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ComEd Building Operator Certification Pilot Impact Evaluation Report

Energy Efficiency/Demand Response Plan: Program Year 2021 (CY2021) (1/1/2021-12/31/2021)

Prepared for:

ComEd

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1. Introduction

This report presents the results of the impact evaluation of the CY2021 Building Operator Certification (BOC) Pilot. Due to the pilot activity timeline that includes training and opportunity identification, planning, budgeting, and implementation, the pilot evaluation seeks to determine savings from measures implemented by participants from the *prior* calendar year. Thus, CY2021 impacts are a result of activities undertaken by CY2020 participants.

This report summarizes the total energy and demand impacts for the pilot broken out by relevant measure and pilot structure details. The appendices provide the impact analysis methodology and details of the total resource cost (TRC) analysis inputs. CY2021 covers savings from January 1, 2021 through December 31, 2021.

2. Pilot Description

BOC is a training and certification for commercial building operators. The curriculum teaches participants how to improve building comfort and efficiency by optimizing the building's systems. The curriculum has been offered for several years and is implemented throughout the region by the Midwest Energy Efficiency Alliance (MEEA).

Due to constraints imposed by the COVID-19 pandemic in 2020 and 2021, the national coordinator of BOC training, the Northwest Energy Efficiency Council, and MEEA changed their training delivery from a 6-day or 7-day, in-person experience to a virtual, online interactive platform. The development time for the online curriculum limited the 2020 course offerings to the last calendar quarter.

ComEd's BOC Pilot offers partial participant tuition-reimbursement for ComEd customers who complete the curriculum. ComEd's goal is to have participants implement energy-saving practices at their facilities. BOC training has two curricula: BOC Level I and BOC Level II.[1] Both curricula require a time commitment of more than 60 hours for class training and assigned projects spread over several months. In CY2020, the BOC training had nine participants from ComEd's service territory (see Table 2-1). Participants implement savings subsequent to their training over one or several years. The evaluation research in CY2021 estimates savings from these activities.

Table 2-1. Number of Participants and Projects

Participation	CY2020 Count
Level I Participants	4
Level II Participants	5
Total Participants	**9**

Source: ComEd tracking data and evaluation team analysis

The BOC Pilot trains participants in methods to reduce energy use and costs. Some measures might be implemented immediately, and others may require a months or years-long budgeting process.

[1] Level I BOC Training is "Building Systems Maintenance" and Level II BOC Training is "Improving Building Operational Performance." The difference between Level I and Level II trainings is in the eligibility criteria; Level II training eligibility requires more years of operations and maintenance (O&M) experience, higher levels of education, or the completion of Level I BOC training. Source: **https://www.theboc.info/building-operator-training/boc-eligibility/**.

3. Pilot Savings Detail

Table 3-1 summarizes the incremental energy and demand savings the BOC Pilot achieved in CY2021. Due to the nature and length of the training and the target business sectors (commercial buildings), it takes some time for the expected behavior to manifest after the training. As a result, the evaluation team interviewed participants from CY2020 to identify actions taken by trainees in CY2021 and the savings from those activities.

Because the BOC training occurred in the final quarter of 2020 and facility 2021 annual budgets had already been prepared and approved before the building operators attended the BOC training, the evaluation team found that few energy projects had been initiated and completed in 2021. Most of those projects had been planned for several years, so BOC training was not a key driver of the savings. More detail on the methods and analysis is presented in Appendix A. Guidehouse found no gas savings attributable to ComEd for this pilot in CY2020.

Table 3-1. Total Annual Incremental Electric Savings

Savings Category	Units	Ex Ante Gross Savings	Pilot Gross Realization Rate	Verified Gross Savings	Pilot Net-to-Gross Ratio (NTG)*	Verified Net Savings
Electric Energy Savings - Direct	kWh	NR	N/A	756,433	0.80	605,146
Electric Energy Savings - Converted from Gas	kWh	NR	N/A	0	0.80	0
Total Electric Energy Savings	kWh	NR	N/A	756,433	0.80	605,146
Summer Peak Demand Savings†	kW	NR	N/A	83	0.80	67

NR = Not reported. ComEd and MEEA did not report ex ante savings.
N/A = not applicable (refers to a piece of data that cannot be produced or does not apply).
* No net-to-gross (NTG) ratio research has been conducted for the BOC Pilot, so the Illinois Energy Efficiency (EE) Policy Manual stipulates that a default value of 0.8 be used for an NTG ratio until such research is completed or a better proxy is determined. Source: **https://www.ilsag.info/policy/illinois-ee-policy-manual/**.
† The coincident summer peak period is defined as 1:00-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and evaluation team analysis

4. Cumulative Persisting Annual Savings

Table 4-1 and Figure 4-1 show the total verified gross savings for the BOC Pilot and the cumulative persisting annual savings (CPAS) for the measures installed in CY2021. The electric CPAS across all measures installed in 2021 is shown in Table 4-1. Guidehouse found no gas savings for this pilot attributable to ComEd, so electric CPAS is equivalent to total CPAS. The historic rows in each table are the CPAS contribution back to CY2020. The Pilot Total Electric CPAS is the sum of the CY2021 contribution and the historic contribution. Figure 4-1 shows the savings across the effective useful life (EUL) of the measures.

Table 4-1. Cumulative Persisting Annual Savings – Electric

End Use Type	Research Category	EUL	CY2021 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings 2018	2019	2020	2021	2022	2023	2024	2025	2026
BOC	Training	10.2	756,433	0.80	6,172,493				605,146	605,146	605,146	605,146	605,146	605,146
CY2021 Pilot Total Electric Contribution to			**756,433**		**6,172,493**				**605,146**	**605,146**	**605,146**	**605,146**	**605,146**	**605,146**
Historic Pilot Total Electric Contribution to CPAS‡						**-**	**-**	**1,750,188**	**1,750,188**	**1,750,188**	**1,750,188**	**1,750,188**	**1,750,188**	**1,750,188**
Pilot Total Electric CPAS						**-**	**-**	**1,750,188**	**2,355,334**	**2,355,334**	**2,355,334**	**2,355,334**	**2,355,334**	**2,355,334**
CY2021 Pilot Incremental Expiring Electric Savings§										**-**	**-**	**-**	**-**	**-**
Historic Pilot Incremental Expiring Electric Savings									**-**	**-**	**-**	**-**	**-**	**-**
Pilot Total Incremental Expiring Electric Savings									**-**	**-**	**-**	**-**	**-**	**-**

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
BOC	Training	605,146	605,146	605,146	605,146	121,029							
CY2021 Pilot Total Electric Contribution to CPAS		**605,146**	**605,146**	**605,146**	**605,146**	**121,029**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Historic Pilot Total Electric Contribution to CPAS‡		**1,750,188**	**1,750,188**	**1,750,188**	**364,584**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pilot Total Electric CPAS		**2,355,334**	**2,355,334**	**2,355,334**	**969,730**	**121,029**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CY2021 Pilot Incremental Expiring Electric Savings§		**-**	**-**	**-**	**-**	**484,117**	**121,029**	**-**	**-**	**-**	**-**	**-**	**-**
Historic Pilot Incremental Expiring Electric Savings		**-**	**-**	**-**	**1,385,604**	**364,584**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pilot Total Incremental Expiring Electric Savings		**-**	**-**	**-**	**1,385,604**	**848,701**	**121,029**	**-**	**-**	**-**	**-**	**-**	**-**

Note: The green highlighted cell shows pilot total first-year electric savings. The gray cells are blank, indicating values irrelevant to the CY2021 contribution to CPAS.

* No NTG ratio research has been conducted for the BOC Pilot, so the Illinois EE Policy Manual stipulates that a default value of 0.8 be used for an NTG ratio until such research is completed or a better proxy is determined. Source: **https://www.ilsag.info/policy/illinois-ee-policy-manual/**.

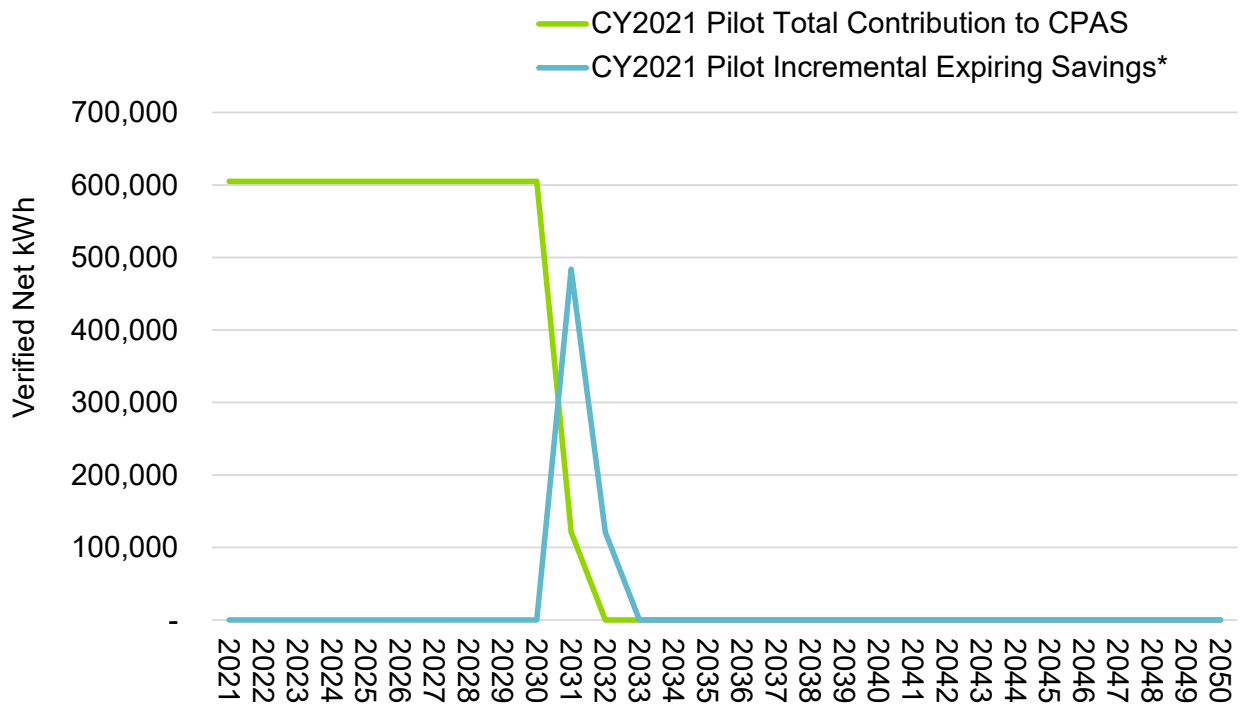
† Lifetime savings are the sum of CPAS savings through the EUL.

‡ Historic savings go back to CY2020.

§ Incremental expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n.

Source: Evaluation team analysis

Figure 4-1. Cumulative Persisting Annual Savings



* Expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n

Source: Evaluation team analysis

5. Pilot Savings by Measure

This pilot has only one measure, so measure-level results are the same as the pilot-level results discussed in the previous section.

6. Impact Analysis Findings and Recommendations

Among the nine CY2020 participants, the evaluation team was able to conduct follow-up research with two. The team created custom savings estimates based on the methodology described in Appendix A. The evaluation team applied the Illinois Technical Reference Manual (IL-TRM) v9.0-based savings to the remaining seven participants, leveraging measure 4.8.24 Building Operator Certification from IL-TRM v10.0. Guidehouse used information collected from the trainees and internet research to determine the inputs into the IL-TRM algorithm.

The evaluation team developed two recommendations for ComEd based on findings from the CY2021 evaluation.

Finding 1. Building operators and managers have a lengthy budget development process with budgets planned in the late summer and approved by the end of October for the following calendar year. Thus, participants who finish the BOC course after late summer have limited opportunities to plan and budget for projects to be completed the following calendar year.

> **Recommendation 1.** Conduct pilot and evaluation research only with participants who complete the training prior to the end of June in the research year. Participants who complete training after June should be given 18 months after completion of the training before they are approached for future custom evaluations (i.e., updating the TRM measure).

Finding 2. The participant facility data captured from the BOC trainees did not provide a level of detail to support calculating impacts using the IL-TRM v10.0 algorithm. Guidehouse researched online sources and confirmed facility details including square footage. ComEd and the evaluation team developed a tool to collect supplemental data from future participants. The evaluation and pilot teams have agreed to emphasize the importance of gathering the supplemental data to participants.

> **Recommendation 2.** Require BOC participants to provide the completed BOC information template[2] to be reimbursed for the training tuition. This will ensure the evaluation team has sufficient information to determine verified savings for each participant.

[2] Guidehouse provided the BOC trainee information template to the pilot team in November 2021.

Appendix A. Impact Analysis Methodology

The impact evaluation followed two paths to determine pilot savings from CY2020 participants[3]. The first path paralleled research for the CY2020 evaluation with participants interviews. The second path was by application of the IL-TRM algorithms with participants the evaluators could not interview. During CY2021, Guidehouse completed impact interviews with two of the nine participants who completed the BOC training in CY2020. The evaluation team determined what changes the participants had made in their operating practices since the training, including capital improvements, both incentivized and non-incentivized by ComEd programs. None of the participants were able to provide savings estimates for individual activities during the interviews, but they did report measures and enhancements made since their training.

To estimate savings, the evaluation team first set limits on the extent of savings achievable by O&M and reported retrofits. The evaluation team researched O&M literature and found that most sources claim a couple of percentage points of improvement in energy efficiency by end use with enhanced O&M practices. Based on the number and type of improvements claimed, the team scaled the potential O&M savings to a value between 0% and the researched achievable O&M savings by end use. The evaluation team multiplied the site-specific O&M savings ratio by the site's end use energy use, determined by the distribution of actual site energy consumption and typical building energy use by end use.

For capital projects, the participants were able to report some limited details about their retrofit activities. For example, the participants reported the area affected by a lighting retrofit. The evaluation team estimated savings from this reported data combined with knowledge of typical commercial retrofit projects and the IL-TRM.

The BOC training takes several months to complete. Trained operators also require additional time to implement the ideas and practices taught in the courses, especially if maintenance has been deferred in the buildings they manage. Substantial pilot energy savings are unlikely to occur at the time of the training, but rather a year or more after training was completed. To account for this time lag, the evaluation team interviewed participants from CY2020 to determine pilot effects.

A.1 Interview Participants

CY2020 BOC trainings in Illinois included nine participants in the ComEd service territory. The evaluation team interviewed two participants who responded to the interview request: one participant supervises facility management for a school district, and the other participant supervises facility operations for a municipality. The evaluation team determined savings for these two participants using the CY2020 evaluation model.

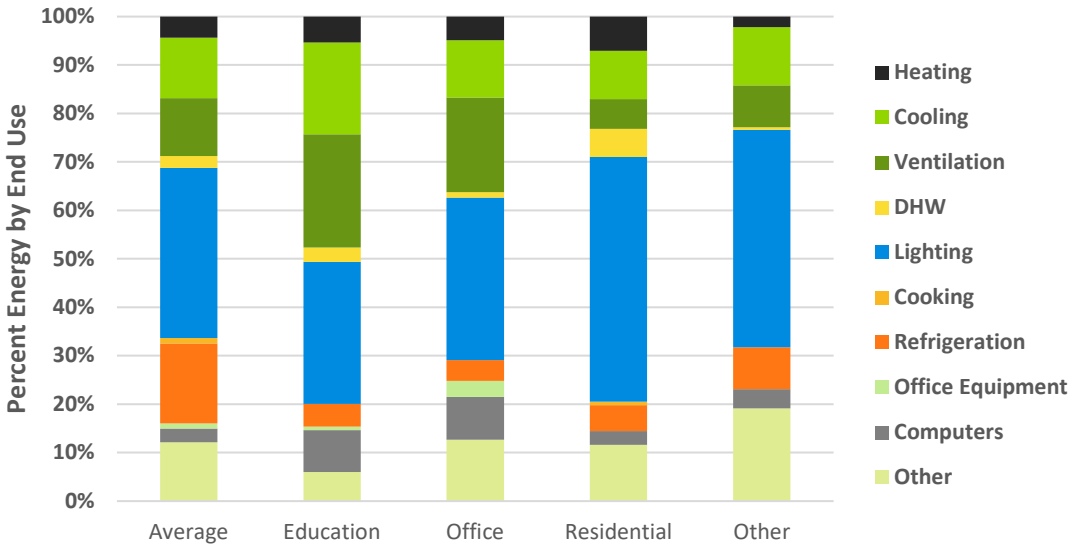
A.2 Model Input Data

The evaluation team constructed a model of typical building energy use by facility type through research with the Buildings Energy Databook and Commercial Buildings Energy Consumption Survey (CBECS). The model result is energy use by end use per conditioned area by facility type. The evaluation team tailored the general model to the specific buildings operated by pilot

[3] The CY2020 BOC impact evaluation report analyzed actions taken by trainees who completed the BOC course during 2018 and 2019.

participants using annual electric consumption data (ComEd) and built area data (online research). The tailored model scales the general model to actual energy use but with the same proportional consumption by end use as the typical buildings by facility type. Figure A-1 shows the modeled building types and their corresponding proportion of energy use by end use.

Figure A-1. Modeled Building Energy by End Use



Source: CBECS and evaluation team analysis

Through research of preventive maintenance practices and engineering estimates, the evaluation team estimated expected savings from various retrofit and operations improvements as a proportion of system energy use. For example, a new unitary HVAC system is 10% more efficient than what was allowed by standard ASHRAE 90.1 15 years ago. A participant who installed all new HVAC units would save 10% of their cooling usage.

The participant interview collected building addresses, facility types (e.g., healthcare, recreation, office), energy efficiency capital improvements with and without incentives, and operations improvements conducted since the participants completed the trainings. The participant interview also categorized the improvements by major building system: lighting, drive power, heating, cooling, compresses air, ventilation, domestic hot water, and controls.

Interview responses applied to the energy model produce estimated site-level savings for the interviewed participants.

A.3 IL-TRM Algorithm Path

For the seven participants who did not complete an interview, the evaluation applied the IL-TRM algorithm, to estimate savings. The savings coefficients in the IL-TRM algorithms were derived with the same modeling approach described previously.

The savings coefficients from the IL-TRM are shown in Table A-1 and they are used in Equation A-1 to estimate electric and gas energy savings and electric demand. Savings are capped at 500,000 square feet per participant equivalent.

Table A-1. Researched Gross Savings by End Use and Per Participant

Savings Type	Variable Name	Value	Unit
Electric Energy	C_e	0.34200	kWh/sqft/participant
Electric Demand	C_d	0.03840	W/sqft/participant
Natural gas	C_g	0.00316	therm/sqft/participant

Source: IL-TRM

Equation A-1. Annual Pilot Savings

Attributable annual participant savings = C_x x Minimum of (participant sqft or 500,000 sqft)

Savings from incentivized retrofits are claimed elsewhere in ComEd's energy efficiency program portfolio.

A.4 Verified Savings per Participant

Guidehouse determined verified savings for nine participants who took the BOC training; two utilizing the custom method (Section A.4), and seven via the TRM algorithm (Section A.3). The savings for each participant, as well as building area and measures completed, is shown in Table A-2.

Table A-2. Participant-level Savings

Site ID	Analysis Path	Buildings*	Managed Area†, ft^2	kWh Savings	kW Savings	Self-Report Measures
A	Custom	7	799,500	26,363	2.5	Benchmarking/tracking, small lighting, EMS adjustment, hot water heater upgrade
B	Custom	6	235,000	15,146	0.6	Benchmarking/tracking, small lighting, EMS adjustment
E	TRM	1	1,800,000	171,000	19.2	NA
F	TRM	1	13,684	4,680	0.5	NA
G	TRM	1	18,038	6,169	0.7	NA
H	TRM	1	58,698	20,075	2.3	NA
I	TRM	1	928,000	171,000	19.2	NA
J	TRM	1	590,000	171,000	19.2	NA
K	TRM	1	650,812	171,000	19.2	NA
Total				**756,433**	**83.4**	

*TRM path assumes the one address associated with the participant since no additional data were proffered.
† Area capped at 500,000 ft^2 per participant
Source: IL-TRM and evaluation team analysis

A.5 Net-to-Gross Ratio

No NTG ratio research has been conducted for the BOC Pilot, so the Illinois EE Policy Manual stipulates that a default value of 0.8[4] be used for an NTG ratio until such research is completed or a better proxy is determined.

[4] **https://www.ilsag.info/policy/illinois-ee-policy-manual/**

Appendix B. Total Resource Cost Detail

Table B-1 shows the TRC cost-effectiveness analysis inputs available at the time of finalizing this impact evaluation report. This table does not include additional required cost data (e.g., measure costs, pilot-level incentives, and non-incentive costs). ComEd will provide this data to the evaluation team later.

Table B-1. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	EUL (years)*	ER Flag†	Gross Electric Energy Savings (kWh)	Gross Peak Demand Reduction (kW)	Gross Gas Savings (Therms)	Gross Secondary Savings due to Water Reduction (kWh)	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG (kWh)	NTG (kW)	NTG (Therms)	Net Electric Energy Savings (kWh)	Net Peak Demand Reduction (kW)	Net Gas Savings (Therms)	Net Secondary Savings due to Water Reduction (kWh)	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
BOC	Training	Participant	9	10.2	NO	756,433	83	0	0	0	0	0.80	0.80	0.80	605,146	67	0	0	0	0
	Total			**10.2**		**756,433**	**83**	**0**	**0**	**0**	**0**				**605,146**	**67**	**0**	**0**	**0**	**0**

Note: To avoid double counting, the verified gross kWh and net kWh used in the TRC analysis exclude secondary energy savings from water reduction measures. The program saved 0 gallons of water representing 0 gross kWh and 0 net kWh.

*The total of the EUL column is the weighted average measure life (WAML) and is calculated as the sum product of EUL and measure savings divided by total pilot savings.

† Early replacement (ER) measures are flagged as YES; otherwise a NO is indicated in the column.

Source: ComEd tracking data and evaluation team analysis