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Ameren Illinois Company 2021 Business Program Impact Evaluation Report

Final

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1. Executive Summary

This report presents impact evaluation results from Ameren Illinois Company's (AIC) 2021 Business Program. The Business Program is part of AIC's overall portfolio of residential and nonresidential energy efficiency programs implemented during 2021. The overarching objective of the 2021 Business Program impact evaluation is to determine gross and net electric energy, electric demand, and natural gas impacts associated with the Program.

1.1 Program Overview

The Business Program is the largest component of AIC's portfolio and is made up of a number of initiatives (further broken down into channels) that the evaluation team assessed as part of the 2021 evaluation:[1]

- Standard Initiative
  - Core channels (described further in Section 3.1)
  - Midstream HVAC
  - Small Business Direct Install (SBDI)
  - Instant Incentives (Midstream Lighting)
  - Online Store
- Custom Initiative
  - Custom Incentives
  - New Construction Lighting
- Retro-Commissioning (RCx) Initiative
  - Large Facilities Retro-Commissioning
  - Virtual Commissioning™
- Streetlighting Initiative
  - Municipality-Owned Streetlighting (MOSL)
  - Utility-Owned Streetlighting (UOSL)
- Building Operator Certification (BOC)[2]

The initiatives are designed to achieve energy savings from nonresidential customers in accordance with AIC's plan filing. The Standard Initiative makes up the bulk of the Business Program in terms of energy savings; it primarily provides prescriptive rebates, energy audits, and direct installation of energy efficiency measures to customers. The Custom and RCx initiatives provide information, technical support, and financial assistance

[1] In addition to the channels described here, the Program operates a number of channels that provide customer services but do not directly produce energy savings (such as the Metering and Monitoring channel of the Custom Initiative), or that were operated in 2021 but did not lead to any completed projects (such as the Retro-Commissioning Lite channel of the Retro-Commissioning Initiative).
[2] BOC is not technically an initiative but is listed here for simplicity. BOC provides education and training to customers to encourage more energy-efficient operation of facilities which can lead to energy-efficient actions being taken by customers without further AIC support. We evaluate this offering to estimate energy savings that directly result from it, but AIC does not claim ex ante BOC savings.

for energy efficiency projects of a more custom nature, while the Streetlighting Initiative seeks to increase adoption of energy-efficient streetlights throughout AIC's territory.

The Business Program is available to the majority of AIC's nonresidential customers, including both public and private sector customers. However, two notable customer groups were ineligible for the Business Program in 2021:

- **Large electric customers**. Nonresidential electric customers with electric demand of over 10 MW became ineligible for AIC's energy efficiency programs as of June 1, 2017. These customers historically provided a majority or near-majority of Business Program electric energy savings, so their exclusion from AIC's programs has had significant effects on the Program and required the Program to generally pursue larger numbers of smaller projects to achieve its goals. This change particularly affected the Custom Initiative, which historically derived 50% or more of its energy savings from 10 MW customers.
- **Large gas customers**. AIC's largest nonresidential natural gas customers also became ineligible for energy efficiency programs beginning in the 2020 program year. All customers with annual usage of 4,000,000 therms or more across all AIC service points, or 8,000,000 therms or more across all Illinois service points, became ineligible for AIC's programs as of January 1, 2020.

1.2 Policy Background

This is the fourth and final calendar year of AIC's four-year 2018 Plan, which AIC developed based on guidance provided in Illinois Senate Bill 2814 (the Future Energy Jobs Act [FEJA]). Key concepts from this legislation that affect program evaluation include:

- **Cumulative Persisting Annual Savings (CPAS):** Since 2018, electric energy savings goals for Illinois utilities have been 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 and persisting savings over the life of delivered measures. As a result, AIC and its program implementer have also sought to deliver programs that achieve savings that persist for a longer period of time.
- **Applicable Annual Incremental Goal (AAIG):** AAIG is defined as the difference between the cumulative persisting electric savings goal for the year being evaluated and the cumulative persisting electric savings goal for the previous year. On a year-to-year basis, AIC must meet an AAIG. The utility must achieve sufficient savings through its programs to replace savings from measures at the end of their measure life before progress can be counted toward the AAIG.
- **Weighted Average Measure Life (WAML):** FEJA replaced 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."[3] Therefore, we present WAML for AIC's electric Business Program in this report in accordance with the guidelines for calculation presented in the Illinois Stakeholder Advisory Group's (SAG) WAML Report.[4]
- **Savings Conversion:** FEJA allows electric utilities to "convert" non-electric energy savings achieved to electric savings for the purposes of goal attainment in certain cases. The total amount of savings allowed to be converted is capped at a maximum of 10% of the utility's AAIG. AIC met the criteria to

[3] Illinois Energy Efficiency Stakeholder Advisory Group. *Weighted Average Measure Life Report*. 2018.
[4] Ibid.

convert savings in 2021 and chose to convert savings from the Custom Initiative as part of the savings conversion.

1.3 Program Savings

In the following sections, the evaluation team presents annual savings (annualized 2021 energy savings) and CPAS. As discussed in greater detail in the *2021 AIC Integrated Impact Evaluation Report*, AIC's performance compared to its AAIG is determined based on both types of savings.

1.3.1 Annual Savings

The 2021 Business Program achieved 235,622 MWh, 35.59 MW, and 1,380,427 therms in verified net savings. These savings are reported after accounting for the FEJA-allowed "conversion" of natural 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 2021 Business Program.

Table 1. 2021 Business Program Electric Energy Annual Savings Summary

Initiative/Channel	Ex Ante Gross MWh	Gross Realization Rate	Verified Gross MWh	Net-to-Gross Ratio (NTGR)	Verified Net MWh
Standard – Core	36,801	100%	36,741	0.825	30,325
Standard – SBDI	103,701	100%	103,675	0.908	94,157
Standard – OS	712	94%	670	0.974	653
Standard – II	40,497	100%	40,497	0.794	32,144
Standard – II Carryover[a]	6,186	100%	6,186	0.916	5,667
Custom	54,352	87%	47,151	0.822	38,768
Retro-Commissioning	314	82%	258	0.940	242
Virtual Commissioning	5,166	89%	4,593	1.000	4,593
Streetlighting	25,823	99%	25,533	0.991	25,301
Business Program Subtotal	*273,552*	97%	*265,303*	0.874	*231,850*
BOC					47
Custom (gas conversion)					3,725
Business Program Total					**235,622**

[a] Carryover savings are those achieved through installation of measures during 2021 that were distributed or rebated in prior Program years. For clarity, we break out carryover separately throughout this report.

Table 2. 2021 Business Program Electric Demand Annual Savings Summary

Initiative/Channel	Ex Ante Gross MW	Gross Realization Rate	Verified Gross MW	NTGR	Verified Net MW
Standard – Core	6.65	100%	6.65	0.827	5.50
Standard – SBDI	15.69	100%	15.68	0.908	14.24
Standard – OS	0.14	150%	0.20	0.951	0.19
Standard – II	9.58	100%	9.58	0.795	7.62
Standard – II Carryover	1.46	100%	1.46	0.916	1.34
Custom	9.01	90%	8.14	0.822	6.69

Initiative/Channel	Ex Ante Gross MW	Gross Realization Rate	Verified Gross MW	NTGR	Verified Net MW
Retro-Commissioning	0.00	N/A	0.00	N/A	0.00
Virtual Commissioning	0.00	N/A	0.00	N/A	0.00
Streetlighting	0.05	0%	0.00	N/A	0.00
Business Program Subtotal	*42.58*	98%	*41.72*	0.853	*35.59*
BOC					0.00
Business Program Total					**35.59**

Table 3. 2021 Business Program Gas Annual Savings Summary

Initiative/Channel	Ex Ante Gross Therms	Gross Realization Rate	Verified Gross Therms	NTGR	Verified Net Therms
Standard – Core	1,170,840	102%	1,193,721	0.549	655,711
Standard – SBDI	0	N/A	0	N/A	0
Standard – OS	36,192	102%	36,839	0.880	32,419
Standard – II	0	N/A	0	N/A	0
Standard – II Carryover	0	N/A	0	N/A	0
Custom	1,158,210	73%	849,741	0.939	797,482
Retro-Commissioning	29,640	79%	23,344	0.940	21,943
Virtual Commissioning	0	N/A	0	N/A	0
Streetlighting	0	N/A	0	N/A	0
Business Program Subtotal	*2,394,882*	88%	*2,103,645*	0.717	*1,507,555*
BOC					0
Custom (gas conversion)					-127,128
Business Program Total					**1,380,427**

1.3.2 Cumulative Persisting Annual Savings

Table 4 summarizes CPAS and WAML for the 2021 Business Program at the initiative level. For additional detail related to CPAS and measure life, please see the individual initiative subsections in Section 3 and Appendix C, which presents CPAS achieved in each future year. The overall WAML for the 2021 Business Program is 14.4 years.

Table 4. 2021 Business Program CPAS and WAML

Initiative	WAML	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	…	2030	…	
Standard - Core	13.1	36,741	0.825	30,325	30,325	30,296	30,135	…	27,294	…	388,135
Standard - SBDI	13.4	103,675	0.908	94,157	94,157	93,624	90,230	…	81,411	…	1,110,512
Standard - OS	9.5	670	0.974	653	653	652	645	…	419	…	5,754
Standard - II	14.2	40,497	0.794	32,144	32,144	32,144	32,144	…	30,031	…	455,384
Standard - II Carryover	14.1	6,186	0.916	5,667	5,667	5,667	5,667	…	5,364	…	80,622
Custom	15.2	47,151	0.822	38,768	38,768	38,768	38,768	…	36,021	…	552,207
Retro-Commissioning	8.6	258	0.940	242	242	242	242	…	0	…	2,084
Virtual Commissioning	7.3	4,593	1.000	4,593	4,593	4,593	4,593	…	0	…	33,529
Streetlighting	20.0	25,533	0.991	25,301	25,301	25,301	24,105	…	24,105	…	485,692
BOC	15.0	47	N/A	47	47	47	47	…	47	…	709
Custom (gas conversion)	15.5	3,969	0.939	3,725	3,725	3,725	3,725	…	3,725	…	57,902
2021 CPAS		**269,320**	**0.875**	**235,622**	**235,622**	**235,059**	**230,301**	**…**	**208,417**	**…**	**3,172,530**
Expiring 2021 CPAS				**0**	**0**	**564**	**4,758**	**…**	**5,482**	**…**	
Expired 2021 CPAS				**0**	**0**	**564**	**5,322**	**…**	**27,205**	**…**	
WAML	**14.4**										

2. Evaluation Approach

The following section of the report describes the evaluation approach taken for the 2021 Business 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 2021 program year (generally Version 1.1[5] and Version 9.0 [V9.0], respectively) wherever relevant.[6] Appendix A of this report provides more detailed initiative-specific methodology where appropriate.

The 2021 Business Program impact evaluation approach included initiative-specific activities with the primary goal of estimating gross and net energy and demand impacts. For the Standard and Streetlighting initiatives, the impact evaluation primarily consisted of applying savings algorithms from the IL-TRM V9.0 to the final initiative tracking databases to estimate verified gross savings. For the Custom and RCx initiatives, the team primarily employed a combination of engineering desk reviews, remote and on-site verification, and statistical analysis to estimate verified gross savings. This report also presents an evaluation of the BOC offering, which used a custom impact analysis to determine impacts from projects completed by BOC participants.

2.1 Research Objectives and Evaluation Activities

The overarching research questions for the impact evaluation of AIC's 2021 Business 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 listed in Table 5. In addition, we reviewed initiative materials and interviewed initiative managers.

Table 5. 2021 Business Program Impact Evaluation Activities

Initiative/Channel	Gross Impacts				Net Impacts
	IL-TRM Application Review	Engineering Desk Reviews	On-Site Measurement and Verification (M&V)	Consumption Analysis	Application of SAG-Approved NTGRs
Standard – Core	✓	✓			✓
Standard – SBDI	✓	✓			✓
Standard – OS	✓	✓			✓
Standard – II	✓	✓			✓
Custom		✓	✓	✓	✓
Retro-Commissioning		✓			✓
Virtual Commissioning				✓	✓
Streetlighting	✓				✓
BOC		✓			

[5] Broadly speaking, Version 1.1 of the Policy Manual was in effect during this evaluation. However, a number of individual policies from Version 2.0 of the Policy Manual were also in effect during this evaluation; those individual policies (e.g., Section 11.1) were applied in this evaluation as well.

[6] In future years, the evaluation team will apply updated versions of these manuals to the evaluation of this Program as required by law, Illinois Commerce Commission orders, and changes to the manuals themselves.

The following sections provide further detail on the approaches to estimating verified gross and net savings.

2.2 Verified Gross Impact Analysis Approach

2.2.1 Application of IL-TRM V9.0

To determine verified gross impacts associated with the Streetlighting Initiative and the majority of measures delivered through the Standard Initiative, 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 V9.0 and the IL-TRM V9.0 errata document. In particular, we applied the algorithms and assumptions provided in the IL-TRM V9.0, while using project-specific data from the initiative tracking databases where appropriate. As part of this process, we also verified measure installations by analyzing initiative tracking databases, as well as by reviewing 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. Further, in accordance with Illinois policy, the evaluation team omitted gas penalties from savings reported in the body of this report. Appendix B presents details on gas penalties for cost-effectiveness purposes.

2.2.2 Carryover Savings

In addition to savings achieved by AIC's Business Program through measures delivered during the 2021 program year, AIC claims savings in 2021 from lighting measures that were distributed by the Business Program in prior years but were not installed until 2021. In 2021, AIC claimed Business Program carryover savings from measures incented through the Standard Initiative's Instant Incentives channel in 2019 and 2020.

Carryover savings are evaluated using the applicable NTGR from the year in which the product was sold, the applicable in-service rate (ISR) trajectory assumption based on the year in which the product was sold, and IL-TRM V9.0 and IL-TRM V9.0 errata assumptions for all other relevant impact parameters.

We reported on AIC's 2021 carryover savings as part of an earlier memo.[7] Carryover savings are not reported as part of individual initiative subsections in Section 3.

2.2.3 Application of Custom Impact Methods

The Custom and RCx Initiatives, as well as a small number of Standard Initiative measures and savings achieved through BOC, are not suitable for gross impact analysis using the IL-TRM. These initiatives require custom energy savings calculations to determine some or all gross impacts.[8] Further details on the custom impact methods applied for these initiatives are presented in Appendix A.

Custom impact evaluation methods as applied to these programs often involve some degree of direct measurement of either energy savings or relevant impact parameters. As a result of the COVID-19 pandemic, which affected program implementation and operation for the majority of the 2021 program year, customer

[7] Memo is awaiting finalization and this report will be updated with a reference when a final version is available.
[8] Note that, where possible, we applied IL-TRM assumptions and measure characterizations for evaluation of these initiatives in accordance with evaluation best practice.

behavior and energy usage may have changed, potentially affecting custom project evaluation.[9] Per SAG agreement, the evaluation team normalized 2021 energy savings estimated through custom evaluation methods to reflect a typical evaluation year,[10] obviating this concern around the pandemic's effects on annual and persisting savings.

2.3 Verified Net Impact Analysis Approach

To determine verified net savings for the 2021 Business Program, we applied SAG-approved NTGRs to verified gross savings. Details on SAG-approved NTGRs applied are presented in Appendix A. The one exception is BOC training, for which we treated the savings as participant spillover per IL-TRM guidance.[11] As a result, we did not apply a SAG-approved NTGR to evaluated savings; all savings claimed were already determined to have been influenced by BOC.

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 2021 evaluation. In particular, we took the following actions to address potential sources of error:

- **Analysis Error:**
  - **Prescriptive Gross Impact Calculations:** For prescriptive gross impact calculations, we applied IL-TRM V9.0 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.
  - **Custom Gross Impact Calculations:** We determined custom gross impacts using desk reviews and data collected during remote and on-site M&V. To minimize data analysis errors, the evaluation team had all calculations reviewed by a separate team member to verify that calculations were performed accurately.
  - **Net Impact Calculations:** For net impact calculations, we applied SAG-approved NTGRs to estimated gross impacts to derive net impacts. To minimize analytical errors, all calculations were reviewed by a separate team member to verify their accuracy.
- **Sampling Error:**
  - **Custom Initiative Impact Sample:** The evaluation team completed an impact review for 44 of 134 Custom Initiative projects achieving savings in 2021, drawing three waves of stratified samples separately for projects claiming electric and gas savings. For gross impact results, at the 90% confidence level, we achieved a relative precision of 8.9% for electric energy savings, 7.4% for electric demand savings, and 9.7% for gas savings. Further detail on our methodology for Custom Initiative sampling is provided in Appendix A.

[9] Note that because relevant impact parameters for prescriptive measures were deemed in the IL-TRM V9.0 before the program year began, no such effect exists for prescriptive measures.
[10] Illinois Energy Efficiency Stakeholder Advisory Group. Policy Resolution – 2020 Program Year and 2021 Program Year. 2021. Accessed at: https://ilsag.s3.amazonaws.com/SAG-Policy-Resolution_Normalization_Final_3-24-2021.pdf
[11] *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, Attachment A: Illinois Statewide Net-to-Gross Methodologies*. Table 2-1. 2021.

  - **RCx Initiative Impact Sample:** The evaluation team completed desk reviews for a census of RCx Initiative projects (two projects). There is therefore no sampling error around our impact results.
- **Non-Sampling Error:**
  - **Measurement Error:** To minimize data collection error during remote and on-site M&V, the evaluation team used trained engineers and technicians familiar with the equipment covered by the Custom and RCx initiatives and BOC and with the methods used to calculate the gross impacts.

For the Virtual Commissioning™ channel specifically, we also addressed the following types of error:

- **Presence of Non-Routine Events:** "Non-routine events" (NREs) refers to changes in facility energy consumption resulting from facility-related changes not related to the interventions recommended through the channel. NREs can make it difficult to accurately measure savings using meter-based approaches, including the approach used for Virtual Commissioning™. NREs were of particular concern in 2021, as facility schedules tended to be irregular and difficult to monitor due to COVID-19 restrictions. The team accounted for NREs in our modeling approach by removing data for the affected period and extending the baseline back in time accordingly, consistent with International Performance Measurement and Verification Protocol (IPMVP) Non-Routine Adjustment Option 1.[12]
- **Model Specification Error**: In this type of error, variables that predict model outcomes are included when they should not be or are left out when they should be included, possibly producing biased estimates. The models used to estimate impacts in 2021 included many terms, which increases the risk of overfitting, which cause the regression coefficients, p-values, and R^2 to be misleading. The team addressed this type of error by recommending that the program implementer provide documentation on their model selection process and rationale as well as include projected R^2 values in each workbook in future program years to help with assessments of overfitting.
- **Measurement Error**: In the context of the Virtual Commissioning™ pilot, measurement error occurs when utility electric meters do not accurately record the true energy consumption of a facility. In practice, little can be done in an evaluation context to address this error. However, it is expected to be small.
- **Prediction Error:** Prediction error occurs when the model does not perfectly predict what future energy consumption will be. We did not have one year of post-period data for all Virtual Commissioning™ projects in 2021, which introduces bias because the model was not able to train on a full range of temperature data after the intervention was initiated. This may increase the prediction error for temperatures that are outside the range of the training data. The team addressed this by carefully examining model fit diagnostics.
- **Multicollinearity:** This type of modeling error can both bias the model results and produce very large variance in the results. The team addressed this issue by carefully considering the model specification and data to ensure that there were no multicollinearity issues.

Finally, note that the calculations in some of the tables in this report cannot be exactly reproduced due to rounding.

[12] Webster, Lia. IPMVP Application Guide on Non-Routine Events and Adjustments. Efficiency Valuation Organization (EVO). 2020.

3. Initiative-Level Results

3.1 Standard Initiative – Core

3.1.1 Initiative Description

Implemented by Leidos, the core channel of the Standard Initiative ("Standard Core") provides AIC nonresidential customers with prescriptive incentives for the installation of specific energy efficiency measures. In 2021, incentives were delivered through several distinct offerings, which are described below:

- Traditional downstream rebates for the following measures:
  - Standard Lighting for Business (SLB)
  - Heating, Ventilating, and Air Conditioning (HVAC)
  - Specialty Equipment (SE)
  - Variable Speed Drives (VSD)
  - Steam Trap Repair/Replacement (STRR)
- Midstream HVAC (MHVAC): AIC began offering midstream incentives for HVAC measures late in 2020 in anticipation of a focus on this channel in 2021.

Summary of Key Implementation Changes in 2021

During 2021, the following significant design and implementation changes were made relative to 2020:

- SLB added networked lighting controls and commercial LED grow lights to its prescriptive lighting measures, with a focus on warehouses, retail, and commercial buildings.
- Lighting incentives for LED fixture replacements (that are not T12) were increased in 2021 to boost participation.
- Agricultural measures and VSDs for Compressor Fans were added to SE for 2021.

3.1.2 Participation Summary

Table 6 presents participation and ex ante gross savings estimates for Standard Core in 2021. We present these data separated by public and private sectors to provide context as to the primary drivers of participation. Altogether, Standard Core reported a total of 36,801 MWh, 6.65 MW, and 1,170,840 therms in ex ante gross savings.

Table 6. 2021 Standard Initiative – Core Participation Summary

Offering	Total Projects	Ex Ante Gross Savings		
		MWh	MW	Therms
Private Sector				
SLB	490	20,429	3.58	0
VFD	19	6,906	1.37	0
HVAC	120	1,871	0.26	171,629
MHVAC	94	426	0.14	22,444
SE	31	554	0.08	36,603
STRR	34	10	0.00	622,680
Private Sector Subtotal	*788*	*30,196*	*5.42*	*853,357*
Public Sector				
SLB	133	3,881	0.63	0
VFD	12	1,298	0.31	0
HVAC	68	1,317	0.25	272,615
MHVAC	10	43	0.01	4,114
SE	3	66	0.01	9,181
STRR	3	1	0.00	31,572
Public Sector Subtotal	*229*	*6,606*	*1.22*	*317,483*
Total	**1,017**	**36,801**	**6.65**	**1,170,840**

Note: Totals may not sum due to rounding.

3.1.3 Initiative Annual Savings Summary

Table 7 presents the annual savings achieved in 2021 from Standard Core. Standard Core achieved 30,325 MWh, 5.50 MW, and 655,711 therms in verified net savings in 2021. Note that the SAG-approved NTGRs were used to convert gross savings to net savings.

Table 7. 2021 Standard Initiative – Core Annual Savings

	Electric Energy Savings (MWh)	Electric Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	36,801	6.65	1,170,840
Gross Realization Rate	100%	100%	102%
Verified Gross Savings	36,741	6.65	1,193,721
NTGR	0.825	0.827	0.549
Verified Net Savings	30,325	5.50	655,711

3.1.4 Initiative Savings Detail

Table 8through Table 10 present the ex ante and verified gross and net electric energy, electric demand, and gas savings for Standard Core, and are followed by a discussion of key reasons for discrepancies between the claimed (ex ante) and verified gross savings.

The gross and net MWh savings are presented in Table 8. Standard Core continued to experience a year-over-year decline in net verified electric energy savings, with a decrease of 43% compared to 2020 and 51% in

2019. Lighting measures maintained their prominent role in savings, accounting for 67% of net verified electric energy savings, but saw an overall decrease of 43% in total savings from 2020. Many of the established offerings experienced a similar decline in savings: VSDs decreased 46%; HVAC decreased 29%; SE decreased 35%. The fastest-growing offering is midstream HVAC (MHVAC), which experienced a twentyfold increase in savings in its second year but accounts for only 1% of total savings. Starting in 2020, the MHVAC offering incented unitary HVAC systems, advanced thermostats, and heat pump water heaters. The STRR offering provides a small amount of secondary electric energy savings associated with water and wastewater treatment, even though the offering targets gas savings.

Table 8. 2021 Standard Initiative – Core Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
SLB	24,310	100%	24,355	0.839	20,439
VSDs	8,204	100%	8,204	0.833	6,835
HVAC	3,188	97%	3,106	0.685	2,126
SE	620	100%	619	0.849	525
MHVAC	469	94%	443	0.881	390
STRR	11	129%	14	0.608	9
Total	**36,801**	**100%**	**36,741**	**0.825**	**30,325**

Verified net electric demand savings, presented in Table 9, are distributed similarly to electric energy, with lighting and VSD measures accounting for 90% of savings, split 64% for lighting and 25% for VSDs. Additionally, electric demand exhibits a similar decline in verified net savings at 39% from 2020 and 45% from 2019. MHVAC saw a sharp increase in demand savings from 2020 and accounts for 3% of electric demand savings for Standard Core.

Table 9. 2021 Standard Initiative – Core Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
SLB	4.21	100%	4.21	0.839	3.54
VSDs	1.68	100%	1.68	0.833	1.40
HVAC	0.51	100%	0.51	0.686	0.35
MHVAC	0.16	100%	0.16	0.881	0.14
SE	0.09	99%	0.08	0.849	0.07
Total	**6.65**	**100%**	**6.65**	**0.827**	**5.50**

Note: STRR measures do not contribute to demand savings.

Overall, verified net natural gas savings for Standard Core, presented in Table 10, increased in 2021 by 54% compared to 2020. The STRR offering drove the overall increase in savings, comprising 62% of net verified natural gas savings. The STRR offering saw a resurgence in 2021 with a 142% increase in verified net natural gas savings compared to 2020. This increase helps to offset the large reduction in STRR savings that occurred from 2019 to 2020 (85% decrease), which is likely attributable to the exclusion of large gas customers from AIC's Business Program beginning in 2020. The HVAC offering accounts for 29% of 2021 savings and shows fluctuating year-over-year savings since 2019, with a 46% increase compared to 2019 and an 18% decrease compared to 2020. SE and MHVAC contribute 5% and 4%, respectively, to 2021 verified net natural gas savings, with both increasing in 2021 compared to 2020. MHVAC did not claim any natural gas savings in 2020.

Table 10. 2021 Standard Initiative – Core Gas Savings by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
STRR	654,252	103%	672,080	0.608	408,625
HVAC	444,245	101%	449,336	0.429	192,844
SE	45,785	100%	45,786	0.675	30,905
MHVAC	26,558	100%	26,519	0.880	23,337
Total	**1,170,840**	**102%**	**1,193,721**	**0.549**	**655,711**

Note: Lighting and VSD measures do not contribute to gas savings. Heating penalties associated with lighting measures are reported in Appendix B.

The following discussion highlights the prominent drivers of realization rates for Standard Core observed by the evaluation team.

- **Standard Lighting for Business (68% of ex ante energy and 66% of ex ante demand savings for the Private Sector; and 59% of ex ante energy and 52% of ex ante demand savings for the Public Sector):** The gross realization rate for SLB is 100% for both energy and demand savings.
  - Verified savings are slightly increased due to differences in space conditioning assumptions presented in the initiative tracking data and those applied in claimed savings calculations. The evaluation team applied the initiative tracking data, which included information on installation locations, space conditioning, and heating fuel source. The two examples discussed below account for the slight increase of 0.2% in verified electric energy savings.
  - For hospital space types, the implementation team applied waste heat factors and interactive factors that do not align with assumptions in the IL-TRM V9.0.[13] The evaluation team applied the IL-TRM V9.0 assumptions. This discrepancy occurred in 17 projects with each exhibiting a 107.5% realization rate for electric energy and 80% for electric demand savings.
  - Ex ante calculations for freezer lighting installations applied annual operating hours and coincidence factors from the IL-TRM V9.0 based on the building space type and assumed no positive impact of interactive waste heat factors. The evaluation team applied the assumptions associated with the Freezer Cases space type. This discrepancy minimally affects the SLB offering's performance, increasing savings by 0.2%.
- **Heating, Ventilating, and Air Conditioning (6%, 5%, and 20% of ex ante energy, demand, and gas savings, for the Private Sector, respectively; and 20%, 20%, and 86% of ex ante energy, demand, and gas savings for the Public Sector, respectively):** The gross realization rate for HVAC is 97% for electric energy, 100% for electric demand, and 101% for therm savings.
  - The driving factor behind HVAC's electric energy savings realization rate is the discrepancy between the implementation and evaluation teams' assumptions for the advanced thermostat measure. The evaluation team reviewed the implementer's analysis workbook and confirmed that the algorithms are correctly aligned with the IL-TRM V9.0. The exact source of the discrepancy is unknown.
  - The evaluation team did identify differences in the assumed baseline equipment. In the verified analysis, the baseline cooling and heating efficiencies are derived from the 2015 International Energy Conservation Code (2015 IECC), in coordination with the cooling and heating capacities

[13] *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, Volume 2: Commercial and Industrial Measures*. Section 4.5, Lighting End Use. 2020. pp 466–468

reported in the initiative tracking data. The specific HVAC equipment is not included in initiative tracking data, leading the evaluation team to infer the equipment based on the reported heating fuel. When heating with natural gas, the assumed HVAC system is a central air conditioner (CAC) with a natural gas furnace; when electrically heated, the assumed system is an air source heat pump (ASHP); when the heating fuel is unknown, a blend of the two systems at 97% gas heating and 3% ASHP heating is assumed. The implementation team assumes the baseline HVAC system is a CAC with either an electric resistance furnace, a natural gas furnace, or a blend of the two when heating fuel is unknown. This difference in the baseline HVAC system accounts for a 2.4% reduction in electric energy savings and 0.3% increase in gas savings.

- The slight increase in verified savings for unitary system measures is the product of two minor discrepancies found in the ex ante analysis relating to initiative tracking data errors. In one project, the building type is listed as Public Sector, which was replaced by Emergency Services in the IL-TRM V9.0 update. The building type is necessary to assign the correct effective full load hours (EFLH), which are used in calculating electric energy savings but not demand savings. The evaluation team suspects, but is unable to confirm, that the implementation team updated their algorithms and lookup tables with the new building type terminology but did not catch the use of the former Public Sector building type in this project. This resulted in zero ex ante electric energy savings and is supported by the fact that the project does claim demand savings; EFLH is not a parameter in demand savings calculations. This results in a slight increase of 0.2% to HVAC electric energy savings.
- In two HVAC projects, the evaluation team observed a discrepancy between the unit capacity reported in the initiative tracking data and the codified measure name. The evaluation team confirmed the correct unit capacity and efficiencies through manufacturer specification datasheets and the Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance.[14] Use of the correct parameters slightly increased electric energy savings by 0.1% and electric demand savings by 0.7% for the HVAC offering.
- For storage water heater measures, the implementation team utilizes a formula to calculate savings that is not in alignment with the IL-TRM V9.0. This results in deflated natural gas savings for these measures. Use of the IL-TRM V9.0 formula results in natural gas therm realization rates ranging between 230% and 471%. This discrepancy accounts for a 0.7% increase in therm savings for the HVAC offering.
- For a single high efficiency furnace project, the ex ante savings do not include electric demand or therm savings, even though electric energy savings are claimed and the high efficiency furnace measure is a gas measure. The evaluation team confirmed in the implementation team's tracking database, AMPLIFY, that the project was completed and qualified for electric and natural gas savings. This had a marginal positive impact on overall measure savings.

- **Specialty Equipment (2%, 1%, and 4% of ex ante energy, demand, and gas savings for the Private Sector, respectively; and 1%, 1%, and 3% of ex ante energy, demand, and gas savings for the Public Sector, respectively):** The gross realization rate for SE is 100% for electric energy, 99% for electric demand, and 100% for therm savings.
  - Three projects included compressed air storage receiver tank measures. Savings for this measure are derived from efficiency improvements to the air compressor. The IL-TRM V9.0 includes deemed compressor factor terms, based on baseline and efficient compressor conditions, to assist with estimating energy savings. The initiative tracking data identifies the baseline compressor condition

[14] The Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance contains equipment operational specifications that are certified through the AHRI program and can be accessed at www.ahridirectory.org.

– e.g., load/no load compressor with one gallon/cubic feet per min (CFM) capacity – but does not include the efficient compressor condition. When the efficient compressor condition is unknown, the IL-TRM V9.0 stipulates use of the deemed compressor factor for a load/no load compressor with four gallon/CFM capacity. The evaluation team calculated the inferred efficient compressor factor used in the ex ante calculations and found that, for two projects, the implementation team applied assumptions for a five gallon/CFM capacity compressor and used a compressor factor for a larger horsepower compressor than in the baseline without evidence in initiative tracking data to support either of the assumptions. While the impact to SE electric energy savings is negligible, this discrepancy is noted in the report because it seems to be systematic and can easily be corrected through the provision of efficient compressor conditions in initiative tracking data or better alignment with the IL-TRM guidance in future years.

- **Midstream HVAC (1%, 3%, and 3% of ex ante energy, demand, and gas savings for the Private Sector, respectively; and 1% of ex ante energy, demand, and gas savings for the Public Sector):** The gross realization rate for MHVAC is 94% for electric energy, 100% for electric demand, and 100% for therm savings.
  - Similar to the HVAC offering, advanced thermostats are the driving factor in the realization rates for the MHVAC offering. The evaluation team reviewed the implementer's analysis workbook and confirmed that the algorithms are aligned with the IL-TRM V9.0. Due to the midstream delivery of the program, the advanced thermostat measure employs several key assumptions, including (1) the type of existing thermostat being replaced and (2) HVAC equipment performance characteristics. Differences between ex ante and verified assumptions are discussed below.
    - The underlying assumption in ex ante savings is that the baseline HVAC system consists of a CAC and a blend of 3% electric resistance heating and 97% natural gas heating. The evaluation team assumes that the existing HVAC system is a mix of 3% ASHP and 97% CAC with natural gas heating. The difference in this assumption appears in the assumed heating seasonal performance factor (HSPF). An electric resistance furnace has an HSPF of 3.41, and an ASHP has an IECC code baseline of 8.2. This slightly reduces electric energy and demand savings claimed.
  - Ex ante calculations for Storage Water Heater measures apply a consumption per capacity of 577 gallons/person. The IL-TRM V9.0 provides an estimate of consumption per capacity for different building types, including one labeled "Other Commercial." The value used in the ex ante calculations is an unweighted average of all these values. The evaluation team received and verified building types from site addresses for each project. Where the verified building type did not align with those listed in the IL-TRM V9.0, the evaluation team applied the Other Commercial assumption of 341 gallons/person. This results in a 22% reduction in electric energy and demand savings for this measure. The overall impact on the MHVAC offering is far less at a reduction of 1% to electric energy and <1% to demand.
- **Steam Trap Repair/Replacement (<1% of ex ante energy and 73% of ex ante gas savings for the Private Sector. <1% of ex ante energy and 10% of ex ante gas savings for the Public Sector):** The gross realization rate for STRR is 129% for electric energy and 103% for therm savings.
  - A difference in natural gas therm savings for all STRR projects is observed and is inversely proportional to the system pressure; as system pressures increase, the difference between ex ante and verified savings decreases. The implementation team provided a detailed calculation workbook for one project, which the evaluation team reviewed and from which attempted to reconstruct ex ante savings. The evaluation team narrowed the source of discrepancy to the application of two terms: (1) specific heat of water (Hs) and (2) temperature differential. Upon

further review, the implementation team discovered that the ex ante formula applied the gauge pressure in place of the absolute pressure. This accounted for all of the discrepancy relating to therm savings.

- Verified savings include a small amount of kWh from secondary water supply and wastewater treatment. In a handful of cases where customers do not receive electric service from AIC, the implementation team did not include these impacts in ex ante savings. However, because secondary water supply and wastewater treatment savings occur at a system level, AIC electric service is not required for these savings to be realized, and therefore the verified analysis includes them.

3.1.5 Cumulative Persisting Annual Savings

Table 11 presents CPAS and WAML for 2021 Standard Core. The table also includes a summary of the measure-specific and total verified gross savings for Standard Core, as well as CPAS in 2021–2024 and 2030.[15] The WAML for Standard Core is 13.1 years.

Table 11. 2021 Standard Initiative – Core CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	…	2030	…	
SLB	12.5	24,355	0.839	20,439	20,439	20,410	20,259	…	17,443	…	242,976
VSDs	15.0	8,204	0.833	6,835	6,835	6,835	6,835	…	6,835	…	102,531
HVAC	13.7	3,106	0.685	2,126	2,126	2,126	2,116	…	2,101	…	30,014
MHVAC	11.3	443	0.881	390	390	390	390	…	390	…	4,403
SE	12.8	619	0.849	525	525	525	525	…	525	…	8,158
STRR	6.0	14	0.608	9	9	9	9	…	0	…	53
2021 CPAS		**36,741**	**0.825**	**30,325**	**30,325**	**30,296**	**30,135**	**…**	**27,294**	**…**	**388,135**
Expiring 2021 CPAS				**0**	**0**	**29**	**161**	**…**	**1,895**	**…**	
Expired 2021 CPAS				**0**	**0**	**29**	**190**	**…**	**3,030**	**…**	
WAML	**13.1**										

[15] For further detail, including achieved CPAS in years not presented in this table, please see Appendix C.

3.1.6 Conclusions and Recommendations

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

- **Key Finding #1:** MHVAC utilizes generalized assumptions to fill gaps in site-specific data due to the program's midstream delivery. This results in several discrepancies between the verified and ex ante analysis assumptions.
  - **Recommendation:** We recommend that the implementation and evaluation teams align assumptions where the IL-TRM V9.0 does not offer guidance. We also recommend that both teams collaborate in the Illinois Technical Advisory Committee (TAC) to develop prescriptive assumptions for inclusion in the IL-TRM V11.0. These actions will improve realization rates in future years, which becomes increasingly important as AIC moves toward more midstream measure offerings.
- **Key Finding #2:** The evaluation team observed several instances where ex ante calculations and assumptions are not aligned with the IL-TRM V9.0. For example, formulas used in STRR and Storage Water Heater measures are not the same as those stipulated in the TRM.
  - **Recommendation:** To minimize risk at evaluation, we recommend that the implementation team review the algorithms and assumptions within AMPLIFY for potential mischaracterizations or misalignments with the IL-TRM V10.0 for the upcoming program year.

3.2 Standard Initiative – Small Business Direct Install

3.2.1 Initiative Description

The Small Business Direct Install (SBDI) channel of the Standard Initiative provides small commercial customers with electric energy saving opportunities by offering a free energy assessment and a simplified process for installing rebated measures. SBDI incentives are paid directly to AIC Business Program allies, which improves the customer's experience through a streamlined transaction at the time of installation with minimal out-of-pocket costs. Many projects are fully funded through SBDI incentives and require no out-of-pocket contribution by the customer.

Summary of Key Implementation Changes in 2021

During 2021, the SBDI channel made the following design and implementation changes relative to 2020:

- The SBDI channel began to offer new refrigeration measures with the goal of broadening the work scope available to SBDI customers beyond lighting.
- After offering an early completion bonus (ECB) for SBDI projects in 2019 and 2020, the SBDI channel removed ECBs in 2021.
- The SBDI channel incrementally increased incentives on 11 lighting measures, many of which are high participation measures. These increases were intended to offset the loss of ECBs, as well as to offset material cost increases due to the effects of the COVID-19 pandemic on raw materials and supply chain processes, costs, and lead times.

3.2.2 Participation Summary

Table 12 presents participation and ex ante gross savings estimates for SBDI in 2021. We present these data separated by public and private sectors to provide context as to the primary drivers of participation. Altogether, the SBDI channel reported a total of 103,701 MWh and 15.69 MW in ex ante gross savings.

Table 12. 2021 Standard Initiative – SBDI Participation Summary

IL-TRM Measure Name	Total Projects	Ex Ante Gross Savings		
		MWh	MW	Therms
Private Sector				
LED Bulbs & Fixtures	2,607	80,497	12.18	0
ECMs for Walk-In and Reach-In Coolers/Freezers	373	4,632	0.53	0
Door Heater Controls for Cooler or Freezer	180	3,131	0.00	0
Fluorescent Delamping	67	978	0.21	0
Evaporator Fan Control for Electrically Commutated Motors	349	782	0.09	0
Lighting Controls	103	318	0.26	0
Automatic Door Closer for Walk-In Coolers and Freezers	143	287	0.04	0
Exit Signs	96	142	0.01	0
Beverage and Snack Machine Controls	15	74	0.00	0
Q-Sync Motors for Walk-In and Reach-In Coolers/Freezers	3	53	0.01	0
Private Sector Subtotal[a]	*2,872*	*90,894*	*13.33*	*0*
Public Sector				
LED Bulbs and Fixtures	384	12,651	2.25	0
ECMs for Walk-In and Reach-In Coolers/Freezers	1	6	0.00	0
Door Heater Controls for Cooler or Freezer	0	0	0.00	0
Fluorescent Delamping	3	10	0.00	0
Evaporator Fan Control for Electrically Commutated Motors	1	2	0.00	0
Lighting Controls	16	104	0.10	0
Automatic Door Closer for Walk-In Coolers and Freezers	0	0	0.00	0
Exit Signs	17	29	0.00	0
Beverage and Snack Machine Controls	2	4	0.00	0
Q-Sync Motors for Walk-In and Reach-In Coolers/Freezers	0	0	0.00	0
Public Sector Subtotal[a]	*385*	*12,807*	*2.36*	*0*
Total[a]	**3,257**	**103,701**	**15.69**	**0**

[a] Numbers do not add to total due to projects implementing measures in multiple measure categories.

3.2.3 Initiative Annual Savings Summary

Table 13 presents the annual savings achieved in 2021 from the SBDI channel and shows that this offering achieved 94,157 MWh and 14.24 MW in verified net savings.

Table 13. 2021 Standard Initiative – SBDI Annual Savings

	Electric Energy Savings (MWh)	Electric Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	103,701	15.69	0
Gross Realization Rate	100%	100%	N/A
Verified Gross Savings	103,675	15.68	0
NTGR	0.908	0.908	N/A
Verified Net Savings	94,157	14.24	0

3.2.4 Initiative Savings Detail

The SBDI channel distributed 439,634 measures in 2021, as shown in Table 14.

Table 14. 2021 Standard Initiative – SBDI Participation Summary by Measure

IL-TRM Measure Name	Measure Quantity	Units	Ex Ante Gross MWh	Ex Ante Gross MW	Ex Ante Gross Therms
LED Bulbs and Fixtures	417,909	Fixtures	93,148	14.43	0
ECMs for Walk-In and Reach-In Coolers/ Freezers	4,369	Motors	4,638	0.53	0
Door Heater Controls for Cooler or Freezer	2,659	Controls	3,131	0.00	0
Evaporator Fan Control for Electrically Commutated Motors	7,878	Controls	988	0.21	0
Fluorescent Delamping	974	Fixtures	784	0.09	0
Lighting Controls	4,778	Controls	422	0.36	0
Automatic Door Closer for Walk-In Coolers and Freezers	228	Door Closers	287	0.04	0
Exit Signs	657	Exit Signs	171	0.02	0
Q-Sync Motors for Walk-In and Reach-In Coolers/Freezers	64	Motors	78	0.00	0
Beverage and Snack Machine Controls	118	Controls	53	0.01	0
Total	**439,634**		**103,701**	**15.69**	**0**

Note: Totals may not sum due to rounding.

The following tables present the ex ante and verified electric energy and electric demand savings for the SBDI channel, and are followed by a discussion of key reasons for discrepancies between the claimed (ex ante) and verified gross savings.

The SBDI channel achieved a 100% realization rate for gross electric energy savings. The majority of net savings are from LED fixtures (90% of savings), followed by electronically commutated motors (ECMs) for walk-in and reach-in coolers and freezers (4% of savings), and, finally, door heater controls for coolers and freezers (3% of savings). Year-over-year electric energy savings since 2020 showed a 3% increase for the SBDI channel. Table 15 summarizes the 2021 electric energy savings for SBDI.

Table 15. 2021 Standard Initiative – SBDI 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 Bulbs and Fixtures	93,148	100%	93,122	0.908	84,573
ECMs for Walk-In and Reach-In Coolers/Freezers	4,638	100%	4,638	0.908	4,213
Door Heater Controls for Cooler or Freezer	3,131	100%	3,131	0.908	2,843
Fluorescent Delamping	988	100%	988	0.908	898
Evaporator Fan Control for Electrically Commutated Motors	784	100%	784	0.908	712
Lighting Controls	422	100%	422	0.908	384
Automatic Door Closer for Walk-In Coolers and Freezers	287	100%	287	0.908	261
Exit Signs	171	100%	171	0.908	156
Beverage and Snack Machine Controls	78	100%	78	0.908	71
Q-Sync Motors for Walk-In and Reach-In Coolers/Freezers	53	100%	53	0.908	48
Total	**103,701**	**100%**	**103,675**	**0.908**	**94,157**

The SBDI channel achieved a 100% realization rate for gross demand savings. The majority of net savings are from LED fixtures (92% of savings), followed by electronically commutated motors (ECMs) for walk-in and reach-in coolers and freezers (3% of savings), and, finally, lighting controls (2% of savings). Year-over-year electric demand savings since 2020 showed a 5% increase for the SBDI channel. Table 16 summarizes the 2021 electric demand savings for the SBDI channel.

Table 16. 2021 Standard Initiative – SBDI 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 Bulbs and Fixtures	14.43	100%	14.42	0.908	13.10
ECMs for Walk-In and Reach-In Coolers/Freezers	0.53	100%	0.53	0.908	0.48
Door Heater Controls for Cooler or Freezer	0.00	N/A	0.00	N/A	0.00
Fluorescent Delamping	0.21	100%	0.21	0.908	0.19
Evaporator Fan Control for Electrically Commutated Motors	0.09	100%	0.09	0.908	0.08
Lighting Controls	0.36	100%	0.36	0.908	0.32
Automatic Door Closer for Walk-In Coolers and Freezers	0.04	100%	0.04	0.908	0.04
Exit Signs	0.02	125%	0.02	0.908	0.02
Beverage and Snack Machine Controls	0.00	N/A	0.00	N/A	0.00
Q-Sync Motors for Walk-In and Reach-In Coolers/Freezers	0.01	100%	0.01	0.908	0.01
Total	**15.69**	**100%**	**15.68**	**0.908**	**14.24**

The following discussion highlights the primary drivers behind the realization rates for the SBDI Offering observed by the evaluation team.

- **LED Bulbs & Fixtures (89% of ex ante energy and 91% of ex ante demand savings for the Private Sector; and 99% of ex ante energy and 95% of ex ante demand savings for the Public Sector):** The gross realization rate for LED Bulbs & Fixtures is 100% for electric energy and demand savings.
  - The Initiative tracking data lists multifamily common area as the building/space type for 60 LED fixture records. The IL-TRM V9.0 includes waste heat factors (WHFs), annual hours of use (HOU), and coincidence factors (CF) for high-rise and mid-rise multifamily buildings. The evaluation team assumes that all records with the multifamily common area label are mid-rise multifamily buildings because additional details are not included in tracking data. The implementer assumes a high-rise multifamily building for five records (<0.1% of records). This results in a minimal decrease in verified electric energy and demand savings.
  - The Initiative tracking data lists hospital as the building/space type for five records (<0.1% of records). The IL-TRM V9.0 includes WHFs, annual HOU, and CFs for hospitals with and without economizers. Because initiative tracking data do not include details on HVAC systems, the evaluation team applies the more conservative hospital with economizer building type and assumptions from the TRM. Conversely, the implementer applies the hospital without economizer building type and assumptions. This results in a negligible decrease in verified electric energy and demand savings.
- **Exit Signs (<1% of ex ante energy and <1% of ex ante demand savings for the Private Sector; <1% of ex ante energy savings for the Public Sector):** The gross realization rate for exit signs is 100% for electric energy savings and 125% for demand savings.
  - Exit signs have a CF of 1.0 regardless of building type, per Section 4.5.5 of the IL-TRM V9.0. The implementer applies a CF based on building type, which is less than 1 in all cases, for 51 exit sign records (43% of records). This results in increased verified demand savings.
  - Exit signs operate continuously (8,766 hours per year). The implementer applies the annual HOU based on building type for three exit sign records (3% of records). This leads to a marginal decrease in verified electric energy savings (<0.4%).

3.2.5 Cumulative Persisting Annual Savings

Table 17 presents 2021 CPAS and WAML for the SBDI channel. The table also includes a summary of the measure-specific and total verified gross savings for the offering, as well as CPAS in 2021–2024 and 2030.[16] The WAML for the SBDI channel is 13.4 years.

Table 17. 2021 Standard Initiative – SBDI CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS –Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	…	2030	…	
LED Bulbs and Fixtures	13.5	93,122	0.908	84,573	84,573	84,039	80,645	…	72,314	…	992,226
ECMs for Walk-In and Reach-In Coolers/Freezers	15.0	4,638	0.908	4,213	4,213	4,213	4,213	…	4,213	…	63,190
Door Heater Controls for Cooler or Freezer	10.0	3,131	0.908	2,843	2,843	2,843	2,843	…	2,843	…	28,432
Fluorescent Delamping	11.0	988	0.908	898	898	898	898	…	898	…	9,874
Evaporator Fan Control for Electrically Commutated Motors	13.0	784	0.908	712	712	712	712	…	712	…	9,253
Lighting Controls	10.0	422	0.908	384	384	384	384	…	384	…	3,836
Automatic Door Closer for Walk-In Coolers and Freezers	8.0	287	0.908	261	261	261	261	…	0	…	2,087
Exit Signs	5.0	171	0.908	156	156	156	156	…	0	…	778
Beverage and Snack Machine Controls	5.0	78	0.908	71	71	71	71	…	0	…	355
Q-Sync Motors for Walk-In and Reach-In Coolers/Freezers	10.0	53	0.908	48	48	48	48	…	48	…	479
2021 CPAS		**103,675**	**0.908**	**94,157**	**94,157**	**93,624**	**90,230**	**…**	**81,411**	**…**	**1,110,512**
Expiring 2021 CPAS				**0**	**0**	**534**	**3,394**	**…**	**2,253**	**…**	
Expired 2021 CPAS				**0**	**0**	**534**	**3,928**	**…**	**12,746**	**…**	
WAML	**13.4**										

[16] For further detail, including achieved CPAS in years not presented in this table, please see Appendix C.

3.2.6 Conclusions and Recommendations

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

- **Key Finding #1:** While the implementation team applied parameters from actual data in calculating savings, they did not provide these data in their data extract for a select set of measures. For example, the implementation team distinguished between high-rise and mid-rise multifamily buildings for LED fixtures, but they only provided the multifamily common area building type label to the evaluation team.
  - **Recommendation:** Include all parameters in the data extract that are applied in ex ante savings calculations. When these data are not made available to the evaluation team, the verified analysis must make assumptions that often disagree with the parameters applied by the implementation team. This will help the evaluation team identify issues earlier in the year and improve overall program realization rates.

3.3 Standard Initiative – Instant Incentives and Online Store

3.3.1 Initiative Description

The Online Store channel within the Standard Initiative provides a convenient e-commerce alternative to purchasing energy-efficient technologies (e.g., LEDs, occupancy sensors, advanced thermostats, and advanced power strips). It also serves as a resource for educating customers about the benefits of energy-efficient products. The target market is small business customers, although the Online Store is available to all business customers. The Instant Incentives channel is a midstream channel within the Standard Initiative that provides discounts at the point of sale, and covers a variety of standard, specialty, and linear LEDs, as well as a number of non-lighting measures in 2021.

Summary of Key Implementation Changes in 2021

During 2021, the Instant Incentives and Online Store channels made the following design and implementation changes relative to 2020:

- AIC offered a promotion to small businesses and commercial buildings of “back to work” bundles with advanced power strips, connected LEDs, and desk lamp equipment.

3.3.2 Participation Summary

Table 18 presents participation and ex ante gross savings estimates for the Instant Incentives and Online Store channels in 2021. We present these data separated by public and private sectors to provide context to the primary drivers of participation. Altogether, the Instant Incentives and Online Store channels reported a total of 41,209 MWh, 9.72 MW, and 36,192 therms in ex ante gross savings.

Table 18. 2021 Standard Initiative – Instant Incentives and Online Store Participation Summary

Channel	Total Projects	Ex Ante Gross Savings		
		MWh	MW	Therms
Private Sector				
Instant Incentives[a]	372	22,733	5.36	0
Online Store	241	688	0.13	35,195
Private Sector Subtotal	*613*	*23,421*	*5.49*	*35,195*
Public Sector				
Instant Incentives[a]	184	17,764	4.23	0
Online Store	13	24	0.01	997
Public Sector Subtotal	*197*	*17,788*	*4.23*	*997*
Total	**810**	**41,209**	**9.72**	**36,192**

[a] Reported ex ante gross savings for Instant Incentives in Table 18 represent savings from 2021 sales only and do not include carryover savings.

3.3.3 Initiative Annual Savings Summary

Table 19 presents the annual savings achieved in 2021 from the Instant Incentives and Online Store channels and shows that these offerings achieved 32,797 MWh, 7.81 MW, and 32,419 therms in verified net savings.

Table 19. 2021 Standard Initiative – Instant Incentives and Online Store Annual Savings

	Electric Energy Savings (MWh)	Electric Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	41,209	9.72	36,192
Gross Realization Rate	100%	101%	102%
Verified Gross Savings	41,167	9.79	36,839
NTGR	0.797	0.798	0.880
Verified Net Savings	32,797	7.81	32,419

3.3.4 Initiative Savings Detail

The Standard Initiative's Instant Incentives and Online Store channels distributed 807,777 measures as shown in Table 20.

Table 20. 2021 Standard Initiative - Instant Incentives and Online Store Participation Summary by Measure

Measure Category	Measure Quantity	Ex Ante Gross MWh	Ex Ante Gross MW	Ex Ante Gross Therms
Instant Incentives Offering				
Linear LED	785,340	34,985	8.35	0
Specialty LED	21,166	5,512	1.23	0
Instant Incentives Subtotal	*806,506*	*40,497*	*9.58*	*0*
Online Store Offering				
Advanced Thermostats	361	483	0.08	36,192
Lighting	817	206	0.04	0
Lighting Controls	76	22	0.02	0
Advanced Power Strips	17	2	0.00	0
Online Store Subtotal	*1,271*	*712*	*0.14*	*36,192*
Total	**807,777**	**41,209**	**9.72**	**36,192**

The following tables present the ex ante and verified electric energy, electric demand, and gas savings for the Instant Incentive and Online Store channels, and are followed by a discussion of key reasons for discrepancies between the claimed (ex ante) and verified gross savings.

The Instant Incentives channel achieved a 100% realization rate for gross electric energy savings. The majority of savings (87%) are from linear LED measures. The Online Store channel achieved a 94% electric energy realization rate, in large part due to discrepancies in the advanced thermostat measure, which accounts for 65.8% of savings. Lighting and lighting controls account for 34% of verified gross energy savings, with advanced power strips accounting for 0.3%. Year-over-year electric energy savings since 2020 showed a 15% increase for the Instant Incentives channel and a 91% increase for the Online Store channel. Table 21 summarizes the electric energy savings for the Instant Incentives and Online Store channels.

Table 21. 2021 Standard Initiative – Instant Incentives and Online Store Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Verified Gross Savings (MWh)	NTGR	Verified Net Savings (MWh)
Instant Incentives					
Linear LED	34,985	100%	34,985	0.813	28,450
Specialty LED	5,512	100%	5,512	0.670	3,694
Instant Incentives Subtotal	*40,497*	*100%*	*40,497*	*0.794*	*32,144*
Online Store					
Advanced Thermostats	483	91%	441	0.880	388
Lighting	206	100%	206	1.156	238
Lighting Controls	22	100%	22	1.156	25
Advanced Power Strips	2	100%	2	1.156	2
Online Store Subtotal	*712*	*94%*	*670*	*0.974*	*653*
Total	**41,209**	**100%**	**41,167**	**0.797**	**32,797**

The Instant Incentives channel achieved a 100% realization rate for demand savings. The majority of savings (87%) are from linear LEDs. The Online Store channel achieved a 150% realization rate for demand, largely attributed to discrepancies in the advanced thermostat measure, which accounts for 74% of savings. Lighting

and lighting control measures accounted for the remainder of savings, as advanced power strips do not contribute to demand savings. Year-over-year demand savings since 2020 showed a 16% increase for the Instant Incentives channel and an 82% increase for the Online Store channel. Table 22 summarizes the demand savings for the Instant Incentives and Online Store channels.

Table 22. 2021 Standard Initiative – Instant Incentives and Online Store Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)	Gross Realization Rate	Verified Gross Savings (MW)	NTGR	Verified Net Savings (MW)
Instant Incentives					
Linear LED	8.35	100%	8.35	0.813	6.79
Specialty LED	1.23	100%	1.23	0.670	0.83
Instant Incentives Subtotal	*9.58*	*100%*	*9.58*	*0.795*	*7.62*
Online Store					
Adv. Thermostat	0.08	182%	0.15	0.880	0.13
Lighting	0.04	100%	0.04	1.156	0.04
Lighting Controls	0.02	100%	0.02	1.156	0.02
Online Store Subtotal	*0.14*	*150%*	*0.20*	*0.951*	*0.19*
Total	**9.72**	**101%**	**9.79**	**0.798**	**7.81**

The Online Store channel achieved a realization rate of 102% for gas savings. Lighting, lighting controls, and advanced power strip measures did not contribute to gas savings. Online Store advanced thermostats saw a 51% increase in gas savings in 2021 compared to 2020. Table 23 summarizes the gas savings for the Online Store channel.

Table 23. 2021 Standard Initiative – Online Store Gas Savings by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Online Store					
Advanced Thermostats	36,192	102%	36,839	0.880	32,419
Total	**36,192**	**102%**	**36,839**	**0.880**	**32,419**

The following discussion highlights the prominent drivers of the realization rates for the Instant Incentives and Online Store channels.

Instant Incentives

The overall gross realization rate for the Instant Incentives channel is 100% for electric energy and demand savings. There are no notable discrepancies between ex ante and verified savings.

Online Store

- **Advanced Thermostat (68%, 57%, and 100% of ex ante energy, demand, and gas savings for the Online Store Offering, respectively):** The gross realization rate for advanced thermostats is 91% for electric energy, 182% for electric demand, and 102% for gas savings.
  - The evaluation team identified differences in the assumed baseline equipment between the ex ante and verified analyses. We infer the HVAC system based on the heating fuel in the initiative

tracking data and derive the baseline cooling and heating efficiencies from the 2015 IECC. The assumed verified baseline is either a CAC with natural gas furnace when heating with natural gas, an air source heat pump (ASHP) for electrically heated buildings, or a blend of these two systems when heating fuel is unknown.

All advanced thermostat records within the Online Store channel are tracked as having natural gas heating. Therefore, the evaluation team applies a 14 Seasonal Energy Efficiency Ratio (SEER) baseline CAC for all records. The implementation team assumes a 13 SEER baseline ASHP for 6 records (3% of records) and a 14 SEER baseline CAC for all remaining records. This results in a small decrease in verified electric energy and demand savings.

- All advanced thermostat records list natural gas as the heating fuel in the initiative tracking data. As a result, the evaluation team quantifies savings based on 100% natural gas heating, as this is a known input tracked by the implementation team. The implementation team applies the IL-TRM V9.0 default assumption when heating fuel is unknown (97% gas heating; 3% electric heating) for 18 records (8% of records).17 The evaluation team cannot confirm the source of this assumption, which is contrary to the initiative tracking data. For 64 records (28% of records), the implementation team overestimates heating by applying a heating fuel mix of 100% gas heating and 3% electric heating, which we corrected in the verified analysis. This decreased verified electric energy and demand savings and increased verified gas savings.
- The implementation team does not report demand savings for 87 records (38% of records), despite the initiative tracking data indicating that the buildings have central cooling. The evaluation team awards demand savings for all buildings with central cooling. This results in an increase in verified demand savings.
- The implementation team applies the Pennsylvania–New Jersey–Maryland (PJM) Interconnection coincidence factor (0.239) for 78 records (34% of records) and the system summer peak coincidence factor (0.457) for all remaining records.[18] The verified analysis applies the system summer peak coincidence factor for all records, in accordance with the IL-TRM V9.0. This results in an increase in verified demand savings.

[17] 2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0 *Volume 3: Commercial and Industrial Measures.*

[18] CFs are defined based on Illinois' two electrical control areas, the PJM Interconnection, and the Midcontinent Independent System Operator (MISO). AIC is a part of MISO and therefore applies the system summer peak CF rather than the PJM CF.

3.3.5 Cumulative Persisting Annual Savings

Table 24 and Table 25 present 2021 CPAS and WAML for the Instant Incentives and Online Store channels, respectively. The tables also include a summary of the measure-specific and total verified gross savings for the channels, as well as CPAS in 2021–2024 and 2030.[19] The WAML for the channels are 14.2 and 9.5 years, respectively.

Table 24. 2021 Standard Initiative – Instant Incentives CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	...	2030	...	
Linear LED	14.9	34,985	0.813	28,450	28,450	28,450	28,450	...	28,450	...	420,978
Specialty LED	9.7	5,512	0.670	3,694	3,694	3,694	3,694	...	1,582	...	34,406
2021 CPAS		**40,497**	**0.794**	**32,144**	**32,144**	**32,144**	**32,144**	**...**	**30,031**	**...**	**455,384**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**...**	**0**	**...**	
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**...**	**2,112**	**...**	
WAML	**14.2**										

Table 25. 2021 Standard Initiative – Online Store CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	...	2030	...	
Advanced Thermostats	11.0	441	0.880	388	388	388	388	...	388	...	4,269
Lighting	6.2	206	1.156	238	238	237	230	...	5	...	1,217
Lighting Controls	10.0	22	1.156	25	25	25	25	...	25	...	252
Advanced Power Strips	7.0	2	1.156	2	2	2	2	...	0	...	15
2021 CPAS		**670**	**0.974**	**653**	**653**	**652**	**645**	**...**	**419**	**...**	**5,754**
Expiring 2021 CPAS				**0**	**0**	**1**	**7**	**...**	**3**	**...**	
Expired 2021 CPAS				**0**	**0**	**1**	**8**	**...**	**234**	**...**	
WAML	**9.5**										

[19] For further details, including achieved CPAS in years not presented in this table, please see Appendix C.

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 Standard Initiative's Instant Incentives and Online Store channels moving forward:

- **Key Finding #1:** Both the implementation team and the evaluation team assumed a manual thermostat baseline in accordance with the IL-TRM V9.0 definition of baseline thermostats. The advanced thermostat measure in IL-TRM V10.0 (section 4.4.48) updates the baseline equipment to allow for either a manual or a programmable thermostat baseline and provides adjustment factors to savings when the baseline is unknown.
  - **Recommendation:** For the Online Store channel, we recommend collecting information from applicants on the existing thermostat. If this is not feasible, we recommend instead applying the unknown baseline assumptions. This will align ex ante savings with the IL-TRM V10.0 updates and further improve realization rates for advanced thermostat measures.
- **Key Finding #2:** Ex ante assumptions do not align with information in the initiative tracking data in certain scenarios. For example, the implementation team assumes an unknown heating fuel despite the program tracking data listing natural gas furnaces for all Online Store advanced thermostat records. Furthermore, every advanced thermostat record is listed as being within a cooled building, but no information is provided on the cooling equipment; the implementation team applied a mix of ASHPs and CACs as the baseline cooling equipment. These findings suggest that the heating fuel is inconsistently tracked in the data.
  - **Recommendation:** Ensure that QA/QC protocols are in place to improve the quality and accuracy of information in the initiative tracking data.
- **Key Finding #3:** The IL-TRM V9.0 and V10.0 do not provide information on what baseline heating and cooling equipment to assume for advanced thermostats when the heating and cooling equipment is unknown.
  - **Recommendation:** We recommend that the implementation and evaluation teams align their baseline assumptions where the IL-TRM does not offer guidance. Furthermore, we recommend that both teams collaborate in the Illinois TAC to develop baseline assumptions for inclusion in the IL-TRM V11.0.

3.4 Custom Initiative

3.4.1 Initiative Description

The Custom Initiative offers incentives to AIC Business Program customers for energy efficiency projects involving equipment not covered through other AIC initiatives. The Custom Initiative allows customers to propose additional measures and tailor projects to the specific needs of their facilities. It also provides an avenue for piloting new measures prior to incorporating them into the Standard Initiative.

Business customers often represent the highest potential for energy savings, but these savings frequently result from highly specialized equipment designed for particular industries or types of facilities. The Custom Initiative allows customers to propose additional measures and tailor projects to their facility and equipment needs.

The Custom Initiative is delivered to customers though several different offerings. Two core offerings provide all the savings claimed through the Initiative:

- The Custom Incentives (or "Core Custom") offering provides incentives for electric and gas measures not incented through other AIC offerings. Some examples of common Custom Incentives measures include compressed air improvements, energy management systems (EMS), and industrial process measures, including heat recovery, process heat, and improvements to steam systems.
- The New Construction Lighting offering offers additional incentives for lighting measures in new construction projects.

Additionally, AIC offers a number of smaller "incubator" offerings through the Custom Initiative, including Metering and Monitoring, Strategic Energy Management (SEM), Feasibility Studies, Staffing Grants, and Competitive Large Incentive Project (CLIP) offerings. These offerings typically serve the purpose of engaging AIC's business customers more deeply with energy efficiency and typically do not yield savings.

Summary of Key Implementation Changes in 2021

AIC made a number of changes to the Custom Initiative during the 2021 program year:

- AIC maintained a focus on getting more savings from the Custom Initiative by offering the CLIP incentives. After running two rounds of the CLIP offering in 2020, a new CLIP offer was announced during the second quarter of 2021 that was intended to build the 2022 Custom projects pipeline.
  - AIC continued to move from the Staffing Grant offering that has been offered over the last few program years into this new CLIP offering.
- AIC changed several incentive structures:
  - AIC set the incentives for small business and public sector customers higher in order to help them overcome their financial barriers and complete more custom projects.
  - AIC decreased gas incentives in 2021 due to a reduced gas budget within the Business Program.
  - AIC increased incentives by up to 14% for New Construction projects to gain additional participation.
- AIC continued to incentivize ground source heat pumps (geothermal) in 2021, following the completion of the 2020 pilot offering.

- AIC continued to offer the building energy assessment for public sector customers in order to provide a performance incentive.
- AIC continued to offer the new Agricultural Audit offering after its launch in late 2020.

3.4.2 Participation Summary

Table 26 presents a summary of the projects completed and unique customers treated through each Custom Initiative offering.

Table 26. 2021 Custom Initiative Participation Summary

Offering	Total Projects/ Grants/ Participants	Unique Customers[a]	Ex Ante Gross Savings [b]		
			MWh	MW	Therms
Custom Incentives	104	90	50,247	8.1	1,158,210
New Construction Lighting	37	37	4,105	0.9	–
Feasibility Study	16	15	–	–	–
Agricultural Energy Audit	11	11	–	–	–
Strategic Energy Management	10	10	–	–	–
Staffing Grant	6	0	–	–	–
Building Energy Assessment	5	5	–	–	–
Metering and Monitoring	2	2	–	–	–
Total	**191**	**170**	**54,352**	**9.0**	**1,158,210**

[a] Column does not sum to total because some unique customers participated in more than one different Custom offering.
[b] Column may not sum to total because of rounding.

Since public sector customers became eligible for AIC initiatives during the Transition Period,[20] they have continued to contribute significantly to the Custom Initiative overall project mix. This program year, it follows that there would be even more growth in the public sector compared to the private sector because of the increased incentives AIC implemented to help these customers overcome the financial barriers they often face. Public sector customers were responsible for 15% of the total Initiative projects completed in 2021. Table 27 summarizes participation by sector.

Table 27. 2021 Custom Initiative Participation Summary by Sector

Offering	Total Projects/Grants/Participants	
	Private Sector	Public Sector
Custom Incentive	74	30
New Construction Lighting	29	8
Feasibility Study	15	1
Agricultural Energy Audit	11	0
Metering and Monitoring	2	0
Strategic Energy Management	9	1
Building Energy Assessment	3	2
Staffing Grant	2	4
Total	**145**	**46**

[20] The Transition Period was a partial program year that ran from June 1, 2017 through December 31, 2017.

Prior to the start of the program year, AIC planned for large electric accounts to be the primary target of the Custom Initiative. AIC reviewed the breakdown of the top 1,000 electric customers by sector and found that those sectors with the largest potential were within the industrial, medical, and educational sectors. As a result, those sectors were chosen to be the primary target for energy advisors, marketing, and other outreach staff. Analysis of the Initiative tracking data shows that completed projects aligned with these targets; the highest percentage of completed Custom projects with positive savings (27%) were completed by businesses from the manufacturing/industrial sectors, followed by the educational sector (23%), and, finally, the medical sector (14%) (Table 28).

Table 28. 2021 Custom Initiative Projects by Organization Type

Organization Type	Share of Total Projects/Grants/ Participants [a] (n=134)
Manufacturing/Industrial	27%
Educational	23%
Medical	14%
Retail	10%
Warehouse	8%
Office	6%
Municipality	4%
Grocery	4%
Other/Unknown	1%
Multifamily	1%
Religious	1%

[a] These counts do not include Custom projects that did not produce savings.

3.4.3 Initiative Annual Savings Summary

Table 29 presents the annual savings achieved by the Custom Initiative in 2021, which totaled 38,768 MWh, 6.69 MW, and 797,482 therms in verified net savings.

Table 29. 2021 Custom Annual Savings

	Electric Energy Savings (MWh)	Electric Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	54,352	9.01	1,158,210
Gross Realization Rate	87%	90%	73%
Verified Gross Savings	47,151	8.14	849,741
NTGR	0.822	0.822	0.939
Verified Net Savings	38,768	6.69	797,482

For gross impact results, at the 90% confidence level, we achieved a relative precision of 7.6% for electric energy savings, 8.2% for electric demand savings, and 8.3% for gas savings. Further detail on our methodology for Custom Initiative sampling is provided in Appendix A.

3.4.4 Initiative Savings Detail

For the Custom Initiative, we verified initiative participation and gross impacts through desk reviews and on-site M&V of a sample of projects, as described in Appendix A. Site-specific M&V was conducted in three distinct waves with samples independently developed for each wave by fuel type (electric or gas). We used a combined ratio estimator to develop a realization rate for each wave by savings type (presented later in this chapter).

Site-Specific Results

Table 30 presents the results of the gross savings analysis for the 44 Custom Initiative projects we reviewed in 2021. Realization rates for individual projects ranged from 0% to 122% for electric energy and 0% to 194% for gas. Additional details for 18 selected project reviews are provided in Appendix D to this report.

Table 30. 2021 Custom Initiative Gross Impact Results for Sampled Projects

Project ID	Sample			Ex Ante Gross Savings			Gross Realization Rate			Verified Gross Savings		
	Wave	Fuel	Stratum	MWh	MW	Therms	MWh	MW	Therms	MWh	MW	Therms
1901309	3	Electric	1	155	0.018	0	0%	0%	N/A	0	0.000	0
2000158	1	Electric	3	447	0.054	0	54%	122%	N/A	240	0.066	0
2000260	1	Both	*	869	0.093	96,042	100%	100%	100%	869	0.093	96,042
2000261	1	Both	*	638	0.048	54,061	98%	98%	98%	622	0.048	53,249
2000305	3	Electric	4	6,181	0.587	0	64%	62%	N/A	3,944	0.366	0
2000349	3	Gas	2	0	0.000	23,571	N/A	N/A	55%	0	0.000	12,907
2000353	1	Electric	3	566	0.066	0	64%	79%	N/A	364	0.052	0
2000915	1	Electric	3	297	0.022	0	38%	41%	N/A	112	0.009	0
2001035	3	Gas	2	0	0.000	26,300	N/A	N/A	46%	0	0.000	12,144
2001135	1	Electric	3	427	0.065	0	60%	62%	N/A	256	0.040	0
2001142	2	Gas	2	0	0.000	18,074	N/A	N/A	114%	0	0.000	20,691
2001187	2	Gas	3	0	0.000	20,394	N/A	N/A	100%	0	0.000	20,394
2001261	3	Gas	2	0	0.000	20,466	N/A	N/A	87%	0	0.000	17,880
2001321	3	Gas	3	0	0.000	66,734	N/A	N/A	41%	0	0.000	27,236
2001387	1	Electric	3	567	0.072	0	114%	100%	N/A	645	0.072	0
2001645	2	Electric	3	5,428	1.239	0	122%	136%	N/A	6,649	1.688	0
2010005	1	Electric	1	27	0.009	0	95%	100%	N/A	25	0.009	0
2100014	2	Both	*	1,489	0.000	21,971	109%	N/A	38%	1,617	0.000	8,418
2100015	2	Electric	4	10,358	1.963	0	100%	100%	N/A	10,358	1.963	0
2100017	2	Gas	4	0	0.000	78,559	N/A	N/A	54%	0	0.000	42,690
2100018	1	Both	*	826	0.000	104,614	103%	N/A	62%	847	0.000	64,690
2100019	1	Both	*	95	0.000	27,650	99%	N/A	57%	93	0.000	15,628
2100020	3	Gas	1	0	0.000	4,890	N/A	N/A	38%	0	0.000	1,836
2100027	3	Gas	3	0	0.000	134,316	N/A	N/A	100%	0	0.000	134,316
2100034	2	Gas	2	0	0.000	12,161	N/A	N/A	100%	0	0.000	12,161
2100054	1	Both	*	324	0.037	43,828	40%	29%	0%	128	0.011	0
2100062	1	Gas	2	0	0.000	11,781	N/A	N/A	100%	0	0.000	11,781
2100085	2	Electric	1	27	0.006	0	97%	100%	N/A	26	0.006	0

Project ID	Sample			Ex Ante Gross Savings			Gross Realization Rate			Verified Gross Savings		
	Wave	Fuel	Stratum	MWh	MW	Therms	MWh	MW	Therms	MWh	MW	Therms
2100088	1	Electric	1	82	0.009	0	100%	100%	N/A	82	0.009	0
2100089	2	Gas	1	0	0.000	205	N/A	N/A	100%	0	0.000	205
2100091	2	Electric	2	719	0.082	0	98%	97%	N/A	702	0.079	0
2100102	1	Electric	3	379	0.044	0	110%	124%	N/A	418	0.054	0
2100106	1	Electric	3	337	0.039	0	109%	123%	N/A	368	0.048	0
2100110	1	Electric	3	451	0.050	0	83%	105%	N/A	374	0.052	0
2100117	3	Gas	3	0	0.000	85,554	N/A	N/A	100%	0	0.000	85,554
2100118	1	Electric	4	1,053	0.123	0	68%	69%	N/A	721	0.084	0
2100128	1	Electric	1	76	0.000	0	70%	N/A	N/A	54	0.000	0
2100218	2	Gas	1	0	0.000	7,747	N/A	N/A	194%	0	0.000	15,015
2100313	3	Electric	2	655	0.000	0	102%	N/A	N/A	670	0.000	0
2100314	2	Electric	1	32	0.002	0	100%	100%	N/A	32	0.002	0
2100445	1	Gas	1	0	0.000	8,592	N/A	N/A	38%	0	0.000	3,293
2100486	1	Electric	2	195	0.022	0	113%	110%	N/A	222	0.024	0
2100957	3	Electric	1	201	0.023	0	63%	63%	N/A	126	0.014	0
2101337	3	Electric	3	1,629	0.191	0	59%	85%	N/A	958	0.164	0

Unlike prescriptive measures, we cannot present a full summary of variances in savings across multiple Custom Initiative projects. For project-specific details, please see Appendix D to this report, as well as the separate backup calculations and documentation provided by the evaluation team for review.

Nevertheless, we did make some specific findings around consistent differences in approach between the evaluation and implementation team that spanned multiple projects. We provide these findings and recommendations for improvement below for consideration. Overarching findings and recommendations are presented in Section 3.4.6.

Recommendations for HVAC and HVAC Controls Projects

- Finding: Some HVAC and HVAC controls projects used Carrier's Hourly Analysis Program (HAP) software to estimate energy savings. This software is limited in its functionality, and we do not recommend its use for projects with controls sequences any more complex than on/off. Additionally, it is not always apparent in the documentation, models, or calculations which HVAC controls measures are included in the project savings.
  - Recommendation: A simple summary of the controls measures being implemented for these projects and the associated setpoints will reduce evaluation risk by ensuring that the evaluation team has all the necessary information to support savings claims. This also supports more in-depth discussion on sources of discrepancies, which the implementation team can address in future projects.

Recommendations for Lighting Projects

- Finding: Many of the lighting projects this year did not include waste heat factors (WHF) or coincidence factors (CF) in their calculations. Additionally, several lighting projects overestimated hours of use (HOU), which the evaluation team observed when confirming HOU from participants' operations data.

- Recommendation: We recommend including WHF and CF in ex ante calculations, to ensure that the full impact of lighting improvements is realized in ex ante savings. We also recommend that the implementation team rely on data from participants in estimating HOU, or the IL-TRM when data is not available.

Recommendations for Projects Utilizing Energy Models for Savings Analysis

- Finding: This year, the evaluation team observed an increase in projects using energy models to estimate ex ante savings. We expect to see similar use of energy models in future years given the increasing complexity of custom projects and system controls. Many of these projects exhibited significant discrepancies in the modeling assumptions. To avoid these discrepancies in future projects that rely on energy modeling, we have the following recommendations:
  - Recommendation: Verify baseline efficiencies and equipment accurately represent the baseline building. For example, we saw a few projects with unrealistically low heating and cooling efficiencies in the baseline models, resulting in overestimated baseline annual energy usage. Even if these conditions are held constant between the baseline and efficient models (EEM), they may artificially inflate the savings by disproportionately increasing the overall energy consumed to condition the building in the baseline model in comparison to the efficient model.
  - Recommendation: Do not allow energy models to "auto-size" HVAC equipment unless the project intends to install HVAC equipment matching the modeled specifications. It is important to understand that energy models were developed for use in design, and the auto-size feature, commonly found in energy modeling software, is intended to facilitate building designers' selection of HVAC equipment. The auto-size feature will adjust the HVAC equipment in the baseline and/or efficient energy model to meet the modeled building loads. This can lead to discrepancies between modeled HVAC equipment and actual equipment at the facility, including potential for HVAC equipment to differ between baseline and efficient models even though HVAC equipment are not a part of the project scope. Since the actual HVAC equipment should be known in the baseline and efficient cases, we recommend the implementation team apply the actual design-specific specifications (e.g., CFM, GPM, motor horsepower, capacity) for all building equipment and terminal loads in both the baseline and efficient models. This reduces the risk of over- or under-estimated energy savings.
  - Recommendation: Model each measure as a separate parametric run with savings quantified for each measure. To ensure full accounting of all interactive effects of the measures, the final ex ante claimed savings should come from the final EEM containing all the measures. This recommendation will help in two ways:
    - Parametric runs improve granularity on the individual measure savings and help QA/QC reviewers flag measurers that have unreasonable savings or are not a part of the project.
    - Parametric runs can illuminate measures that are incorrectly modeled, and are resulting in negative savings, which may otherwise be obscured by measures with larger impacts.
  - Recommendation: Where possible, calibrate baseline models to building meter data using actual weather data at a monthly level and not just to an annual level using typical weather data. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Guideline 14 provides guidance on this topic.[21] This step will increase development time for models but make it more likely that the models accurately reflect the building's actual operation.

[21] ASHRAE Guideline 14-2014: Measurement of Energy, Demand, and Water Savings

Recommendations for Documentation of Baseline Conditions

- Finding: The evaluation team observed several projects where the implementation team's assumed baseline condition, such as equipment and operational characteristics, would result in an increase to operating costs over the existing case, and are not supported in project documentation. For example, one project had a baseline that required HVAC system modifications to even make the baseline work. There are legitimate reasons a participant may choose to operate inefficiently, such as reduced downtime of manufacturing equipment for a quick fix. However, because energy costs are a significant portion of some business's costs, e.g., manufacturing, it is also likely that a customer might reevaluate a quick fix decision after assessing a cost benefit analysis. Without well documented evidence of a customer's decision, it is up to the evaluation team to interpret from project documents and customer interviews the appropriate baseline.
  - Recommendation: We recommend that the implementation team document the customer's initial plans for addressing, or not addressing, building inefficiencies. Example documentation includes quotes from vendors or construction plans. The evaluation team can use this information in their independent evaluation to verify baseline assumptions. This documentation will also support the implementation and evaluation team in determining whether customer decisions need to be considered with respect to gross or net effects.

Recommendations for Compressed Air Projects

- Finding: For compressed air projects, the implementation team used calculation approaches this year that did not rely on data collected before implementation. In place of empirical data, the ex ante calculations relied on significant assumptions that did not have supporting documentation.
  - Recommendation: We recommend using pre-project data collection to estimate energy savings. This includes collecting at least one representative week of data before and after project implementation when possible.

Recommendations for Gas Projects

- Finding: For most gas projects that we reviewed, the savings were a large enough percentage of the building's energy usage that they should be detectable in a simple regression model.
  - Recommendation: Because the evaluation team will typically attempt a regression for large projects, we recommend the implementation team create a simple regression model using heating-degree days and billing data to verify and adjust savings estimates based on one to three months of post installation data. This will help mitigate the risk of large savings reductions due to equipment or controls not operating as expected.

Overall Results

We used a combined ratio estimation technique[22] to estimate gross realization rates for each wave by fuel type.

Table 31. 2021 Custom Initiative Realization Rates by Wave and Fuel Type

Wave	kWh	kW	Therms
1	87.6%	92.7%	69.8%
2	105.5%	111.4%	80.6%

[22] Cochran, William G. *Sampling Techniques.* New York: John Wiley & Sons, 1977.

Wave	kWh	kW	Therms
3	63.7%	61.9%	73.4%

Applying these gross realization rates to the population of projects in each wave produced verified gross savings for the Initiative. Table 32, Table 33, and Table 34 present the annual ex ante and verified gross and net electric energy, electric demand, and gas savings for each wave.

Table 32. 2021 Custom Initiative Electric Energy Savings by Wave

Wave	Ex Ante Gross MWh	Gross Realization Rate	Verified Gross MWh	NTGR	Verified Net MWh
1	9,621	88%	8,431	0.822	6,932
2	24,446	106%	25,799	0.822	21,212
3	20,285	64%	12,921	0.822	10,624
Total	**54,352**	**87%**	**47,151**	**0.822**	**38,768**

Table 33. 2021 Custom Initiative Electric Demand Savings by Wave

Wave	Ex Ante Gross MW	Gross Realization Rate	Verified Gross MW	NTGR	Verified Net MW
1	1.16	93%	1.08	0.822	0.89
2	4.45	111%	4.96	0.822	4.07
3	3.40	62%	2.11	0.822	1.73
Total	**9.01**	**90%**	**8.14**	**0.822**	**6.69**

Table 34. 2021 Custom Initiative Gas Savings

Wave	Ex Ante Gross Therms	Gross Realization Rate	Verified Gross Therms	NTGR	Verified Net Therms
1	355,599	70%	248,283	0.939	233,014
2	169,522	81%	136,614	0.939	128,212
3	633,089	73%	464,844	0.939	436,256
Total	**1,158,210**	**73%**	**849,741**	**0.939**	**797,482**

3.4.5 Cumulative Persisting Annual Savings

Table 35 presents CPAS and WAML for the 2021 Custom Initiative. The table also includes a summary of the channel-specific and total verified gross savings for the Initiative, as well as CPAS in 2021–2024 and 2030.[23] The WAML for the Initiative is 15.2 years. In 2021, AIC also converted natural gas savings produced by four Custom Initiative projects to CPAS for the purposes of goal attainment; those savings are presented separately in Table 36.

The evaluation team reviewed and adjusted measure lives provided by the implementation team for all sampled projects and calculated adjustments to measure lives based on that review. These adjustments were then applied to the population to calculate CPAS. Further detail on this adjustment is provided in Appendix A.

Table 35. 2021 Custom Initiative CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	…	2030	…	
Custom Incentives	15.5	43,799	0.822	36,012	36,012	36,012	36,012	…	34,152	…	520,510
New Construction Lighting	12.5	3,352	0.822	2,756	2,756	2,756	2,756	…	1,869	…	31,697
2021 CPAS		**47,151**	**0.822**	**38,768**	**38,768**	**38,768**	**38,768**	**…**	**36,021**	**…**	**552,207**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**…**	**1,185**	**…**	
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**…**	**2,747**	**…**	
WAML	**15.2**										

Table 36. 2021 Custom Initiative Gas Conversion CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	…	2030	…	
Custom Gas Conversion	15.5	3,969	0.939	3,725	3,725	3,725	3,725	…	3,725	…	57,902
2021 CPAS		**3,967**	**0.939**	**3,725**	**3,725**	**3,725**	**3,725**	**…**	**3,725**	**…**	**57,902**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**…**	**0**	**…**	
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**…**	**0**	**…**	
WAML	**15.5**										

[23] For further details, including achieved CPAS in years not presented in this table, please see Appendix C.

3.4.6 Conclusions and Recommendations

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

- **Key Finding #1:** As in 2020, we again reviewed some of the larger Custom Initiative projects prior to their completion to ensure that the ex ante calculations were reasonable. When we later evaluated some of these projects as a part of this year's sample, we did not have to make very many (if any) adjustments to the ex ante savings values and the project evaluation was very efficient.
  - **Recommendation:** Consider refining the criteria for which projects receive early reviews. Having the evaluation team complete early reviews for not only/exclusively large projects, but also for those that are more complex/have uncertain ex ante calculations, and those that utilize energy modeling. Providing the evaluation team with the opportunity to review complex projects ahead of project implementation will allow for significant mistakes to be avoided before projects are completed.
- **Key Finding #2:** During the present evaluation year, we observed a significant number of projects where baselines and efficient case estimates were not reasonable compared to benchmark data, and/or that had not been fully implemented by the time we went onsite. These observations are indicators of significant evaluation risk around claimed savings, and predictably we found very low realization rates on a number of 2021 projects. We recommend that the implementation team improve several items in the documentation and classification of major custom projects to avoid this risk. The evaluation team recommends the following:
  - **Recommendation:** Custom Initiative project savings claims should include a number of key components: a full articulation of the baseline conditions chosen for a project (including reasoning to support why the chosen baseline is appropriate), a clear explanation of what was (or will be) done to improve energy efficiency, clearly documented and verifiable savings calculations, and a clear description of planned/actual post-implementation operating conditions. In the absence of one or more of these components, Custom Initiative projects are subject to significant evaluation risk. While we have observed improvement around a number of these items, project support is still not sufficient in all cases.
  - **Recommendation:** We recommend that the implementation team refine the existing project QA/QC checklist to better support data required for successful project evaluation. As a follow-on to the 2021 evaluation report, the evaluation team plans on putting together and sharing with the implementation team a suggested checklist, standard engineering judgements/assumptions to support common project types, and a set of rules for determining when projects should be determined "complete" to help ensure a common understanding of what is needed for a successful Custom Initiative project.
- **Key Finding #3:** As we observed in the 2019 and 2020 Business Program evaluation report, we found that demand savings are most often calculated either by taking the difference between the equipment's pre- and post- demand, or by dividing energy savings by the hours of use. These methodologies do not account for the peak period as defined in the IL-TRM.
  - **Recommendation:** As demand savings are likely to become more important in the coming years, we recommend that the program require trade allies to take into consideration the IL-TRM's definition of the peak period when calculating demand savings.

3.5 Retro-Commissioning Initiative

3.5.1 Initiative Description

The RCx Initiative helps AIC business customers evaluate their existing mechanical equipment, energy management, and industrial compressed air systems to identify no-cost and low-cost efficiency measures to optimize existing energy-using systems.

Over time, deferred maintenance and changing operating directives and practices can lead to inefficient operation of building systems. Retro-commissioning is a process that examines current operations relative to the needs of equipment owners and those served by the equipment, and then determines opportunities for increasing equipment efficiency through maintenance, system tune-ups, scheduling, and optimization of operations. Most of the identified measures require little, if any, capital funds to implement. Secondary objectives of the Initiative include:

- Channeling participation into other AIC initiatives to implement cost-effective equipment replacements and retrofits
- Developing a network of Retro-Commissioning Service Providers (RSPs) that will continue to operate in the AIC service territory

Major market barriers to these energy efficiency opportunities are lack of awareness and the cost of the detailed engineering studies. Furthermore, even with a quality study in hand, customer apathy can inhibit the implementation of recommendations despite being no-cost. To overcome these barriers, the Initiative subsidizes RSP studies and publicizes the benefits of retro-commissioning to foster a market for the services, with utility-certified RSPs providing the marketing outreach. AIC incentives pay for 90% of the study cost, and implementation incentives are paid at a level of $0.02/kWh and $0.10/therm (see Table 37).

During 2021, the RCx Initiative had four channels:

- **Industrial Refrigeration Retro-Commissioning:** The Industrial Refrigeration channel provided incentives to defray the cost of a retro-commissioning study of industrial refrigeration equipment, leading to the implementation of low- and no-cost energy efficiency measures for existing industrial refrigeration systems. Typical measures included lowering condensing pressure, raising suction pressure, evaporator fan control, evaporator defrost settings, and compressor sequencing.
- **Large Facilities Retro-Commissioning:** The Large Facilities channel has historically targeted two separate types of facilities: healthcare facilities and large commercial facilities (primarily offices). Healthcare facilities represent a major opportunity for energy savings in AIC territory and historically have driven this channel. The typical source of savings is from energy management system (EMS) settings adjustments to optimize the operation of HVAC systems and other HVAC and lighting optimization activities. Since the passage of FEJA, the Large Facilities channel has also targeted public sector facilities (e.g., schools), as have the other RCx Initiative channels.

  Large Facilities retro-commissioning projects go through a screening phase that examines the feasibility of retro-commissioning at the facility. Sites with good savings potential are eligible to apply to the Initiative after AIC reviews the project. RSPs commit resources to this deliverable, which may or may not result in a viable retro-commissioning project. To defray the financial risk to the RSP and to encourage the RSPs to market the Initiative more aggressively, AIC pays a screening stipend of 5 to 10% of the retro-commissioning study cost to the RSP for complex projects. This stipend does not

require a commitment to implement a project and does not necessarily mean that energy savings will be achieved in future years.

- **Retro-Commissioning Lite:** Beginning in 2018, the RCx Initiative began offering an option to smaller facilities that would not qualify for the Large Facilities channel. To date, there has been one Retro-Commissioning Lite project completed in the AIC territory.
- **Virtual Commissioning™:** Beginning in mid-2020, the RCx Initiative launched a Virtual Commissioning™ channel. Due to substantial differences between the Virtual Commissioning™ channel and the remainder of the RCx Initiative, Virtual Commissioning™ is discussed separately in Section 3.6. All remaining information presented in this section discusses only the previous three RCx Initiative channels.

Table 37. 2021 Retro-Commissioning Initiative Incentive Structure

Offering	Survey Incentive	Customer Implementation Incentive	Incentive Requirements
Industrial Refrigeration	▪ 90% of survey cost	▪ $0.02/kWh saved	▪ Payback period of 0–1 year ▪ Measure must be completed before incentive is paid
Large Facilities	▪ 90% of survey cost for facilities where AIC provides both electric and gas service; 45% for facilities where AIC provides only one fuel source ▪ 10% of survey cost as "stipend" to RSPs for complex projects	▪ $0.02/kWh saved ▪ $0.10/therm saved	▪ Payback period of 0–1 year ▪ Measure must be completed before incentive is paid ▪ Measures do not need to be completed for stipend to be paid
Lite	▪ 100% of survey cost, capped at $15,000; 50% for facilities where AIC provides only one fuel source	▪ $0.02/kWh saved ▪ $0.10/therm saved	▪ Payback period of 0–1 year ▪ Measure must be completed before incentive is paid

Summary of Key Implementation Changes in 2021

In 2021, the implementation team launched a monitoring-based commissioning pilot at a facility enrolled in the RCx Lite channel.[24] This pilot offered participants an enhanced incentive to install monitoring equipment, which will remain in place after the project is completed to monitor performance. Additionally, as documented in Table 37, the implementation team revised the incentive structure for the Industrial Refrigeration, Large Facilities, and RCx Lite channels. The team increased the survey incentives and decreased the implementation incentive for gas-saving measures.

3.5.2 Participation Summary

Table 38 presents RCx participation during 2021. Two projects were completed through the Large Facilities channel.

[24] The monitoring-based commissioning project has an estimated completion date in 2022, and therefore impacts are not reported for this project in this year's evaluation report.

Table 38. 2021 Retro-Commissioning Participation Summary

Channel	Projects	Ex Ante Gross Savings			
		MWh	%	Therms	%
Industrial Refrigeration	0	0	0%	0	0%
Large Facilities	2	314	100%	29,640	100%
Lite	0	0	0%	0	0%
Total	**2**	**314**	**–**	**29,640**	**–**

The RCx Initiative has existed since the inception of the AIC portfolio in 2008. Historically, the Initiative has maintained consistent, but relatively low, participation over its life. Notably, the exclusion of 10 MW customers from AIC's programs beginning in the Transition Period has significantly affected the overall savings achieved by the Initiative, which declined precipitously after Program Year PY9 (2016–2017). Additionally, the COVID-19 pandemic and resulting supply chain disruptions negatively impacted participation in 2021. The RCx Initiative has historically targeted hospitals and other large medical facilities. Constraints on financial and staffing resources, as well as limiting non-essential visitors to the facilities, likely resulted in lower-than-normal participation. Disruptions to the supply chain caused delays in procuring equipment, which extended the timelines of some projects in the pipeline and prevented them from being completed in 2021. Table 39 shows historic RCx Initiative participation for PY1 through 2021.

Table 39. 2021 Retro-Commissioning Participation Summary by Program Year

Program Year	Projects[a]	Ex Ante Gross Savings	
		MWh	Therms
PY1 (2008–2009)	1	2,045	0
PY2 (2009–2010)	17	10,640	0
PY3 (2010–2011)	21	29,819	0
PY4 (2011–2012)	25	19,273	412,666
PY5 (2012–2013)	35	29,257	577,834
PY6 (2013–2014)	26	12,091	248,851
PY7 (2014–2015)	16	10,175	226,171
PY8 (2015–2016)	18	12,193	514,070
PY9 (2016–2017)	21	10,741	252,564
Transition Period	6	932	266,604
2018	12	5,992	190,552
2019	20	5,322	83,622
2020	9	5,192	74,471
2021	2	314	29,640

[a] This project count reflects projects with associated savings. A number of projects listed in the AIC database as paid—the vast majority of which are "stipend" projects—have no associated savings.

3.5.3 Initiative Annual Savings Summary

Table 40 presents RCx annual savings achieved in 2021.[25] The 2021 RCx Initiative achieved 242 MWh and 21,943 therms in verified net savings. Note that we converted gross savings to net savings using SAG-approved NTGRs.

Table 40. 2021 Retro-Commissioning Annual Savings

	Electric Energy Savings (MWh)	Electric Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	314	0	29,640
Gross Realization Rate	82%	N/A	79%
Verified Gross Savings	258	0	23,344
NTGR	0.940	N/A	0.940
Verified Net Savings	242	0	21,943

3.5.4 Initiative Savings Detail

The RCx Initiative completed two projects through the Large Facilities channel in 2021. Table 41 presents the ex ante and verified gross savings for each project.

Table 41. 2021 Retro-Commissioning Participation Summary by Measure

Project ID	Project Type	Ex Ante Gross Savings			Gross Realization Rate			Verified Gross Savings		
		MWh	MW	Therms	MWh	MW	Therms	MWh	MW	Therms
1800330	Large Facilities	0	0	29,640	N/A	N/A	79%	0	0	23,344
2100083		314	0	0	82%	N/A	N/A	258	0	0
Total		**314**	**0**	**29,640**	**82%**	**N/A**	**79%**	**258**	**0**	**23,344**

- The gross realization rate for Project 1800330 was 79% for gas savings. Discrepancies between ex ante and verified savings are detailed below by RCx measure.
  - **Schedule air-handler unit (AHU) DDC terminal units:** The verified analysis applied AIC standard values for heating efficiency and motor efficiency when calculating savings. We also updated the scheduling based on findings from the virtual site visit. Both of these updates resulted in lower verified therm savings.
  - **Discharge air temperature reset – pneumatic terminal units:** The verified analysis applied AIC standard values for heating efficiency and motor efficiency. We also discovered in the virtual site visit that the reset for one of the units was set at 55°F rather than the reported 60°F. We applied the 55°F reset in the verified savings calculations. Overall, these updates resulted in lower verified therm savings.
  - **Discharge air temperature reset – standalone AHU controls:** The verified analysis applied AIC standard values for heating efficiency and motor efficiency to the savings calculations, which resulted in an increase in therm savings. However, the evaluation team also found in the virtual site review that the reset was set at 55°F rather than the reported 65°F; this resulted in an overall reduction to therm savings.

[25] As previously discussed, please note that these savings do not include savings from the Virtual Commissioning™ channel. Those savings are presented separately in Section 3.6.

- **Variable-air-volume box controls:** The evaluation team applied AIC standard values for heating efficiency and motor efficiency to the verified savings calculations. Additionally, we increased the operating hours based on findings from the virtual site review, which resulted in an increase in therm savings.

- The gross realization rate for Project 2100083 was 82% for electric energy. Discrepancies between ex ante and verified savings are detailed below by RCx measure.
  - **Scheduling rooftop units (RTU) and exhaust fans:** The verified analysis applied AIC standard values for heating efficiency, motor efficiency, and kW/ton for the RTUs. We also adjusted the outside-air inputs, which previously assumed that the minimum operating outside air was equivalent to the maximum outside-air design for the unit. The verified analysis applied typical outside-air minimums—20% for hospitals and 10% for office space. Lastly, we updated the operating hours based on findings from the desk reviews and the virtual site review. These changes reduced kWh savings.
  - **Scheduling AHUs and exhaust fans:** The verified analysis applied AIC standard values for heating efficiency, motor efficiency, and kW/ton for the RTUs. We also adjusted the outside-air inputs, which previously assumed the minimum operating outside air was equivalent to the maximum outside-air design for the unit. The verified analysis applied typical outside-air minimums—20% for hospitals and 10% for office space. Lastly, we updated the night setback to 65°F based on findings from the virtual site review. These changes reduced kWh savings.
  - **Increasing economizer enable setpoint on AHUs:** The verified analysis applied AIC standard values for heating efficiency, motor efficiency, and kW/ton for direct-expansion systems. We also adjusted the outside-air inputs, which previously assumed the minimum operating outside air was equivalent to the maximum outside-air design for the unit. The verified analysis applied typical outside-air minimums— 20% for hospitals and 10% for office space. In two cases, we corrected the economizer enable setpoint from 50°F to 55°F based on findings in the desk reviews. In one case, ex ante calculations inadvertently reversed supply and return fan horsepower; we corrected this in the verified analysis. These changes reduced kWh savings.
  - **Scheduling VAV terminal units:** We applied AIC standard values for heating efficiency, motor efficiency, and kW/ton for the direct-expansion system. We also adjusted the outside-air inputs, which previously assumed the minimum operating outside air was equivalent to the maximum outside-air design for the unit. The verified analysis applied typical outside-air minimums—20% for hospitals and 10% for office space. These changes reduced kWh savings.
  - **Adding controls to kitchen equipment:** The evaluation team applied AIC standard values for heating efficiency, motor efficiency, and kW/ton for the direct-expansion system. We also updated the operating schedule based on findings from the virtual site visit. These changes resulted in a reduction to kWh savings.

3.5.5 Cumulative Persisting Annual Savings

Table 42 presents CPAS and WAML for the 2021 RCx Initiative. The table also includes a summary of the measure-specific and total verified gross savings for the Initiative, as well as CPAS in 2021–2024 and 2030.[26] The WAML for the Initiative is 8.6 years.

Table 42. 2021 Retro-Commissioning CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	…	2030	…	
Large Facilities Retro-Commissioning	8.6	258	0.940	242	242	242	242	…	0	…	2,084
2021 CPAS		**258**	**0.940**	**242**	**242**	**242**	**242**	…	**0**	…	**2,084**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	…	**145**	…	
Expired 2021 CPAS				**0**	**0**	**0**	**0**	…	**242**	…	
WAML	**8.6**										

[26] For further details, including achieved CPAS in years not presented in this table, please see Appendix C.

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 RCx Initiative moving forward:

- **Key Finding #1:** RSPs have improved in their use of AIC standard assumptions in calculations where measured data are not available. For example, the evaluation made only a few corrections to load factors and cube law exponents in verified savings calculations. However, we noted that, in most cases, service providers did not apply AIC standard assumptions for motor efficiencies and heating and cooling efficiencies. When plant cooling and heating data are not available, it is preferable to use the AIC standard assumptions and to be consistent throughout the calculations. The evaluation team applied AIC standard assumptions in verified savings calculations, which reduced savings.
  - **Recommendation:** Continue to educate the RSPs on the list of standard input assumptions that should be used in calculations if measured data are not available. This will ensure that the same assumptions are consistently applied in calculations and will result in a reduction in the difference between ex ante and verified savings.
- **Key Finding #2:** RSPs consistently assumed that the amount of outside air being used was equal to the difference between the Design Supply Air and the Design Return Air. This is incorrect, and, in general, resulted in an overestimation of the outside air percentage. These data should have been pulled from the facility's Building Automation System (BAS). The evaluation team applied standard assumptions for outside air, which decreased verified savings.
  - **Recommendation:** RSPs should use data from the BAS for assumptions on outside air percentage, rather than relying on design parameters, which are the maximum that a given unit is designed for, not the minimum actual outside air.
- **Key Finding #3:** The RSPs are doing a good job of documenting baseline conditions with BAS trend data and demonstrating the implementation of measures with pictures and screen shots from the BAS. However, this year, the RSP embedded links to trend data and equipment data in their reports that were not accessible for the verification process. The evaluation team was able to obtain this information through the virtual site visits. Additionally, the RSPs provided limited trend data to demonstrate conditions after implementation.
  - **Recommendation:** RSPs should submit electronic files for all trend data and equipment data as part of the documentation submission process, rather than linking to files that are located on the RSPs' servers.
  - **Recommendation:** If possible, post-implementation data should include at least two weeks of seasonal trend data. Measures with predominately cooling or heating savings should include summer trend data or winter trend data, respectively. These data should be used in the ex ante savings calculations as part of the RSPs' verification process.
  - **Recommendation:** RSPs should seek to obtain trend verification data that reflect conditions after implementation. Ideally these trends would also be available during the evaluation process to determine if changes were made after implementation.
- **Key Finding #4:** Due to an increase in the prevalence of COVID-19 cases in early 2022, the evaluation team conducted virtual site visits to verify measure status and other key project data. We met with participants to verify savings inputs and review BAS trend data. The most common adjustments made to verified savings calculations as a result of these virtual site visits were increases in operation schedules and changes to equipment set points.

3.6 Virtual Commissioning™

AIC considers Virtual Commissioning™ to be a channel of the RCx Initiative (see Section 3.5). As a result, when summary tables in this report present savings at the Initiative level, Virtual Commissioning™ is rolled up with the remainder of the RCx Initiative. However, because the Virtual Commissioning™ channel is implemented separately and required substantially different evaluation methods from the remainder of the RCx Initiative, we present our evaluation of the Virtual Commissioning™ channel in this separate section of the report.

3.6.1 Initiative Description

AIC launched Virtual Commissioning™, implemented by Power TakeOff, as a pilot in 2020. Virtual Commissioning™ is an approach that remotely targets the traditionally hard-to-reach customer segment of small and medium business customers to support low- and no-cost energy-saving measures. The Virtual Commissioning™ approach leverages Advanced Metering Infrastructure (AMI) data to support targeted insights for hard-to-reach customers through the design, implementation, and evaluation phases of the channel.

Power TakeOff uses their internal software to complete an initial analysis of AMI data from AIC's small and medium business customers to identify prospective participants. Power TakeOff then uses the outcomes of this analysis to remotely identify opportunities for low- and no-cost energy-saving improvements at the participants' facilities. These opportunities commonly include HVAC system modifications and lighting scheduling adjustments.

Power TakeOff energy advisors then contact potential participants to share the results of the analysis, confirm the energy-saving opportunities, and verify facility characteristics. After participants implement the recommended changes, Power TakeOff develops individual facility-level regression models using the participants' pre- and post-participation energy consumption to estimate savings. The models must meet certain criteria for robustness in order for Power TakeOff to claim savings.[27] If a project both demonstrates continued savings for three months and meets the model robustness criteria, Power TakeOff can claim annualized savings for the project for the program year.

Power TakeOff also provides Leidos with small and medium business customer contact information and referrals to support lead generation for other AIC initiatives.

Summary of Key Implementation Changes in 2021

Power TakeOff reported that the design and delivery of the 2021 Virtual Commissioning™ channel was generally consistent with 2020. They also reported spending more time targeting schools for enrollment in the channel in 2021, and participation from the school customer segment increased accordingly.

Both AIC and Power TakeOff staff noted that the Virtual Commissioning™ channel's remote intervention capabilities were advantageous in 2021, as Power TakeOff was able to deliver the channel without any major disruptions during the ongoing COVID-19 pandemic. While COVID-19 had a minimal impact on Virtual Commissioning™ performance overall, Power TakeOff reported that some customers were unable to make

[27] These criteria are specified in AIC's Virtual Commissioning™ M&V Plan, authored by Power TakeOff, and are as follows: the normalized savings uncertainty must be below 50% at 68% confidence; the absolute value of normalized mean bias error (NMBE) must be below 0.5%; and the coefficient of variation of root mean square error [CV(RMSE)] must be below 25%. CV(RMSE) and NMBE are both metrics of how well a regression model explains or fits the data.

changes to their ventilation systems due to COVID-19 safety protocols, which reduces their sites' savings potential.

3.6.2 Participation Summary

The Virtual Commissioning™ channel served 50 participants (i.e., unique sites) across 37 unique organizations[28] in 2021. This represents substantial growth in participation from 2020 when Virtual Commissioning™ was in a pilot phase and served 10 participants. Virtual Commissioning™ participants commonly adjusted their HVAC system setpoints, lighting system scheduling, and/or HVAC system scheduling. Of note, both Power Takeoff and AIC staff reported that they did not have specific Virtual Commissioning™ participation goals in 2021; because Virtual Commissioning™ operates using a pay-for-performance delivery model, the channel focuses more on achieving savings goals by serving customers with a high potential to save energy and less on enrolling a target number of customers to participate in the channel.

3.6.3 Initiative Annual Savings Summary

Opinion Dynamics verified the Virtual Commissioning™ Initiative gross and net electric savings estimates by validating Power TakeOff's facility-level modeling. Our approach, which leans heavily on the IPMVP Option C guidelines,[29] was limited to verification of Power TakeOff's methods. We were able to take this approach because Power TakeOff agreed to adopt the evaluation team's methodological recommendations from the 2020 AIC Virtual Commissioning™ impact evaluation, which enabled both Power TakeOff and the evaluation team to come to agreement on a common methodology to estimate savings for 2021. We provide high-level savings results below, with additional methodological details in Appendix A of this report.

As part of the verification process, the evaluation team assessed Power TakeOff's data cleaning and processing methods; their model specifications and model evaluation process; and their process for calculating electric savings. We identified a few minor issues related to data cleaning and data provision through this process. These issues are discussed in Section 3.6.5 and Appendix A. Note that we did not have one year of post-period data for all projects, which may increase the prediction error for the modeling results.

In addition to verifying the savings associated with Virtual Commissioning™, the evaluation team independently verified whether the individual project modeling results met the channel's guidelines with respect to model robustness. Two projects that Power TakeOff claimed as part of the 2021 Virtual Commissioning™ channel did not meet model robustness criteria. These issues are discussed in more detail in Appendix A.

Table 43 presents the annual savings achieved by the Virtual Commissioning™ channel in 2021: 4,593 MWh in verified net savings. This resulted in a gross realization rate of 89%. AIC did not claim demand savings or gas savings from Virtual Commissioning™ in 2021.

[28] We identified unique organizations by summing unique contacts in the program tracking database.
[29] EVO. *International Performance Measurement and Verification Protocol Core Concepts.* 2016.

Table 43. 2021 Virtual Commissioning™ Annual Savings

	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	5,166	0	0
Gross Realization Rate	89%	N/A	N/A
Verified Gross Savings	4,593	0	0
NTGR	1.000	N/A	N/A
Verified Net Savings	4,593	0	0

The evaluation team identified three main causes for the discrepancies between ex ante gross savings and verified gross savings. First, two projects with a combined ex ante savings value of 196,528 kWh did not meet model robustness criteria, which accounts for 34% of the differential between ex ante gross and verified gross savings. Second, Power TakeOff did not account for instances of cross-program participation in their ex ante savings estimates. Five Virtual Commissioning™ participants completed projects through other AIC initiatives, which reduced the total electric savings for the channel by 92,471 kWh and accounts for 16% of the differential between ex ante gross and verified gross savings. Third, through ongoing discussion with Power TakeOff, some minor data cleaning and provision errors were identified related to their handling of change dates and the way their models pulled in raw data, which likely contributed to the remaining discrepancies in results.

3.6.4 Cumulative Persisting Annual Savings

Table 44 presents CPAS and WAML for the 2021 Virtual Commissioning™ channel. The table also includes a summary of the total verified gross savings for the channel, as well as CPAS in 2021–2024 and 2030.[30] The WAML for the channel is 7.3 years.

Table 44. 2021 Virtual Commissioning™ CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	...	2030	...	
Virtual Commissioning™	7.3	4,593	1.000	4,593	4,593	4,593	4,593	...	0	...	33,529
2021 CPAS		**4,593**	**1.000**	**4,593**	**4,593**	**4,593**	**4,593**	...	**0**	...	**33,529**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	...	**0**	...	
Expired 2021 CPAS				**0**	**0**	**0**	**0**	...		...	
WAML	**7.3**										

[30] For further details, including achieved CPAS in years not presented in this table, please see Appendix C.

3.6.5 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for Virtual Commissioning™ moving forward:

- **Key Finding #1:** The evaluation team found that five Virtual Commissioning™ participants also participated in other AIC Business Initiatives during the treatment period. Power TakeOff did not account for these instances of cross-program participation in their ex ante savings estimates.
  - **Recommendation:** We recommend that Power Takeoff coordinate with Leidos to acquire a list of Virtual Commissioning™ participants that also participated in other AIC Business Program initiatives and leverage this list to account for known instances of cross-program participation in ex ante savings estimates.
- **Key Finding #2:** Given the number of projects completed in 2021, Opinion Dynamics used a loop function to run the models for each project, which enabled efficiencies in developing the code to evaluate each project. In some cases, the project workbooks and model specifications provided were challenging to include in the loop function because they required individual customization.
  - **Recommendation:** We recommend that Power TakeOff include flags in each individual project workbook that indicates which model terms they are using.
- **Key Finding #3:** The models used to estimate impacts in 2021 included many terms, which increases the risk of overfitting. This could potentially threaten the validity of results that are extrapolated to future program years, including CPAS calculations.
  - **Recommendation:** We suggest documenting the model selection process and rationale. This documentation should include the criteria that Power TakeOff used for model selection and the steps that were taken to avoid overfitting. We also recommend that Power TakeOff include projected R^2 values in each workbook in future program years to help with assessments of overfitting.
- **Key Finding #4:** Following the evaluation team's recommendation from the 2020 AIC Virtual Commissioning™ Impact Evaluation, Power TakeOff included interaction terms between the treatment variable and any independent variables related to the intervention in the model specifications. However, in some cases, adding these interaction terms was unnecessary—for instance, with interactions between an NRE occurring in the summer and heating weather terms.
  - **Recommendation:** Remove unnecessary interaction terms.

3.7 Streetlighting Initiative

3.7.1 Initiative Description

The AIC Streetlighting Initiative, launched in 2018, encourages replacement of streetlighting using high-pressure sodium (HPS) and mercury vapor (MV) lighting with energy-efficient LED technology. High-intensity discharge lighting, specifically HPS, is still the standard technology used for streetlighting in the United States.

The Initiative targets streetlighting for upgrades through two channels:

- **Municipality-Owned Streetlighting (MOSL):** Through this channel, AIC targets municipal customers who own their streetlighting fixtures. Incentives are provided to encourage customers to replace existing MV and HPS streetlights with LED streetlights.
- **Utility-Owned Streetlighting (UOSL):** Through this channel, AIC targets municipal customers who have AIC-owned streetlighting fixtures. Early replacement of functioning HPS and MV streetlights with LED streetlights is available to customers through the Initiative for a per-fixture fee. The Initiative incentivizes customers to request early replacement of these fixtures and provides an incentive to decrease the per-fixture cost of the early replacement to customers. In addition, through this channel, AIC claims savings from ongoing replacement of existing AIC-owned HPS streetlighting with LED streetlights upon burnout.

3.7.2 Participation Summary

Table 45 presents Streetlighting Initiative participation during 2021, including subtotals for fixtures that are owned by the municipality versus those owned by AIC. The measure counts are based on the total quantity of LED fixtures installed.

Table 45. 2021 Streetlighting Initiative Participation Summary

Participation	MOSL	UOSL	Total
Participants	9	51	60
Project Count	9	63	72
Fixture Count	864	39,574	40,438

Note: UOSL participant count is presented as the number of unique municipalities participating, plus one additional participant representing all AIC replace-on-burnout (ROB) upgrades.

As shown in Table 46, the Streetlighting Initiative replaced 40,438 measures during 2021, described in more detail below. Note that Table 46 presents measure counts as defined in ex ante data; as part of our impact analysis, some measures were recategorized (discussed further in Section 3.7.4). [31]

Table 46. 2021 Streetlighting Initiative Participation Summary by Measure

Measure Category[a]	IL-TRM Measure Name	Measure Quantity	Units	Ex Ante Gross MWh	Ex Ante Gross MW
MOSL (HPS Baseline)	LED Streetlighting	864	Streetlights	749	0.000
UOSL (HPS Baseline)	LED Streetlighting	5,487	Streetlights	3,225	0.000

[31] Most notably, the implementation team shared that all 285 fixtures marked as 24/7 operation were inadvertently recorded as such, and therefore all fixtures are treated as dawn-to-dusk operation in the final analysis.

Measure Category[a]	IL-TRM Measure Name	Measure Quantity	Units	Ex Ante Gross MWh	Ex Ante Gross MW
UOSL (HPS Baseline, AIC ROB)	LED Streetlighting	30,827	Streetlights	19,171	0.000
UOSL (HPS Baseline, 24/7 Operation)	LED Streetlighting	157	Streetlights	212	0.024
UOSL (MV Baseline)	LED Streetlighting	2,975	Streetlights	2,260	0.000
UOSL (MV Baseline, 24/7 Operation)	LED Streetlighting	128	Streetlights	205	0.023
Total		**40,438**		**25,823**	**0.048**

[a] Unless otherwise noted, all measures are dusk-to-dawn operation and customer-requested streetlighting replacements.

3.7.3 Initiative Annual Savings Summary

Table 47 presents Streetlighting Initiative annual savings achieved in 2021. The 2021 Streetlighting Initiative achieved 25,301 MWh in verified net savings.

Table 47. 2021 Streetlighting Initiative Annual Savings

	Electric Energy Savings (MWh)	Electric Demand Savings (MW)	Gas Savings (Therms)
Ex Ante Gross Savings	25,823	0.05	0
Gross Realization Rate	99%	0%	N/A
Verified Gross Savings	25,533	0.00	0
NTGR	0.991	N/A	N/A
Verified Net Savings	25,301	0.00	0

3.7.4 Initiative Savings Detail

Ex ante gross, verified gross, and verified net electric energy savings for the Initiative are presented in Table 48. The Initiative produced no verified net demand savings.

Table 48. 2021 Streetlighting 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)
MOSL (HPS Baseline)	749	100%	749	0.690	517
UOSL (HPS Baseline)	3,437	95%	3,253	1.000	3,253
UOSL (HPS Baseline, AIC ROB)	19,171	100%	19,171	1.000	19,171
UOSL (MV Baseline)	2,465	96%	2,360	1.000	2,360
Total	**25,823**	**99%**	**25,533**	**0.991**	**25,301**

While the overall realization rate for the Initiative is very high (99% for energy savings [MWh]), we identified and commented on a small number of errors in the verified analysis, detailed below, many of which led to minor changes in verified savings.

- **A number of streetlighting replacements were incorrectly categorized:**
  - Three sets of customer requested UOSL fixture replacements labeled as HPS replacements appear to be replacements of 327W and 690W incandescent multiple streetlighting (measure IDs

a0G5d00000qsg6rEAA, a0G5d00000qsg79EAA, and a0G5d00000qsieUEAQ) with 39W LED fixtures.

- Incandescent multiple streetlighting is much less efficient on a lumen-per-watt basis than typical streetlighting fixtures and has a much shorter measure life. IL-TRM Measure 4.5.16 does not characterize this replacement type.
- For the 2021 evaluation, we determined an appropriate HPS-equivalent baseline for these replacements when calculating verified savings based on a lumen comparison. For the 690W incandescent replacements, we used a 100W HPS fixture as a baseline. For the 327W incandescent replacements, we used a 50W HPS fixture as a baseline. These changes dramatically reduced verified savings for these measures.
- This may be a conservative treatment of this measure, given that alternative, less efficient options that do not require complete replacements of the incandescent multiple streetlighting fixtures could be possible. If AIC expects these replacements to increase in frequency in future years, we suggest that the implementation and evaluation teams discuss how to fully characterize these replacements on a prescriptive basis.

- Two sets of AIC ROB fixture replacements labeled as 125W HPS replacements appear to be replacements of 125W MV fixtures (measure IDs a0G1Y00000qs7zRUAQ and a0G5d00000rUA3JEAW).
  - These replacements are not addressing currently functioning equipment, and therefore, early retirement assumptions are not required. However, the ex ante analysis used the previously existing MV fixture wattage as an HPS baseline when computing savings. Without program action, the correct baseline would be a 125W MV-equivalent HPS fixture of 66W (as detailed in Appendix A – Table 74). The verified analysis used a 66W baseline when calculating savings for these replacements.
- One set of customer requested UOSL fixture replacements labeled as HPS replacements appear to be replacements of non-MV metal halide (MH) fixtures (measure ID a0G1Y00000qs1U5UAI).
  - MH streetlighting is much less efficient on a lumen-per-watt basis than HPS fixtures and has a much shorter measure life, and IL-TRM Measure 4.5.16 does not specifically characterize this replacement type.
  - Given the small impact of this one replacement, we passed ex ante assumptions through in the verified analysis. However, if AIC expects to continue to replace these types of fixtures in future years, further discussion around the most appropriate savings methodology is warranted.

- **Adjusted baseline wattage for many MV fixtures (125W and 290W) were incorrectly set:**
  - For MV fixture early retirement, the ex ante analysis used inappropriate adjusted baseline wattages after the expiration of the fixture remaining useful life (RUL) in a number of cases. The verified analysis updates these wattages so that they are in line with equivalencies that AIC and the evaluation team agreed upon, presented in Appendix A – Table 74. This change does not affect annual savings but decreases post-baseline shift CPAS as compared to the ex ante analysis.
- **Operation type for a number of fixtures was improperly reported:**
  - For all 285 fixtures flagged as 24/7 operation in final Initiative tracking data, the implementation team provided a correction indicating that these fixtures were instead standard (dusk-to-dawn) operation. We adjusted this in the verified analysis, which decreases annual savings but increases

measure life for these fixtures. In addition, as a result of this change the Initiative produces no verified net demand savings; ex ante demand savings are reported entirely on the basis of this inaccurate fixture characterization.

3.7.5 Cumulative Persisting Annual Savings

Table 49 presents CPAS and WAML for the 2021 Streetlighting Initiative. The table also includes a summary of the measure-specific and total verified gross savings for the Initiative, as well as CPAS in 2021–2024 and 2030.[32] The WAML for the Initiative is 20.0 years.

Table 49. 2021 Streetlighting Initiative CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	...	2030	...	
MOSL (HPS Baseline)	20.0	749	0.690	517	517	517	517	...	517	...	10,339
UOSL (HPS Baseline)	20.0	3,253	1.000	3,253	3,253	3,253	3,253	...	3,253	...	65,059
UOSL (HPS Baseline, AIC ROB)	20.0	19,171	1.000	19,171	19,171	19,171	19,171	...	19,171	...	383,413
UOSL (MV Baseline)	20.0	2,360	1.000	2,360	2,360	2,360	1,165	...	1,165	...	26,881
2021 CPAS		**25,533**	**0.991**	**25,301**	**25,301**	**25,301**	**24,105**	**...**	**24,105**	**...**	**485,692**
Expiring 2021 CPAS				**0**	**0**	**0**	**1,196**	**...**	**0**	**...**	
Expired 2021 CPAS				**0**	**0**	**0**	**1,196**	**...**	**1,196**	**...**	
WAML	**20.0**										

[32] For further details, including achieved CPAS in years not presented in this table, please see Appendix C.

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 Streetlighting Initiative moving forward:

- **Key Finding #1:** In 2021, the Streetlighting Initiative appears to have replaced a handful of measures that are not HPS or MV, including incandescent, metal halide, and in some cases, even existing LED streetlights.
  - **Recommendation:** Clearly label non-HPS or non-MV replacements in the database to ensure that baselines can be set correctly and that savings assumptions are transparent.
  - **Recommendation:** If non-HPS or non-MV streetlights are replaced, it is important to carefully document the existing baseline condition beyond the current level of documentation provided by the Initiative. Unlike for HPS and MV streetlights, the IL-TRM does not currently provide strong guidance on how to treat replacements of other streetlighting technologies, and it is not clear what the expected behavior would be in the absence of the Initiative. We applied generally conservative assumptions in verified savings calculations for these cases given their small impact on Initiative savings, but additional discussions on how to best handle these replacements might lead to different outcomes.
  - **Recommendation:** Consider whether it is a good use of Initiative funding to pay incentives for replacing existing LED streetlighting; delta watts are much smaller compared to other existing streetlighting types, and unless there is carefully documented evidence provided to support the presence of efficiency gains, savings could be at risk.
    - In some cases, actual existing baseline wattages were not collected for LED streetlighting, and the implementation team applied what they labelled as a conservative average to calculate ex ante savings. We do not feel that these assumptions are well supported. Given the small number of such replacements in 2021, and the limited documentation available, we applied the implementation team's assumptions in verified savings. However, in future years, we will likely set savings to zero in these cases if additional evidence of efficiency gains is not provided.
- **Key Finding #2:** In many cases, the adjusted baseline wattages for MV streetlights were not correctly defined in the database, which likely resulted in incorrect implementation estimates of CPAS produced by the Initiative.
  - **Recommendation:** Update adjusted baseline wattage assumptions for MV streetlights to match agreed-upon values presented in Appendix A (Table 74), which we expect to be included in IL-TRM V10.0 errata and the IL-TRM V11.0.

3.8 Building Operator Certification

While not considered an "initiative" like Standard, Custom, RCx, and Streetlighting, AIC offers BOC training to its customers as part of the Business Program. This section details our 2021 evaluation of those efforts.

3.8.1 Training Description

AIC, in partnership with the Midwest Energy Efficiency Alliance (MEEA), offers BOC training to building operators in AIC territory. BOC is a nationally recognized training and certification program that was developed by the Northwest Energy Efficiency Council and focuses on energy-efficient building operations and preventative maintenance procedures. The BOC training consists of two levels of training. The Level I course consists of seven classes focused on building systems maintenance, and the Level II course consists of six classes focused on equipment troubleshooting and maintenance (see Table 50). Both courses include classroom training, project assignments to be completed at a participant's facility, and in-class tests at the end of each day. In 2020, MEEA offered a Level I course from August 5th through November 5th and a Level II course from October 28th through December 17th.[33] Due to COVID-19, MEEA and AIC delivered all 2020 trainings virtually.

Table 50. List of BOC Training Topics

Topics	Level I	Level II
1001 – Energy-Efficient Operation of Building HVAC Systems	✓	
1002 – Measuring and Benchmarking Energy Performance	✓	
1003 – Efficient Lighting Fundamentals	✓	
1004 – HVAC Controls Fundamentals	✓	
1005 – Indoor Environmental Quality	✓	
1006 – Common Opportunities for Low-Cost Operational Improvements	✓	
1007 – Facility Electrical Systems	✓	
2001 – Building Scoping for Operational Improvements		✓
2002 – Optimizing HVAC Controls for Energy Efficiency		✓
2003 – Introduction to Building Commissioning		✓
2004 – Water Efficiency for Building Operations		✓
2011 – Motors in Facilities		✓
2005 – Project Peer Exchange: Present Final Report		✓

Successful graduates of BOC training earn certificates of completion. If graduates elect to take the certification exam and pass, they earn the BOC Certification and become Certified Building Operators. Certified Building Operators retain their certification by maintaining employment, attending approved continuing education webinars, and implementing projects at their facilities. While participants do not need to be AIC customers to enroll in the course, AIC provides a partial tuition reimbursement to its customers upon completion of the course ($500 to put toward the total cost of $1,400) to incentivize participation.[34]

[33] MEEA offered a second Level I course from September 17th through December 18th, but no AIC participants completed the course.
[34] This incentive structure reflects what was in place in 2020. In 2021, AIC offered full scholarships to participants.

Summary of Evaluation Methodology

The evaluation team aligned the impact evaluation of BOC training with Kirkpatrick's Framework for evaluating adult learning interventions (see Appendix A), the gold standard framework for assessing the impacts of adult learning interventions. Opinion Dynamics' approach involved following students throughout the training process and targeting specific research activities at different stages of participation. Research activities included:

- **Baseline operations and maintenance (O&M) and energy efficiency equipment survey:** Participants completed this survey as their first homework assignment. The survey established baseline O&M conditions and collected information on the energy-related equipment in place prior to the training intervention.
- **Reaction interviews:** Directly following the course, we interviewed participants to: (1) solicit feedback regarding their satisfaction with the course; (2) understand what they learned; (3) document any changes that they made to their facilities during the training; (4) record any future plans for energy efficiency projects; and (5) identify the role that BOC training played in these future plans. We provided a $50 incentive to participants for completing these reaction interviews.
- **Post-course savings interview:** We interviewed participants a year after they completed BOC training to understand the actions (if any) that they took as a result of what they learned, including energy efficiency projects and modifications to building or equipment operations. We provided a $100 incentive to participants for completing these post-course interviews.
- **Savings verification:** Due to COVID-19, we did not conduct any on-site audits to verify the details of any energy efficiency projects reported by the participants. In lieu of an on-site audit, we provided participants with an additional incentive to provide documentation of projects, where possible, to support the development of our impact calculations. We provided a $500 incentive to participants for providing us with the information we requested.

Through these activities, we gathered information about the energy-saving actions that participants took and how BOC training may have motivated participants to take these actions. Because BOC training indirectly influences participants to implement energy efficiency projects, program administrators do not track detailed information to estimate ex ante energy and demand savings. As a result, we can estimate savings only for participants who complete the post-course savings interview. Four participants completed the post-course savings interview, but we were only able to obtain sufficient information to estimate savings for one respondent; two other respondents reported that they completed energy efficiency projects as a result of their participation in BOC training, but these respondents did not respond to our follow-up data requests to support savings calculations (see Table 37).[35] The fourth participant reported that the BOC training did not impact their actions—they were already familiar with the information covered in the training but took the training at the request of their employer.

Savings resulting from training programs are akin to spillover in that they are follow-on actions taken by participants as a result of information received from program administrators. Based on guidance provided in the IL-TRM V9.0, the evaluation team treated these savings as participant spillover, which informed our methodology for determining program influence, as well as the timing of this evaluation.[36]

[35] The evaluation team followed up with each participant several times. We also shared the data requests with the implementation team, who contacted the participants separately to try and collect the information.
[36] IL-TRM V9.0 Attachment A: Illinois Statewide Net-to-Gross Methodologies. Page 37.

By their nature, follow-on actions from training interventions require time to be completed, particularly those aimed at encouraging upgrades in large commercial facilities. Because the 2020 BOC trainings occurred in Q3 and Q4 of 2020, the evaluation team felt strongly that the 2020 evaluation would not capture all the follow-on work completed by participants, given that most large commercial projects have long lead times. Therefore, we chose to evaluate follow-on savings resulting from the 2020 training as part of the 2021 evaluation. Similarly, because these savings were evaluated in the manner of spillover, we did not apply a NTGR to evaluated savings. The evaluation team calculated verified savings only for projects we deemed attributable to BOC training based on participant responses to attribution questions in the post-course interviews. A more detailed discussion of the evaluation methodology is provided in Appendix A.

3.8.2 Participation Summary

Table 51 summarizes participation in the 2020 BOC trainings by segment. Overall, eight AIC customers participated in the training.

Table 51. 2020 BOC Training Participation Summary

Participant ID	BOC Level	Segment
8001	I	Office
8002	I	Office
8003	I	Hospital/Medical
8004	I	Hospital/Medical
8005	I	Hospital/Medical
8006	I	Hospital/Medical
9004	II	Local Government
9005	II	Local Government

Table 52 summarizes student participation in each of the evaluation activities.

Table 52. Summary of Evaluation Activities by Student

Participant ID	Baseline Survey	Reaction Interview	Post-Course Savings Interview	Desk Reviews and Savings Verification
8001	✓	✓	✓	N/A
8002	✓	✓	✓	
8003	✓	✓		
8004	✓	✓		
8005	✓	✓	✓	
8006	✓	✓		
9004	✓	✓		
9005	✓	✓	✓	✓

Note: Participant 8001 reported that the BOC training did not influence any of their energy-related actions in the year following the training; therefore, a desk review/savings verification was not needed. Participant 8003 no longer worked for the organization at the time of the post-course interviews, and their contact information was no longer valid.

3.8.3 Initiative Annual Savings Summary

Table 53 presents the BOC training annual savings achieved in 2021. Overall, the 2020 BOC trainings led to 47 MWh in verified net savings.

Table 53. BOC Training Annual Savings Achieved in 2021

	Electric Energy Savings (MWh)	Electric Demand Savings (MW)	Gas Savings (Therms)
Verified Net Savings	47.3	0	0

3.8.4 Initiative Savings Detail

Table 54 presents BOC training annual savings achieved in 2021, broken out by project.

Table 54. BOC Training Electric Energy, Demand, and Gas Savings by Participant

Measure	Verified Net Savings		
	Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
Integrate HVAC equipment into EMS	47	0	0
Integrate circulating pumps into EMS	0.3	0	0

The participant for which we estimated BOC savings also enrolled in other AIC initiatives in 2020 and 2021.[37] The participant saved an additional 2.88 MWh of verified net energy savings through the Instant Incentive channel of the Standard Initiative. Therefore, approximately 94% of the participant's total verified energy savings achieved in 2020 and 2021 are not attributable to other AIC initiatives and are therefore claimable by BOC training.

[37] This evaluation quantifies the energy savings produced in the year following the 2020 BOC training. Therefore, our analysis period spans 2020 and 2021. As a result, the evaluation team conducted a cross-participation analysis for the year following the training to: (1) ensure that we did not claim savings for the BOC training that were already claimed through other initiatives (in 2020 or 2021), and (2) identify all cases where BOC students participated in other AIC initiatives following the training.

3.8.5 Cumulative Persisting Annual Savings

Table 55 presents CPAS achieved in 2021 as a result of BOC training and the resulting and WAML. The table also includes a summary of the measure-specific and total verified gross savings for BOC, as well as CPAS in 2021–2024 and 2030.[38] The WAML for the Initiative is 15.0 years.

Table 55. BOC Training CPAS Achieved in 2021 and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross Savings (MWh)	NTGR	CPAS – Verified Net Savings (MWh)							Lifetime Savings (MWh)
				2021	2022	2023	2024	…	2030	…	
Integrate HVAC equipment into EMS	15.0	47.0	N/A	47.0	47.0	47.0	47.0	…	47.0	…	705
Integrate circulating pumps into EMS	15.0	0.3	N/A	0.3	0.3	0.3	0.3	…	0.3	…	5
2021 CPAS		**47.3**	**N/A**	**47.3**	**47.3**	**47.3**	**47.3**	…	**47.3**	…	**709**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	…	**0**	…	
Expired 2021 CPAS				**0**	**0**	**0**	**0**	…	**0**	…	
WAML	**15.0**										

[38] For further details, including achieved CPAS in years not presented in this table, please see Appendix C.

Appendix A. Impact Analysis Methodology

Standard Initiative – Core

Gross Impact Methodology

The evaluation team calculated verified savings for Standard Core by applying savings algorithms from the IL-TRM V9.0. The team leveraged initiative tracking data such as primary heating and cooling type, the delivery mechanism (e.g., direct install, midstream), 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 V9.0. Table 56 lists the measures in Standard Core, their corresponding IL-TRM entry, and whether or not TRM errata applied to the measure in the 2021 evaluation. For HVAC measures—denoted by a TRM entry starting 4.4—the TRM errata updated the 4.4 HVAC overarching effective full load hour tables, which affects only those measures that rely on the tables. Not all HVAC measures use those tables.

Table 56. Standard Initiative – Core Offering Measures Evaluated

Evaluation Measure Category	IL-TRM Measure	Errata Applied?
Commercial LED Grow Lights	4.1.11	No errata present for this measure
Commercial Solid and Glass Door Refrigerators and Freezers	4.2.2	No errata present for this measure
Commercial Steam Cooker	4.2.3	No errata present for this measure
ENERGY STAR® Dishwasher	4.2.6	No errata present for this measure
ENERGY STAR® Fryer	4.2.7	No errata present for this measure
ENERGY STAR® Hot Food Holding Cabinets	4.2.9	No errata present for this measure
Kitchen Demand Ventilation Controls	4.2.16	No errata present for this measure
Rack Oven – Double Oven	4.2.18	No errata present for this measure
Water Heater	4.3.1	Errata applied
Space Heating Boiler Tune-up	4.4.2	Errata applied
Process Boiler Tune-up	4.4.3	No errata present for this measure
Electric Chiller	4.4.6	Errata applied
High Efficiency Boiler	4.4.10	Errata applied
High Efficiency Furnace	4.4.11	Errata applied
Package Terminal Air Conditioner (PTAC) and Package Terminal Heat Pump (PTHP)	4.4.13	Errata applied
Single-Package and Split System Unitary Air Conditioners	4.4.15	Errata applied
Steam Trap Replacement or Repair	4.4.16	Errata applied
Variable Speed Drives for HVAC Pumps and Cooling Tower Fans	4.4.17	No errata present for this measure
Demand Controlled Ventilation	4.4.19	No errata present for this measure
Variable Speed Drives for HVAC Supply and Return Fans	4.4.26	No errata present for this measure
High Temperature Heating and Ventilation (HTHV) Direct Fired Heater	4.4.39	No errata present for this measure
Advanced Rooftop Controls (ARC)	4.4.41	No errata present for this measure

Evaluation Measure Category	IL-TRM Measure	Errata Applied?
Small Commercial Thermostats	4.4.48	Errata applied
Fluorescent Delamping	4.5.2	No errata present for this measure
LED Bulbs and Fixtures	4.5.4	No errata present for this measure
Commercial LED Exit Signs	4.5.5	No errata present for this measure
Lighting Controls	4.5.10	No errata present for this measure
LED Streetlighting	4.5.16	No errata present for this measure
Door Heater Controls for Cooler or Freezer	4.6.3	No errata present for this measure
Electronically Commutated Motors (ECM) for Walk-In and Reach-In Coolers/Freezers	4.6.4	No errata present for this measure
Evaporator Fan Control for Electrically Commutated Motors	4.6.6	No errata present for this measure
VSD Air Compressor	4.7.1	No errata present for this measure
Compressed Air Low Pressure Drop Filters	4.7.2	No errata present for this measure
Compressed Air No-Loss Condensate Drains	4.7.3	No errata present for this measure
Efficient Compressed Air Nozzles	4.7.4	No errata present for this measure
Compressed Air Storage Receiver Tank	4.7.10	No errata present for this measure
Variable Speed Drives for Process Fans	4.8.13	No errata present for this measure

Non-TRM Measures

Process VSDs are available through the Standard Initiative – Core VSD Offering and include installations for both process fans and process pumps. The IL-TRM V9.0 Volume 2 includes a VSD measure for process fans but does not provide an approach for calculating gross impacts for process pump VSDs. For VSDs controlling process pumps, the evaluation team used the approach summarized below.

Variable-Speed Drives for Process Pumps

The evaluation team applied a mix of methods to evaluate verified savings, including the use of IL-TRM V9.0 Section 4.8.13 algorithms and assumptions in coordination with a 2010 memorandum[39] that provides guidance on capping savings at a percentage of estimated base energy consumption. The following discussion details the evaluation team's methods for evaluating verified savings.

The evaluation team adopted the IL-TRM V9.0 Section 4.8.13 algorithms for calculating the base energy consumption of processes before the installation of VSDs. The algorithms for calculating verified energy and demand savings are provided below in Equation 1 through Equation 3, with all input variable descriptions and values, if deemed, provided in Table 57:

Equation 1. Base Annual Electric Energy Usage

$$kWh_{base} = \left[\left(0.746 \times HP \times \frac{LF}{\eta_{motor}}\right) \times RHRS_{Base} \times \sum_{0\%}^{100\%} (\%FF \times PLR_{Base})\right]$$

[39] The memorandum titled "Recommendations for Verifying Savings for non-HVAC VFDs" was submitted in response to program administrator comments regarding the PY2 evaluation methods for non-HVAC VSDs.

Equation 2. VSD Electric Energy Savings for Process Pumps

$$\text{Energy (kWh)} = kWh_{base} \times ESF$$

Equation 3. VSD Electric Demand Savings for Process Pumps

$$\text{Demand (kW)} = \left[\left(0.746 \times HP \times \frac{LF}{\eta_{motor}}\right) \times PLR_{Base,FFpeak}\right] \times ESF$$

Energy and demand savings are capped by the energy savings factor (ESF) of 42% for pump applications. To ensure that savings are capped, the evaluation team compares the verified energy and demand savings against the claimed savings. If the proportion of claimed savings to kWh_{base} is greater than the savings limit, then the savings limit is applied to the kWh_{base}. If the proportion is less than the claimed savings, then the claimed savings are accepted as the verified savings.

Table 57. Deemed Inputs for VSD Calculations

Algorithm Variable	Description	Value	Source
kWh_{base}	Base energy consumption of the existing motor prior to installation of the VSD	Calculated	IL-TRM V9.0
HP	Nominal horsepower of controlled motor	Actual value	Initiative tracking database
Motor LF	Motor load factor	75%	2010 memorandum [b]
Σ (%FF * PLR)	Flow Fraction and Part Load Ratio factor; assumes "No Control or Bypass Damper"	1	IL-TRM V9.0
ηmotor	Installed nominal/nameplate motor efficiency, based on horsepower[a]	NEMA Standard	Extracted from IL-TRM V9.0 Table of NEMA Motor Efficiencies
RHRSbase	Annual operating hours of base motor	Actual value	Initiative tracking database
ESF (pump)	Energy Savings Factor for pump applications	42%	2010 memorandum [b]

[a] Default motor type is a National Electrical Manufacturers Association (NEMA) Premium Efficiency, Open Drip Proof, 4-pole/1800 RPM fan motor.
[b] *Recommendations for Verifying Savings for non-HVAC VFDs* provides details on load factor and ESF assumptions.

The evaluation team will continue to apply the methods outlined above to calculate verified savings for VSDs installed on process pumps until the IL-TRM provides guidance for this application of VSDs.

Measure Lives and Cumulative Persisting Annual Savings

For prescriptive measures, the evaluation team applied measure lives from the IL-TRM V9.0. The measure life a process pump VSD is 15 years, in alignment with the IL-TRM V9.0 VSD for Process Fans measure lives.

Net Impact Methodology

The evaluation team applied SAG-approved 2021 NTGRs to verified gross savings to calculate verified net savings. Table 58 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 58. SAG-Approved Standard Initiative – Core NTGRs

Measure	Electric NTGR	Gas NTGR
SLB	0.839	0.839[a]
HVAC	0.683	0.426
HVAC – Thermostats	0.842	0.713
MHVAC	0.890	N/A
MHVAC – Thermostats	0.880	0.880
VSDs	0.833	N/A
SE	0.849	0.675
STRR	0.608[b]	0.608

[a] The SAG-approved electric NTGRs for lighting measures are also applied to gas heating penalties associated with lighting measures for cost-effectiveness purposes.

[b] The SAG-approved gas NTGRs are also applied to secondary electric energy savings for water supply and wastewater treatment.

Standard Initiative – Small Business Direct Install

Gross Impact Methodology

The evaluation team calculated verified savings for the Standard Initiative's SBDI channel by applying savings algorithms from the IL-TRM V9.0. The team leveraged initiative tracking data such as existing and proposed LED wattages, LED lamp type, project location (e.g., for weather-dependent variables), and installed measure location to inform savings assumptions. For variables outside these parameters, the evaluation team relied on defaults from the IL-TRM V9.0. Table 59 lists the measures in the SBDI channel, their corresponding IL-TRM entry, and whether or not TRM errata applied to the measure in the 2021 evaluation.

Table 59. Standard Initiative - SBDI Measures Evaluated

Evaluation Measure Category	IL-TRM Measure	Errata Applied?
Fluorescent Delamping	4.5.2	No errata present for this measure
LED Fixtures	4.5.4	No errata present for this measure
Exit Signs	4.5.5	No errata present for this measure
Lighting Controls	4.5.10	No errata present for this measure
Automatic Door Closer for Walk-In Coolers and Freezers	4.6.1	No errata present for this measure
Beverage and Snack Machine Controls	4.6.2	No errata present for this measure
Door Heater Controls for Cooler or Freezer	4.6.3	No errata present for this measure
ECMs for Walk-In and Reach-In Coolers/Freezers	4.6.4	No errata present for this measure
Evaporator Fan Control for Electrically Commutated Motors	4.6.6	No errata present for this measure
Q-Sync Motors for Reach-in Coolers/Freezers	4.6.11	No errata present for this measure

Measure Lives and Cumulative Persisting Annual Savings

For prescriptive measures, the evaluation team applied measure lives from the IL-TRM V9.0.

Net Impact Methodology

The evaluation team applied SAG-approved 2021 NTGRs to verified gross savings to calculate verified net savings. Table 60 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 60. SAG-Approved Standard Initiative – SBDI NTGRs

Measure	Electric NTGR
All SBDI Measures	0.908

Standard Initiative – Instant Incentives and Online Store

Gross Impact Methodology

The evaluation team calculated verified savings for the Standard Initiative's Instant Incentives and Online Store channels by applying savings algorithms from the IL-TRM V9.0. The team leveraged initiative tracking data such as primary heating and cooling type, LED wattage, LED lamp type, LED lumens, project location (e.g., for weather-dependent variables), and building/space type to inform savings assumptions. For variables outside these parameters, the evaluation team relied on defaults from the IL-TRM V9.0. Table 61 lists the measures in the Instant Incentives and Online Store channels, their corresponding IL-TRM entry, and whether or not TRM errata applied to the measure in the 2021 evaluation. For advanced thermostats, the TRM errata updated the 4.4 HVAC overarching effective full load hour tables.

Table 61. Standard Initiative – Instant Incentives and Online Store Measures Evaluated

Evaluation Measure Category	IL-TRM Measure	Errata Applied?
Lighting – Standard LED, Specialty LED, and Linear LEDs	4.5.4	No errata present for this measure
Lighting Controls	4.5.10	No errata present for this measure
Advanced Thermostats	4.4.48	Errata applied
Advanced Power Strip – Tier 1	4.8.7	No errata present for this measure

Measure Lives and Cumulative Persisting Annual Savings

For prescriptive measures, the evaluation team applied measure lives from the IL-TRM V9.0.

Net Impact Methodology

The evaluation team applied SAG-approved 2021 NTGRs to verified gross savings to calculate verified net savings, outlined in Table 62.

Table 62. SAG-Approved Standard Initiative – Instant Incentives/Online Store Offerings NTGRs

Measure	Electric NTGR	Gas NTGR
Instant Incentives		
Lighting – Linear LED	0.813	0.813
Lighting – Specialty/Standard LED	0.670	0.670
Online Store		
Advanced Thermostat	0.880	0.880
All Other Online Store Measures	1.156	1.156

Custom Initiative

Gross Impact Methodology

The evaluation team's gross impact analysis for the Custom Initiative used desk reviews and on-site M&V to determine verified gross impacts. Overall, the evaluation team reviewed a total of 44 Custom projects.

The evaluation team completed desk reviews (and in most cases, on-site M&V to provide increased accuracy) at a sample of 44 (Core and NCL) projects to determine gross impact results. Desk reviews were used to compare the inputs provided in the application to the assumptions used in the analysis, verify consistency in savings estimates throughout the project file, and provide insight into the validity of the ex ante energy savings. The team accomplished this by reviewing the submitted information and calculations for consistency, accuracy, and correct application of engineering principles.

Sampling Approach

We selected the sample of 2021 projects for evaluation in three waves, drawing each sample from the entire population of completed Custom projects. As part of this process, we selected projects independently by fuel type and by wave to satisfy random sampling requirements.

We chose the sample of 44 Custom projects using a stratified random sample design targeting 10% relative precision at 90% level of confidence. For the stratification, we used the Dalenius-Hodges method to determine strata boundaries and the Neyman allocation to determine the optimal allocation of the available projects to the strata. In total, the sample drawn included 29 projects chosen for the electric sample and 21 projects chosen for the gas sample. The 50 reviews across 44 unique projects that we conducted account for 64% of the total ex ante gross electric energy savings and 75% of ex ante gas savings. Table 63 and Table 64 present details around the sample of electric and gas projects chosen for the 2021 evaluation.

Table 63. Custom Sampling Approach for Projects with Electric Savings

Wave	Sampling Stratum	Savings Range	Population of Projects		Completed Reviews	
			Count	Ex Ante MWh	Count	Ex Ante MWh
1	1	< 89 MWh	21	745	3	185
	2	> 89 MWh & < 259 MWh	11	1,694	2	290
	3	> 259 MWh & < 1,052 MWh	12	6,129	12	6,129
	4	> 1,052 MWh	1	1,053	1	1,053
		Subtotal	*45*	*9,621*	*18*	*7,657*
2	1	< 441 MWh	24	2,237	2	59
	2	> 441 MWh & < 1,278 MWh	6	4,933	1	719
	3	> 1,278 MWh & < 10,358 MWh	2	6,917	2	6,917
	4	> 10,358 MWh	1	10,358	1	10,358
		Subtotal	*33*	*24,446*	*6*	*18,053*
3	1	< 366 MWh	34	4,108	2	355
	2	> 366 MWh & < 961 MWh	8	4,092	1	655
	3	> 961 MWh & < 6,180 MWh	4	5,904	1	1,629
	4	> 6,180 MWh	1	6,181	1	6,181
		Subtotal	*47*	*20,285*	*5*	*8,820*
		Total	**125**	**54,352**	**29**	**34,530**

Table 64. Custom Sampling Approach for Projects with Gas Savings

Wave	Sampling Stratum	Savings Range	Population of Projects		Completed Reviews	
			Count	Ex Ante Therms	Count	Ex Ante Therms
1	1	< 10,400 therms	2	17,623	1	8,592
	2	> 10,400 & < 49,000 therms	3	83,259	3	83,259
	3	> 49,000 therms	3	254,717	3	254,717
		Subtotal	8	355,599	7	346,568
2	1	< 9,900 therms	3	6,145	2	7,952
	2	> 9,900 & < 19,000 therms	3	42,453	2	30,234
	3	> 19,000 & < 78,000 therms	2	42,365	2	42,365
	4	> 78,000 therms	1	78,559	1	78,559
		Subtotal	9	169,522	7	159,109
3	1	< 13,040 therms	8	42,384	1	4,890
	2	> 13,040 & < 46,100 therms	12	238,158	3	70,337
	3	> 46,100 therms	4	352,547	3	286,604
		Subtotal	24	633,089	7	361,831
	Total		**41**	**1,158,210**	**21**	**867,508**

To estimate the Initiative's verified savings, the evaluation team used the combined ratio adjustment method.[40] As described in Equation 4, we calculated the gross realization rate based on the desk reviews (and on-site M&V for the majority of projects) for a stratified random sample of projects. We

[40] Cochran, William G. *Sampling Techniques*. New York: John Wiley & Sons,1977.

then used the ratio of the verified gross savings to the ex ante gross savings (the realization rate) to adjust the ex ante gross savings for the population of all 2021 Custom projects with savings (N=134).

Equation 4. Ratio Adjustment Method

$$I_{EP} = \frac{I_{EPS}}{I_{EAS}} * I_{EA}$$

Where:

I_{EP} = the verified population energy and demand impacts
I_{EA} = the ex ante population energy and demand impacts
I_{EPS} = the verified sample energy and demand impacts
I_{EAS} = the ex ante sample energy and demand impacts

Precision Calculations

We calculated precision for our gross impact results by pooling the results from all waves of site visits[41]. To calculate relative precision, the team first determined the variance in the sample and then calculated the standard error and confidence interval. Equation 5 through Equation 8 were used.

Equation 5. Stratified Ratio Estimator

$$Stratified\ Ratio\ Estimator = \frac{\sum_{i=1}^{n} w_i\ y_i}{\sum_{i=1}^{n} w_i\ x_i}$$

Equation 6. Standard Error

$$Standard\ Error = \frac{1}{\hat{X}} \sqrt{\sum_{i=1}^{n} w_i\ (w_i - 1)\ e_i^2}$$

Equation 7. Confidence Interval

$$90\%\ Confidence\ Interval = \ 1.645 * Standard\ Error$$

Equation 8. Relative Precision

$$Relative\ Precision = \frac{90\%\ Confidence\ Interval}{Stratified\ Ratio\ Estimator}$$

Where:

w = case weights for each stratum h (Nh/nh)
y = verified savings
x = ex ante savings
e = yi – b xi
$\hat{X} = \ w_i\ x_i$

[41] The error bound of the total savings is estimated by calculating the square root of the sum of the squared error bounds of each wave or group of projects. These calculations are consistent with California Evaluation Framework.

Measure Lives and Cumulative Persisting Annual Savings

In accordance with methods presented and discussed in the IL-TRM V9.0 Attachment B,[42] the evaluation team reviewed the ex ante measure life assumptions provided by the implementation team for sampled Custom projects in 2021 and revised these assumptions where necessary. We then calculated an adjustment to ex ante measure lives in a manner similar to that of calculating a gross savings realization rate and applied that adjustment to all population ex ante measure lives. Table 65 provides a summary of Custom Initiative project measure lives that were adjusted after evaluation. All other ex ante measure lives in our sample were determined to have been appropriately applied.

Table 65. Custom Measure Life Adjustment due to Evaluation

Project Number	End Use	Measure Life		Rationale for Adjustment
		Ex Ante	Verified	
2000158	Custom Lighting	6.1	9.3	EUL was modified to be a non-weighted average of all fixtures. Verified EUL was calculated by taking a 50,000-hour average lifetime divided by the average yearly operating hours.
2000305	Custom Compressed Air	13.0	15.0	IL-TRM V9.0 Measure 4.7.7 deems an EUL of 15 years for this measure type.
2000349	Custom HVAC	20.0	25.0	IL-TRM V9.0 Measure 4.4.10 deems a measure life of 25 years for this measure type.
2001142	Custom HVAC	10.0	15.0	The EUL used in the ex ante was for HVAC applications. The verified EUL is for a similar measure that is specifically meant for kitchen applications, which better matches this project's end use.
2001187	Custom HVAC	21.0	16.0	EUL for high turndown boiler was 21 years, oxygen trim 18 years, and linkageless controls 16 years. The lowest EUL should be used to be conservative, as the savings beyond year 16 may no longer be attributable to the linkageless controls measure from this project.
2100062	Custom HVAC	20.0	16.0	The evaluation team updated the EUL reference to the most recent version of the Illinois TRM. This changed the EUL value from 20 years to 16 years.
2100106	Custom Lighting	5.7	8.0	The top 3 fixtures with the largest impact on savings (accounting for 61% of total wattage reduction) had 70,000-hour lifetimes, not 50,000-hour.

Net Impact Methodology

The evaluation team applied SAG-approved 2021 NTGRs to verified gross savings to calculate verified net savings. Table 66 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 66. SAG-Approved Custom NTGRs

Measure	Electric NTGR	Gas NTGR
Core Custom	0.8222	0.9385
New Construction Lighting	0.8222	0.9385

[42] Illinois Statewide Technical Reference Manual – Attachment B: Effective Useful Life for Custom Measure Guidelines.

Retro-Commissioning Initiative

This section discusses the impact analysis methodology used to evaluate the legacy RCx Initiative channels (e.g., Large Facilities Retro-Commissioning). Virtual Commissioning™ is discussed separately in the next section.

Gross Impact Methodology

The evaluation team examined Initiative impacts to estimate a realization rate of savings between ex ante and verified gross savings. The evaluation team conducted engineering desk reviews and virtual site visits for a census of projects to determine verified gross savings.

The engineering desk reviews consisted of a thorough examination of all available project documentation, including project reports, communications, equipment submittals, and calculations, and any other project-specific data that were available to our team. The evaluation team also conducted virtual site visits to verify measure status and collect supplemental data, as needed.

Because the evaluation team reviewed all projects, there is no sampling error around impact evaluation results.

Measure Lives and Cumulative Persisting Annual Savings

In accordance with the methodology presented and discussed in the IL-TRM Attachment B, the evaluation team reviewed the ex ante measure life assumptions provided by the implementation team for all RCx Initiative projects in 2021.

Table 67 provides a summary of the RCx Initiative project measure lives that were adjusted after evaluation.

Table 67. Retro-Commissioning Initiative Measure Life Adjustment Due to Evaluation

Project Number	Channel	Measure Life		Rationale for Adjustment
		Ex Ante	Verified	
1800330	Large Facilities Retro-Commissioning	8.8	8.6	Ex ante used incorrect value from IL-TRM V9.0.[a]
2100083	Large Facilities Retro-Commissioning	7.5	8.6	Ex ante used outdated value from IL-TRM V7.0.

[a] Please note that IL-TRM V9.0 Attachment B provides a measure life of 8.8 years for electric RCx measures. This is a typo, which has since been corrected for IL-TRM V10.0. The correct measure life is 8.6 years, as described in Navigant Memo to ComEd Re: Effective Useful Life for Retro-Commissioning and Behavior Programs: https://ilsag.s3.amazonaws.com/ComEd-EUL-Comm-RCx-and-Behavior-Memo-2019-09-17.pdf.

Net Impact Methodology

The evaluation team applied SAG-approved 2021 NTGRs to verified gross savings to calculate verified net savings. Table 68 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 68. SAG-Approved Retro-Commissioning NTGRs

Measure	Electric NTGR	Gas NTGR
Large Facilities Retro-Commissioning	0.940	0.940

Virtual Commissioning™

The evaluation team evaluated gross savings resulting from Virtual Commissioning™ in 2021 by replicating and verifying Power TakeOff's facility-level modeling approach.

Impact Analysis Methodology

Data Review and Cleaning

Opinion Dynamics used each facility's raw AMI data, provided by Power TakeOff, to independently verify the data cleaning process that Power TakeOff used to estimate their models. The evaluation team received AMI data in both hourly and 15-minute intervals and reviewed the data for completeness.

During the data review process, the evaluation team identified several minor data provision issues, which contributed to discrepancies between the evaluation team's and Power Takeoff's calculations of baseline energy consumption and efficient energy consumption, as well as other results that draw on these inputs, including normalized energy savings:

- Seven sites were missing dates specifying either the start or the end of an NRE;
- Power TakeOff identified a slight error in how they handled the change dates, which impacted the actual change date in the model; and
- When Power TakeOff provided data to the evaluation team, they omitted a portion of the AMI data that should have been included in the models.

Modeling Approach

The evaluation team verified the electric savings results Power TakeOff claimed for Virtual Commissioning™ by validating their site-level model specifications and replicating Power TakeOff's results. To calculate annualized savings, we first developed regression-based baseline energy usage models. We then used these baseline models, together with Typical Meteorological Year Version 3 (TMY3) data, to estimate normalized gross annual savings.

Following Power TakeOff's process, we developed the baseline model by fitting a regression model to pre- and post-intervention data. Power TakeOff selected either an hourly or a daily regression model, depending on the project. Model specifications also differed depending on whether there was a non-routine event (NRA), or if weather interactions were included. Power TakeOff estimated hourly models for 38 facilities and daily models for 12 facilities. Opinion Dynamics evaluated the same model specification for each project (daily or hourly) as Power TakeOff.

Power TakeOff enrolls sites on a rolling basis throughout the program year. As a result, not all sites had a full year of post-period data available. This introduces bias because the model was not able to train on a full range of temperature data after the intervention was initiated. This may increase the prediction error of the model.

Time Based Regression Model

Equation 9 through Equation 12 below describe the four model specifications utilized in our evaluation.

Equation 9. Regression Model Considering Time Interactions

$$E(i) = \sum_{j=1}^{k} \beta_j Time(i) + \alpha_j Change(i) + H(i) + C(i) + \left(\sum_{j=1}^{k} \beta_j Time(i) * \alpha_j Change(i) \right)$$

Equation 10. Regression Model Considering Time and Weather Interactions

$$E(i) = \sum_{j=1}^{k} \beta_j Time(i) + \alpha_j Change(i) + H(i) + C(i) + \left(\sum_{j=1}^{k} \beta_j Time(i) * \alpha_j (Change(i) \right) + \Big(\big(H(i) + C(i) \big) * \alpha_j Change(i) \Big)$$

Equation 11. Regression Model Considering Time and NRA Interactions

$$E(i) = \sum_{j=1}^{k} \beta_j Time(i) + \alpha_j Change(i) + H(i) + C(i) + NRA(i) + \left(\sum_{j=1}^{k} \beta_j Time(i) * \alpha_j Change(i) \right) + \left(\sum_{j=1}^{k} \beta_j Time(i) * NRA(i) \right)$$

Equation 12. Regression Model Considering Time, Weather, and NRA Interactions

$$E(i) = \sum_{j=1}^{k} \beta_j Time(i) + \alpha_j Change(i) + H(i) + C(i) + NRA(i) + \left(\sum_{j=1}^{k} \beta_j Time(i) * \alpha_j Change(i) \right) + \left(\sum_{j=1}^{k} \beta_j Time(i) * NRA(i) \right) + \Big(\big(H(i) + C(i) \big) * \alpha_j Change(i) \Big) + \Big(\big(H(i) + C(i) \big) * \mathrm{NRA}(i) \Big)$$

Across these four specifications, two time-based models were run.

Where daily consumption data were present, the time used in *j* was the day of the week, *k* represents 1 through 7 for the days in a week, and $H(i)$ [the heating component] and $C(i)$ [the cooling component] represent $HDD(i)$ and $CDD(i)$ respectively. $CDD(i)$ and $HDD(i)$ represent the total cooling degree days and total heating degree days for day i, respectively, and are defined as:

$$CDD(i) = \sum_{j=1}^{24} \max\left(Temp(j) - CBP, 0 \right)$$

$$HDD(i) = \sum_{j=1}^{24} \max\left(HBP - Temp(j), 0 \right)$$

where $Temp(j)$ is temperature in degrees Fahrenheit for hour j of day i, and CBP and HBP are the cooling balance point and heating balance point, respectively.[43]

Power TakeOff used a grid-search algorithm to determine CBP and HBP. The grid search runs the daily regression model repeatedly for various combinations of CBP and HBP and selects the combination with the highest adjusted R^2 as the best-fitting CBP and HBP. The selected CBP and HBP are then used in the final model evaluation. Due to the lack of hourly temperature data for the twelve facilities for which Power TakeOff estimated the daily model, the evaluation team could not validate Power TakeOff's chosen values of CBP and HBP.

Where hourly data were present, the time period *j* used was the hour of the week and *k* represents the hours in a week (1 of 168). $H(i)$ represents the heating component while $C(i)$ reflects the cooling component. $H(i)$ is defined as:

$$H(i) = h_1 T_1(i) + h_2 T_2(i) + h_3 T_3(i) + h_4 T_4(i)$$

Where:

$$T_1(i) = \min(\max(55 - Temp(i), 0), 10)$$
$$T_2(i) = \min(\max(45 - Temp(i), 0), 10)$$
$$T_3(i) = \min(\max(35 - Temp(i), 0), 15)$$
$$T_4(i) = \max(20 - Temp(i), 0)$$

$Temp(i)$ is temperature in degrees Fahrenheit for hour i.

$C(i)$ is defined as:

$$\mathrm{C}(i) = c_1 P_1(i) + c_2 P_2(i) + c_3 P_3(i) + c_4 P_4(i)$$

Where

$$P_1(i) = \min(\max(Temp(i) - 55, 0), 10)$$
$$P_2(i) = \min(\max(Temp(i) - 65, 0), 10)$$
$$P_3(i) = \min(\max(Temp(i) - 75, 0), 15)$$
$$P_4(i) = \max(Temp(i) - 90, 0)$$

$Time(i)$ is an indicator variable set to one if i is the j^{th} hour of the week or day of the week and zero otherwise. $Change(i)$ is the treatment variable, set to one if hour i occurs during the reporting period and zero otherwise.

NRA(i) is a flag for all nonroutine adjustment periods. There can be multiple NRA periods per model; each NRA is treated as separate and will add a new set of NRA terms and interactions if applicable.

Normalized Gross Annual Savings

To verify gross annual savings resulting from the Virtual Commissioning™ pilot, the evaluation team first estimated the hourly model for 38 facilities and daily model for 12 facilities using actual weather data. Next, we calculated annual predicted baseline and reporting period electricity consumption for each facility using estimated regression coefficients and TMY3 weather data. Finally, we computed the annual savings by calculating the difference between the annual predicted baseline and reporting

[43] A balance point is the point at which a customer theoretically turns on their heating or cooling.

period electricity consumption. The following equations show how we calculated the gross annual savings in detail.

For each facility for which Power TakeOff estimated the hourly regression model specified in Equation 9 through Equation 12, the evaluation team calculated hourly predicted baseline period electricity consumption based on Equation 13 defined below. Equation 13 contains the maximum terms that would be used to calculate the baseline. Models that do not include an NRA (Equation 9 and Equation 10) will not include NRA terms.

Equation 13. Hourly Predicted Baseline Period Electricity Consumption

$$E_B(i) = \sum_{j=1}^{7\times24} \hat{\beta}_j HOW_j(i) + \hat{H}(i) + \hat{C}(i) + NRA(i) + \left(\sum_{j=1}^{7\times24} \beta_j HOW_j(i) * NRA(i)\right) + \left(\left(\hat{H}(i) + \hat{C}(i)\right) * \mathrm{NRA}(i)\right)$$

In Equation 13, $E_B(i)$ is predicted baseline period electricity consumption for hour i. $\hat{\beta}_j$ is the estimated coefficient on the j^{th} hour/day of the week indicator variable as defined in Equation 9 through Equation 12, $\hat{H}(i)$ and $\hat{C}(i)$ specified below are estimated heating and cooling components evaluated using TMY3 weather data and regression coefficients.

$$\hat{H}(i) = \hat{h}_1 T_1(i) + \hat{h}_2 T_2(i) + \hat{h}_3 T_3(i) + \hat{h}_4 T_4(i)$$
$$\hat{C}(i) = \hat{c}_1 P_1(i) + \hat{c}_2 P_2(i) + \hat{c}_3 P_3(i) + \hat{c}_4 P_4(i)$$

We calculated hourly reporting period electricity consumption based on Equation 14 defined below. Equation 14 contains the maximum terms that would be used to calculate the reporting period. Models that do not interact the *Change* variable with weather (Equation 9 and Equation 11) will not include that interaction.

Equation 14. Hourly Predicted Reporting Period Electricity Consumption

$$E_R(i) = \sum_{j=1}^{7\times24} \hat{\beta}_j HOW_j(i) + \hat{H}(i) + \hat{C}(i) + \alpha_j Change(i) + \left(\sum_{j=1}^{7\times24} \beta_j HOW_j(i) * \alpha_j(Change(i)\right) + \left(\left(\hat{H}(i) + \hat{C}(i)\right) * \alpha_j Change(i)\right)$$

In Equation 14, $E_R(i)$ is predicted reporting period electricity consumption for hour i. $\hat{\alpha}_j$ is the estimated coefficient on the interaction term between the treatment variable and the j^{th} hour of the week indicator variable as defined for the hourly model versions of Equation 9 through Equation 12.

Annual savings were calculated as:

$$\sum_{i\in TMY} E_B(i) - \sum_{i\in TMY} E_R(i)$$

Where each sum was over all the hours in the TMY.

Similarly, for each facility for which Power TakeOff estimated the daily regression model specified in Equation 9 through Equation 12, the evaluation team calculated daily predicted baseline and reporting period electricity consumption based on Equation 15 and Equation 16 defined below. We calculated annual savings using the formula defined above, but the sum included all the days in the TMY.

Equation 15 below contains the maximum terms that would be used to calculate the daily baseline. Models that do not include an NRA (Equation 9 and Equation 10) will not include NRA terms. Equation 16 below contains the maximum terms that would be used to calculate the reporting period. Models that do not interact the *Change* variable with weather (Equation 9 and Equation 11) will not include that interaction.

Equation 15. Daily Predicted Baseline Period Electricity Consumption

$$E_B(i) = \hat{\beta}_0 + \sum_{j=1}^{7} \hat{\beta}_j W_j(i) + \hat{\beta}_7 CDD(i) + \hat{\beta}_8 HDD(i) + NRA(i) + \left(\sum_{j=1}^{7} \beta_j W_j(i) * NRA(i) \right) + \left(\left(\hat{\beta}_7 CDD(i) + \hat{\beta}_8 HDD(i) \right) * \mathrm{NRA}(i) \right)$$

Equation 16. Daily Predicted Reporting Period Electricity Consumption

$$E_R(i) = \hat{\beta}_0 + \sum_{j=1}^{7} \hat{\beta}_j W_j(i) + \hat{\beta}_7 CDD(i) + \hat{\beta}_8 HDD(i) + \alpha_j Change(i) + \left(\sum_{j=1}^{7} \beta_j W_j(i) * \alpha_j (Change(i) \right) + \left(\left(\hat{\beta}_7 CDD(i) + \hat{\beta}_8 HDD(i) \right) * \alpha_j Change(i) \right)$$

Non-Routine Events

Power TakeOff identified several types of NRE that occurred at participating sites in 2021, including shutdowns associated with the COVID-19 pandemic, school closures, and other variations in building operating schedules. Both teams handled these NREs in accordance with the IPMVP NRE guidelines[44] by dropping data for the affected period and extending the baseline back in time accordingly.

Model Fitness Criteria

To claim project savings as part of the Initiative, the model for each project must meet the following goodness-of-fit criteria:

- Absolute Value of Normalized Mean Bias Error (NMBE) < 0.5%
- Coefficient of Variation of Root Mean Square Error CV(RMSE) < 25%
- Savings Uncertainty < 50% at 68% confidence

These goodness-of-fit metrics were calculated consistent with industry best practices. Two projects did not meet savings uncertainty criteria.

Measure Lives and Cumulative Persisting Annual Savings

The evaluation team applied an EUL of 7.3 for Virtual Commissioning™ based on the most recent available Illinois-specific research.[45]

[44] Webster, Lia. (2020). IPMVP Application Guide on Non-Routine Events and Adjustments. Energy Valuation Organization (EVO).
[45] Harris, J. and Maoz, K. "ComEd EUL Research CY2020 Commercial Behavioral and Operations and Maintenance Measures EUL Values Delphi Panel Final Outcomes." (Memo provided to ComEd). 2020. Accessed at: https://ilsag.s3.amazonaws.com/ComEd-EUL-Research-CY2020-Final-Outcomes-Virtual-Delphi-Panel-2020-12-18.pdf.

Detailed Project Impacts

Detailed Project Savings

Table 69 presents the results of the net savings analysis for the 50 Virtual Commissioning™ projects completed in 2021. Realization rates for individual projects range from 0% to 109% for electric savings. Four projects had 0% realization rates. Two of these projects did not meet model uncertainty thresholds the other two projects (or sites) also claimed savings from cross-program participation in other AIC Initiatives. In these two cases, the savings resulting from the other AIC Initiatives were greater than the site-level savings resulting from Virtual Commissioning, which produced a 0% realization rate. We provide more details about projects with 0% realization rates in the following sections.

Table 69. 2021 Virtual Commissioning™ Annual Savings by Project

Project ID	Ex Ante Net kWh	Verified Net kWh[a]	Realization Rate
a1C1Q00000KnIvaUAB	112,673	107,746	96%
a1C1Q00000KnIvWUAR	20,832	20,561	99%
a1C1Q00000KnIvXUAR	27,289	27,785	102%
a1C1Q00000KnIvYUAR	175,321	173,682	99%
a1C1Q00000KnIvZUAR	31,280	31,541	101%
a1C1Q00000KnsP0UAJ	5,499	5,472	100%
a1C1Q00000KnsP1UAJ	58,963	0	0%
a1C1Q00000KnsP2UAJ	46,805	35,862	77%
a1C1Q00000LvwTuUAJ	44,765	44,880	100%
a1C1Q00000LvwTvUAJ	283,669	280,433	99%
a1C1Q00000LvwTwUAJ	28,352	27,572	97%
a1C1Q00000M5ORBUA3	16,150	0	0%
a1C1Q00000M5ORCUA3	48,922	49,468	101%
a1C1Q00000M5ORDUA3	9,059	8,912	98%
a1C1Q00000M5ORGUA3	112,979	112,891	100%
a1C1Q00000M5ORHUA3	214,185	213,506	100%
a1C1Q00000M5ORLUA3	93,464	93,692	100%
a1C1Q00000MBcC4UAL	143,506	117,925	82%
a1C1Q00000MBcC5UAL	185,519	185,476	100%
a1C1Q00000MBcC6UAL	27,954	27,799	99%
a1C1Q00000MBcC7UAL	35,474	35,428	100%
a1C1Q00000MBcC8UAL	25,130	25,240	100%
a1C1Q00000Met9tUAB	61,196	59,959	98%
a1C1Q00000Met9wUAB	23,520	23,635	100%
a1C1Q00000Met9zUAB	27,015	27,073	100%
a1C1Q00000MetA0UAJ	50,030	49,830	100%
a1C1Q00000MetA2UAJ	58,834	59,653	101%
a1C1Q00000MkczSUAR	144,652	144,528	100%
a1C1Q00000MkczVUAR	36,673	36,681	100%
a1C1Q00000MkczYUAR	213,213	208,910	98%
a1C1Q00000N0mEMUAZ	59,500	59,034	99%

Project ID	Ex Ante Net kWh	Verified Net kWh[a]	Realization Rate
a1C1Q00000N0mENUAZ	271,900	0	0%
a1C1Q00000N0mEPUAZ	35,867	35,805	100%
a1C1Q00000NjAbaUAF	14,984	14,803	99%
a1C1Q00000NjAbbUAF	76,674	75,867	99%
a1C1Q00000NjAbYUAV	116,244	110,172	95%
a1C1Q00000NJO5yUAH	88,080	83,961	95%
a1C1Q00000NJO5zUAH[b]	58,266	57,450	99%
a1C1Q00000NJO60UAH	87,663	87,651	100%
a1C1Q00000NJO61UAH	412,455	431,683	105%
a1C1Q00000NJO62UAH	54,786	53,897	98%
a1C1Q00000NJO63UAH	13,117	13,121	100%
a1C1Q00000NJO66UAH	75,962	74,134	98%
a1C1Q00000NvjknUAB	50,798	50,584	100%
a1C1Q00000NvjkoUAB	335,154	320,402	96%
a1C1Q00000NvjkqUAB	393,301	390,421	99%
a1C1Q00000NvjkrUAB	178,057	0	0%
a1C1Q00000NvjksUAB	22,732	22,949	101%
a1C1Q00000NvjktUAB	211,865	231,258	109%
a1C1Q000000OMvTYUA1	245,582	243,351	99%
Total	**5,165,907**	**4,592,682**	**89%**

[a] Note: Numbers may not sum due to rounding.

[b] The weather term modeling inputs for this project were summed instead of averaged based on model diagnostics

Table 70 shows the model goodness-of-fit metrics that Power TakeOff and the evaluation team produced for the 50 Virtual Commissioning™ projects. The evaluation team was unable to exactly reproduce Power TakeOff's adjusted R^2 values. Given that there are several formulas to calculate adjusted R^2, it is unclear which variation of formulas Power TakeOff used to produce these numbers.

Table 70. 2021 Virtual Commissioning™ Model Goodness-of-Fit Metrics by Project

Project ID	Adjusted R^2		CV(RMSE)		NMBE		Savings Uncertainty	
	Opinion Dynamics	Power TakeOff	Opinion Dynamics	Power TakeOff	Opinion Dynamics	Power TakeOff	Opinion Dynamics	Power TakeOff
a1C1Q00000KnIvWUAR	0.75	0.75	0.23	0.23	0%	0%	14%	15%
a1C1Q00000KnIvXUAR	0.78	0.78	0.22	0.21	0%	0%	15%	9%
a1C1Q00000KnIvYUAR	0.68	0.69	0.17	0.16	0%	0%	9%	4%
a1C1Q00000KnIvZUAR	0.77	0.78	0.21	0.21	0%	0%	34%	20%
a1C1Q00000KnIvaUAB	0.63	0.63	0.23	0.23	0%	0%	9%	5%
a1C1Q00000KnsP0UAJ	0.51	0.51	0.23	0.24	0%	0%	9%	9%
a1C1Q00000KnsP1UAJ	0.83	0.83	0.17	0.17	0%	0%	7%	6%
a1C1Q00000KnsP2UAJ	0.69	0.69	0.18	0.18	0%	0%	29%	28%
a1C1Q00000LvwTuUAJ	0.62	0.62	0.23	0.23	0%	0%	11%	7%
a1C1Q00000LvwTvUAJ	0.75	0.74	0.24	0.25	0%	0%	17%	13%
a1C1Q00000LvwTwUAJ	0.82	0.82	0.19	0.20	0%	0%	31%	19%
a1C1Q00000M5ORBUA3	0.83	0.83	0.16	0.16	0%	0%	16%	9%
a1C1Q00000M5ORCUA3	0.81	0.81	0.17	0.17	0%	0%	15%	21%
a1C1Q00000M5ORDUA3	0.74	0.74	0.20	0.20	0%	0%	46%	48%
a1C1Q00000M5ORGUA3	0.86	0.86	0.11	0.11	0%	0%	9%	5%
a1C1Q00000M5ORHUA3	0.77	0.77	0.21	0.21	0%	0%	13%	8%
a1C1Q00000M5ORLUA3	0.80	0.80	0.22	0.22	0%	0%	5%	4%
a1C1Q00000MBcC4UAL	0.79	0.79	0.24	0.25	0%	0%	28%	15%
a1C1Q00000MBcC5UAL	0.77	0.77	0.20	0.20	0%	0%	11%	8%
a1C1Q00000MBcC6UAL	0.90	0.90	0.12	0.12	0%	0%	21%	11%
a1C1Q00000MBcC7UAL	0.86	0.86	0.15	0.15	0%	0%	22%	19%
a1C1Q00000MBcC8UAL	0.93	0.93	0.10	0.10	0%	0%	8%	5%
a1C1Q00000Met9tUAB	0.90	0.90	0.14	0.14	0%	0%	12%	8%
a1C1Q00000Met9wUAB	0.88	0.88	0.16	0.17	0%	0%	9%	7%
a1C1Q00000Met9zUAB	0.91	0.91	0.10	0.10	0%	0%	4%	3%
a1C1Q00000MetA0UAJ	0.75	0.76	0.21	0.21	0%	0%	33%	27%
a1C1Q00000MetA2UAJ	0.83	0.82	0.12	0.12	0%	0%	10%	9%

Project ID	Adjusted R^2		CV(RMSE)		NMBE		Savings Uncertainty	
	Opinion Dynamics	Power TakeOff	Opinion Dynamics	Power TakeOff	Opinion Dynamics	Power TakeOff	Opinion Dynamics	Power TakeOff
a1C1Q00000MkczSUAR	0.77	0.77	0.17	0.17	0%	0%	21%	16%
a1C1Q00000MkczVUAR	0.78	0.78	0.10	0.10	0%	0%	7%	4%
a1C1Q00000MkczYUAR	0.81	0.81	0.19	0.19	0%	0%	15%	10%
a1C1Q00000N0mEMUAZ	0.52	0.52	0.18	0.18	0%	0%	31%	31%
a1C1Q00000N0mENUAZ	0.80	0.79	0.18	0.19	0%	0%	65%	26%
a1C1Q00000N0mEPUAZ	0.72	0.72	0.10	0.10	0%	0%	6%	5%
a1C1Q00000NJO5yUAH	0.85	0.85	0.20	0.20	0%	0%	11%	7%
a1C1Q00000NJO5zUAH	0.44	0.52	0.22	0.20	0%	0%	27%	32%
a1C1Q00000NJO60UAH	0.76	0.76	0.20	0.20	0%	0%	10%	5%
a1C1Q00000NJO61UAH	0.78	0.79	0.07	0.07	0%	0%	14%	10%
a1C1Q00000NJO62UAH	0.77	0.77	0.20	0.20	0%	0%	20%	14%
a1C1Q00000NJO63UAH	0.81	0.81	0.21	0.21	0%	0%	14%	15%
a1C1Q00000NJO66UAH	0.87	0.87	0.22	0.22	0%	0%	23%	15%
a1C1Q00000NjAbYUAV	0.84	0.84	0.21	0.21	0%	0%	11%	7%
a1C1Q00000NjAbaUAF	0.79	0.79	0.11	0.11	0%	0%	14%	12%
a1C1Q00000NjAbbUAF	0.71	0.71	0.19	0.20	0%	0%	14%	15%
a1C1Q00000NvjknUAB	0.76	0.75	0.17	0.17	0%	0%	9%	8%
a1C1Q00000NvjkoUAB	0.73	0.73	0.21	0.21	0%	0%	37%	22%
a1C1Q00000NvjkqUAB	0.78	0.78	0.21	0.21	0%	0%	12%	9%
a1C1Q00000NvjkrUAB	0.89	0.89	0.13	0.13	0%	0%	348%	31%
a1C1Q00000NvjksUAB	0.66	0.66	0.24	0.24	0%	0%	33%	31%
a1C1Q00000NvjktUAB	0.74	0.74	0.13	0.13	0%	0%	11%	11%
a1C1Q000000MvTYUA1	0.75	0.75	0.23	0.23	0%	0%	21%	13%

We rejected two projects because they failed to meet the savings uncertainty threshold of 50% at 68% confidence for the channel as project a1C1Q00000NvjkrUAB had a savings uncertainty value of 348% and project a1C1Q00000N0mENUAZ had a savings uncertainty value of 65%.

Uplift from Other AIC Initiatives

The savings analysis for the Virtual Commissioning™ offering considers energy savings that resulted from energy-efficient actions taken through other AIC Business Program initiatives. The evaluation team identified five Virtual Commissioning™ participants that completed projects through other AIC Business Program Initiatives after they began participating in the Virtual Commissioning™ offering in 2021. The evaluation team accounted for instances of cross-program participation by subtracting ex ante net electric deemed savings for each project completed through another AIC Initiative from the verified net electric savings from the Virtual Commissioning™ channel at the corresponding site. Table 71 summarizes the projects completed through other AIC Initiatives and the associated verified gross electric savings.

Table 71. Summary of Projects Completed through Other AIC Initiatives

Project ID	Source of Cross-Program Participation	Unadjusted Verified Net Savings from Virtual Commissioning	Ex Ante Net Energy Savings from Cross-Program Participation	Verified Net Savings Adjusted for Cross-Program Participation
a1C1Q00000KnIvaUAB	Instant Incentives	112,960	5,214	107,746
a1C1Q00000NJO5yUAH	SBDI	86,588	2,627	83,961
a1C1Q00000KnsP1UAJ	SBDI	59,605	76,250	-
a1C1Q00000KnsP2UAJ	Standard Lighting for Business	44,763	8,901	35,862
a1C1Q00000M5ORBUA3	SBDI	16,124	77,427	-

Net Impact Methodology

The evaluation team applied the SAG-approved 2021 NTGR of 1.000 to verified gross savings to calculate verified net savings. Table 72 outlines the SAG-approved NTGR value applied to verified gross savings to calculate verified net savings.

Table 72. SAG-Approved Virtual Commissioning™ NTGR

Measure	Electric NTGR
Virtual Commissioning™	1.000

Streetlighting Initiative

Gross Impact Methodology

The evaluation team calculated verified savings for the Streetlighting Initiative by applying savings algorithms from the IL-TRM V9.0. The team leveraged initiative tracking data such as fixture quantity, baseline fixture wattage and type, and LED wattage to inform savings assumptions. For variables outside these parameters, the evaluation team relied on defaults from the IL-TRM V9.0. Table 73 lists the measures in the Streetlighting Initiative, their corresponding IL-TRM entry, and whether or not TRM errata applied to the measure in the 2021 evaluation.

Table 73. Streetlighting Initiative Measures Evaluated

Evaluation Measure Category	IL-TRM Measure	Errata Applied?
LED Streetlighting	4.5.16	No errata present for this measure

Measure Lives and Cumulative Persisting Annual Savings

We applied EULs and baseline adjustments per IL-TRM V9.0 to determine CPAS for this evaluation. The IL-TRM indicates EULs of 20 years for an LED streetlight under standard operation and 10 years for an LED streetlight under continuous operation.

In cases where LED streetlights replaced existing, functional MV fixtures,[46] a baseline adjustment is made after the remaining useful life (RUL) of the MV fixture expires. The RUL for MV streetlights is assumed to be three years under standard operation and one-and-a-half years under continuous operation per IL-TRM V9.0.

At the time of the baseline adjustment, it is assumed that the existing MV streetlighting would have been replaced with HPS streetlighting of roughly equivalent lumen output but different wattage. The IL-TRM V9.0 does not provide guidance on equivalencies between HPS and MV fixtures; therefore, we used an equivalency table jointly developed by the Illinois evaluation teams, and agreed upon with AIC, presented in Table 74 below to determine equivalencies.[47] System wattages are used in all cases to best represent actual system energy consumption, but lamp wattages are provided for ease of review.

Table 74. Mercury Vapor to High Pressure Sodium Lamp and System Wattage Equivalencies

MV Lamp Watts	MV System Watts	HPS Lamp Watts	HPS System Watts
100	125	50	66
175	205	100	138
250	290	100	138
400	455/469[a]	250	295
1000	1075	400	465

[a] All 400W MV lamps are used in 469W fixtures in AIC applications.

Net Impact Methodology

The evaluation team applied SAG-approved 2021 NTGRs to verified gross savings to calculate verified net savings. Table 75 outlines the SAG-approved NTGR values applied to verified gross savings to calculate verified net savings.

Table 75. SAG-Approved Streetlighting Initiative NTGRs

Measure	Electric NTGR
Utility-Owned Streetlighting	1.000
Municipality-Owned Streetlighting	0.690

Building Operator Certification

Gross Impact Methodology

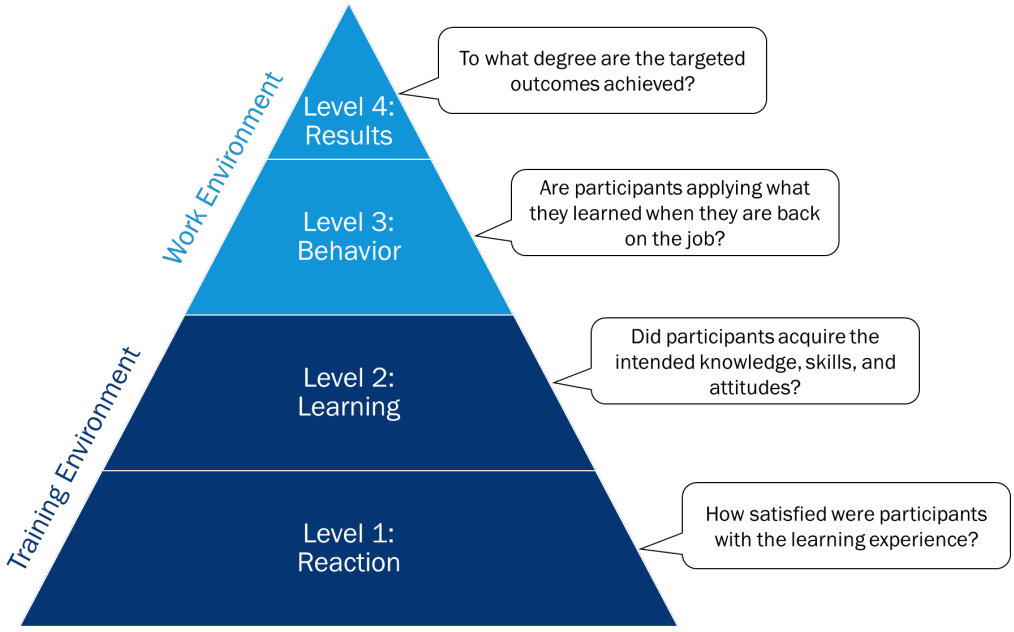
The evaluation team leveraged an innovative evaluation approach to calculate the 2021 gross impacts resulting from BOC training. We aligned the approach with Kirkpatrick's Framework for evaluating adult

[46] Or, as detailed in Section 3.7.4, MH fixtures.
[47] This equivalency table will be submitted as an errata for IL-TRM V10.0 and a measure update for IL-TRM V11.0.

learning interventions—the gold standard for evaluating adult training interventions in the training industry. As illustrated in Figure 1, Kirkpatrick's Framework consists of four levels:

- **Level 1: Reaction:** Measures how participants feel about the learning experience. The value of Level 1 is that a good training experience improves knowledge transfer.
- **Level 2: Learning:** Measures the degree to which participants change attitudes, increase knowledge, or enhance skills as a result of the learning experience. The value of Level 2 is to demonstrate that learning occurs as a result of the training.
- **Level 3: Behavior:** Measures the degree to which participants apply what they have learned outside of the learning environment. This level seeks to demonstrate whether trainees take the information they learn and apply it.
- **Level 4: Results:** The degree targeted outcomes are achieved system wide. In this study, we measured BOC training results in terms of energy savings. The value of measuring Level 4 is to inform the return on training investment realized from the training endeavor.

Figure 1. Kirkpatrick Model



To measure the four levels of learning, we conducted several research activities targeted at specific stages of the training process (see Table 76), including:

- **Baseline O&M and energy efficiency equipment survey:** Participants completed this survey as their first homework assignment. The survey established baseline O&M conditions and collected information on the energy-related equipment that was in place prior to the training intervention.
- **Review of course materials:** We reviewed the results of several in-class activities, including a baseline knowledge assessment, exam scores, homework scores, and exit surveys for each class in which participants assessed the effectiveness of the class and the instructor.
- **Reaction interviews:** Directly following the course, we interviewed participants to (1) solicit feedback regarding their satisfaction with the course; (2) understand what they learned; (3) document any changes that they made to their facilities during the training; (4) record any

future plans for energy efficiency projects; and (5) identify the role BOC training played in these future plans.

- **Post-course savings interview:** We interviewed participants a year after they completed BOC training to understand the actions (if any) that they took as a result of what they learned, including energy efficiency projects and modifications to building or equipment operations.
- **Engineering desk reviews:** Our engineers reviewed the data collected in the post-course savings interviews, set up savings calculations, and identified additional data required to calculate impacts.
- **Savings verification:** Due to COVID-19, we could not conduct on-site audits to verify the details of any energy efficiency projects reported by the participants. In lieu of an on-site audit, we provided participants with an additional incentive to provide documentation of projects, where possible, to support the development of our impact calculations.

Table 76. Summary of Research Activities and the Associated Kirkpatrick Levels

Research Activity	Level 1	Level 2	Level 3	Level 4
Review of course materials	✓	✓		
Reaction interviews	✓	✓	✓	
Baseline O&M and energy efficient equipment survey			✓	
Post-course savings interviews			✓	✓
Engineering desk reviews				✓
Savings verification				✓

Overall, the evaluation team estimated verified savings for two projects for a single participant. We estimated savings using information collected through the post-course interviews, documentation provided by the participant on system schedules and operating specifications, and IL-TRM V9.0. When the IL-TRM V9.0 did not provide guidance, we looked to other established TRMs and industry practices for estimating savings. Both projects consisted of integrating existing equipment into the facility's energy management system. Table 77 illustrates the impacted end use for each project. The following section provides additional details about the evaluation team's impact methodology and assumptions.

Table 77. End Uses Impacted by BOC Projects

Measure Category	HVAC	DHW
Integrate circulating pumps into EMS		✓
Integrate HVAC equipment into EMS	✓	

Integration of Equipment into EMS

The evaluation team estimated verified savings for the integration of existing equipment into an EMS, including: (1) circulatory pumps for domestic hot water (DHW), and (2) air handling units (AHU) and a chiller for climate control of a server room. In both cases, the primary source of energy savings is from reduced operating schedules of existing equipment. The verified analysis quantified energy savings from reduced operating hours using participant-provided documentation and guidance from IL-TRM V9.0.

For the circulating pumps, the evaluation team developed hourly weekday and weekend operating schedules based on information provided by the participant. The participant also provided information on the pumps affected by this project, including photos of the pump nameplates and model numbers. The evaluation team used algorithms similar to those in IL-TRM V9.0, along with the specific pump characteristics and operating schedules, to estimate hourly consumption of the pumps in the baseline

and efficient scenarios.[48] The circulating pumps serve laundry and bathroom facilities, so their energy consumption is not dependent on weather. Therefore, we estimated savings by calculating the difference in hourly energy consumption from the baseline and efficient scenarios and annualized these savings to estimate first year verified savings and CPAS. One of the impacted pumps is a three-speed pump, which operated at full capacity in the baseline scenario but operates at varying speeds in the efficient scenario through EMS scheduling and control. By developing hourly schedules, we were able to reflect the varying operating speeds in our savings calculations.

The AHUs and chiller that were integrated into the EMS are significantly impacted by weather because they provide space conditioning to a server room. Therefore, the evaluation team developed a weather-normalized energy model to estimate energy savings. The participant provided scheduling and setpoint information for the baseline and efficient scenarios, as well as detailed information on the AHUs and chiller, including photos of nameplates and model numbers from which the evaluation team determined the capacity and efficiency of the units. The participant was unable to provide EMS trend data or interval usage data to facilitate a comprehensive analysis on the interaction between AHUs and chiller or a billing regression analysis which would have captured those interactions. The evaluation team concluded that the AHU runtimes could not be determined without EMS trend data. Therefore, the verified savings presented in the report are derived from the chiller operation alone. The evaluation team used TMY3 weather data in developing an 8760 model of equipment operation and energy usage. We estimated savings by calculating the difference in energy usage under the baseline operating schedule and setpoints, and the efficient schedule and setpoints.

Measure Lives and Cumulative Persisting Annual Savings

The evaluation team applied prescriptive measure lives from the IL-TRM V9.0. For both measures, we applied the IL-TRM Attachment B default for energy management system measures of 15 years.

Attribution Analysis

The participant reported that BOC training was one of several important factors that influenced the energy efficiency improvements described in Table 63. However, they reported BOC training was a critical driver of these improvements. The respondent provided an average rating of 5 out of 10 when rating the likelihood that they would have completed the projects in absence of the training, where 0 meant “definitely would not have taken the action” and 10 meant “definitely would have taken the action.” Additionally, when considering the importance of the BOC training on the projects, the respondent provided an average rating of 6.5 out of 10, where 0 equated to “very little importance” and 10 equated to “a great deal of importance.” Further, the respondent allocated an average of 50 out of 100 “points of influence” to BOC training when considering all influencing factors in their decision to complete the energy-savings projects.

As expected, the respondent reported that other non-program factors were influential in their decision-making process. Table 78 includes information on the other factors that influenced the respondent's actions.

[48] See section 4.8.1 of the Illinois Technical Reference Manual Version 9, Volume 2: Commercial and Industrial Measures: https://www.ilsag.info/technical-reference-manual/il-trm-version-9/.

Table 78. Influence of Non-BOC Training Factors on Decision to Implement Energy-Saving Projects

Factor	Influence Score
Reducing operating costs	9
Rate of return	8
Increased comfort	8
Employee complaints	7
Organization commitments to "going green"	2

Note: Respondents rated the influence of factors other than BOC training on a scale from 0 to 10, where 0 was "very little influence" and 10 was "a great deal of influence."

Appendix B. Cost-Effectiveness Inputs

In this appendix, we provide additional inputs for the cost-effectiveness testing of AIC's Business Program. Two specific types of additional inputs are provided: summaries of gas penalties that are not counted toward goal attainment and summaries of secondary electric savings from water supply and wastewater treatment.

Gas Penalties

By agreement with SAG,[49] AIC is not penalized for gas penalties resulting from the installation of efficient prescriptive measures that create an increase in energy usage when considering savings for goal attainment purposes. 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.

In the following sections, the evaluation team focuses specifically on the following gas 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.
- **Furnace Blower 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 HPWHs 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 gas penalties were calculated using algorithms from the IL-TRM V9.0 (with applicable errata applied).

Water Savings and Secondary Electric Savings for Water Supply and Wastewater Treatment

Some measures delivered through the Business Program produce water savings as well as energy savings. For applicable measures, the IL-TRM V9.0 includes an algorithm to calculate the secondary electric impacts of these water savings and decreased electricity usage for water supply and wastewater treatment as a result of water savings stemming from the energy efficient measures. As directly instructed in the IL-TRM, these savings may be included in savings when considered for goal attainment but must be removed from savings for the purpose of cost-effectiveness calculations. Therefore, we present these savings separately in this appendix to provide transparency on the reduced savings that will be used when conducting testing for cost-effectiveness. All secondary electric savings were calculated using algorithms from the IL-TRM V9.0.

[49] Treatment of interactive effects is consistent with a draft SAG policy agreement on this topic. The draft agreement is no longer available on the SAG website but can be provided by the evaluation team on request. SAG is currently working to finalize the draft agreement.

Standard Initiative – Core

Gas Penalties

Table 79 presents gas penalties not reported in the body of the report for Standard Core.

Table 79. 2021 Standard Initiative – Core Gas Penalties

Measure Category	Therms
LED Fixtures	−215,332
Lighting Controls	−9,454
Delamping	−908
Exit Signs	−174
Total Gas Penalties	**−225,868**

Water Savings and Secondary Electric Savings for Water Supply and Wastewater Treatment

Table 80 presents water savings and secondary electric savings for Standard Core. Water savings are not reported in the body of the report because they are converted to secondary electric savings for the purposes of goal attainment. These electric savings occur due to the displaced energy usage needed to power the water supply and wastewater treatment. However, water savings are included in the Illinois TRC as gallons of water saved and secondary electric savings are excluded to avoid double counting. As a result, we calculate water savings and then convert them into secondary energy savings in line with the guidance provided in IL-TRM V9.0.

Table 80. 2021 Standard Initiative – Core Secondary Electric Savings

Measure	Gallons	Conversion Factor	Secondary Electric Savings (kWh)
Steam Trap Repair or Replace Savings	5,615,816	5,010 kWh/million gal[a]	14,438
ENERGY STAR Dishwasher Savings	40,908		205
Commercial Steam Cooker Savings	65,745		169
Total Savings	**5,722,469**		**14,812**

[a] Source: IL-TRM V9.0.

Total Impacts for Cost-Effectiveness

Table 81 presents final total 2021 Standard Core verified gross impacts to be used for cost-effectiveness, adjusted for gas penalties and secondary electric savings.

Table 81. 2021 Standard Initiative – Core Verified Gross Impacts for Cost-Effectiveness

	kWh	Therms	Gallons
Verified Gross Impacts for Goal Attainment	36,740,588	1,193,721	N/A
Gas Penalties	N/A	−225,868	N/A
Water Savings	N/A	N/A	5,722,469
Secondary Electric Savings	−14,812	N/A	N/A
Final Verified Gross Impacts for Cost-Effectiveness	**36,710,963**	**967,852**	**5,722,469**

Standard Initiative – Small Business Direct Install

Gas Penalties

Table 82 presents gas penalties not reported in the body of the report for the Standard Initiative's SBDI channel.

Table 82. 2021 Standard Initiative – SBDI Gas Penalties

Measure	Therms
LED Fixtures	−990,411
Fluorescent Delamping	−16,131
Lighting Controls	−6,233
Exit Signs	−2,408
Total Gas Penalties	**−1,015,183**

Water Savings and Secondary Electric Savings for Water Supply and Wastewater Treatment

There are no measures in the SBDI channel with secondary electric savings in the 2021 program year.

Total Impacts for Cost-Effectiveness

Table 83 presents final total 2021 SBDI channel verified gross impacts to be used for cost-effectiveness, adjusted for gas penalties and secondary electric savings.

Table 83. 2021 Standard Initiative – SBDI Verified Gross Impacts for Cost-Effectiveness

	kWh	Therms
Verified Gross Impacts for Goal Attainment	103,674,802	0
Gas Penalties	N/A	−1,015,183
Final Verified Gross Impacts for Cost-Effectiveness	**103,674,802**	**−1,015,183**

Standard Initiative – Instant Incentives and Online Store

Gas Penalties

Table 84 presents gas penalties not reported in the body of the report for the Standard Initiative's Instant Incentives and Online Store channels.

Table 84. 2021 Standard Initiative – Instant Incentives and Online Store Gas Penalties

Measure	Therms
Instant Incentives	
Linear LED	−485,901
Specialty LED	−76,654
Instant Incentives Subtotal	*−562,555*
Online Store	
Lighting	−3,607
Lighting Controls	−207
Online Store Subtotal	*−3,814*
Total Gas Penalties [a]	**−566,369**

[a] Numbers do not add to total due to rounding.

Water Savings and Secondary Electric Savings for Water Supply and Wastewater Treatment

There were no measures in the Instant Incentives and Online Store channels with secondary electric savings in the 2021 program year.

Total Impacts for Cost-Effectiveness

Table 85 presents final total 2021 Instant Incentives and Online Store verified gross impacts to be used for cost-effectiveness, adjusted for gas penalties and secondary electric savings.

Table 85. 2021 Standard Initiative – Instant Incentives and Online Store Verified Gross Impacts for Cost-Effectiveness

	Therms
Verified Gross Impacts for Goal Attainment	36,839
Gas Penalties	−566,369
Final Verified Gross Impacts for Cost-Effectiveness	**−529,530**

Custom Initiative

No measures delivered through the Custom Initiative in 2021 produced quantifiable gas penalties or water savings.

Retro-Commissioning Initiative

Gas Penalties

No measures delivered through the RCx Initiative in 2021 produced quantifiable gas penalties.

Water Savings and Secondary Electric Savings for Water Supply and Wastewater Treatment

No measures delivered through the RCx Initiative in 2021 produced quantifiable water savings.

Streetlighting Initiative

Gas Penalties

Because all measures installed through the Streetlighting Initiative in 2021 are located in unconditioned space, no measures installed through the Initiative produced gas heating penalties.

Water Savings and Secondary Electric Savings for Water Supply and Wastewater Treatment

No measures delivered through the Streetlighting Initiative in 2021 produced quantifiable water savings.

Building Operator Certification

Gas Penalties

No measures installed as a result of BOC produced quantifiable gas penalties.

Water Savings and Secondary Electric Savings for Water Supply and Wastewater Treatment

No measures installed as a result of BOC produced quantifiable water savings.

Appendix C. Cumulative Persisting Annual Savings

This appendix presents detailed CPAS for the Business Program and its subcomponents. Due to many years of CPAS, tables are challenging to read; please reference the separately provided CPAS spreadsheet for additional detail as needed.

Table 86 provides CPAS for the 2021 Business Program through 2046 at the initiative level. Lifetime savings for the 2021 Business Program through 2047 are 3,172,530 MWh.

Table 86. 2021 Business Program CPAS and WAML

Initiative	Initiative-Level WAML	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)												
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Standard - Core	13.1	36,741	0.825	30,325	30,325	30,296	30,135	29,768	29,590	29,441	29,278	29,190	27,294	25,063	20,004	15,657
Standard - SBDI	13.4	103,675	0.908	94,157	94,157	93,624	90,230	87,473	86,062	85,104	84,404	83,664	81,411	76,586	60,379	34,668
Standard - OS	9.5	670	0.974	653	653	652	645	507	495	478	434	421	419	391	2	2
Standard - II	14.2	40,497	0.794	32,144	32,144	32,144	32,144	31,393	31,393	31,305	30,127	30,031	30,031	30,024	30,024	30,024
Standard - II Carryover	14.1	6,186	0.916	5,667	5,667	5,667	5,667	5,538	5,528	5,510	5,364	5,364	5,364	5,362	5,362	5,362
Custom	15.2	47,151	0.822	38,768	38,768	38,768	38,768	38,720	38,379	37,592	37,257	37,206	36,021	32,469	30,178	25,557
Retro-Commissioning	8.6	258	0.940	242	242	242	242	242	242	242	242	145	0	0	0	0
Virtual Commissioning	7.3	4,593	1.000	4,593	4,593	4,593	4,593	4,593	4,593	4,593	1,378	0	0	0	0	0
Streetlighting	20.0	25,533	0.991	25,301	25,301	25,301	24,105	24,105	24,105	24,105	24,105	24,105	24,105	24,105	24,105	24,105
BOC	15.0	47	N/A	47	47	47	47	47	47	47	47	47	47	47	47	47
Custom (gas conversion)	15.5	3,969	0.939	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725
2021 Portfolio CPAS		**269,320**	**0.875**	**235,622**	**235,622**	**235,059**	**230,301**	**226,111**	**224,160**	**222,143**	**216,361**	**213,899**	**208,417**	**197,772**	**173,826**	**139,148**
Expiring 2021 Portfolio CPAS				**0**	**0**	**564**	**4,758**	**4,190**	**1,952**	**2,016**	**5,783**	**2,461**	**5,482**	**10,645**	**23,946**	**34,678**
Expired 2021 Portfolio CPAS				**0**	**0**	**564**	**5,322**	**9,511**	**11,463**	**13,479**	**19,262**	**21,723**	**27,205**	**37,851**	**61,796**	**96,475**

Initiative	Initiative-Level WAML	First-Year Verified Gross MWh	NTGR													
				2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Standard - Core	13.1	36,741	0.825	14,962	14,742	396	362	328	328	328	108	108	108	0	0	0	0
Standard - SBDI	13.4	103,675	0.908	29,927	28,666	0	0	0	0	0	0	0	0	0	0	0	0
Standard - OS	9.5	670	0.974	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Standard - II	14.2	40,497	0.794	29,776	22,682	0	0	0	0	0	0	0	0	0	0	0	0
Standard - II Carryover	14.1	6,186	0.916	5,290	3,909	0	0	0	0	0	0	0	0	0	0	0	0
Custom	15.2	47,151	0.822	23,179	13,227	10,722	10,722	10,052	9,965	3,750	925	912	243	35	27	0	0
Retro-Commissioning	8.6	258	0.940	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Virtual Commissioning	7.3	4,593	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streetlighting	20.0	25,533	0.991	24,105	24,105	24,105	24,105	24,105	24,105	24,105	0	0	0	0	0	0	0
BOC	15.0	47	N/A	47	47	0	0	0	0	0	0	0	0	0	0	0	0
Custom (gas conversion)	15.5	3,969	0.939	3,725	3,725	2,029	0	0	0	0	0	0	0	0	0	0	0
2021 Portfolio CPAS		**269,320**	**0.875**	**131,013**	**111,104**	**37,252**	**35,189**	**34,485**	**34,398**	**28,183**	**1,032**	**1,020**	**351**	**35**	**27**	**0**	**0**
Expiring 2021 Portfolio CPAS				**8,135**	**19,908**	**73,853**	**2,063**	**704**	**87**	**6,215**	**27,151**	**13**	**668**	**316**	**9**	**27**	**0**
Expired 2021 Portfolio CPAS				**104,610**	**124,518**	**198,371**	**200,433**	**201,137**	**201,225**	**207,440**	**234,590**	**234,603**	**235,271**	**235,587**	**235,596**	**235,622**	**235,622**
WAML	**14.4**																

Standard Initiative - Core

Table 87 provides CPAS for the 2021 Standard Initiative – Core Offering through 2044. Lifetime savings for Standard Core are 388,135MWh.

Table 87. 2021 Standard Initiative – Core Offering CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)											
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
SLB	12.5	24,355	0.839	20,439	20,439	20,410	20,259	19,893	19,714	19,575	19,412	19,338	17,443	15,811	11,137
VSDs	15.0	8,204	0.833	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835
HVAC	13.7	3,106	0.685	2,126	2,126	2,126	2,116	2,116	2,116	2,116	2,116	2,101	2,101	1,597	1,573
MHVAC	11.3	443	0.881	390	390	390	390	390	390	390	390	390	390	390	29
SE	12.8	619	0.849	525	525	525	525	525	525	525	525	525	525	430	430
STRR	6.0	14	0.608	9	9	9	9	9	9	0	0	0	0	0	0
2021 CPAS		**36,741**	**0.825**	**30,325**	**30,325**	**30,296**	**30,135**	**29,768**	**29,590**	**29,441**	**29,278**	**29,190**	**27,294**	**25,063**	**20,004**
Expiring 2021 CPAS				**0**	**0**	**29**	**161**	**367**	**178**	**149**	**163**	**89**	**1,895**	**2,231**	**5,059**
Expired 2021 CPAS				**0**	**0**	**29**	**190**	**557**	**735**	**884**	**1,046**	**1,135**	**3,030**	**5,261**	**10,320**

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)											
				2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
SLB	12.5	24,355	0.839	6,825	6,232	6,012	8	8	8	8	8	0	0	0	0
VSDs	15.0	8,204	0.833	6,835	6,835	6,835	0	0	0	0	0	0	0	0	0
HVAC	13.7	3,106	0.685	1,573	1,573	1,573	175	142	108	108	108	108	108	108	0
MHVAC	11.3	443	0.881	29	29	29	0	0	0	0	0	0	0	0	0
SE	12.8	619	0.849	395	292	292	213	213	213	213	213	0	0	0	0
STRR	6.0	14	0.608	0	0	0	0	0	0	0	0	0	0	0	0
2021 CPAS		**36,741**	**0.825**	**15,657**	**14,962**	**14,742**	**396**	**362**	**328**	**328**	**328**	**108**	**108**	**108**	**0**
Expiring 2021 CPAS				**4,347**	**695**	**220**	**14,346**	**34**	**34**	**0**	**0**	**220**	**0**	**0**	**108**
Expired 2021 CPAS				**14,668**	**15,363**	**15,583**	**29,929**	**29,963**	**29,997**	**29,997**	**29,997**	**30,217**	**30,217**	**30,217**	**30,325**
WAML	**13.1**														

Standard Initiative – Small Business Direct Install

Table 88 provides CPAS for the 2021 Standard Initiative's SBDI channel through 2040. Lifetime savings for the SBDI channel are 1,110,512 MWh.

Table 88. 2021 Standard Initiative – SBDI CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
LED Bulbs & Fixtures	13.5	93,122	0.908	84,573	84,573	84,039	80,645	77,888	76,704	75,747	75,046	74,568	72,314
ECMs for Walk-in and Reach-in Coolers / Freezers	15.0	4,638	0.908	4,213	4,213	4,213	4,213	4,213	4,213	4,213	4,213	4,213	4,213
Door Heater Controls for Cooler or Freezer	10.0	3,131	0.908	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843
Fluorescent Delamping	11.0	988	0.908	898	898	898	898	898	898	898	898	898	898
Evaporator Fan Control for ECMs	13.0	784	0.908	712	712	712	712	712	712	712	712	712	712
Lighting Controls	10.0	422	0.908	384	384	384	384	384	384	384	384	384	384
Automatic Door Closer for Walk-In Coolers and Freezers	8.0	287	0.908	261	261	261	261	261	261	261	261	0	0
Exit Signs	5.0	171	0.908	156	156	156	156	156	0	0	0	0	0
Beverage and Snack Machine Controls	5.0	78	0.908	71	71	71	71	71	0	0	0	0	0
Q-Sync Motors for Walk-in and Reach-in Coolers/Freezers	10.0	53	0.908	48	48	48	48	48	48	48	48	48	48
2021 CPAS		**103,675**	**0.908**	**94,157**	**94,157**	**93,624**	**90,230**	**87,473**	**86,062**	**85,104**	**84,404**	**83,664**	**81,411**
Expiring 2021 CPAS				**0**	**0**	**534**	**3,394**	**2,757**	**1,411**	**958**	**701**	**739**	**2,253**
Expired 2021 CPAS				**0**	**0**	**534**	**3,928**	**6,685**	**8,095**	**9,053**	**9,754**	**10,493**	**12,746**

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
LED Bulbs & Fixtures	13.5	93,122	0.908	70,763	55,454	29,744	25,714	24,454	0	0	0	0	0
ECMs for Walk-in and Reach-in Coolers / Freezers	15.0	4,638	0.908	4,213	4,213	4,213	4,213	4,213	0	0	0	0	0
Door Heater Controls for Cooler or Freezer	10.0	3,131	0.908	0	0	0	0	0	0	0	0	0	0
Fluorescent Delamping	11.0	988	0.908	898	0	0	0	0	0	0	0	0	0
Evaporator Fan Control for ECMs	13.0	784	0.908	712	712	712	0	0	0	0	0	0	0
Lighting Controls	10.0	422	0.908	0	0	0	0	0	0	0	0	0	0
Automatic Door Closer for Walk-In Coolers and Freezers	8.0	287	0.908	0	0	0	0	0	0	0	0	0	0
Exit Signs	5.0	171	0.908	0	0	0	0	0	0	0	0	0	0
Beverage and Snack Machine Controls	5.0	78	0.908	0	0	0	0	0	0	0	0	0	0
Q-Sync Motors for Walk-in and Reach-in Coolers/Freezers	10.0	53	0.908	0	0	0	0	0	0	0	0	0	0
2021 CPAS		**103,675**	**0.908**	**76,586**	**60,379**	**34,668**	**29,927**	**28,666**	**0**	**0**	**0**	**0**	**0**
Expiring 2021 CPAS				**4,825**	**16,207**	**25,710**	**4,742**	**1,260**	**28,666**	**0**	**0**	**0**	**0**
Expired 2021 CPAS				**17,572**	**33,779**	**59,489**	**64,231**	**65,491**	**94,157**	**94,157**	**94,157**	**94,157**	**94,157**
WAML	**13.4**												

Standard Initiative – Instant Incentives and Online Store

Table 89 provides CPAS for the 2021 Standard Initiative's Instant Incentives channel through 2040. Lifetime savings for Instant Incentives are 455,384 MWh.

Table 89. 2021 Standard Initiative – Instant Incentives CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Linear LED	14.9	34,985	0.813	28,450	28,450	28,450	28,450	28,450	28,450	28,450	28,450	28,450	28,450
Specialty LED	9.7	5,512	0.670	3,694	3,694	3,694	3,694	2,943	2,943	2,855	1,677	1,582	1,582
2021 CPAS		**40,497**	**0.794**	**32,144**	**32,144**	**32,144**	**32,144**	**31,393**	**31,393**	**31,305**	**30,127**	**30,031**	**30,031**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**751**	**0**	**88**	**1,178**	**95**	**0**
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**751**	**751**	**839**	**2,017**	**2,112**	**2,112**

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Linear LED	14.9	34,985	0.813	28,450	28,450	28,450	28,450	22,682	0	0	0	0	0
Specialty LED	9.7	5,512	0.670	1,574	1,574	1,574	1,326	0	0	0	0	0	0
2021 CPAS		**40,497**	**0.794**	**30,024**	**30,024**	**30,024**	**29,776**	**22,682**	**0**	**0**	**0**	**0**	**0**
Expiring 2021 CPAS				**8**	**0**	**0**	**248**	**7,094**	**22,682**	**0**	**0**	**0**	**0**
Expired 2021 CPAS				**2,120**	**2,120**	**2,120**	**2,368**	**9,461**	**32,144**	**32,144**	**32,144**	**32,144**	**32,144**
WAML	**14.2**												

Table 90 provides CPAS for the 2021 Standard Initiative's Online Store channel through 2040. Lifetime savings for Online Store are 5,754 MWh.

Table 90. 2021 Standard Initiative – Online Store CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Advanced Thermostat	11.0	441	0.880	388	388	388	388	388	388	388	388	388	388
Lighting	6.2	206	1.156	238	238	237	230	91	80	62	20	8	5
Lighting Controls	10.0	22	1.156	25	25	25	25	25	25	25	25	25	25
Advanced Power Strip	7.0	2	1.156	2	2	2	2	2	2	2	0	0	0
2021 CPAS		**670**	**0.974**	**653**	**653**	**652**	**645**	**507**	**495**	**478**	**434**	**421**	**419**
Expiring 2021 CPAS				**0**	**0**	**1**	**7**	**138**	**12**	**17**	**44**	**12**	**3**
Expired 2021 CPAS				**0**	**0**	**1**	**8**	**146**	**158**	**175**	**219**	**232**	**234**

Cumulative Persisting Annual Savings

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Advanced Thermostat	11.0	441	0.880	388	0	0	0	0	0	0	0	0	0
Lighting	6.2	206	1.156	3	2	2	2	1	0	0	0	0	0
Lighting Controls	10.0	22	1.156	0	0	0	0	0	0	0	0	0	0
Advanced Power Strip	7.0	2	1.156	0	0	0	0	0	0	0	0	0	0
2021 CPAS		**670**	**0.974**	**391**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**0**
Expiring 2021 CPAS				**28**	**389**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**
Expired 2021 CPAS				**262**	**651**	**651**	**652**	**653**	**653**	**653**	**653**	**653**	**653**
WAML	**9.5**												

Table 91 provides CPAS for 2021 Instant Incentives carryover savings through 2040 by measure. Lifetime savings for 2021 Instant Incentives carryover are 80,622 MWh.

Table 91. 2021 Standard Initiative – Instant Incentives Carryover CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2020 Instant Incentives - Linear LED	14.8	3,082	0.916	2,824	2,824	2,824	2,824	2,824	2,824	2,824	2,824	2,824	2,824
2020 Instant Incentives - Specialty LED	10.4	488	0.916	447	447	447	447	393	391	385	314	314	314
2019 Instant Incentives - Linear LED	14.8	2,269	0.916	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079
2019 Instant Incentives - Specialty LED	9.3	320	0.916	293	293	293	293	233	229	222	147	147	147
2019 Instant Incentives - Standard LED	7.8	27	0.916	25	25	25	25	10	5	0	0	0	0
2021 CPAS		**6,186**	**0.916**	**5,667**	**5,667**	**5,667**	**5,667**	**5,538**	**5,528**	**5,510**	**5,364**	**5,364**	**5,364**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**130**	**10**	**18**	**147**	**0**	**0**
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**130**	**139**	**157**	**304**	**304**	**304**

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2020 Instant Incentives - Linear LED	14.8	3,082	0.916	2,824	2,824	2,824	2,824	2,251	0	0	0	0	0
2020 Instant Incentives - Specialty LED	10.4	488	0.916	314	314	314	264	0	0	0	0	0	0
2019 Instant Incentives - Linear LED	14.8	2,269	0.916	2,079	2,079	2,079	2,079	1,658	0	0	0	0	0
2019 Instant Incentives - Specialty LED	9.3	320	0.916	146	146	146	123	0	0	0	0	0	0
2019 Instant Incentives - Standard LED	7.8	27	0.916	0	0	0	0	0	0	0	0	0	0
2021 CPAS		**6,186**	**0.916**	**5,362**	**5,362**	**5,362**	**5,290**	**3,909**	**0**	**0**	**0**	**0**	**0**
Expiring 2021 CPAS				**1**	**0**	**0**	**72**	**1,381**	**3,909**	**0**	**0**	**0**	**0**
Expired 2021 CPAS				**305**	**305**	**305**	**377**	**1,759**	**5,667**	**5,667**	**5,667**	**5,667**	**5,667**
WAML	**14.1**												

Custom Initiative

Table 92 provides CPAS for the 2021 Custom Initiative through 2048. Lifetime savings for the Initiative are 552,207 MWh.

Table 92. 2021 Custom Initiative CPAS and WAML

Channel	WAML	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)												
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
CI - Custom Incentives	15.5	43,799	0.8222	36,012	36,012	36,012	36,012	35,964	35,690	35,690	35,354	35,303	34,152	30,608	28,320	23,700
NCL - New Construction Lighting	12.5	3,352	0.8222	2,756	2,756	2,756	2,756	2,756	2,690	1,903	1,903	1,903	1,869	1,861	1,858	1,857
2021 CPAS		**47,151**	**0.822**	**38,768**	**38,768**	**38,768**	**38,768**	**38,720**	**38,379**	**37,592**	**37,257**	**37,206**	**36,021**	**32,469**	**30,178**	**25,557**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**47**	**341**	**787**	**335**	**51**	**1,185**	**3,552**	**2,291**	**4,620**
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**47**	**388**	**1,175**	**1,510**	**1,562**	**2,747**	**6,299**	**8,590**	**13,210**

Cumulative Persisting Annual Savings

Channel	WAML	First-Year Verified Gross Savings (MWh)	NTGR	CPAS - Verified Net Savings (MWh)														
				2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048
CI - Custom Incentives	15.5	43,799	0.8222	21,337	12,994	10,722	10,722	10,052	9,965	3,750	925	912	243	35	27	0	0	0
NCL - New Construction Lighting	12.5	3,352	0.8222	1,842	233	0	0	0	0	0	0	0	0	0	0	0	0	0
2021 CPAS		**47,151**	**0.822**	**23,179**	**13,227**	**10,722**	**10,722**	**10,052**	**9,965**	**3,750**	**925**	**912**	**243**	**35**	**27**	**0**	**0**	**0**
Expiring 2021 CPAS				**2,379**	**9,952**	**2,505**	**0**	**670**	**87**	**6,215**	**2,825**	**13**	**668**	**208**	**9**	**27**	**0**	**0**
Expired 2021 CPAS				**15,589**	**25,541**	**28,046**	**28,046**	**28,716**	**28,803**	**35,018**	**37,843**	**37,856**	**38,524**	**38,732**	**38,741**	**38,768**	**38,768**	**38,768**
WAML	**15.2**																	

Table 93 provides CPAS converted from therms for the 2021 Custom Initiative through 2040. Lifetime savings for the 2021 Custom Initiative gas conversion are 57,902 MWh.

Table 93. 2021 Custom Initiative Gas Conversion CPAS and WAML

Measure	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)									
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Custom Gas Conversion	15.5	3,967	0.939	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725	3,725
2021 CPAS		**3,967**	**0.939**	**3,725**	**3,725**	**3,725**	**3,725**	**3,725**	**3,725**	**3,725**	**3,725**	**3,725**	**3,725**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Measure	Measure Life	First-Year Verified Gross MWh	NTGR										
				2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Custom Gas Conversion	15.5	3,967	0.939	3,725	3,725	3,725	3,725	3,725	2,029	0	0	0	0
2021 CPAS		**3,967**	**0.939**	**3,725**	**3,725**	**3,725**	**3,725**	**3,725**	**2,029**	**0**	**0**	**0**	**0**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**1,696**	**2,029**	**0**	**0**	**0**
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**1,696**	**3,725**	**3,725**	**3,725**	**3,725**
WAML	**15.5**												

Retro-Commissioning Initiative

Table 94 provides CPAS for the 2021 RCx Initiative through 2030. Lifetime savings for the Initiative are 2,084 MWh.

Table 94. 2021 Retro-Commissioning CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)											
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Large Facilities Retro-Commissioning	8.6	258	0.940	242	242	242	242	242	242	242	242	145	0	0	0
2021 CPAS		**258**	**0.940**	**242**	**242**	**242**	**242**	**242**	**242**	**242**	**242**	**145**	**0**	**0**	**0**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**97**	**145**	**0**	**0**
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**97**	**242**	**242**	**242**
WAML	**8.6**														

Virtual Commissioning™

Table 95 provides CPAS for the 2021 Virtual Commissioning™ channel through 2032. Lifetime savings for Virtual Commissioning™ are 33,529 MWh.

Table 95. 2021 Virtual Commissioning™ CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)											
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Virtual Commissioning™	7.3	4,593	1.000	4,593	4,593	4,593	4,593	4,593	4,593	4,593	1,378	0	0	0	0
2021 CPAS		**4,593**	**1.000**	**4,593**	**4,593**	**4,593**	**4,593**	**4,593**	**4,593**	**4,593**	**1,378**	**0**	**0**	**0**	**0**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,215**	**1,378**	**0**	**0**	**0**
Expired 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,215**	**4,593**	**4,593**	**4,593**	**4,593**
WAML	**7.3**														

Streetlighting Initiative

Table 96 provides CPAS for the 2021 Streetlighting Initiative through 2042. Lifetime savings for the Initiative are 485,692 MWh.

Table 96. 2021 Streetlighting Initiative CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)										
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
MOSL (HPS Baseline)	20.0	749	0.690	517	517	517	517	517	517	517	517	517	517	517
UOSL (HPS Baseline)	20.0	3,253	1.000	3,253	3,253	3,253	3,253	3,253	3,253	3,253	3,253	3,253	3,253	3,253
UOSL (HPS Baseline, AIC ROB)	20.0	19,171	1.000	19,171	19,171	19,171	19,171	19,171	19,171	19,171	19,171	19,171	19,171	19,171
UOSL (MV Baseline)	20.0	2,360	1.000	2,360	2,360	2,360	1,165	1,165	1,165	1,165	1,165	1,165	1,165	1,165
2021 CPAS		**25,533**	**0.991**	**25,301**	**25,301**	**25,301**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**
Expiring 2021 CPAS				**0**	**0**	**0**	**1,196**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Expired 2021 CPAS				**0**	**0**	**0**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)										
				2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MOSL (HPS Baseline)	20.0	749	0.690	517	517	517	517	517	517	517	517	517	0	0
UOSL (HPS Baseline)	20.0	3,253	1.000	3,253	3,253	3,253	3,253	3,253	3,253	3,253	3,253	3,253	0	0
UOSL (HPS Baseline, AIC ROB)	20.0	19,171	1.000	19,171	19,171	19,171	19,171	19,171	19,171	19,171	19,171	19,171	0	0
UOSL (MV Baseline)	20.0	2,360	1.000	1,165	1,165	1,165	1,165	1,165	1,165	1,165	1,165	1,165	0	0
2021 CPAS		**25,533**	**0.991**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**24,105**	**0**	**0**
Expiring 2021 CPAS				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**24,105**	**0**
Expired 2021 CPAS				**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**1,196**	**25,301**	**25,301**
WAML	**20.0**													

Building Operator Certification

Table 97 provides CPAS achieved in 2021 as a result of the BOC training through 2044. Lifetime savings for the Initiative are 709 MWh.

Table 97. 2021 BOC CPAS and WAML

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR												
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Integrate HVAC equipment into EMS	15.0	47.0	N/A	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0
Integrate circulating pumps into EMS	15.0	0.3	N/A	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2021 CPAS		**47.3**	**1.000**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**
Expiring 2021 CPAS				-	-	-	-	-	-	-	-	-	-	-	-
Expired 2021 CPAS				-	-	-	-	-	-	-	-	-	-	-	-

Cumulative Persisting Annual Savings

Evaluation Measure Category	Measure Life	First-Year Verified Gross MWh	NTGR	CPAS (Verified Net MWh)											
				2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Integrate HVAC equipment into EMS	15.0	47.0	N/A	47.0	47.0	47.0	-	-	-	-	-	-	-	-	-
Integrate circulating pumps into EMS	15.0	0.3	N/A	0.3	0.3	0.3	-	-	-	-	-	-	-	-	-
2021 CPAS		**47.3**	**1.000**	**47.3**	**47.3**	**47.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Expiring 2021 CPAS				**-**	**-**	**-**	**47.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Expired 2021 CPAS				**-**	**-**	**-**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**	**47.3**
WAML	**15.0**														

Appendix D. Custom Initiative Project Reports

This appendix is provided under a separate cover.

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