation team used a heating efficiency value of 72% for all records indicating the presence of gas furnace heating. The evaluation team used the efficiency values available in the database.
- **Gas Furnace Runtime Savings:** The implementation team did not include gas furnace fan runtime savings for any of the records indicating the presence of gas furnace heating.
- **Electric Resistance Heating Efficiency:** For three records with the label, 'PH Attic Ins R19 to R49 ERES w/wo CAC (PY18),' heating efficiencies were not reported as 1.0, but rather 0.72 for two records, and 1.78 for one. The evaluation team assumed a heating efficiency of 1.0 for these records, which corresponds with electric resistance heating per the IL-TRM V6.0.

■ Air Sealing Differences

- **Cooling Savings:** The implementation team included cooling savings for approximately half of the records that did not indicate central cooling was present. This discrepancy occurred in 98 of the 202 records.
- **Full Load Cooling Hours:** The implementation team applied the full load cooling hours for single family homes instead of the values for multifamily homes provided in the IL-TRM V6.0.

- **Heat Pump Heating Efficiency:** The implementation team used a heating efficiency (COP) value of 1.78. Since actual efficiency and age data is not available, the evaluation team determined it appropriate to use value of 1.92, which is the IL-TRM V6.0 specified value for a heat pump manufactured between 2006 and 2014.
- **Faucet Aerator Differences**
 - **Energy per Gallon (EPG):** The implementation team incorrectly applied the IL-TRM V6.0 EPG value for “unknown” installed location for participants with gas water heating in cases where the initiative tracking database indicates the aerators are installed in kitchens.
- **Advanced Thermostat Differences**
 - **Full Load Cooling Hours:** The implementation team incorrectly applied the full load cooling hours for single family homes instead of the values for multifamily homes provided in the IL-TRM V6.0.
 - **Cooling Capacity:** The IL-TRM V6.0 does not provide a default cooling capacity for multifamily homes. The implementation team applied a cooling capacity of 33,600 BTUh, which is the default for single family homes from the IL-TRM V6.0. The IL-TRM V7.0 has since updated this variable and includes a default cooling capacity for multifamily homes using evaluation results from various multifamily programs implemented within the state. The evaluation team feels that the value in the IL-TRM V7.0 more appropriately represents multifamily cooling capacities than the single family value chosen by the implementation team, and as a result, applied the multifamily cooling capacity of 28,000 BTUh from the IL-TRM V7.0.

3.3.5 Cumulative Persisting Annual Savings

Table 32 presents CPAS and WAML for the 2018 Public Housing Initiative. The measure-specific and total verified gross savings for the Initiative are summarized, and CPAS in each year of the 2018-2021 Plan are presented.¹⁵ The weighted average measure life for the Initiative is 12.1 years.

Table 32. 2018 Public Housing Initiative CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
LED - In-Unit	10.0	641	1.000	641	641	641	194	...	0	...	3,279
LED - Common Area	8.4	116	1.000	116	116	116	44	...	0	...	584
LED - Exterior	10.2	3	1.000	3	3	3	1	...	0	...	15
Faucet Aerator	9.0	132	1.000	132	132	132	132	...	0	...	1,191
Showerhead	10.0	246	1.000	246	246	246	246	...	0	...	2,463
Pipe Insulation	15.0	28	1.000	28	28	28	28	...	28	...	421
Advanced Thermostat	10.0	15	N/A	15	15	15	15	...	0	...	151
Advanced Power Strip - Tier 1	7.0	162	1.000	162	162	162	162	...	0	...	1,135
Attic Insulation	25.0	250	1.000	250	250	250	250	...	250	...	6,262
Air Sealing	15.0	80	1.000	80	80	80	80	...	80	...	1,205
2018 CPAS		1,675	1.000	1,675	1,675	1,675	1,153	...	359	...	16,707
Expired 2018 CPAS				0	0	0	522	...	1,316	...	
WAML	12.1										

¹⁵ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.3.6 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Public Housing Initiative:

- **Key Finding #1:** In a number of cases, the implementation team applied either incorrect measure inputs or default measure inputs even when more detailed information was available.
- **Recommendation:** Carefully review chosen ex ante savings parameters against the IL-TRM to avoid significant realization rate discrepancies in future years.

3.4 Behavioral Modification

3.4.1 Initiative Description

In 2018, AIC administered the Behavioral Modification Initiative to one cohort of dual-fuel (electric and gas) customers, with implementation support from Tendril and oversight from Leidos. The Initiative’s primary method for encouraging energy-efficient behaviors is a Home Energy Report (HER). The initiative offered the following treatment types to participants in 2018: hard-copy HERs mailed to participating customers six times between May and November; six electronic HERs (eHERs) sent to participating customers with email addresses on file using the same delivery schedule as the hard-copy HERs; and monthly high usage alerts (HUAs) sent to treatment customers with emails who were at risk of experiencing a spike in energy usage in a given month. Each HER includes the following information:

- A summary of the customer’s energy use and the charges from the previous month’s energy use;
- A comparison of the customer’s current and past energy usage over the past year;
- A comparison of the customer’s energy usage to that of households with similar characteristics;
- A chart that forecasts which energy use categories will contribute the most to their energy use in the next month (heating, cooling, electronics, lighting etc.);
- Promotion of applicable AIC initiatives and rebates; and
- Tips for reducing energy consumption tailored to the customer’s home energy profile (e.g., type of home, square footage, and number of occupants).

The Initiative also provides access to an online Home Energy Portal that encourages customers to participate in weekly energy challenges and serves as a platform for customers to view data related to their energy usage. Table 33 presents the number of HERs and eHERs that the treatment cohort, Expansion Cohort 1,¹⁶ received in 2018 as well as the delivery schedule.

Table 33. Frequency of HERs and eHERs Sent to 2018 Behavioral Modification Initiative Treatment Group

Cohort	Fuel Type	Number of HERs and eHERs	Timing of HERs
Expansion Cohort 1	Dual-Fuel	6	May, Jun, Jul, Aug, Sep, and Nov

¹⁶ The cohort selected for treatment in 2018 is a legacy cohort previously treated by Oracle in earlier years of the Behavioral Modification Initiative’s operation. We continue to refer to this cohort as “Expansion Cohort 1,” its Oracle designation, for consistency with prior reports.

Summary of Key Implementation Changes in 2018

AIC first began offering a behavioral program in August 2010 and added new cohorts (eight in total) on a rolling basis until the Initiative reached roughly one-third of AIC's one million residential customers by 2017. With the launch of the 2018 Plan period, AIC decided to significantly reduce the number of participants in the Initiative (from eight cohorts to one) and selected a new implementer, Tendril, to provide the HERs. Tendril selected the legacy cohort known as Expansion Cohort 1 to continue receiving HER treatment during 2018. The other eight legacy cohorts that received HERs in prior years (the Original Cohort and Expansion Cohort 2 through Expansion Cohort 8) did not receive HERs in 2018. Tendril also made modifications to the existing Home Energy Portal and added High Usage Alerts (HUAs) and home energy challenges to the list of Initiative features. Each of the changes are described below.

- **Treatment Customers.** Tendril selected Expansion Cohort 1 to continue receiving HER treatment in 2018 and ceased treating all previous cohorts. Aside from the differences in the treatment and control group sizes due to attrition, the cohort is the same group of customers that was treated in prior years. Tendril selected Expansion Cohort 1 based on various criteria typically associated with higher overall energy savings, the most important being higher customer counts and lower attrition rates, energy savings achieved in prior program years, and higher baseline energy consumption. Expansion Cohort 1 achieved high scores in all three selection criteria categories.
- **HUAs.** All treatment customers with an email on file and who have not opted out of receiving HERs are enrolled to receive HUAs. HUAs are sent to treatment customers that, according to the individual customer's home characteristics and upcoming weather forecasts, are at risk to experience a spike in energy usage in a given month. The alerts are sent in the middle of the monthly billing cycle to give participants time to change energy consumption habits before the billing cycle ends.
- **Home Energy Portal.** Tendril offers both treatment and control customers access to an online Home Energy Portal with information about their energy usage and tips to adopt energy efficient behaviors. The portal displays many of the same energy use statistics as provided to treatment customers in their HERs and eHERs, but also invites users to participate in the weekly energy challenges and provides a form for user comments. While all AIC customers can access the Home Energy Portal, only treatment group customers receive promotional information about the portal through HERs.
- **Energy Challenges.** Tendril sends energy challenges to Expansion Cohort 1 customers who have logged into the Home Energy Portal, a majority of whom are treatment group customers directed to the portal from HERs, eHERs and/or HUAs. These challenges encourage customers to take an action each week to save energy. The energy challenges are also promoted on the Home Energy Portal.
- **Summary of Evaluation Changes**

As in prior years, the evaluation of the 2018 Behavioral Modification Initiative includes both unadjusted¹⁷ and adjusted verified net electric and therm savings for Expansion Cohort 1. This year, the evaluation also includes estimates of the Initiative's peak demand reductions for this cohort.

The evaluation team continues to use an intent to treat (ITT) approach and estimates savings using a difference-in-differences (DID) model, as discussed in detail in Appendix A.

¹⁷ Unadjusted net savings refer to the estimated savings based on the consumption analysis prior to removing any savings that may come from participation in other initiatives by treatment participants in comparison to control participants.

3.4.2 Participation Summary

The Behavioral Modification Initiative reached about 43,600 of AIC's approximately 1 million residential customers in 2018.¹⁸ This cohort is composed of dual-fuel customers that have been receiving HERs for close to 8 years. Table 34 provides a breakdown for Expansion Cohort 1 of treatment customers who received at least one bill in 2018, as well as the approximate time in the Initiative.

Table 34. Behavioral Modification Initiative Participation in 2018

Cohort Name	Fuel Type	Number of Customers Treated		Start Date	Approximate Time in Initiative
		Gas	Electric		
Expansion Cohort 1	Dual-Fuel	43,609	43,610	April 2011	7 years 9 months

Below, we outline the results of analyses performed to assess savings in the Behavioral Modification Initiative.

3.4.3 Initiative Annual Savings Summary

Table 9 presents Behavioral Modification annual savings achieved in 2018. Overall, the Initiative achieved 6,789 MWh, 2,044 MW, and 224,699 therms in unadjusted net verified savings. The unadjusted savings results for electric and gas savings are slightly higher than the savings calculated by Tendril.¹⁹ Differences in savings estimates can stem from different data cleaning steps and using different participant counts in the model, both of which can result from the adoption of different exclusion criteria. After adjusting for savings claimed by other initiatives, the Initiative achieved 6,680 MWh, 1.15 MW, and 212,435 therms in verified net savings.

Table 35. 2018 Behavioral Modification Initiative Annual Savings

	Energy Savings (MWh)	Demand Savings (MW) ^a	Gas Savings (Therms)
Net Savings Claimed by Tendril ^b	6,729	N/A	177,590
Unadjusted Evaluated Net Initiative Savings	6,789	2.04	224,699
Uplift Adjustment	109	N/A	12,264
Final Net Impacts after Accounting for Uplift	6,680	1.15	212,435
Net Realization Rate ^d	99%	N/A	120%

^a Unadjusted and adjusted demand savings are calculated by using the summer coincident peak demand savings equation from volume 4, page 11 of the IL-TRM V6.0.

^b Reflect year to date (YTD) Savings (actual) values from Tendril's AIC Behavioral Modification Initiative report through December 2018.

^c Tendril does not report demand savings from the Initiative.

^d Net realization rate for the Initiative is calculated as final net impacts after accounting for uplift divided by the net savings claimed by Tendril.

¹⁸ This number excludes customers who moved out or opted out before the experiment start date (May 1st, 2018).

¹⁹ Tendril's electric and gas savings are within the 90% confidence interval of Opinion Dynamics' unadjusted savings results.

Unadjusted Initiative Savings

Table 36 presents the unadjusted net kWh, kW, and therm savings for Expansion Cohort 1 for 2018. All results are statistically significant. The evaluation team fit several statistical models to estimate the unadjusted net impacts of the Initiative. We ultimately selected the lagged dependent variable (LDV) model after a series of model diagnostics. Results from the other models the evaluation team ran are included in Appendix A of this report. After calculating the adjusted net savings, we apply the uplift analysis²⁰ and derive the final net impact savings.

Table 36. 2018 Behavioral Modification Initiative Unadjusted Per-Household Net Savings

Fuel Type	Number of Customers Treated in 2018 ^a	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (per household) ^b	Unadjusted Net Initiative Savings ^c
kWh	43,610	1.78%	155.68	6,789,282
kW	43,610	1.78%	0.05	2,044
Therms	43,609	1.12%	5.15	224,699

^a Refers to the number of customers to whom AIC selected to provide HERs (e.g., has an experiment start date in file) and who received at least one bill.

^b Reflect the per household per day savings multiplied by the average number of days the participating households were in the Initiative in 2018.

^c Pro-rated for participants whose accounts closed during 2018.

Uplift from Other AIC Initiatives

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

The uplift in savings from other AIC initiatives is significant, particularly in terms of therm savings. Legacy uplift, which reflects Initiative participation in prior years, represents all uplift found in the evaluation period. Table 37 presents the results from the uplift analysis. The evaluation team deducted approximately 5.5% of unadjusted therm savings due to this analysis, all of which are due to legacy measures installed in prior years. Additionally, the team deducted approximately 1.6% of unadjusted MWh savings due to this analysis, all of which are due to legacy measures installed in prior years.

Table 37. 2018 Behavioral Modification Initiative Savings Uplift Results

Fuel Type	Unadjusted Initiative Savings	2018 Savings Uplift		Legacy Savings Uplift		Total Savings Uplift	
		Savings	%	Savings	%	Savings	%
MWh	6,789	0	0.0%	109	1.6%	109	1.6%
MW	2.04	N/A	N/A	N/A	N/A	N/A	N/A
Therms	224,699	0	0.0%	12,264	5.5%	12,246	5.5%

²⁰ Uplift measures the degree to which the treatment customers in the Behavioral Modification Initiative participate in other AIC initiatives more than control customers.

Final Net Adjusted Savings Impacts

The Initiative achieved 6,680 MWh and 212,435 therms in adjusted net savings, along with 1.15 MW in adjusted energy reductions (Table 38). For the electric and gas savings, adjusted net savings refer to modeled impacts (presented as unadjusted savings) using the LDV model, minus the savings accounted for from participation in other AIC residential initiatives (e.g., uplift from other AIC initiatives). These findings confirm that the Behavioral Modification Initiative reduces energy consumption.

Table 38. 2018 Behavioral Modification Initiative Annual Savings

Fuel Type	Initiative Savings Unadjusted for Uplift	Savings Uplift	Final Adjusted Net Initiative Savings
MWh	6,789	109	6,680
MW	2.04	N/A	1.15
Therms	224,699	12,264	212,435

3.4.4 Cumulative Persisting Annual Savings

Table 39 presents CPAS and WAML for the 2018 Behavior Modification Initiative. The measure-specific and total verified net savings for the Behavior Modification Initiative are summarized, and CPAS in each year of the 2018-2021 Plan are presented.²¹ The WAML for the Initiative is 5 years.

Table 39. 2018 Behavioral Modification Initiative CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh) ^a	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
Home Energy Reports ^b	5.0	6,680	N/A ^a	6,680	4,932	3,048	1,615	...	0	...	16,997
2018 CPAS		6,680	N/A^a	6,680	4,932	3,048	1,615	...	0	...	16,997
Expired 2018 CPAS				0	1,748	3,632	5,065	...	6,680	...	
WAML	9.3										

^b The analysis approach used for this initiative directly estimates net savings. Therefore, no NTGR is applied to determine net savings, and “first-year verified gross savings,” reported for the purpose of WAML calculation, are set equal to net savings.

^b Decay in savings from home energy reports decay is estimated based on algorithms in the IL-TRM V6.0 Measure 6.1.1.

²¹ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.4.5 Conclusions

Based on the results of this evaluation, the evaluation team offers the following key finding for the Behavioral Modification Initiative:

- **Key Finding #1:** The Initiative reduced energy consumption and achieved a high electric energy net realization rate. Our evaluation found a 99% net realization rate for electric energy, indicating that evaluated electric energy savings align closely with the implementer's claimed electric energy savings.

3.5 HVAC

3.5.1 Initiative Description

Since June 2009, AIC has offered HVAC incentives to its customers to encourage the purchase of higher-efficiency heating and cooling equipment. Over time, the measure offerings and incentive levels have changed as federal standards and efficient product markets have changed. During 2018, the HVAC Initiative offered incentives for high-efficiency air source heat pumps (ASHPs), central air conditioners (CACs), heat pump water heaters (HPWHs), brushless permanent magnet blower motors (BPMs), and advanced thermostats.

The design of the HVAC Initiative has remained consistent since the 2011-2012 program year. AIC provides incentives to customers through registered initiative allies as direct discounts on the equipment and installation purchase. The incentive appears as a line item deduction on contractors' installation invoices.

The HVAC Initiative also offered a higher incentive to customers for CAC and ASHP measures when the customer replaced working, but inefficient older equipment, and standard incentives for replacing broken equipment (replace-on-burnout [RB]) with new equipment of SEER 16.0 or higher (ASHPs must also be rated a minimum of 9.0 HSPF). To be considered early replacement (ER) a unit being replaced had to be verifiably operable with a seasonal energy efficiency ratio (SEER) rating of 10.0 or less.

Summary of Key Implementation Changes in 2018

For the 2018 program year the HVAC Initiative increased its measure offerings and incentives as follows:

- Reintroduced the 16.0 SEER CAC measures (ER and RB), which had both been dropped from the Initiative in June 2016
- Reintroduced the standard (RB) ASHP offering, which had been dropped from the Initiative in August 2016
- Reintroduced the advanced thermostat measure, which had been transitioned out of the initiative in August 2017 and into the Retail Products Initiative (offered in both initiatives in 2018)
- Added HPWHs to the Initiative as a new measure
- Increased the advanced thermostat incentive from \$100 to \$169 in September 2018 to boost participation, and added a bonus incentive of \$100 to cover installation by an initiative ally

In addition to changes to the measure mix, the Initiative also saw a transition of staff and responsibilities from CLEAResult to Leidos. Starting on January 1, 2018 Leidos took over all remaining implementation activities

from CLEAResult, and the field energy specialists that worked with the initiative ally program moved from CLEAResult to Leidos, where they maintained their role.

Leidos also made the following implementation changes:

- Elimination of the reservation requirement from the standard CAC and ASHP measures,
- A dedicated technical review team to check every application when received,
- A dedicated data entry staff to be responsible from pre-approval to final approval for each application,
- Implementation of a one-page application for initiative allies.

Finally, on-bill financing, which was available until September 2017, was not available in 2018.

3.5.2 Participation Summary

Table 6 presents HVAC Initiative participation during 2018. In 2018, the Initiative offered RB and ER ASHPs (16.0 SEER and 9.0 HSPF) and CACs (16.0 SEER), BPM furnace fan motors installed as part of a new gas furnace, advanced and programmable thermostats, heat pump water heaters replacing electric resistance water heaters, as well as high efficiency pool pumps. Although not formally tracked by the Initiative, the table also includes line items for ductless mini-split heat pumps (DMSHPs) identified during the evaluation. DMSHPs are a subset of air source heat pumps (ASHPs), but because the IL-TRM V6.0 outlines different methods for evaluating savings for central ASHPs and DMSHPs, they are shown as a separate category in subsequent tables.

Table 40. 2018 HVAC Initiative Participation Summary

Measure Category	Participants ^a	Measure Count ^b
ASHP	270	281
ASHP ER	138	141
CAC	1,472	1,504
CAC ER	1,748	1,795
Pool Pump	1	1
BPM	4,054	4,146
Heat Pump Water Heater	6	6
Programmable Thermostat	169	177
Advanced Thermostat	858	917
Ductless Heat Pump	62	68
Ductless Heat Pump ER	10	10
Initiative Total	5,408	9,046

^a Total participant count reflects the number of unique participants in the Initiative while participant count by measure category reflects the number of unique participants who installed that measure.

^b Measure count is the total number of measures installed through the Initiative.

3.5.3 Initiative Annual Savings Summary

Table 41 presents the HVAC Initiative annual savings achieved in 2018. Overall, the Initiative achieved gross realization rates over 100% in all three categories: electric energy savings (MWh), electric demand savings (MW) and gas energy savings (therms).

Table 41. 2018 HVAC Initiative Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	6,718	2.247	57,136
Gross Realization Rate	104%	110%	115%
Verified Gross Savings	6,955	2.476	65,737
NTGR	0.752	0.748	0.930
Verified Net Savings	5,230	1.852	61,151

3.5.4 Initiative Savings Detail

Table 42 presents the HVAC Initiative annual electric energy savings achieved in 2018 by measure. Approximately 91% of Initiative savings are attributable to the ASHP, ASHP ER, CAC, CAC ER, and BPM measures, with the BPM measure accounting for over one-third (33.8%) of ex ante Initiative savings. After the BPM measure, the CAC ER (26.2%) and ASHP ER (16.6%) measures contributed the largest portion of ex ante savings.

Table 42. 2018 HVAC Initiative Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
ASHP	351	99%	348	0.641	223
ASHP ER	1,115	97%	1,084	0.761	825
CAC	646	100%	646	0.641	414
CAC ER	1,759	119%	2,100	0.761	1,598
Pool Pump	2	100%	2	1.000	2
BPM	2,272	99%	2,257	0.761	1,718
Heat Pump Water Heater	32	27%	9	0.760	7
Programmable Thermostat	32	86%	27	0.870	24
Advanced Thermostat	344	84%	290	N/A	290
Ductless Heat Pump	86	156%	134	0.641	86
Ductless Heat Pump ER	78	74%	58	0.761	44
Initiative Total	6,718	104%	6,955	0.752	5,230

The evaluation team estimated savings for every reported measure by following the IL-TRM V6.0 methodology. The implementation team used the IL-TRM V6.0 and additional supplemental sources to calculate verified savings. The differences between ex ante and verified savings are attributable to a combination of several verified savings assumptions that differed somewhat from ex ante ones, summarized below.

■ **Multiple Measures:**

- A small number of projects (0.15% of all projects) were not allocated ex ante savings. These line items received zero ex ante savings in the tracking database. We estimated verified savings for all measures. This mainly affected thermostats.
- A small number of projects were assigned to different heating and/or cooling regions in the ex ante savings calculation than in the verified savings calculation, resulting in slightly different equivalent full-load hours, heating consumption, or cooling consumption. This impacted approximately 2.0% of measures rebated through the Initiative and tended to result in higher verified savings than ex ante savings.
- A small number of projects did not meet the Initiative's requirements (16.0 SEER for CACs and 16.0 SEER as well as 9.0 HSPF for ASHPs). These projects received verified savings of zero kWh and kW. Approximately 0.15% of all projects were impacted.

■ **ASHP:** The measure achieved a realization rate of 99%.

- Six projects did not meet the minimum efficiency required by the Initiative (16.0 SEER and 9.0 HSPF) and received verified savings of zero kWh and kW.

■ **ASHP ER:** The measure achieved a realization rate of 97%.

- The realization rate is lower than 100% because of different assumptions regarding the efficiency of the existing equipment. The verified savings use the SEER of the existing equipment where those data are available. The ex ante savings use the IL-TRM V6.0 default values that are based on equipment type, rather than using the actual efficiency of the replaced equipment.

■ **CAC ER:** The realization rate for early replacement CACs was 119%.

- The verified analysis applied actual existing equipment efficiency levels to calculate verified savings for ER measures rather than the IL-TRM assumed efficiency. If the existing equipment's efficiency levels were unknown or fell below the threshold outlined in the IL-TRM, we used the IL-TRM-provided efficiency value instead. The actual baseline efficiency levels were typically lower than the IL-TRM deemed values, resulting in higher savings.

■ **BPM:** The realization rate for BPMs was 99%.

- In some cases, ex ante savings assumed a central cooling system when the tracking database indicated that there was none (4.9% of BPM measures), and in other cases ex ante savings assumed no central cooling system when the tracking database indicated that there was one (0.3% of BPM measures).

■ **Heat Pump Water Heater:** The realization rate for heat pump water heaters was 27%.

- Verified savings are based on the algorithms in the IL-TRM V6.0 and equipment-specific values for tank capacity (gallons) and energy factor. AHRI certificate numbers were provided for five of the six HPWHs rebated in 2018, and savings were calculated accordingly. An average savings value was applied to the single unit that did not have an AHRI certificate number. The evaluation team was not able to reproduce the ex ante savings using the inputs and algorithms tracked in the initiative dataset, so is unable to identify the cause of the savings discrepancy.

- **Programmable Thermostat:** The programmable thermostat realization rate was 86%.
 - The IL-TRM calculates heating savings at the household level as a percentage of baseline heating consumption. Since this value remains the same regardless of the number of thermostats installed, no extra energy savings are attributed to thermostats beyond the first one purchased. In the case of ex ante, heating savings values were multiplied by the quantity of thermostats installed. This impacted 3.4% of programmable thermostats.
 - Savings appear to be based on the existing heating equipment types. In some instances, a household received a new thermostat as well as a new ASHP, but the existing heating system was something different, such as electric resistance or a natural gas furnace. In these cases, we assumed that that thermostat controls the new ASHP rather than the existing system. This impacted 4.5% of programmable thermostats.
- **Advanced Thermostat:** The advanced thermostat realization rate was 84%.
 - The IL-TRM calculates heating savings at the household level as a percentage of baseline heating and cooling consumption. Since this value remains the same regardless of the number of thermostats installed, no extra energy savings are attributed to thermostats beyond the first. In the case of ex ante, both heating and cooling savings values were multiplied by the quantity of thermostats installed. This impacted 7.0% of advanced thermostats.
 - Savings appear to be based on the existing heating and cooling equipment types. In some instances, a household received a new thermostat as well as a new ASHP, but the existing heating system was something different, such as electric resistance or a natural gas furnace. In these cases, we assumed that that new thermostat controls the new ASHP rather than the existing system. This impacted 5.5% of advanced thermostat measures.
 - Approximately 17.8% of advanced thermostats were installed in homes where the presence of a new or existing thermostatically controlled cooling system is unknown. The ex ante savings assume that all these homes have thermostatically controlled cooling systems whereas verified savings use the TRM-deemed savings fractions based on home type.
- **DMSHP:** The measure achieved a realization rate of 156%.
 - Ex ante savings estimates for DMSHPs were based on ASHP measure assumptions, primarily, a baseline SEER of 14.0 and HSPF of 8.2. The DMSHP algorithm outlined in the IL-TRM V6.0 stipulates a baseline SEER of 13.0 for DMSHPs installed in homes with CACs or with no existing cooling system, and a baseline HSPF of 3.412 for DMSHPs installed in homes with electric resistance heat. The baseline HSPF assumption has a significant impact on measure savings. Approximately 85.3% of DMSHP measures are impacted by the baseline SEER assumption and 20.6% are impacted by the HSPF assumption.
- **DMSHP ER:** The measure achieved a realization rate of 74%.
 - For early replacement measures, the IL-TRM V6.0 stipulates similar existing HSPF assumptions for both the ASHP and DMSHP measures. As a result, the early replacement realization rate is largely driven by the full-load heating and cooling inputs, which are lower for DMSHPs than for standard ASHPs. This impacts all of the DMSHP ER measures.

Table 43 presents the HVAC Initiative annual electric demand savings achieved in 2018 by measure.

Table 43. 2018 HVAC Initiative Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (kW)	Gross Realization Rate	Verified Gross Savings (kW)	NTGR	Verified Net Savings (kW)
ASHP	17	86%	15	0.641	10
ASHP ER	135	85%	115	0.761	87
CAC	408	100%	408	0.641	262
CAC ER	1,267	121%	1,535	0.761	1,168
Pool Pump	1	100%	1	1.000	1
BPM	315	98%	309	0.761	235
Heat Pump Water Heater	0	N/A	0	0.760	0
Programmable Thermostat	0	N/A	0	0.870	0
Advanced Thermostat	93	85%	79	N/A	79
Ductless Heat Pump	4	182%	8	0.641	5
Ductless Heat Pump ER	6	98%	6	0.761	4
Initiative Total	2,247	112%	2,476	0.748	1,852

In most cases, the realization rates differ from 100% for the same reasons outlined above for electric energy (kWh) savings. Where savings differ for other reasons, they are noted below.

- **ASHP:** The measure achieved a realization rate of 86%.
 - The realization rate for time of sale measures is less than 100% due to two records with inaccurate information recorded in the tracking database. In one instance, the tracked cooling capacity was an order of magnitude higher than the rated capacity, and in the second instance the SEER value was used in the ex ante calculations instead of the EER value.
- **ASHP ER:** The measure achieved a realization rate of 85%.
 - The realization rate for early replacement measures is 85% because we used the known efficiency levels of existing equipment to calculate verified savings for ER measures. If the existing equipment's efficiency levels were unknown or fell below the threshold outlined in the IL-TRM, we used the IL-TRM-provided efficiency value instead. In all cases, ex ante savings used the IL-TRM deemed value. The known efficiency levels tended to be higher than the deemed values outlined in the TRM, resulting in lower savings.
- **DMSHP:** The measure achieved a realization rate of 182%.
 - Realization rates for replace on burnout measures are 182% because ex ante savings estimates for DMSHPs were based on ASHP measure assumptions, primarily, a baseline EER of 11.8. The DMSHP algorithm outlined in the IL-TRM V6.0 indicates a baseline EER of 11.0 for DMSHPs installed in homes with CACs or with no existing cooling system. Approximately 85.3% of DMSHP measures are impacted by this assumption.
- **DMSHP ER:** The measure achieved a realization rate of 98%.
 - The measure achieved a realization rate of 98% because of differences in the existing EER value for one installation. The ex ante savings assume a baseline of 8.15 EER (consistent with a unit replacing a CAC) whereas the verified savings assume a baseline of 8.55 EER (consistent with a

unit replacing an ASHP). Based on the data available in the tracking data, it appears the DMSHP was installed in a home with an ASHP.

Table 44 presents the HVAC Initiative annual gas savings achieved in 2018 by measure.

Table 44. 2018 HVAC Initiative Gas Savings by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Programmable Thermostat	7,582	98%	7,446	0.870	6,478
Advanced Thermostat	49,554	97%	48,212	N/A	48,212
Ductless Heat Pump ^a	0	N/A	10,079	0.641	6,461
Initiative Total^b	57,136	115%	65,737	0.930	61,151

^a DMSHPs were initially tracked as ASHPs and ex ante savings estimates assume an ASHP is replacing an existing electric heating system. Because the ASHP installation assumes an electric heating system as the baseline, no gas savings are expected. DMSHPs can be installed in gas heated homes, reducing the energy consumption of the existing gas heating systems, therefore verified savings include gas. No measure-level realization rate can be computed because no ex ante savings were claimed.

^b Initiative overall realization rates and NTGR values reflect the total of all ex ante, verified savings, and verified net savings.

The differences are attributable to verified assumptions that differ from ex ante ones, summarized below.

- **Programmable Thermostat:** The measure achieved a realization rate of 98%.
 - As mentioned previously, savings for the thermostat measures are lower than 100% as a result of multiple thermostats installed in the same home.
- **Advanced Thermostat:** The measure achieved a realization rate of 97%.
 - As mentioned previously, savings for the thermostat measures are lower than 100% as a result of multiple thermostats installed in the same home.
- **DMSHPs:**
 - No ex ante gas savings were reported for the measure because it was not specifically tracked as DMSHP, but rather claimed in the ASHP category which does not include gas savings (because it is assumed to replace an electric heating system). Despite this, we evaluated verified savings as outlined in the IL-TRM V6.0 for DMSHP equipment, including those installed in homes with existing gas heating systems. Though the measure itself does not have a realization rate, the additional savings resulting from this measure have a significant impact on the initiative's overall realization rate.

3.5.5 Cumulative Persisting Annual Savings

Table 45 presents CPAS and WAML for the 2018 HVAC Initiative. The measure-specific and total verified gross savings for the HVAC Initiative are summarized, and CPAS in each year of the 2018-2021 Plan are presented.²² The weighted average measure life for the Initiative, based on first-year verified gross savings, is 18.3 years. Each of the three early replacement measures (ASHP, CAC, and DMSHP) receive early replacement savings for the first six years following measure installation. During this period, the remaining useful life (RUL) of the existing equipment, savings are calculated based on the size and efficiency of the existing heating and cooling equipment. After six years, the baseline changes to a federal standard baseline and per-unit savings are the same as the time of sale measure for the duration of the equipment's existing useful life (EUL).

Table 45. 2018 HVAC Initiative CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
ASHP	18	348	0.641	223	223	223	223	...	223	...	4,019
ASHP ER	18	1,084	0.761	825	825	825	825	...	110	...	6,264
CAC	18	646	0.641	414	414	414	414	...	414	...	7,449
CAC ER	18	2,100	0.761	1,598	1,598	1,598	1,598	...	539	...	16,060
Pool Pump	10	2	1.000	2	2	2	2	...	0	...	19
BPM	20	2,257	0.761	1,718	1,718	1,718	1,718	...	1,718	...	34,353
Heat Pump Water Heater	13	9	0.760	7	7	7	7	...	7	...	87
Programmable Thermostat	5	27	0.870	24	24	24	24	...	0	...	119
Advanced Thermostat	10	290	N/A	290	290	290	290	...	0	...	2,903
Ductless Heat Pump	18	134	0.641	86	86	86	86	...	86	...	1,540
Ductless Heat Pump ER	18	58	0.761	44	44	44	44	...	11	...	397
2018 CPAS		6,955	0.752	5,230	5,230	5,230	5,230	...	3,107	...	73,210
Expired 2018 CPAS				0	0	0	0	...	2,123	...	
WAML	18.3										

²² For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.5.6 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the HVAC Initiative moving forward:

- **Key Finding #1:** The evaluation team found that the IL-TRM V6.0 BPM protocol does not account for the installation of an BPM along with a new ASHP or new CAC. BPM savings may overlap with high efficiency ASHP or CAC as BPMS are already assumed in the ASHP or CAC efficiency ratings (SEER, EER, HSPF). As a result, verified BPM savings were reduced for projects that received a new ASHP or new CAC in addition to a new BPM.
- **Recommendation:** Provide BPM incentives only to those installations where a new ASHP or CAC has not been installed. Barring that, update ex ante savings to account for the installation of competing measures and decrement the BPM savings accordingly: an BPM installed along with a new ASHP is only eligible for savings in circulation mode and an BPM installed along with a new CAC is only eligible for savings in heating mode and circulation mode. The IL-TRM V7.0 accounts for the recommended update and should be used to calculate ex ante savings in 2019.
- **Key Finding #2:** The evaluation team identified multiple incidences of missing or incorrect information in the tracking database: blank values in key fields (product type, primary heating system, primary cooling system, etc.), AFUE values in HSPF columns, heating or cooling capacities off by an order of magnitude, and cooling systems with higher EER values than SEER values.
- **Recommendation:** Review information entered into the tracking database to ensure where possible, that: the information matches the AHRI database, all values fall within a reasonable range for the given variable, and that information for a given record make sense together (i.e., SEER should always be higher than EER).
- **Recommendation:** Add an error flag into the database that detects when there are blank values in any given record. Additional logic can be built in to check for blanks in a subset of columns by measure.
- **Recommendation:** Consider establishing high and low bounds for equipment characteristics such as heating and cooling capacity. The team identified typographical / data entry errors in the database that impacted Initiative realization rates and would have been caught with flags for high and low data values.
- **Key Finding #3:** Ex ante savings for HPWHs are substantially higher than savings evaluated using the IL-TRM V6.0 and though some key equipment characteristics (energy factor and rated storage volume) are recorded on the rebate form, they don't appear in the tracking database. The team was not able to reproduce the ex ante savings using the IL-TRM V6.0 and the information recorded in the tracking database.
- **Recommendation:** Update the tracking database and ex ante savings algorithm to account for the specific characteristics of the HPWHs rebated through the Initiative. Key inputs include storage volume, energy factor, location, and heating and cooling system efficiencies.
- **Key Finding #4:** The evaluation team identified a number of DMSHPs entered in the tracking database. While this type of ASHP is not excluded based on the initiative requirements, it does require a different savings algorithm than is used for a traditional ASHP and in some cases is eligible for gas savings.
- **Recommendation:** Check the AHRI certificate number for all rebated ASHPs and, if appropriate, recategorize measures as DMSHPs.

- Recommendation: Ex ante savings for DMSHPs should not use the ASHP savings algorithms and inputs outlined in the IL-TRM, but rather the IL-TRM approach for DMSHP savings.
- Key Finding #5: Ex ante savings for early replacement measures are based on an assumed baseline rather than the existing equipment.
 - Recommendation: Consider updating ex ante savings methodologies for early replacement measures to calculate savings based on the efficiency of existing equipment.
- Key Finding #6: Approximately 3.4% of programmable thermostat measures and 7.0% of advanced thermostat measures were purchased as multiple thermostats by Initiative participants. The IL-TRM only considers savings on a per household basis and therefore additional sales to the same participant do not result in additional savings.
 - Recommendation: Update the ex ante assumptions to account for zero savings for any additional thermostats beyond one per participant.
- Key Finding #7: In cases where a home received a new heating or cooling system in addition to a new thermostat, the type of heating and cooling system controlled by a new thermostat is ambiguous. The database tracks and evaluates savings based on the existing heating and cooling systems for homes that receive new thermostats, however verified savings were based on the new heating and/or cooling system.
 - Recommendation: Update the tracking database to reflect whether new thermostats control existing or newly installed heating and cooling equipment.
- Key Finding #8: Approximately 33.8% of Initiative ex ante savings are attributable to the BPM measure – the largest proportion of Initiative savings attributable to any single measure. A new efficiency standard from the U.S. Department of Energy is mandated to take effect in July 2019,²³ which will establish efficiency requirements for furnace fan motors in furnaces manufactured on or after July 3, 2019. The minimum efficiency requirement of the new standard is roughly equivalent to the efficiency of contemporary BPM fan motors.
 - Recommendation: The evaluation team expects there will be a sell-through period for existing equipment backlogs, but by the end of 2019 we expect that BPM-style furnace fan motors will be the baseline furnace fan motor. We recommend the IL-TRM update process include consideration of this federal standard change. Because this measure is a large contributor to Initiative ex ante savings, such a change could significantly impact the potential for future savings from the Initiative.

3.6 Appliance Recycling

3.6.1 Initiative Description

The Appliance Recycling Initiative (ARI) encourages residential customers to retire working, primary and secondary, inefficient refrigerators and freezers. AIC offered a \$50 incentive to pick up and recycle (free of charge) working, full size (between 10 and 27 cubic feet) refrigerators and freezers directly from the homes of AIC electric customers. The goal of this activity is to eliminate the removed appliances' electricity consumption from the grid. Leidos managed the Initiative, providing reporting, quality control, and customer support.

²³ U.S. Department of Energy: Energy Efficiency and Renewable Energy. Building Technologies Office. *Appliance and Equipment Standards for Consumer Furnace Fans*. Available online: https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=54&action=viewlive

Solutions for Energy Efficient Logistics (SEEL), a subcontractor to Leidos, scheduled pickups and collected appliances, recycled units in an environmentally sound manner, and processed customer incentives.

Summary of Key Implementation Changes in 2018

The ARI was reinstated in March 2018, having been discontinued at the end of 2016. The program design was largely unchanged from previous years, continuing to recycle refrigerators and freezers but discontinuing the recycling of room air conditioners. Additionally, the implementation subcontractor (SEEL) was new in 2018.

3.6.2 Participation Summary

Table 6 presents ARI participation during 2018. Overall, the ARI had 5,532 participants who recycled 5,875 units. Of appliances recycled, refrigerators represented the bulk of the Initiative, with 4,703 refrigerators recycled between March and December 2018, compared to 1,172 freezers.

Table 46. 2018 Appliance Recycling Initiative Participation Summary

Participation	Count
Participants	5,532
Refrigerators	4,703
Freezers	1,172

3.6.3 Initiative Annual Savings Summary

Table 47 presents ARI annual savings achieved in 2018. Overall, the ARI achieved 2,862 MWh and 0.35 MW in verified net savings.

Table 47. 2018 Appliance Recycling Initiative Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)
Ex Ante Gross Savings	5,108	0.62
Gross Realization Rate	104%	105%
Verified Gross Savings	5,321	0.65
NTGR	0.538	0.537
Verified Net Savings	2,862	0.35

3.6.4 Initiative Savings Detail

The ARI recycled refrigerator and freezer savings are shown in the following table. Refrigerators represented the majority of both recycled units (4,711 vs. 1,173 freezers as illustrated in Table 47 above) and total Initiative savings (Table 48 and Table 49 below). The two primary reasons for realization rates different than 100% are the evaluation team's more granular approach to HDD and CDD based on NOAA data, and slightly different categorization as to which units are considered "primary."

Table 48. 2018 Appliance Recycling Initiative Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
Refrigerator	4,087	107%	4,376	0.520	2,275
Freezer	1,021	92%	945	0.620	586
Total	5,108	104%	5,321	0.540	2,862

Table 49. 2018 Appliance Recycling Initiative Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
Refrigerator	0.50	108%	0.54	0.520	0.28
Freezer	0.12	92%	0.11	0.620	0.07
Total	0.62	105%	0.65	0.540	0.35

3.6.5 Cumulative Persisting Annual Savings

Table 50 presents CPAS and WAML for the 2018 ARI. The measure-specific and total verified gross savings for the ARI are summarized, and CPAS in each year of the 2018-2021 Plan are presented.²⁴ The weighted average measure life for the Initiative is 8 years.

Table 50. 2018 Appliance Recycling Initiative CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
Refrigerator	8	4,376	0.520	2,275	2,275	2,275	2,275	...	0	...	18,200
Freezer	8	945	0.620	586	586	586	586	...	0	...	4,688
2018 CPAS		5,316	0.537	2,862	2,862	2,862	2,862	...	0	...	22,888
Expired 2018 CPAS				0	0	0	0	...	2,861	...	
WAML	8										

²⁴ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.7 Multifamily

3.7.1 Initiative Description

The Multifamily Initiative offers incentives and services that enable energy savings and lower operating costs in market-rate multifamily housing (buildings with three or more units managed by a private entity). The Initiative's implementer, CMC Energy, conducts all outreach and recruitment, performs audits to identify installation opportunities, and provides direct installation of energy-saving measures for building common areas and tenant units. Measures are provided free-of-charge. The provided measures are as follows:

- **In-unit:** Initiative offerings for tenant units include LEDs, low-flow showerheads, faucet aerators, programmable thermostats, advanced thermostats, pipe wrap, and Tier 1 advanced power strips. The implementer is responsible for installing LEDs, low-flow showerheads, faucet aerators, and pipe wrap in tenant units. Delivery methods for the advanced and programmable thermostats vary by property; in most cases, property management staff install thermostats under CMC supervision, although CMC occasionally leaves thermostats behind for property management staff to install later. Before projects wrap up, CMC staff verify the installation of all thermostats left behind. Similarly, delivery methods for the advanced power strips also vary by property as CMC Energy staff either provide tenants with in-person tutorials about how to use their advanced power strips or they leave the power strips behind for tenants to install.
- **Common Areas:** Common area offerings include light bulb replacements. The implementer offers properties medium screw-based standard and specialty LED upgrades for incandescent or halogen lamps in interior and exterior settings. The implementation contractor conducts all lighting upgrades.

Leidos also provides several implementation services to support the Multifamily Initiative, including developing marketing materials, providing initiative oversight, conducting QA/QC inspections, and managing Initiative tracking data.

Summary of Key Implementation Changes in 2018

AIC made several changes to the Multifamily Initiative during the 2018 program year:

- The Multifamily Initiative's implementer changed from CLEAResult to CMC Energy in 2018. Initiative staff reported that this change resulted in the Initiative starting in February instead of January due to the added time requirements of onboarding a new implementer. Overall, AIC and Leidos staff feel that CMC Energy implemented the Initiative effectively. Initiative staff also believe the implementer change has had a limited impact on the Initiative overall.
- In previous program years, AIC offered air sealing and insulation upgrades to market rate multifamily properties. Program allies were responsible for delivering these upgrades to customers and generating new leads for the Initiative. In 2018, AIC stopped offering air sealing and insulation upgrades through the Multifamily Initiative and program allies no longer have a role in initiative delivery.
- The Multifamily Initiative began offering several new in-unit measures to customers in 2018 including advanced power strips, advanced thermostats and pipe wrap. Implementer staff did not begin distributing advanced thermostats to customers until mid-way through the program year; however, customer uptake of this measure was strong once delivery started. Overall, initiative staff reported that the new advanced power strip and advanced thermostat offerings had a positive

impact on the Initiative because property managers²⁵ had a strong interest in the measures and the measure delivery process ran smoothly. Initiative staff also reported receiving positive feedback from tenants about the advanced thermostats, as tenants found the thermostats to be user-friendly. Furthermore, initiative staff reported that offering advanced power strips and thermostats helped them to deal with challenges associated with market saturation because they were able to go back and offer these measures to customers who had participated in the Multifamily Initiative in previous program years. The evaluation team will conduct surveys of property managers and tenants in 2019 to gather additional feedback about their experience with advanced thermostats and power strips and the results of this research will be provided in a separate memo.

3.7.2 Participation Summary

Table 6 presents Multifamily Initiative participation during 2018. The Multifamily Initiative served 3,421 tenant units in 2018, which is slightly lower than the internal initiative target of serving 4,000 tenant units.²⁶ Implementation staff reported that because they prioritized achieving savings goals over participation goals, they adjusted their tenant unit targets over the course of the year.

Table 51. 2018 Multifamily Participation Summary

Participation	Count
Unique Participants (property managers)	54
Unique Tenant Units	3,421
Measure Count	21,330

Table 52 presents the quantity and frequency of measures delivered to property managers. Property managers most frequently received LEDs, advanced power strips and advanced thermostats. These three measures also comprised the greatest quantity of measures delivered to property managers. These results fit with the overarching goals for the Initiative, as initiative staff reported they had a strong focus on delivering advanced thermostats and power strips to customers in 2018.

Table 52. 2018 Multifamily Frequency and Quantity of Measures Delivered

Measure Type	Count of Unique Property Managers Receiving Measure	Quantity of Measures Distributed
LED	35	13,827
Advanced Power Strip – Tier 1	42	3,316
Advanced Thermostat	26	2,247
Faucet Aerator	18	976
Pipe Insulation	11	492
Showerhead	11	447
Programmable Thermostat	3	25
Total	N/A	21,330

Note: Quantities of pipe insulation are measured in linear feet and all other quantities are measured in units of equipment.

²⁵ We use the term “property manager” to refer to both property managers and property owners.

²⁶ The evaluation team received two datasets from the implementer; a tenant-level dataset and a property-level dataset. The evaluation team calculated counts of unique participants and measures using the property-level dataset and we calculated counts of unique tenant units using the tenant-level dataset.

3.7.3 Initiative Annual Savings Summary

Table 53 presents the Multifamily Initiative annual savings achieved in 2018. The Multifamily Initiative met its preliminary internal initiative electric savings target of 2,250 MWh and fell slightly short of the preliminary internal initiative gas savings target of 44,576 therms. Initiative staff revised these internal savings goals mid-way through the program year to reflect progress serving multifamily properties across all AIC initiatives. The Multifamily Initiative achieved these revised savings goals.

Table 53. 2018 Multifamily Initiative Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	2,558	0.27	37,383
Gross Realization Rate	99%	117%	100%
Verified Gross Savings	2,539	0.31	37,480
NTGR	0.924	0.930	1.000
Verified Net Savings	2,345	0.29	37,480

Note: Any apparent variances in calculations are due to rounding.

3.7.4 Initiative Savings Detail

In 2018, the Multifamily Initiative distributed 14 different measure categories to property managers. Two of the newly introduced measures, advanced power strips and advanced thermostats, contribute over 75% of the Initiative's total verified savings. In 2018, the Multifamily Initiative achieved 2,345 MWh, 0.29 MW, and 37,480 therms in verified net savings while achieving 99%, 117%, and 100% realization rates for electric energy, electric demand, and gas, respectively. The following tables summarize the ex ante and verified electric energy, electric demand, and gas savings for all 2018 measures.

Table 54. 2018 Multifamily Initiative Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
Advanced Thermostat	1,621	99%	1,602	N/A	1,602
Advanced Power Strip – Tier 1	261	100%	261	0.794	207
LED – In-Unit (A-Type)	239	100%	239	0.773	185
LED – Common Area (A-Type)	163	100%	163	0.830	135
LED – In-Unit (Candelabra)	60	100%	60	0.773	46
Showerhead	51	100%	51	0.794	41
LED – In-Unit (Globe)	45	100%	45	0.773	35
Faucet Aerator	35	100%	35	0.794	27
LED – In-Unit (Reflector)	25	100%	25	0.773	19
Programmable Thermostat	17	100%	17	0.794	14
LED – Exterior (A-Type)	15	100%	15	0.830	13
LED – Common Area (Reflector)	15	100%	15	0.830	12
Pipe Insulation	9	100%	9	0.794	7
LED – Exterior (Globe)	2	100%	2	0.830	2
Total	2,558	99%	2,539	0.924	2,345

Note: Totals may not sum due to rounding.

Table 55. 2018 Multifamily Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
Advanced Thermostat	0.16	128%	0.20	N/A	0.20
Advanced Power Strip – Tier 1	0.03	100%	0.03	0.794	0.02
LED – In-Unit (A-Type)	0.02	100%	0.02	0.773	0.02
LED – Common Area (A-Type)	0.02	100%	0.02	0.830	0.02
Faucet Aerator	0.01	100%	0.01	0.794	0.01
LED – In-Unit (Candelabra)	0.01	100%	0.01	0.773	0.00
Showerhead	0.01	100%	0.01	0.794	0.00
LED – In-Unit (Globe)	0.01	100%	0.01	0.773	0.00
LED – In-Unit (Reflector)	<0.01	100%	<0.01	0.773	0.00
LED – Common Area (Reflector)	<0.01	100%	<0.01	0.830	0.00
Pipe Insulation	<0.01	100%	<0.01	0.794	0.00
Total	0.27	117%	0.31	0.930	0.29

Note: Totals may not sum due to rounding.

Table 56. 2018 Multifamily Gas Savings by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Advanced Thermostat	29,783	100%	29,783	N/A	29,783
Showerhead	5,440	100%	5,440	1.000	5,440
Faucet Aerator	2,094	105%	2,192	1.000	2,192
Pipe Insulation	66	100%	66	1.000	66
Total	37,383	100%	37,480	1.000	37,480

Note: Totals may not sum due to rounding.

Electric energy and demand realization rates are entirely driven by differences between ex ante and verified savings calculations for advanced thermostats. Although there were also differences between ex ante and verified gas savings calculations for faucet aerators, this measure contributes just 5% of the overall ex ante gas savings for the Initiative, and therefore the differences in savings calculations are negligible when combined with all gas measures and result in an overall gas realization rate of 100%.

We describe the differences between the ex ante and verified savings calculations 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. The following differences between ex ante and verified savings calculations contribute to the overall resulting energy and gas realization rates:

■ Advanced Thermostat Differences

- **Full Load Cooling Hours:** The implementation team applied the full load cooling hours for single family homes instead of the values for multifamily homes provided in the IL-TRM V6.0. As a result, realization rates decreased.
- **Cooling Capacity:** The IL-TRM V6.0 does not provide a default cooling capacity for multifamily homes. The implementation team applied a cooling capacity of 21,840 BTUh, which is the result

of multiplying the IL-TRM default cooling capacity for single family (SF) homes (33,600 BTUh) by the multifamily Household Factor (HF) of 65%. The HF accounts for smaller floor area and heating loads for multifamily when compared to SF households, but there are no supporting data to validate the assumed percentage value. The IL-TRM V7.0 has since updated this variable and includes a default cooling capacity for multifamily homes using evaluation results from various multifamily programs implemented within the state. The evaluation team feels that the value in the IL-TRM V7.0 more appropriately represents multifamily cooling capacities, and therefore applied the multifamily cooling capacity of 28,000 BTUh from the IL-TRM V7.0. As a result, realization rates increased.

- **Misaligned HVAC Dependent Variables:** The ex ante savings assumptions are misaligned with the primary heating and cooling types identified in the tracking database for approximately 14% of all advanced thermostats. For example, gas values were applied to some homes with electric heating, or air conditioner values were applied in some cases where the cooling equipment is a heat pump. Each case is unique, and the evaluation team did not identify a recognizable pattern to the application of HVAC assumptions for these specific cases. Calculating verified savings using HVAC assumptions that align with the primary heating and cooling types specified in the tracking database slightly decreased realization rates.
- **Faucet Aerator Differences**
 - **Energy per Gallon (EPG):** The implementation team applied the IL-TRM V6.0 EPG value for “unknown” installed location for participants with gas water heating, although the initiative tracking database indicates the aerators are installed in kitchens.

3.7.5 Cumulative Persisting Annual Savings

Table 57 presents CPAS and WAML for the 2018 Multifamily Initiative. This table includes a summary of the measure-specific and total verified gross savings for the Multifamily Initiative, and a presentation of CPAS in each year of the 2018-2021 Plan.²⁷ The WAML for the Initiative is 9.6 years.

Table 57. 2018 Multifamily CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
Advanced Thermostat	10.0	1,602	N/A	1,602	1,602	1,602	1,602	...	0	...	16,020
LED – In-Unit	10.0	369	0.773	285	285	285	151	...	0	...	1,914
Advanced Power Strip – Tier 1	7.0	261	0.794	207	207	207	207	...	0	...	1,449
LED – Common Area	8.4	178	0.830	147	147	147	49	...	0	...	709
Showerhead	10.0	51	0.794	41	41	41	41	...	0	...	408
Faucet Aerator	9.0	35	0.794	27	27	27	27	...	0	...	247
Pipe Insulation	15.0	9	0.794	7	7	7	7	...	7	...	106
LED – Exterior	10.2	17	0.830	14	14	14	5	...	0	...	83
Programmable Thermostat	5.0	17	0.794	14	14	14	14	...	0	...	69
2018 CPAS		2,539	0.924	2,345	2,345	2,104	2,104	...	7	...	21,005
Expired 2018 CPAS				0	0	0	241	...	2,338	...	
WAML	9.6										

²⁷ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.7.6 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Multifamily Initiative moving forward:

- **Key Finding #1:** The implementation team applied IL-TRM V6.0 values for single family full load cooling hours when calculating energy savings for advanced thermostats installed in multifamily apartments.
 - **Recommendation:** Revise full load cooling hours for advanced thermostats to use the multifamily values from the IL-TRM V6.0 instead of those for single family homes.
- **Key Finding #2:** Because the IL-TRM V6.0 does not provide a default cooling capacity for multifamily homes, the implementation team applied a cooling capacity of 21,840 BTUh. The 21,840 BTUh was calculated by multiplying the IL-TRM default cooling capacity for single family homes (33,600 BTUh) by the multifamily Household Factor (HF) of 65%.
 - **Recommendation:** The HF in the IL-TRM V6.0 does not provide data to support the assumed value, and as a result the evaluation team recommends applying the multifamily cooling capacity of 28,000 BTUh from the IL-TRM V7.0 which is based on actual data from other multifamily programs within the state.
- **Key Finding #3:** The ex ante savings assumptions for advanced thermostats did not always reflect the primary heating and cooling types identified in the tracking database. A mismatch occurred for four unique participants (property managers), impacting close to 14% of all advanced thermostats.
 - **Recommendation:** QC all savings calculation inputs, specifically those that are dependent on parameters that vary by property, such as HVAC type, home type, etc.
- **Key Finding #4:** For kitchen faucet aerator savings, the implementation team applied IL-TRM V6.0 EPG values for “unknown” installed locations, instead of kitchen locations.
 - **Recommendation:** Update the EPG value for kitchen aerators to the IL-TRM V6.0 value for aerators installed in kitchens instead of the value for an “unknown” installed location.

3.8 Direct Distribution of Efficient Products

3.8.1 Initiative Description

The Direct Distribution of Efficient Products Initiative (“Direct Distribution Initiative”) provided energy savings kits and in-class energy education presentations to fifth- through eighth-grade students. In 2018, the initiative was designed and delivered similarly to previous years, with an added focus on low to moderate income (LMI) schools. Participating schools were recruited by CLEAResult, the initiative implementer, primarily through past participation, conference presentations and educator events, and direct-mail outreach; CLEAResult used the Illinois Report Card website to identify schools and geographic areas that qualified as LMI.

Kits were assembled and delivered to participating schools by Energy Federation Incorporated (EFI), and contained the following energy efficient products:

- Four LED light bulbs
- Advanced power strip
- High performance showerhead

- Kitchen sink aerator
- Bathroom sink aerator
- Hot water temperature card thermometer

In 2018, the Direct Distribution Initiative provided education and kits to 8,536 students. CLEAResult distributed the kits to students at the start of each in-school presentation, which explained the value of energy efficiency and educated students on how to install the energy-saving measures with their families. The presentation and kit materials also provided opportunities to increase customer awareness of other AIC energy efficiency initiatives. Initiative staff and participating teachers provided students with an informative worksheet that students were encouraged to complete at home. Students were offered a five-dollar incentive for installing the kit contents, completing the worksheet, and participating in an online survey; students from 30 schools participated in the survey with a response rate of 29%. Teachers with the highest participation of students in the online survey received a \$250 incentive from Ameren Illinois; in 2018, two teachers received the incentive, one with a 98% participation rate. An additional five-dollar incentive was offered to students whose parents completed a follow-up web-based survey. Twenty-one parents from eight schools completed the follow-up survey.

Summary of Key Implementation Changes in 2018

The Direct Distribution Initiative implemented two key changes in the 2018 program year. First, the initiative established a goal of distributing fifty percent of the school kits to students in LMI communities. Second, in September 2018, CLEAResult initiated a mini-kit pilot targeting third- and fourth-grade students. Each mini-kit included two LED light bulbs; one LED nightlight; one shower timer; two splash proof Save Water clings; and two vinyl Turn Out the Light stickers. CLEAResult developed an energy worksheet for inclusion in the kits and provided in-school presentations on the importance of energy conservation and use of the kit contents. The goal of the pilot was to distribute 500 mini-kits exclusively to students in LMI communities; the pilot ultimately delivered 481 mini-kits.

3.8.2 Participation Summary

According to the implementer's tracking database, 60 schools in 51 different service cities received energy savings kits during 2018, and the number of kits distributed to each of the participating schools ranged from 10 to 450. Table 58 presents the number of Direct Distribution Initiative measures distributed during 2018.

Table 58. 2018 Direct Distribution Initiative Participation Summary

Measure	Number of Measures Distributed
9W LED	33,412
1.0 GPM Bath Faucet Aerator	8,536
1.5 GPM Kitchen Faucet Aerator	8,536
1.5 GPM High Efficiency Showerhead	8,536
Hot Water Temperature Card Thermometer	8,536
Advanced Power Strip	7,689
Program Total	75,726

3.8.3 Initiative Annual Savings Summary

Table 59 presents annual savings achieved by the Direct Distribution Initiative in 2018.

Table 59. 2018 Direct Distribution Initiative Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	1,485	0.175	54,887
Gross Realization Rate	117%	132%	36%
Verified Gross Savings	1,740	0.231	19,543
NTGR	0.926	0.952	1.038
Verified Net Savings	1,612	0.220	20,294

The low gas savings realization rate of 36% is primarily due to the implementer using a gas water heater fuel saturation value for an installation with an unknown water heater fuel type (84% as prescribed in IL-TRM V6.0). In accordance with the evaluation plan, the evaluation team used the 2018 implementer web-based participant surveys to estimate 52% gas water heater fuel saturation; this percentage was applied to the Initiative participant population, resulting in total verified gross gas savings lower than the calculated ex ante gross savings.

The overall Initiative level gross MWh realization rate of 117% is due to significant differences between ex ante gross savings and verified gross savings for all measures except LEDs and advanced power strips. This is essentially the same reason for the Initiative total (including carryover savings) MW gross realization rate of 132%. A careful examination of Table 60 and Table 61 shows that the primary difference between the two overall Initiative level gross realization rates (117% MWh vs 132% MW) is a significantly higher LED MW realization rate (116%) than MWh realization rate (100%). LED savings represent a large proportion of Direct Distribution Initiative savings and the LED realization rates have a significant influence on the overall initiative level weighted gross realization rates.

3.8.4 Initiative Savings Detail

Table 60, Table 61, and Table 62 present the Direct Distribution Initiative savings for each traditional kit measure; mini-kit pilot savings are provided separately in Table 63, Table 64, and Table 65. Net savings for delayed CFL and LED installations attributed to the PY8, PY9 and Transition Period School Kits Programs are included as carryover savings in Table 60 and Table 61.²⁸

Table 60. 2018 Direct Distribution Initiative Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
9W LED	604	100%	602	0.830	500
1.0 GPM Bath Faucet Aerator	9	224%	20	1.040	21
1.5 GPM Kitchen Faucet Aerator	63	232%	146	1.040	152
1.5 GPM High Efficiency Showerhead	128	198%	254	1.050	267

²⁸ Five-twelfths of delayed 13W CFL installations by PY8 participants in year 3, five-twelfths of delayed 13W CFL installations by PY9 participants in year 2, seven-twelfths of delayed 13W CFL installations by PY9 participants in year 3, and delayed 9W LED installations by Transition Period participants in year 2, estimated as installed during 2018 (in accordance with IL-TRM V6.0), were credited to the final 2018 Direct Distribution Initiative ex ante gross, verified gross and verified net impacts.

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
Hot Water Temperature Card Thermometer	27	163%	43	1.000	43
Advanced Power Strip	546	100%	546	0.950	519
Initiative Subtotal	1,378	117%	1,613	0.932	1,502
Carryover Savings from 2017 [Year 2 Transition Period] – 9W LEDs	21	115%	25	0.830	20
Carryover Savings from 2016 [Year 3 PY9] – 13W CFLs	24	106%	26	0.830	21
Carryover from 2016 [Year 3 PY8 and Year 2 PY9] – 13W CFLs	37	108%	40	0.830	33
Initiative Total Including Carryover Savings^a	1,461	117%	1,703	0.927	1,578

Note: Totals may not sum due to rounding.

^a Does not include mini-kit savings, provided separately.

Table 61. 2018 Direct Distribution Initiative Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MWh)
9W LED	0.052	116%	0.060	0.830	0.050
1.0 GPM Bath Faucet Aerator	0.013	220%	0.028	1.040	0.029
1.5 GPM Kitchen Faucet Aerator	0.015	232%	0.036	1.040	0.037
1.5 GPM High Efficiency Showerhead	0.014	202%	0.028	1.050	0.029
Hot Water Temperature Card Thermometer	0.003	145%	0.005	1.000	0.005
Advanced Power Strips	0.062	100%	0.061	0.950	0.058
Initiative Subtotal	0.159	137%	0.218	0.957	0.208
Carryover Savings from 2017 [Year 2 Transition Period] – 9W LEDs	0.002	117%	0.002	0.830	0.002
Carryover Savings from 2016 [Year 3 PY9] – 13W CFLs	0.003	99%	0.003	0.830	0.002
Carryover from 2016 [Year 3 PY8 and Year 2 PY9] – 13W CFLs	0.004	95%	0.004	0.830	0.003
Initiative Total Including Carryover Savings^a	0.167	136%	0.227	0.952	0.216

Note: Totals may not sum due to rounding.

^a Does not include mini-kit savings, provided separately.

Table 62. 2018 Direct Distribution Initiative Gas Savings by Measure

Research Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
1.0 GPM Bath Faucet Aerator	2,049	47%	966	1.040	1,005
1.5 GPM Kitchen Faucet Aerator	14,511	48%	7,034	1.040	7,315

Research Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
1.5 GPM High Efficiency Showerhead	29,876	29%	8,612	1.050	9,042
Hot Water Temperature Card Thermometer	7,085	29%	2,079	1.000	2,079
Initiative Total^a	53,521	35%	18,691	1.040	19,442

Note: Totals may not sum due to rounding.

^a Does not include mini-kit savings, provided separately.

Table 63. 2018 Direct Distribution Initiative Mini-Kit Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
9W LED	18	100%	18	0.830	15
Shower Timer	6	318%	19	1.000	19
Mini-Kit Total	24	155%	37	0.918	34

Note: Totals may not sum due to rounding.

Table 64. 2018 Direct Distribution Initiative Mini-Kit Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
9W LED	0.002	100%	0.002	0.830	0.001
Shower Timer	0.006	47%	0.003	1.000	0.003
Mini-Kit Total	0.008	57%	0.004	0.930	0.004

Note: Totals may not sum due to rounding.

Table 65. 2018 Direct Distribution Initiative Mini-Kit Gas Savings by Measure

Measure Category	Ex Ante Gross Savings (therms)	Gross Realization Rate	Verified Gross Savings (therms)	NTGR	Verified Net Savings (therms)
Shower Timer	1,356	63%	852	1.000	852
Mini-Kit Total	1,356	63%	852	1.000	852

The evaluation team received ex ante gross savings estimates and assumptions from the implementer and compared them to the verified savings. The differences between total ex ante and verified savings estimates resulted from differences in ex ante and verified gross per-unit savings assumptions and installation rates. The following sections address the discrepancies for each measure:

- **LEDs:** The LED electric energy gross realization rate of 100% occurs because the ex ante 9W LED per-unit savings estimate of 18.6 kWh is only slightly higher than the verified per-unit savings estimate of 18.5 kWh. The slightly higher ex ante per-unit savings estimate results from the ex ante calculation using the “residential interior or unknown” location waste heat factor value of 1.06 from the IL-TRM V6.0, while the evaluation team used single family and multifamily specific waste heat factor values from IL-TRM V6.0 in conjunction with the 79% single family and 21% multifamily customer population distribution from the 2013 Market Potential Assessment²⁹ to calculate a

²⁹ EnerNOC Utility Solutions Consulting. Ameren Illinois Energy Efficiency Market Potential Assessment. Report Number 1404. Volume 2: Market Research. June 10, 2013. Available online: http://ilsagfiles.org/SAG_files/Potential_Studies/Ameren/Appendix%204_AIC%20DSM%20Potential%20Study%202013%20Volume%202%20Market%20Research.docx

weighted average waste heat factor for energy of 1.056. The LED electric demand gross realization rate is 116% due to the ex ante calculations using a 7.1% coincidence factor value, while the evaluation team used a 8.1% coincidence factor value prescribed in IL-TRM V6.0 for a LED installed in an unknown location.

- **Bath Faucet Aerators (electric):** The gross realization rate of 224% for energy and 220% for demand occur due to differences in electric water heater saturation assumptions. Ex ante assumptions used the 16% as electric “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 48% electric saturation results from the 2018 implementer-administered participant surveys, resulting in higher savings. The difference between ex ante and verified gross savings calculations that resulted in ex ante gross savings higher than verified gross savings, holding all else equal, is the implementer assumed an ISR of 36% to estimate ex ante savings, while the evaluation team applied the bath faucet aerator-specific ISR of 27%, calculated from the implementer-administered, web-based student participant survey. The electric demand gross realization rate of 220% is lower than the electric energy gross realization rate of 224% due to the rounding of inputs used in the ex ante electric savings calculations and the rounding of the ex ante per-unit savings estimates reported. Electric energy and demand gross realization rates are calculated to be the same values if all ex ante inputs and ex ante per-unit savings values are not rounded.
- **Bath Faucet Aerators (gas):** The gross realization rate of 47% occurs due to differences in gas water heater saturations and ISR assumptions. Ex ante assumptions used the 84% as gas “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 52% gas saturation results from the 2018 implementer-administered participant surveys, resulting in lower savings. Further, ex ante savings assumed a 36% ISR, while the verified calculations relied upon the survey results of 27% ISR.
- **Kitchen Faucet Aerators (electric):** The realization rate of 232% occurs due to differences in electric water heater saturation assumptions. Ex ante assumptions used the 16% as electric “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 48% electric saturation results from the 2018 implementer-administered participant surveys, resulting in higher savings. A difference between ex ante and verified gross savings calculations that resulted in ex ante gross savings higher than verified gross savings, holding all else equal, is the implementer assumed an ISR of 35% to estimate ex ante savings, while the evaluation team applied the kitchen faucet aerator-specific ISR of 27%, calculated from the implementer-administered, web-based student participant survey.
- **Kitchen Faucet Aerators (gas):** The realization rate of 48% occurs due to differences in gas water heater saturation and ISR assumptions. Ex ante assumptions used the 84% as gas “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 52% gas saturation results from the 2018 implementer-administered participant surveys, resulting in lower savings. Further, ex ante savings assumed a 35% ISR, while the verified calculations relied upon the survey results of 27% ISR.
- **Showerheads (electric):** The realization rates of 198% for energy and 202% for demand are due to differences in electric water heater saturation assumptions. Ex ante assumptions used the 16% as electric “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 48% electric saturation results from the 2018 implementer-administered participant surveys, resulting in higher savings. A difference between ex ante and verified gross savings calculations that resulted in ex ante gross savings higher than verified gross savings, holding all else equal, is the implementer assumed an ISR of 38% to estimate ex ante savings, while the evaluation team applied an ISR of 25% to estimate verified savings, calculated from the implementer-administered, web-

based student participant survey. The electric demand gross realization rate of 202% is higher than the electric energy gross realization rate of 198% due to the rounding of inputs used in the ex ante electric savings calculations and the rounding of the ex ante per-unit savings estimates reported. Electric energy and demand gross realization rates are calculated to be the same values if all ex ante inputs and ex ante per-units savings values are not rounded.

- **Showerheads (gas):** The realization rate of 29% is due to differences in gas water heater saturation and ISR assumptions. Ex ante assumptions used the 84% as gas “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 52% gas saturation results from the 2018 implementer-administered participant surveys, resulting in lower savings. Further, ex ante savings assumed a 38% ISR, while the verified calculations relied upon the survey results of 25% ISR.
- **Hot Water Temperature Card Thermometers (electric):** The realization rate of 163% for energy and 145% for demand are due to differences in electric water heater saturation assumptions. Ex ante assumptions used the 16% as electric “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 48% electric saturation results from the 2018 implementer-administered participant surveys, resulting in higher savings. The difference between ex ante and verified gross savings calculations that resulted in ex ante gross savings higher than verified gross savings, holding all else equal, is the implementer assumed an ISR of 24% to estimate ex ante savings, while the evaluation team applied the hot water temperature card thermometer-specific ISR of 13%, calculated from the implementer-administered, web-based student participant survey. The electric demand gross realization rate of 145% is lower than the electric energy gross realization rate of 163% due to the rounding of the ex ante per-unit savings estimates reported in the tracking data. Electric energy and demand gross realization rates are calculated to be the same values if all ex ante per-units savings values are not rounded.
- **Hot Water Temperature Card Thermometers (gas):** The realization rate of 29% occurs due to differences in gas water heater saturation and ISR assumptions. Ex ante assumptions used the 84% as gas “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 52% gas saturation results from the 2018 implementer-administered participant surveys, resulting in lower savings. Further, ex ante savings assumed a 24% ISR, while the verified calculations relied upon the survey results of 13% ISR.
- **Advanced Power Strips (electric):** Since the evaluation team used the same savings assumptions as the implementer for the advanced power strips, the verified gross per-unit savings match the ex ante per-unit savings (71.1 kWh) for a 100% realization rate.
- **Shower Timer (electric):** The realization rates of 318% for energy and 42% for demand are due to differences in electric water heater saturation assumptions. Ex ante assumptions used the 16% as electric “unknown water heater fuel type” from the IL-TRM V6.0, while verified calculations applied the 48% electric saturation results from the 2018 implementer-administered participant surveys, resulting in higher savings. The electric demand gross realization rate of 47% is lower than the electric energy gross realization rate of 318% due to the ex ante electric savings calculations using an annual electric hot water recovery hours for showerhead use value of 27.51, while the evaluation team used a value of 210.34 in accordance with IL-TRM V6.0. The hours value of 27.51 that the implementer used in the ex ante demand savings calculation is the gallons per hour (GPH) of recovery of electric water heater value prescribed in IL-TRM V6.0, not the actual hours value to be used in the demand savings calculation.
- **Shower Timer (gas):** The realization rate of 63% occurs due to differences in gas water heater saturations. Ex ante assumptions used the 84% gas as the “unknown water heater fuel type” from

the IL-TRM V6.0, while verified calculations applied the 52% gas saturation results from the 2018 implementer-administered participant surveys, resulting in lower savings.

The IL-TRM V6.0 assumes that students install 61% of the LEDs during the year that they are distributed. Up to 86% of all remaining LEDs are eventually installed during the following two years. Therefore, in addition to gross savings achieved from measure installations during 2018, the evaluation team calculated gross savings for future LED installations, per the IL-TRM V6.0. Table 66 shows savings from bulbs provided to participants and installed in 2018 as well as bulbs that will be installed and claimed in future program years.

Table 66. 2018 Direct Distribution Initiative Verified Gross Impacts of Lighting Measures by Assumed Installation Year

Measure	Energy (MWh)			Demand (MW)		
	2018	2019	2020	2018	2019	2020
9W LED	620	81	68	0.062	0.008	0.007

The evaluation team credited the Direct Distribution Initiative with savings from CFL and LED bulbs distributed during PY8, PY9 and Transition Period program years, and installed during the 2018 program year. Because the Transition Period accounted for only 7 of the 12 months of a year, we claimed 5/12 of Future Year 2 CFL installations from PY8 (19 MWh and 0.002 MW in verified gross savings), 5/12 of Future Year 2 CFL installations from PY9 (22 MWh and 0.002 MW in verified gross savings), 7/12 of Future Year 3 CFL installations from PY9 (26 MWh and 0.003 MW in verified gross savings) and delayed 9W LED installations by Transition Period participants (25 MWh and 0.002 MW in verified gross savings).

3.8.5 Cumulative Persisting Annual Savings

Table 67 presents CPAS and WAML for the 2018 Direct Distribution Initiative. The measure-specific and total verified gross savings for the Direct Distribution Initiative are summarized, and CPAS in each year of the 2018-2021 Plan are presented.³⁰ The WAML for the Direct Distribution Initiative is 8.4 years.

Table 67. 2018 Direct Distribution Initiative CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
9W LED (2018 [Year 1])	10.0	602	0.830	500	500	500	162	...	0	...	2,630
9W LEDs (Carryover from 2017 [Year 2 Transition Period])	10.0	25	0.830	20	20	20	13	...	0	...	114
13W CFLs (Carryover from 2017 [Year 3 PY9])	3.0	26	0.830	21	21	21	0	...	0	...	64
13W CFLs (Carryover from 2016 [Year 3 PY8 and Year 2 PY9])	3.0	40	0.830	33	33	33	0	...	0	...	100
1.0 GPM Bath Faucet Aerator	9.0	20	1.040	21	21	21	21	...	0	...	188
1.5 GPM Kitchen Faucet Aerator	9.0	146	1.040	152	152	152	152	...	0	...	1,371
1.5 GPM High Efficiency Showerhead	10.0	254	1.050	267	267	267	267	...	0	...	2,670
Hot Water Temperature Card Thermometer	2.0	43	1.000	43	43	0	0	...	0	...	87
Advanced Power Strips	7.0	546	0.950	519	519	519	519	...	0	...	3,634
9W LED (Mini-Kit)	10.0	18	0.830	15	15	15	5	...	0	...	78
Shower Timer (Mini-Kit)	2.0	19	1.000	19	19	0	0	...	0	...	38
2018 CPAS		1,703	0.926	1,612	1,612	1,549	1,132	...	0	...	10,968
Expired 2018 CPAS				0	0	63	479	...	1,612	...	
WAML	8.4										

³⁰ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.8.6 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Direct Distribution Initiative moving forward:

- **Key Finding #1:** Realization rates varied significantly due to widely differing fuel type saturations and installation rates than assumed for “unknown water heater fuel type” in the IL-TRM V6.0. Assuming this year’s school participation is similar in the future, values based on the 2018 survey may provide better estimates for future programs.
- **Recommendation:** Calculate future ex ante savings using the water heater saturations and ISRs from the 2018 implementer participant surveys.
- **Key Finding #2:** The 2018 implementer participant survey did not collect single family and multifamily home type information, data related to whether the LED light bulbs were installed in interior or exterior locations, or whether the advanced power strips were installed.
- **Recommendation:** Collect information on home type, location of LED light bulb installations and installation of advanced power strips in future survey efforts to inform gross savings calculations.

3.9 Smart Savers

3.9.1 Pilot Description

The Smart Savers Pilot launched in August 2018 as a market development effort to provide advanced thermostats at no-cost to hard-to-reach customers. AIC identified four geographic areas (East St. Louis, Decatur, Peoria, and Champaign) in which to initiate the Pilot. Customers in the targeted areas received email invitations to apply online or by phone for a free advanced thermostat to install in their home. Implementers also leveraged AIC-sponsored events to recruit both single family and multifamily customers. Participating customers in single family homes were given the option of requesting a thermostat to install themselves or a contractor to install the device. For interested multifamily customers, implementation staff contacted property managers to arrange for device installs.

3.9.2 Participation Summary

Most of the 5,478 advanced thermostats distributed by the Smart Savers Pilot in 2018 were installed in single family homes (71%). Of thermostats installed in single family homes, 56% were self-installed and 44% were installed by a service professional. Participants in single family homes almost exclusively enrolled online or at events (99%), while nearly all multifamily participants enrolled by phone (99%). Table 6 presents participation in the Smart Savers Pilot during 2018.

Table 68. 2018 Smart Savers Pilot Participation Summary

Installation Type	Enrollment Channel	Share of Sales
Single family (self-installed)	Online	40%
Single family (self-installed)	Phone	<1%
Single family (direct install)	Online	31%
Single family (direct install)	Phone	<1%
Multifamily (direct install)	Online	<1%
Multifamily (direct install)	Phone	29%
Total (n=5,478)		100%

3.9.3 Pilot Annual Savings Summary

Table 9 presents Smart Savers Pilot annual savings achieved in 2018. In 2018, the Smart Saver Pilot achieved 2,631 MWh in verified net electric energy savings, 0.556 MW in verified net electric demand savings, and 245,238 therms in verified net gas savings.³¹

Table 69. 2018 Smart Savers Pilot Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	2,560	0.358	247,233
Gross Realization Rate	103%	155%	99%
Verified Gross Savings	2,631	0.556	245,238
NTGR	1.000	1.000	1.000
Verified Net Savings	2,631	0.556	245,238

³¹ For purposes of goal attainment, as allowed by FEJA, some 2018 Smart Savers gas savings are eventually converted to electric energy savings. This section's presentation of annual savings achieved *does not* consider this conversion. For further detail on that conversion, see the Executive Summary of this report, the forthcoming 2018 AIC Integrated Impact Evaluation Report, and Section 3.9.4, which presents CPAS from converted Smart Savers gas savings.

3.9.4 Cumulative Persisting Annual Savings

Table 70 presents CPAS and WAML for the 2018 Smart Savers Pilot (not including converted gas savings). Table 71 presents CPAS converted from 2018 Smart Savers gas savings and the associated WAML. The measure-specific and total verified gross savings for the Smart Saver Pilot are summarized, and CPAS in each year of the 2018-2021 Plan are presented.³² The overall WAML for the Pilot is 10 years.

Table 70. 2018 Smart Savers Pilot CPAS and WAML Without Gas Conversion

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
Advanced Thermostats	10.0	2,631	1.000	2,631	2,631	2,631	2,631	...	0	...	26,313
2018 CPAS		2,631	1.000	2,631	2,631	2,631	2,631	...	0	...	26,313
Expired 2018 CPAS				0	0	0	0	...	2,631	...	
WAML	10.0										

Table 71. 2018 Smart Savers Pilot CPAS and WAML – Gas Conversion

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
Advanced Thermostats	10.0	915	1.000	915	915	915	915	...	0	...	9,152
2018 CPAS		2,631	1.000	915	915	915	915	...	0	...	9,152
Expired 2018 CPAS				0	0	0	0	...	915	...	
WAML	10.0										

³² For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.9.5 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Smart Saver Pilot moving forward:

- **Key Finding #1:** Ex ante savings parameters were not tracked or consistently applied in line with recommendations from the IL-TRM V6.0.
 - **Recommendation:** Maintain a record of ex ante savings assumptions for each record in the Smart Saver tracking data. This should draw attention to any unintended discrepancies and help ensure consistency between ex ante and verified savings. A clear record of ex ante savings parameters has the added benefit of ensuring evaluators can draw informed conclusions when seeking to explain any differences found.
- **Key Finding #2:** Advanced thermostat ex ante savings did not always account for the fuel type supplied by AIC – savings were sometimes claimed for electricity or gas not provided by AIC or vice versa.
 - **Recommendation:** Update ex ante savings formulas to consistently claim all electric heating and cooling savings for AIC electric customers only and all gas heating savings for AIC gas customers only.

3.10 DCEO New Construction Commitments

3.10.1 Effort Description

The DCEO New Construction Commitments are affordable housing new construction projects that were initiated as part of DCEO programs but not completed before DCEO programs ended on May 31, 2017. At that time, AIC assumed the outstanding commitments in its territory to ensure that projects could be completed. As a result, AIC assumed the project costs, payout of incentives, and the resulting savings

3.10.2 Participation Summary

Table 6 presents the DCEO New Construction Commitments from 2018. Four participants completed four projects.

Table 72. 2018 DCEO New Construction Commitments Participation Summary

Participation	Count
Participants	4
Project Count	4
Measure Count	25

3.10.3 Effort Annual Savings Summary

Table 9 presents the annual energy savings achieved in 2018 from the DCEO New Construction Commitments. Verified gross savings amount to 826 MWh and 0.05 MW, achieving a gross realization rate of 82% for electric energy and 141% for electric demand. The DCEO New Construction Commitments also achieved verified gas savings of 22,851 therms (a gross realization rate of 92%).

Table 73. 2018 DCEO New Construction Commitments Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	1,011	0.04	24,878
Gross Realization Rate	82%	141%	92%
Verified Gross Savings	826	0.05	22,851
NTGR	1.000	1.000	1.000
Verified Net Savings	826	0.05	22,851

Provided documentation identified the measures that contributed to each project. However, ex ante savings estimates were provided only at the project level (i.e., individual measure level ex ante savings estimates and related details were not provided). The lack of detailed measure level information and some related key parameters, such as attic insulation areas, impeded the evaluation team's assessment of impacts. Although some equipment specification was provided, the evaluation team needed to make assumptions for the missing information based on engineering judgement or the IL-TRM. In particular, we used engineering judgement to adjust for operating hours, efficiency, size of equipment, and other parameters that resulted in gross electric energy and gas realization rates less than 100% for the projects and the DCEO New Construction Commitments overall.

3.10.4 Effort Savings Detail

Table 3 through 5 present the details of the measures installed in the 2018 DCEO New Construction Commitments, as well as the related gross and net savings adjustments for energy, demand, and therms.

Table 74. 2018 DCEO New Construction Commitments Electric Energy Savings by Measure

Project	Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
AMIL0000019029	HVAC - PTAC Unit	N/A	N/A	305	1.000	305
	Attic Insulation	N/A	N/A	197	1.000	197
	Refrigerators	N/A	N/A	6	1.000	6
	Lighting	N/A	N/A	47	1.000	47
	<i>Project Subtotal</i>	672	0.82	554	1.000	554
AMIL0000019030	Single Package Vertical Heat Pumps (SPVHP)	N/A	N/A	19	1.000	19
	Wall/Attic Insulation	N/A	N/A	128	1.000	128
	Foundation Wall Insulation	N/A	N/A	30	1.000	30
	Lighting	N/A	N/A	18	1.000	18
	Refrigerators	N/A	N/A	3	1.000	3
	Clothes Washer	N/A	N/A	0.2	1.000	0
	Dishwasher	N/A	N/A	1	1.000	1
	Ceiling Fan	N/A	N/A	5	1.000	5
	Clothes Dryer	N/A	N/A	1	1.000	1
	<i>Project Subtotal</i>	263	0.78	205	1.000	205

Project	Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
AMIL0000019032	Air Source Heat Pump (ASHP)	N/A	N/A	7	1.000	7
	Lighting	N/A	N/A	17	1.000	17
	Refrigerators	N/A	N/A	1	1.000	1
	Clothes Washer	N/A	N/A	1	1.000	1
	Dishwasher	N/A	N/A	1	1.000	1
	Clothes Dryer	N/A	N/A	5	1.000	5
	<i>Project Subtotal</i>	39	0.81	32	1.000	32
AMIL0000019033	Air Source Heat Pump (ASHP)	36	0.44	16	1.000	16
	Attic Insulation	N/A	N/A	0.09	1.000	0
	Lighting	N/A	N/A	10	1.000	10
	Refrigeration	N/A	N/A	3	1.000	3
	Clothes Washer	N/A	N/A	3	1.000	3
	Dishwasher	N/A	N/A	141	1.000	1
	<i>Project Subtotal</i>	36	0.95	34	1.000	34
Total		1,011	0.82	826	1.000	826

Table 75. 2018 DCEO New Construction Commitments Electric Demand Savings by Measure

Project	Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
AMIL0000019029	PTAC	N/A	N/A	0.000	1.000	0.000
	Attic Insulation	N/A	N/A	0.018	1.000	0.018
	Refrigerators	N/A	N/A	0.001	1.000	0.001
	Lighting	N/A	N/A	0.005	1.000	0.005
	<i>Subtotal</i>	N/A	N/A	0.024	1.000	0.024
AMIL0000019030	SPVHP	N/A	N/A	0.002	1.000	0.002
	Wall/Attic Insulation	N/A	N/A	0.012	1.000	0.012
	Foundation Wall Insulation	N/A	N/A	0.003	1.000	0.003
	Lighting	N/A	N/A	0.002	1.000	0.002
	Refrigeration	N/A	N/A	0.000	1.000	0.000
	Clothes Washer	N/A	N/A	0.000	1.000	0.000
	Dishwasher	N/A	N/A	0.000	1.000	0.000
	Ceiling Fan	N/A	N/A	0.001	1.000	0.001
	Clothes Dryer	N/A	N/A	0.000	1.000	0.000
	<i>Subtotal</i>	0.030	0.67	0.020	1.000	0.020

Project	Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
AMIL0000019032	Air Source Heat Pump (ASHP)	N/A	N/A	0.001	1.000	0.001
	Lighting	N/A	N/A	0.002	1.000	0.002
	Refrigeration	N/A	N/A	0.000	1.000	0.000
	Clothes Washer	N/A	N/A	0.000	1.000	0.000
	Dishwasher	N/A	N/A	0.000	1.000	0.000
	Clothes Dryer	N/A	N/A	0.001	1.000	0.001
	<i>Subtotal</i>	0.005	0.93	0.004	1.000	0.004
AMIL0000019033	Air Source Heat Pump (ASHP)	0.004	1.16	0.005	1.000	0.005
	Attic Insulation	N/A	N/A	0.005	1.000	0.005
	Lighting	N/A	N/A	0.000	1.000	0.000
	Refrigeration	N/A	N/A	0.001	1.000	0.001
	Clothes Washer	N/A	N/A	0.000	1.000	0.000
	Dishwasher	N/A	N/A	0.000	1.000	0.000
	<i>Project Subtotal</i>	0.004	1.65	0.007	1.000	0.007
Total		0.039	1.41	0.054	1.000	0.054

Table 76. 2018 DCEO New Construction Commitments Gas Savings by Measure

Project	Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
AMIL0000019029	Attic Insulation	N/A	N/A	6,786	1.000	6,786
	High Efficiency Boiler	N/A	N/A	7,719	1.000	7,719
	High Efficiency Gas Water Heater	N/A	N/A	8,345	1.000	8,345
Total		24,878	0.92	22,851	1.000	22,851

As we noted earlier, no details were provided by the implementer or in the tracking database on the measure level ex ante savings. Thus, the evaluation team had to make multiple assumptions about individual measures, equipment size and specifications. For example, we deduced that ex ante savings estimates for some measures assumed year-round operation of equipment while our verification approach adjusted for seasonal operation such as using equivalent full load hours for heating and cooling from the IL-TRM.

3.10.5 Cumulative Persisting Annual Savings

Table 77 presents CPAS and WAML for the 2018 DCEO New Construction Commitments. The measure-specific and total verified gross savings are summarized, and CPAS in each year of the 2018-2021 Plan are presented.³³ The WAML for the DCEO New Construction Commitments is 18.8 years.

Table 77. 2018 DCEO New Construction Commitments CPAS and WAML

Measure	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2018	2019	2020	2021	...	2030	...	
ASHP	18.0	42	1.000	42	42	42	42	...	42	...	758
Wall/Attic/Foundation Wall Insulation	25.0	355	1.000	355	355	355	355	...	355	...	8,864
Ceiling Fan	10.0	5	1.000	5	5	5	5	...	0	...	50
Clothes Washer	14.0	5	1.000	5	5	5	5	...	5	...	72
Dishwasher	13.0	3	1.000	3	3	3	3	...	3	...	42
PTAC	15.0	305	1.000	305	305	305	305	...	305	...	4,569
Lighting	10.0	92	1.000	92	92	92	92	...	0	...	922
Refrigerators	12.0	13	1.000	13	13	13	13	...	0	...	157
Clothes Dryer	14.0	6	1.000	6	6	6	6	...	6	...	79
2018 CPAS		826	1.000	826	826	826	826	...	715	...	15,514
Expired 2018 CPAS				0	0	0	0	...	110	...	
WAML	18.8										

³³ For further detail, including achieved CPAS in years not presented in this table, please see the summary CPAS spreadsheet attached to this report.

3.10.6 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations should AIC pursue public sector new construction efforts in the future:

- **Key Finding #1:** The evaluation team found lack of adequate documentation on the post installation energy efficiency measures implemented by the participating facilities. Most of the data available to evaluation were pre-approval and final application documents, and projected (draft) specifications. The evaluation team did not find photos of completed improvements, post inspection or implementation reports. This lack of information impeded the evaluation team's assessment of impacts and required a conservative evaluation approach. We note that this is likely a result of the project's lineage through DCEO rather than any fault of the AIC implementation team, and is unlikely to occur in future years.
- **Recommendation:** Any future implementer should provide a list of documentation and eligibility requirements to applicants to ensure that adequate information on improvements and measures, including invoices, photos, detailed specifications, completion dates, and inspections reports is collected.
- **Key Finding #2:** The evaluation team referenced mechanical and electrical drawings to determine the lighting configuration of the building structures. Project documentation indicated lighting fixtures were ENERGY STAR-rated fluorescent or LED fixtures. However, the information available did not specify wattage specifications or the quantity installed. As such, the evaluation team relied on the building or unit square footage and assumed the lighting power density of the space (watt per square feet) to calculate lighting savings.
- **Recommendation:** Ensure that adequate information is provided in the tracking system at the measure level, including all savings assumptions and sources.
- **Key Finding #3:** Since the evaluation team did not find the specifications of the actual systems installed, we assumed ENERGY STAR models exceeding 14 and 8.2 (respectively 15 SEER and 8.5 HSPF as recommended by the IL- TRM) to calculate verified savings.
- **Recommendation:** Any future implementer should ensure that adequate documentation is collected about the size and type of any heat pump systems implemented. In particular, the application should specify the ENERGY STAR rating for appliances and HVAC systems promoted.
- **Key Finding #4:** Project applications usually referred to the home energy rating tool REM/Rate as the source of custom assumptions and calculations of claimed savings. However, the details of the analysis were not readily available for verification. As a result, wherever appropriate, the evaluation team relied on the IL-TRM, supplemental data from the implementation contractor, and engineering expertise to calculate verified savings.
- **Recommendation:** Rather than REM/Rate, any future implementer should consider relying on the IL-TRM as a reliable source of savings assumptions on Illinois climate, degree days, equivalent full load cooling and heating hours. The implementer can appropriately adapt code compliance standards in the determination of custom savings.
- **Key Finding #5:** The evaluation team adjusted gross savings based on an assessment of the electrical load, mechanical drawings, and general specifications of potential energy efficiency improvements including building envelop, appliances, lighting, HVAC, and hot water systems. The verified gross electric energy savings realization rate was 80%, partly because documentation

assumed year-round operating hours of 8,760 for all projects, which the evaluation team adjusted for seasonality.

- Recommendation: If implementers will continue to rely on the REM/Rate tool for custom calculations, they should consider adjusting seasonal operating conditions and other climate specific assumptions.

Appendix A. Detailed Impact Analysis Methodology

This appendix presents details of the impact analysis methods used for the 2018 Residential Program.

Retail Products

Verified Gross Impact Methodology

This appendix contains detail on the savings assumptions used to estimate verified gross electric energy, electric demand, and gas savings from lighting, advanced power strips, advanced thermostats, and variable-speed pool pumps for the Retail Products Initiative in 2018.

Lighting Savings Assumptions

The evaluation team calculated verified gross electric and demand savings for 2018 Retail Products Initiative lighting products using the Initiative tracking database and applying algorithms and savings assumptions based on the IL-TRM V6.0. The evaluation team used the following equations from the IL-TRM V6.0 to estimate electric energy, electric demand, and gas savings for LED lighting:

Equation 1. Lighting Energy and Demand Savings Equations

$$\begin{aligned}
 kWh &= \left[Qty \times LA \times \%Res \times \left[\frac{(Base\ Watt - EE\ Watt)}{1000} \times ISR_{res} \times HOU_{res} \times WHFe_{res} \right] \right] \\
 &\quad + \left[Qty \times LA \times \%Com \times \left[\frac{(Base\ Watt - EE\ Watt)}{1000} \times ISR_{com} \times HOU_{com} \times WHFe_{com} \right] \right] \\
 kW &= \left[Qty \times LA \times \%Res \times \left[\frac{(Base\ Watt - EE\ Watt)}{1000} \times ISR_{res} \times CF_{res} \times WHFd_{res} \right] \right] \\
 &\quad + \left[Qty \times LA \times \%Com \times \left[\frac{(Base\ Watt - EE\ Watt)}{1000} \times ISR_{com} \times CF_{com} \times WHFd_{com} \right] \right]
 \end{aligned}$$

Where:

- Qty = Quantity of bulbs from initiative tracking data
- LA = Leakage adjustment (1 – leakage rate)
- %Res = Portion of bulbs purchased for residential application
- %Com = Portion of bulbs purchased for commercial application
- Base Watt = EISA-compliant baseline wattage
- EE Watt = Actual wattage of installed energy efficient bulb
- ISR = In-service rate
- HOU = Hours of use
- WHFe = Waste heat factor for energy savings
- WHFd = Waste heat factor for demand savings
- CF = Coincidence factor
- Res = Residential values
- Com = Commercial values

Lighting Baseline Wattage and EISA Compliance

The baseline wattages in the IL-TRM V6.0 vary depending on the bulb type. Baseline wattages for standard LEDs are based on the lumen output and account for EISA efficiency standards, where appropriate. Table 78 lists the baseline wattages as they were applied to calculate 2018 verified savings for standard LEDs.

Table 78. Baseline Wattages for Standard LEDs

Lumen Range	Base Wattage
250–309	25
310–749	29
750–1,049	43
1,050–1,489	53
1,490–2,600	72
2,601–2,999	150
3,000–5,279	200
5,280–6,209	300

The baseline wattages for directional LEDs vary depending on the directional bulb type and lumen range and account for the Department of Energy (DOE) energy efficiency standards for incandescent reflector lamps and any appropriate exemptions to the standards. Table 79 lists the baseline wattages as they were applied to calculate 2018 verified savings for specialty reflector LEDs.

Table 79. Baseline Wattages for Reflector LEDs

Bulb Type	Lumen Range	Base Wattage
R, ER, BR with medium screw bases w/ diameter >2.25" (*see exceptions below)	420–472	40
	473–524	45
	525–714	50
	715–937	65
	938–1,259	75
	1,260–1,399	90
	1,400–1,739	100
	1,740–2,174	120
	2,175–2,624	150
	2,625–2,999	175
	3,000–4,500	200
*R, BR, and ER with medium screw bases w/ diameter ≤2.25"	400–449	40
	450–499	45
	500–649	50
	650–1,199	65
*ER30, BR30, BR40, or ER40	400–449	40
	450–499	45
	500–649	50
*BR30, BR40, or ER40	650–1,419	65

Bulb Type	Lumen Range	Base Wattage
*R20	400–449	40
	450–719	45
*All reflector lamps below lumen ranges specified above	200–299	20
	300–399	30

For PAR and MR directional products, we did not have the necessary product specifications to use the Center Beam Candle Power (CBCP) and beam angle formula to calculate baseline wattage. Instead, we relied on the claimed baseline wattage for these bulbs, per TRM instruction.

Table 80 lists the baseline wattages as they were applied to calculate 2018 verified savings for specialty non-reflector LEDs.

Table 80. Baseline Wattages for Specialty Non-Reflector LEDs

Bulb Type	Lumen Range	Base Wattage
3-Way	250–449	25
	450–799	40
	800–1,099	60
	1,100–1,599	75
	1,600–1,999	100
	2,000–2,549	125
	2,550–2,999	150
Globe (medium and intermediate bases less than 750 lumens)	90–179	10
	180–249	15
	250–349	25
	350–749	40
Decorative (Shapes B, BA, C, CA, DC, F, G, medium and intermediate bases less than 750 lumens)	70–89	10
	90–149	15
	150–299	25
	300–749	40
Globe (candelabra bases less than 1050 lumens)	90–179	10
	180–249	15
	250–349	25
	350–499	40
	500–1,049	60
Decorative (Shapes B, BA, C, CA, DC, F, G, candelabra bases less than 1050 lumens)	70–89	10
	90–149	15
	150–299	25
	300–499	40
	500–1,049	60

Lighting Leakage and Residential Versus Commercial Installation

The nature of an upstream lighting offering prevents implementers from directly verifying that each bulb sold goes to an Ameren Illinois customer and is installed in a residential setting. The IL-TRM V6.0 provides a deemed 13.1% leakage rate that can be applied to AIC upstream lighting programs, which the evaluation team chose to use in this evaluation. Of the remaining 86.9% of bulbs, the IL-TRM V6.0 stipulates that 95% go to residential settings and 5% go to commercial applications.

Lighting In-Service Rate and Carryover Savings

Per the IL-TRM V6.0, first-year in-service rate (ISR) varies by bulb type and installation location, and 98% of all bulbs are projected to be installed within three years of purchase while the remaining 2% are never installed. Using this trajectory, savings are claimed in the year that bulbs are installed. Therefore, the 2018 Retail Products Initiative claims savings from first-year installations of 2018 bulb sales as well as carryover savings from bulbs sold in previous years but not installed until 2018. Likewise, savings associated with bulbs purchased in 2018 but not installed until the second or third year after purchase will be claimed as carryover savings the year they get installed. Table 81 below provides an installation trajectory by bulb type and installation location.

Table 81. Illinois Statewide TRM Version 6.0 LED Lighting ISR Trajectory

Install Location	Bulb Type	First Year	Second Year	Third Year	Cumulative
Residential	Standard	89.9%	4.3%	3.7%	98.0%
	Specialty	93.5%	2.4%	2.1%	98.0%
Commercial	All	95.7%	1.2%	1.1%	98.0%

2018 lighting impacts include carryover savings from products purchased in previous program years but not installed until 2018. Up until June 1, 2017, AIC programs ran from June 1 through May 31, instead of on a calendar year as they do now. To align carryover savings from bulbs sold prior to June 1, 2017, we adjust second-year and third-year savings from each prior program year proportionally based on the number of months the program year overlapped with 2016 and 2017 calendar years.

Because PY8 spanned just five months of 2016, carryover savings from PY8 sales installed three years after purchase are multiplied by 5/12th to represent the portion of these third-year installations installed in 2018. PY9 spanned seven months of 2016 and five months of 2017, so 7/12th of third-year installations and 5/12th of second-year installations are assumed installed in 2018. The Transition Period fell entirely in 2017, so 100% of second-year installations are claimed as carryover in 2018.

Figure 4 provides a visualization of how carryover savings are apportioned.

Figure 4. 2018 Retail Products Initiative Carryover Savings Claimed in 2018

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	PY8 Residential Lighting Program Sales (third-year installations claimed in 2018)					PY9 Residential Lighting Program Sales (third-year installations claimed in 2018)						
2017	PY9 Residential Lighting Program Sales (second-year installations claimed in 2018)					Transition Period (PYTP) Retail Products Initiative Sales (second-year installations claimed in 2018)						
2018	2018 Retail Products Initiative Sales (first-year installations claimed in 2018)											

When calculating carryover savings, installation trajectory and NTGR are based on values used for the evaluation associated with the year of purchase. Other gross savings assumptions are assigned in line with the TRM leveraged for evaluation of the year bulbs are installed. Table 82 provides carryover energy and demand savings claimed by the 2018 Retail Products Initiative for bulbs sold in 2016 and 2017 but not installed until 2018.

Table 82. 2018 Retail Products Initiative Carryover Savings Claimed in 2018

Source	Verified Gross Savings (MWh)	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MWh)	Verified Net Savings (MW)
PY8 / third-year installs	4,261	0.512	0.63	2,699	0.324
PY9 / third-year installs	2,191	0.261	0.62	1,351	0.161
PY9 / second-year installs	1,822	0.217	0.62	1,125	0.134
PYTP / second-year installs	681	0.079	0.58	397	0.046
Total	8,955	1.069	N/A	5,571	0.666

Lighting Hours of Use

The IL-TRM V6.0 provides different residential HOU assumptions for different bulb types depending on where they get installed. For the 95% of bulbs sold to residential customers, we applied the residential HOU, and for the 5% of bulbs sold to commercial entities we applied the commercial HOU. Table 83 provides the applied HOU assumptions by bulb type and installation location.

Table 83. Illinois Statewide TRM Version 6.0 Lighting HOU Assumptions

Bulb Type	Residential	Commercial
Standard	847	3,612
3-way/dimmable	850	3,612
Reflector	891	3,612
Decorative	1,190	3,612
Globe	639	3,612

Lighting Waste Heat Factors

The IL-TRM V6.0 provides different waste heat factor values for energy and demand savings and depending on installation location. For the 95% of bulbs sold to residential customers, we applied the residential factors and, for the remaining 5%, we applied the commercial factors. Table 84 outlines waste heat factor assumptions by savings type and installation location.

Table 84. Illinois Statewide TRM Version 6.0 Lighting WHF Assumptions

Savings Type	Residential	Commercial
Waste Heat Factor (Energy)	1.06	1.09
Waste Heat Factor (Demand)	1.11	1.36

Lighting Coincidence Factors

The IL-TRM V6.0 provides peak CFs based on bulb type and installation location. For the 95% of bulbs sold to residential customers, we applied the residential factors and, for the remaining 5%, we applied the commercial factors. Table 85 provides coincidence factor assumptions by bulb type and installation location.

Table 85. Illinois Statewide TRM Version 6.0 Lighting CF Assumptions

Bulb Type	Residential	Commercial
Standard	0.081	0.580
3-way/dimmable	0.078	0.580
Reflector	0.094	0.580
Decorative	0.121	0.580
Globe	0.075	0.580

Advanced Power Strip Savings Assumptions

The evaluation team calculated verified gross electric and demand savings for 2018 Retail Products Initiative advanced power strips using the initiative tracking database and applying algorithms and savings assumptions based on the IL-TRM V6.0.

The evaluation team used the following equations from the IL-TRM V6.0 to estimate electric energy, electric demand, and gas savings for advanced power strips:

Equation 2. Advanced Power Strip Energy and Demand Savings Equations

$$kWh = Qty \times HOU \times ISR$$

$$kW = Qty \times CF \times ISR$$

Where:

Qty = Quantity of advanced power strips from initiative tracking data

HOU = Hours of use = 7,129

ISR = In-service rate = 100%

CF = Coincidence factor = 0.80

Advanced Thermostat Savings Assumptions

The evaluation team calculated verified gross electric and demand savings for 2018 Retail Products Initiative advanced thermostats using the initiative tracking database and applying algorithms and savings assumptions based on the IL-TRM V6.0.

The evaluation team used the following equations from the IL-TRM V6.0 to estimate electric energy, electric demand, and gas savings for advanced thermostats:

Equation 3. Advanced Thermostat Energy and Demand Savings Equation

$$kWh = kWh_{Cool} + kWh_{Heat} + kWh_{Run}$$

$$kWh_{Cool} = Qty \times \%AC \times \frac{1 \div SEER}{1000} \times Capacity_{Cool} \times Reduct_{Cool} \times FLH_{Cool} \times ISR$$

$$kWh_{Heat} = Qty \times \%Elec_{Heat} \times ElecUsage_{Heat} \times HF \times Reduct_{Heat} \times ISR$$

$$kWh_{Run} = Qty \times Therms \times Furnace_e \times 29.3$$

$$kW = Qty \times \%AC \times \frac{1 \div EER}{1000} \times Capacity_{Cool} \times Reduct_{Cool} \times CF \times ISR$$

$$Therms = Qty \times \%Gas_{Heat} \times GasUsage_{Heat} \times HF \times Reduct_{Heat} \times ISR$$

Where:

Qty = Quantity of service addresses receiving at least one advanced thermostat based on initiative tracking data

%AC = Portion of cooling controlled by thermostat = 100% if central cooling or heat pump, otherwise 0%

SEER = Cooling efficiency of central air conditioner or heat pump controlled by the advanced thermostat in units of SEER = Actual; if unknown assumed 8.60 for central air conditioners and 9.12 for heat pumps

Capacity_{Cool} = Cooling capacity of air conditioner = 33,600 BTU/hour (deemed)

Reduct_{Cool} = Reduction in cooling energy consumption due to installing an advanced thermostat = 8.0%

FLH_{Cool} = Full load cooling hours (applied per participant based on project location)

Table 86. Full Load Cooling Hours by Climate Zone

Climate Zone	FLH _{Cool}
1 (Rockford)	512
2 (Chicago)	570
3 (Springfield)	730
4 (Belleville)	1,035
5 (Marion)	903
Weighted Average	629

ISR = Percentage of thermostats installed and effectively programmed = 100%

%Elec_{Heat} = 100% if electric space heating fuel, 0% if gas space heating fuel, 6.5% if unknown

$\text{ElecUsage}_{\text{Heat}}$ = Estimated annual household heating consumption for electrically heated homes (applied per participant based on project location and electric heating type [i.e., electric resistance, heat pump])

Table 87. Electric Heating Consumption by Climate Zone

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

HF = Household factor to adjust heating consumption for single family homes = 100%

$\text{Reduct}_{\text{Heat}}$ = Reduction in heating energy consumption = 7.4%

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

EER = Cooling efficiency of central air conditioner or heat pump controlled by the advanced thermostat in units of EER = Actual; if unknown assumed 8.15 for central air conditioners and 8.55 for heat pumps

CF = Summer system peak coincidence factor = 0.34

$\%\text{Gas}_{\text{Heat}}$ = 100% if gas space heating fuel, 0% if electric space heating fuel, 93.5% if unknown

$\text{GasUsage}_{\text{Heat}}$ = Estimated annual household heating consumption for gas-heated homes (applied per participant based on project location)

Table 88. Gas Heating Consumption by Climate Zone

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

Advanced thermostat tracking data included detailed information on heating fuel and heating and cooling systems for most participants. Climate zones were assigned based on customer zip code from the initiative tracking data. Per the IL-TRM V6.0, additional savings cannot be claimed for a second advanced thermostat installed in a single location.

Variable-Speed Pool Pump Savings Assumptions

The evaluation team calculated verified gross electric and demand savings for 2018 Retail Products Initiative variable-speed pool pumps using the initiative tracking database and applying algorithms and savings assumptions based on the IL-TRM V6.0.

The evaluation team used the following equations from the IL-TRM V6.0 to estimate electric energy and electric demand savings for variable-speed pool pumps:

Equation 4. Variable Speed Pool Pump Energy and Demand Savings Equations

$$kWh = Qty \times \frac{\left[\left(\frac{HOU_{base} * GPM_{base} * 60}{EF_{base}} \right) - \left(\left(\frac{HOU_{vsH} * GPM_{vsH} * 60}{EF_{vsH}} \right) + \left(\frac{HOU_{vsL} * GPM_{vsL} * 60}{EF_{vsL}} \right) \right) \right]}{1000 \times Days}$$

$$kW = \left[\left(\frac{kWh_{base}}{Days} / HOU_{base} \right) - \left(\left(\frac{kWh_{vsH} + kWh_{vsL}}{Days} \right) / (HOU_{vsH} + HOU_{vsL}) \right) \right] \times CF$$

Where:

Qty = Quantity of variable-speed pool pumps from initiative tracking data

HOU = Running hours per day = 11.4 for single-speed pump; 2 for variable-speed pump at high speed; 16 for variable-speed pump at low speed; 18 for variable-speed pump

GPM = Gallons per minute = 64.4 for single-speed pump; 50 for variable-speed pump at high speed; 30.6 for variable-speed pump at low speed

EF = Energy factor = 2.1 for single-speed pump; 3.8 for variable-speed pump at high speed; 7.3 for variable-speed pump at low speed

Days = Days per year that swimming pool is operational = 125

kWh = Annual energy consumption = 2,622 for single-speed pump; 197 for variable-speed pump at high speed; 503 for variable-speed pump at low speed

CF = Coincidence factor = 0.831

Base = single-speed pump

vsH = variable-speed pump at high speed

vsL = variable-speed pump at low speed

Verified Net Impact Methodology

The evaluation team applied SAG-approved NTGRs to all verified savings by measure type and delivery method. Table 89 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 89. SAG-Approved Retail Products NTGRs

Measure	Electric NTGR	Gas NTGR
LED lighting	0.700	N/A
Advanced thermostats	N/A	N/A
Advanced power strips (discount channel)	1.000	N/A
Advanced power strips (online marketplace)	0.860	N/A
Variable-speed pool pumps	0.800	N/A

Income Qualified

Verified Gross Impact Methodology

The evaluation team calculated verified savings for the IQ Initiative by applying savings algorithms from the IL-TRM V6.0. The team leveraged initiative tracking data such as primary heating and cooling type, water heating fuel, existing equipment age, efficiency, and capacity, delivery mechanism (e.g., direct install, leave behind, mailed), LED wattage, LED lamp type, pre- and post- insulation R-values, project location (e.g., for weather dependent variables), installed measure location (e.g., interior, exterior, bathroom, kitchen, etc.), and home type (e.g., single family, multifamily) to inform savings assumptions. For variables outside these parameters, the evaluation team relied on defaults from the IL-TRM V6.0.

It should be noted that the evaluation team leveraged IL-TRM V7.0 inputs for advanced thermostats in some cases. The IL-TRM V6.0 does not provide a default cooling capacity for multifamily homes, and therefore the evaluation team relied on the default value from the IL-TRM V7.0 instead. All other values come directly from the IL-TRM V6.0 or from the 2018 initiative tracking database.

Verified Net Impact Methodology

The IQ initiative SAG-approved NTGRs are 1.00 for all measures. Therefore, gross savings are equivalent to net savings.

Public Housing

Verified Gross Impact Methodology

The evaluation team calculated verified savings for the Public Housing Initiative by applying savings algorithms from the IL-TRM V6.0. The team leveraged initiative tracking data, such as primary heating and cooling type, delivery mechanism (e.g., direct install, leave behind), LED wattage, LED lamp type, project location (e.g., for weather dependent variables), and installed measure location (e.g., for faucet aerators) to inform savings assumptions. For variables outside these parameters, the evaluation team relied on defaults from the IL-TRM V6.0.

Of note, the IL-TRM V6.0 does not provide a default cooling capacity for multifamily homes for use in calculating energy savings from advanced thermostats. Therefore, the evaluation team relied on the default cooling capacity value from the IL-TRM V7.0 to estimate savings in this case. All other values come directly from the IL-TRM V6.0 or from the 2018 initiative tracking database.

Verified Net Impact Methodology

Because the Public Housing Initiative serves low income customers, it is assumed that all savings can be attributed to the initiative. As such, the evaluation team applied the SAG-approved 2018 NTGR of 1.0 to all measures delivered through this initiative.

Behavior Modification

Attrition Analysis Results

Expansion Cohort 1 experienced some attrition in 2018, as customers opted out, closed accounts, or never received a report. Table 90 shows the attrition rates for 2018 and over time since the Initiative began in PY3. Specifically, 3.9% of participants moved, 0.6% of participants opted-out, and 2.2% of participants never received a report after the experiment start date (May 2018). Given that the percent of participants that never received a report is larger than in previous years, the evaluation team inquired about the subset of customers who never received reports and learned that Tendril has certain quality checks in place to ensure customer satisfaction and prevent reports with anomalous billing data errors from going out. This may have contributed to the slightly higher attrition rate as well.

Table 90. Behavioral Modification Initiative Attrition Rates for Expansion Cohort 1

Cohort Name	PY3	PY4	PY5	PY6	PY7	PY8	PY9	PYTR	2018
Expansion Cohort 1	2.22%	9.68%	8.26%	7.61%	7.02%	6.58%	6.23%	3.70%	6.62%

Data Source: Tendril Behavioral Modification Initiative tracking database.

Equivalency Analysis Results

The evaluation team performed an equivalency analysis to ensure that the treatment and control groups were equivalent in terms of energy consumption for Expansion Cohort 1 and the results are presented in Table 91. We compared average daily consumption (ADC) of electricity and gas between treatment and control groups during their pre-participation period to assess whether these groups were equivalent after accounting for attrition. Based on our analysis, we found that the two groups were equivalent. In the year prior to receiving reports for the Initiative (April 2010 through March 2011), ADC for the Expansion Cohort 1 was 41.3 kWh/day and 2.9 therms/day for households in both the control group and treatment group.

Table 91. Pre-Participation Average Daily Consumption, kWh and Therms

Fuel Type	Treatment (Pre-Participation) Consumption	Control (Pre-Participation) Consumption
kWh	41.32	41.31
Therms	2.91	2.90

Figure 5 presents the pre-participation period electric consumption for both treatment and control groups and exhibits equivalency. We present a similar figure for gas consumption in Figure 6, which also exhibits equivalency across the cohorts.

Figure 5. Pre-Participation Period Electric Consumption, Treatment vs. Control

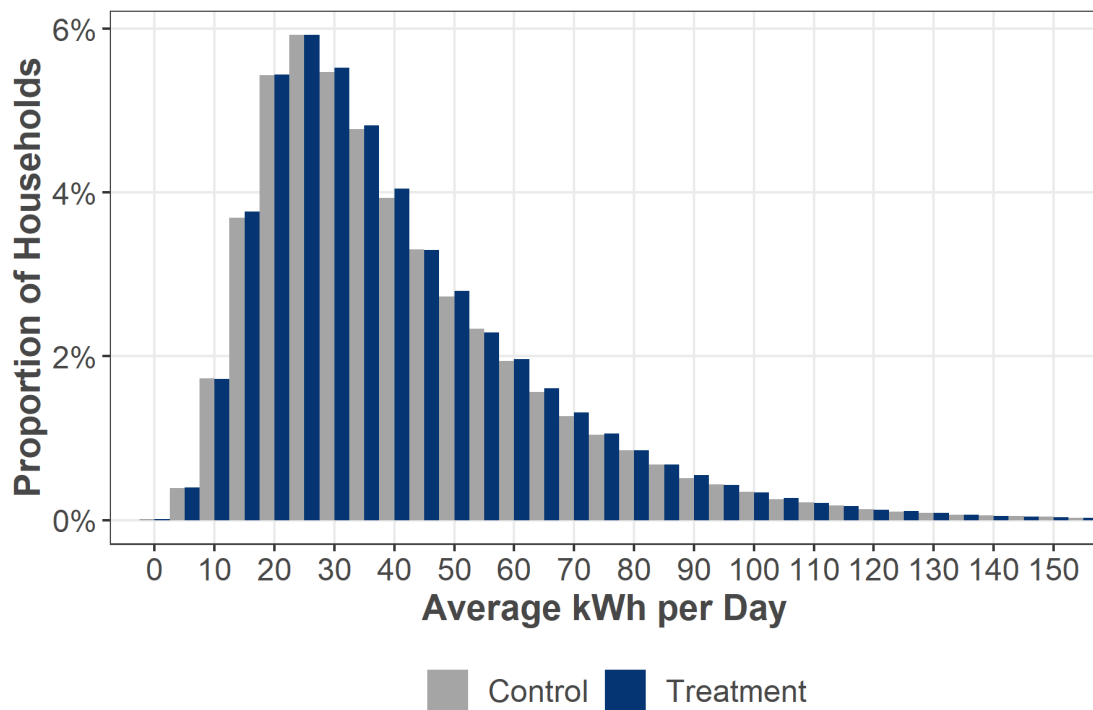
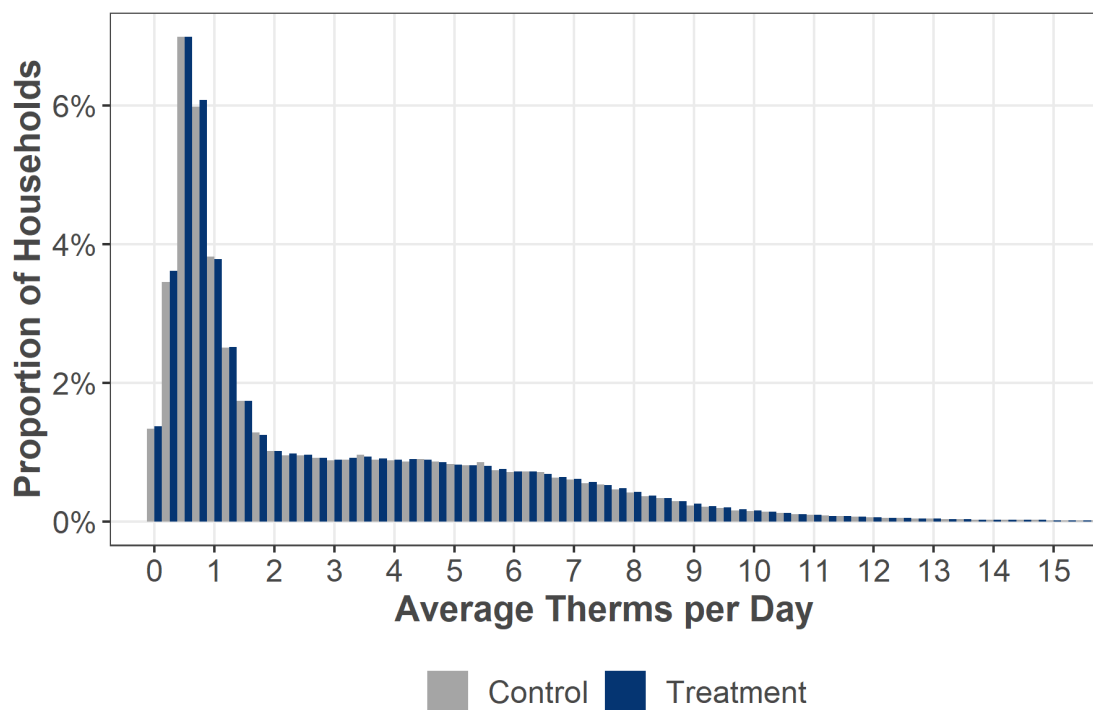


Figure 6. Pre-Participation Period Gas Consumption, Treatment vs. Control



Data Cleaning Results

This section shows the results of the data cleaning effort for the billing analysis (see Table 92). Results include all customers who were ever assigned to a treatment or control group with available billing data. The primary driver leading to removal of customers for the analysis is customers that moved out or opted-out of the Initiative before the experiment start date. This group of customers was 13% of the initial treatment population.

Table 92. Data Cleaning Results for Treatment and Control Groups, Gas and Electric

Fuel Type	Metric ^a	Unique Customers		Observations ^b	
		Treatment	Control	Treatment	Control
Gas	Initial #	43,610	14,953	762,247	261,891
	Final #	39,404	13,564	691,507	238,139
	% Remaining	90.36%	90.71%	90.72%	90.93%
Electric	Initial #	43,609	14,953	760,730	261,312
	Final #	39,261	13,513	686,219	236,339
	% Remaining	90.03%	90.37%	90.21%	90.44%

^a The initial number of customers the evaluation team began with does not include customers that moved out or opted out before the experiment start date.

^b Note that the number of observations (i.e., bills) the evaluation team began with includes those from the pre-period and 2018 post-period.

Modeling Initiative Impacts

Energy Savings

The impact analysis relied on a statistical analysis of monthly electric and gas billing data for all AIC customers who received a HER (the treatment group) and a randomly selected group of customers who did not receive a HER (the control group). The evaluation team used an intent to treat (ITT) approach in 2018,³⁴ and in implementing this approach, we estimated savings using a difference-in-differences (DID) model. The DID refers to the model's implicit comparison of consumption before and after treatment of both treatment and control group customers. The model includes customer-specific intercepts (i.e., fixed effects) to capture unobserved differences between customers that do not change over time, and which affect customers' energy use.

As part of the impact analysis, we selected three different types of DID models:

- A lagged dependent variable (LDV) model (Equation 5), that incorporates the post-participation period only.
- A weather adjusted model (Equation 6), which allows direct year-to-year savings comparison.
- A simple base model (Equation 7), which is run as a base case specification to help calibrate the magnitude of results.

³⁴ Intent to treat (ITT) estimates the impacts of the initiative for a group of customers the initiative intended to treat, (i.e., customers AIC intended to receive HERs or eHERs). In previous years, we used the average treatment effect of the treated (ATT), which estimates the impacts of the initiative for the group of customers that received HERs and/or eHERs. These approaches differ in the number of customers used in the analysis.

We provide impact estimates for the Initiative using the first model. Our model specifications are as follows:

Model 1: Lagged Dependent Variable (LDV) Model

The evaluation team used an LDV model to estimate the electric and gas savings experienced by the Initiative's treatment group for 2018. This model differs from Model 2 and Model 3, which are linear fixed effects regression (LFE) models in that only usage from the post-participation period is used in estimating the model. Information from the pre-participation period is used only to calculate pre-usage variables that are incorporated into the LDV model, but pre-period usage is not directly modeled. Following last year's evaluation, we used three levels of pre-participation period usage for each customer: overall pre-participation period average daily consumption (ADC), summer pre-participation period ADC, and winter pre-participation period ADC. The LDV model uses the control group in the same way as the LFE model, in that the treatment effect is corrected for control group ADC so that the coefficient of the treatment variable is the average ITT effect. We employed the following estimating equation:

Equation 5. Post-Participation Period Only Model Estimating Equation

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

Where:

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

α = Model intercept

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

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

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

β_4 = Coefficient for the average daily usage over the months of June through September across household i available pretreatment meter reads

β_5 = Vector of coefficients for month-year dummies

β_6 = Vector of coefficients for month-year dummies by average daily pretreatment usage

β_7 = Vector of coefficients for month-year dummies by average daily winter pretreatment usage

β_8 = Vector of coefficients for month-year dummies by average daily summer pretreatment usage

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

$PreUsage_i$ = Average daily usage for household i over the entire pre-participation period

$PreWinter_i$ = Average daily usage for household i over the pre-participation months of December through March

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

$MonthYear_t$ = Vector of month-year dummies

ε_{it} = Error

Model 2: Weather-Adjusted Model

This model incorporates weather terms within a simple LFER model. This improves the precision in the modeled results by accounting for possible differences in weather experienced by the study population. We controlled for weather by accounting for HDD and CDD, using a base of 65 °F for HDD and 75 °F for CDD. This model also helps account for differences between treatment and control group usages that correlate with weather.

Equation 6. Weather-Adjusted Model Estimating Equation

$$ADC_{it} = \alpha_i + \beta_1 Post_t + \beta_2 Treatment_i \cdot Post_t + \beta_3 HDD_{it} + \beta_4 CDD_{it} + \varepsilon_{it}$$

Where:

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

β_1 = Coefficient for the change in consumption between pre- and post-participation periods

β_2 = Coefficient for the change in consumption for the treatment group in the post-participation period compared to the pre-participation period and to the control group; this is the basis for the net savings estimate

β_3 = Coefficient for HDD

β_4 = Coefficient for CDD

$Post_t$ = Variable to represent the pre- and post-participation periods (0 = pre-participation period, 1 = post participation period³⁵)

HDD_{it} = Sum of HDD (base 65 °F)

CDD_{it} = Sum of CDD (base 75 °F)

Model 3: Base Model

Equation 7. Base Model Estimating Equation

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

Where:

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

³⁵ We defined the pre-period as the 12 months before the customer's first report. The month in which a customer receives his or her first report is neither pre-period nor post-period. The post period is the time period after the experiment start date (May 2018).

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

Results Using Alternative Model Specifications

Three model specifications were used to estimate the electric and gas savings from the 2018 Behavioral Modification Initiative. The evaluation team presents the unadjusted per household savings for each of the models below. Based on model diagnostics,³⁶ the evaluation team considered the LDV model results to best represent the savings from the Initiative. The LDV results in Table 93 replicate those presented in the body of the report in Table 36 and are included here for easy comparison to the results from the other models run by the evaluation team. For the weather adjusted model, the evaluation team notes that average percent electric and gas savings for Expansion Cohort 1 are greater than 1%. Similar to the weather adjusted model, the average percent electric and gas savings for the base model are positive. The average percent gas savings are slightly lower compared to the weather adjusted model, which is mostly likely due to not having all the winter months in the post-period (i.e., the post-period was June – December 2018).

Table 93. 2018 Unadjusted Per-Household Net Savings – LDV Model

Fuel Type	Model	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (per household)
kWh	LDV	1.78%	155.68
	Weather Adjusted	1.85%	161.89
	Base	1.76%	153.57
Therms	LDV	1.12%	5.15
	Weather Adjusted	1.15%	4.66
	Base	0.84%	3.36

Billing Analysis Model Coefficients

Below we provide the billing analysis model coefficients for both electric and gas results for the model specifications.

Table 94. LDV Model Billing Analysis Model Coefficients – Electric

Cohort	Coefficient ^a	Robust Standard Error
treat	-0.743811709	0.066603377
pre_adc	1.12935683	0.019742716
pre_adc_summ	-0.083339852	0.009087481
pre_adc_win	-0.289816548	0.00903866

^a All coefficients are statistically significant at the 90% confidence level.

Table 95. LDV Model Billing Analysis Model Coefficients – Gas

Cohort	Coefficient	Robust Standard Error
treat	-0.024617571	0.00352555
pre_adc	0.195799332	0.012803207
pre_adc_summ	0.335903323	0.011532757
pre_adc_win	0.018769949	0.004791975

^a All coefficients are statistically significant at the 90% confidence level.

³⁶ Model diagnostics included comparing the R², adjusted R², and standard errors across the three models for each fuel type.

Table 96. Weather-Adjusted Model Billing Analysis Model Coefficients – Electric

Cohort	Coefficient	Robust Standard Error
post	-2.2477680	0.0598231
CDD	0.2561927	0.0003596
HDD	0.0104097	0.0000458
post:treat	-0.7734630	0.0691808

^a All coefficients are statistically significant at the 90% confidence level.

Table 97. Weather-Adjusted Model Billing Analysis Model Coefficients – Gas

Cohort	Coefficient	Robust Standard Error
post	-0.27896	0.00507
CDD	0.00371	0.00003
HDD	0.00564	0.00000
post:treat	-0.02228	0.00586

Table 98. Original Model Billing Analysis Model Coefficients – Electric

Cohort	Coefficient	Robust Standard Error
post	0.52196375	0.07936174
post:treat	-0.73369931	0.09202399

^a All coefficients are statistically significant at the 90% confidence level.

Table 99. Original Model Billing Analysis Model Coefficients – Gas

Cohort	Coefficient	Robust Standard Error
post	-0.97658413	0.01176597
post:treat	-0.01604905	0.0136436

^a All coefficients are statistically significant at the 90% confidence level.

Demand Reductions

We calculated demand impacts based on the IL-TRM V6.0³⁷, which applies a peak adjustment factor to modeled energy savings results. The demand reductions leveraged 2018 electric savings and are adjusted to account for persistence from previous years.

³⁷ Volume 4, page 11.

Participation Uplift and Channeling Analysis

2018 Uplift

To determine whether the Behavioral Modification Initiative treatment generated participation uplift in 2018 (e.g., an increase in participation in other energy efficiency initiatives in 2018 as a result of the Behavioral Modification Initiative), we calculated whether more treatment than control group members participated in other AIC residential energy efficiency initiatives after receiving HERs compared to participation before receiving HERs. We cross-referenced the Behavioral Modification Initiative database—both treatment and control groups—with the databases of other residential energy efficiency initiatives in 2018. We include five residential initiatives in our analysis for 2018:

- Appliance Recycling (ARI)
- HVAC
- Income Qualified (IQ)
- Retail Products (RP)
- Smart Savers (SS)

The participation uplift analysis calculates the number of customers who participated in both the Behavioral Modification Initiative **and** other energy efficiency initiatives in 2018. To ensure the participation uplift is attributable solely to the Behavioral Modification Initiative, we calculate participation uplift using a post-only difference estimator and tested the result for statistical significance. To do so, we identify the total number of treatment and control group customers who participated in an AIC energy efficiency initiative in 2018. Any positive difference between the treatment and control population that is statistically significant is the net participation due to the Behavioral Modification Initiative.

Table 100 presents the result of our participation uplift analysis for initiatives that were active during 2018. We did not observe a statistically significant effect for participants in any 2018 AIC initiative.

Table 100. 2018 Participation Uplift Rate by Initiative

Initiative Name	Expansion Cohort 1 Uplift
ARI	0.07%
IQ	0.04%
HVAC	-0.03%
RP	0.13%
SS	0.00%

Legacy Uplift

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

Savings are calculated in the same manner as the uplift adjustment for 2018, with one additional adjustment. We multiply the net participation uplift due to the Behavioral Modification Initiative for each of the past years

analyzed by the median first year verified net savings per treatment group customer participating in another AIC residential initiative in for that year. However, when a measure has reached the end of its effective useful life by 2018, we exclude it from our analysis (e.g., if a measure installed in PY4 has only a three-year effective useful life, it is not considered in the median first year verified net savings value for PY4 customers).

Table 101 presents the initiatives considered in our legacy uplift savings adjustment. We include discontinued initiatives (e.g., Residential Efficient Products), as energy savings from these initiatives' past activity continue to persist in following years.

Table 101. Initiatives Included in Legacy Uplift Savings Adjustment

Initiative	Years Included						
	PY4	PY5	PY6	PY7	PY8	PY9	PYTR
Residential Lighting (Online Store Component Only) (OLS)	✓	✓	✓	✓			
ARI	✓	✓	✓	✓	✓	✓	
IQ	✓	✓	✓	✓	✓	✓	✓
Home Efficiency Standard (HES)	✓	✓	✓	✓	✓		
HVAC	✓	✓	✓	✓	✓	✓	✓
Moderate Income Kits (MICK)					✓	✓	
Residential Efficient Products (REEP)	✓	✓	✓				

Electric Legacy Uplift

Table 102 presents electric legacy uplift savings from PY4 through the Transition Period that we deduct from 2018 Behavioral Modification Initiative savings.

Table 102. Legacy Uplift MWh Savings

Initiative Year	Savings Attributable to Legacy Initiatives (MWh)							Total Savings Attributable to Legacy Initiatives (MWh)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
PY4	51	0	24	0	N/A	0	0	N/A
PY5	0	0	34	0	N/A	0	0	N/A
PY6	0	0	0	0	N/A	0	0	N/A
PY7	0	0	0	0	N/A	N/A	0	N/A
PY8	0	0	0	0	0	N/A	N/A	N/A
PY9	0	0	N/A	0	0	N/A	N/A	N/A
PYTR	N/A	0	N/A	0	N/A	N/A	N/A	N/A
Total	51	0	58	0	0	0	0	0

Gas Legacy Uplift

Table 103 presents gas legacy uplift savings from PY4 through the Transition Period that we deduct from 2018 Behavioral Modification Initiative savings.

Table 103. Legacy Uplift Therm Savings

Initiative Year	Savings Attributable to Legacy Initiatives (Therms)							Total Savings Attributable to Legacy Initiatives (Therms)
	ARP	HEIQ	HES	HVAC	MICK	OLS	REEP	
PY4	N/A	0	2,922	0	N/A	0	0	N/A
PY5	N/A	0	9,343	0	N/A	0	0	N/A
PY6	N/A	0	0	0	N/A	0	0	N/A
PY7	N/A	0	0	0	N/A	0	0	N/A
PY8	N/A	0	0	0	0	N/A	N/A	N/A
PY9	N/A	0	N/A	0	0	0	N/A	N/A
PYTR	N/A	0	N/A	0	N/A	N/A	N/A	N/A
Total	0	0	12,264	0	0	0	0	0

Persisting Savings

Continued implementation of HER programs in Illinois and across the country has demonstrated persistence of savings beyond the first year, leading Illinois to adopt a measure decay framework.³⁸ This framework assumes that savings persist over five years but the persistence decays in each year. The TRM recommends using the persistence factors presented in Table 104 over the five-year life to estimate lifetime electric energy savings for the program.

Table 104. HER Electric Savings Persistence Factors^a

Year	Electric Persistence Factor
Year 1 (program year under evaluation)	100%
Year 2	80%
Year 3	54%
Year 4	31%
Year 5	15%

In addition to applying persistence rate factors, lifetime savings need to account for customer attrition over time due to move-outs and account closures.³⁹ Based on the observations evaluating the Behavior Modification Initiative, as well as other energy efficiency programs in Illinois and across the country, the evaluation team concludes that multiple factors can drive attrition:

³⁸ IL-TRM V6.0 Section 6.1.1.

³⁹ It is possible that some savings resulting from HER program interventions persist after customers move out as either (a) energy efficient improvements to the residence that continue to deliver savings or (b) habituated energy conservation behaviors that customers continue to exercise at their new residence (as long as that residence is within a utility's service territory). As of this time, no definitive data exists to estimate the extent to which either of these two scenarios occurs. Version 6.0 of the IL TRM therefore assumes no persisting savings upon customer move-out, though it encourages additional research on the matter.

- Macroeconomic factors – economic downturns or upturns can drive customer mobility in a given year resulting in account closures
- Sociodemographic characteristics – household income levels, home ownership status, and home type are among key characteristics likely to drive differences in the attrition rate within each customer segment
- Length of customer participation in the initiative – attrition is generally higher in the first year upon program launch and decreases over time

To best balance these competing priorities in the prospective retention rate estimate, the evaluation team chose to develop a prospective retention rate for the initiative by developing a weighted average rate across the cohorts in the initiative from PY5 through the Transition Period. Using customers across these cohorts allowed us to capture the various customer segments (e.g., high users, low users, etc.) that can have differing attrition due to move out or other reasons in the estimate. Using a 5-year period allowed for a balance between capturing the general decrease in attrition over time, which is important to consider for existing participants, and possible economic changes affecting customer transiency, which is important from a forward-looking perspective.

To calculate the retention rate using this approach, we specified a simple linear regression, shown in Equation 8, to calculate a change in retention after each month of initiative treatment.

Equation 8. Prospective Retention Rate Regression Model

$$Retention\ Rate_{it} = \alpha_i + \beta_1 Months\ Treated_{it}$$

Where:

$Retention\ Rate_{it}$	is the retention rate for cohort i in program year t
α_i	is the model intercept
β_1	is the model coefficient of interest
$Months\ Treated_{it}$	is the number of treated months for cohort i in program year t

The model intercept (α_i) represents the average weighted retention rate at the start of each cohort, and the regression coefficient represents the increase in the retention rate for each additional treatment month. We then calculated the overall participant weighted treatment months from the last five years and included it in the regression output to calculate the overall weighted average retention rate. The weighted average retention rate is 92.3%. We used this rate as a multiplier when estimating persisting savings from the 2018 Behavior Modification Initiative.

HVAC

Verified Gross Impact Methodology

The evaluation team used tracking data and algorithms in the IL-TRM V6.0 to determine verified gross savings for the HVAC Initiative. Detailed information in the tracking database included data on unit type, size, efficiency, and measure installation locations. These served as inputs to savings algorithms in the IL-TRM V6.0. The evaluation team reported ex ante savings by summarizing data from the tracking database, while gross verified savings were calculated in two steps. First, the team calculated verified savings for every installed measure with sufficient supporting information in the tracking database in accordance with the IL-TRM V6.0 and with additional assumptions as appropriate. Second, the team applied a weighted average

statewide value to those measures with insufficient supporting detail. Verified net savings were determined by applying SAG-approved NTGRs to verified gross savings.

Air Source Heat Pumps

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for residential air source heat pumps.

Equation 9. Air Source Heat Pump Energy Savings Algorithm (Time of Sale)

$$\Delta kWh = ((FLH_{cooling} * Capacity_{cooling} * (1/SEER_{base} - 1/SEER_{ee})) / 1000) + ((FLH_{heat} * Capacity_{heating} * (1/HSPF_{base} - 1/HSPF_{ee})) / 1000)$$

Equation 10. Air Source Heat Pump Demand Savings Algorithm (Time of Sale)

$$\Delta kW = (Capacity_{cooling} * (1/EER_{base} - 1/EER_{ee})) / 1000 * CF$$

Equation 11. Air Source Heat Pump Energy Savings Algorithm (Early Replacement)

$$\Delta kWh = ((FLH_{cooling} * Capacity_{cooling} * (1/SEER_{exist} - 1/SEER_{ee})) / 1000) + ((FLH_{heat} * Capacity_{heating} * (1/HSPF_{exist} - 1/HSPF_{ee})) / 1000)$$

Equation 12. Air Source Heat Pump Demand Savings Algorithm (Early Replacement)

$$\Delta kW = (Capacity_{cooling} * (1/EER_{exist} - 1/EER_{ee})) / 1000 * CF$$

Table 105 provides the assumptions used to estimate verified savings for residential air source heat pump measures.

Table 105. Verified Assumptions for Residential Air Source Heat Pumps

Parameter	Value	Data Source
FLH _{cooling}	Location 1-5	ZIP code from tracking data to determine the county using a crosswalk file developed by the U.S. Department of Housing and Urban Development. Use the county in Table 3.8 of the IL-TRM V6.0 Volume 1 to determine cooling climate zone (1-5).
Capacity _{cooling}	Equipment Nameplate	Tracking database
SEER _{exist}	ER: ^a Varies If ASHP replacing ASHP: 9.12. If ASHP replacing CAC: 8.60. If installed in home without central cooling: 0 (negative savings).	IL-TRM V6.0
SEER _{base}	TOS: ^b 14	IL-TRM V6.0 (federal standard)
SEER _{ee}	Equipment Nameplate	Tracking database
FLH _{heating}	Location 1-5	ZIP code from tracking data to determine the county using a crosswalk file developed by the U.S. Department of Housing and Urban Development. Use the county in Table 3.7 of the IL-TRM V6.0 Volume 1 to determine heating climate zone (1-5).

Parameter	Value	Data Source
Capacity _{heating}	Equipment Nameplate	Tracking database
HSPF _{exist}	ER: ^a Varies If replacing ASHP: 5.44 (TRM). If replacing electric heat: 3.41 (TRM). Actual reported (tracking database).	IL-TRM V6.0
HSPF _{base}	TOS: ^b 8.2	IL-TRM V6.0 (federal standard)
HSPF _{ee}	Equipment Nameplate	Tracking database
EER _{exist}	ER ^a : Varies If ASHP replacing ASHP: 8.55. If ASHP replacing CAC: 8.15. If installed in home without central cooling: 0 (negative savings). Or algorithm (if SEER is provided).	IL-TRM V6.0
EER _{base}	TOS: ^b 11.8	IL-TRM V6.0 (federal standard)
EER _{ee}	Equipment Nameplate	Tracking database
CF _{pjm}	SF: 46.6% MF: 28.5%	IL-TRM V6.0
CF _{peak}	SF: 72.0% MF: 67.0%	IL-TRM V6.0

^a Early replacement^b Time of sale

The full-load heating and cooling hours, by climate zone, are shown in Table 106.

Table 106. FLH Values From IL-TRM V6.0

Climate Zone	City	Cooling FLH		Heating FLH (Single Family and General Multifamily)
		Single Family	Multifamily	
1	Rockford	512	467	1,969
2	Chicago	570	506	1,840
3	Springfield	730	663	1,754
4	Belleville	1,035	940	1,266
5	Marion	903	820	1,288
Weighted Average		629	564	1,821

Furnace Blower Motors (BPMs)

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for BPMs. The evaluation team found that while the IL-TRM V6.0 outlines savings for furnace blower motors, it does not account for the installation of an BPM along with a new ASHP or new CAC. BPM savings may overlap with savings attributable to a high efficiency ASHP or CAC as BPMs are already accounted for in

the ASHP or CAC efficiency ratings (SEER, EER, HSPF). As a result, verified BPM savings were reduced for projects that received a new ASHP or new CAC in addition to a new BPM: BPMs installed along with a new ASHP received shoulder season savings and BPMs installed along with a new CAC received shoulder and heating season savings.

Equation 13. BPM Energy Savings Algorithm

$$\Delta kWh = \text{Heating Savings} + \text{Cooling Savings} + \text{Shoulder Season Savings}$$

Equation 14. BPM Demand Savings Algorithm

$$\Delta kW = \text{Cooling Savings} / FLH_{cooling} * CF$$

Table 107 provides the assumptions used to estimate verified savings for BPM measures.

Table 107. Verified Assumptions for BPMs

Parameter	Value	Data Source
FLH _{cooling}	Location 1-5	ZIP code from tracking data to determine the county using a crosswalk file developed by the U.S. Department of Housing and Urban Development. Used county in Table 3.8 of the IL-TRM V6.0 Volume 1 to determine cooling climate zone (1-5).
BPM Heating Savings	418 kWh	IL-TRM V6.0
BPM Cooling Savings	With existing AC: 263 kWh No existing AC: 175 kWh Existing AC unknown: 241 kWh	IL-TRM V6.0 Presence of a new or existing central air conditioner or air source heat pump determined from the tracking database.
BPM Shoulder Savings	51 kWh	IL-TRM V6.0
CF _{pjm}	46.6%	IL-TRM V6.0
CF _{peak}	68.0%	IL-TRM V6.0

The full load heating and cooling hours, by climate zone, are shown in Table 108.

Table 108. FLH Values From IL-TRM V6.0

Climate Zone	City	Cooling FLH
1	Rockford	512
2	Chicago	570
3	Springfield	730
4	Belleveille	1,035
5	Marion	903
Weighted Average		629

Ductless Heat Pumps

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for residential ductless heat pumps.

Equation 15. Ductless Heat Pump Energy Savings Algorithm (Time of Sale)

$$\Delta kWh = \Delta kWh_{heat} + \Delta kWh_{cool}$$

$$\Delta kWh_{heat} = ElecHeat * Capacity_{heat} * EFLH_{heat} * \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}} \right) / 1000$$

$$\Delta kWh_{cool} = Capacity_{cool} * EFLH_{cool} * \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}} \right) / 1000$$

Equation 16. Ductless Heat Pump Demand Savings Algorithm (Time of Sale)

$$\Delta kW = (Capacity_{cool} * (1/EER_{base} - 1/EER_{ee})) / 1000 * CF$$

Equation 17. Ductless Heat Pump Energy Savings Algorithm (Early Replacement)

$$\Delta kWh = \Delta kWh_{heat} + \Delta kWh_{cool}$$

$$\Delta kWh_{heat} = ElecHeat * Capacity_{heat} * EFL_{heat} * \left(\frac{1}{HSPF_{exist}} - \frac{1}{HSPF_{ee}} \right) / 1000$$

$$\Delta kWh_{cool} = Capacity_{cool} * EFLH_{cool} * \left(\frac{1}{SEER_{exist}} - \frac{1}{SEER_{ee}} \right) / 1000$$

Equation 18. Ductless Heat Pump Demand Savings Algorithm (Early Replacement)

$$\Delta kW = (Capacity_{cool} * (1/EER_{exist} - 1/EER_{ee})) / 1000 * CF$$

Table 109 provides the assumptions used to estimate verified savings for residential ductless heat pump measures.

Table 109. Verified Assumptions for Ductless Heat Pumps

Parameter	Value	Data Source
ElecHeat	1.0 if building is electrically heated 0.0 if building is not electrically heated	Tracking database
Capacity _{cool}	Equipment Nameplate	Tracking database
Capacity _{heat}	Equipment Nameplate	Tracking database
SEER _{exist}	Varies: If replacing ASHP: 9.12. If replacing CAC: 8.6. If replacing Room AC: 8.0. If installed in home without central cooling: 0 (negative savings).	IL-TRM V6.0
SEER _{base}	Varies: Installed in lieu of (or offsetting) ASHP: 14. Installed in lieu of (or offsetting) CAC: 13. Installed in home with no central cooling: 13.	IL-TRM V6.0
SEER _{ee}	Equipment Nameplate	Tracking database
EER _{exist}	Varies: If replacing ASHP: 9.12. If replacing CAC: 8.60. If replacing Room AC: 8.0.	IL-TRM V6.0

Parameter	Value	Data Source
	If installed in home without central cooling: 0 (negative savings).	
EER _{base}	Varies: Installed in lieu of (or offsetting) ASHP: 11.8. Installed in lieu of (or offsetting) CAC: 11.0. Installed in home with no central cooling: 11.0.	IL-TRM V6.0
EER _{ee}	Equipment Nameplate	Tracking database
HSPF _{exist}	Varies: If replacing ASHP: 5.44. If replacing electric resistance: 3.412.	IL-TRM V6.0
HSPF _{base}	Varies: Installed in lieu of (or offsetting) ASHP: 8.2. Installed in lieu of (or offsetting) electric resistance: 3.41	IL-TRM V6.0
HSPF _{ee}	Equipment Nameplate	Tracking database
CF _{pjm}	Time of sale measure installed in a home with an existing CAC or ASHP: 28.0% Early replacement measure or time or sale measure installed in a home with an existing CAC or ASHP: 46.6%	IL-TRM V6.0
CF _{peak}	Time of sale measure installed in a home with an existing CAC or ASHP: 43.1% Early replacement measure or time or sale measure installed in a home with an existing CAC or ASHP: 72.0%	IL-TRM V6.0

The full load hours, by climate zone, are shown in Table 110.

Table 110. FLH Values from the IL-TRM V6.0

Climate Zone	City	Cooling FLH	Heating FLH
1	Rockford	323	1,520
2	Chicago	308	1,421
3	Springfield	468	1,347
4	Belleville	629	977
5	Marion	549	994
Weighted Average		364	1,406

High Efficiency Pool Pumps

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for residential pool pumps. All inputs are deemed by the TRM. All pool pumps were variable speed.

Equation 19. High Efficiency Pool Pump Energy Savings Algorithm (Two Speed)

$$\Delta kWh = (((Hrs/Day_{base} * GPM_{base} * 60)/EF_{base}) - (((Hrs/Day_{2spH} * GPM_{2spH} * 60)/EF_{2spH} + ((Hrs/Day_{2spL} * GPM_{2spL} * 60)/EF_{2spL}))))/1000 * Days$$

Equation 20. High Efficiency Pool Pump Energy Savings Algorithm (Variable Speed)

$$\Delta kWh = (((Hrs/Day_{base} * GPM_{base} * 60)/EF_{base}) - (((Hrs/Day_{vsH} * GPM_{vsH} * 60)/EF_{vsH} + ((Hrs/Day_{vsL} * GPM_{vsL} * 60)/EF_{vsL}))))/1000 * Days$$

Equation 21. High Efficiency Pool Pump Demand Savings Algorithm (Two Speed)

$$\Delta kW = ((kWh/day_base)/(Hrs/day_base) - (kWh/day_2sp)/(Hr/day_2sp)) * CF$$

Equation 22. High Efficiency Pool Pump Demand Savings Algorithm (Variable Speed)

$$\Delta kW = ((kWh/day_base)/(Hrs/day_base) - (kWh/day_var)/(Hr/day_var)) * CF$$

Table 111 provides the assumptions used to estimate verified savings for high efficiency pool pump measures.

Table 111. Verified Assumptions for High Efficiency Pool Pumps from the IL-TRM V6.0

Parameter	Value	Data Source
EUL	10.0	IL-TRM V6.0
Hrs/Day_base	11.4	IL-TRM V6.0
GPM_base	64.4	IL-TRM V6.0
conversion	60.0	IL-TRM V6.0
EF_base	2.1	IL-TRM V6.0
Hrs/Day_2spH	2.0	IL-TRM V6.0
GPM_2spH	56.0	IL-TRM V6.0
EF_2spH	2.4	IL-TRM V6.0
Hrs/Day_2spL	15.7	IL-TRM V6.0
GPM_2spL	31.0	IL-TRM V6.0
EF_2spL	5.4	IL-TRM V6.0
Hrs/Day_vsH	2.0	IL-TRM V6.0
GPM_vsH	50.0	IL-TRM V6.0
EF_vsH	3.8	IL-TRM V6.0
Hrs/Day_vsL	16.0	IL-TRM V6.0
GPM_vsL	30.6	IL-TRM V6.0
EF_vsL	7.3	IL-TRM V6.0
Days	125.0	IL-TRM V6.0
kWh/day_base	20.98	IL-TRM V6.0
kWh/day_2sp	8.21	IL-TRM V6.0
kWh/day_var	5.6	IL-TRM V6.0
Hr/day_var	18.0	IL-TRM V6.0
Hr/day_2sp	17.7	IL-TRM V6.0
CF	83.1%	IL-TRM V6.0

Programmable Thermostats

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for programmable thermostats. Programmable thermostats are not eligible for demand savings.

Equation 23. Programmable Thermostat Energy Savings Algorithm

$$\Delta kWh = \%ElectricHeat * Elec_Heating_Consumption * Heating_Reduction * HF * Eff_ISR + (\Delta Therms * Fe * 29.3)$$

$$\Delta Therms = \%FossilHeat * Gas_Heating_Consumption * Heating_Reduction * HF * Eff_ISR$$

Equation 24. Programmable Thermostat Demand Savings Algorithm

$$\Delta kW = 0$$

Table 112 provides the assumptions used to estimate verified savings for programmable thermostat measures.

Table 112. Verified Assumptions for Thermostats from the IL-TRM V6.0

Parameter	Value	Data Source
EUL	10.00	IL-TRM V6.0
%ElectricHeat	Actual	Tracking database
Elec_Heating_Consumption	Varies	IL-TRM V6.0
Heating_Reduction	Varies	IL-TRM V6.0
HF	Varies	IL-TRM V6.0
Eff_ISR	100%	IL-TRM V6.0
Fe	3.14%	IL-TRM V6.0
%FossilHeat	Actual	Tracking database
Gas_Heating_Consumption	Varies	IL-TRM V6.0
29.3	29.3	IL-TRM V6.0

Advanced Thermostats

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for Advanced thermostats. Advanced thermostats are eligible for demand savings.

Equation 25. Advanced Thermostat Energy Savings Algorithm

$$\Delta kWh = \%ElectricHeat * Elec_Heating_Consumption * Heating_Reduction * HF * Eff_ISR + (\Delta Therms * Fe * 29.3) + (\%AC * ((FLH * Btu/hr * 1/SEER)/1000) * Cooling_Reduction * Eff_ISR)$$

$$\Delta Therms = \%FossilHeat * Gas_Heating_Consumption * Heating_Reduction * HF * Eff_ISR$$

Equation 26. Advanced Thermostat Demand Savings Algorithm

$$\Delta kW = \%AC * (Cooling_Reduction * Btu/hr * (1/EER))/1000 * EFF_ISR * CF$$

Table 113 provides the assumptions used to estimate verified savings for advanced thermostat measures.

Table 113. Verified Assumptions for Advanced Thermostats from the IL-TRM V6.0

Parameter	Value	Data Source
EUL	10.00	IL-TRM V6.0
%ElectricHeat	Actual	Tracking database
Elec_Heating_Consumption	Varies	Tracking database
Heating_Reduction	Varies	IL-TRM V6.0
HF	Varies	IL-TRM V6.0
Eff_ISR	100%	IL-TRM V6.0
Fe	3.14%	IL-TRM V6.0
%FossilHeat	Actual	IL-TRM V6.0
Gas_Heating_Consumption	Varies	IL-TRM V6.0
29.3	29.3	IL-TRM V6.0
%AC	Actual	Tracking database
FLH	Varies	IL-TRM V6.0
Btu/hr	Actual	Tracking database
SEER	Actual	Tracking database
EER	Actual	Tracking database
Cooling_Reduction	8.0%	IL-TRM V6.0
CF_SSP	34.0%	IL-TRM V6.0
CF_PJM	23.3%	IL-TRM V6.0

Heat Pump Water Heaters

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for heat pump water heaters. Algorithms and inputs used to calculate gas penalties associated with this measure are provided in O.

Equation 27. Heat Pump Water Heater Energy Savings Algorithm

$$\Delta kWh = (((1/EF_{base} - 1/EF_{efficient}) * GPD * Household * 365.25 * \gamma_{Water} * (T_{out} - T_{in}) * 1.0) / 3412) + kWh_{cooling} - kWh_{heating}$$

$$kWh_{cooling} = (((((GPD * Household * 365.25 * \gamma_{Water} * (T_{out} - T_{in}) * 1.0) / 3412) - ((1/EF_{efficient} * GPD * Household * 365.25 * \gamma_{Water} * (T_{out} - T_{in}) * 1.0) / 3412)) * LF * 27\%) / COP_{cool}) * LM$$

$$kWh_{heating} = (((((GPD * Household * 365.25 * \gamma_{Water} * (T_{out} - T_{in}) * 1.0) / 3412) - ((1/EF_{efficient} * GPD * Household * 365.25 * \gamma_{Water} * (T_{out} - T_{in}) * 1.0) / 3412)) * LF * 49\%) / COP_{heat}) * (1 - \%NaturalGas)$$

Equation 28. Heat Pump Water Heater Demand Savings Algorithm

$$\Delta kW = \Delta kWh / Hours * CF$$

Table 114 provides the assumptions used to estimate verified savings for heat pump water heaters.

Table 114. Verified Assumptions for Heat Pump Water Heaters from the IL-TRM V6.0

Parameter	Value	Data Source
EUL	13.0	IL-TRM V6.0
EF_base	Actual	AHRI Database
EF_efficient	Actual	AHRI Database
GPD	17.6	IL-TRM V6.0
Household	Single Family: 2.56 Multifamily: 2.10	IL-TRM V6.0
365.25	365.3	IL-TRM V6.0
yWater	8.3	IL-TRM V6.0
T_out	125.0	IL-TRM V6.0
T_in	54.0	IL-TRM V6.0
1.0	1.0	IL-TRM V6.0
3412	3,412.0	IL-TRM V6.0
LF	Conditioned: 100% Unknown: 50% Unconditioned: 0%	IL-TRM V6.0
27%	27%	IL-TRM V6.0
COP_cool	Actual	IL-TRM V6.0
LM	1.3	IL-TRM V6.0
49%	49%	IL-TRM V6.0
COP_heat	Actual	IL-TRM V6.0
Hours	2,533.0	IL-TRM V6.0
CF	12.0%	IL-TRM V6.0

Verified Net Impact Methodology

The evaluation team applied the SAG-approved NTGR by measure type and delivery method, as summarized below. Table 115 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 115. SAG-Approved HVAC Initiative NTGRs

Measure Category	Electric NTGR	Gas NTGR
ASHP	0.641	—
ASHP ER	0.761	—
CAC	0.641	—
CAC ER	0.761	—
Pool Pump	1.000	—
BPM	0.761	0.761
Heat Pump Water Heater	0.760	0.760 ^a
Programmable Thermostat	0.870	0.870
Advanced Thermostat	NA	NA
Ductless Heat Pump	0.641	0.641 ^a

Measure Category	Electric NTGR	Gas NTGR
Ductless Heat Pump ER	0.761	0.761 ^a

^a Assumed to be the same as the SAG-approved electric NTGR.

Appliance Recycling

Verified Gross Impact Methodology

The IL-TRM V6.0 algorithm provides coefficients to calculate energy consumption of recycled appliances based on a collaborative metering study conducted for Commonwealth Edison Company and two Michigan utilities (Consumers Energy, and DTE Energy). Holding all other variables constant, the coefficient of each independent variable indicates the influence of that variable on annual consumption as follows:

- A positive coefficient indicates an upward influence on consumption
- A negative coefficient indicates a downward influence on consumption

With the exception of the intercept, the coefficient value indicates the marginal impact of a one-point increase in the independent variable on the unit energy consumption (UEC). For instance, a single cubic-foot increase in refrigerator size results in a 27.15 kWh increase in average annual consumption. For dummy variables, the coefficient value represents the difference in consumption if a given condition holds true. For example, the 161.86 coefficient for the dummy variable “Primary Usage Type” indicates the customer used the refrigerator as a primary unit; all else equal, this means a primary refrigerator annually consumed 161.86 kWh more than a secondary unit. Table 116 lists the IL-TRM V6.0 coefficients for refrigerators.

Table 116. UEC Refrigerator Regression Algorithm

Intercept	83.32
Independent Variables	Estimate Coefficient
Age (years)	3.68
Pre-1990 (= 1 if manufactured pre-1990)	485.04
Size (cubic feet)	27.15
Dummy: Side-by-Side (= 1 if side-by-side)	406.78
Dummy: Primary Usage Type (in absence of the Initiative) (= 1 if primary unit)	161.86
Interaction: Located in Unconditioned Space x CDD/365.25	15.37
Interaction: Located in Unconditioned Space x HDD/365.25	-11.07

Table 117 lists the regression coefficients for freezers from the IL-TRM V6.0.

Table 117. UEC Freezer Regression Algorithm

Intercept	132.12
Independent Variables	Estimate Coefficient
Age (years)	12.13
Pre-1990 (= 1 if manufactured pre-1990)	156.18
Size (cubic feet)	31.84
Chest Freezer Configuration (= 1 if chest freezer)	-19.71
Interaction: Located in Unconditioned Space x CDD/365.25	9.78

Intercept	132.12
Interaction: Located in Unconditioned Space x HDD/365.25	-12.76

Extrapolation

Using the 2018 tracking database, the evaluation team determined the corresponding characteristics (i.e., independent variables) for participating appliances that were then entered into the IL-TRM V6.0 algorithm. Table 118 summarizes Initiative averages or proportions for each independent variable.

Table 118. 2018 Appliance Recycling Initiative Mean Explanatory Variables

Appliance	Independent Variables	Participant 2018 Population Mean Value	Participant Population Mean Value (PY8)
Refrigerator	Age (years)	23.35	22.70
	Pre-1990 (= 1 if manufactured pre-1990)	0.30	0.37
	Size (cubic feet)	19.52	19.02
	Dummy: Side-by-Side (= 1 if side-by-side)	0.27	0.23
	Dummy: Primary Usage Type (in absence of the Initiative) (= 1 if primary unit)	0.67	0.67
	Interaction: Located in Unconditioned Space x CDD/365.25	0.95	0.99
	Interaction: Located in Unconditioned Space x HDD/365.25	5.20	5.09
Freezer	Age (years)	27.72	27.65
	Pre-1990 (= 1 if manufactured pre-1990)	0.46	0.58
	Size (cubic feet)	17.34	15.68
	Chest Freezer Configuration (= 1 if chest freezer)	0.44	0.44
	Interaction: Located in Unconditioned Space x CDD/365.25	2.38	2.49
	Interaction: Located in Unconditioned Space x HDD/365.25	13.22	12.85

To determine annual and average-annual per-unit energy consumption using the IL-TRM V6.0 algorithm and 2018 AIC tracking data, the evaluation team applied average participant refrigerator and freezer characteristics to the regression model coefficients. This approach ensured we based the resulting UEC on specific units recycled through AIC's initiative in 2018, rather than on a point estimate based on a secondary data source. Table 119 shows the annual UEC for refrigerators and freezers AIC recycled in 2018 and per-unit demand savings.

Table 119. 2018 ARI Unit Energy Savings (without part-use)

Measure	Unit Energy Savings (kWh)	Unit Demand Savings (kW)
Refrigerator	1,018	0.13
Freezer	938	0.11

The evaluation team calculated demand savings by applying the following formula from the IL-TRM V6 for refrigerators and freezers:

$$\text{Unit Demand Savings} = \Delta kW = \frac{kWh}{8760} * \text{Coincidence Factor}$$

Where:

Coincidence factor = 1.081 for refrigerators and 1.028 for freezers.

Part-Use

The part-use factor accounts for appliances not plugged in year-round prior to participation. For PY9, the evaluation team applied a part-use factor of 0.91 for refrigerators and 0.86 for freezers, estimated using PY6 survey responses, as specified in the IL-TRM V6.0.

We applied part-use factors to the modeled annual consumption value listed in Table 119 to calculate average per-unit gross energy savings for 2018. As shown in Table 120, the verified per-unit values for refrigerators and freezers were 928 kWh and 804 kWh, respectively.

Table 120. 2018 Evaluated Gross Energy Savings (Per-Unit)

Recycling Measure	Ex Ante (kWh)	Verified (kWh)	Percent Difference
Refrigerator	869	928	7%
Freezer	871	804	-8%

Table 120 also compares ex ante and verified gross savings. The ex ante savings are estimates generated by Leidos using the IL-TRM V6.0 algorithm. The discrepancy between ex ante and verified savings is because Leidos used the initiative tracking data to determine which units were primary and which were secondary, whereas the evaluation team used the PY6 participant surveys to determine the proportion of primary units. Using the PY6 survey responses is consistent with past evaluation methodology and specifically asks how appliances were used for the entire year prior to being recycled.

Since the most recent survey data was collected in PY6, the evaluation team reviewed the locations in the tracking data and compared them against the reported use to determine if the initiative tracking data would be a reliable source for determining how appliances were used prior to recycling. The evaluation team found that tracking results were not useful because the unit location was inconsistent with the reported primary or secondary status in the tracking data.

As shown in Table 121, for primary refrigerators, only 29% were reported to have been in use in a location that would be consistent with a primary refrigerator—located either on the first or second floor. Most units were located in the garage, basement, driveway, or other location that would be unlikely for a primary refrigerator. It appears the tracking data recorded location at the time of pickup rather than location during the previous year of operation. Given these inconsistencies, the evaluation team applied the share of primary units determined in the PY6 participant surveys and will conduct surveys with 2018 participants to update data for future evaluation years.

Table 121. Tracking Data Reported Use and Location

Primary/Secondary	Reported Location	Likely Primary	Percent of Units
Primary	1st Floor	Yes	28%

Primary/Secondary	Reported Location	Likely Primary	Percent of Units
	2nd Floor	Yes	1%
	Basement	No	6%
	Driveway	No	5%
	Garage	No	47%
	Outbuilding	No	2%
	Porch	No	6%
	Road	No	0%
	Yard	No	4%
Secondary	1st Floor	Yes	16%
	2nd Floor	Yes	1%
	Basement	No	12%
	Driveway	No	5%
	Garage	No	58%
	Outbuilding	No	2%
	Porch	No	4%
	Road	No	0%
	Yard	No	3%

Overall, there were only minor discrepancies in per-unit savings, with verified gross refrigerator savings 7% higher than ex ante savings and verified gross freezer savings 8% lower than ex ante savings. The initiative realization rate, overall, was 104%.

Verified Net Impact Methodology

The evaluation team applied the SAG-approved NTGRs by measure type and delivery method, as summarized below.

Table 122 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 122. SAG-Approved ARI NTGRs

Measure	Electric NTGR
Refrigerator	0.520
Freezer	0.620

Multifamily

Verified Gross Impact Methodology

The evaluation team calculated verified savings for the Multifamily Initiative by applying savings algorithms from the IL-TRM V6.0. The team leveraged initiative tracking data such as primary heating and cooling type, delivery mechanism (e.g., direct install, leave behind), LED wattage, LED lamp type, project location (e.g., for weather dependent variables), and installed measure location (e.g., for faucet aerators) to inform savings

assumptions. For variables outside these parameters, the evaluation team relied on defaults from the IL-TRM V6.0.

It should be noted that the evaluation team deviated from the IL-TRM V6.0 inputs for advanced thermostats. The IL-TRM V6.0 does not provide a default cooling capacity for multifamily homes, and therefore the evaluation team relied on the default value from the IL-TRM V7.0 instead. All other values come directly from the IL-TRM V6.0 or from the 2018 initiative tracking database.

Verified Net Impact Methodology

To determine verified net savings, the evaluation team applied the SAG-approved NTGR values outlined in Table 123 to the Initiative's verified gross savings.

Table 123. SAG-Approved Multifamily NTGRs

Measure	Electric NTGR	Gas NTGR
LED - In-Unit	0.773	N/A
LED - Common Area	0.830	N/A
LED - Exterior	0.830	N/A
Faucet Aerator	0.794	1.000
Showerhead	0.794	1.000
Pipe Insulation	0.794	1.000
Programmable Thermostat	0.794	1.000
Advanced Thermostat	N/A	N/A
Advanced Power Strip	0.794	N/A

Direct Distribution of Efficient Products

Verified Gross Impact Methodology

To estimate gross savings values for Direct Distribution Initiative measures, the evaluation team used the tracking database to verify the reported distribution of kits and to apply the IL-TRM V6.0 deemed per-unit gross savings inputs, in combination with the implementer-administered, web-based student participant survey results for installation rates and water heater fuel saturation. Because this information is not collected through the surveys, we used home-type information from the 2013 AIC Energy Efficiency Market Potential Assessment⁴⁰ to estimate single- and multifamily weighted averages for verified gross per-unit savings parameters, in conjunction with parameter values prescribed for single- and multifamily participants in the IL-TRM V6.0.⁴¹ To estimate energy savings associated with the initiative, the evaluation team applied electric water heater saturation rates based on the implementer-administered, web-based student participant survey data to verified installations of energy kit measures.

⁴⁰ Ameren Illinois Company. *Energy Efficiency Market Potential Assessment*. Report Number 1404. Volume 2: Market Research. June 10, 2013. Available online: http://ilsagfiles.org/SAG_files/Potential_Studies/Ameren/Appendix%204_AIC%20DSM%20Potential%20Study%202013%20Volume%202%20Market%20Research.docx.

⁴¹ Note that 79% of customers live in single family homes and 21% live in multifamily homes. The IL-TRM V6.0 reports the average number of people per household in single family homes as 2.56 and the average number of people in multifamily homes as 2.10. The evaluation team used this information to create a weighted average of 2.46 people per household. Mathematically, this is expressed as $((79\% * 2.56) + (21\% * 2.10)) = 2.46$.

To determine gross savings and net realization rates, the evaluation team applied deemed per-unit gross savings inputs set forth in the IL-TRM V6.0, in combination with non-LED measure installation rates and water heater fuel saturations derived from the implementer-administered, web-based student participant survey results for initiative measures.

LEDs

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for LEDs.

Equation 29. ENERGY STAR LED Energy Savings Algorithm

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1,000} \right) \times ISR \times (1 - Leakage) \times Hours \times WHFe$$

Equation 30. ENERGY STAR LED Demand Savings Algorithm

$$\Delta kW = \left(\frac{Watts_{base} - Watts_{EE}}{1,000} \right) \times ISR \times WHFd \times CF$$

Table 124 lists the assumptions the evaluation team used to estimate verified savings for the 9-watt LED measure.

Table 124. Verified Assumptions for ENERGY STAR LED

Parameter	Value	Units	Notes/Reference
Watts _{base}	43	watts	Base watts incandescent equivalent (IL-TRM V6.0)
Watts _{EE}	9	watts	Actual wattage of LED installed
1,000	1,000	W/kW	Conversion factor
ISR	61%	N/A	Installation rate (IL-TRM V6.0) – School Kits
Leakage	0%	N/A	The evaluation team assumed a 0% leakage rate since the implementer doesn't collect utility information and the Direct Distribution Initiative targets AIC customers.
Hours	847	Hours	IL-TRM V6.0 – Unknown installation location
WHFe	Single Family: 1.06 Multifamily: 1.04	N/A	Waste heat factor (WHF) for energy (IL-TRM V6.0). The evaluation team used single family/multifamily values in conjunction with the 79% single family/21% multifamily customer population distribution from the 2013 Market Potential Assessment ^a to calculate a weighted average waste heat factor for energy of 1.056.
WHFd	Single Family: 1.11 Multifamily: 1.07	N/A	WHF for demand (IL-TRM V6.0). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average waste heat factor for demand of 1.102.
CF	8.1%	N/A	Summer peak coincidence factor (IL-TRM V6.0).

^a EnerNOC Utility Solutions Consulting. *Ameren Illinois Energy Efficiency Market Potential Assessment. Report Number 1404. Volume 2: Market Research.* June 10, 2013. Available online: http://ilsagfiles.org/SAG_files/Potential_Studies/Ameren/Appendix%204_AIC%20DSM%20Potential%20Study%202013%20Volume%202%20Market%20Research.docx

Bathroom and Kitchen Faucet Aerators

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for faucet aerators.

Equation 31. Faucet Aerator Electric Energy Savings Algorithm

$$\Delta kWh = \%ElectricDHW \left(\frac{(GPM_{base} * L_{base} - GPM_{low} * L_{low}) * Household * 365.25 * DF}{FPH} \right) \times EPG_{electric} \times ISR$$

Equation 32. Faucet Aerator Electric Demand Savings Algorithm

$$\Delta kW = \left(\frac{\Delta kWh}{Hours} \right) \times CF$$

Equation 33. Faucet Aerator Gas Savings Algorithm

$$\Delta Therms = \%FossilDHW \left(\frac{(GPM_{base} * L_{base} - GPM_{low} * L_{low}) * Household * 365.25 * DF}{FPH} \right) \times EPG_{gas} \times ISR$$

Table 125 provides assumptions used to estimate verified savings for bathroom faucet aerators.

Table 125. Verified Assumptions for Bathroom Faucet Aerators

Parameter	Value	Units	Notes/Reference
%ElectricDHW	48%	N/A	In accordance with the 2018 Direct Distribution Evaluation Plan, we used the 2018 implementer-administered web-based student participant survey data to estimate electric and gas water heater saturation rates. 48% of Initiative measures were installed in residences with electric water heating and 52% installed in homes with gas water heating.
%FossilDHW	52%	N/A	
GPM _{base}	1.39	gal/min	Base case flow (IL-TRM V6.0)
GPM _{low}	0.94	gal/min	Low case flow (IL-TRM V6.0)
L _{base}	1.6	min/day	Base case use length (IL-TRM V6.0)
L _{low}	1.6	min/day	Low case use length (IL-TRM V6.0)
Household	Single family: 2.56 Multifamily: 2.10	# of people	Average number of people per household (IL-TRM V6.0). The evaluation team used single family/multifamily values in conjunction with the 79% single family/21% multifamily customer population distribution from the 2013 <i>Market Potential Assessment</i> to calculate a weighted average people per household value of 2.46.
365.25	365.25	Average days in a year	Days in a year, on average (IL-TRM V6.0)
DF	90%	Percent	Drain factor (IL-TRM V6.0) – ‘Bath’
FPH	Single Family: 2.83 Multifamily: 1.50	Faucets per household	Bath faucets per household (IL-TRM V6.0). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average for bathroom faucets per household value of 2.55.
EPG _{electric}	0.0795	kWh/gal	Energy per gallon of hot water supplied by electricity (IL-TRM V6.0) – Bath

Parameter	Value	Units	Notes/Reference
EPG_gas	Single Family: 0.00341 Multifamily: 0.00397	Therm/gal	Energy per gallon of hot water supplied by gas (IL-TRM V6.0) Bath. The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average energy per gallon of hot water supplied by natural gas value of 0.00353.
ISR	27%	N/A	Evaluation team applied the 27% ISR calculated from the 2018 implementer-administered web-based student participant survey data, in accordance with the 2018 Direct Distribution Evaluation Plan.
Hours	Single Family: 14 Multifamily: 22	Hours/Year	Annual electric water heating recovery hours for faucet use per faucet (IL-TRM V6.0 "Bathroom"). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average recovery hours per faucet value of 16.
CF	0.022	N/A	Coincidence Factor for electric load reduction (IL-TRM V6.0)

Table 126 provides assumptions used to estimate verified savings for kitchen faucet aerators.

Table 126. Verified Assumptions for Kitchen Faucet Aerators

Parameter	Value	Units	Notes/Reference
%ElectricDHW	48%	N/A	In accordance with the 2018 Direct Distribution Evaluation Plan, we used the 2018 implementer-administered web-based student participant survey data to estimate electric and gas water heater saturation rates. 48% of Initiative measures were installed in residences with electric water heating and 52% installed in homes with gas water heating.
%FossilDHW	52%	N/A	
GPM _{base}	1.39	gal/min	Base case flow (IL-TRM V6.0)
GPM _{low}	0.94	gal/min	Low case flow (IL-TRM V6.0)
L _{base}	4.5	min/day	Base case use length (IL-TRM V6.0)
L _{low}	4.5	min/day	Low case use length (IL-TRM V6.0)
Household	Single family: 2.56 Multifamily: 2.10	# of people	Average number of people per household (IL-TRM V6.0). The evaluation team used single family/multifamily values in conjunction with the 79% single family/21% multifamily customer population distribution from the 2013 <i>Market Potential Assessment</i> to calculate a weighted average people per household value of 2.46.
365.25	365.25	Average days in a year	Days in a year, on average (IL-TRM V6.0)
DF	75%	Percent	Drain factor (IL-TRM V6.0) – 'Kitchen'
FPH	1.0	Kitchen faucets per household	Kitchen faucets per household (IL-TRM V6.0).
EPG_electric	0.0969	kWh/gal	Energy per gallon of hot water supplied by electricity (IL-TRM V6.0) – 'Kitchen'
EPG_gas	Single Family: 0.00415 Multifamily: 0.00484	Therm/gal	Energy per gallon of hot water supplied by natural gas (IL-TRM V6.0 "Kitchen"). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average energy per gallon of hot water supplied by natural gas value of 0.00429.

Parameter	Value	Units	Notes/Reference
ISR	27%	N/A	Evaluation team applied the 27% ISR calculated from the 2018 implementer-administered web-based student participant survey data, in accordance with the 2018 Direct Distribution Evaluation Plan.
Hours	Single Family: 94 Multifamily: 77	Hours/Year	Annual electric water heating recovery hours for faucet use per faucet (IL-TRM V6.0 “Kitchen”). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average recovery hours per faucet value of 90.
CF	0.022	N/A	Coincidence factor for electric load reduction (IL-TRM V6.0)

Showerheads

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for showerheads.

Equation 34. Showerhead Electric Energy Savings Algorithm

$$\Delta kWh = \%ElectricDHW \left(\frac{(GPM_{base} * L_{base} - GPM_{low} * L_{low}) * Household * SPCD * 365.25}{SPH} \right) \times EPG_{electric} \times ISR$$

Equation 35. Showerhead Electric Demand Savings Algorithm

$$\Delta kW = \left(\frac{\Delta kWh}{Hours} \right) \times CF$$

Equation 36. Showerhead Gas Energy Savings Algorithm

$$\Delta Therms = \%FossilDHW \left(\frac{(GPM_{base} * L_{base} - GPM_{low} * L_{low}) * Household * SPCD * 365.25}{SPH} \right) \times EPG_{gas} \times ISR$$

Table 127 provides assumptions used to estimate verified savings for showerheads.

Table 127. Verified Assumptions for Showerheads

Parameter	Value	Units	Notes/Reference
%ElectricDHW	48%	N/A	In accordance with the 2018 Direct Distribution Evaluation Plan, we used the 2018 implementer-administered web-based student participant survey data to estimate electric and gas water heater saturation rates. 48% of Initiative measures were installed in residences with electric water heating and 52% installed in homes with gas water heating.
%FossilDHW	52%	N/A	
GPM _{base}	2.35	gal/min	Base case flow (IL-TRM V6.0)
GPM _{low}	1.50	gal/min	Actual case flow
L _{base}	7.8	min/day	Base case use length (IL-TRM V6.0)
L _{low}	7.8	min/day	Low case use length (IL-TRM V6.0)
Household	Single family: 2.56	# of people	Average number of people per household (IL-TRM V6.0). The evaluation team used single family/multifamily values in conjunction

Parameter	Value	Units	Notes/Reference
	Multifamily: 2.10		with the 79% single family/21% multifamily customer population distribution from the 2013 <i>Market Potential Assessment</i> to calculate a weighted average people per household value of 2.46.
SPCD	0.6	Showers per capita per day	Showers per capita per day (IL-TRM V6.0)
365.25	365.25	Average days in a year	Days in a year, on average (IL-TRM V6.0)
SPH	Single family: 1.79 Multifamily: 1.30	Showerheads per household	Showerheads per household (IL-TRM V6.0). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average showerheads per household value of 1.69.
EPG_electric	0.117	kWh/gal	Energy per gallon of hot water supplied by electricity (IL-TRM V6.0)
EPG_gas	Single Family: 0.00501 Multifamily: 0.00583	Therm/gal	Energy per gallon of hot water supplied by natural gas (IL-TRM V6.0). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average energy per gallon of hot water supplied by natural gas value of 0.00518.
ISR	25%	N/A	Evaluation team applied the 25% ISR calculated from the 2018 implementer-administered web-based student participant survey data, in accordance with the 2018 Direct Distribution Evaluation Plan.
Hours	Single Family: 266 Multifamily: 218	Hours/Year	Annual electric water heating recovery hours for showerhead use (IL-TRM V6.0 “EE Kits”). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average recovery hours per faucet value of 256.
CF	0.0278	N/A	Coincidence Factor for electric load reduction (IL-TRM V6.0)

Hot Water Temperature Card Thermometer

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for hot water temperature card thermometers.

Equation 37. Hot Water Temperature Card Thermometer Electric Energy Savings Algorithm

$$\Delta kWh = \left(\frac{(UA * (T_{pre} - T_{post}) * Hours * ISR)}{3,412 * RE_{electric}} \right)$$

Equation 38. Hot Water Temperature Card Thermometer Electric Demand Savings Algorithm

$$\Delta kW = \left(\frac{\Delta kWh}{Hours} \right) \times CF$$

Equation 39. Hot Water Temperature Card Thermometer Gas Energy Savings Algorithm

$$\Delta Therms = \left(\frac{(UA * (T_{pre} - T_{post}) * Hours * ISR)}{100,000 * RE_{gas}} \right)$$

Table 128 provides assumptions used to estimate verified savings for hot water temperature card thermometers.

Table 128. Verified Assumptions for Hot Water Temperature Card Thermometers

Parameter	Value	Units	Notes/Reference
%ElectricDHW	48%	N/A	In accordance with the 2018 Direct Distribution Evaluation Plan, we used the 2018 implementer-administered web-based student participant survey data to estimate electric and gas water heater saturation rates. 48% of Initiative measures were installed in residences with electric water heating and 52% installed in homes with gas water heating.
%FossilDHW	52%	N/A	
U	0.083	Btu/Hr- °F-ft ²	Overall heat transfer coefficient of tank (IL-TRM V6.0)
A	24.99	Square Feet	Surface area of storage tank (IL-TRM V6.0)
T _{pre}	135	Degrees °F	Deemed hot water set point prior to adjustment (IL-TRM V6.0)
T _{post}	120	Degrees °F	Deemed new hot water set point (IL-TRM V6.0)
Hours	8,766	Hours	Number of hours in a year
3,412	3,412	N/A	Conversion from Btu to kWh (IL-TRM V6.0)
RE _{electric}	0.98	kWh/gal	Recovery efficiency of electric hot water heater (IL-TRM V6.0)
RE _{gas}	Single Family: 0.78 Multifamily: 0.67	Therm/gal	Recovery efficiency of gas water heater (IL-TRM V6.0). The evaluation team used single family/multifamily values in conjunction with the 79% single family/21% multifamily customer population distribution from the 2013 <i>Market Potential Assessment</i> to calculate a weighted average recovery efficient of gas water heater value of 0.757.
ISR	13%	N/A	Evaluation team applied the 13% ISR calculated from the 2018 implementer-administered web-based student participant survey data, in accordance with the 2018 Direct Distribution Evaluation Plan.
CF	1	N/A	Coincidence factor for electric load reduction (IL-TRM V6.0)

Advanced Power Strip

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for advanced power strips.

Equation 40. Advanced Power Strip Electric Energy Savings Algorithm

$$\Delta kWh = kWh \times ISR$$

Equation 41. Advanced Power Strip Electric Demand Savings Algorithm

$$\Delta kW = \left(\frac{\Delta kWh}{Hours \times CF} \right)$$

Table 129 list the assumptions the evaluation team used to estimate verified savings for advanced power strips.

Table 129. Verified Assumptions for Advanced Power Strips

Parameter	Value	Units	Notes/Reference
kWh	103	kWh	IL-TRM V6.0 – 7-plug Tier 1 APS
ISR	69%	N/A	Installation rate (IL-TRM V6.0)
Hours	7,129	Hours	IL-TRM V6.0 – Annual number of hours during which the controlled standby loads are turned off by the advanced power strip
CF	0.8	N/A	Summer peak coincidence factor (IL-TRM V6.0).

Shower Timer

The evaluation team used the following equations from the IL-TRM V6.0 to estimate energy and demand savings for shower timers.

Equation 42. Shower Timer Electric Energy Savings Algorithm

$$\Delta kWh = \%ElectricDHW \times GPM \times (L_{base} - L_{timer}) \times Household \times 365.25 \times SPCD \times UsageFactor \times EPG_{electric}$$

Equation 43. Shower Timer Electric Demand Savings Algorithm

$$\Delta kW = \left(\frac{\Delta kWh}{Hours} \right) \times CF$$

Equation 44. Shower Timer Gas Energy Savings Algorithm

$$\Delta Therms = \%GasDHW \times GPM \times (L_{base} - L_{timer}) \times Household \times 365.25 \times SPCD \times UsageFactor \times EPG_{gas}$$

Table 130 provides assumptions used to estimate verified savings for shower timers.

Table 130. Verified Assumptions for Shower Timers

Parameter	Value	Units	Notes/Reference
%ElectricDHW	48%	N/A	In accordance with the 2018 Direct Distribution Evaluation Plan, we used the 2018 implementer-administered web-based student participant survey data to estimate electric and gas water heater saturation rates. 48% of Initiative measures were installed in residences with electric water heating and 52% installed in homes with gas water heating.
%FossilDHW	52%	N/A	
GPM	1.93	gal/min	Flow rate of showerhead as used - Unknown (IL-TRM V6.0)
L _{base}	7.8	min/day	Base case use length (IL-TRM V6.0)
L _{timer}	5.79	min/day	Number of minutes in shower after shower timer (IL-TRM V6.0)
Household	Single family: 2.56 Multifamily: 2.10	# of people	Average number of people per household (IL =-TRM V6.0). The evaluation team used single family/multifamily values in conjunction with the 79% single family/21% multifamily customer population distribution from the 2013 <i>Market Potential Assessment</i> to calculate a weighted average people per household value of 2.46.
SPCD	0.6	Showers per capita per day	Showers per capita per day (IL-TRM V6.0)
365.25	365.25	Average days in	Days in a year, on average (IL-TRM V6.0)

Parameter	Value	Units	Notes/Reference
		a year	
UsageFactor	Single family: 1.79 Multifamily: 1.30	Showerheads per household	Showerheads per household (IL-TRM V6.0). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average showerheads per household value of 1.69.
EPG_electric	0.117	kWh/gal	Energy per gallon of hot water supplied by electricity (IL-TRM V6.0)
EPG_gas	Single Family: 0.00501 Multifamily: 0.00583	Therm/gal	Energy per gallon of hot water supplied by natural gas (IL-TRM V6.0). The evaluation team used the 79% single family/21% multifamily customer population distribution to calculate a weighted average energy per gallon of hot water supplied by natural gas value of 0.00518.
Hours	210.3	Hours/Year	Annual electric water heating recovery hours for showerhead use (IL-TRM V6.0)
CF	0.0278	N/A	Coincidence Factor for electric load reduction (IL-TRM V6.0)

Verified Net Impact Methodology

The evaluation team applied SAG-approved NTGRs by measure type and delivery method to calculate verified net savings. Table 131 outlines the SAG-approved NTGR values applied to verified gross savings to calculate 2018 verified net savings.

Table 131. SAG-Approved Direct Distribution Initiative NTGRs

Measure	Electric NTGR	Gas NTGR
9W LED	0.830	N/A
1.0 GPM Bath Faucet Aerator	1.040	1.040
1.5 GPM Kitchen Faucet Aerator	1.040	1.040
1.75 GPM High Efficiency Showerhead	1.050	1.050
Hot Water Temperature Card Thermometer	1.000	1.000
Advanced Power Strip	0.950	N/A
Shower Timer	1.000	1.000

Smart Savers

Verified Gross Impact Methodology

Advanced Thermostat Savings Assumptions

The evaluation team calculated verified gross electric and demand savings for 2018 Smart Savers Pilot advanced thermostats using the initiative tracking database and applying algorithms and savings assumptions based on the IL-TRM V6.0.

The evaluation team used the following equations from the IL-TRM V6.0 to estimate electric energy, electric demand, and gas savings for advanced thermostats:

Equation 45. Advanced Thermostat Energy and Demand Savings Equation

$$kWh = kWh_{Cool} + kWh_{Heat} + kWh_{Run}$$

$$kWh_{Cool} = Qty \times \%AC \times \frac{1 \div SEER}{1000} \times Capacity_{Cool} \times Reduct_{Cool} \times FLH_{Cool} \times ISR$$

$$kWh_{Heat} = Qty \times \%Elec_{Heat} \times ElecUsage_{Heat} \times HF \times Reduct_{Heat} \times ISR$$

$$kWh_{Run} = Qty \times Therms \times Furnace_e \times 29.3$$

$$kW = Qty \times \%AC \times \frac{1 \div EER}{1000} \times Capacity_{Cool} \times Reduct_{Cool} \times CF \times ISR$$

$$Therms = Qty \times \%Gas_{Heat} \times GasUsage_{Heat} \times HF \times Reduct_{Heat} \times ISR$$

Where:

Qty = Quantity of service addresses receiving at least one advanced thermostat based on initiative tracking data

%AC = Portion of cooling controlled by thermostat = 100% if central cooling or heat pump, otherwise 0%

SEER = Cooling efficiency of central air conditioner or heat pump controlled by the advanced thermostat in units of SEER = 8.60 for central cooling, 9.12 for heat pumps, 13.0 for ground-source heat pumps

Capacity_{Cool} = Cooling capacity of air conditioner = 33,600 BTU/hour (deemed for single-family)

Reduct_{Cool} = Reduction in cooling energy consumption due to installing a advanced thermostat = 8.0%

FLH_{Cool} = Full Load Cooling Hours (applied per participant based on project location)

Table 132. Full Load Cooling Hours by Climate Zone

Climate Zone	Single Family	Multifamily
1 (Rockford)	512	467
2 (Chicago)	570	506
3 (Springfield)	730	663
4 (Belleville)	1,035	940
5 (Marion)	903	820

ISR = Percentage of thermostats installed and effectively programmed = 100%

%Elec_{Heat} = 100% if electric space heating fuel, 0% if gas space heating fuel, 6.5% if unknown

ElecUsage_{Heat} = Estimated annual household heating consumption for electrically heated homes (applied per participant based on project location and electric heating type [i.e., electric resistance, heat pump])

Table 133. Electric Heating Consumption by Climate Zone

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

HF = Household factor to adjust heating consumption = 100% for single family; 65% for multifamily

Reduct_{Heat} = Reduction in heating energy consumption = 7.4%

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

EER = Cooling efficiency of central air conditioner or heat pump controlled by the advanced thermostat in units of EER = 8.15 for central cooling, 8.55 for heat pumps, 11.0 for ground-source heat pumps

CF = Summer system peak coincidence factor = 0.34

%Gas_{Heat} = 100% if gas space heating fuel, 0% if electric space heating fuel, 93.5% if unknown

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

Table 134. Gas Heating Consumption by Climate Zone

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

Advanced thermostat tracking data included detailed information on heating fuel and heating and cooling systems for most participants. Climate zones were assigned based on customer zip code from the tracking data. Per the IL-TRM V6.0, additional savings cannot be claimed for a second advanced thermostat installed in a single location.

Verified Net Impact Methodology

By SAG agreement, the savings achieved by advanced thermostats are considered to be net, and therefore, we applied no NTGR to savings achieved by the Smart Savers Pilot.

DCEO New Construction Commitments

Verified Gross Impact Methodology

In this section we outline the measure improvement and savings assumptions used to calculate the verified savings for the DCEO New Construction Commitments. We relied on the IL-TRM V6.0 for the verified savings and reviewing project inputs.

Project AMIL0000019029 (CCICS-9029)

This project performed rehabilitation improvement at a site with two multifamily buildings and a total of 140 dwelling units. The list of measures identified for energy savings included packaged terminal air conditioners (PTACs), attic insulation, high efficiency boilers, gas water heaters, ENERGY STAR refrigerators, and lighting.

Verified electric energy savings (553,979 kWh) are lower than the ex ante electric savings (672,242 kWh), resulting in a gross savings realization rate of 82%. Verified gas savings (24,878 therms) are lower than the ex ante gas savings (22,851 therms), resulting in a gross realization rate of 92%.

The evaluation team found a discrepancy between the ex ante savings and the verified energy savings. No details were provided for the ex ante savings calculation for each improvement. This was mainly due to missing

values for several parameters, including capacity of the PTAC unit at Hershey Tower, attic area, and details of the energy savings calculations. The evaluation team made reasonable assumptions based on engineering expertise, reliance on the IL-TRM, and adjusting assumptions for yearly hours of system operation to seasonal equivalent full load hours.

Table 135 provides key assumptions for calculating electric energy savings from PTACs.

Table 135. Key Parameters for Calculating PTAC Savings

Parameter	Value	Sources
Cooling/heating capacity at Hershey Tower	80 units, 18,000 BTUh each	Engineering assumptions based on unit size and floor area
Cooling/heating capacity at Senior Village	60 units, 18,000 BTUh each	Engineering assumptions based on unit size and floor area
EFLH_cool	1,011 hours for MF-high rise (Residential, Springfield)	IL-TRM V6.0
EER_ee	10.4 (Hershey Tower) 9.6 (Senior Village)	Equipment specs from project documents
EER_base	8	IL-TRM V6.0
EFLH_heat	1,330 hours for MF-high rise (Residential, Springfield)	IL-TRM V6.0
COP_ee	2.9	IL-TRM V6.0
COP_base	1	IL-TRM V6.0

Table 136 provides key assumptions for calculating electric and gas savings from attic insulation.

Table 136. Key Parameters for Calculating Attic Insulation Savings

Parameter	Value	Source
Attic area	107,392 (sq. ft.)	100% of floor area
R_old	5	IL-TRM V6.0
R_attic	49	Specs from project documents
Framing factor attic	0.07	IL-TRM V6.0
CDD	1,108	IL-TRM V6.0
DUA	0.75	IL-TRM V6.0
η_{cool}	14	IL-TRM V6.0
AD_Atticcool	1.21	IL-TRM V6.0
HDD	4,379	IL-TRM V6.0
ADJAtticElectHeat	60	IL-TRM V6.0
ADJatticfan	107	IL-TRM V6.0
η_{heat}	2	IL-TRM V6.0

Table 137 provides key assumptions for calculating gas savings from high efficiency gas boilers.

Table 137. Key Parameters for Calculating Boiler Savings

Parameter	Value	Source
Boiler capacity	5,684,050 BTU/h	Assumed based on 50 BTU/sq. ft. and 20% equipment oversizing
AFUE_eff	93	Specs from project documents
AFUE_base	82	IL-TRM V6.0
UEF_base	0.5973	IL-TRM V6.0
UEF_eff	0.933	IL-TRM V6.0
EFLH	836	IL-TRM V6.0
GPD	17.6 gallons	IL-TRM V6.0
Household	2.56	IL-TRM V6.0
Gamma_water	8.33	IL-TRM V6.0

Table 138 provides key assumptions for calculating gas savings from high efficiency gas water heaters.

Table 138. Key Parameters for Calculating Gas Water Heater Savings

Parameter	Value	Sources
Number of units	140	Specs from project documents
UEF_base	0.563	IL-TRM V6.0
UEF_eff	0.79	IL-TRM V6.0
GPD	17.6	IL-TRM V6.0
Household	2.56	IL-TRM V6.0
Gamma_water	8.33	IL-TRM V6.0

Table 139 provides key assumptions for calculating electric savings from ENERGY STAR refrigerators.

Table 139. Key Parameters for Calculating ENERGY STAR Refrigerator Savings

Parameter	Value	Sources
Number of units	140	Specs from project documents
UEC_base	431.14	IL-TRM V6.0 (refrigerator, freezer with partial automatic defrost)
UEC_ee	388	IL-TRM V6.0 (refrigerator, freezer with partial automatic defrost)

Table 140 provides key assumptions for calculating electric savings from lighting.

Table 140. Key Parameters for Calculating Lighting Savings

Parameter	Value	Sources
Area (sq. ft.)	113,681	Specs from project documents
Lighting density (watts/sq. ft.)	0.51	IL-TRM V6.0
Total wattage	57,977.31	Calculated using IL-TRM V6.0 parameters
Hours	759	IL-TRM V6.0
WHFe	1.06	IL-TRM V6.0
WHFd	1.11	IL-TRM V6.0
CF	0.071	IL-TRM V6.0

Project AMIL0000019030 (MLS-19030)

This project is a 62-unit multifamily building. The list of measures identified for energy savings included single package vertical heat pumps (SPVHP), wall/attic and foundation wall insulation, lighting, and appliances (refrigerators, clothes washers, dishwashers, ceiling fans, and clothes dryers).

Overall calculated electric energy savings (205,176 kWh) are lower than the ex ante electric savings (262,800 kWh), i.e. realization rate of 78%. The evaluation team found a discrepancy between the ex ante savings and the verified energy savings. This was mainly due to missing values for several parameters including, capacity, make and model of the SPVHPs, attic area, and details of the energy savings calculations. The team made reasonable assumptions based on engineering expertise, reliance on the IL-TRM, and adjusting assumptions for yearly hours of system operation to seasonal equivalent full load hours.

Table 141 summarizes key assumptions for calculating electric savings from SPVHPs. Since no specific energy saving algorithm for SPVHPs is available in the IL-TRM, the energy savings were calculated using the air source heat pump measure (5.3.1) in the IL-TRM V6.0.

Equation 46. Electric Energy Savings Algorithm for Air Source Heat Pumps

$$\Delta kWh = \frac{FLH_{cooling} * Capacity_{cooling} * \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}} \right)}{1000} + \frac{FLH_{heat} * Capacity_{heating} * \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}} \right)}{1000}$$

Table 141. Key Parameters for Calculating SPVHP Savings

Parameter	Value	Source
Cooling/heating capacity	36,000 Btuh for 15 units 24,000 Btuh for 47 units 48,000 Btuh for common areas	Assumed based on unit size and floor area
FLH_cool	940 (Belleville)	IL-TRM V6.0
EER_ee	12.5	IL-TRM V6.0
SEER_base	14	IL-TRM V6.0
SEER_ee	15	IL-TRM V7.0
FLH_heat	1,266 (Belleville)	IL-TRM V6.0
HSPF_base	8.2	IL-TRM V6.0
HSPF_ee	8.5	IL-TRM V7.0

Table 142 summarizes key assumptions for calculating savings from attic, wall, and foundation wall insulation.

Table 142. Key Parameters for Calculating Attic, Wall, and Foundation Wall Insulation Savings

Parameter	Value	Source
Area	44,970 sq. ft. – Attic	100% of floor or wall area
	55,118 sq. ft. – Wall	
	44,970 sq. ft. – Foundation Wall	
R_old	5	IL-TRM V6.0
R_attic	49	Specs from project documents

Parameter	Value	Source
Framing factor attic	0.07	IL-TRM V6.0
Conditioned CDD	1,108	IL-TRM V6.0
DUA	0.75	IL-TRM V6.0
η_{cool}	14	IL-TRM V6.0
AD_Atticcool	1.21	IL-TRM V6.0
Conditioned HDD	4,379	IL-TRM V6.0
ADJAtticElectHeat	60	IL-TRM V6.0
ADJatticfan	107	IL-TRM V6.0
η_{heat}	2	IL-TRM V6.0
Unconditioned HDD	1,789	IL-TRM V6.0
Unconditioned CDD	538	IL-TRM V6.0
ADJFloorCool	0.80	IL-TRM V6.0
Framing_factor (floor)	0.12	IL-TRM V6.0

Savings from lighting were calculated using assumptions similar to those in Table 140 but for a building space of 44,970 square feet.

Table 143 summarizes key parameters for calculating appliance savings.

Table 143. Key Parameters for Calculating Appliance Savings

Parameter	Units	Unit Savings Value	Source
Refrigerators	62 units	43.14 kWh/unit	IL-TRM V6.0
Dishwashers	62 units	19.60 kWh/unit	IL-TRM V6.0
Ceiling Fans	62 units	81.20 kWh/unit	IL-TRM V6.0
Clothes Washers	5 units or assumed common areas	48.10 kWh/unit	IL-TRM V6.0
Clothes Dryers	5 units or assumed common areas	160.44 kWh/unit	IL-TRM V6.0

Project AMIL0000019032 (ICADC-19032)

This project consists of energy efficiency measures deployed in a building with 30 single family units. The list of measures identified for energy savings included air source heat pumps, lighting, and appliances.

Calculated electric energy savings (32,040 kWh) are lower than the ex ante electric savings (39,481 kWh), producing a gross realization rate of 81%. Savings were determined based on the ex ante calculation which were based only on electrical load of 4.5 kW. Savings assumed 8,760 hours, but we adjusted for seasonal cooling and heating use of heat pump equipment.

Table 144 summarizes key parameters for estimating savings from air source heat pumps.

Table 144. Key Parameters for Calculating Air Source Heat Pump Savings

Parameter	Value	Source
Cooling/heating capacity	18 units, 24,000 BTUh each 12 units, 18,000 BTUh each	Supplemental data from implementer
FLH_cool	730 (Springfield)	IL-TRM V6.0
EER_ee	12.5	IL-TRM V6.0

Parameter	Value	Source
SEER_base	14	IL-TRM V6.0
SEER_ee	15	IL-TRM V7.0
FLH_heat	1,754 (Springfield)	IL-TRM V6.0
HSPF_base	8.2	IL-TRM V6.0
HSPF_ee	8.5	IL-TRM V7.0

Savings from efficient lighting are estimated using lighting density. Savings from appliances use the same per-unit values from Table 143 with updated unit values to reflect this project.

Project AMIL0000019033 (RHD-19033)

This project consists of SPVHPs deployed at a building with 72 single family units and 13 common areas. Calculated electric energy savings (34,433 kWh) are lower than the ex ante electric savings (36,108 kWh), producing gross savings realization rate of 95%. Savings were determined based on the ex ante calculation which was based only on electrical load of 4.1 kW. The team made reasonable assumptions based on engineering expertise and reliance on the IL-TRM. Savings assumed 8,760 hours, but we adjusted for seasonal cooling and heating use of heat pump equipment. Table 145 summarizes key parameters used to estimate savings.

Table 145. Key Parameters for Calculating SPVHP Savings

Parameter	Value	Source
Cooling/heating capacity	Units = 72x Carrier 25HHA418 18,000 BTUh cooling 10,600 BTUh heating Common Areas = 13x Carrier 25HHA460 59,000 BTUh cooling 24,000 BTUh heating	Supplemental data from implementer
FLH_cool	940 (Belleville)	IL-TRM V6.0
EER_ee	12.5	IL-TRM V6.0
SEER_base	14	IL-TRM V6.0
SEER_ee	15	IL-TRM V7.0
FLH_heat	1,266 (Belleville)	IL-TRM V6.0
HSPF_base	8.2	IL-TRM V6.0
HSPF_ee	8.5	IL-TRM V7.0

Table 146 summarizes key assumptions for calculating savings from attic insulation.

Table 146. Key Parameters for Calculating Attic Insulation Savings

Parameter	Value	Source
Area	25,200 sq. ft. – Attic	assumed 350 sq.ft of attic insulation for 72 units
R_old	49	Code baseline as specified in documentation
R_attic	50	Specs from project documents
Framing factor attic	0.07	IL-TRM V6.0
Conditioned CDD	1,570	IL-TRM V6.0
DUA	0.75	IL-TRM V6.0

Parameter	Value	Source
η_{cool}	14	IL-TRM V6.0
AD_Atticcool	0.80	IL-TRM V6.0
Conditioned HDD	3,378	IL-TRM V6.0

Savings from lighting were calculated using assumptions similar to those in Table 140, but for a building space of 25,200 square feet. Savings from appliances use the same per-unit values from Table 143 with updated unit values to reflect this project.

Verified Net Impact Methodology

The evaluation team applied the SAG-approved NTGR for income qualified programs of 1.0 to verified gross savings to determine verified net savings for the DCEO New Construction Commitments.

Appendix B. Cost-Effectiveness Inputs

In this appendix, we provide inputs for the cost-effectiveness testing of AIC's Business Program. By agreement with SAG, AIC is not penalized for interactive effects resulting from the installation of efficient prescriptive measures that create an increase in energy usage when considering savings for the purpose of goal attainment. Therefore, we exclude those effects in all savings reported throughout the body of this report. However, these effects must be evaluated and considered as part of cost-effectiveness testing, and are therefore presented in this appendix.

Within the following sections, the evaluation team focuses specifically on the following heating penalties:

- **Lighting Heating Penalties.** 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, less-efficient lamp type. The team applied the IL-TRM waste heat factors to lamps based on heating fuel types provided in the tracking database to arrive at gross heating penalties. For the cases where tracking data did not provide the heating type, the team assumed natural gas heating per the IL-TRM.
- **BPM Motor Heating Penalties.** High efficiency fan motors operate at cooler temperatures than traditional furnace blower motors. The amount of heat that is released decreases due to cooler operating conditions. Heating equipment must make up for this loss of heat during the heating season, resulting in an increase in HVAC heating loads. The team applied IL-TRM algorithms to calculate the associated heating penalty.
- **Heat Pump Water Heater Penalties.** When heat pump water heaters are installed in conditioned space, they move heat from the ambient air into water stored in a tank. During the heating season, this can result in an increase in HVAC heating loads. The team applied IL-TRM algorithms to calculate the associated heating penalty.

All heating penalties were calculated using algorithms from the IL-TRM V6.0 (with applicable errata applied).

Retail Products

The gross gas heating penalty associated with additional space heating needed as a result of Retail Products Initiative efficient lighting installations is shown in Table 147. In addition to the gross gas heating penalty from measure installations in 2018, the evaluation team calculated the gross gas heating penalty from delayed LED installations, per the IL-TRM V6.0.

Table 147. 2018 Retail Products Initiative Gross Gas Heating Penalties

Measure	Heating Penalty (Therms)		
	2018	2019	2020
Standard LEDs	2,281,867	94,615	81,706
Specialty LEDs (Reflector)	546,970	12,837	11,282
Specialty LEDs (Non-Reflector)	226,112	5,384	4,727
Total	3,054,950	112,836	97,714

Table 148 shows the gross 2018 gas impacts for the Retail Products Initiative including heating penalties.

Table 148. 2018 Retail Products Initiative Gross Impacts with Heating Penalties

	MWh	MW	Therms
Gross Savings	156,077	19.645	510,661
Lighting Heating Penalty	N/A	N/A	-3,054,950
Total Gross Savings with Heating Penalty	156,077	19.645	-2,544,289

Income Qualified

Table 149 presents total gross impacts for the IQ Initiative including heating penalties. Overall, the application of heating penalties reduces total gross electric energy savings by 0.58% and gas savings by 7.82%.

Table 149. 2018 IQ Initiative Gross Impacts with Heating Penalties

	kWh	kW	Therms
Gross Savings	11,108,231	3,042	1,064,023
Lighting Heating Penalty	-64,020	N/A	-52,917
BPM Motor Heating Penalty	N/A	N/A	-30,312
Total Gross Savings with Heating Penalty	11,044,212	3,042	980,836

Public Housing

Table 150 presents total gross impacts for the Public Housing Initiative including heating penalties. Overall, the application of heating penalties reduces total gross electric energy savings by nearly 7% and therm savings by nearly 29%.

Table 150. 2018 Public Housing Initiative Gross Impacts with Heating Penalties

	MWh	MW	Therms
Gross Savings	1,630	0.21	41,702
Lighting Heating Penalty	-112	N/A	-11,936
Total Gross Savings with Heating Penalty	1,519	0.21	29,766

Behavior Modification

Home energy reports do not produce interactive effects.

HVAC

Table 151 presents total gross impacts for the HVAC Initiative including heating penalties.

Table 151. 2018 HVAC Initiative Gross Impacts with Heating Penalties

	MWh	MW	Therms
Gross Savings	6,955	0.748	65,737
BPM Heating Penalty	N/A	N/A	-822.1
Heat Pump Water Heater Heating Penalty	N/A	N/A	-7.4
Total Gross Savings with Heating Penalty	6,955	0.748	64,908

Appliance Recycling

No measures delivered through the Appliance Recycling Initiative in 2018 produce interactive effects.

Multifamily

Table 152 presents total gross impacts for the Multifamily Initiative including heating penalties. Overall, the application of heating penalties reduces total gross electric energy savings by 6% and therm savings by 15%.

Table 152. Total Multifamily Initiative Gross Impacts with Heating Penalties

	kWh	kW	Therms
Gross Savings	2,538,924	311	37,480
Lighting Heating Penalty	- 148,173	N/A	- 5,649
Total Gross Savings with Heating Penalty	2,390,751	311	31,831

Direct Distribution of Efficient Products

In addition to the gross gas heating penalty from measure installations in 2018, the evaluation team calculated the gross gas heating penalty from delayed LED installations, per the IL-TRM V6.0. In particular, the IL-TRM V6.0 assumed consumers would install 86% of kit LEDs within three years. Table 153 shows gross gas heating penalties by year for the 2018 Direct Distribution Initiative.

Table 153. 2018 Direct Distribution Initiative Gas Heating Penalties by Year

Measure	Gross Gas Impacts (Therms)		
	2018	2019	2020
9W LED	-14,019	-1,822	-1,542

Table 154 shows the gross 2018 gas impacts for the Direct Distribution Initiative including heating penalties.

Table 154. 2018 Direct Distribution Initiative Gross Impacts with Heating Penalties

	MWh	MW	Therms
Gross Savings	1,740	0.231	19,543
Lighting Heating Penalty	N/A	N/A	-14,019
Total Gross Savings with Heating Penalty	1,740	0.231	5,525

Smart Savers

No measures delivered through the Smart Savers effort in 2018 produce interactive effects.

DCEO New Construction Commitments

No measures installed as part of the DCEO New Construction Commitments in 2018 produce interactive effects.

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