

Memorandum

Ameren Illinois Company 2019 Building Operator Certification Evaluation Lessons Learned

To: Fernando Morales, Ameren Illinois Company (AIC), and Jennifer Morris (ICC Staff)
From: The Opinion Dynamics Evaluation Team
Date: August 24, 2020
Re: 2019 AIC BOC Evaluation Process Review

This memo contains a summary of the evaluation team's approach to evaluating the 2019 impact results for the 2018 Building Operator Certification (BOC) Training, as presented in the 2019 impact evaluation report, and a retrospective assessment of our evaluation approach.¹ We leveraged an innovative approach to quantifying impacts for the training; including capturing baseline O&M practices, facility equipment, and knowledge prior to training interventions; capturing energy-saving actions; and quantifying the resulting savings attributable to the BOC Training. Overall, this effort was successful. More than half the energy savings quantified through the BOC Training evaluation were not claimed through other AIC initiatives, and respondents identified the BOC Training as an important influence in completing these projects. However, the evaluation team did encounter barriers to executing this detailed evaluation approach. The following sections provide a detailed description of our evaluation approach, the theory behind this approach, challenges to execution, and proposed improvements for future evaluations.

Initiative 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 (NEEC) 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 (Table 1). Both courses include classroom training, project assignments to be completed at the participant's facility, and in-class tests at the end of each day. Course graduates must renew their credentials annually by accumulating points for maintaining employment; attending approved continuing education webinars; and, implementing projects at their facility. While participants do not need to be AIC customers to enroll in BOC training, AIC provides a partial tuition

¹ Given that most large commercial projects have very long lead times, we designed this process to calculate the 2019 BOC Training impacts based on the actions of 2018 BOC Training participants. Therefore, we refer to the 2018 BOC Training throughout this memo, though the associated impacts were claimable in the 2019 program year.

reimbursement upon completion of the course (\$500 to put toward the total cost of \$1,400) to incentivize participation.

Table 1. List of BOC Training Topics

Topic	Level I	Level II
1001 - Energy Efficient Operation of Building HVAC Systems	✓	
1002 - Measuring and Benchmarking Energy Performance	✓	
1003 - Efficient Lighting Fundamentals	✓	
1004 - HVAC Control Fundamentals	✓	
1005 - Indoor Environmental Quality	✓	
1006 - Common Opportunities for Low-Cost Operational Improvement	✓	
1007 - Facility Electrical Systems	✓	
2001 - Building Scoping for Operational Improvements		✓
2002 - Optimizing HVAC Controls for Operational Improvements		✓
201 - Preventative Maintenance & Troubleshooting Principles		✓
202 - Advanced Electrical System Diagnostics		✓
214 - Building Commissioning		✓
216 - Enhanced Automation and Demand Reduction		✓

Expected BOC Outcomes

As Table 1 illustrates, the BOC Trainings cover many topics and participants may identify a variety of opportunities to improve their facilities. Table 2 includes a list of common outcomes with high energy savings potential. The table also provides information on which classes each outcome is linked to. The evaluation team prioritized these outcomes in data collection activities.²

Table 2. List of Expected Outcomes from BOC Courses

Outcome	1001	1002	1003	1004	1005	1006	2001	2002	201	202	214	216
Tune up boiler(s)	X						X					
Test and replace faulty steam traps	X											
Optimize chiller sequencing	X							X				
Install thermal storage systems												X
Measure and optimize chiller performance	X											
Schedule optimum starts for AHU system	X							X				
Match AHU schedule to space occupancy	X							X				
Schedule boilers	X							X				

² The evaluation team also asked about outcomes not included in Table 2, including outcomes not directly linked to a specific BOC class such as large capital investments where the BOC Training may have impacted the decision-making process.

Outcome	1001	1002	1003	1004	1005	1006	2001	2002	201	202	214	216
Schedule exhaust fans	X							X				
Schedule fan-powered boxes	X							X				
Schedule fan-powered/VAV boxes	X							X				
Schedule heaters	X							X				
Schedule pumps	X							X				
Schedule return/exhaust fans	X							X				
Set back space temperature	X							X				
Install demand control ventilation	X							X				
Install hot water pump VSD(s)		X								X		
Install combustion fan VSD(s)		X								X		
Use variable speed condenser fans for capacity control		X						X				
Utilize VSDs for fans		X								X		
Install VSD(s) for pumps		X								X		
Install ECM(s)		X										
Install VSD(s)		X								X		
Install occupancy sensors			X									
Install daylighting/photocells on interior fixtures (skylights/window walls)			X									
Install lighting control panels (sweep/timers)			X									
Replace incandescent, CFL, HID, or fluorescent fixtures with LED lighting			X									
Replace incandescent or CFL exit signs with LED exit signs			X									
Replace stairwell lights with bi-level fixtures with sensors			X									
Install CO-based ventilation control					X			X				
Install CO2-based demand control ventilation					X			X				
Use economizer and outdoor air control					X			X				
Optimize condenser water temperature						X		X				
Schedule heaters						X		X				
Use natural ventilation instead of cooling						X		X				
Install building pressurization control								X				

Outcome	1001	1002	1003	1004	1005	1006	2001	2002	201	202	214	216
Perform night purge cycle for pre-cooling						X						
Perform economizer commissioning						X					X	
Reset supply air temperature						X		X				
Balance airside supply						X		X				
Reduce simultaneous heating and cooling						X		X				
Reduce outside air ventilation						X		X				
Commission air systems						X					X	

Impact Evaluation Methodology

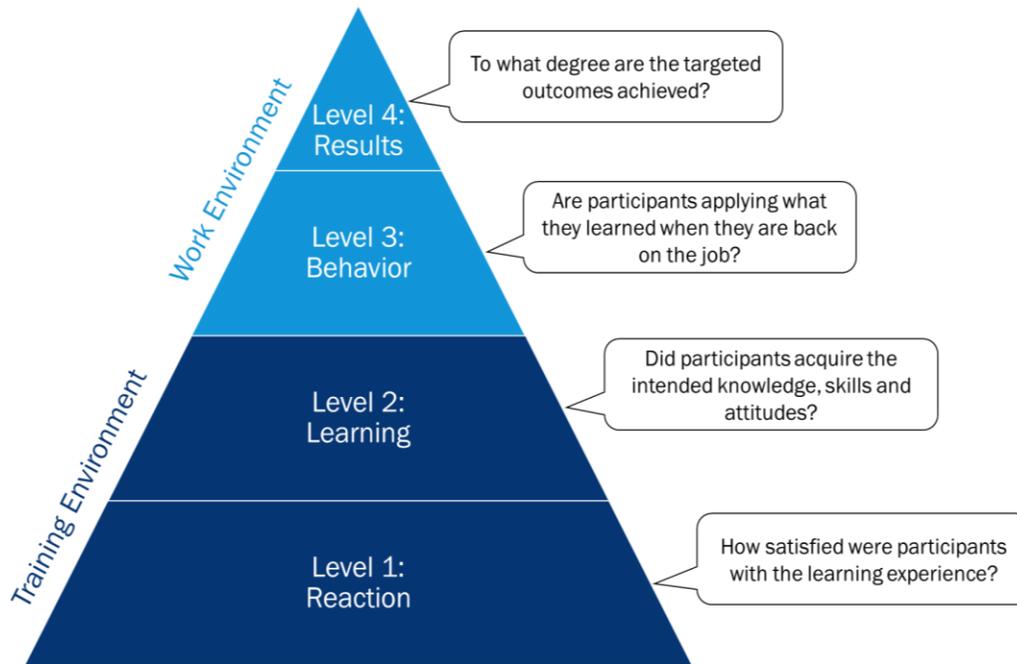
The objective of our evaluation was to measure the energy savings attributable to the 2018 BOC Training. To do so, we developed and employed an evaluation approach based on Kirkpatrick's framework of adult training evaluation which is described in more detail in the Detailed Methodology Section. Kirkpatrick's framework evaluates the effectiveness of adult training by measuring four levels of the training: (1) Reaction, (2) Learning, (3) Behavior, and (4) Results. For the purposes of our evaluation, level three equated to the outcomes described in the Expected BOC Outcomes Section and level four equated to the energy and demand savings resulting from those outcomes.

Detailed Methodology

The evaluation team leveraged an innovative evaluation approach to calculate the 2019 gross impacts resulting from the 2018 BOC Training. We aligned the approach with Kirkpatrick's Framework—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 the training's 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 3Table 3), including:

- **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.
- **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 instructor.
- **Participant 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 they made to their facilities during the training; (4) record any future plans for energy efficiency projects; and, (5) identify the role the BOC Training played in these future plans. We provided a \$50 incentive as a thank you for participating in the interviews.
- **Post-course savings survey:** We surveyed participants a year after they completed the BOC Training to understand the actions (if any) they took as a result of what they learned, including energy efficiency projects and modifications to building or equipment operations. Following the survey, we asked participants for the opportunity to schedule an onsite audit. We provided a \$100 incentive as a thank you for participating in the survey.
- **Engineering desk reviews:** Our engineers reviewed the data collected in the post-course savings survey, set up savings calculations, and identified additional data required to calculate impacts.

- Onsite audit:** Our engineers (1) verified the installation and operation of the measures indicated in the post-course savings survey, (2) ensured the measures were installed following the BOC Training, and (3) gathered additional information to support impact calculations. We provided a \$250-\$500 incentive as a thank you for participating in the audit.³

Table 3 illustrates how each of the research activities contributed to the assessment of Kirkpatrick's four levels. It is important to note that because the 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 such, we could only estimate savings for participants that participated in the data collection activities at least through the post-course savings survey. The scope of this memo is to discuss lessons learned from the described approach, and as such, we do not present detailed information on the results of each research activity. More information on the results from these activities can be found in the Ameren Illinois Company 2019 Business Program Impact Evaluation Report and the forthcoming Ameren Illinois Company 2019 Building Operator Certification Process Evaluation Memo.

Table 3. Summary of Research Activities and the Associated Kirkpatrick Levels

Research Activity	Level 1	Level 2	Level 3	Level 4
Review of course materials	✓	✓		
Participant interviews	✓	✓	✓	
Baseline O&M and EE equipment survey		✓	✓	
Post-course savings survey			✓	✓
Engineering desk reviews				✓
Onsite audit				✓

Lessons Learned

The evaluation team experienced some unexpected barriers in the first year deploying this novel approach. The following sections provide details on these barriers, as well as potential solutions to mitigate them in the future.

Evaluation Barriers

The primary barrier we experienced during the evaluation was a lack of participation in research activities. As previously mentioned, our approach was heavily dependent on consistent participation in research activities, particularly in the post-course savings survey and onsite audit. As Table 4 shows, participation in later critical data collection activities was low. While we expected minor attrition between research activities, we felt incentive levels for the post-course savings survey and onsite audit were high enough to maintain strong levels of participation. This proved not to be the case.

³ The onsite audit incentive was originally set at \$250 but due to lack of interest we raised it to \$500 for participants with multiple facilities.

Table 4. Summary of Participation in Evaluation Activities

Participant ID	BOC Level	Baseline Survey	Post-Course Interview	Post-Course Savings Survey	Onsite Audit
20001	I	✓	✓		
20017	I	✓	✓	✓	✓
20033	I	✓	✓	✓	
20049	I	✓	✓	✓	
20081	I	✓	b	b	
20097	I	✓	✓	✓	
20113	I	✓	b	b	
20129	I	✓	✓		
30001	II	✓	✓		
30002	II	✓	✓		
30003	II	✓	✓	✓	
30004	II	a	✓		

^a Participant 30004 did not complete a baseline survey because their role is supplemental to the role of Participant 30001.

^b Participants 20081, 20097, and 20113 held similar roles and worked together on the same building—each having different work shifts around the clock. These participants indicated that it would be duplicative for each of them to complete the data collection activities and thus we only completed the post-course interview and post-course savings survey with Participant 20097.

The lack of participation presented challenges on two levels. First, we could not calculate savings for about half the participants because they did not complete the post-course savings survey. Therefore, we did not have any information on the changes they made to their facilities after completing the course. Second, the post-course savings survey was designed as a precursor to the onsite audit. As such, the survey was not designed to gather all required data on each of the projects reported by the participants. The expectation was that additional project details would be collected onsite to help refine savings calculations. However, just one participant agreed to an onsite audit. As a result, we had to rely on the survey as the primary source of data for engineering calculations for the rest of the participants. In future years, it will be critical to find ways to encourage continued participation in research activities so that all savings can be quantified. Our current approach to assume zero savings for non-respondents mirrors industry standards for quantifying spillover. An alternative approach could be to treat non-respondents as they are treated in free-ridership analyses – drop them from the analysis and extrapolate the results from respondents to the entire population. We feel the current approach, while more conservative, is the appropriate approach to take when quantifying savings from the BOC Training.

Lastly, missing program materials and materials with missing names caused challenges when the evaluation team attempted to make connections between course activities associated with reaction and learning and the behavior changes and resulting energy savings captured in evaluation activities. For example, the evaluation team was missing pre-assessments for a number of students; others lacked names or grading. Additionally, many of the exit surveys lacked names and others were only partially completed. The methodology leveraged in this evaluation is dependent on consistent, complete, and detailed data from the beginning of the course through the completion of data collection activities. This allows the evaluation team to draw linkages between a participant’s reaction to a course, a resulting increase in knowledge, and associated behavior change that produces the desired results of the training. This type of linkage is useful in illuminating the connection

between a participant's experience with a specific class and their implementation of a related energy-saving action. With BOC moving online in 2020, we believe this issue will be minimized.

Potential Solutions

The evaluation team identified several actions that could be implemented in future evaluation periods to encourage participation in research activities, limit reliance on onsite verification, and capture additional energy savings.

Encourage Participation

One adjustment AIC could make to help increase participation in research activities is requiring participation as part of the incentive agreement between AIC and the participants. It is typical for traditional energy efficiency programs to require participants to accommodate verification activities. We understand AIC does not want to discourage participation in the BOC Training by overburdening participants; however, these research activities are critical to understanding the impact of the training. Alternatively, AIC could inform participants when they register that participation in evaluation activities is expected. They could then stress the importance of their participation in data collection activities during the first and last class. This would avoid any contractual obligations to participate but could set the expectation that all participants complete the activities. AIC and our evaluation team can also help communicate to instructors the importance of collecting completed program materials from all participants and ensuring these materials are graded and include participant names. We do expect that online BOC courses that are happening in 2020 and are using a learning management system will help significantly with this issue.

Adjustments to incentive structures could also encourage participation. AIC could offer alternative incentives for participants who complete all the evaluation activities, including an additional partial tuition reimbursement (right now AIC provides \$500 to put toward the total cost of \$1,400); discounted costs for the BOC certification exam, or increased incentives for the Level II course if the participant chooses to enroll. Furthermore, the evaluation team could consider increasing incentive levels, particularly for the post-course savings survey.

Additionally, improved communication strategies could combat attrition. During the 2019 evaluation, there was a year-long gap in communication between the evaluation team and BOC participants between completion of the participant interview and fielding of the post-course savings survey. In the future, finding ways to maintain communication between these research activities may improve response rates. Further, greater consideration for the timing of research activities could prove beneficial. During the 2019 evaluation, we attempted to complete onsite audits in December and January, which presented barriers to participation for some participants; one participant who managed a large religious facility was busy preparing for the holidays and another participant who worked at an educational facility was on holiday break. The evaluation team could avoid conducting data collection activities during traditional busy periods for BOC students to better enable participation.

Finally, the evaluation team could make it easier for participants to report that they have not made any changes to their facilities since completing the training. It is possible that some participants did not respond to the post-course savings survey because they did not want to report that they had not implemented what they learned. However, this data is valuable to evaluation results. Moving forward, the evaluation team could be proactive in addressing this issue and include language in our outreach to make participants more comfortable reporting they have not made changes to their facility. Some example language is provided below:

"We understand you may not have had time to complete any projects since completing the BOC Training. This information is just as valuable to our evaluation. If this is the case, please respond to this email stating you have not made any changes since participation and we will remove you from the outreach list."

Limit Reliance on Onsite Verification

We can also modify the evaluation approach to reduce reliance on the onsite collection of detailed engineering information needed to calculate energy savings. We can expand the post-course savings survey to capture a greater level of project detail including the characteristics (measure types, quantity, size, etc.) of baseline and efficient equipment. Capturing all the data required to calculate energy savings in the post-course savings survey would enable us to accurately calculate energy savings even if the participant does not participate in verification activities. Expanding the survey would also allow us to offer alternative modes of verification in addition to or in place of the onsite audit, including providing project invoices, manufacturer cut sheets, or EMS data from before and after the training. In the 2019 evaluation, several participants were unwilling or unable to accommodate an onsite audit. These other forms of verification are less intrusive for the participant and less expensive for the evaluation team. Additionally, onsite verification activities may not be possible in 2020 due to restrictions from COVID-19. Accommodating other forms of verification will allow the evaluation team to remain flexible in this period of uncertainty.

Capture Additional Energy Savings

Lastly, the evaluation team could continue fielding the post-course savings survey with 2018 participants in future evaluation periods. Many participants represent public entities or larger organizations where the project approval and resource allocation process can be lengthy. As a result, larger projects may take longer than a year to approve and implement. Additionally, the BOC Training can generate a "careers-worth" of energy savings. Continuing to follow up with responsive participants can help capture future savings and potentially compensate for the savings lost through a lack of participation from other participants. The evaluation team could limit follow up surveys to participants who indicate in the first post course savings survey that are in the process of planning projects related to the BOC Training. For example, the participant that completed an onsite verification visit as part of the 2019 evaluation indicated they were in the process of converting the lighting in some school buildings to LEDs. They also mentioned converting some school buildings to geothermal heat. Following up with this participant could uncover additional energy savings that are potentially attributable to BOC.

Recommended Improvements for 2020

Based on the suite of solutions presented above, we recommend implementing a combination of changes that would bolster the evaluation approach and potentially reduce evaluation costs. First, we could reduce reliance on the onsite audit by expanding the post-course savings survey. It is important to collect as much detail as possible in the survey in case the participant chooses not to participate in verification activities. As part of this adjustment, we recommend prioritizing asking participants about common BOC outcomes with high energy savings potential. We also recommend fielding the survey in a similar manner to spillover surveys, which generally include an engineer from the evaluation team in the interview to ask technical questions. The engineer could provide upfront notice to the participant about the follow up information the evaluation team might need to request. Implementing a more detailed survey process would also enable the use of alternative modes of verification. We would need to prioritize the equipment and behavior changes we ask about to minimize respondent burden and maximize response rate. Allowing participants to submit materials such as

invoices or EMS data in lieu of an onsite audit could increase participation and offer a cheaper alternative to verifying the information reported in the survey.

We can pair this refined engineering approach with some of the low-risk and easy to implement strategies for improving participation such as maintaining communication with participants throughout the year, ensuring all program materials include names and grades, increasing incentives for the post-course savings survey, avoiding fielding research activities during busy times of the year (e.g. holidays and late summer/back to school), and facilitating the reporting of "no change" results. Pairing these refined strategies should mitigate the barriers we experienced during the 2019 evaluation. In the event these adjustments do not produce the desired results, we can revisit the other solutions presented in this memo.