



ComEd Building Operator Certification Pilot Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Program Year 2020 (CY2020)
(1/1/2020-12/31/2020)

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1. Introduction

This report presents results from the CY2020 impact evaluation of ComEd's Building Operator Certification (BOC) Pilot. It 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) inputs. CY2020 covers January 1, 2020 through December 31, 2020.

2. Pilot Description

Building Operator Certification (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 COVID-19, in 2020, 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.

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 tracks, BOC Level I and BOC Level II.¹ Both tracks require a time commitment of more than 60 hours for class training and assigned projects spread over several months. In CY2018 and CY2019, the BOC training included 33 participants from ComEd's service territory. Participants implement savings subsequent to their training over one or several years. Our research in CY2020 captures savings from these activities. Due to COVID-19 and modified curriculum delivery, the only CY2020 trainings occurred near year-end, thus no savings from CY2020 participants accrue in CY2020.

Table 2-1. CY2020 Volumetric Findings Detail

Participation	CY2018 & CY2019 Count
Level I participants	21
Level II participants	12
Total Participants	33

Source: ComEd tracking data and evaluation team analysis

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 O&M experience, or higher levels of education, or the completion of Level I BOC training. Source: <https://www.theboc.info/building-operator-training/boc-eligibility/>

Figure 2-1. Measures Implemented by Type

Participation	Totals
Number of capital projects inspired by training that received incentives	25
Number of capital projects inspired by training that did not receive incentives	31
Number of O&M enhancements inspired by training	29

Source: ComEd tracking data and evaluation team analysis

3. Pilot Savings Detail

Table 3-1 summarizes the incremental energy and demand savings from the BOC Pilot. Due to the nature and length of the training and the target (commercial buildings), it takes some time for the expected behavior to materialize after the training. As a result, we interviewed participants from CY2018 and CY2019 to identify actions taken by trainees. Since the sample covered two years of training, we calculated total savings from the group and divided by two to approximate one year's worth of savings to credit to CY2020. More detail on the methods and analysis is presented in Appendix A. The evaluation had insufficient data to estimate gas savings for the pilot in CY2020.

Table 3-1. CY2020 Total Annual Incremental Electric Savings

Savings Category	Energy Savings (kWh)	Summer Peak* Demand Savings (kW)
Electricity		
Ex Ante Gross Savings	NR	NR
Program Gross Realization Rate	NA	NA
Verified Gross Savings	2,187,735	295
Program Net-to-Gross Ratio (NTG)†	0.80	0.80
Verified Net Savings	1,750,188	236
Converted from Gas		
Ex Ante Gross Savings	NA	NA
Program Gross Realization Rate	NA	NA
Verified Gross Savings	NA	NA
Program Net-to-Gross Ratio (NTG)	NA	NA
Verified Net Savings	NA	NA
Total Electric Plus Gas		
Ex Ante Gross Savings	NR	NR
Program Gross Realization Rate	NA	NA
Verified Gross Savings	2,187,735	295
Program Net-to-Gross Ratio (NTG)†	0.80	0.80
Verified Net Savings	1,750,188	236

NR = not reported

NA = not applicable (refers to a piece of data that cannot be produced or does not apply).

*The coincident summer peak period is defined as 1:00 p.m.-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

† Policy manual default value <https://www.ilsag.info/policy/illinois-ee-policy-manual/>

Source: ComEd tracking data and evaluation team analysis

4. Cumulative Persisting Annual Savings

Table 4-1 shows the total verified gross savings for the BOC Pilot and the cumulative persisting annual savings (CPAS) for the measures installed in CY2020. Figure 4-1 shows the savings across the useful life of the measures. The electric CPAS across all measures installed in 2020 is 1,750,188 kWh (Table 4-1). The evaluation team did not evaluate gas savings for this pilot; as such, electric CPAS is equivalent to total CPAS.

Table 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric

End Use Type	Research Category	EUL	CY2020 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	2,187,735	0.80	17,866,464			1,750,188	1,750,188	1,750,188	1,750,188	1,750,188	1,750,188	1,750,188		
CY2020 Program Total Electric Contribution to CPAS			2,187,735		17,866,464			1,750,188	1,750,188	1,750,188	1,750,188	1,750,188	1,750,188	1,750,188		
Historic Program Total Electric Contribution to CPAS [‡]																
Program Total Electric CPAS								1,750,188	1,750,188	1,750,188	1,750,188	1,750,188	1,750,188	1,750,188		
CY2020 Program Incremental Expiring Electric Savings [§]									-	-	-	-	-	-		
Historic Program Incremental Expiring Electric Savings ^{‡§}									-	-	-	-	-	-		
Program Total Incremental Expiring Electric Savings [§]									-	-	-	-	-	-		

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
BOC	Training												
CY2020 Program Total Electric Contribution to CPAS		1,750,188	1,750,188	1,750,188	364,584								
Historic Program Total Electric Contribution to CPAS [‡]													
Program Total Electric CPAS		1,750,188	1,750,188	1,750,188	364,584								
CY2020 Program Incremental Expiring Electric Savings [§]						-	-	-	1,385,604	364,584	-	-	-
Historic Program Incremental Expiring Electric Savings ^{‡§}						-	-	-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings [§]						-	-	-	1,385,604	364,584	-	-	-

Note: The green highlighted cell shows pilot total first-year electric savings. The gray cells are blank, indicating no values or no contribution to calculating CPAS in CY2020.

* Policy manual default value. Source: <https://www.ilsag.info/policy/illinois-ee-policy-manual/>

† Lifetime savings are the sum of CPAS savings through the effective useful life (EUL).

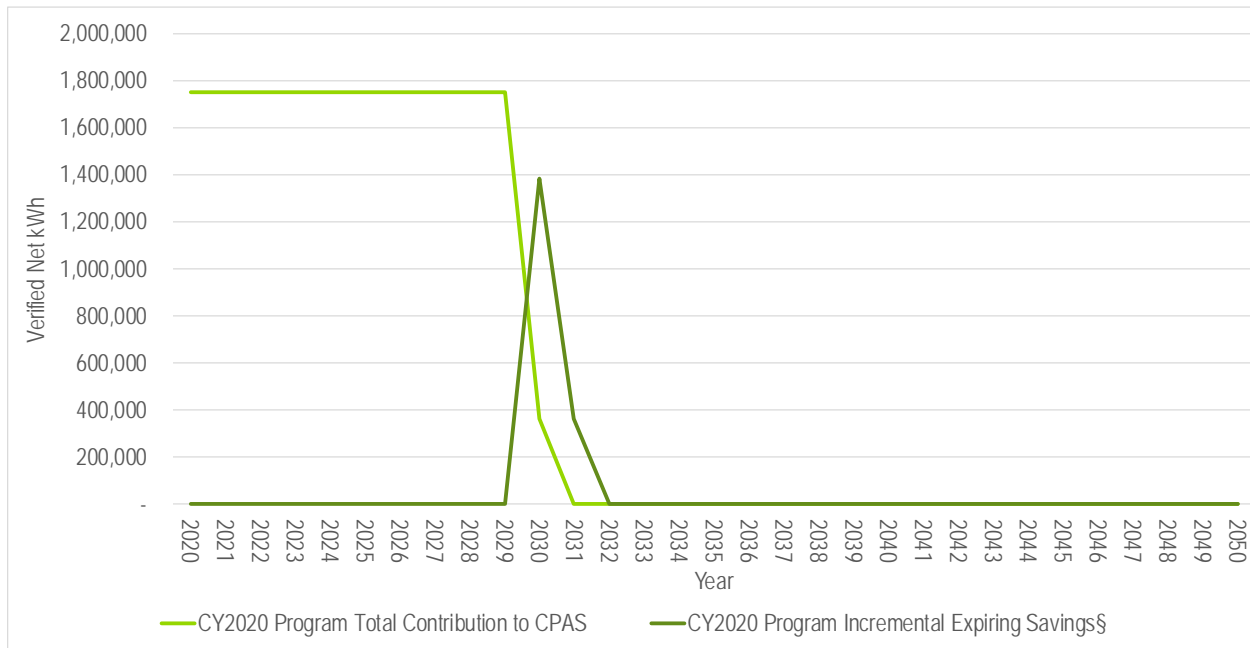
‡ Historic savings go back to CY2018.

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

|| Weighted average measure life of reported implemented measures.

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

The evaluation team analyzed savings for the BOC Pilot as a whole instead of by measure. Appendix B details the savings by end use as reported by participants.

6. Impact Analysis Findings and Recommendations

6.1 Impact Parameter Estimates

The evaluation team created custom models for each participant to estimate savings. There were no deemed impact parameters used.

6.2 Other Impact Findings and Recommendations

The evaluation team developed several recommendations based on findings from the CY2020 evaluation.

Finding 1: Guidehouse estimates that, in addition to the savings attributable to the BOC Pilot, participants implemented almost 3,000 MWh of energy efficient projects that were incentivized through other ComEd Energy Efficiency Programs over two years. In this manner, the BOC training acts as a marketing tool for other ComEd programs and increases portfolio savings. This finding also demonstrates that the building operators implement capital projects even without incentives, indicating they understand and value these projects as a result of their BOC training.

Finding 2. The data captured by ComEd on the BOC Training program does not provide a level of detail to support calculating impacts with any precision. SAG discussions are planned to discuss creating a Illinois Technical Reference Manual (TRM) measure for BOC. As part of that discussion, ComEd and the evaluation team should discuss data that might be captured during training and entered into ComEd's database that would support estimating future impacts.

Appendix A. Impact Analysis Methodology

Guidehouse conducted extensive impact interviews with 10 of the 33 participants who completed the BOC training in CY2018 and CY2019. 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 evaluation 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 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 horsepower and application of motors replaced or retrofitted with variable speed drives, or the area affected by a lighting retrofit. The evaluation team estimated savings from these reported data combined with knowledge of typical commercial retrofit projects and the Illinois Technical Reference Manual (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 CY2018 and CY2019 to determine pilot effects. The evaluation team calculated the average per participant savings from the interviewed participants and extrapolated that savings to the 33 CY2018 and CY2019 participants and applied half of that savings (approximating the effects of one year of participants) in CY2020.

This impact methodology differs from that performed by ODC for Ameren Illinois in that ODC had much more contact with the twelve participants for Ameren Illinois. ODC surveyed participants at the start of training, after training and one year later. ODC also conducted on-site verification at one site. As a result, the ODC impact analysis had more precise inputs for making savings estimates, since they were able to confirm data in subsequent conversations, and energy saving activities were more contemporaneous with the interviews.

A.1 Survey Participation

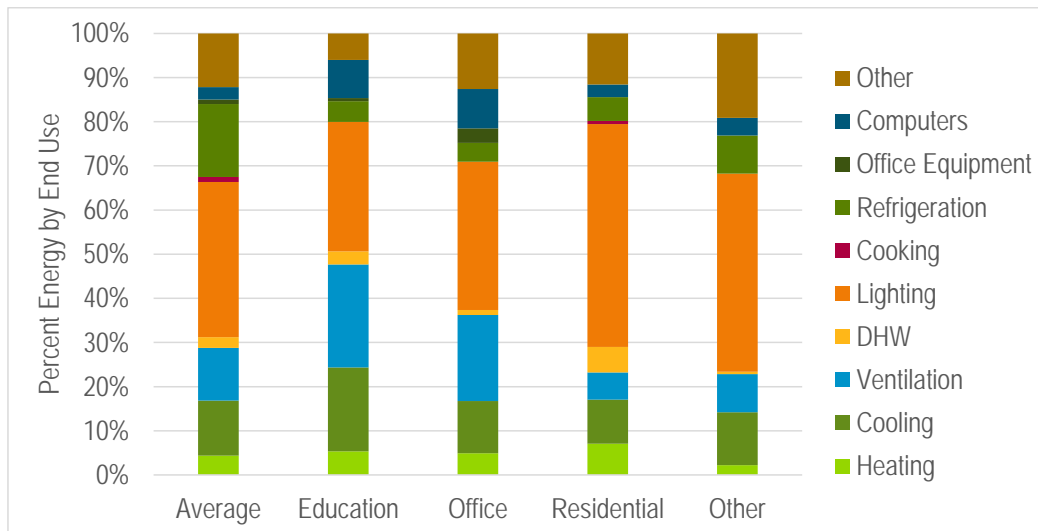
CY2018 and CY2019 BOC trainings in Illinois included 38 participants in the ComEd service territory. Among the participants, five were employees of a company implementing utility energy efficiency programs, who were getting training to improve their understanding of the customers they work with but had no building operations responsibilities. These five participants were not included in our final population of 33 building operators. Among the 33 operator participants, the evaluation team completed surveys with 10 individuals who collectively oversaw the operations

of at least² 19 unique buildings, while several buildings’ operations were overseen by a combination of training participants. The evaluation team determined the gross conditioned area of these buildings is at least 3.2 million square feet.

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. 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 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 therefore save 10% of their cooling usage.

The participant survey 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 survey also categorized the improvements by major building system: lighting, drive-power, heating, cooling, compresses air, ventilation, domestic hot water, and controls.

² Two participants operate portfolios of buildings, including several small service-buildings that were not enumerated.

A.3 Model Results

The evaluation team applied information about energy efficiency projects and enhanced operation activities to the tailored models of energy use to estimate savings first by system and then, collectively, by the pilot. Table A-1 shows savings researched via the survey, by end use, and the total savings per participant.

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

End Use	With Incentives		Without Incentives		O&M kWh
	Retrofit kW	Retrofit kWh	Retrofit kW	Retrofit kWh	
Lighting	90	319,900	64	226,300	-
Lighting Controls	8	57,600	-	-	-
Building Controls	-	419,700	-	311,100	102,500
Drivepower	-	-	62	338,400	-
Compressed Air	-	-	1	2,500	1,000
Cooling	43	45,400	52	54,400	120,400
Domestic hot water	-	16,300	-	26,000	-
Ventilation	-	139,600	-	19,600	-
Other	-	-	-	-	123,700
Total (Surveyed Participant)	142	998,500	179	978,300	347,600
Per participant	14	99,850	18	97,830	34,760

Source: Evaluation team analysis

Savings from incentivized retrofits are claimed elsewhere in ComEd's energy efficiency program portfolio. The evaluation team multiplied per participant O&M plus retrofit without incentives by total operator participation (33 operator participants) and divided by two program years to determine pilot annual savings as shown in Table A-2.

Equation A-1 Annual Pilot Savings

$$\text{Attributable annual BOC savings} = (\text{Per participant retrofit} + \text{Per participant O\&M}) \times \frac{33 \text{ participants}}{2 \text{ years}}$$

Table A-2. CY2020 Savings

Metric	Value
Retrofit kWh per person	97,830
O&M kWh per person	34,760
Total kWh per person	132,590
Number of participants (Two years)	33
Verified gross savings Total (Two years)	4,375,470
Verified gross savings Total (One year)	2,187,735
NTG	0.8
Verified Net Savings Total	1,750,188

Source: Evaluation team analysis

A.4 Net-to-Gross Ratio

No net-to-gross ratio research has been conducted for the BOC Pilot, so the Illinois EE Policy Manual stipulates that a default value of 0.8³ be used for a net-to-gross (NTG) ratio until such research is completed or a better proxy is determined.

³ <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. Additional required cost data (e.g., measure costs, pilot-level incentive and non-incentive costs) is not included in this table and will be provided 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	Participants	17	10.2	No	2,187,735	295	0	0	0	0	0.80	0.80	0.80	1,750,188	236	0	0	0	0
	Total			NA		2,187,735	295	0	0	0	0	NA	NA	NA	1,750,188	236	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 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.

‡ The EUL for this measure varies over time. See the CPAS table (Table 4-1).

Source: ComEd tracking data and evaluation team analysis