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Ameren Illinois Company 2019 Integrated Process Evaluation Report

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Table of Contents

1. Executive Summary 5
   - 1.1 Overview of the AIC Portfolio 5
   - 1.2 Process Evaluation Approach 7
2. 2019 Portfolio Process Findings 8
   - 2.1 Income Qualified Initiative 8
     - 2.1.1 Income Qualified Initiative Implementation Process Review Memo 8
     - 2.1.2 Income Qualified Community Action Agency Interview Findings Memo 14
     - 2.1.3 Income Qualified Single Family Site Visit Findings Memo 21
   - 2.2 HVAC Initiative 34
     - 2.2.1 HVAC Initiative Participant and Trade Ally Survey Process Results Memo 34
   - 2.3 Standard Initiative 50
     - 2.3.1 Small Business Direct Install Participant Survey Results Memo 51
   - 2.4 Building Operator Certification Offering 61
     - 2.4.1 Building Operator Certification Evaluation Lessons Learned Memo 61
     - 2.4.2 Building Operator Certification Process Evaluation Report 70
   - 2.5 Non-Energy Impacts Research 95
     - 2.5.1 Negative Non-Energy Impacts Literature Review Memo 95

Table of Tables

Table 1. 2019 AIC Portfolio Program Descriptions 5
Figure 1. 2019 AIC Portfolio Verified Net Electric Energy Savings by Initiative 6
Figure 2. 2019 AIC Portfolio Ex Ante Gas Savings by Initiative 7
Table 2. 2019 Process Evaluation Activities 7
Table 3. 2019 IQ Initiative - Key Implementation Partners and Roles 9
Table 4. Implementation Process Overview 11
Table 5. Snapshot of Responding CAAs (n=9) 20
Table 6. EE Measures Offered by AIC IQ Initiative CAA Channel and IHWAP 21
Table 7. Summary of Measures Reviewed On-Site, by Project Type 22
Table 8. ISR Summary, by Measure and Project Type 24
Table 9. ISR Summary – Standard LEDs 25
Table 10. ISR Summary – Advanced Power Strips 25
Table 11. Quality Installation Pass Rate, by Measure and Project Type 27
Table 12. Potential Missed Opportunities Observed, by Project Type 29
Table 13. Potential Remaining Opportunities Observed, by Project Type 31
Table 14. Satisfaction Scores for the Initiative, by Project Type 32
Table 15. Definition of Quality Installation and Potential Missed Opportunity, by Measure 33
Table 16. Participant Survey Disposition Summary 36
Table 17. Trade Ally Survey Disposition Summary 36
Table 18. Participant Respondent Demographics 37
Table 19. How Participants First Heard about the HVAC Initiative 38
Table 20. Overview of Trade Ally Respondents 39
Table 21. List of BOC Training Topics 61
Table 22. List of BOC Training Topics 62
Table 23. List of Expected Outcomes from BOC Courses 63
Table 24. Summary of Research Activities and the Associated Kirkpatrick Levels 66
Table 25. Summary of Participation in Evaluation Activities 67
Table 26. BOC Level I Course Exit Survey Results 71
Table 27. BOC Level I Course Interview Results 71
Table 28. BOC Level I Course Average Exam and Project Grades 73
Table 29. BOC Level II Course Exit Survey Results – Classes 202, 214, and 216 74

Table 30. BOC Level II Course Exit Survey Results – Classes 2001A, 2001B, and 2002 74
Table 31. BOC Level II Course Interview Results 75
Table 32. BOC Level II Course Average Exam and Project Grades 76
Table 33. Influence of Non-BOC Factors on Decision to Take Energy-Saving Actions 77
Table 34. 2019 BOC Level I Course Energy Savings by Enduse 77
Table 35. Influence of Non-BOC Factors on Decision to Take Energy-Saving Actions 79
Table 36. 2019 BOC Level II Course Energy Savings by Enduse 79
Table 37. Post-Series Energy-Saving Actions Reported by Participant 80
Table 38. Energy Savings Claimed for Participant 81
Table 39. Post-Series Energy-Saving Actions Reported by Participant 81
Table 40. Energy Savings Claimed for Participant 82
Table 41. Post-Series Energy-Saving Actions Reported by Participant[a] 83
Table 42. Energy Savings Claimed for Participant 83
Table 43. BOC Level I Course Exit Survey Results 84
Table 44. BOC Level II Course Exit Survey Results – Classes 202, 214, and 216 85
Table 45. BOC Level I Course Average Exam and Project Grades 86
Table 46. BOC Level II Course Average Exam and Project Grades 86
Table 47. 2019 BOC Level I Course Energy Savings by Enduse 87
Table 48. 2019 BOC Level II Course Energy Savings by Enduse 87
Table 49. 2018 BOC Training Participation Summary 89
Table 50. List of Expected Outcomes from BOC Courses 90
Table 51. Summary of Research Activities and the Associated Kirkpatrick Levels 93
Table 52. Summary of Participation in Evaluation Activities 94

Table of Figures

Figure 3. Participant Satisfaction with AIC, the HVAC Initiative, and Initiative Components 38
Figure 4. Active Trade Allies Satisfaction with Initiative Elements [a] 40
Figure 5. Barriers to Trade Allies Participating in the HVAC Initiative 41
Figure 6. Trade Ally Likelihood to Participate in the Future a 42
Figure 7. How Respondents First Heard about HPWHs (n=159) 44
Figure 8. Respondent Familiarity with Heat Pump Water Heaters (n=155) 44
Figure 9. HPWH Benefits that are Attractive to Customers (n=51) 45
Figure 10. Reasons Customers Chose Not to Install HPWHs 46
Figure 11. Trade Ally Awareness of HPWHs (n=54) 46
Figure 12. Trade Ally HPWH Training Sources (n=32) 47
Figure 13. Frequency that Trade Allies Reported Barriers to Installing HPWHs (n=23) 48
Figure 14. Small Business Offering Participant Types (n=124) 53
Figure 15. Program Awareness Channels (n=124): Have you ever 54
Figure 16. Customer Interest in Energy Efficiency Measures (n=124) 55
Figure 17. Customer Awareness of Other Program Offerings (n=124) 55
Figure 18. Customer Awareness of and Interest in Other Program Offerings (n=124) 56
Figure 19. Customer Satisfaction with Small Business Offering 57
Figure 20. Reasons Customers did not Install all the Recommended Equipment (Multiple Responses Allowed, n=10) 58
Figure 21. Linear Lighting Products Installed at Small Business Offering Facilities 58
Figure 22. Respondents' Plans to Replace T12/T8 Fluorescent Lamps 59
Figure 23. Respondent Lighting Purchase Behaviors: Agreement or Disagreement with the Following Statements 60
Figure 24. Upgrading Lighting Products in the Absence of the Small Business Offering (n=124) 60
Figure 25. Kirkpatrick Model 65
Figure 26. Kirkpatrick Model 92

1. Executive Summary

This report presents a compilation of process evaluation findings from Ameren Illinois Company's (AIC) portfolio of energy efficiency programs implemented during the 2019 calendar year. The purpose of this report is to aggregate results from process-focused deliverables developed and submitted on an ongoing basis as part of the 2019 evaluation. Each of the deliverables cited within this report are available on the Illinois Stakeholder Advisory Group (SAG) website.[1]

1.1 Overview of the AIC Portfolio

AIC's 2019 portfolio is made up of two programs: the Residential Program and the Business Program. Each program is made up of a number of initiatives as detailed in Table 1 below.

Table 1. 2019 AIC Portfolio Program Descriptions

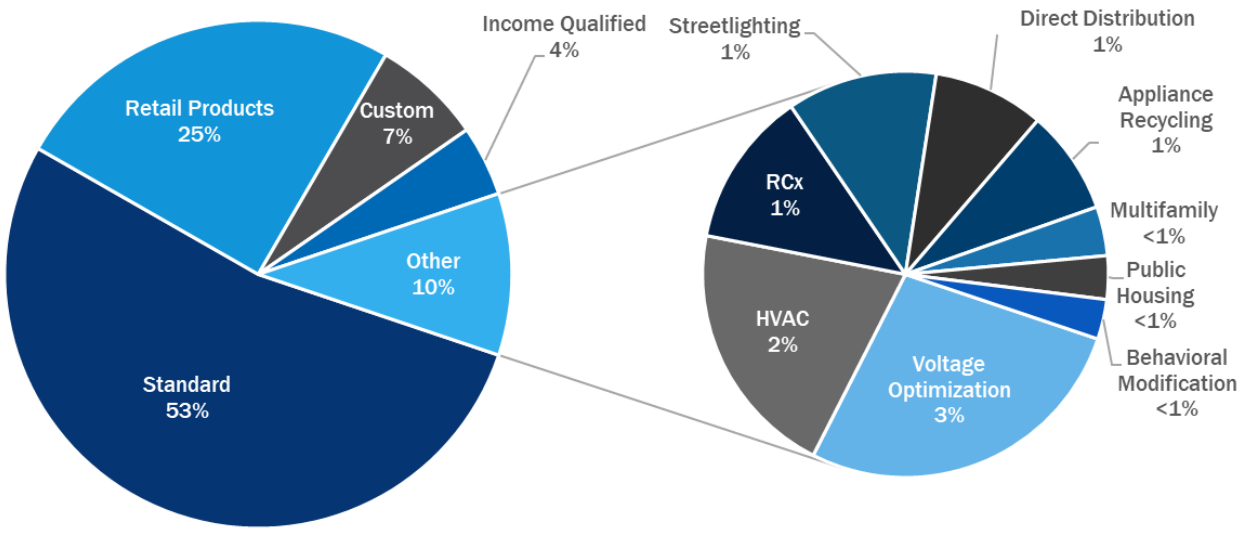
Program	Initiative	Description
Residential	Retail Products	Residential efficient products, including upstream lighting and advanced thermostat and appliance rebates
	Income Qualified – CAA	Whole-building low income program, including direct install and shell measures, delivered through Community Action Agencies (CAAs)
	Income Qualified – Single Family	Whole-building low-to-moderate income program, including direct install and shell measures for single family homes
	Income Qualified – Multifamily	Whole-building low-to-moderate income program, including direct install and shell measures for multifamily facilities
	Income Qualified – Smart Savers	Program directly providing advanced thermostats to low-income customers
	Public Housing	Public housing program providing energy efficiency measures to public housing facilities
	Heating and Cooling (HVAC)	HVAC program offering instant or mail-in rebates on energy efficient heating and cooling equipment
	Behavioral Modification	Home energy reports program targeting both electric and gas customers
	Appliance Recycling	Refrigerator and freezer recycling program
	Multifamily	Market-rate multifamily program providing direct install measures
	Direct Distribution of Efficient Products (Direct Distribution)	Program providing energy efficiency kits through a variety of channels (K-12 education, kits distributed to Appliance Recycling participants, kits distributed at community events)
Business	Standard	Non-residential prescriptive incentive program, also including small business direct install, midstream lighting, and online store components
	Custom	Non-residential custom incentive program providing incentives for more complex non-residential projects
	Retro-Commissioning (RCx)	Non-residential retro-commissioning program including compressed air and industrial refrigeration components in addition to more traditional whole-building RCx measures
	Streetlighting	Program incentivizing municipalities to upgrade municipality- or AIC-owned streetlighting to LED technology

[1] https://www.ilsag.info/evaluation-documents/final-evaluation-reports/#ameren

Program	Initiative	Description
	Building Operator Certification (BOC)	Training program focused on energy-efficient building operations and preventative maintenance procedures
Voltage Optimization		Energy efficiency technology implemented by AIC at the distribution substation or circuit level that optimizes voltage levels along distribution circuits to reduce energy usage

The portfolio's savings are driven heavily by a small number of these initiatives. The Business Program's Standard Initiative and the Residential Program's Retail Products Initiative together provide over 75% of portfolio verified net energy savings.[2] Figure 1 shows portfolio verified net electric energy savings by initiative.

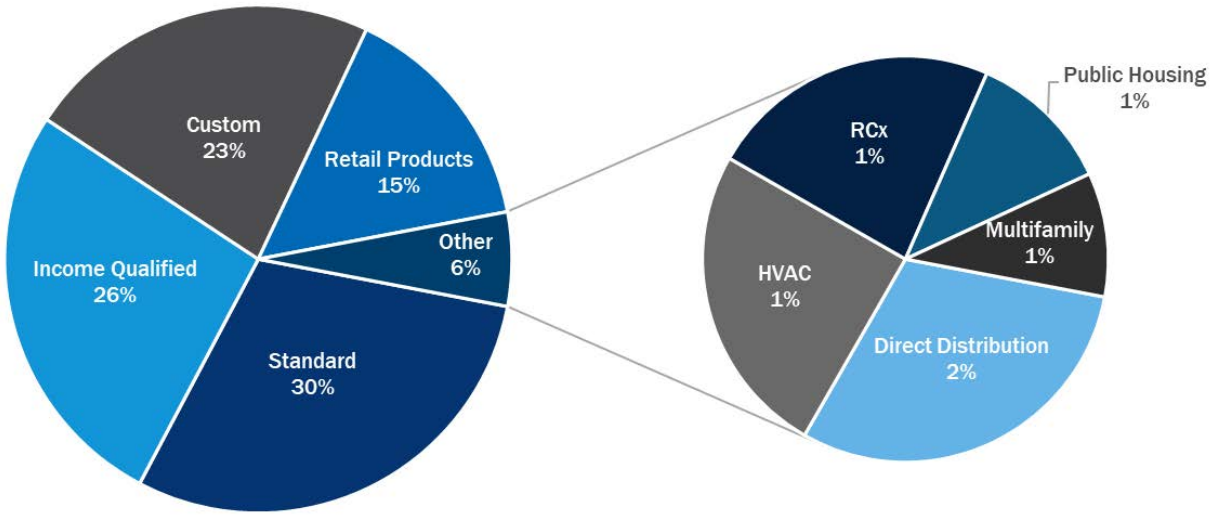
Figure 1. 2019 AIC Portfolio Verified Net Electric Energy Savings by Initiative



Gas savings are somewhat more diversified across initiatives. Four initiatives (Business Standard and Custom, as well as Residential Income Qualified and Retail Products) each provide 15% of portfolio gas savings or more. Figure 2 shows portfolio verified net gas savings by initiative.[3]

[2] Excluding the conversion of alternate fuels to MWh for goal attainment, residential NPSO, and Building Operator Certification.
[3] Excluding the conversion of alternate fuels to MWh for goal attainment, residential NPSO, and Building Operator Certification.

Figure 2. 2019 AIC Portfolio Ex Ante Gas Savings by Initiative



1.2 Process Evaluation Approach

The 2019 evaluation plan served as the foundation for the process evaluation activities conducted for the 2019 program year. As shown in Table 2, the evaluation team's targeted process activities focused on the Residential Income Qualified (IQ) and HVAC Initiatives, as well as the Business Standard Initiative and Building Operator Certification (BOC) offering.

Table 2. 2019 Process Evaluation Activities

Evaluation Activity	Residential Program								Business Program				
	Retail Products	Income Qualified	Public Housing	Behavioral Modification	HVAC	Appliance Recycling	Multifamily	Direct Distribution	Standard	Custom	Retro-Cx	Streetlighting	BOC
Program Material & Data Review	All programs												
Program Manager and Implementer Interviews	All programs												
Market Actor Interviews					X								
Participant Survey / Interviews					X				X				X
Community Organization Interviews		X											
Site Visits		X											

2. 2019 Portfolio Process Findings

In the following sections, the evaluation team presents a comprehensive series of deliverables containing process-related findings from the 2019 AIC evaluation.

2.1 Income Qualified Initiative

The Income Qualified (IQ) Initiative is a home energy diagnostic and whole house retrofit offering. The target markets for the initiative are (1) single family customers with household incomes up to 300% of federal poverty guidelines for household size and (2) multifamily properties with the majority of tenants receiving state, federal, or other income-qualified assistance. The IQ Initiative provides Building Performance Institute (BPI) energy audits that identify building shell and HVAC retrofit opportunities and provide health and safety inspections. During the audit, implementation staff also install energy efficient "direct install" (DI) measures, such as LEDs, showerheads, faucet aerators, advanced power strips, and pipe insulation. Following the audit, customers may also receive building shell measures (e.g., air sealing and insulation) or high efficiency HVAC measures (e.g., advanced thermostats, central air conditioners, and furnaces).

Leidos oversees the implementation of the IQ Initiative in coordination with several implementation partners, and the single family portion of the Initiative has two implementation channels. Walker-Miller and AIC program allies implement the non-CAA or "Moderate Income" channel, which serves low to moderate-income single family customers who do not participate in the Illinois Home Weatherization Assistance Program (IHWAP). CAAs, with support from AIC partner Resource Innovations, implement the CAA channel, which serves low-income single family AIC customers that also participate in IHWAP. With AIC funding, CAAs provide direct install measures such as standard LEDs, faucet aerators, and showerheads, as well as air sealing and insulation. CAAs can also leverage IHWAP funding to provide HVAC, weatherization, and DI measures that the Initiative does not fund for CAAs.

As part of the 2019 evaluation, the evaluation team issued three process related deliverables included in the sections below and available on the SAG website.[4] [5] [6]

2.1.1 Income Qualified Initiative Implementation Process Review Memo

This memo provides key findings from program and implementation staff interviews and updated implementation process models for the Ameren Illinois Company (AIC) 2019 Income Qualified (IQ) Initiative. The initiative is in its second year of implementation. While the core offerings of the Initiative are consistent with 2018, AIC and its partners are fine-tuning design and implementation processes as needed in reaction to policy changes, increasing demand for the Initiative, and lessons learned by implementation partners on the ground. The purpose of this memo is to assist with that effort by documenting the current implementation model and summarizing feedback from initiative and implementation staff on the successes and challenges so far in 2019.

Overview of the 2019 IQ Initiative

The AIC IQ Initiative is a home energy diagnostic and whole house retrofit offering. The target markets for the initiative are (1) single family customers with household incomes up to 300% of federal poverty guidelines for household size and (2) multifamily properties with the majority of tenants receiving state, federal, or other income-qualified assistance. The IQ Initiative provides Building Performance Institute (BPI) energy audits that

[4] https://ilsag.s3.amazonaws.com/AIC-IQ-CAA-Study-Findings-Memo-FINAL-2020-02-24.pdf
[5] https://ilsag.s3.amazonaws.com/AIC-IQ-Initiative-Single-Family-Site-Visit-Findings-FINAL-2020-07-10.pdf
[6] https://ilsag.s3.amazonaws.com/AIC-IQ-Initiative-Implementation-Process-Review-FINAL-2019-11-19.pdf

identify building shell and HVAC retrofit opportunities and provide health and safety inspections. During the audit, implementation staff also install energy efficient "direct install" (DI) measures such as LEDs, showerheads, faucet aerators, advanced power strips, and pipe insulation. Following the audit, customers may also receive building shell measures (e.g., air sealing and insulation) and high efficiency Heating Ventilation and Air Conditioning (HVAC) measures (i.e., smart thermostats, central air conditioners, boilers, and air source heat pumps). In addition, the IQ Initiative distributes kits with energy efficient products[7] at community events to market the program to potential participants.

The Initiative provides all audit services and DI measures at no cost to the customer. Low-income single family customers and multifamily properties pay no out-of-pocket costs for shell and HVAC retrofits. Moderate-income[8] single family participants may pay out of pocket costs for HVAC-related mechanical repairs exceeding $1,000 and building shell retrofits exceeding $2,000.

Leidos oversees the implementation of the IQ Initiative in coordination with several implementation partners across three channels. Walker-Miller and AIC program allies serve low to moderate-income single family customers who do not participate in the Illinois Home Weatherization Assistance Program (IHWAP). Community Action Agencies (CAAs), with support from AIC partner Resource Innovations, serve low-income single family customers that also participate IHWAP. CMC Energy and three[9] specific AIC program allies serve IQ multifamily properties. All AIC program allies providing initiative services must be "core" allies, meaning they are BPI-certified. Table 1 below briefly describes each implementation partner's role.

Table 3. 2019 IQ Initiative - Key Implementation Partners and Roles

Partner	Multifamily Channel	Single Family Non-CAA Channel (without IHWAP)	Single Family CAA Channel (with IHWAP)
Leidos	Overall marketing and implementation lead, customer eligibility review, QC field inspections, technical reviews of scopes of work, incentive application review		
CMC Energy	Marketing, audits and DI	None	None
Walker-Miller	None	Marketing, audits and DI, QC field inspections of program ally projects [a]	None
Resource Innovations	None	None	Marketing, CAA oversight and support, incentive application review;
CAAs	None	None	Marketing, waitlist management, eligibility review, audits and DI, shell/HVAC retrofits, QC field inspections
Program Allies	Marketing, shell/HVAC retrofits	Marketing, audits and DI, shell/HVAC retrofits [a]	None [b]

a. For the single family non-CAA channel, either Walker Miller or a program ally may complete the energy audit with DI, depending on who identified the lead. Program allies complete all shell and HVAC retrofits.

b. Most CAAs complete projects on their own but some smaller CAAs may bid out project work to certified contractors.

[7] Kit contents vary depending on customer type. Dual-fuel ("full") kits include four LEDs, two faucet aerators, one showerhead, one advanced power strip, and a water heater temperature card. Electric-only kits exclude hot water measures and include four additional LEDs (eight total). Gas-only kits exclude LEDs and power strips but include a shower timer and a thermostatic valve.

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

[9] Assured Energy does all shell retrofits. AAA Northgate or Rebel Inc. do all HVAC retrofits.

Key Changes to Implementation in 2019

There were a few key changes in 2019 that significantly impacted single family non-CAA and CAA channel implementation, coordination, and communication processes. There were no substantial changes to multifamily channel implementation.

- After achieving participation goals, the single family non-CAA channel began offering a scaled-down audit, called the Instant Savers Audit. This new, scaled down offering reduced costs for the audit and helped preserve the implementation budget while enabling AIC to continue to meet customer demand for services. The Instant Savers Audit provides the same DI measures and health and safety inspections as the original audit but does not perform blower door or combustion testing and does not provide a proposed shell and HVAC retrofit scope of work. Walker-Miller then puts customers on a wait list for shell and HVAC retrofits in 2020 if such opportunities potentially exist. Leidos and AIC commented that removing these tests was a logical way to lower the cost of audit implementation per customer as these tests would need to be performed again just prior to receiving shell and HVAC retrofits in 2020.
- Resource Innovations made changes to CAA project forecasting support and invoice payment processes. In 2018, CAAs provided volume forecasts only on an annual basis although AIC reports on progress monthly. Resource Innovations now meets with each CAA quarterly to review forecasts, confirm monthly targets, and re-allocate funding as needed. Resource Innovations, Leidos, and AIC all agree that this has significantly improved forecasting accuracy. As for incentive payment to CAAs, incentives were originally processed in bulk monthly, causing some CAAs to wait four weeks or more. In 2019, Resource Innovations now processes incentives as they come and CAAs receive incentives no more than three weeks after project completion.
- Leidos' Home Energy Specialist (HES) call center now monitor the status of single family non-CAA audits completed by program allies. HES staff follow-up with program allies to confirm that audits are scheduled and completed.
- Leidos changed the standard pricing process in 2019. Leidos brings together implementation staff and top-performing single family and multifamily program allies (i.e., allies that provide most project volume) for annual review process.
- Walker-Miller added a new internal QA/QC process for audits. A Field Supervisor now shadows a sample of field staff audits. There is no specific goal for the percentage of audits the supervisor shadows. The supervisor aims for equal coverage across Walker-Miller field staff.

Additional Successes and Challenges

AIC and implementation staff across the board commented that the Initiative has been very successful across all channels. According to interim tracking data, the IQ Initiative does appear to have gained significant traction in IQ communities since launching in 2018; at the midway mark, the Initiative had already achieved or exceeded 2018 full year participation achievements. According to staff, increased communication between program allies, AIC and implementation staff, increased engagement with CAAs, and positive word of mouth about the initiative have all contributed to the heightened success of each channel in 2019. Key successes that staff mentioned are below.

- Staff considered achieving full subscription of the single family non-CAA channel as of July and the ability to roll-out a scaled down audit to continue to meet customer demand to be a notable success. Also, of note, the single family CAA channel has avoided scaling down services because CAAs braid AIC and IHWAP funds, suggesting that this is a beneficial partnership for the Initiative.

- CMC Energy hired an outreach coordinator to provide specialized outreach to qualifying multifamily properties for the IQ Initiative. CMC attributed much of this channel's ability to fill the pipeline to this new hire.
- Increased engagement with CAAs, such as forecasting assistance and more frequent check-ins, has improved the accuracy of project volume forecasts, enabling Leidos and Resource Innovations to synchronize CAA and AIC reporting timelines.

While the Initiative has been largely successful, initiative staff reported a few challenges.

- Leidos reported that managing customer satisfaction is a top priority when delaying shell and HVAC retrofits for customers. HES staff play a key role in addressing any customer concerns. Walker-Miller noted that the transition to scaled-down audits and delaying shell and HVAC work is challenging for program allies who depend heavily on the initiative for their business.
- Changes in federal energy policy left AIC and Leidos with some uncertainty regarding the future of standard LEDs. AIC originally phased out standard LEDs from the Initiative during 2019. However, recent updates to the IL-TRM have led to an Initiative design that will include standard LEDs in the 2020 program year. Leidos will continue to explore opportunities to add new electric savings measures and is also conducting research to understand if there are any remaining specialty lighting opportunities.
- Resource Innovations experienced increased administrative burden associated with providing more rapid payment to CAAs but reported that it is a worthwhile tradeoff as timely payments improve CAA relationships with the initiative.

Program Implementation Details and Process Models

The evaluation team updated process models for the Initiative, provided below. Table 3 following the files provides a summary description of the process steps included in the process models and highlights key distinguishing factors of each channel. We provide process model files following the table. Notably, the single family non-CAA model reflects the initial process for the first half of 2019, not the transition to the Instant Savers Audit in mid-2019. We note key differences in the process in the next table in green text.


Single Family Non-CAA


Single Family CAA


Multifamily

Table 4. Implementation Process Overview

Process Step	General Process Description	Key Distinguishing Features of Each Channel
Marketing, Outreach, and Coordination	AIC, Leidos, implementation staff, and Program Allies attend an annual kickoff meeting, and there is an annual pricing review that top-performing Program Allies are invited to attend. AIC, Leidos, implementation staff, program allies, and CAAs conduct collaborative marketing efforts such as community fairs, as well as their own marketing efforts. The	**Single Family Non-CAA** ▪ Customers have two paths for applying. They can apply through Program Allies or apply themselves via phone, web, or e-mail. Leidos HES staff process applications and assign Walker-Miller or the referring Program Allies for audits. **Single Family CAA** ▪ CAAs do not attend the annual kickoff or the annual pricing review meetings. ▪ CAAs meet regularly with Resource Innovations to update forecasts and funding allocations

Process Step	General Process Description	Key Distinguishing Features of Each Channel
	customer decides to participate and fills out an application.	▪ CAAs typically must waitlist customers who are interested in participating. ▪ Customers submit applications to CAAs and CAAs move forward with work. AIC and the Initiative implementation staff are not involved until after project completion. **Multifamily:** ▪ CMC works with Leidos to compile a list of target multifamily properties. ▪ CMC handles all application paperwork and asks for the customers' signature.
Energy Audit and Direct Installs	CAAs, program allies, and implementation partners schedule and perform energy audits and install DI measures. The outputs of the audit are an audit report and a proposed scope of work for shell and HVAC retrofits.	**Single Family Non-CAA** ▪ Either Walker-Miller or the referring program ally perform audits, depending on how the customer applied. ▪ The Instant Savers Audit does not provide a shell and HVAC scope of work. **Single Family CAA** ▪ Because they braid AIC, IHWAP, and other funding sources, CAAs use the WeatherWorks tool to determine what funding mix to use for DI measures. **Multifamily:** ▪ CMC performs all audit and DI projects ▪ CMC must provide a DI scope of work to Leidos for technical review and eligibility confirmation.
Installation Shell/ HVAC Retrofits	The customer decides to complete shell and HVAC retrofits. Leidos performs a technical review of the shell and HVAC scope of work and a pre-inspection of the property for the multifamily and non-CAA channels. Program Allies and CAAs schedule and complete shell and HVAC retrofits.	**Single Family Non-CAA** ▪ After the transition to an Instant Savers Audit, a second audit will be performed to develop a scope of work. ▪ Program Allies perform all shell and HVAC retrofits. Any "core" (BPI-certified) program ally can complete this work. **Single Family CAA** ▪ CAA scopes of work are not subject to Leidos' QA/QC process ▪ CAAs use the WeatherWorks tool to determine what funding mix to use for shell and HVAC measures. **Multifamily:** ▪ AIC has three specific Program Allies that work on multifamily shell and HVAC retrofits.

Process Step	General Process Description	Key Distinguishing Features of Each Channel
Incentive Application	After work is completed, Program Allies and CAAs provide incentive applications to AIC and Leidos. Leidos performs technical reviews of incentive applications and performs field QA/QC inspections. After any issues are rectified, CAAs and Program Allies are paid.	**Single Family Non-CAA** ▪ Moderate income customers may need to pay Program Allies for HVAC-related mechanical repairs exceeding $1,000 and shell retrofits exceeding $2,000. ▪ Leidos' goal is to perform field inspections of 10% of projects. **Single Family CAA** ▪ CAAs' internal QC staff conduct their own field inspections on 100% of all projects. IHWAP and Leidos may also select CAA projects for field inspections. As a result, it is possible that a customer could receive up to three field inspections. Leidos coordinates with IHWAP to avoid duplicative visits. ▪ Leidos' field inspection target is 100% of the first five projects completed by a given CAA, a minimum of 20% of the next 20 projects, and 5% of projects thereafter. ▪ Resource Innovations assists CAAs with preparing the AIC incentive application and rectifying any errors. **Multifamily:** ▪ Leidos performs field inspections of 100% of projects.

Note: green text indicates key differences between the original 2019 audit and the Instant Savers Audit for the single family non-CAA channel.

2.1.2 Income Qualified Community Action Agency Interview Findings Memo

Introduction

As part of the evaluation of the 2019 Ameren Illinois Company (AIC) Income Qualified (IQ) Initiative, the evaluation team conducted in-depth interviews with participating Community Action Agencies (CAAs) in October and November 2019. The in-depth interviews aimed to build on research conducted in 2018 and capture feedback from CAAs regarding their experiences, successes, and challenges implementing projects through the Initiative. Additionally, the in-depth interviews collected feedback on customer satisfaction and opportunities to streamline coordination among Initiative stakeholders.

The CAAs provide HVAC, weatherization, and other home upgrades as well as health and safety improvements to income qualified customers throughout Illinois. With AIC funding, CAAs provide their local AIC single family income qualified customers with direct install measures such as LED lighting, advanced thermostats, water saving measures (i.e., faucet aerators and showerheads) and air sealing and insulation (see Table 5). In addition to Initiative funds, CAAs can also leverage funding for the Illinois Home Weatherization Assistance Program (IHWAP), which is funded by three agencies: U.S. Department of Energy (DOE), the State Energy Program, and the U.S. Department of Health and Human Services (HHS) through the Low Income Home Energy Assistance Program (LIHEAP)[10]. Resource Innovations is the primary Initiative implementation partner that works directly with CAAs. Their main role is to support CAAs with marketing, budget forecasting and production management[11], braiding AIC and IHWAP funding, and review of AIC funding applications.

The evaluation team used a census approach and reached out to all 20 CAAs that have completed projects in either 2018 or 2019 and completed interviews with nine agencies, two of whom were also interviewed by our team in 2018.

Table 4 in Appendix A presents a snapshot of the responding CAAs, including the number of staff available for weatherization projects, the use of external contractors for projects, the number of funding sources, marketing education and outreach activities, the biggest benefits and challenges related to the Initiative, and project waitlist information.

[10] http://www.iacaanet.org/energy_ihwap.php (accessed December 26, 2019).
[11] According to Resource Innovations, they currently use two tools to collect budget forecast data. The first tool is an Allocation Planner used in-house and is updated solely by Resource Innovations twice a year. The second tool is an email sent out to CAAs on a quarterly basis for review, and it displays their original forecast numbers and allows the CAA to either confirm or input changes to their actuals.

Key Findings

CAA and Customer Satisfaction with the Initiative

- **The IQ Initiative has improved the ability of CAAs to reach income qualified communities.** Eight out of nine CAAs reported that the main benefit of participating in the AIC Initiative is the increased funding from AIC, which allows CAAs to complete more projects, serve more people, and provide more comprehensive upgrades than they otherwise would in the absence of the Initiative.

> *"Well from my point of view, it allows our funds from the other sources to go much further. Therefore, we can do many more houses than what we used to do. Therefore, touching more people and providing more services to the clients in our service territory. We are not spending all our normal budget funds from the DOE or HHS or the State. Portions of the costs are being paid for by Ameren that allows the other funds to go much farther and do more homes and save more energy… My opinion is that we simply help more people."*

- **CAAs report that participating customers are satisfied with the Initiative application and participation process, the cost savings, and the health and comfort improvements from the energy efficiency upgrades they received.** CAAs report that customers are motivated to participate in weatherization programs because it allows them to achieve energy and cost savings, which improves their home comfort and indoor air quality. All nine responding CAAs indicated that the majority of the feedback they receive from customers is positive. Feedback that CAAs received from their customers included:
  - Reduced energy bills (n=5);
  - Improved home comfort and indoor air quality (n=5);
  - Satisfaction with the application and participation process (n=5); and
  - Positive experiences interacting with the work crews (n=2).

> *"I hear about cost saving a lot. When I go to the final inspection, I am thinking 'how can they already know they are saving energy'? But some of them have already gotten the next bill. A lot of improved comfort. You hear that a lot. A lot of people don't understand the non-energy benefits that we do. Like doing the crawl space sealing and different things that are health benefits. Once you start explaining it to them, I think they realize it… Every once in a while, you will get people who have breathing problems and [they] will tell you they can breathe better."*

- **Long waitlists are a continual challenge that CAAs face, and duration of time spent on the waitlist may affect customer participation or satisfaction with the Initiative.** Seven out of nine CAAs reported having a waitlist for weatherization projects at their agency. The size and duration of time spent on the waitlist for participants varies based on the CAA and the county in which they reside. CAAs report having waitlists of up to 1,500 customers, or wait times ranging from six months to five years before receiving an audit. The waitlists generally operate on a first come first serve basis; however, once an application

for the waitlist is submitted, participants are given a priority number (issued by the State) to determine the order by which weatherization projects are completed. Applicants who are given points for higher priority include the elderly, people with disabilities, and people with children under age six. However, long waitlists can be burdensome to agencies because of the need to redetermine customer eligibility on an annual basis, and the long wait times may cause some frustration for customers and affect their overall satisfaction with the Initiative. One agency reported that they frequently hear from customers who wanted to participate in the program for a particular, often urgent need (i.e., a broken furnace), but by the time the CAA reaches the customer, they have already had to find a different way to address the immediate need.

Feedback on Administrative Processes and Coordination with the Initiative

- **Interactions with Resource Innovations are generally positive, reliable, and consistent for CAAs, though agencies report their communication can at times be too frequent or duplicative.** Among the seven CAAs that could speak to their agency's interactions with Resource Innovations, six agencies described positive experiences working with Resource Innovations.[12] CAAs indicated that Resource Innovations is readily available to them via phone or email when needed. However, despite reporting positive interactions overall, CAAs reported some additional administrative burden related to the frequency of contact and, for those that serve multiple utility territories, duplicative budget forecast reporting to multiple points of contact at Resource Innovations. Among the seven CAAs that could speak to their coordination with Resource Innovations, all reported submitting forecasting reports on at least a quarterly basis, in addition to ad-hoc communications at least monthly. We spoke with two agencies that receive funding from several utilities, and they both mentioned that they have a different point of contact at Resource Innovations per utility. They commented that working with two points of contact is both confusing and time consuming. When asked about suggestions for improving the relationship between Resource Innovations and CAAs, one agency indicated:

> *"I guess it is just a matter of surveying and forecasting constantly. I realize they [Resource Innovations] have to do that. They need to know where they are at and need to stay on track. But it is cumbersome and burdensome for us sometimes… Between the State and Fed and Ameren, etc., someone always wants a report. I feel like if I could stop making reports, I could actually get something done."*

Recommendation 1: To streamline coordination and reduce administrative reporting burden for CAAs, Resource Innovations should consider establishing a single point of contact for CAAs that serve multiple territories (nine out of 36 CAAs), where feasible. Another potential strategy is for Resource Innovations to develop one budget reporting document for each CAA that fulfils all utilities' requirements.

- **In comparison to 2018, measure funding requirements are more widely understood by CAAs.** Five CAAs we spoke with indicated that, in 2018 when they were first participating in the Initiative, they were initially confused about what would be funded by AIC. However only two of those same five agencies reported that the confusion is still an issue this year. The three CAAs who have reduced

[12] Notably, all nine responding CAAs were asked about their experience working with Resource Innovations. However, two CAAs could not provide answers as one staff did not work with Resource Innovations directly and the other had not worked with Resource Innovations at the time of the interview due to staff turnover at their agency.

confusion ascribe this change to experience with the Initiative process over time. However, confusion remains for some agencies and warrants attention as the Initiative brings on another new CAA in PY2020. This confusion may create an administrative burden on agencies because they would need to spend more time determining how to appropriately braid funding rather than completing weatherization projects.

Recommendation 2: Continue to work toward resolving confusion around measure funding to streamline administrative processes, reduce the risk of funding issues when CAAs seek reimbursement from AIC, and allow CAAs to dedicate more resources to project implementation. Consider offering detailed documents, workshops, or other means of communication to inform and update CAAs about AIC offerings.

- **The Grant Accountability and Transparency Act (GATA)[13] increased the amount of paperwork and complexity involved in applying for Federal and State grants.** All CAAs that we spoke to reported having at least four funding sources: the DOE, HHS, a State-funded grant, and AIC. Except for AIC funding[14], each funding source has its own grant application process that CAAs must complete annually in Q2. CAAs reported that GATA has created redundancy and complexity to the grant application process, resulting in additional administrative burden to them. During the grant application period (in Q2), agencies report they must spend more time working on administrative paperwork rather than spending their time completing projects for the AIC IQ Initiative.

  Recommendation 3: If feasible, we recommend AIC pursue strategies to shift AIC reporting requirements for CAAs away from Q2 as much as possible. Importantly, AIC will need to balance reducing CAA reporting burden with AIC's own internal needs for project forecasting updates. However, even if reducing Q2 reporting is not possible, it may be beneficial to work with the CAAs to develop a reporting schedule that avoids similar timelines and due dates as GATA.

- **There are duplicative quality control (QC) field inspections, in some cases without information sharing between AIC Initiative staff and CAAs.** A single CAA project could potentially receive up to four QC inspections, though in most cases they receive one or two. All nine CAAs reported that, per IHWAP rules, every weatherization project must receive a final QC inspection upon completion of the project. Some CAAs also conduct inspections during the installation process for 25% of their projects. IHWAP also conducts random QC inspections of CAA work. Finally, Leidos conducts QC inspections for the Initiative on a selection of CAA projects.[15] Seven of the nine CAA staff we spoke with were familiar with QC inspection processes. Of those seven, five CAAs were unaware that AIC was also conducting their own inspections and two were aware. One of the two who were aware reported that AIC implementation staff conducted QC inspections alongside their internal QC inspector on a portion of their agency's projects. For instance, one of these CAAs mentioned that AIC staff will contact them to learn when the CAA's QC inspection will occur and will attempt to join the inspection, if possible.

  Recommendation 4: AIC should consider ways to improve coordination with CAAs and IHWAP on QC inspections. During an interview with Leidos, we learned that Leidos attempts to coordinate with CAAs and IHWAP as much as possible to perform joint QC inspections and reduce the burden on the customer. Leidos should continue to take advantage of opportunities for joint inspections, but there may be additional communication and/or training strategies that could help CAAs better understand

[13] In 2014, GATA was signed into law to "establish consistent, federally compliant requirements for all grants regardless of the source of funding."
[14] CAAs sign participation agreements in their first year utilizing AIC funds and each year thereafter they sign extensions to the original agreement noting any changes.
[15] Leidos' field inspection target is 100% of the first five jobs completed by a given CAA, a minimum of 20% of the next 20 jobs, and 5% of jobs thereafter.

Initiative QC inspection processes and communicate it to their customer upfront to set the appropriate expectations. For instance, the Initiative could share Leidos' QC protocol with CAAs, which contains information on what the QC inspection entails, how many completed projects will be inspected, as well as the timing of inspections. Another potential strategy is for AIC to coordinate directly with CAAs to add any unique, AIC-specific topics to IHWAP inspections of Initiative projects. This may reduce or eliminate the need for duplicative inspections, and potentially provide cost-savings to the Initiative.

- **CAAs did not report a strong need for help with marketing and outreach efforts, but those who need it reported receiving the necessary help from Resource Innovations.** Although two of nine CAAs reported that Resource Innovations helps with their marketing and outreach efforts, none of the remaining seven agencies indicated a need for marketing and outreach assistance due to the long waitlists already in place. As indicated in Table 5, eight of nine CAAs reported that they do marketing and outreach for their weatherization programs. Marketing and outreach methods include community events, social media outreach, distributing energy kits, and Low Income Home Energy Assistance Program (LIHEAP) related marketing and outreach activities funded by HHS.

Feedback on Measures Funded by AIC

- **CAAs report that the inability to use AIC funds for HVAC and mechanical repairs is a significant challenge when braiding funds for projects.** AIC funds do not cover HVAC or mechanical repairs[16] for CAA projects. CAAs report that these measures make up a large portion of the necessary home upgrades and utilize IHWAP funding to cover these repairs. CAAs find this challenging because it complicates the process of braiding AIC funds with other sources as AIC funds only specific measures (see Table 5). As such, CAAs spend time reviewing multiple measure catalogues in order to determine funding for each customer. Meanwhile CAAs report that there are fewer restrictions on measures funded through other utility programs elsewhere in the state, which allows CAAs to divide project costs evenly between funding sources. Notably, one CAA mentioned that they do not face similar constraints when braiding Commonwealth Edison Company (ComEd) and the northern gas utilities'[17] funds. Specifically, the agency reported that they may split the cost of HVAC and mechanical repairs 50/50 with other funding sources. See Table 5 in Appendix B for a list of measures offered by AIC versus IHWAP.

  Recommendation 5: Consider funding a portion of the cost of HVAC and mechanical repairs through the CAA channel to improve the efficiency of CAA's administration and completion of weatherization projects. If plausible, consider funding at least some HVAC measure types using a 50/50 split between government grants and AIC funds. CAAs report that ComEd has allowed for a similar strategy; AIC may want to consider discussing the topic with ComEd and the northern gas utilities' income qualified program staff to help determine if this could be a feasible approach for AIC. We note that there may be budgetary constraints for such a strategy, depending on the type of HVAC system installed and replaced – AIC should consider cost per unit of savings in determining which measures this strategy can reasonably be pursued for.

- **CAAs mentioned several remaining opportunities amongst income qualified customers that the Initiative does not currently fund.** CAAs reported that it would be helpful if AIC could provide funding for windows and doors, stoves, refrigerators, furnaces, and more extensive insulation offerings.

[16] Mechanical work includes any work or repairs that need to be done to install or replace existing HVAC equipment, water heaters, thermostats, or other equipment offerings. Based on interviews completed by the evaluation team in 2018, these repairs commonly include duct work, repairing doors and windows, and electrical work.
[17] The northern gas utilities include Nicor Gas, Peoples Gas and North Shore Gas.

Notably, AIC funds furnaces and extensive insulation for non-CAA projects, but does not fund them for CAA projects. These measures are currently covered by IHWAP funding.

Recommendation 6: As AIC continues to seek opportunities for new measures to add to the Initiative, consider whether any CAA-recommended would be cost-effective additions to the list of eligible measures. In particular, refrigerators may merit consideration based on dollars per kWh produced. AIC should also consider whether it is possible and cost-effective to allow CAAs to split the cost of furnaces and more extensive insulation offerings with their other funding sources.

Conclusion

Overall, the partnership between CAAs and the Initiative appears successful in 2019. The CAAs we spoke with were supportive of the Initiative and said the injection of AIC funds allows them to serve more customers than they otherwise could. They were also generally satisfied with their coordination with Resource Innovations, though a few opportunities for improvement remain. Many CAAs also reported that they are becoming more accustomed to the braided funding process. However, some of the key customer demand and administrative issues we identified during the 2018 evaluation remain pertinent issues for CAAs in 2019 and going into 2020, namely long waitlists, constrained resources, and limitations on what measures AIC will fund. Some of these challenges, like waitlists and constrained resources, are not entirely addressable through Initiative changes. However, AIC should continue to work closely with the CAAs, Resource Innovations, and other partners like Walker-Miller to explore any possible strategies for streamlining CAA administrative processes and expanding their ability to deliver energy savings to AIC customers.

Appendix A. Snapshot of Responding CAAs

Table 5. Snapshot of Responding CAAs (n=9)

CAA	Completed Interview in 2018	Number of Administrative Staff	External Contractors	Waitlist	Waitlist Length	Number of Funding Sources	Greatest Benefit	Biggest Challenge	Marketing Efforts
1	No	4	Yes	No	0	4	Ability to serve more people with the greatest need	Having enough certified staff	Community events, social media, newspaper ads
2	No	3	No	No	0	4	Ability to serve more people with the greatest need	Confusion in measures offered	Energy kits, Head Start program, educational materials
3	No	2	Yes	Yes	3 years	4	More funding allows them to complete more jobs	Adjusting to braided funding	Social media, LIHEAP program
4	Yes	2	No	Yes	2-3 years	4	Ability to complete more jobs	Confusion in measures offered	Community events, educational materials
5	No	3	Yes	Yes	1-2 years	4	More funding for staffing and purchasing equipment	Initial confusion with paperwork	Website, handout materials, office outreach staff
6	Yes	5	Yes	Yes	1,500 households	4	More funding allows them to complete more homes	HVAC and Mechanical not funded by AIC	Community events, office outreach staff, radio ads
7	No	4	Yes	Yes	6 months	6	Ability to spend more money on projects	Paperwork is time consuming	Not actively marketing
8	No	8	Yes	Yes	1 year	5	Reaching more people and providing more services to their clients in their territory	Maintaining accurate catalogues and paperwork	Office outreach staff, website, and social media
9	No	3	Yes	Yes	2-3 years	4	Program funding allows them to complete more projects	Unaware of any existing challenges	Social media, community events, distributing flyers

Appendix B. Energy Efficiency Measures Offered by AIC and IHWAP

Table 6. EE Measures Offered by AIC IQ Initiative CAA Channel and IHWAP

Measure Offerings	AIC IQ (CAA Channel) [a]	IHWAP[b]
Administrative and program support costs	✓	✓
Advanced power strips	✓	
Appliances: cleaning, mechanical repairs, or replacement of appliances (i.e., refrigerators, freezers, & water heaters)		✓
Blower door testing	✓	✓
Burner retrofits		✓
Combustion appliance safety inspections		✓
Conversion to solar thermal installations, repairs and replacements		✓
Duct sealing, including repairs and additions		✓
Energy audits	✓	✓
Envelope measures – insulation and air sealing	✓	✓
Exhaust fan replacement	✓	
Health and safety repairs	✓	✓
Health and safety measures, i.e., carbon monoxide and smoke alarms, lead-safe weatherization procedures	✓	✓
HVAC replacement and repair (furnaces, central air conditioners, and heat pumps)		✓
HVAC-related health and safety checks and cleaning and tuning		✓
Lighting	✓	✓
Low-flow water measures (i.e., faucet aerators and showerheads)	✓	✓
Minor electrical and plumbing repairs		✓
Pipe insulation		✓
Repair or replacement of damaged minor roof and wall leaks		✓
Thermostat replacement, including valves and adjustments	✓	✓
Window and door repair or replacement		✓

[a] *Source: Ameren Illinois Company. "PY19 Implementation Plan – Residential Measure List" and "Ameren Illinois Program Year 2019 Implementation Plan Sec. 8-103B/8-104". Illinois: Ameren Illinois Company, 2019*

[b] *Source: Illinois Department of Commerce. "2018 DOE State Weatherization Plan For the period of July 1, 2018 – June 30, 2019". Illinois: DCEO https://www2.illinois.gov/dceo/CommunityServices/HomeWeatherization/Pages/WeatherizationStatePlan.aspx (Date Accessed: October 15, 2018). Page 17.*

2.1.3 Income Qualified Single Family Site Visit Findings Memo

Introduction

As part of the evaluation of the 2019 Ameren Illinois Company (AIC) Income Qualified (IQ) Initiative, the evaluation team conducted site visits of AIC IQ Initiative single family participant homes. In 2018, AIC made significant changes to the design of the Initiative and began working with a new type of implementation partner for single family projects, Community Action Agencies (CAAs). The purpose of this research was to assess the effectiveness of the new implementation design across several areas and identify any differences between CAA and non-CAA projects. Specifically, the objectives of these visits were to:

1. Assess in-service rate (ISR);

2. Assess the accuracy of other types of data tracking elements;
3. Review the quality of measure installation; and
4. Identify potential missed or remaining opportunities for energy efficiency measures.

This memorandum summarizes the key findings in these areas based on 40 site visits, including 19 CAA projects and 21 non-CAA projects. These visits provided detailed qualitative findings regarding the four topics above for these 40 projects, though we note that this sample represents a small portion of the approximately 2,700 total CAA and non-CAA projects completed through the Initiative in 2019.

Summary of Approach

The evaluation team used interim initiative tracking data through July 2019 to randomly select 200 projects for the site visit recruitment list, including100 CAA projects and 100 non-CAA projects. We then recruited in random order until we filled the quota of 40 site visits, aiming for an even mix of CAA and non-CAA projects.

Table 6 summarizes the measure types we assessed across the sampled projects and the number of homes that included them. Notably, we were unable to review boilers, air source heat pumps, and duct sealing because these measures were relatively uncommon in the interim data (installed in less than 4% of projects in the interim tracking data) and no homes we recruited completed projects that included them. Further, we excluded wall insulation, floor insulation, and brushless permanent magnet motors from the ISR and quality install review because these measures are typically not readily visible, though we did note any potential missed or remaining opportunities that we observed for these measures. Finally, as shown in the table, there are some measures that AIC does not fund for CAA projects, but that CAAs may still provide to customers using IHWAP funding. AIC does not capture these measures in Initiative tracking data, but we did catalogue any additional energy efficiency upgrades we observed on site when assessing potential missed or remaining opportunities.

Table 7. Summary of Measures Reviewed On-Site, by Project Type

Measure Installed	Project Type		
	Non-CAA Projects (n=21)	CAA Projects (n=19)	All Projects (n=40)
Standard LEDs	15	17	**32**
Air sealing	10	18	**28**
Attic insulation	10	15	**25**
Rim joist insulation	6	14	**20**
Low-flow faucet aerators	6	12	**18**
Bathroom fans	10	8	**18**
Low-flow showerheads	2	13	**15**
Advanced power strips	13	N/A[a]	**13**
Crawlspace insulation	2	10	**12**
Advanced thermostats	7	4	**11**
Specialty LEDs	6	N/A[a]	**6**
Furnaces	5	N/A[a]	**5**
Central air conditioners	5	N/A[a]	**5**
Pipe insulation	1	N/A[a]	**1**

a. AIC funding does not support certain measures for CAA projects. Customers may have received these measures through IHWAP funding.

Site visits generally included the following activities, when applicable:

- At the beginning of the site visit, we gave each customer an opportunity to provide feedback on their experience with the Initiative. Some customers did not participate in the survey because of time constraints or other factors.
- Where possible based on a visual inspection, we determined whether the measures were still installed and, if removed, the reasons for removal;
- We verified several data tracking elements related to household and equipment characteristics;
- Where possible based on a visual inspection, we reviewed measures for quality installation. We defined quality install specifically for each measure based on industry best practices and AIC, Walker-Miller, and IHWAP installation guidance,[18] where available; and
- We reviewed all homes for potential missed or remaining opportunities. A potential "missed" opportunity is an Initiative measure that could potentially have been applicable for the home based on our visual inspection, but that the Initiative did not provide. Potential "remaining" opportunities include measures that are *not* included in the Initiative but *are* included in the Illinois Technical Reference Manual (IL TRM) Version 7 for residential homes. Appendix A provides the definitions of quality installation and potential missed opportunity for each measure.

Importantly, we refer to missed and remaining opportunities as "potential" opportunities to acknowledge that some of the opportunities we found may not actually be feasible for Initiative projects. For instance, implementation staff may have considered installing the "missed" opportunities we found but did not include them based on the results of a full BPI audit or savings-to-investment ratio (SIR) cost-effectiveness tests. Further, AIC should only consider adding "remaining" opportunities to the Initiative if they are cost-effective.

Summary of Key Findings

The sections below provide key findings for each of the topics covered during the site visits: ISR, data tracking accuracy, quality installation, potential missed and remaining opportunities, and customer satisfaction feedback.

ISR Findings

ISRs for weatherization and HVAC measures fell within the range we expected based on our evaluations of similar programs and the current assumptions in the IL TRM Version 7. However, ISRs for measures provided during the initial audit were notably lower compared to current IL TRM assumptions and, where they could be compared, CAA ISRs were typically much higher compared to non-CAA ISRs.

Standard LED ISRs for the non-CAA channel are notably low, and much lower than CAA standard LED ISR. Upon investigating this issue, we found that many non-CAA LED measures were left behind in boxes by implementation staff, which is a concern given that the Initiative is designed to directly install LEDs. Table 2 summarizes ISR findings for each measure. We provide additional measure-specific findings following the table.

[18] These include the AIC Quality Control Work Inspection Checklist (February 2019), the Walker-Miller Quality Control Process Manual (V4), and the IHWAP Program Operations Manual (July 2019)

Table 8. ISR Summary, by Measure and Project Type

Measure	ISR			IL TRM V7 Assumptions for ISR
	Non-CAA Projects (n=21)	CAA Projects (n=19)	All Projects (n=40)	
Measures Provided During the Initial Audit				
Standard LEDs	36% (n=256)	84% (n=403)	66% (n=659)	97%
Specialty LEDs	64% (n=28)	N/A[a]	64% (n=28)	97%
Low-flow faucet aerators	57% (n=7)	95% (n=22)	86% (n=29)	95%
Low-flow showerheads	100% (n=2)	71% (n=17)	74% (n=19)	98%
Advanced power strips	29% (n=24)	N/A[a]	29% (n=24)	100% (direct install) 40% (leave-behind)
Pipe insulation	Could not assess [b]	N/A[a]	Could not assess [b]	100%
Weatherization and HVAC Measures				
Air sealing	80% (n=10)	100% (n=18)	93% (n=28)	100%
Attic insulation	100% (n=10)	100% (n=15)	100% (n=25)	100%
Rim joist insulation	83% (n=6)	100% (n=14)	95% (n=20)	100%
Crawlspace insulation	100% (n=2)	90% (n=10)	92% (n=12)	100%
Bathroom exhaust fans	100% (n=10)	100% (n=8)	100% (n=18)	100%
Advanced thermostats	86% (n=7)	100% (n=4)	91% (n=11)	100%
Furnace	100% (n=5)	N/A[a]	100% (n=5)	100%
Central air conditioning	100% (n=5)	N/A[a]	100% (n=5)	100%

a. AIC funding does not support certain measures for CAA projects. Customers may have received these measures through IHWAP funding, but the measure would not be included in AIC tracking data.
b. Only one project the team reviewed had pipe insulation. We were unable to directly inspect the insulation because the team could not access the basement.

We identified the following measure-specific issues:

- **Standard LEDs:** We found that 163 of the 256 LEDs tracked for non-CAA projects were not installed at the time of the visit. The most common reason the bulbs were not installed (two-thirds of uninstalled LEDs) was that Initiative staff left behind a box of LEDs that the customer never installed themselves. These customers collected and showed evaluation team members boxes with unused LED lamps during many of the site visits. Note, the evaluation team collaborated with AIC and Leidos staff to explore this issue further and ultimately determined that the issue was primarily attributable to a single program ally. Table 8 details the reasons why LEDs were not installed according to participating customers.

Table 9. ISR Summary – Standard LEDs

Reason Not Installed	Number of Measures		
	Non-CAA Projects	CAA Projects	All Projects
Left behind and never installed by customer	110	24	**134**
Customer did not recall receiving the measure	37	18	**55**
Customer had already installed LEDs and reported they did not accept additional LEDs from implementation staff	16	0	**16**
Initiative staff installed new LED fixtures, not LED lamps	0	16	**16**
Removed by the customer, no rationale captured	0	4	**4**
Removed by the customer, broken/not functioning properly	0	2	**2**
Total Uninstalled Standard LEDs	*163*	*64*	***227***
Total Installed Standard LEDs	*93*	*339*	***432***
ISR	**36% (n=256)**	**84% (n=403)**	**66% (n=659)**

- **Specialty LEDs:** We found that 10 of the 28 specialty LEDs tracked for non-CAA projects were not installed at the time of the visit. In nine cases, customers did not recall receiving the measure and we did not observe them in the home.
- **Advanced power strips:** We found that 17 of the 24 strips tracked for non-CAA projects were not installed at the time of the visit. Similar to standard LEDs, the most common reason (10 of 17 strips) was that Initiative staff left the measure behind in a box and the customer never installed it. Note, the Initiative tracking data does clearly track whether an advanced power strip is left behind or directly installed, and the evaluation team applies a different ISR in each case. According to Initiative tracking data, 14 of the 24 strips were directly installed and 10 strips were left behind. There were unverified measures in both cases. Table 9 details the reasons why advanced power strips were not installed.

Table 10. ISR Summary – Advanced Power Strips

Reason Not Installed	Number of Measures		
	Non-CAA Projects	CAA Projects	All Projects
Left behind and never installed by customer	10	N/A[a]	**10**
Removed by the customer, not working properly	6		**6**
Removed by the customer, customer plans to reinstall in a different location	1		**1**
Total Uninstalled Advance Power Strips	*17*		***17***
Total Installed Advance Power Strips	*7*		***7***
ISR	**29% (n=24)**		**29% (n=24)**

a. AIC funding does not support this measure for CAA projects. Customers may have received this measure through IHWAP funding, but the measure would not be included in AIC tracking data.

- **Low-flow showerheads:** We found that five of the 17 showerheads tracked for non-CAA projects were not installed at the time of the visit. Most commonly (four of five cases), customers did not recall receiving the measure.

- **Low-flow aerators:** We found that three of the seven aerators tracked for non-CAA projects were not installed at the time of the visit. One customer reported that Initiative staff did not have the proper parts or tools to install the aerator and left the part with the customer. The customer purchased and installed their own aerator.
- **Air sealing and insulation:** There were several cases amongst air sealing (two non-CAA projects of 10), rim joist insulation (one non-CAA project of six), and crawl space insulation (one CAA project of 10) where the customer reported not receiving the measure. We only counted the measure as uninstalled if we observed corroborating evidence. For example, one customer reported that air sealing work was not performed at the home and our field staff could not verify window caulking, weatherstripping of doors, door sweeps, or other air sealing efforts.
- **Advanced thermostats:** We found that one of the six advanced thermostats tracked for non-CAA projects was not installed at the time of the visit. The customer reported that he already installed a Nest thermostat in the home and, therefore, did not need or accept an advanced thermostat from the Initiative.

Recommendations

- **Finding 1:** The standard LED ISR for the Non-CAA channel is notably low (36%). We found that standard LED measures were left behind in boxes by implementation staff. We confirmed that these were not provided or tracked in Initiative data as kits from community events, and customers collected and showed boxes with unused LED lamps to our field staff during many of the site visits.
  - **Recommendation 1-1:** We recommend that Initiative staff do not leave any LED measures behind for customers to install themselves. By design, the Initiative assumes that LEDs are directly installed, and the evaluation team applies ISRs appropriate for DI measures when estimating savings.
  - **Recommendation 1-2:** Based on Initiative QC process documentation, it is unclear whether there is a formal QC inspection process for Walker-Miller-implemented DI projects. Our understanding, based on Initiative staff interviews, is that a Walker-Miller field supervisor may shadow new field staff during their audits, but Walker-Miller only performs formal QC inspections for projects completed by AIC program allies. If there is no formal QC process for Walker-Miller DI projects, we recommend that AIC consider adopting one. We recommend establishing a target post-installation inspection rate, based on available staff and budget resources, for each of Walker-Miller's field staff to ensure adequate coverage of Initiative projects.
- **Finding 2:** The ISR for advanced power strips was low (29%) in comparison to what the IL-TRM V7 currently assumes for DI (100%) and leave-behind (40%) advanced power strip measures.
  - **Recommendation 2.** We recommend that Initiative staff avoid leaving behind advanced power strips as much as possible. While the Initiative currently tracks whether advanced power strips are left behind or installed, and the evaluation team applies different ISRs in each case, leaving this measure behind carries the risk that it could be installed improperly by the customer given the complex installation process for this measure. We understand that installing advanced power strips can be time-consuming, and as such may negatively impact the cost per unit of energy saved (i.e., dollars per kWh) for the project. If installing these measures is not cost-effective, we recommend not leaving the measure behind.
- **Finding 3.** There were multiple cases across several measure types, for instance, nine cases for specialty LEDs and four cases for showerheads, where customers did not recall receiving measures or reported that they did not accept them.

- **Recommendation 3:** We recommend including a detailed review of QA/QC processes for the Initiative as part of future evaluation efforts to help determine the potential cause of this issue (e.g., lack of customer understanding or recollection versus areas for improvement in the QA/QC process).

Accuracy of Other Data Tracking Findings

The evaluation team reviewed the accuracy of Initiative tracking data related to several home and equipment characteristics. Specifically, we verified Initiative data tracking records for:

- Water heater fuel type;
- Space heating system type;
- Central cooling presence;
- Whether crawlspaces are vented or unvented.

We found that the Initiative accurately tracked this information for all 40 sites, where applicable.

Quality Installation Findings

Based on visual inspections, the evaluation team found that the majority of non-CAA and CAA measures were quality installations (refer to Appendix A for more detail on the criteria for each measure). A quarter of projects we reviewed (10 of 40) had a quality install issue of some kind, including five of 21 Non-CAA projects and five of 19 CAA projects. Nine of these 10 projects had an issue with one type of measure, and one Non-CAA project had issues with three types of measures.

CAA projects had fewer issues compared to non-CAA projects, which is to be expected because a single CAA project could receive up to four QC inspections, though in most cases they receive one or two.[19] Non-CAA projects, which either Walker-Miller or program allies implement, also had very few challenges. The notable exceptions for non-CAA projects were that three of seven advanced power strips had quality installation issues, and three projects had air sealing issues. Walker-Miller performs field inspections on behalf of Leidos for approximately 10% of program ally projects but, based on available QC process documentation, our understanding is that Walker-Miller does not perform field inspections of Walker-Miller-implemented DI work before projects move on to program allies for further weatherization work. Walker-Miller does, however, shadow new field staff as they perform assessments for training purposes.

Table 10 below summarizes quality installation pass rates for each measure, and we provide more detail on measure-specific issues following the table.

Table 11. Quality Installation Pass Rate, by Measure and Project Type

Measure	Quality Installation Pass Rate		
	Non-CAA Projects	CAA Projects	All Projects
Standard LEDs	All (n=93)	228 of 229 (99%)	431 of 432 (99.7%)
Specialty LEDs	All (n=18)	N/A [a]	All (n=18)
Low-flow faucet aerators	All (n=4)	All (n=21)	All (n=25)
Low-flow showerheads	All (n=2)	All (n=12)	All (n=14)

[19] The evaluation team recently interviewed nine CAAs who implement projects using Initiative funds. All nine CAAs reported that, per IHWAP rules, every weatherization project must receive a final QC inspection upon completion of the project. Some CAAs also conduct inspections during the installation process for 25% of their projects. IHWAP also conducts random QC inspections of CAA work. Finally, Leidos conducts QC inspections for the Initiative on a selection of CAA projects.

Measure	Quality Installation Pass Rate		
	Non-CAA Projects	CAA Projects	All Projects
Advanced power strips	4 of 7	N/A[a]	4 of 7
Pipe insulation	Could not assess [b]	N/A[a]	Could not assess [b]
Air sealing	5 of 8	17 of 18	22 of 26
Attic insulation	All (n=10)	All (n=15)	All (n=25)
Rim joist insulation	All (n=5)	All (n=14)	All (n=19)
Crawlspace insulation	All (n=2)	All (n=9)	All (n=11)
Bathroom exhaust fans	9 of 10	7 of 8	16 of 18
Advanced thermostats	All (n=6)	All (n=4)	All (n=10)
Furnace	All (n=5)	N/A[a]	All (n=5)
Central air conditioners	All (n=5)	N/A[a]	All (n=5)

Note: the base (n) for this analysis is installed measures. Orange highlighting indicates a pass rate less than 100%.
a. AIC funding does not support this measure for CAA projects.
b. Only one project the team reviewed had pipe insulation. We were unable to directly inspect the insulation because the team could not access the basement.

The evaluation team observed the following quality installation issues:

- **Advanced power strips (3 cases):** We observed that the equipment was not properly connected to the "control", "always on", and "switched" outlets. In two cases, the customer reported that they had not altered the implementation staff's work. In one case, the customer had reconfigured the advanced power strip and used it as a basic power strip.
- **Air sealing (4 cases):** Air sealing issues we observed during site visits included gaps in door weatherstripping (1 case, non-CAA), untreated basement bypasses (1 case, non-CAA), and air leakage at exterior wall outlets (2 cases, 1 CAA and 1 non-CAA).
- **Bathroom exhaust fan (2 case):** For one non-CAA measure, the fan did not appear to operate at the time of the site visit. For one CAA measure, we observed gaps around the base of the exhaust fan.
- **Standard LEDs (1 case)**: One CAA project bulb was not functioning. It is unclear whether this was a burnt-out bulb or a problem with the fixture.

Recommendations

- **Finding 4.** We observed that three of the seven installed advanced power strips were not quality installations. We also found that despite an initial quality install, one customer repurposed the advanced power strip in a way that does not save energy, and six removed the measure after installation because they did not think it worked properly (see Table 9 in the ISR findings section).
  - **Recommendation 4:** We recommend that AIC and its implementation partners take two actions to address quality installation issues with advanced power strips. First, to ensure that power strips are appropriately installed, we recommend developing trainings and/or a guidance document for field staff. Note, we requested all field staff instructions, audit forms, and QC inspection checklists from Leidos, but did not find installation instructions for advanced power strips in the documents we received. We recommend that Leidos and/or their partners specifically provide guidance on how advanced power strips are different from standard power strips, typical applications that benefit from advanced power strips, and the definitions of the "control", "always on", and "switched" outlets on the strip. Second, Walker-Miller should consider walking the customer through the instruction manual that comes with the measure, if it is available and clearly explains

the topics above. Otherwise, we recommend proving educational collateral about advanced power strips to the customer. Note, AIC began partially funding advanced power strips for CAA projects in 2020, and the IHWAP manual is similarly missing guidance on advanced power strips. As such, we recommend that CAAs also receive this additional training and materials to the extent possible.

Potential Missed Opportunity Findings

The evaluation team defined a potential "missed" opportunity as an Initiative measure that could potentially have been applicable for the home based on our visual inspection, but that the Initiative did not provide. Please refer to Appendix A for more detail on the specific definition for each measure. The goal of this analysis was to identify potential gaps in the treatment of participating homes. However, it is important to note that there may be legitimate reasons why certain measures were not installed in a given home (e.g., Initiative staff determined a measures was not appropriate for the home or did not include it for cost-effectiveness reasons Notably, six non-CAA projects had only received DI measures at the time of the evaluation team's onsite visit. Based on the design of the Initiative, it is possible that these homes received HVAC and weatherization upgrades from the Initiative later in 2019 or will receive them in 2020. As such, we did not count any HVAC or weatherization missed opportunities for these six projects. We also excluded any unverified measures from this analysis.[20]

Each home we visited had a potential missed opportunity of some kind. CAA projects generally had fewer potential missed opportunities than non-CAA projects, which may be in part due to the availability of IHWAP funding. CAA projects had two to three potential missed opportunities, on average, with the most potential missed opportunities in a single home being six. Non-CAA projects had five to six potential missed opportunities, on average, with the most potential missed opportunities in a single home being ten. Table 11 below provides a full list of potential missed opportunities we observed.

The Initiative appears to have taken advantage of all opportunities to provide heating and cooling systems to the homes we visited, as there were no potential missed opportunities for those measures. Weatherization measures (i.e., insulation and air sealing) were the most common type of potential missed opportunity for both channels. There were also many potential opportunities to install more standard LEDs, as we noted 165 potential opportunities across the 40 projects (about four per project, on average). However, we note that given the limited horizon for standard LEDs savings it likely does not make sense to expand LED distribution beyond current levels. For non-CAA projects, there were also 30 potential missed opportunities for Specialty LEDs (one or two per project, on average), including linear lights for hallways and exterior flood lamps. Finally, there were multiple potential missed opportunities for domestic hot water measures.

Table 12. Potential Missed Opportunities Observed, by Project Type

Potential Missed Opportunity	Number of Projects Where A Potential Missed Opportunity Was Observed		
	Non-CAA Projects (n=21)	CAA Projects (n=19)	All Projects (n=40)
Weatherization Measures			
Wall insulation	17	14	31
Air sealing	10	5	15
Duct sealing	11	N/A[a]	11

[20] If measures were tracked as provided in the Initiative tracking data, but we did verify them as installed, we removed hose cases from the missed opportunities analysis. For example, if we noted 15 sockets that could have received LEDs, but we did not verify 10 tracked LEDs, the number of potential missed opportunities would be five LEDs.

Potential Missed Opportunity	Number of Projects Where A Potential Missed Opportunity Was Observed		
	Non-CAA Projects (n=21)	CAA Projects (n=19)	All Projects (n=40)
Attic insulation	3	1	4
Rim joist insulation	3	0	3
Crawlspace insulation	1	0	1
Direct Install Measures			
Standard LEDs	12	10	22
Low-flow faucet showerheads	15	4	19
Specialty LEDs	14	N/A[a]	14
Pipe insulation	11	N/A[a]	11
Low-flow faucet aerators	7	2	9
Advanced power strips	5	N/A[a]	5
HVAC Measures			
Advanced thermostats	6	8	14

Note: The unit of analysis is the number of projects with each type of opportunity, not number of measures.

Recommendations

- **Finding 6:** We identified at least one potential missed opportunity at each home we visited. We noted numerous potential opportunities for standard and specialty LEDs.
  - **Recommendation 6-1:** We recommend that AIC and its implementation partners ensure they are maximizing all opportunities to provide the measures listed above, within the limits of budget and Savings-to-Investment Ratio (SIR) requirements. As mentioned earlier, it is likely that some of the potential missed opportunities were not feasible for the home based on BPI audit results or from a project cost-effectiveness standpoint.
  - **Recommendation 6-2:** We recommend that AIC and its implementation partners discuss with field staff the most common types of specialty LED opportunities that they are unable to address, and why. We specifically identified opportunities for exterior flood lamps, but there could be other common specialty LED opportunities that field staff are unable to address. Reasons for not addressing these applications could be, for instance, that certain specialty applications do not meet SIR requirements, that they run out of certain types of specialty LEDs, or that the specialty application is relatively rare. Based on these discussions, AIC could consider making changes to the mixture of LED types field staff bring to visits.

Potential Remaining Opportunity Findings

The evaluation team defined a potential "remaining" opportunity as a measure that is *not* included in the Initiative but *is* included in the IL TRM Version 7 for residential homes. As with the missed opportunities analysis, it is important to note that it may not be feasible for the Initiative to offer all these measures. However, we felt it was valuable to highlight these opportunities for future consideration by AIC and program implementation staff.

Overall, we noted at least one potential remaining opportunity in each of the 40 homes we visited. Considering the expected phase out of LEDs, we paid special attention to opportunities to add measures with electric

savings potential. The top opportunity was lighting controls, which may have been applicable in almost every home we visited. There were also several types of opportunities for domestic hot water and appliance replacement measures that may provide additional electric savings to the Initiative. Notably, as we show at the bottom of the table, there were many instances for CAA projects where neither the Initiative nor IHWAP funding supported certain DI measures. However, the Initiative will now support these measures for CAA projects in 2020. Table 12 below provides the full list of potential remaining opportunities we observed.

Table 13. Potential Remaining Opportunities Observed, by Project Type

Potential Remaining Opportunity	Number of Projects Where A Potential Remaining Opportunity Was Observed		
	Non-CAA Projects (n=21)	CAA Projects (n=19)	All Projects (n=40)
Lighting Controls			
Occupancy sensor	21	18	39
Photocell sensors	21	18	39
Domestic Hot Water			
Shower timer	19	17	36
Thermostatic restrictor shower valve [a]	14	9	23
Water heater temperature setback	15	8	23
Water heater replacement	6	0	6
Water heater tank wrap	1	5	6
Appliances			
ENERGYSTAR® refrigerator	19	12	31
ENERGYSTAR® clothes dryer	13	16	29
ENERGYSTAR® clothes washer	11	14	25
ENERGYSTAR® dishwasher	6	7	13
ENERGYSTAR® freezer	3	7	10
ENERGYSTAR® room A/C	4	0	4
ENERGYSTAR® dehumidifier	2	0	2
Ductwork			
Duct insulation	15	7	22
Duct sealing	N/A[a]	7	7
HVAC Tune-ups			
Central A/C tune-up	9	2	11
Heating equipment tune-up	10	0	10
Direct Install Measures (not supported by AIC for CAA projects in 2019)			
Advanced power strips	N/A[b]	15	15
Specialty LEDs	N/A[b]	10	10
Pipe insulation	N/A[b]	3	3

a. Thermostatic restrictor shower valves are not available through the audits, but the Initiative does provide them in kits distributed to income-qualified gas-only customers at community events.

b. This measure is provided through the non-CAA channel, as such it cannot qualify as a remaining opportunity for non-CAA projects.

Customer Satisfaction

At the beginning of the site visit, we gave each customer an opportunity to provide feedback on their experience with the Initiative. Some customers did not participate in the survey because of time constraints or other factors. We asked customers to rate their degree of satisfaction with the Initiative and several components of their participation experience. We found that overall, most participants, both CAA and Non-CAA, were highly satisfied with the quality of the energy efficiency measures installed in their homes, and the care and professionalism of Initiative staff. Many had also begun to see positive benefits (i.e. lower charges) in their home energy bills. Further, 27 of 36 respondents (75%) reported that their opinion of AIC was more favorable after participating in the Initiative (five said it stayed the same, one said it was less favorable, and three "did not know"). Table 13 below summarizes the satisfaction scores provided by respondents across various elements of the Initiative.

Table 14. Satisfaction Scores for the Initiative, by Project Type

Component	Average Score	
	Non-CAA Respondents	CAA Respondents
The Home Energy Assessment	8 (n=20)	10 (n=16)
Initiative staff	8 (n=17)	8 (n=16)
Efforts to reduce disruptiveness of the work	9 (n=20)	9 (n=16)
Time from scheduling to completion	8 (n=20)	9 (n=16)
Measures installed	9 (n=19)	9 (n=16)
Initiative overall	9 (n=20)	10 (n=16)

Note: Average score on a scale of 0 to 10, where 0 is very dissatisfied and 10 is very satisfied. Average scores exclude invalid responses (e.g., "don't know", "no response").

Conclusion

Our site visits results indicate that both single family channels of the Initiative are successful at providing quality installation services to customers and tracking key home characteristics that are useful for estimating savings. However, there is room for improvement in terms of DI measure delivery and QA/QC processes that may help maximizes in-service rates. Specifically, leaving behind measures, while potentially a cost-effective strategy, typically results in a lower ISRs compared to directly installing measures. The IL TRM currently accounts for this with a significantly lower ISR for leave-behind measure, but these site visits results strongly suggest a need for the evaluation team to continue to monitor the ISR of these measures through participant surveys and, potentially, additional site visits.

Finally, this research identified numerous potential opportunities to expand the portfolio of eligible measures in ways that may shore-up the electric savings of the Initiative as standard LEDs begin to phase out over the next few years. Namely, amongst the homes we visited, we identified the potential to add a few entirely new categories of measures to the Initiative (lighting controls, appliances upgrades, and HVAC tune-ups), as well as additional measures within existing categories like domestic hot water and ductwork should these measures screen as cost effective.

Appendix A. Key Definitions

Table 14 below describes the criteria we used to determine quality installation and potential missed opportunities. In developing the quality installation criteria, we reviewed AIC, Walker-Miller, and IHWAP installation guidance documentation to ensure that there were no conflicts with the evaluation team's criteria. Notably, these criteria are limited to facets that we could observe through a visual inspection.

Table 15. Definition of Quality Installation and Potential Missed Opportunity, by Measure

Measure	Quality Installation	Potential Missed Opportunity
LEDs	LEDs are functioning. Specialty lamps are installed in appropriate applications.	A socket or application that could have received an LED but did not.
Low-flow faucet aerators	Faucet aerators are installed on hot water faucets only and are functioning properly. The installed aerator is properly sealed with plumbers' tape such that there are no leaks.	A faucet that could have received an aerator but did not.
Low-flow showerheads	Showerheads are functioning properly. The installed showerhead is properly sealed with plumbers' tape such that there are no leaks.	An inefficient showerhead that was not replaced.
Advanced power strips	Advanced power strips are installed in appropriate locations (e.g. where TVs or computers exist with peripheral devices). The appropriate types of appliances are plugged in and are plugged into the correct sockets on the advanced power strip (e.g., "always on", "control", and "switched").	An advanced power strip was not installed in an area of the home that has at least one "control" device (e.g., TV, PC) and one peripheral that could be controlled (e.g. a speaker).
Pipe insulation	The insulation is installed on the correct pipe (the hot water pipe), covers the entire exposed piping from water heater to wall/floor/ceiling (no visible gaps), and is properly taped. The pipe is of the proper thickness for the pipe, the first six feet of both the hot and cold-water pipe are insulated, and the pipe insulation is at least three inches away from the flue.	There is exposed hot water pipe that was not insulated and could be safely insulated.
Air sealing	The air sealing has no obvious gaps, compressions, or thin areas. There are no drafts around windows, doors, and outlets.	Attics, crawlspaces, windows, doors, or outlets that are drafty or have obvious sealing gaps
Duct sealing	The ducts are properly taped there is no ripped, torn, or crushed ductwork.	A duct system in poor condition (crushed, ripped, torn) that was not remediated by the initiative.
Attic, rim joist, and crawlspace insulation	The insulation has no gaps, compressions, or areas that are too thin.	Attics, rim joists, or crawlspaces that are uninsulated.
Bathroom exhaust fans	The exhaust fan is operating, is pulling air out of the room, and there are no gaps around the casement. The exhaust fan includes a light, if needed.	A bathroom without an existing efficient exhaust fan.
Advanced thermostats	The thermostat is connected to the internet, and to the customer's phone if desired. The thermostat properly operates heating and cooling equipment. The thermostat has a programmed schedule.	An existing manual thermostat
Furnaces	The furnace delivers heating to the home and there are no issues with airflow or any "comfort gaps" (e.g., cold spots) in any part of the home.	A boiler was not installed in a gas heating home that has a failed or functioning heating system at or below current code.
Central air conditioners	The central air conditioner delivers cooling to the home and there are no issues with airflow or any "comfort gaps" (e.g., warm spots) in any part of the home.	An existing HVAC system that is below code.
Air source heat pumps	The air source heat pump delivers heating and cooling to the home and there are no issues with	An existing HVAC system that is below code.

Measure	Quality Installation	Potential Missed Opportunity
	airflow or any "comfort gaps" (e.g. hot/cold spots) in any part of the home.	

2.2 HVAC Initiative

Since June 2009, AIC has offered HVAC incentives to its customers to encourage the purchase of higher-efficiency heating and cooling equipment. During the 2019 program year, the HVAC Initiative offered incentives for advanced thermostats, air-source heat pumps (ASHPs), ductless heat pumps, central air conditioners (CACs), high-efficiency Brushless Permanent Magnet (BPM) blower motors, and heat pump water heaters (HPWHs).

Through the HVAC Initiative, AIC provides incentives to customers through registered trade allies as direct discounts on the equipment and installation costs. The incentive appears as a line item deduction on the contractors' installation invoices. The initiative offers standard incentives for replacing failed equipment (replace-on-burnout [RB] or time of sale [TOS]) with new equipment of SEER 16.0 or higher (ASHPs must also be rated a minimum of 9.0 HSPF) and offers a higher incentive to customers for CAC and ASHP measures when the customer replaces working, but inefficient older equipment. To be considered an early replacement (ER) project, a unit that is being replaced had to be verifiably operable with a seasonal energy efficiency ratio (SEER) rating of 10.0 or less.

As part of the 2019 evaluation, the evaluation team issued a memo summarizing Initiative feedback from participating customers and contractors. This memo is included in the section below and available as a on the SAG website.[21]

2.2.1 HVAC Initiative Participant and Trade Ally Survey Process Results Memo

Introduction and Background

This memo presents the results of the process evaluation of the 2019 Ameren Illinois Company (AIC) Heating and Cooling (HVAC) Initiative. It presents a description of the initiative, a summary of 2019 participation, and a section detailing customer and trade ally awareness of heat pump water heater technology to inform future initiative years.

Since June 2009, AIC has offered HVAC incentives to its customers to encourage the purchase of higher-efficiency heating and cooling equipment. During the 2019 initiative year, the HVAC Initiative offered incentives for advanced thermostats, air source heat pumps (ASHPs), ductless heat pumps (DMSHP), central air conditioners (CACs), high efficiency Brushless Permanent Magnet (BPM) blower motors,[22] and heat pump water heaters (HPWHs).

AIC provides incentives to customers through registered trade allies as direct discounts on the equipment and installation costs. The incentive appears as a line item deduction on the contractors' installation invoices. The initiative offers standard incentives for replacing failed equipment (replace-on-burnout [RB]) with new equipment of SEER[23] 16.0 or higher (ASHPs must also be rated a minimum of 9.0 HSPF) and offers a higher incentive to customers for CAC and ASHP measures when the customer replaces working, but inefficient older

[21] https://ilsag.s3.amazonaws.com/AIC-2019-HVAC-Initiative-Process-Memo-FINAL-2020-09-21.pdf
[22] This measure is also known as Electronically Commutated Motor (ECM) fans.
[23] SEER stands for seasonal energy efficiency ratio and is the ratio of cooling output of an air conditioner over a typical cooling season divided by the energy it consumes in watt hours.

equipment. To be considered an early replacement (ER) project, the replaced unit has to be verifiably operable with a SEER rating of 10.0 or less.

The overall goal of this initiative is to persuade customers to purchase higher-efficiency equipment than they might otherwise purchase. AIC implementation staff work directly with contractors and distributors to educate them about the incentives available, as well as to train them on promoting the Initiative.

The HVAC initiative made the following changes to its offerings and delivery in 2019:

- Reduced the advanced thermostat incentive from $269 to $100 in April 2019 due to budgetary considerations
- Removed programmable thermostat and high efficiency pool pumps from initiative offerings
- Implemented an online portal for initiative allies to submit applications at the end of 2019
- Developed case studies of AIC HVAC initiative participants and promoted these case studies on the AIC website

Initiative staff reported and initiative data revealed a low uptake of HPWHs resulting in the Initiative not meeting its HPWH installation goals. Initiative staff attributed this to lack of customer awareness of HPWH technology as well as a limited number of trained initiative allies who can perform HPWH installations. Due to the low uptake of HPWHs, we added a battery of questions to both surveys to explore why HPWH installations are so rare in AIC territory.

Evaluation Overview

The 2019 evaluation of the HVAC initiative had two overarching objectives: 1) Assess energy saving impacts and 2) assess initiative processes. This memo covers the process objectives while another document addresses the impact objectives.[24]

We address these process-related objectives in this memo:

- Participating Customer Experience and Satisfaction
  - How did customers hear about the HVAC Initiative? What motivated customers to participate?
  - How satisfied are customers with the initiative overall and initiative components (e.g. application process, incentive level, interactions with the participating trade ally)?
  - What is the awareness of HPWHs among customers and what drives their interest and adoption of HPWHs?
- Trade Ally Experience and Satisfaction
  - How satisfied are trade allies with their experience in the Initiative? How satisfied are they with the level of training provided?
  - What barriers, if any, do trade allies face related to participating in the Initiative? How can these barriers be overcome?
  - What effects, if any, has the HVAC initiative had on trade ally practices?

[24] See AIC 2019 HVAC Initiative Impact Evaluation Report.

- How aware are trade allies of heat pump water heaters (HPWH), what are the barriers to selling HPWHs, and what is their forecast for sales of HPWHs.

We relied on results of a survey of initiative participants and trade allies to address the process evaluation objectives. The remainder of this memo describes the data collection activities and summarizes the results from both surveys.

Evaluation Activities

Participant Survey

We fielded an online survey with 460 participating customers (
Table 15) in Q1 2020. The survey explored key aspects of the participation process, the key drivers of purchase decisions, the role of the initiative in those purchases, and overall satisfaction with the Initiative. Our sample frame of 3,428 records included all customers who installed at least one HVAC initiative measure in 2019. We recruited respondents with an initial email sent to the entire sample frame and sent two reminders to non-respondents spacing the emails three to four days apart.

Table 16. Participant Survey Disposition Summary

Disposition	Count
Complete	460
Incomplete (started but did not finish survey)	72
Ineligible	41
Bad emails	193
Non-respondents	2,662
Total	3,428

Active and Inactive Trade Ally Survey

We conducted a survey with active registered and non-active registered contractors about initiative requirements, processes, and design in Q2 2020. Active trade allies completed a project in 2019 and non-active trade allies did not complete a project in 2019. We identified 218 active contractors and 102 on-active contractors and completed surveys with 54 and 12 respectively (Table 16). We recruited respondents with an initial email and sent two reminders to non-respondents spacing the emails three to four days apart from one another.

Table 17. Trade Ally Survey Disposition Summary

Disposition	Active Trade Allies (AR)	Non-Active Trade Allies (NAR)
Complete	54	12
Incomplete (started but did not finish survey)	5	3
Ineligible	4	0
Bad emails	6	0
Non-respondents	149	87
Total	218	102

Initiative Process Results

The following sections provide a summary of results by the two data sources, starting with the participants and concluding with the trade allies.

Participants

Participants reported about how they became aware of the Initiative, their satisfaction with the Initiative, and about possible barriers that could have kept them from participating. Additionally, they provided some demographic information about their households and we start this section with a brief overview of those demographic characteristics.

Overview of Participants

Respondents were generally homeowners, living in single family detached home. Most had education beyond high school and about half earned more than $100,000 per year (Table 17).

Table 18. Participant Respondent Demographics

Characteristic	Percent (n=460)
Age	
26 to 44	19%
45 to 64	41%
65 or older	37%
Education	
High school or less	10%
Trade school or some college	31%
Bachelor's degree	32%
Graduate or professional degree	27%
Prefer not to answer	1%
Income	
Less than $50,000	17%
$50,000 to $100,000	33%
$100,000 to $150,000	18%
More than $150,000	11%
Prefer not to answer	21%
Race/Ethnicity	
White or Caucasian	86%
Black or African American	2%
Asian	2%
Prefer not to answer	10%

Initiative Awareness

- **Contractors drive participant awareness of the HVAC Initiative.** Most respondents (73%) reported hearing about the HVAC initiative through their contractors. Nineteen percent of respondents heard of the initiative through marketing efforts such as the AIC website, emails, newsletters, bill inserts, and door hangers. Referrals from friends and family were the least commonly cited source of awareness (Table 18).

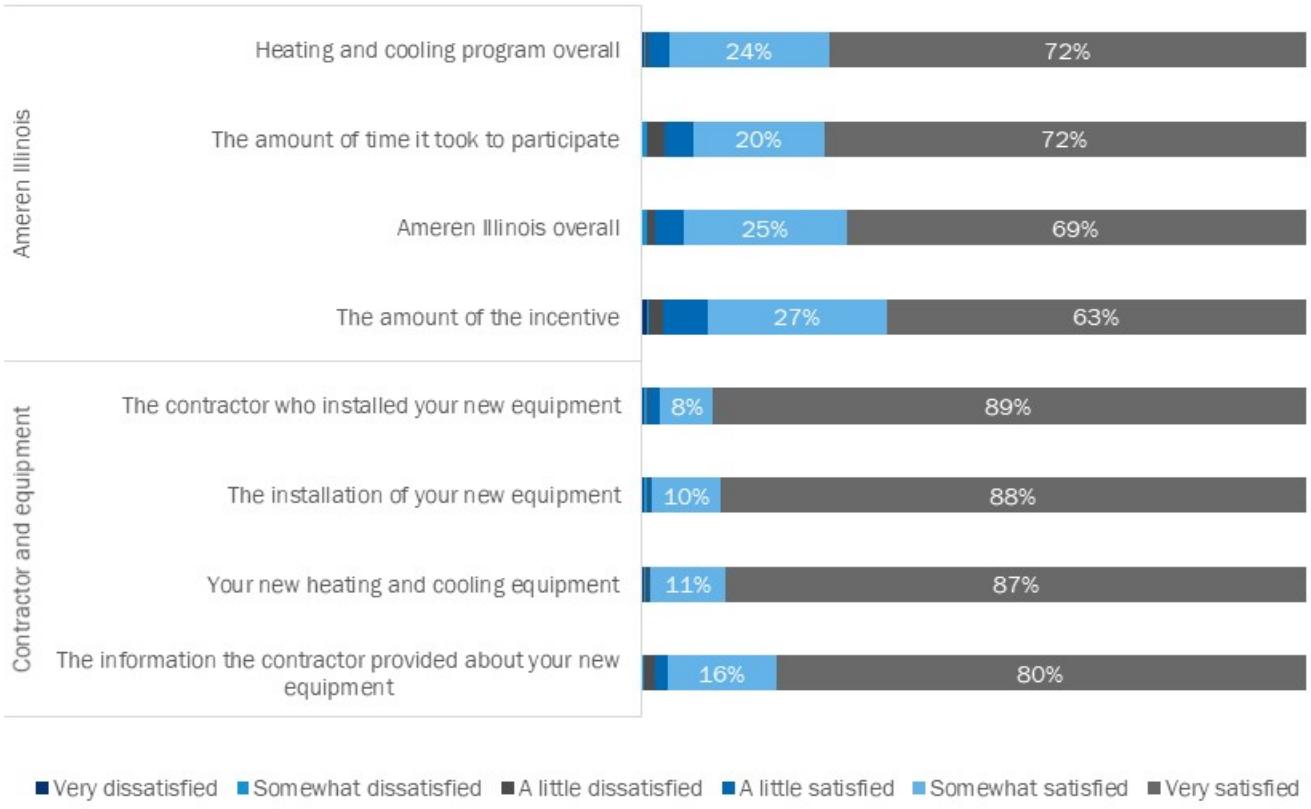
Table 19. How Participants First Heard about the HVAC Initiative

First Heard About the HVAC Initiative	Percent of Participants (n=460)
A contractor	**73%**
Any advertising or marketing effort	**19%**
Ameren Illinois' website	6%
An email, newsletter, bill, door hanger	6%
An advertisement from the internet	3%
Ameren Illinois Home Energy Reports	2%
An Ameren Illinois representative	1%
An internet search on Google, Yahoo, or Bing	1%
A family member, friend, and or colleague	**5%**

Initiative Satisfaction and Possible Barriers to Participation

- **Participants report high satisfaction across most initiative components.** More than 80% of respondents noted being very satisfied with all aspects of their participation with their contractor and the equipment they received. About two-thirds to three-quarters of respondents reported being very satisfied with AIC and the initiative (Figure 1).

Figure 3. Participant Satisfaction with AIC, the HVAC Initiative, and Initiative Components



- **Few respondents report dissatisfaction with the initiative.** Twelve of the 66 respondents report some dissatisfaction with the overall initiative or AIC in general. Ten of those twelve provided additional details.
  - Five reported their dissatisfaction stemmed from generally high energy bills with one of the five specifying that their new equipment was not providing bill savings like they expected.
  - Five other respondents reported dissatisfaction with the process of participating in the initiative and four offered greater detail. Three expressed frustration trying to get information about the initiative, and one stated the initiative information did not provide them with accurate information about the size of the incentive they would receive.

Trade Allies

The trade ally survey asked active trade allies about their satisfaction with the initiative and the effect of the initiative on their business practices. Additionally, active trade allies and inactive trade allies reported possible barriers to participating in the initiative and about their awareness and possible sales of heat pump water heaters. The sections below summarize results, beginning with a brief overview of respondent firmographics.

Overview of Respondents

Respondents tended to represent local firms, with 15 employees or less, that had been in business for 25 or more years, with at least $500,000 in annual revenue (Table 19).

Table 20. Overview of Trade Ally Respondents

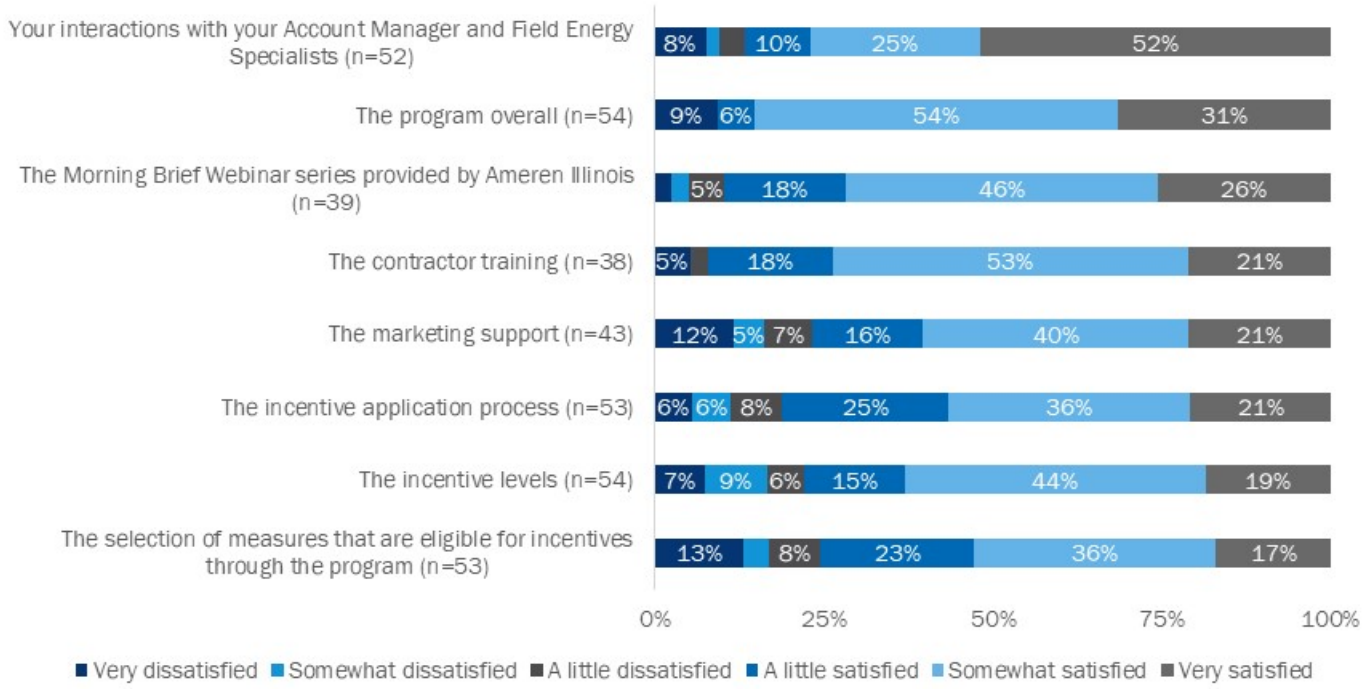
	Inactive (n=12)		Active (n=54)	
	Count	Percent	Count	Percent
Gross Annual Revenue				
Less than $100,000	0	0%	0	0%
$100,000 to less than $250,000	4	33%	4	7%
$250,000 to less than $500,000	0	0%	2	4%
$500,000 to less than $1 million	0	0%	8	15%
$1 million or more	7	58%	25	46%
Prefer not to answer	1	8%	15	28%
Number of Employees				
1 to 5 Employees	4	33%	13	25%
6 to 10 Employees	6	50%	18	34%
11 to 15 Employees	1	8%	14	26%
More than 15 Employees	1	8%	8	15%
Range of Company				
Local	10	83%	44	81%
Regional	2	17%	9	17%
National	0	0%	1	2%
International	0	0%	0	0%
Years in Business				
1 to 25 years	7	58%	22	43%
26 to 50 years	5	42%	18	35%

	Inactive (n=12)		Active (n=54)	
	Count	Percent	Count	Percent
51 to 75 years	0	0%	9	18%
More than 75 years	0	0%	2	4%
Key Areas of Expertise				
HVAC	11	92%	54	100%
Boilers, hot water, steam fitting	3	25%	12	22%
Refrigeration	3	25%	9	17%
Plumbing	1	8%	8	15%
Lighting	1	8%	5	9%
Electrical	2	17%	4	7%

Satisfaction with Initiative Experience

- **Active trade allies are generally satisfied with all HVAC initiative elements.** On average, active respondents reported high levels of satisfaction with their account managers and the overall initiative. There was less agreement among respondents about their satisfaction with marketing support, the application process, incentive levels, and the selection of measures; however, most respondents still reported being at least a little satisfied with these elements (Figure 2).

Figure 4. Active Trade Allies Satisfaction with Initiative Elements [a]



[a] We removed labels with percentages less than 5% because they became obscured by the image.

Additionally, the 12 respondents that receive co-branded marketing support from the Initiative, all were either “somewhat” or “very” satisfied with that support.

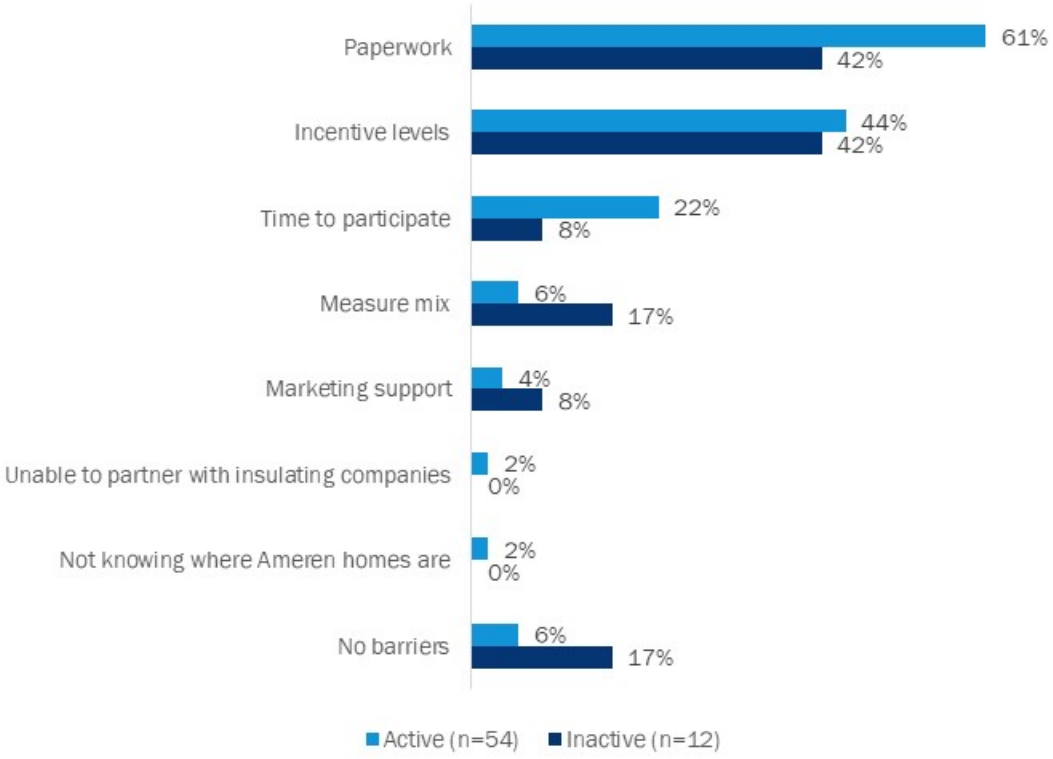
Twenty-one of the 26 respondents that noted some type of dissatisfaction with the initiative (reported they were very, somewhat, or a little dissatisfied with an initiative element) provided details about their dissatisfaction.

- Incentives were too low to spur action among customers (7 mentions).
- Communication with initiative staff needed improvement (6 mentions).
- Too few measures included in the initiative (5 mentions).
- Initiative paperwork and process is too confusing or time-consuming (4 mentions).
- Heat pump water heaters not promoted enough by initiative (1 mention).
- Replacing a 10 SEER air conditioner does not qualify for incentives (1 mention).[25]

Barriers to Trade Ally Participation and Solutions to Overcoming Those Barriers

- **Most trade allies report paperwork requirements and inadequate incentive levels as the key barriers to participating in the initiative.** About four out of five respondents indicated being at least a little satisfied with the initiative paperwork and incentive amounts (Figure 3) yet many respondents also reported that paperwork and low incentive amounts could be a barrier to participation. Less cited participation barriers included the time required to participate and an insufficient mix of measures offered by the initiative (Figure 4).

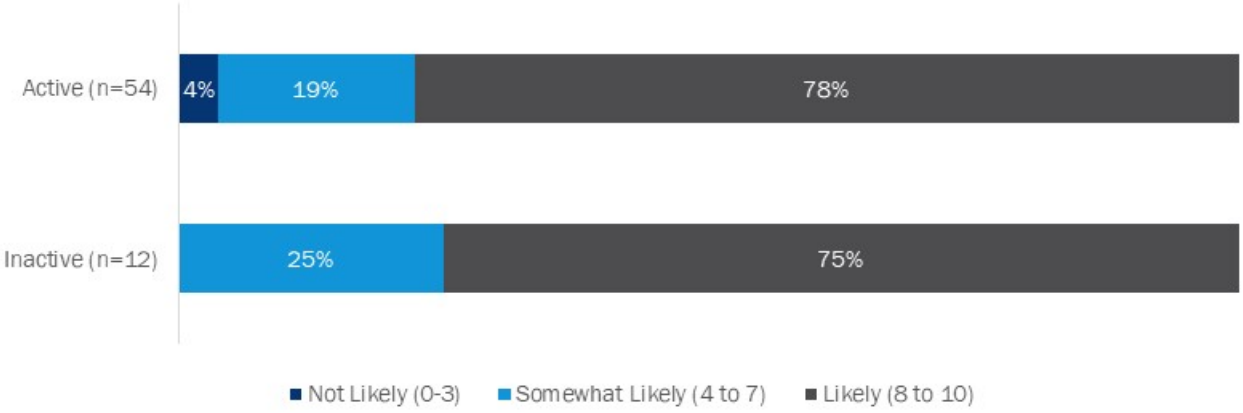
Figure 5. Barriers to Trade Allies Participating in the HVAC Initiative



[25] This respondent thought that 10 SEER air conditioners were not incented even though the initiative information says they are.

- **Both active and non-active trade allies report they are likely to participate in the initiative in the future.** Three-quarters of respondents reported they were likely to participate and only two active respondents indicated they were not likely to participate in the future (Figure 4)

Figure 6. Trade Ally Likelihood to Participate in the Future a



a Likelihood was asked about using a 0 to 10 scale where 0 was not at all likely and 10 was highly likely.

- **Most trade ally respondents provided suggestions for what the initiative could do to make it easier for trade allies to participate.** Forty-six respondents (39 Active and 7 Inactive) offered suggestions for ways that AIC could make it easier for their business to participate in the HVAC Initiative.
  - **Make the application process easier for contractors (22 mentions, 19 Active and 3 Inactive).** Recommendations to make it easier included providing an online application process that auto fills some application information (like contractor contact information). One of these respondents suggested a smartphone application where contractors could upload photos to the application while on a customer site.
  - **Increase incentives (15 mentions, 13 Active and 2 Inactive).** A few of these respondents requested higher incentives for very efficient equipment (e.g. 20 SEER units) compared to lesser units (e.g. 16 SEER).
  - **Improve timeliness of initiative response (5 mentions, 3 Active and 2 Inactive).** One respondent specified that it takes too long for the initiative to process incentives.
  - **Improve communications between initiative and contractors (4 mentions, 4 Active and 0 Inactive).** One respondent specified that he would like more in-person contact with a initiative representative.
  - **Change mix of equipment that receives incentives (3 mentions, 3 Active and 0 Inactive).** One of these respondents reported that the initiative should remove the requirement that makes ultra-high efficient multi-stage equipment ineligible for rebates. Another respondent reported that individual pieces of efficient equipment should receive incentives and receiving an incentive should not require bundling measures together.

Effects of Initiative on Trade Ally Practices

- **Most active trade allies are aware of AIC's mass media and targeted marketing campaigns.** However, almost half of respondents (47%) rated the marketing efforts as a little effective, on a 4-point scale

from not at all effective to very effective. The remaining respondents rated the marketing efforts as very effective (18%), extremely effective (3%), or not at all effective (32%).

Heat Pump Water Heater Research

A key challenge that initiative staff experienced with the HVAC Initiative in 2019 was a low uptake of HPWHs. Initiative staff attributed this to lack of customer awareness of HPWH technology and a limited number of trained initiative allies who can perform HPWH installations.

Historically, changing out a domestic hot water heater is a relatively simple task involving a single trade ally assuming the fuel type stays the same. However, recent research has shown that switching from natural gas to electric water heating (either a conventional electric water heater or HPWH) will often require a trade ally with electrical and plumbing knowledge or a fair amount of coordination between these two trades that do not typically work together. Removing the existing gas water heater requires an installer who will need to disconnect the water lines, disconnect the gas line, remove the water heater, and remove a portion of the gas piping and cap it. Installing a new HPWH often requires a plumber to reconnect the water lines. [26]

To better understand the reasons for low uptake and to understand the existing prevalence and possible adoption of heat pump water heaters (HPWHs) in AIC territory, we asked participants about their awareness and interest in HPWHs and what barriers they may face to installing a HPWH. Additionally, we asked trade allies to report about their awareness of HPWH technology, their experience installing HPWHs, customer interest in HPWHs, and their forecast for HPWH adoption.

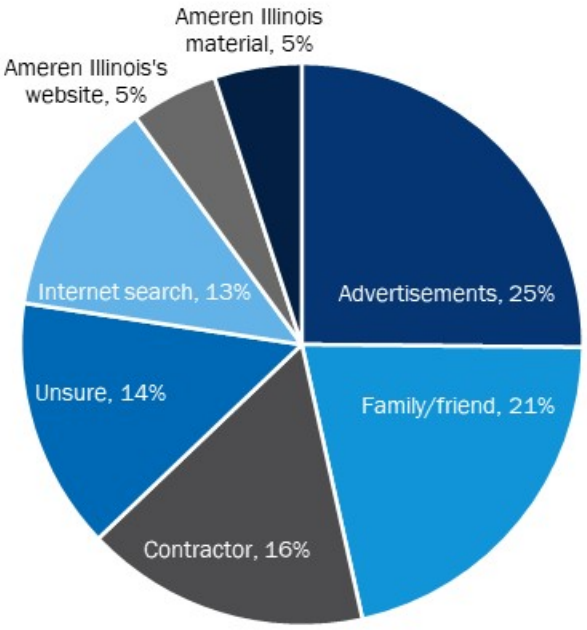
Participants

Awareness

- **Participant awareness of HPWH technology is relatively low.** About one-third (31%) of respondents indicated that they have heard of HPWHs. Not quite half of respondents who were aware of HPWHs (46%) heard about the technology through an advertisement or word-of-mouth (Figure 5). Not quite one-fifth of respondents learned about the technology through a contractor.

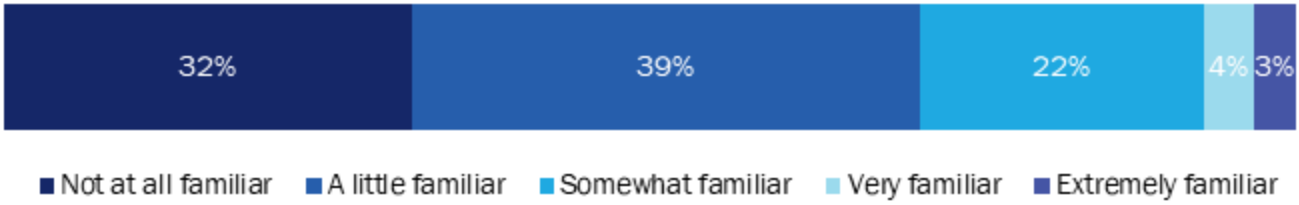
[26] *Successes and Challenges of Residential Heat Pump Water Heater Programs Through the Lens of Customers and Contractors*. American Council for an Energy Efficient Economy (ACEEE) Summer Study, 2020 Conference Proceedings (in development).

Figure 7. How Respondents First Heard about HPWHs (n=159)



- **Even among those who are aware of the technology, respondents reported low familiarity with HPWHs.** As seen in Figure 6, a majority (71%) of respondents who were aware of HPWHs indicated that they had little to no familiarity with the technology. A very small share of respondents (7%) said they were very or extremely familiar with HPWHs.

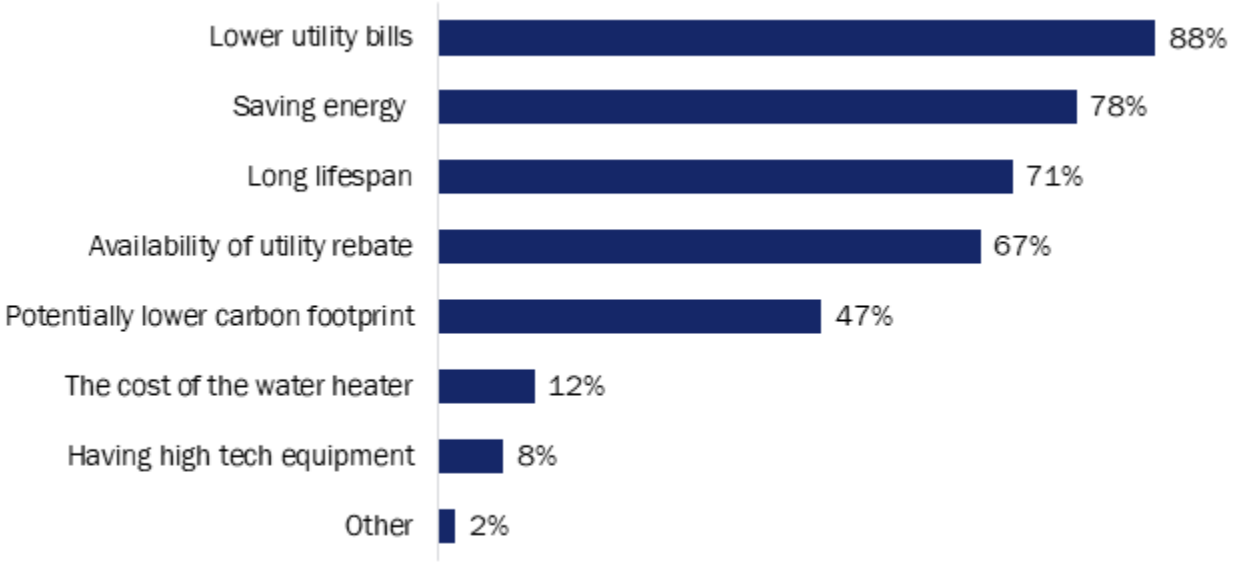
Figure 8. Respondent Familiarity with Heat Pump Water Heaters (n=155)



Participant Drivers

- **Participants reported the most popular features of HPWHs being lower operating costs and the opportunity to save energy.** Figure 7 presents the key benefits of HPWHs that respondents indicated an interest in. Respondents noted that achieving lower utility bills for water heating (88%) is the most desired benefit of residential customers. About three-quarters of respondents also listed saving energy and the longer lifespan of the unit as key HPWH benefits that they are interested in.

Figure 9. HPWH Benefits that are Attractive to Customers (n=51)

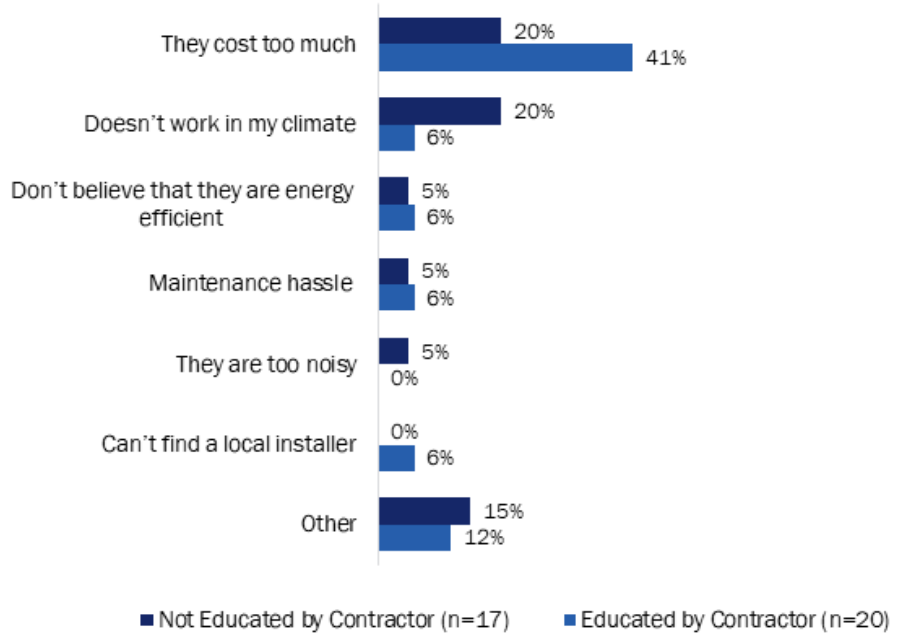


Participant Barriers

- **The largest barrier to adoption of HPWHs for participants is upfront cost.** Respondents were asked why they did not choose to install a HPWH if they indicated that their contractor had discussed the technology with them or if their contractor did not discuss the technology with them, but they had previously considered installing a HPWH in their home. Figure 8 compares the responses of these two groups. Both groups of customers noted the main reason they chose not to install a HPWH is due to the upfront cost of the unit.

  Respondents educated about the technology by their contractor indicated that cost (41%) was a more common concern than those not educated by their contractor (20%). Additionally, a fifth of respondents not educated by their contractor indicated concerns about HPWH performance in cold climates while only 6% of respondents in the educated group indicated this concern.

Figure 10. Reasons Customers Chose Not to Install HPWHs



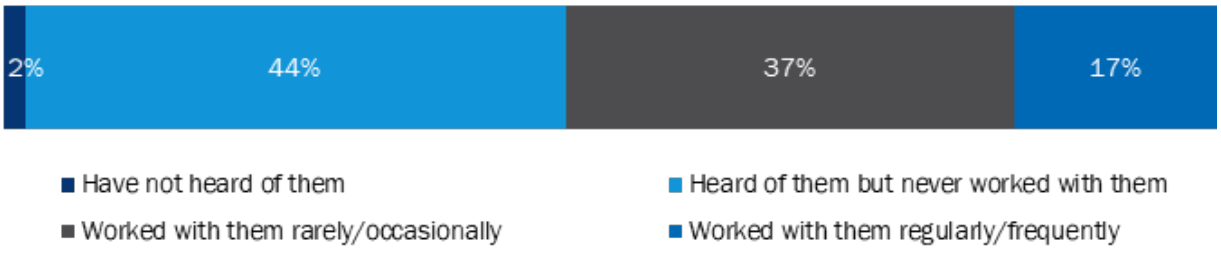
- **Survey results indicate that respondents are not likely to replace their existing water heater with a HPWH unless the existing unit breaks down (57%) or the cost of HPWHs decreases (57%).** Ten percent of respondents indicated that nothing would increase their likelihood of purchasing a new HPWH.

Trade Allies

Awareness and Recommendation Tendencies

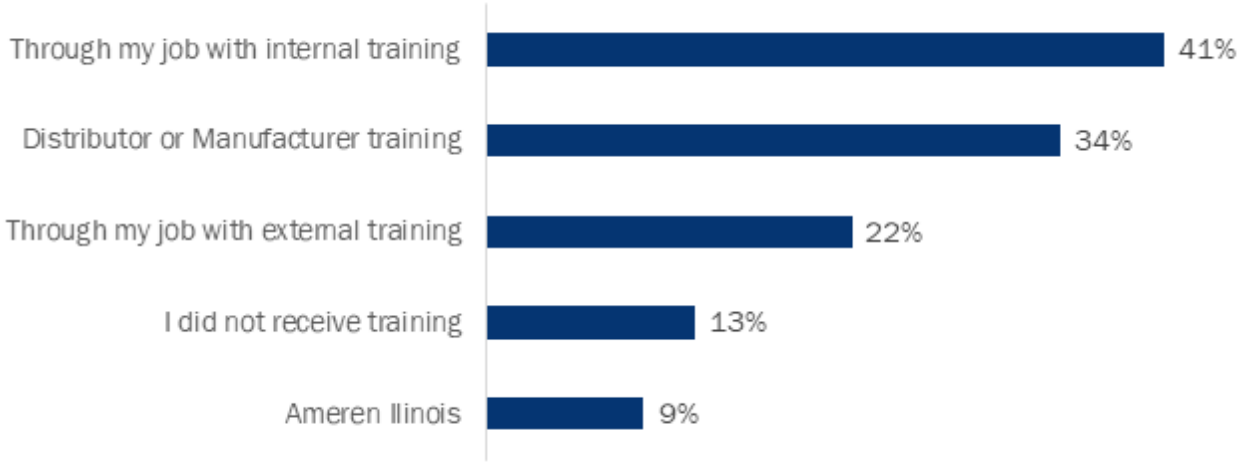
- **Trade allies indicated that they are somewhat familiar with HPWH technology.** As shown in Figure 9, 54% of respondents noted that they have worked with HPWHs regularly or on occasion while another 44% of trade allies had only heard of them but had never worked with them.

Figure 11. Trade Ally Awareness of HPWHs (n=54)



- **Trade allies primarily receive their training to install HPWHs from internal training or trainings from distributors or manufacturers. As noted in Figure 10, many** respondents (41%) received their training from internal job trainings with distributor and manufacturer trainings being the second most common training resource (34%).

Figure 12. Trade Ally HPWH Training Sources (n=32)



- **Trade allies are most likely to recommend HPWHs to their customers when the water heater has failed or is old or near failure.** When asked what percent of the time that contractors would recommend HPWHs to customers, 15% of respondents reported that they would recommend HPWHs more than half of the time when their customer is replacing a near failure water heater, a failed water heater, or in a new construction scenario.

  Respondents also provided insight into what scenario customers would be more likely to accept their recommendation to install a HPWH. Specific responses are highlighted below.

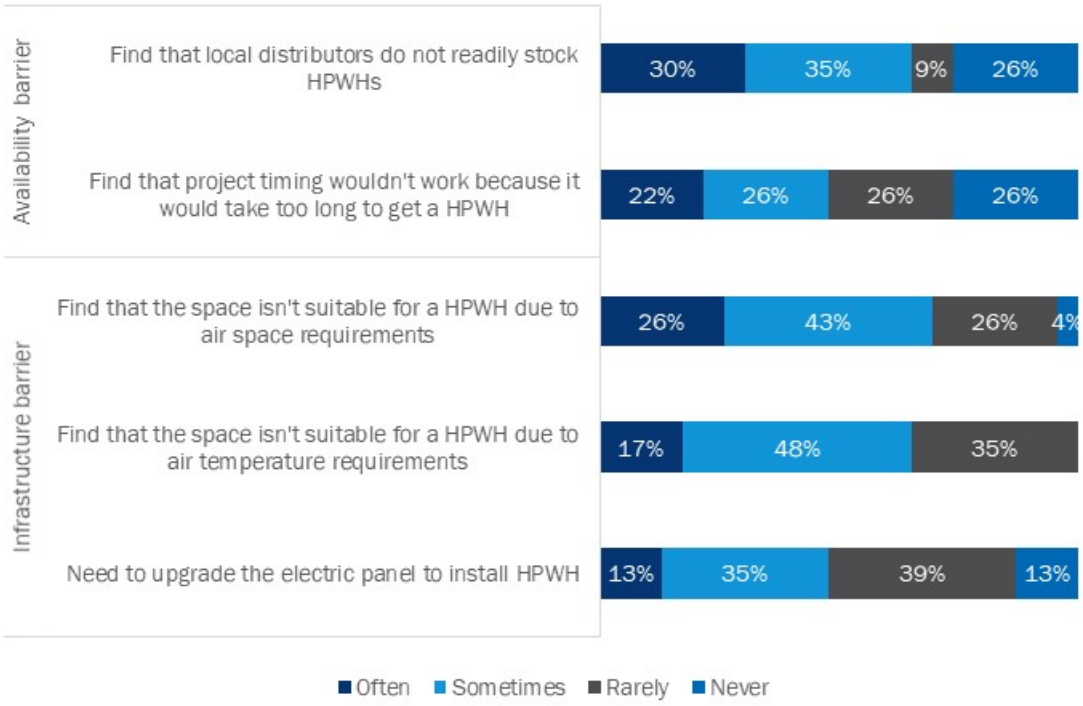
  - *Customers who have high hot water demand and who have the funds to install a HPWH.*
  - *When the space is available and when they can take advantage of the rebate*
  - *If the prices and rebates are fair, they would be easier to recommend.*

Barriers to Installing HPWHs

- **Trade allies reported two overarching barriers to installing HPWHs: HPWHs are not readily available and customer's homes often cannot physically accommodate a HPWH.** HPWHs have specific infrastructure needs. They require at least 1,000 cubic feet of air space around the unit, require the air temperature around the unit to be from 40 to 90 degrees, and they need to be near a suitable power source.[27] Seventy-eight percent of trade allies noted they either often or sometimes found infrastructure barriers in homes that would make installing a HPWH difficult or impossible. Additionally, 65% of trade allies reported often or sometimes having difficulties acquiring HPWHs because distributors did not stock them, or they could not order them in time to complete a project. Figure 11 shows the specific infrastructure and availability barriers trade allies noted.

[27] Energy Star. Considerations – Heat Pump Water Heaters. (Accessed on 9/1/2020). https://www.energystar.gov/products/water_heaters/high_efficiency_electric_storage_water_heaters/considerations

Figure 13. Frequency that Trade Allies Reported Barriers to Installing HPWHs (n=23)



- **Most residential trade ally business does not come from water heater replacement or repair. Trade ally** respondents reported that 6% of their residential business comes from water heater replacement and only 4% comes from water heater repair. Respondents who reported that water heater replacement was 20% or more of their residential business are companies that specialize in plumbing as well as HVAC.

HPWH Market Forecast

- **Trade allies predict that the HPWH market will either stay the same or experience growth in the next five years.** Trade ally respondents generally believe that the number of installations of HPWH will either stay the same or increase over the next five years (70%). Trade allies indicated that the main barrier to the customer is cost. As utilities offer more point of sale rebates and layered incentives to make the cost comparable to other water heater options, HPWHs could achieve greater market penetration. Contractors mentioned that due to the trend towards solar and all electric fuel sources, HPWHs could have more success in the residential market moving forward. Contractors expect new construction to drive the market for HPWHs because new homes can accommodate the size and electric demands of HPWHs. Other drivers of potential HPWH growth include increased contractor and customer awareness of HPWHs and their benefits, increased availability of utility initiative incentives that address first-cost barriers, and increased municipal, state, and federal greenhouse gas emission reduction goals.

Conclusions

Results of the participant and trade ally surveys lead us to reach the following conclusions and make a few recommendations.

- **Conclusion: Trade allies play the key role in recruiting participants to the initiative and they see value in participating in the initiative.** Almost three-quarters of participants heard of the initiative via their contractor and almost all trade allies--even non-active contractors and those expressing some dissatisfaction with the Initiative---indicated they are likely to participate in the initiative in the future.
- **Conclusion: Customers are largely satisfied with the initiative processes, contractors, and equipment.** Customer satisfaction was particularly high with contractors and equipment. The few participants that did report dissatisfaction specified unhappiness with perceived high energy bills and unclear initiative processes.
- **Conclusion: Trade allies were generally satisfied with all aspects of the initiative and most stated they would participate in the initiative in the future. However, most trade allies also reported paperwork requirements and inadequate incentive levels as the key barriers to participating in the Initiative.** Many trade allies described the paperwork as cumbersome and had recommendations for the online application portal released at the end of 2019. Some allies also stated that incentives were not high enough to make participants choose the efficient option and some other allies reported the initiative did not include enough measures in the initiative to appeal to other customers.
  - **Recommendation:** Conduct a tool usability study on the online application portal released at the end of 2019. A tool usability testing is a diagnostic method that identifies potential issues and improvements in a user interface, such as an online tool. Users may interpret an online tool in a manner completely different than that intended by its designers, or they may simply have difficulty navigating the tool. Through a usability study, feedback on the user interface and its navigation can be gathered, prioritized, and then updates can be made more cost-effectively. A study could also support (or not) the recommendations for improvement provided by a few trade ally respondents such as providing an autofill feature in applications and a way to easily upload pictures into the application while at a customer site.
- **Conclusion: Most trade allies associated with the HVAC initiative are not plumbing contractors.** Just over 10% of trade ally respondents reported that plumbing was a key part of their business[28] and few trade allies reported water heating was a key aspect of their business. As water heaters are a measure associated with the plumbing industry, it is likely that the initiative will need to engage more plumbers to encourage HPWH installations.
  - **Recommendation:** Look for ways to expand the trade ally network to include more plumbing contractors and handymen who are the trade allies that typically install HPWHs. This could include outreach to plumbing associations, distributors, and manufacturer representatives that support plumbing contractors in the field.
- **Conclusion: HPWHs are a nascent technology in AIC territory.** Few participants have a HPWH and few trade allies have experience with HPWHs. Awareness of HPWHs is low among participants, and few of those who are aware, are familiar with HPWHs. About one-third of participants were aware of HPWHs and about three-quarters of those, who were aware, indicated they had little to no familiarity with HPWHs. Furthermore, few trade allies have knowledge or experience installing HPWHs and trade allies reported that few (if any) customers ask for HPWHs. To increase adoption of HPWHs through the

[28] This is consistent with a review of initiative data that shows about 10% of all 320 trade allies have "plumbing" in their company name.

Initiative, trade allies in general and plumbing trade allies specifically will need more knowledge and experience with HPWHs that they can then share with their customers.

- **Recommendation:** Provide workforce education and training opportunities to trade allies that work with water heating to address the benefits of HPWHs, the technical difference in installing HPWHs compared with traditional water heaters, and sales training. Educating customers about the benefits of HPWHs will fall on trade allies that with water heating and they will need to know how to effectively position the benefits of HPWHs to drive sales.
- **Recommendation:** Consider providing HPWHs to trade allies for their own use so they can speak first-hand about their experience with the technology to their customers.
- **Recommendation:** Develop a marketing campaign displaying the benefits of HPWHs to customers and trade allies that work with water heating. This campaign could include marketing collateral that trade allies could share with customers, online advertisements when people search for water heater replacement, and advertisements about HPWHs in distributor warehouses and big box stores like Home Depot, Lowes, or other retailers that sell HPWHs

- **Conclusion: Participants expressed the most interest in the following benefits of HPWHs: Lower utility bills, saving energy, and the long lifespan of the equipment.** More than two-thirds of participants reported interest in the lower utility bills, saving energy, and the long life-span of HPWHs. Fewer participants were interested in other benefits of HPWHs such as receiving a utility rebate and being "green" by installing a HPWH.
  - **Recommendation:** Consider using these three benefits as the foundation of a marketing campaign to drive HPWH awareness and familiarity.

2.3 Standard Initiative

Implemented by Leidos, the Standard Initiative offers AIC non-residential customers fixed incentives for the installation of specific energy efficiency measures. Incentives are delivered through several distinct offerings which are described below:

- **Core**: The Core offering covers lighting, variable speed drives (VSDs), HVAC equipment, refrigeration/grocery store equipment, commercial kitchen equipment, steam traps, leak survey and repair, and other measures.
- **Instant Incentives**: Instant Incentives is a midstream offering that offers discounts at the point of sale and covers a variety of standard, specialty, and linear LEDs.
- **Online Store**: Through the Initiative, AIC operates the Online Store that offers all-electric business customers a variety of energy-saving products, such as LEDs, occupancy sensors, advanced thermostats, and advanced power strips.
- **Small Business Direct Install**: Small Business Direct Install (SBDI) became an offering through the Initiative beginning in 2018. SBDI relies on AIC Business Program allies to provide small businesses with a free energy assessment and a simplified process for installing rebated measures.
- **Small Business Energy Performance**: Small Business Energy Performance (SBEP) began as a pilot in 2019. SBEP currently involves the completion of pilot projects in small nonresidential facilities.
- **Green Nozzles**: The Initiative also includes the Green Nozzles offering, which offers free low-flow pre-rinse nozzles to all AIC all-gas business customers, as well as customers in the foodservice sector who use electric water heating.

As part of the 2019 evaluation, the evaluation team conducted research around the SBDI offering including topics such as awareness of the offering, barriers to participation and satisfaction among small business customers. This memo is included in the section below and available as a on the SAG website.[29]

2.3.1 Small Business Direct Install Participant Survey Results Memo

Overview

The Ameren Illinois Company (AIC) Small Business offering provides direct install energy efficiency measures to AIC's small (primarily DS-2 and/or GDS-2) customers. While the Standard Initiative is designed to serve business customers of all sizes, this offering is a critical participation channel for AIC's small customers, who prior to 2018 were targeted by a series of stand-alone Illinois Power Agency approved energy efficiency programs. 2019 was the second year the Standard Initiative included a Small Business offering. The Small Business offering includes mostly LED replacements for linear lighting, but also offers specialty LEDs and occupancy sensors.

The evaluation team conducted research to better understand Small Business offering participants. More specifically, the evaluation team aimed to provide a better understanding of the following:

- How customers heard about the Small Business offering
- Customer satisfaction with their participation in the Small Business offering
- The barriers customers face related to participating in the Small Business offering
- Customer awareness of and interest in other Initiative offerings
- Small business lighting product purchase behaviors.

To meet these research goals, the evaluation team developed and fielded an online survey in December 2019. The evaluation team invited a census of the customers who completed the Small Business offering projects between mid-December 2018 and early July 2019 to the online survey. The survey was designed to gather data from the person responsible for making decisions about energy-using equipment within their companies. The sample included 684 unique contactable Small Business offering participants, and total of 124 participants completed the survey, yielding a response rate of 24%.[30]

Summary of Key Findings

Key findings and recommendations from this research are explained below:

- **Key Finding #1: Most participants received information about the Small Business offering by discussing the program with a contractor or Program Ally.** Although there were several ways participants may have seen or heard information about the offering, most respondents (73%) indicated they have discussed the program with a contractor or Program Ally. Other common ways respondents heard information about the offering include through friends and family (42%), the AIC website (27%), and information on their monthly utility bill (27%).
- **Key Finding #2: Participants are highly satisfied with AIC and the Small Business offering overall.** Almost all respondents reported being satisfied with AIC overall (94%) and the Small Business offering

[29] https://ilsag.s3.amazonaws.com/AIC-2019-SBDI-Survey-Results-Memo-FINAL-2020-08-10.pdf
[30] The evaluation team used the Response Rate 3 (RR3) method recommended by American Association for Public Opinion Research (AAPOR). RR3 excludes partially completed survey from the numerator and includes estimated number of eligible sample in the denominator.

overall (98%). The vast majority of respondents (94%) reported they did not experience any problems during their participation in the offering.

- **Key Finding #3: Small Business offering participants are interested in non-lighting equipment currently not offered by the program.** When asked if they would be interested in various non-lighting equipment if an assessment report recommended it, most respondents indicated they would be interested in advanced or "smart" thermostats (55%), advanced power strips (60%), and air sealing (64%). Additionally, when asked if there was any other energy-saving equipment they wished the Small Business offering provided, 23 respondents provided a recommendation, the most common being HVAC equipment (48%, n=23).
- **Key Finding #4: Most respondents were unaware of other Initiative offerings even though many of these offerings are likely applicable to them.** About half of respondents indicated they had not heard about Lighting Instant Incentives (50%), the Online Store (52%), or Standard Lighting (52%). Most respondents indicated they had not heard about HVAC and Water Heater Incentives (73%), or Steam Trap Incentives (93%). When asked if they were interested in learning more about each of the Initiative offerings, nearly half of respondents - whether they were aware or unaware of the offering - indicated they were interested in learning more about Lighting Instant Incentives (46%) and HVAC and Water Heater Incentives (49%).
- **Key Finding #5: Most respondents plan on replacing their T12 or T8 fluorescent lamps with Linear LEDs (TLEDs).** Nearly three-quarters of respondents who reported they had T12 lighting (73%, n=15) and more than half of respondents who reported they had T8 lighting (54%, n=35) installed in their facility reported they plan to replace these fluorescent lamps with Linear LED lamps. About 17% of those with T8 lighting plan to replace their T8 lighting with another T8 product. Among the respondents who indicated they had any kind of linear lighting installed at their facility, 76% reported they will purchase the most energy efficient product the next time their facility needs a replacement of linear lighting.

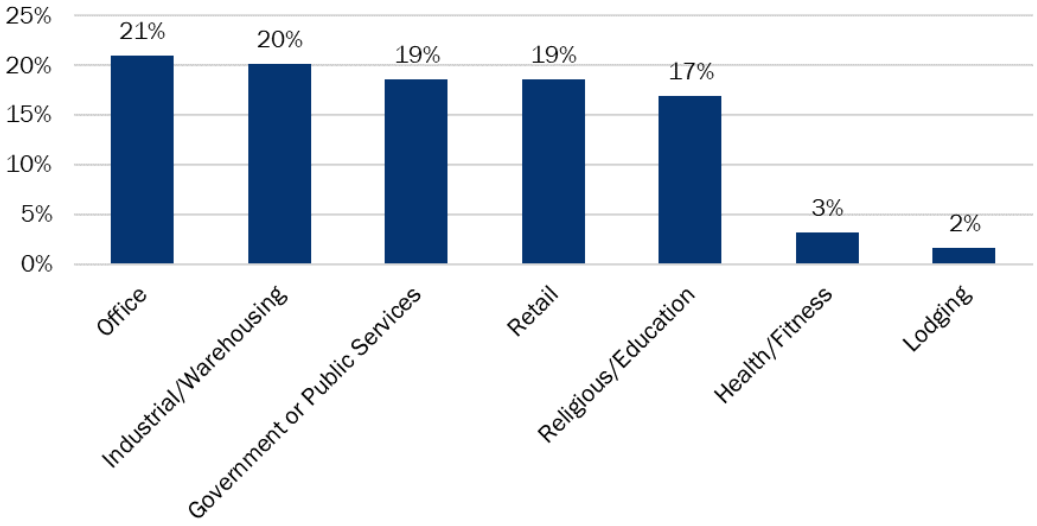
Detailed Results

This section outlines the detailed results from the online survey completed by 124Small Business offering participants.

Respondent Characteristics

The Small Business offering participants who responded to the online survey reported diverse firmographic characteristics, encompassing a wide range of business types and sizes. The most common business type was offices (21%), followed by industrial/warehousing (20%), government or public services (19%), and retail (19%). Figure 1 shows the distribution of the respondents' business types.

Figure 14. Small Business Offering Participant Types (n=124)



More than half of respondents (56%) reported their business was small, with fewer than ten total employees, while 29% reported their businesses were medium sized (ten to 49 employees), and 12% reported their businesses were large (50 or more employees). Additionally, 90% of respondents indicated their business was an independent business, not part of a chain or franchise. About 90% of respondents owned the facilities they occupied. Among the other 10% of respondents who rent their facilities, 100% reported they pay for their electric and/or gas bills, indicating all the respondents have an incentive to make energy efficient upgrades at their facilities. Eighty-four percent of respondents reported their facility was at least 20 years old.

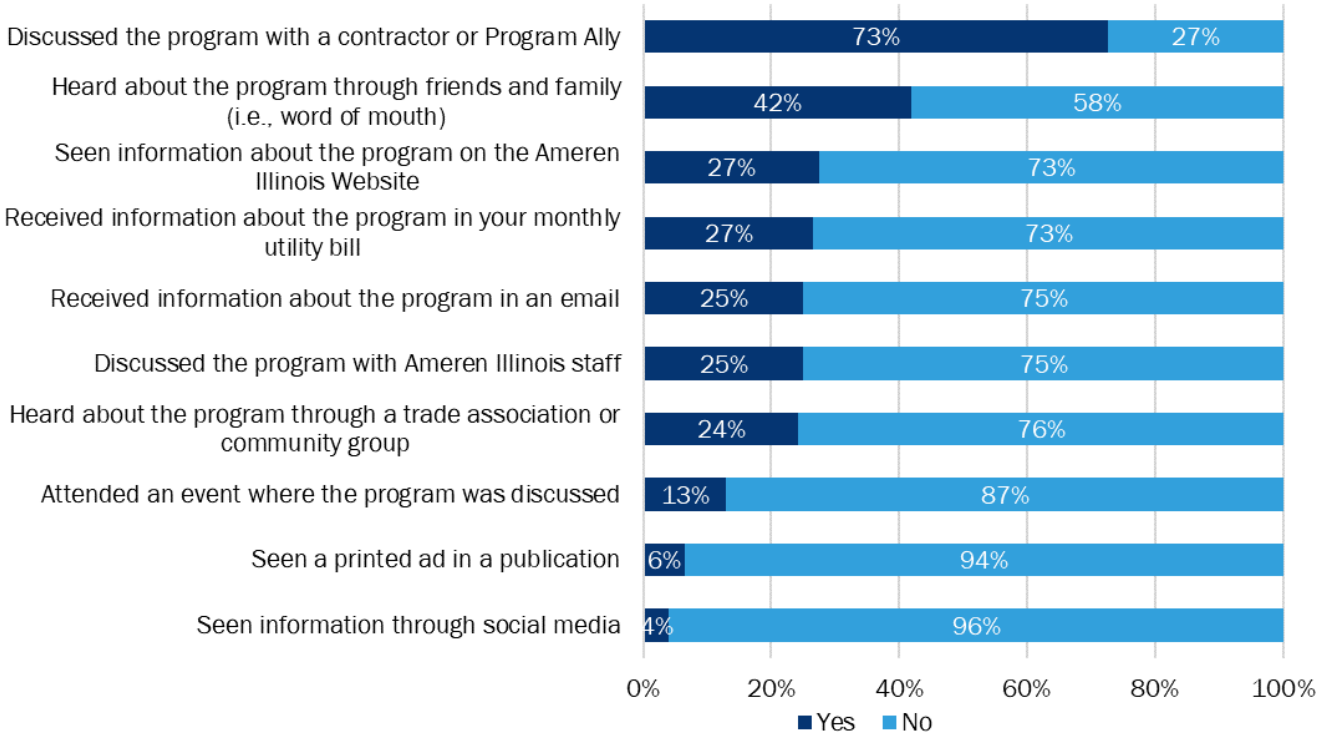
Program Awareness and Interest

Sources of Information

There were several channels through which respondents learned about the Small Business offering, as shown in Figure 13. Respondents most commonly reported they learned about the offering from a contractor or Program Ally (73%) or heard about through word-of-mouth (42%). About one-quarter also reported seeing or hearing about the program from the AIC website (27%), information on their utility bill (27%), program emails (25%), AIC program staff (25%), or at trade associations (24%). Only a few respondents reported seeing program information through social media (4%) or in printed ads (6%).

The evaluation team found that large businesses with 50 or more employees were more likely than smaller businesses to learn about the program at an event where the program was discussed (47% among large businesses, while 8% among small-medium sized businesses). This indicates that AIC's presence at these events is an important way to funnel larger businesses into the Small Business offering.

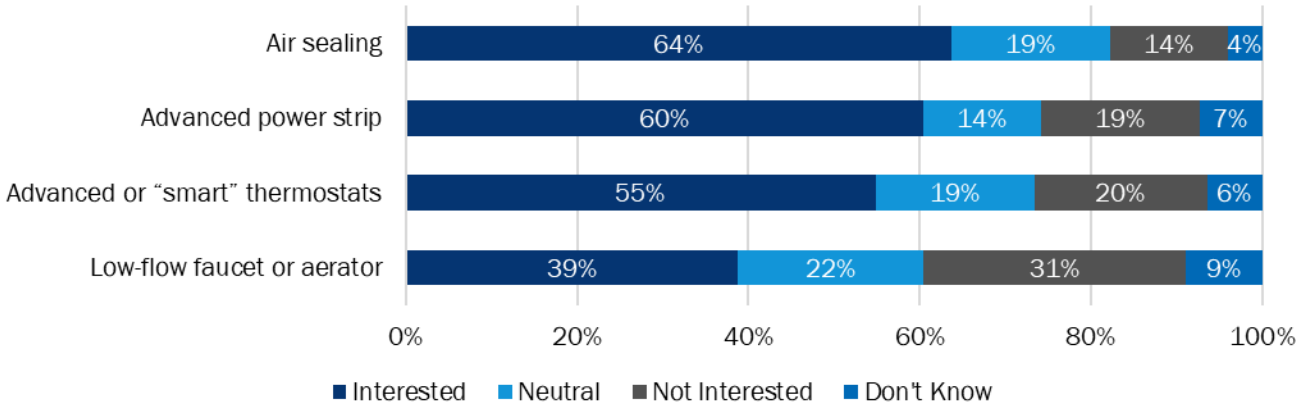
Figure 15. Program Awareness Channels (n=124): Have you ever . . .



Interest in Energy-Saving Measures

The evaluation team also asked respondents how interested they were in non-lighting energy-saving equipment the program could offer in the future for qualifying small business customers. A majority of respondents indicated they would be interested in moving forward with air sealing (64%), advanced power strips (60%), and advanced thermostats (55%) if an assessment report recommended it. A smaller share of respondents (39%) indicated they would be interested in low-flow aerators if the assessment report recommended them. Figure 14 displays respondent interest in non-lighting measures the program could potentially add to the Small Business offering.

Figure 16. Customer Interest in Energy Efficiency Measures (n=124)



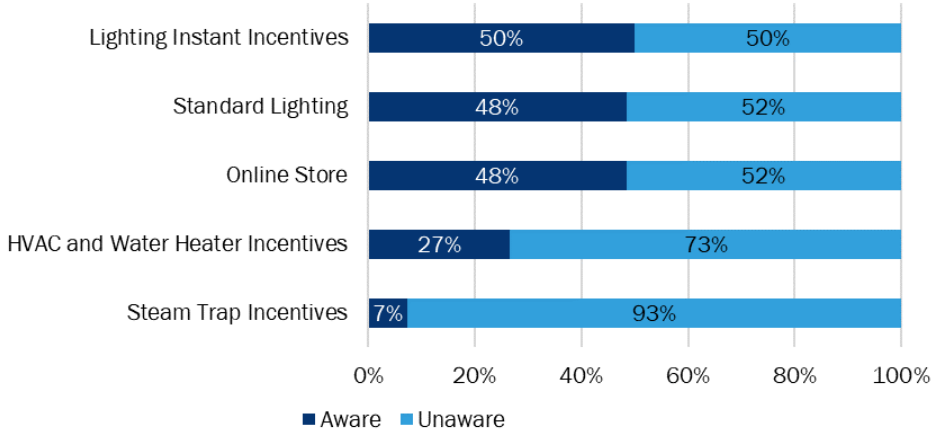
Note: The research team asked the respondents to rate their interest in each measure using an 11-point scale, where 0 is not at all interested and 10 is very interested. The responses were coded to 'Not Interested' (0 - 3), 'Neutral' (4 - 6), and 'Interested' (7-10).

When asked if there was any other energy saving equipment they wished the Small Business offering provided, respondents most commonly reported they would like HVAC equipment, such as furnaces and air conditioning equipment (11). Other frequent responses included outdoor lighting (4), solar panels (2), and water heaters (2).

Awareness of and Interest in Other Offerings for Small Business Customers

Many respondents indicated they were aware of other AIC offerings that provide small business customers with energy-saving equipment. As shown in Figure 15, about half of respondents reported they were aware of Lighting Instant Incentives (50%), the AIC Online Store (48%), and the Standard Lighting offering (48%). Awareness of HVAC and Water Heater Incentives and Steam Trap Incentives were much lower, at 27% and 7%, respectively.

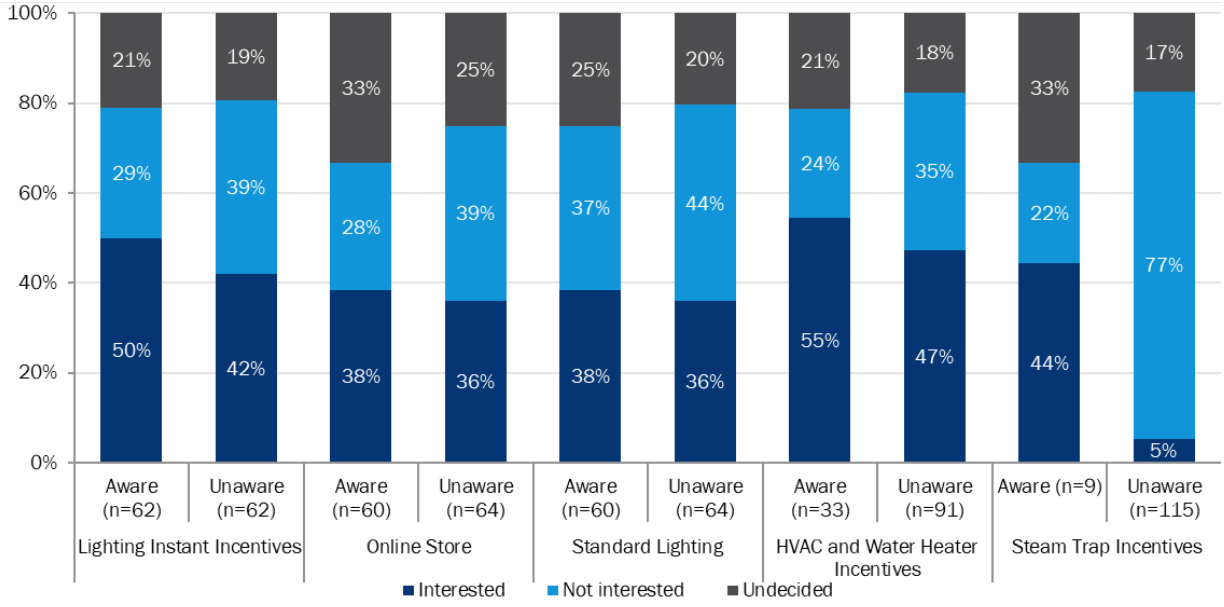
Figure 17. Customer Awareness of Other Program Offerings (n=124)



The evaluation team also asked respondents if they were interested in learning more about these offerings to understand if these offerings may be applicable to them. Figure 16 shows the responses for each offering or

program by awareness of the offering. Generally speaking, both respondents who are aware of the offering and those who are unaware reported a similar level of interest in the offerings. This indicates that many of the participants are still uninformed of these offerings even though these offerings are likely applicable to them. Another interesting finding is that, despite lower awareness than most programs, HVAC and Water Heater Incentives program received the highest share of the respondents who are interested in learning more (49% overall), followed closely by Lighting Instant Incentives (46% overall). Many respondents were also interested in learning more about the Standard Lighting offering (37% overall) and the AIC Online Store (37% overall).

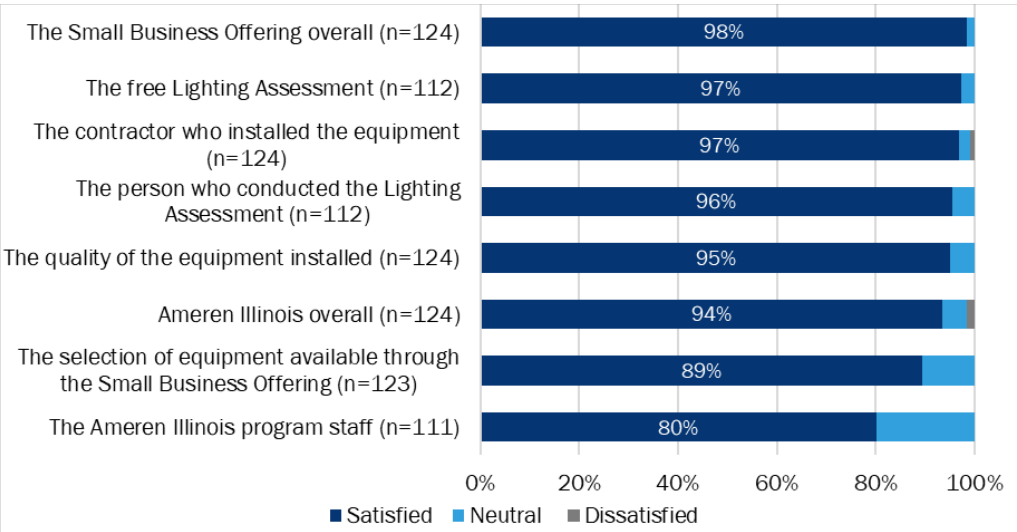
Figure 18. Customer Awareness of and Interest in Other Program Offerings (n=124)



Customer Satisfaction

Respondents were, overall, highly satisfied with the Small Business offering. An overwhelming majority of respondents provided "satisfied" ratings with the Small Business offering and AIC overall as well as various offering components, including the free lighting assessment (97%) and the installation contractors (97%). Figure 17 shows the distribution of satisfaction ratings with various components of the Small Business offering.

Figure 19. Customer Satisfaction with Small Business Offering



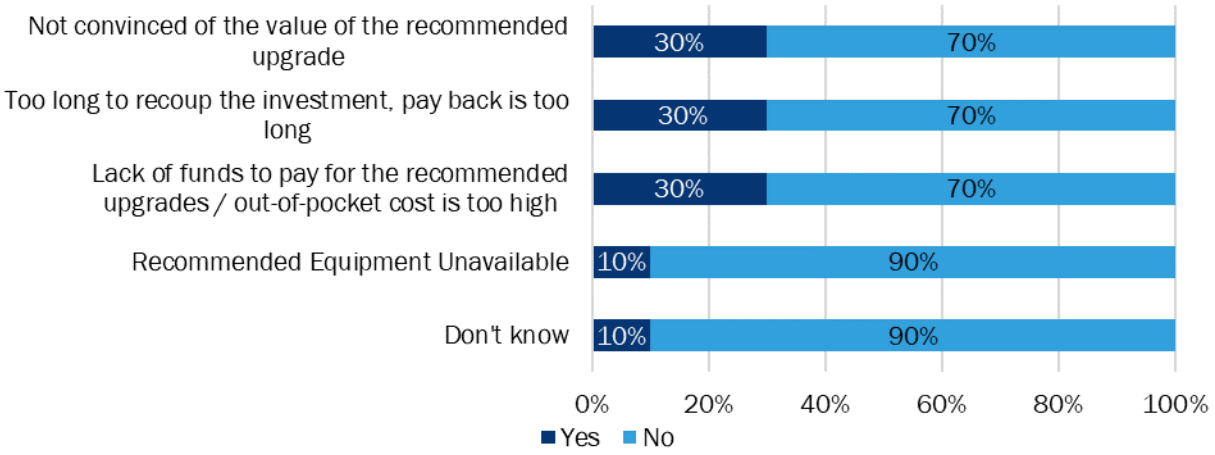
Note: The research team asked the respondents to rate each of the satisfaction questions using an 11-point scale, where 0 is very dissatisfied and 10 is very satisfied. The responses were coded to 'Dissatisfied' (0 - 3), 'Neutral' (4 - 6), and 'Satisfied' (7 - 10). Responses of "Don't know" were included as "Neutral".

Only 8 respondents (6%) indicated they experienced problems during their participation in the Small Business offering. The most common problems respondents reported were related to equipment (installation problem, or equipment availability) and administrative issues (scheduling problems, longer than expected time it took for project approval).

Barriers to Participation

Approximately 77% of respondents recalled receiving both the free Lighting assessment and the assessment report, and among these respondents, 84% installed all the equipment recommended in the assessment report. For those who did not install all the recommended equipment (n=10), the research team inquired about the reasons not all the recommended equipment was installed. The most common reasons include the payback period for the investment was too long (30%), respondents were not convinced of the value of the recommended upgrade (30%), and a lack of funds to pay for the recommended upgrades (30%). When asked if they plan to have all the recommended equipment installed, two respondents indicated yes, two respondents indicated no, and six respondents did not know if they would have all the recommended equipment installed.

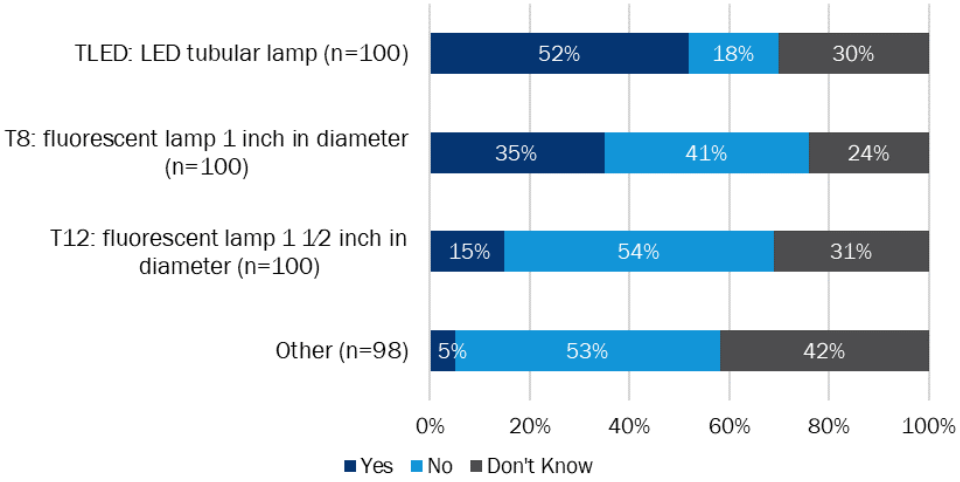
Figure 20. Reasons Customers did not Install all the Recommended Equipment (Multiple Responses Allowed, n=10)



Lighting Product Purchase Behavior

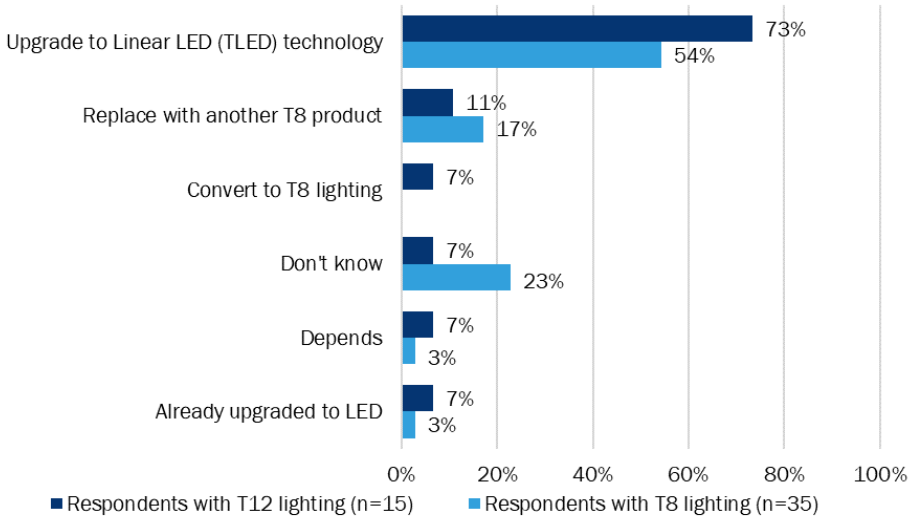
The evaluation team asked respondents a series of questions about their lighting-related purchase and installation decisions at their facilities. Four out of five respondents (81%) reported their facilities used linear tube-shaped overhead lighting. Figure 19 shows the types of linear lighting currently installed in their facilities. While many respondents could not provide specific types of linear lighting installed in their facilities, more than half (52%) reported they have efficient TLED installed. Non-LED linear lightings are still commonplace in many respondents' facilities. T12 lamps are in less than one-fifth of the respondents' facilities (15%), and T8 lamps are in more than one-third of the respondent's facilities (35%). This suggests there is a remaining opportunity for the Small Business offering to help these customers.

Figure 21. Linear Lighting Products Installed at Small Business Offering Facilities



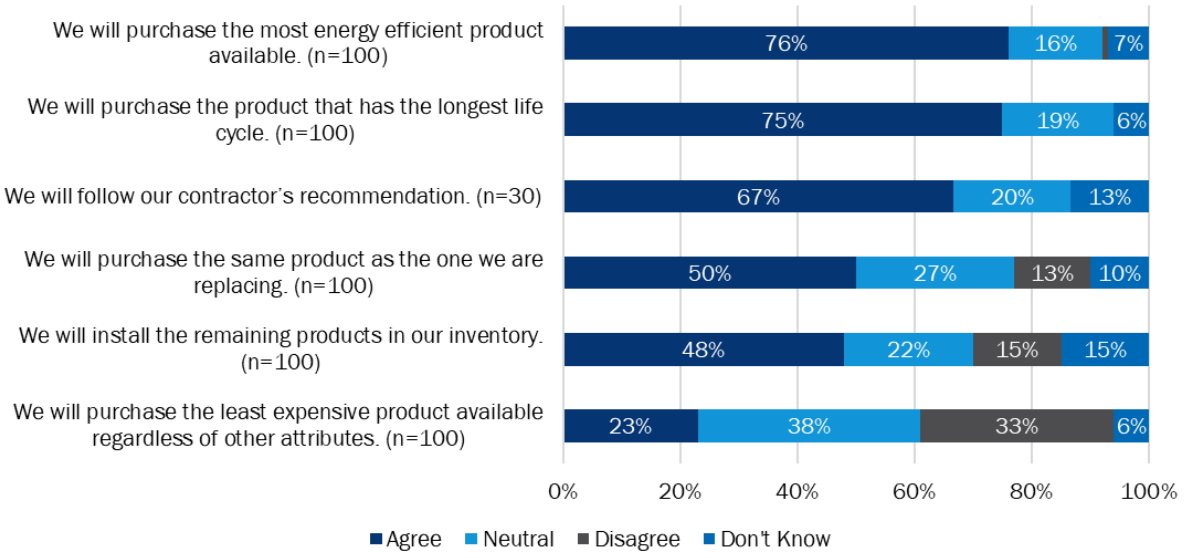
The evaluation team also asked respondents who indicated they have T12 or T8 fluorescent lamps what they plan to do when they replace those products. As shown in Figure 20, most respondents with T12 and T8 lamps indicated they would replace their fluorescent lamps with TLED lamps (73% and 54% respectively). A notable portion of respondents with T8 (17%) also indicated they plan to replace with another T8 lamps.

Figure 22. Respondents' Plans to Replace T12/T8 Fluorescent Lamps



The evaluation team asked the respondents whose facility has linear lighting installed about the importance of several attributes in their future purchase of linear lighting products, as shown in Figure 21. The next time their facility needs to replace linear lighting, approximately three-quarters of respondents indicated they will purchase the most energy efficient product available (76%) and will purchase the product that has the longest life cycle (75%). Contractor recommendations are also highly important to respondents, as 67% of those who indicated they normally hire a contractor to complete lighting projects indicated they would follow their contractor's recommendation. Only about half of respondents reported they would purchase the same product they are replacing (50%) or install the remaining products in their inventory (48%), although in many cases these could include already efficient lighting. Less than one-quarter (23%) indicated they would purchase the least expensive product available.

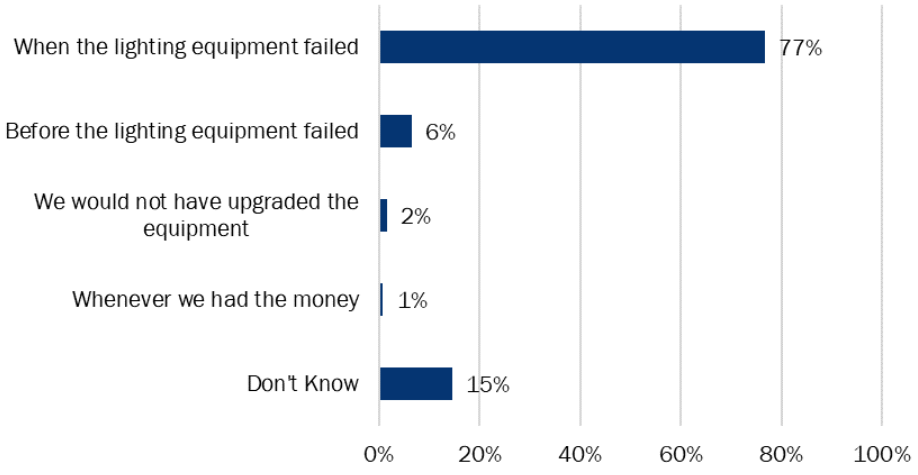
Figure 23. Respondent Lighting Purchase Behaviors: Agreement or Disagreement with the Following Statements



Note: The research team asked the respondents to rate each of the satisfaction questions using an 11-point scale, where 0 is strongly disagree and 10 is strongly agree. The responses were coded to 'Disagree' (0 - 3), 'Neutral' (4 - 6), and 'Agree' (7-10).

The Small Business offering encourages small business customers to consider early retirement of inefficient lighting products. Without the offering, nearly three-quarters (77%) reported they would have upgraded their lighting equipment when it failed. Only 6% of respondents said they would have upgraded their lighting before it failed. Figure 22 shows when respondents would have upgraded their lighting equipment had the Small Business offering not been available.

Figure 24. Upgrading Lighting Products in the Absence of the Small Business Offering (n=124)



2.4 Building Operator Certification Offering

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

Table 21. 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		✓

In 2018, MEEA offered a Level I course in AIC territory from early October through the end of November and a Level II course from late October through December. In total, eight students completed the Level I course, and four completed the Level II course. Participants included facilities staff from universities, school districts, town governments, industrial facilities, and religious organizations.

As part of the 2019 evaluation, the evaluation team conducted two process related research efforts, a more comprehensive process evaluation of the BOC offering, and a lessons learned review based on the evaluation approach employed for the offering. Each are presented below and also available on the SAG website.[31] [32]

2.4.1 Building Operator Certification Evaluation Lessons Learned Memo

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,

[31] https://ilsag.s3.amazonaws.com/AIC-2019-BOC-Lessons-Learned-Memo-Final-2020-08-24.pdf
[32] https://ilsag.s3.amazonaws.com/AIC-2019-BOC-Initiative-Process-Report-FINAL-2020-10-20.pdf

and a retrospective assessment of our evaluation approach.[33] 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.

Offering 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 20). 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 reimbursement upon completion of the course ($500 to put toward the total cost of $1,400) to incentivize participation.

Table 22. 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

[33] 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.

As Table 20 illustrates, the BOC Trainings cover many topics and participants may identify a variety of opportunities to improve their facilities. Table 21 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.[34]

Table 23. 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				
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									

[34] 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
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				
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

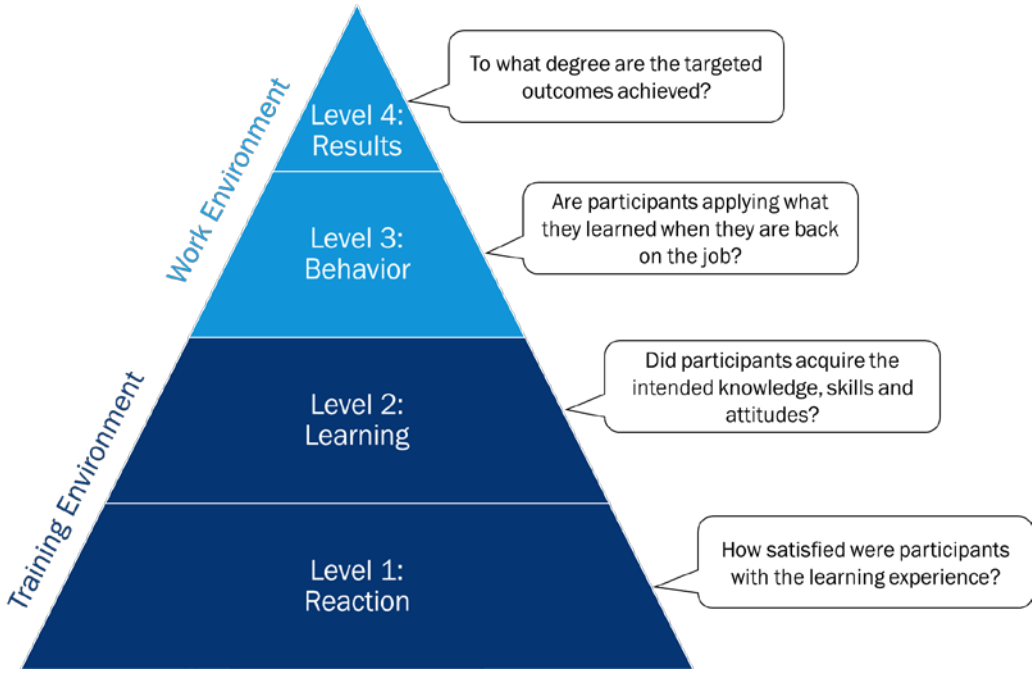
The objective of our evaluation was to measure the energy savings attributable to the 2018 BOC Training. To do so, we developed and employed an evaluation approach based on Kirkpatrick's framework of adult training evaluation which is described in more detail in the Detailed Methodology Section. Kirkpatrick's 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 23, 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 25. Kirkpatrick Model



To measure the four levels of learning, we conducted several research activities targeted at specific stages of the training process (see Table 22Table 22), 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.[35]

Table 22 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 24. 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 23 shows, participation in later critical data collection activities was low. While we expected minor attrition between research activities, we felt

[35] 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.

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.

Table 25. 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.

2.4.2 Building Operator Certification Process Evaluation Report

Introduction

This report presents the evaluation team's process findings from the 2019 evaluation of the 2018 Building Operator Certification (BOC) Training.[36] These findings are meant to accompany the impact results presented in the 2019 impact evaluation report. As noted in the impact report, we leveraged an innovative approach to quantifying impacts for the BOC 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. To do so, we conducted several research activities that allowed us to evaluate the training based on Kirkpatrick's Four-Level Training Model--the gold standard for evaluating adult training interventions. This framework evaluates trainings on four levels: (1) Reaction, (2) Learning, (3) Behavior, and (4) Results. Since the process and impact activities are intertwined in this evaluation approach, we have also included impact results in this report with the goal of illustrating the connections between each of Kirkpatrick's four levels and to demonstrate how a positive training experience can ultimately result in energy savings.

Kirkpatrick's Levels

The following sections provide detailed results for the assessment of each of Kirkpatrick's four levels.

Reaction and Learning

This section includes the results of the evaluation team's analysis of Kirkpatrick's first two levels as they relate to the BOC Training: Reaction and Learning. We present the results of the BOC Level I and Level II courses separately.

Level I Course

Overall, the BOC Level I course participants reported positive reactions to the course. Each participant was asked to complete an "exit survey" after each class to evaluate the instructor, content, and overall usefulness of the class. For each class, the participants reported high ratings for all the components (Table 24). Additionally, all respondents reported the course was a valuable use of their time (n=5), and nearly all respondents reported they would recommend each of the classes to others in their network. Notably, four participants reported their company would make equipment purchase decisions within the next two years (n=5), with two reporting that such decisions would take place within the next six months. However, just two respondents said they planned to start energy efficiency projects at their facility in the near future (n=5).

[36] Given that most large commercial projects have very long lead times, we designed this process to calculate the 2019 BOC Training evaluation 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.

Table 26. BOC Level I Course Exit Survey Results

Question	Average Rating for Each Class							
	1001 n=9	1002 n=8	1003 n=9	1004 n=9	1005 n=8	1006 n=7	1007 n=6	All Classes
How would you rate the instructor's time management?[a]	4.89	4.13	4.33	4.89	4.63	4.43	4.83	4.59
How would you rate the instructor's organization?[a]	4.67	4.38	4.33	4.89	4.63	4.43	5.00	4.62
How would you rate the instructor's clarity?[a]	4.78	4.25	3.78	4.78	4.88	4.29	5.00	4.53
How would you rate the instructor's in-class exercises?[a]	4.67	4.38	4.00	4.89	4.75	4.43	4.80	4.56
How would you rate the opportunity for questions?[a]	4.89	4.38	4.33	4.89	4.75	4.43	5.00	4.67
In general, how useful was today's BOC class?[b]	4.89	4.13	4.22	4.89	4.63	4.14	4.83	4.53
How much of the information presented was new?[c]	3.67	4.38	4.11	3.78	3.88	4.00	4.67	4.07
How would you rate the technical level of the content presented?[d]	3.11	3.38	3.33	3.11	3.00	3.29	3.50	3.25
Do you feel that today's course provided proper instruction and preparation to complete the on-site project (homework)?[e]	4.38	4.75	4.00	4.38	4.57	N/A	N/A	4.41
To what extent do you think this course information will increase the likeliness that you/your company will purchase energy-efficient equipment or energy efficiency practices in the future?[f]	3.75	4.25	3.86	3.88	4.29	4.00	4.40	4.06

[a] Scale of 1 to 5, where 1 = “Needs improvement” and 5 = “Excellent”

[b] Scale of 1 to 5, where 1 = “Not useful”, 3 = “Somewhat useful”, and 5 = “Useful”

[c] Scale of 1 to 5, where 1 = “None”, 3 = “Some”, and 5 = “All”

[d] Scale of 1 to 5, where 1 = “Too basic”, 3 = “Comprehensive”, and 5 = “Too technical”

[e] Scale of 1 to 5, where 1 = “No”, 3 = “Maybe”, and 5 = “Yes”

[f] Scale of 1 to 5, where 1 = “Very unlikely” and 5 = “Very likely”

The evaluation team also completed interviews with each of the participants following the completion of the course. Table 25 contains the detailed results of these interviews. Overall, participants reported they were impressed by the instructors and pleased with the content covered in the classes. Participants noted that the course covered a lot of material in a short amount of time which sometimes made it difficult to digest all the information. Some participants also reported it was difficult to complete the course and homework assignments on top of the responsibilities of their jobs. However, participants noted the homework assignments were useful because they had to apply the course material in a practical way that helped them gain a deeper understanding of the material. Participants also felt the value of the course was worth the challenging workload. Based on the results of the exit surveys and interviews, the evaluation team found that the BOC Level I course successfully addressed Kirkpatrick’s first level (Reaction).

Table 27. BOC Level I Course Interview Results

Component	Participant Experience
Schedule and Pace	▪ Participants noted that the course covered a lot of content in a short amount of time, and classes moved fast so you had to be sure to keep up. ▪ Some participants found completing the course and homework assignments on top of a full-time job to be a lot of work. One participant suggested having previous participants spread the word about the value of the course, which they perceived to be extremely useful, relative to the workload. They felt this would encourage future participants to overcome the perception that the course is "too much work".

Component	Participant Experience
	▪ Two participants suggested that the course be spread out over a longer timeframe to allow more time to digest the materials and complete the homework assignments. Another participant suggested that each class be broken out into two days per week to allow for more time to digest. ▪ One participant suggested that BOC 1007 "Facility Electrical Systems" should have been held earlier in the course. They felt the content overlapped with the other topics, which all seemed to relate in one way or another to electricity. They also suggested that BOC 1005 "Indoor Environmental Quality" be combined with another class because there was not much content to cover in the 1005 class.
Homework and Tests	▪ Participants found the homework assignments to be time-consuming but useful and worthwhile in bringing the coursework to life and making participants think about the coursework in relation to their facilities. ▪ Participants had mixed reactions to the tests. Two found the tests to be stressful and tricky. One liked that the tests reiterated the key material covered each day. Another took a more neutral stance but felt that the homework assignments were generally more useful than the testing.
Content	▪ Participants said they picked up new ideas, and/or were reminded of concepts they had heard before but had not thought about in a while. ▪ Participants generally felt the content was the right technical level for them. Multiple participants noted entering the class with a base knowledge of the concepts discussed is critical. They felt someone without any experience would struggle to comprehend some of the concepts, and result in wasted money for AIC. ▪ One of the participants who was in a managerial position noted that they did not have hands-on experience with the technical tasks discussed during the course, and instead managed a team of technicians. Because they were not able to go back to their facility and directly apply the course learnings through hands-on-work, some of the content was a bit more challenging for them to digest compared to other participants. On the one hand, they wished there was more of a managerial component to the course, but on the other, they felt they walked away from the course better able to converse with their team about tasks.
Instructors	▪ Participants were impressed by the quality of the instructors who they felt were invaluable to the success of the course. ▪ Participants were impressed by the experience and knowledge of the instructors. They also found instructors to be relatable, and good at helping them digest the course materials by sharing relevant real-world examples. ▪ Participants described instructors as involved and were impressed that instructors offered their phone numbers to the class in the event anyone had questions after the course. A few participants took the instructors up on this offer. ▪ Two participants mentioned that one of the instructors was not very good. This instructor mainly read from his PowerPoint presentation and talked about their own experience, but in a way that was difficult to apply to multiple scenarios. Because everyone in the class came from different industries, sharing experiences that were applicable to a myriad of scenarios seemed to be important to participants.
Other Participants	▪ Participants described their classmates as a diverse group, with participants coming from different industries. They also found their classmates to be engaged in the material.
Miscellaneous	▪ One participant mentioned that the instructors' coursebook appeared to be a bit outdated and did not always match the content in the participant book. ▪ One participant mentioned that there were a few technical difficulties with equipment which prevented the class from starting on time. ▪ One participant mentioned an interest in additional content on water, geothermal, and solar.

This positive learning experience translated to strong performance on the course assignments. Average exam scores for each of the classes generally fell in the mid-to-high eighties; performance on the projects was slightly

better (Table 26). Notably, the average score on the pre-assessment fielded by MEEA at the beginning of the first class was a 74 (n=6).

Table 28. BOC Level I Course Average Exam and Project Grades

Class	Topic	Average Exam Grade	Average Project Grade
1001A	Energy-Efficient Operation of Building HVAC Systems	88.9	88.6
1001B		85.0	
1002	Measuring and Benchmarking Energy Performance	83.3	87.4
1003	Efficient Lighting Fundamentals	86.1	94.8
1004	HVAC Control Fundamentals	87.8	86.7
1005	Indoor Environmental Quality	95.6	100.0
1006	Common Opportunities for Low-Cost Operational Improvement	81.7	N/A
1007	Facility Electrical Systems	N/A	N/A

[a] N/A indicates the class did not include this assignment.

Participants also reported in the interviews that they learned new concepts in the course about how to operate their buildings better. Additionally, participants noted the course reviewed important base concepts, which refreshed participants' memories on key information. One participant mentioned they had never heard of scheduling HVAC equipment to match building occupancy until attending the BOC Training. This participant said they made alterations to their HVAC programming during the course. They also were coordinating with departments in their building to understand when staff are typically in the building to assist in matching system scheduling to building activity. A different participant said they learned about the benefits of staggering start times for different components of their HVAC system. They implemented this practice in their facility to limit demand charges. This participant also installed variable speed drives (VSDs) on blowers to assist with limiting run times. The participant said these changes were a direct result of the BOC Training. A third participant altered an existing lighting project based on learnings from the training. This participant was in the process of converting lighting in a school gymnasium and auditorium to LEDs. They insisted on adding occupancy sensors to the new fixtures based on learnings about arc flash—electrical explosions that can lead to serious injuries. Students and faculty had become accustomed to manually turning breakers on and off in these spaces to turn on lighting, which can result in arc flash. The participant wanted to eliminate this practice by installing occupancy sensors and locking breaker boxes. The same participant also gained a greater understanding of how to optimize the programming of HVAC equipment using a Building Management System (BMS). This allowed the participant to provide their staff with more detailed feedback and assistance about building conditions. Based on the feedback provided in the interviews and the average grades for the exams and projects, the evaluation team found that the BOC Level I course successfully addressed Kirkpatrick's second level (Learning).

"IT WAS REALLY AN EYE-OPENING EXPERIENCE FOR ME, BECAUSE NOW I CAN HAVE NOTEWORTHY CONVERSATIONS WITH OUR MAINTENANCE GUYS AND WITH OUR HEAD DAY CUSTODIANS WHO CONTROL THOSE SYSTEMS. IF IT'S TOO HOT, [I CAN ASK] 'HOW MUCH OUTSIDE AIR ARE YOU BRINGING IN?' 'WHAT PERCENTAGE IS YOUR DAMPER OPENING FOR OUTSIDE AIR?' 'WHAT ABOUT THE DAMPER FOR MIXED AIR?'…THERE'S JUST SO MANY THINGS THAT I NOW UNDERSTAND" – PARTICIPANT

Level II Course

The BOC Level II course participants also reported positive reactions to their course. For each class, the participants reported high ratings for all components covered in the exit surveys (Table 27 and Table 28).[37] Additionally, all respondents reported they would recommend each of the classes to others in their network.

Table 29. BOC Level II Course Exit Survey Results – Classes 202, 214, and 216

Question	Average Rating for Each Class			
	202 n=4	214 n=4	216 n=4	All Classes
How would you rate the instructor's time management?[a]	5.00	4.75	4.75	4.83
How would you rate the instructor's organization?[a]	5.00	4.75	4.75	4.83
How would you rate the instructor's clarity?[a]	5.00	4.75	4.50	4.75
How would you rate the instructor's in-class exercises?[a]	5.00	4.50	4.75	4.75
How would you rate the opportunity for questions?[a]	5.00	4.75	4.75	4.83
In general, how useful was today's BOC class?[b]	5.00	4.50	3.75	4.42
How much of the information presented was new?[c]	3.50	3.75	3.25	3.50
How would you rate the technical level of the content presented?[d]	3.00	3.00	3.00	3.00
Do you feel that today's course provided proper instruction and preparation to complete the on-site project (homework)?[e]	5.00	4.75	5.00	4.92
To what extent do you think this course information will increase the likeliness that you/your company will purchase energy-efficient equipment or energy efficiency practices in the future?[f]	3.50	3.75	2.75	3.33

[a] Scale of 1 to 5, where 1 = "Needs Improvement" and 5 = "Excellent"

[b] Scale of 1 to 5, where 1 = "Not useful", 3 = "Somewhat useful", and 5 = "Useful"

[c] Scale of 1 to 5, where 1 = "None", 3 = "Some", and 5 = "All"

[d] Scale of 1 to 5, where 1 = "Too basic", 3 = "Comprehensive", and 5 = "Too Technical"

[e] Scale of 1 to 5, where 1 = "No", 3 = "Maybe", and 5 = "Yes"

[f] Scale of 1 to 5, where 1 = "Very unlikely" and 5 = "Very likely"

Table 30. BOC Level II Course Exit Survey Results – Classes 2001A, 2001B, and 2002

Question	Average Rating for Each Class			
	2001A n=4	2001B n=4	2002 n=4	All Classes
In general, how useful was today's BOC class?[a]	8.75	8.5	9.25	8.83
How much of the information presented was new?[b]	7.5	8.5	7.25	7.75
How would you rate the technical level of the content presented?[c]	6.75	6.25	5.5	6.17
Do you feel that you can complete the on-site project based on today's presentation?[d]	7.5	9.25	9.5	8.75

[a] Scale of 1 to 10, where 1 = "Not Useful", 4 = "Somewhat Useful", 7 = "Useful", and 10 = "Very Useful"

[b] Scale of 1 to 10, where 1 = "None" and 10 = "All"

[c] Scale of 1 to 10, where 1 = "Too Basic", 5 = "About Right", and 10 = "Too Technical"

[d] Scale of 1 to 10, where 1 = "No" and 10 = "Yes"

[37] Two different exit survey forms were used in the BOC Level II classes. Classes 202, 214, and 216 used one form and classes 2001A, 2001B, and 2002 used a different form.

In addition to the responses shown in Table 28, all respondents agreed or strongly agreed that the instructional methods used by the instructors of classes 2001A, 2001B, and 2002 were effective at conveying key material, the instructors were well prepared, and the pace of the course was adequate.

Table 29 contains detailed results from the interviews we completed with BOC Level II course participants. Similar to the BOC Level I course, Level II course participants felt the instructors were experienced and knowledgeable. They also felt the course sequencing was effective, and the tests helped to reinforce the key material from each class. Further, participants were pleased with the technical level of the material and noted the course included a good balance of new material and review of familiar concepts. One participant felt two classes on consecutive days to begin the course produced a challenging workload. However, the other participants felt the pacing of individual classes worked well. Based on the results of the exit surveys and interviews, the evaluation team found that the BOC Level II course successfully addressed Kirkpatrick's first level (Reaction).

Table 31. BOC Level II Course Interview Results

Component	Participant Experience
Schedule and Pace	▪ Participants generally felt the pace and class sequencing worked well. ▪ One participant did not like how the first two classes were back to back. They found that starting the course out with a heavy load and without a weekend in between to work on assignments (back to back homework assignments, plus an additional MEEA assignment) was frustrating. Others did not share this sentiment, stating they thought the structure worked fine. One participant liked having the first two classes back to back because it meant the back end of the course was a bit lighter.
Homework and Tests	▪ Participants did not have strong feelings about the homework assignments or tests. ▪ Participants thought the homework assignments were fine, and the tests helped reinforce the class content each day. One participant felt that a debriefing discussion at the end of each class to make sure everyone understood the main points would have been more effective than a test.
Content	▪ Participants said the content was a mix of review and new content and, in general, the right technical level. The content was most useful in providing a high-level view of systems, which allowed participants to have more informed conversations with team members and contractors.
Instructors	▪ Participants were impressed by the quality of the instructors; specifically, their experience and knowledge. The participants noted the instructors were invaluable to the success of the course. ▪ Participants also found the instructors to be relatable and good at helping them digest the course materials by sharing relevant real-world examples. ▪ Participants described instructors as involved and were impressed that instructors offered their phone numbers to the class in the event anyone had questions after the course. A few participants took the instructors up on this offer.
Other Participants	▪ Participants described their classmates as a diverse group, with participants coming from different industries. They also found their classmates to be engaged in the material. ▪ Participants liked the small size of the class which produced an informal teaching environment and inspired discussion among the group. This was notable for some who had taken the BOC Level I course with a much larger class size which included participants who did not appear to be engaged in the material.
Miscellaneous	▪ One participant mentioned that the course materials (specifically around controls) were a bit dated, but the instructors made up for this by clarifying outdated material and providing feedback on updates.

The average exam score for most of the Level II classes was in the low nineties, and performance on the projects was even better (Table 30). These results indicate that the participants understood the material presented in each class and successfully applied the material in a practical context.

Table 32. BOC Level II Course Average Exam and Project Grades

Class	Topic	Average Exam Grade	Average Project Grade
2001A	Building Scoping for Operational Improvements	85.0	93.3
2001B		93.8	95.8
2002	Optimizing HVAC Controls for Operational Improvements	91.3	100.0
201	Preventative Maintenance & Troubleshooting Principles	95.0	N/A
202	Advanced Electrical System Diagnostics	96.3	100.0
214	Building Commissioning	91.3	N/A
216	Enhanced Automation and Demand Reduction	90.0	N/A

[a] N/A indicates the class did not include this assignment.

The feedback shared in the participant interviews also indicate the BOC Training resulted in successful learning outcomes. One participant learned that the BMS utilized at their facility lacked functionality typically included in newer systems; such as the ability to compare current usage to historical usage and develop consumption trends. This participant planned to speak with decision-makers about implementing a new system. Another participant felt the most important learning they took away from the training was an understanding of the benefits to implementing regular maintenance schedules. They planned to develop a consistent maintenance schedule and utilize opportunities when buildings are empty to complete detailed equipment checks. A third participant planned to take an in-depth look at equipment scheduling to try and reduce energy consumption and reduce the load on equipment. Based on these results, the evaluation team found that the BOC Level II course successfully addressed Kirkpatrick's second level (Learning).

"[I AM] DEFINITELY BEING MORE ENERGY EFFICIENT MINDED AS FAR AS WHEN WE NEED TO RUN EQUIPMENT AND WHEN WE DON'T. [I CAME AWAY WITH] NEW IDEAS ON HOW WE CAN SCHEDULE OUR EQUIPMENT MORE EFFICIENTLY SO THAT WE CAN SAVE ON EQUIPMENT LIFE AND SAVE ENERGY FOR THE COMPANY. YOU KNOW, 'WHAT LIGHTING REALLY TRULY HAS TO BE ON AND WHAT CAN WE SHUT OFF AT NIGHT?', THINGS OF THAT NATURE." – PARTICIPANT

Behavior and Results

This section includes the results of the evaluation team's analysis of Kirkpatrick's third and fourth levels as they relate to the BOC Training: Behavior and Results. The results of the BOC Level I and Level II courses are presented separately.

Level I Course

Two Level I course participants (n=6) reported in the interviews that they made changes to their building operations during the training, including adding insulation to ductwork, staggering ramp-up schedules for blowers and motors, and matching HVAC scheduling to building occupancy. Both participants mentioned these were new concepts that they learned about in the BOC Training.

All but one respondent reported that they planned to make energy-saving changes in the future based on what they learned in the training. These changes ranged from minor adjustments like modifying the use of economizers on air-handling units, installing programmable thermostats, refining HVAC scheduling, and performing maintenance on boilers, to more intensive efforts like implementing a new preventative maintenance plan, installing a BMS, converting current lighting to LEDs, replacing blower units, and retro-commissioning an entire facility.

Four of the six participants that completed interviews also completed the post-course savings survey. These respondents reported making several changes to their facilities following the BOC Training, including lighting replacements, installation of VSDs, motor replacements, scheduling and maintenance of HVAC equipment and a boiler replacement. These results indicate the BOC Training successfully resulted in targeted behavior changes (Kirkpatrick's third level). Importantly, these respondents reported that the BOC Training was one of several important factors that influenced their decision to take these energy-saving actions. As is typical for large commercial facilities, decision-makers plan building upgrades well in advance of execution and weigh a range of factors when considering whether to move forward with a major capital improvement.

On average, respondents rated the likelihood they would have taken the action in the absence of the training as an 8 out of 10, where 0= "definitely would not have taken the action" and 10= "definitely would have taken the action." Still, respondents reported that the BOC Training was very important when planning their energy-saving changes. On average, respondents rated the importance of the BOC Training as an 8.5 out of 10, where 0 equated to "very little importance and 10 equated to "a great deal of importance." Further, respondents allocated an average of 64 out of 100 "points of influence" to the BOC Training when considering all factors that influenced their decision to implement energy-saving changes. Expectedly, the respondents reported that other non-program factors were influential in their decision-making process as well—e.g., respondents most commonly cited sustainability initiatives, financial benefits, and increasing occupant comfort as influential factors (Table 31).

Table 33. Influence of Non-BOC Factors on Decision to Take Energy-Saving Actions

Factor	Post-Course Survey Respondents			
	Total	Influence Score[a]		
		0-3	4-6	7-10
Company commitment to going green	3	0	0	3
Reducing operating costs	3	0	0	3
Rate of return	3	0	0	3
Increased comfort	3	0	0	3
Employee, customer or student complaints	3	1	0	2
Other	2	0	1	1

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

The energy-saving actions the participants completed following the BOC Training resulted in energy savings (Table 32). Notably, the evaluation team removed savings associated with projects that participants completed through other AIC initiatives. Given the participants allocated an average of 64 out of 100 points of influence to the BOC Training and 36 to all other factors when considering their decision to take energy-saving actions in addition to the other data reviewed above, the evaluation team believes there is a large amount of evidence to suggest that BOC training was influential. The evaluation team attributed savings not claimed by other AIC initiatives to the BOC Training as level four results under Kirkpatrick's framework.

Table 34. 2019 BOC Level I Course Energy Savings by Enduse

Enduse Category	Descriptions	Verified Net Savings (MWh)	Verified Net Savings (MW)	Verified Net Savings (Therms)
Cooling tower optimization	VSDs on chiller cooling tower	109	0.021	0
Boiler/hot water/steam system	High-efficiency boiler	65	0.000	16,219

Enduse Category	Descriptions	Verified Net Savings (MWh)	Verified Net Savings (MW)	Verified Net Savings (Therms)
Lighting	Occupancy sensors, LED exit signs, bi-level stairwell fixtures, LED installations	49	0.016	0
Chiller/chilled water system	VSDs on chiller loops, condensate pumps, and chillers	9	0.002	0
Economizer and ventilation controls	Economizer repair and optimization	3	0.000	0
Water pump optimization	Pump replacements	3	0.000	0
Package/Split-System HVAC Changes	High-efficiency motor switch-outs	1	0.000	0
HVAC equipment scheduling or space temperature	Equipment scheduling, occupancy-based scheduling	0	0.000	808
Domestic hot water	Low-flow faucets	0	0.000	37
Total		**238**	**0.039**	**17,063**

Level II Course

One Level II course participant (N=4) reported in their interview that they made changes to equipment scheduling during the training; this was a new concept for the participant. Three respondents reported they planned to make energy-saving changes in the future based on what they learned in the training. These changes included upgrading/replacing boilers, implementation of preventative maintenance plans, changing equipment scheduling, implementation of a new BMS, and altering operation of air handler units based on weather conditions.

Just one participant that completed an interview also completed the post-course savings survey. As such, the following results should be interpreted accordingly. This respondent reported making several changes to their facilities following the BOC Training, including lighting retrofits, replacement of a water heater, and changes to HVAC scheduling. Based on these changes reported by the one respondent to the survey, as well as the planned changes reported by other participants in the interviews, the evaluation team determined the Level II training successfully resulted in targeted behavior changes (Kirkpatrick's third level).

The participant that completed the post-course savings survey reported the BOC Training was an important influence in their decision to take the energy-saving actions following the training; though, they placed less weight in the training than the Level I course participants. The participant indicated they likely would have moved forward with two of the three energy-saving actions had they not attended the BOC Training. On a scale of 0 to 10, where 0= "definitely would not have taken the action" and 10= "definitely would have taken the action", they reported an average rating of 7.3 out of 10 for the likelihood they would have made the changes in absence of the training. Additionally, the respondent provided an average rating of 1.3 (on a scale of 0 to 10, where 0 equated to "very little importance and 10 equated to "a great deal of importance") when evaluating the importance of the BOC Training on their decision to take the energy-saving actions. Notably, the respondent allocated an average of 30 out of 100 "points of influence" to the BOC Training when considering all influencing factors in their decision to make energy-saving changes. Table 33 includes information on additional factors that influenced the participant's decisions to take the energy-saving actions.

Table 35. Influence of Non-BOC Factors on Decision to Take Energy-Saving Actions

Factor	Post-Course Survey Respondents			
	Total	Influence Score[a]		
		0-3	4-6	7-10
Company commitment to going green	1	0	0	1
Reducing operating costs	1	0	1	0
Rate of return	1	1	0	0
Increased comfort	1	1	0	0
Employee, customer or student complaints	1	1	0	0

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

The energy-saving actions the participant took following the training resulted in energy savings (Table 34). As with Level I course participants, the evaluation team removed savings associated with projects the participant completed through other AIC initiatives. The evaluation team deemed the remaining savings attributable to the BOC training as level four results under Kirkpatrick's framework. While the participant reported less influence from the BOC training than Level I course participants, they provided an average of 30 out of 100 points of influence to the training. They also rated all other influencing factors as a 0 or 1 on a 0-10 scale, with the exception of organizational sustainability initiatives (8/10) and desire to cut operating expenses (4/10). Given these savings are not claimed through other AIC initiatives and the training was a driving factor in making the energy-saving changes, we felt comfortable attributing the savings to BOC.

Table 36. 2019 BOC Level II Course Energy Savings by Enduse

Enduse Category	Descriptions	Verified Net Savings (MWh)	Verified Net Savings (MW)	Verified Net Savings (Therms)
Lighting	LED installations	79	0.019	0
HVAC equipment scheduling or space temperature	Equipment scheduling	4	0.006	716
Domestic hot water	Water heater replacement	0	0.000	297
Total		**84**	**0.025**	**1,013**

Case Studies

To investigate the connection between Kirkpatrick's four levels on a more granular level, the evaluation team took a deeper look at the data collection results for three participants who represent the majority of the energy savings claimed for the BOC Training. The following sections include the results of this analysis.

School District

Building Description

One of the participants from the Level I course was a Facilities Manager for a local school district. The participant provided information on three of their largest buildings in the baseline O&M survey.[38] The facilities ranged in size from 150,000 to 300,000 square feet and typical occupancy ranged from 900-2,300 people

[38] The evaluation team captured energy-saving actions related to additional facilities during onsite verification activities which are included in the impact analysis.

per day. Two of the facilities were in operation 24 hours a day during the school week and 8-12 hours on the weekend. The third facility was in operation for 18 hours a day during the school week and two hours on the weekend. All three buildings utilized natural gas boilers for space heating and chillers for space cooling though one facility was in the process of converting part of the space heating load to a geothermal system.

Energy-Saving Actions

The participant reported taking several energy-saving actions following completion of the BOC Level I course, including a boiler replacement, changes to HVAC scheduling, and installation of LED lighting and occupancy sensors. The participant installed the occupancy sensors as a direct result of what they learned in the BOC Training. The participant was already working with a contractor to convert lighting in a gymnasium and auditorium to LED fixtures. The participant added occupancy sensors to the scope of the lighting projects because faculty and other staff were in the habit of using breaker boxes to turn lights on and off in these spaces manually; a practice that can lead to arc flash. The participant learned about the dangers of arc flash in the BOC training and adjusted the scope of the lighting projects to include occupancy sensors to eliminate the need to turn breakers on and off manually and to avoid the risk of arc flash.

The participant also mentioned they learned useful information about their BMS and how to operate their HVAC system more efficiently. This allowed the participant to have more informed conversations with their maintenance team and day custodians who handle the day-to-day operations to manage those systems more efficiently. Specifically, the participant mentioned one of the homework assignments prompted them to take a deep look at the heating zones of one of their buildings, the occupancy of those zones, and the schedules for the air handler units in each zone. As Table 35 indicates, the participant applied these learnings and changed the scheduling on air handler units to match building occupancy. This participant received an average score of 98.2 on the course homework assignments and 85 on course exams. It is clear from these results that the participant understood the material well and directly implemented what they learned in their facilities.

Table 37. Post-Series Energy-Saving Actions Reported by Participant

Enduse Category	Action	Related Course
Boiler/hot water/steam system	Replace existing boilers with new high-efficiency boilers	BOC 1001
HVAC equipment scheduling or space temperature	Schedule optimum starts for AHU system	BOC 1001
	Match AHU schedule to space occupancy	
	Schedule fan-powered/VAV boxes	
Lighting	Install occupancy sensors	BOC 1003
	Replace T12, T8, or T5 fluorescents with LED lighting	
	Replace HID fixtures with LED technology	
	Replace incandescent or CFL exit signs with LED exit signs (not in baseline)	

Program Influence

The evaluation team uncovered many of the post-course changes included in Table 35 during the on-site visit rather than the post-course savings survey. Therefore, we did not collect information on how the BOC Training influenced the lighting conversions or boiler replacement. We do have this information for the HVAC scheduling changes, however. Considering all of the factors that influenced their decision to improve their HVAC scheduling, the participant allocated 40 out of a total of 100 influence points to the BOC Training. They indicated they likely would have implemented these changes without attending the training (10 out of 10 - definitely would have taken the action). However, they also rated the importance of the BOC Training as a 10

out of 10 (a great deal of importance). Based on this feedback, it is clear the BOC Training played a large role in the participant executing these changes.

Savings

Table 36 includes a summary of the savings resulting from the post-course changes the participant made.

Table 38. Energy Savings Claimed for Participant

Verified Net Savings		
Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
227	0.035	16,219

Religious Organization

Building Description

Another Level I participant was a Facilities Manager for a religious organization. This participant managed a single 77,000 square foot facility that typically operated for 10 hours a day during the week and 4-6 hours a day on the weekends. The average daily occupancy for the space was 25-50 people. The facility utilized natural gas boilers for space heating and chillers for space cooling.

Energy-Saving Actions

The participant reported taking several energy-saving actions following completion of the BOC Level I course, including domestic hot water upgrades, changes to HVAC scheduling, and water pump related adjustments. The participant specifically mentioned in their interview that the training covered new information related to HVAC systems that they were not aware of before the training. The participant felt they extracted the most value from this material. As Table 37 indicates, most of the energy-saving actions the participant took were related to HVAC scheduling. This material was mostly covered in the 1001 and 1006 classes. The 1001 class covered optimization of boiler operations, and the 1006 class covered equipment scheduling and strategies for identifying and reducing simultaneous heating and cooling. As the table shows, the participant took actions directly related to these topics. Additionally, the projects following the 1004 and 1005 classes also related to HVAC equipment scheduling. For the 1004 project, participants were tasked with identifying controls for their HVAC system and assessing the operation of the controlled equipment. For the 1005 project, students developed an occupancy schedule for their facility. The participant scored an 85 and 100 on these projects, respectively, indicating they understood the material well. As a result, it is not surprising they took actions to modify the controls on their system and to match scheduling to building occupancy.

Table 39. Post-Series Energy-Saving Actions Reported by Participant

Enduse Category	Action	Related Course
DHW	Install low-flow faucets	BOC 1002
HVAC System Equipment Scheduling or Space Temperature Changes	Match AHU schedule to space occupancy	BOC 1001
	Schedule boilers	
	Reset supply air temperature	BOC 1006
	Reduce simultaneous heating and cooling	
	Replace failed VAV box	BOC 1001

Enduse Category	Action	Related Course
Water Pump Optimization Changes	Adjust the freeze protection sequence for pumps	BOC 1006
	Replace failed pumps	

Program Influence

This participant reported that the BOC Training was a factor in their decision to take the energy-saving actions included in Table 37, particularly the HVAC scheduling and water pump changes. While they reported they likely would have implemented the changes if they did not complete the BOC Training (7.3 out of 10), they also rated the importance of the BOC Training as an 8 out of 10 (on average) and allocated an average of 63 out of 100 "points of influence" to the BOC Training when considering all influencing factors in their decision to make these energy-saving changes. Based on this feedback, it is clear the BOC Training played an important role in the participant executing these changes.

Savings

Table 38 includes a summary of the savings resulting from all the post-course changes the participant made.

Table 40. Energy Savings Claimed for Participant

Verified Net Savings		
Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
3	0.000	844

University

Building Description

One participant in the Level II course was a Maintenance Mechanic for a local college. The participant provided information on three of the largest buildings on campus, ranging in size from 20,000--60,000 square feet. The participant estimated the typical occupancy for these buildings ranged from 350-750 people per day. All three of the buildings were in operation 24 hours a day, seven days a week. Additionally, all three buildings utilized packaged units for space cooling needs. However, each building employed a different type of heating system; one building used a natural gas heat pump, another had electric room heaters, and the third had a natural gas furnace.

Energy-Saving Actions

The participant reported taking several energy-saving actions following completion of the BOC Level II course, including domestic hot water upgrades, changes to HVAC scheduling, and LED installations. As Table 39 indicates, class 2002 discussed how to optimize operation of HVAC systems through use of controls. The participant received a perfect score on both the exam and project for this course. For the project, students were tasked with writing a sequence of operation for air handlers in one of their buildings, as well as a test procedure for verifying proper operation of the sequence of operation. The participant was able to implement these learnings in their facility and noted in their interview they were working with their BMS to optimize equipment scheduling. In addition to the HVAC control changes, the participant mentioned their organization would likely begin to convert the fluorescent lighting in their facility to LEDs; an action they followed through with. Notably, this participant completed the Level I course prior to taking the Level II course. We do not have

information on how the participant performed in that course, but we do know they would have learned about the benefits of converting to efficient lighting, optimizing HVAC equipment scheduling, and low-cost opportunities to improve operational efficiency such as installing efficient showerheads.

Table 41. Post-Series Energy-Saving Actions Reported by Participant[a]

Enduse Category	Action	Related Course
DHW	Install showerheads	BOC 1002
	Direct-fired water heater replacement	N/A
HVAC System Equipment Scheduling or Space Temperature Changes	Schedule boilers	BOC 1001/BOC 2002
	Schedule heaters	
Lighting	Replace T12, T8, or T5 fluorescents with LED lighting	BOC 1003
	Replace HID fixtures with LED technology	
	Replace incandescent or CFL exit signs with LED exit signs	
	Replace incandescent lamps or CFLs with LEDs	

[a] This participant completed the Level I course prior to the Level II. Therefore, we included both Level I and Level II related courses.

[b] N/A means the action is not specifically covered in a BOC class.

Program Influence

This participant reported that the BOC Training was a factor in their decision to take the energy-saving actions included in Table 39, particularly the HVAC scheduling changes. While the participant indicated they likely would have implemented the changes if they did not complete the BOC Training (7.3/10), they also indicated the BOC Training was an important factor in their decision to move forward, allocating an average of 30 out of 100 "points of influence" to the BOC Training when considering all influencing factors in their decision to implement the energy-savings changes. The participant noted in their interview that there are other decision makers in the department that plan larger energy-related projects. Therefore, it makes sense the participant felt the BOC Training did not have much influence on the lighting and hot water changes; but had the most impact on changes to HVAC scheduling. The daily management of the building automation system is likely a day-to-day task of this participant, whereas planning larger projects is the responsibility of other decision-makers.

Savings

Table 40 includes a summary of the savings resulting from the post-course changes the participant made.

Table 42. Energy Savings Claimed for Participant

Verified Net Savings		
Energy Savings (MWh)	Demand Savings (MW)	Gas Savings (Therms)
84	0.025	1,013

Evaluation Findings and Recommendations

This section includes the evaluation team's key findings and recommendations based on the results of the 2019 process evaluation.

Participant Satisfaction

Overall, participants in both the Level I and Level II BOC Trainings reported they were very satisfied with the training. All the students were complementary of the instructors and reported they were knowledgeable, helpful, and delivered the content of the course in an effective manner. In terms of the material, participants were pleased with the technical level of the course and felt the course content included a nice balance of review of important concepts and introduction of new information. Table 41 and Table 42 include results from exit surveys that participants completed at the end of each class to evaluate the instructors and content. The results show the participants were very satisfied with the instructors and content.

Table 43. BOC Level I Course Exit Survey Results

Question	Average Rating for Each Class							
	1001	1002	1003	1004	1005	1006	1007	All Classes
	n=9	n=8	n=9	n=9	n=8	n=7	n=6	
How would you rate the instructor's time management?[a]	4.89	4.13	4.33	4.89	4.63	4.43	4.83	4.59
How would you rate the instructor's organization?[a]	4.67	4.38	4.33	4.89	4.63	4.43	5.00	4.62
How would you rate the instructor's clarity?[a]	4.78	4.25	3.78	4.78	4.88	4.29	5.00	4.53
How would you rate the instructor's in-class exercises?[a]	4.67	4.38	4.00	4.89	4.75	4.43	4.80	4.56
How would you rate the opportunity for questions?[a]	4.89	4.38	4.33	4.89	4.75	4.43	5.00	4.67
In general, how useful was today's BOC class?[b]	4.89	4.13	4.22	4.89	4.63	4.14	4.83	4.53
How much of the information presented was new?[c]	3.67	4.38	4.11	3.78	3.88	4.00	4.67	4.07
How would you rate the technical level of the content presented?[d]	3.11	3.38	3.33	3.11	3.00	3.29	3.50	3.25

[a] Scale of 1 to 5, where 1 = "Needs improvement" and 5 = "Excellent"

[b] Scale of 1 to 5, where 1 = "Not useful", 3 = "Somewhat useful", and 5 = "Useful"

[c] Scale of 1 to 5, where 1 = "None", 3 = "Some", and 5 = "All"

[d] Scale of 1 to 5, where 1 = "Too basic", 3 = "Comprehensive", and 5 = "Too technical"

Table 44. BOC Level II Course Exit Survey Results – Classes 202, 214, and 216

Question	Average Rating for Each Class			
	202 n=4	214 n=4	216 n=4	All Classes
How would you rate the instructor's time management?[a]	5.00	4.75	4.75	4.83
How would you rate the instructor's organization?[a]	5.00	4.75	4.75	4.83
How would you rate the instructor's clarity?[a]	5.00	4.75	4.50	4.75
How would you rate the instructor's in-class exercises?[a]	5.00	4.50	4.75	4.75
How would you rate the opportunity for questions?[a]	5.00	4.75	4.75	4.83
In general, how useful was today's BOC class?:[b]	5.00	4.50	3.75	4.42
How much of the information presented was new?[c]	3.50	3.75	3.25	3.50
How would you rate the technical level of the content presented?[d]	3.00	3.00	3.00	3.00

[a] Scale of 1 to 10, where 1 = "Not Useful", 4 = "Somewhat Useful", 7 = "Useful", and 10 = "Very Useful"

[b] Scale of 1 to 10, where 1 = "None" and 10 = "All"

[c] Scale of 1 to 10, where 1 = "Too Basic", 5 = "About Right", and 10 = "Too Technical"

[d] Scale of 1 to 10, where 1 = "No" and 10 = "Yes"

Three Level I participants experienced challenges with the pace of the course. These participants noted the course covers a lot of material in a short amount of time; spreading the course over a longer timeframe would allow students more time to digest the material and complete assignments. Two Level I and one Level II participant mentioned it was difficult to balance the workload from the training with the workload from their job; particularly at the beginning of the course when there are classes on consecutive days and multiple assignments to complete.

Recommendation

Training staff should consider spreading the course over a longer timeframe or altering the schedule of assignments to avoid overburdening students and to provide participants with more time to explore the material.

Participant Learning

This positive learning experience translated to strong performance on the course assignments. Average exam scores for each of the courses generally fell in the mid-eighties to low-nineties; performance on the projects was even better (Table 43 and Table 44). These results indicate that the participants understood the material presented in each class and successfully applied the material in a practical context.

Table 45. BOC Level I Course Average Exam and Project Grades

Class	Topic	Average Exam Grade	Average Project Grade
1001A	Energy-Efficient Operation of Building HVAC Systems	88.9	88.6
1001B		85.0	
1002	Measuring and Benchmarking Energy Performance	83.3	87.4
1003	Efficient Lighting Fundamentals	86.1	94.8
1004	HVAC Control Fundamentals	87.8	86.7
1005	Indoor Environmental Quality	95.6	100.0
1006	Common Opportunities for Low-Cost Operational Improvement	81.7	N/A
1007	Facility Electrical Systems	N/A	N/A

[a] N/A indicates the class did not include this assignment.

Table 46. BOC Level II Course Average Exam and Project Grades

Class	Topic	Average Exam Grade	Average Project Grade
2001A	Building Scoping for Operational Improvements	85.0	93.3
2001B		93.8	95.8
2002	Optimizing HVAC Controls for Operational Improvements	91.3	100.0
201	Preventative Maintenance & Troubleshooting Principles	95.0	N/A
202	Advanced Electrical System Diagnostics	96.3	100.0
214	Building Commissioning	91.3	N/A
216	Enhanced Automation and Demand Reduction	90.0	N/A

[a] N/A indicates the class did not include this assignment.

Five Level I participants and one Level II participant mentioned in their interviews that they learned new concepts in the course about how to operate their buildings more effectively. For example, one Level I participant said they learned about the benefits of staggering start times for different components of their HVAC system. They implemented this practice in their facility to limit demand charges. This participant also installed variable speed drives (VSDs) on blowers to assist with limiting run times. The participant said these changes were a direct result of the BOC Training. One Level II participant learned that the BMS utilized at their facility lacked functionality typically included in newer systems; such as the ability to compare current usage to historical usage and develop consumption trends. This participant planned to speak with decision-makers about implementing a new system.

Recommendation

Participants in both the Level I and Level II courses expressed interest in learning more about building infrastructure, occupant education, renewables, and water efficiency.[39] Training staff may want to explore opportunities to incorporate these topics into the curriculum if possible. One student in the Level I course suggested the indoor air quality course could likely be combined with another topic.

Participant Behavior Change and Energy Savings

It is clear from the feedback that participants learned useful information on how to improve the operation of their facilities during the BOC Trainings. More importantly, the participants applied the new information in their

[39] Water efficiency topics are being added to the BOC Level II training in the Fall of 2020.

facilities. Two Level I participants and one Level II participant reported making energy-saving changes in their facilities during the training, and five participants (four Level I and one Level II) made changes in the year following the training. These energy-saving changes include lighting replacements, alterations to HVAC equipment scheduling, installation of VSDs, and replacement of inefficient equipment (Table 45 and Table 46).

Participants reported the BOC Training was an important driver in making these changes. As is typical for large commercial facilities, decision-makers plan building upgrades well in advance of execution and weigh a range of factors when considering whether to move forward with a major capital improvement. As such, surveyed participants indicated they likely would have moved forward with most of the energy-saving actions they completed had they not attended the BOC Training. However, on average Level I participants allocated 64 out of 100 "points of influence" to the BOC Training when considering all factors that influenced their decision to implement energy-saving changes; one Level II participant allocated an average of 30 points. These energy-saving actions produced energy savings, indicating MEEA and AIC successfully achieved their goal of generating energy savings through educating building operators about efficient building practices (Table 45 and Table 46).

Table 47. 2019 BOC Level I Course Energy Savings by Enduse

Enduse Category	Descriptions	Verified Net Savings (MWh)	Verified Net Savings (MW)	Verified Net Savings (Therms)
Cooling tower optimization	VSDs on chiller cooling tower	109	0.021	0
Boiler/hot water/steam system	High efficiency boiler	65	0.000	16,219
Lighting	Occupancy sensors, LED exit signs, bi-level stairwell fixtures, LED installations	49	0.016	0
Chiller/chilled water system	VSDs on chiller loops, condensate pumps, and chillers	9	0.002	0
Economizer and ventilation controls	Economizer repair and optimization	3	0.000	0
Water pump optimization	Pump replacements	3	0.000	0
Package/Split-System HVAC Changes	High efficiency motor switch outs	1	0.000	0
HVAC equipment scheduling or space temperature	Equipment scheduling, occupancy-based scheduling	0	0.000	808
Domestic hot water	Low-flow faucets	0	0.000	37
Total		**238**	**0.039**	**17,063**

Table 48. 2019 BOC Level II Course Energy Savings by Enduse

Enduse Category	Descriptions	Verified Net Savings (MWh)	Verified Net Savings (MW)	Verified Net Savings (Therms)
Lighting	LED installations	79	0.019	0
HVAC equipment scheduling or space temperature	Equipment scheduling	4	0.006	716
Domestic hot water	Water heater replacement	0	0.000	297
Total		**84**	**0.025**	**1,013**

Recommendation

AIC should consider ways to increase participation in evaluation activities, particularly the post-course savings survey. AIC could require participation as part of the tuition reimbursement agreement or adjust the incentive structure to provide additional incentives to participants who complete all the activities–either through additional tuition reimbursement or discounting costs of the certification exam. Without robust participation in these activities it is difficult to get a full picture of the effectiveness of the training and identify opportunities for improvement. Further, lack of participation makes it difficult to assess the success of the training to determine whether AIC's investment in the training is producing the results AIC is seeking.

Appendix B. Participant Summary

In 2018, MEEA offered a Level I course in Peoria from October 11 through November 29, 2018, and a Level II course in Bloomington from October 31 through December 13, 2018. Table 48 presents a summary of the 2018 Level I and Level II course participants by certification level, organization, and segment.

Table 49. 2018 BOC Training Participation Summary

Participant ID	BOC Level	Segment
20001	I	Government
20017	I	School/University
20033	I	Church
20049	I	Process Industrial
20081	I	School/University
20097	I	School/University
20113	I	School/University
20129	I	School/University
30001	II	Office
30002	II	Government
30003	II	School/University
30004	II	Office

Appendix C. Expected BOC Outcomes

Table 49 includes a list of common outcomes with high energy savings potential. The table also provides information on the BOC classes that are linked to each outcome. The evaluation team prioritized these outcomes in data collection activities.[40]

Table 50. List of Expected Outcomes from BOC Courses

Outcome	1001	1002	1003	1004	1005	1006	2001	2002	201	202	214	216
Tune-up boiler(s)	✓						✓					
Test and replace faulty steam traps	✓											
Optimize chiller sequencing	✓							✓				
Install thermal storage systems												✓
Measure and optimize chiller performance	✓											
Schedule optimum starts for AHU system	✓							✓				
Match AHU schedule to space occupancy	✓							✓				
Schedule boilers	✓							✓				
Schedule exhaust fans	✓							✓				
Schedule fan-powered boxes	✓							✓				
Schedule fan-powered/VAV boxes	✓							✓				
Schedule heaters	✓							✓				
Schedule pumps	✓							✓				
Schedule return/exhaust fans	✓							✓				
Set back space temperature	✓							✓				
Install demand control ventilation	✓							✓				
Install hot water pump VSD(s)		✓								✓		
Install combustion fan VSD(s)		✓								✓		
Use variable speed condenser fans for capacity control		✓						✓				
Utilize VSDs for fans		✓								✓		
Install VSD(s) for pumps		✓								✓		
Install ECM(s)		✓										
Install VSD(s)		✓								✓		
Install occupancy sensors			✓									
Install daylighting/photocells on interior fixtures (skylights/window walls)			✓									
Install lighting control panels (sweep/timers)			✓									

[40] The evaluation team also asked about outcomes not included in Table 26, 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.

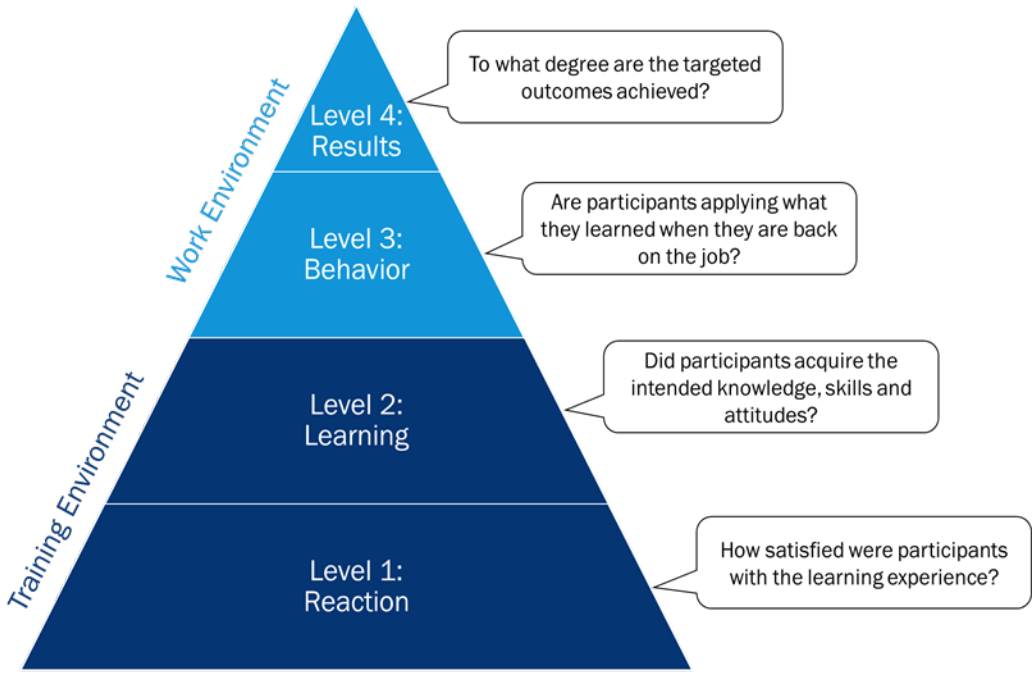
Outcome	1001	1002	1003	1004	1005	1006	2001	2002	201	202	214	216
Replace incandescent, CFL, HID, or fluorescent fixtures with LED lighting			✓									
Replace incandescent or CFL exit signs with LED exit signs			✓									
Replace stairwell lights with bi-level fixtures with sensors			✓									
Install CO-based ventilation control					✓			✓				
Install CO2-based demand control ventilation					✓			✓				
Use economizer and outdoor air control					✓			✓				
Optimize condenser water temperature						✓		✓				
Schedule heaters						✓		✓				
Use natural ventilation instead of cooling						✓		✓				
Install building pressurization control								✓				
Perform night purge cycle for pre-cooling						✓						
Perform economizer commissioning						✓					✓	
Reset supply air temperature						✓		✓				
Balance airside supply						✓		✓				
Reduce simultaneous heating and cooling						✓		✓				
Reduce outside air ventilation						✓		✓				
Commission air systems						✓					✓	

Appendix D. Evaluation Methodology

The evaluation team sought to measure the energy savings attributable to the 2018 BOC Training by leveraging an evaluation approach based on Kirkpatrick's framework of adult training evaluation. The approach is designed to collect information on each of the four levels included in Kirkpatrick's framework (Figure 24):

- **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 26. Kirkpatrick Model



To measure the four levels of learning, we conducted several research activities targeted at specific stages of the training process (see Table 50), including:

- **Baseline operations and maintenance (O&M) and energy efficiency equipment survey**: Participants completed this survey as their first homework assignment. Through the survey, our team 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-saving changes to building operations; 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 on-site 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.
- **On-site audit**: Our engineers (1) verified the energy-saving actions indicated in the post-course savings survey, (2) ensured participants took these actions following the BOC Training, and (3) gathered additional information to support impact calculations. We provided a $500 incentive as a thank you for participating in the audit.

Table 50 illustrates how each of the research activities contributed to the assessment of Kirkpatrick's four levels. Through these activities, we gathered information about the energy-saving actions that participants took, and how the BOC Training may have motivated participants to take these actions.

Table 51. 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				✓
On-site audit				✓

As the BOC Training *indirectly* influences participants to take energy-saving actions, program administrators do not track detailed information to estimate ex ante energy and demand savings. As such, we estimated savings for those that participated in the data collection activities described above. Table 51 presents participation in the evaluation activities by each participant. Notably, five participants completed the post-course savings survey, and one agreed to an on-site audit.

Table 52. Summary of Participation in Evaluation Activities

Participant ID	Baseline Survey	Post-course Interview	Post-course Savings Survey	On-site Audit
20001	✓	✓		
20017	✓	✓	✓	✓
20033	✓	✓	✓	
20049	✓	✓	✓	
20081	✓	[b]	[b]	
20097	✓	✓	✓	
20113	✓	[b]	[b]	
20129	✓	✓		
30001	✓	✓		
30002	✓	✓		
30003	✓	✓	✓	
30004	[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 at the same organization. We only completed the post-course interview and post-course savings survey with participant 20097.

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 Illinois Technical Reference Manual (IL-TRM), 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.

By their nature, follow-on actions such as these require time to be completed after the intervention (training) occurs. Because the 2018 BOC trainings occurred in Q4 of 2018 (ending in November and December, respectively), the evaluation team felt strongly that follow-on actions from the 2018 trainings would not be completed and able to be observed as part of the 2018 evaluation year. We, therefore, chose to evaluate follow-on savings resulting from the trainings during 2019 as part of the 2019 evaluations. Similarly, because these savings are evaluated in the manner of spillover, we do not apply a NTGR to evaluated savings – all savings claimed are already determined to have been influenced by BOC.

The evaluation team calculated energy savings using a combination of data collected through the post-course savings survey and assumptions from version 7.0 of the IL-TRM. Originally, we expected to collect detailed information during on-site verification visits to inform impact calculations; however, just one participant agreed to an on-site visit. In cases where participants applied for incentives through other Ameren Illinois initiatives, we pulled the information from that initiative's tracking database and removed those savings from our BOC impact analysis. Finally, we filled in gaps with TRM baseline assumptions when needed.

2.5 Non-Energy Impacts Research

2.5.1 Negative Non-Energy Impacts Literature Review Memo

Introduction

Non-energy impacts (NEIs) are the impacts, both positive and negative, that energy efficiency programs produce in addition to energy savings and demand reduction. Impacts include economic, environmental, health, and other ancillary outcomes of an efficiency project. The added costs and benefits may accrue to the sponsoring utility, the individual participant, or to society at large. While energy efficiency program evaluators often discuss the potential for both added benefits and for added costs, Opinion Dynamics' 2018 NEI literature review identified a gap: there are only a few rigorous studies about identifying and measuring negative NEIs.

This memo focused on collecting the limited readily available research on negative NEIs, determining which negative NEIs have been the most heavily studied and what types of effects have been observed, and exploring the research methods that could be employed to assess negative NEIs in the future. Available evidence confirms that most primary research studies tend to focus on benefits (positive NEIs). We identified 12 studies that specifically explored costs (negative NEIs); even in these studies, researchers found that they are rare. Like positive NEIs, negative NEIs depend on the program design, customer sector, and efficient equipment. The reported negative effects included:

- Increased operation and maintenance costs of commercial efficient equipment compared to conventional equipment;
- Negative customer sentiment about the aesthetic appearance or performance of efficient equipment compared to conventional equipment;
- Negative human health and wildlife effects of cool-temperature LEDs; and
- Ventilation and indoor air quality problems associated with weatherization projects that are not completed correctly.

Search Methods

We focused our review on studies that mentioned negative NEIs, added costs of energy efficiency, or other related terms. We focused our search on publicly available energy efficiency program evaluation reports, as well as conference papers and presentations from the energy efficiency evaluation industry. We identified 23 studies that mentioned negative NEIs. Half of the studies only discussed the potential for negative NEIs at a high level. We completed a detailed review of the 12 that provided greater detail or attempted to quantify and/or monetize the negative association or effect.

Key Findings

This section contains our key findings (organized by program design and measure mix) as well as our observations about available methods to research negative NEIs for Ameren Illinois in the future.

Negative NEIs by Sector and Program Type

- **All Sectors – Lighting:** Generally, LEDs are brighter and longer lasting than conventional lighting, leading to better-lit common spaces and reduced trips and falls. Our review identified few negative NEIs of

LEDs.[41] Identified negative NEIs of LEDs appear limited to LEDs that have a cooler color temperature (discussed below), and an isolated number of program participants who have perceived that LEDs are dimmer than conventional bulbs. Outside of the energy efficiency industry, cool color lights and "blue light" have been associated with circadian rhythm disruption, negative occupant health and mental health, and LED streetlights that interfere with nocturnal wildlife. This said, Ameren Illinois plans to stock 3000k streetlights, which the American Medical Association[42] recommends as the ideal color for outdoor installations.

- Tetra Tech, NMR, and DNV GL (2018): This framework study presented to Massachusetts Program Administrators (PAs) developed an assessment of the available methods for addressing and quantifying NEIs in the residential, low-income, and commercial and industrial (C&I) sectors. According to the report, program staff noted that other studies had reported negative health NEIs due to the blue light associated with LED technology, and that this made PAs hesitant to support energy efficient street lighting. Among these potential blue light effects are increased glare, decreased visual acuity and safety, and melatonin-suppression at night that disrupts circadian rhythms and can cause sleep and health problems. To minimize these effects, the American Medical Association recommends the use of LED lighting that minimizes blue light exposure.43

- NMR (2016): As part of a process evaluation of the Home Energy Solutions (HES) program and the HES Income Eligible (HES-IE) program conducted for the Connecticut Energy Efficiency Board, NMR measured NEIs from the programs through participant surveys and in-depth interviews with landlords and property managers. Negative impacts reported by program participants were 'very rare,' including safety issues from perceived dimness from lighting changes. Program participants had received LEDs.

- Gaston et al. (2012): This ecological study addresses the potential environmental consequences of night-time light pollution, which is relevant to LED streetlighting programs that either install new lights or retrofit existing warm-spectrum but less-efficient streetlights with LEDs. The findings suggest that integrating light into previously dark night-time environments negatively affects biodiversity and animal health. Like humans, animals are sensitive to the changes in the spectrum, composition, and duration of lighting. Integrating artificial lighting into naturally unlit outdoor areas at night—or changing the existing light infrastructure—can also negatively affect wildlife sleep patterns and seasonal behaviors. LEDs specifically can affect animals that are sensitive to light cool-color wavelengths.

- **All Sectors – Demand Response:** While AIC does not currently offer demand response programs as part of its core energy efficiency portfolio, we provide the following findings to support any future program planning. Demand response participants are compensated for reducing their energy use at certain times of day or year, such as through a bill credit or payment per event. Because reductions may target heating and cooling equipment, participants may experience indoor temperature changes during events. Program participants report experiencing NEIs both before a demand response event is called and during demand response events. When reducing cooling usage during hot summer months, some business and residential participants may observe increased discomfort, inconvenience, or (for businesses) lost revenue relative to leaving their cooling system on "as usual."

[41] Standard CFLs–which most programs no longer offer—were more often associated with negative NEIs than LEDs are. Relative to incandescent and halogen bulbs, CFLs took longer to warm up and customers disliked their dimness, bulb appearance, flicker, and added disposal and environmental hazard costs (CPUC, 2011).
[42] American Medical Association. Policy H-135.927, Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting. https://policysearch.ama-assn.org/policyfinder/detail/H-135.927?uri=%2FAMADoc%2FHOD-135.927.xml
[43] American Medical Association (2016) "AMA adopts guidance to reduce harm from high intensity street lights" Press Release, https://www.ama-assn.org/press-center/press-releases/ama-adopts-guidance-reduce-harm-high-intensity-street-lights

- CPUC (2011): In a framework study conducted by the California Public Utilities Commission (CPUC) for California utilities, the CPUC Energy Division staff examined NEIs attributable to demand-side programs and methods for addressing them in the CPUC's cost-effectiveness tests. Demand response program participants in California experience non-energy costs both before and during demand response events. Prior to a demand response event, non-energy costs include those associated with developing a load shedding plan. During a demand response event, the associated costs are productivity and comfort losses that stem from reduced energy services. Additionally, if customers use back up diesel generators during demand response events, then a cost is also incurred by society for the added fossil fuel use. Because these costs are difficult to quantify, CPUC required that the utility estimate these costs as 75 percent of the incentives received by participants (as of the 2011 study).

- **Business and Industrial Sectors – Standard and Custom Programs:** Based on one large study of C&I sector NEIs, negative NEIs are rare and tend to be small relative to positive NEIs in these sectors. The most discussed negative NEIs are increased Operations and Maintenance (O&M) costs, including increased preventive maintenance and staff salaries/ administrative costs associated with the efficient equipment.

  - Tetra Tech (2012): Through a large-scale in-depth interview effort to analyze the NEIs of C&I retrofit programs administered by Massachusetts PAs, the evaluation team found that 3% of the program's measure installations resulted in net negative NEIs (22 of the 789 prescriptive and custom electric and gas measures installed by 788 interview respondents). Participants were asked to discuss positive or negative changes in each of 12 cost categories[44] associated with prescriptive electric projects (HVAC, lighting, motors and drives, refrigeration, and other), gas prescriptive projects (envelope, HVAC, and water heaters), as well as for custom electric and gas projects. The prevalence of negative non-energy impacts appears to be primarily measure-specific for retrofit programs due to the variability of installation difficulties and familiarity (or lack thereof) for each type of energy efficient equipment.

    - Estimated annual prescriptive program NEIs were net positive and statistically significant for electric HVAC ($0.10/kWh), lighting ($0.03/kWh), gas envelope ($3.62/therm) and gas HVAC ($755/therm) but not statistically different from zero for other prescriptive electric and gas measure categories. The identified net negative effects were limited to two areas. Electric program participants noted net negative effects due to prescriptive HVAC (other labor, -0.3% contribution to net NEI value for HVAC, n=138 projects) and due to motors and drives (sales revenue, -0.5% contribution to net NEI value for motors and drives, n=92 projects). The negative sales effects for motors and drives resulted from a Variable Speed Drive (VSD) malfunction that caused the equipment to shut down for two hours. The negative labor effects for HVAC projects was because some respondents reported an increase in labor due to preventative maintenance and increased time to ensure that all equipment was operating correctly.

    - Estimated annual custom program NEIs were often net positive and statistically significant. Five of six custom electric measures had significant positive NEIs; values ranged from $0.02/kWh (HVAC, n=20) to $0.06/kWh (Lighting, n=89). Two of four custom gas measures had significant positive NEIs, including Envelope ($0.48/therm, n=46) and HVAC ($0.22/therm, n=41). Combined Heat and Power (CHP)/Cogeneration was the only custom measure associated with a significant negative NEI (-$0.01/kWh, n=6), attributed to increased preventative maintenance and administrative costs for the energy efficiency equipment. For the average CHP/Cogeneration project, the negative NEI amounted to $12,949 per year. Authors noted that this negative effect

[44] Cost categories included administrative, fees, material handling and movement, O&M, product spoilage, rent revenue, sales revenue, other revenue, waste disposal, other labor, and other costs.

"was largely because co-generation requires an entirely new piece of equipment" as well as new back office labor to support it.

- Overall, while the study found that negative effects are generally rare and that average effects stem from a small number of customers or projects, the costs can be quite noticeable for those participants who do experience them. Within the bounds of a large program, multiple customers may experience these types of effects.

- **Residential Sector– Efficient Products:** Negative NEIs associated with efficient products are rare and measure-specific. In some instances, evaluations have found that customers had a negative experience with the installation process or disliked the aesthetics of the efficient equipment compared to conventional equipment.

  - SERA (2014): This residential program framework study of non-energy impacts found negative household impacts to be rare and that they were "not usually found to be important/valuable" quantitatively; however, the authors discuss the potential for negative NEIs including the hassle of installation, disapproval of aesthetic appearance, and maintenance issues. This study also suggests that negative NEIs of energy efficiency could be interpreted as a quantitative measure of program barriers. For example, visual differences between efficient and standard equipment could be a participation barrier for those with strong aesthetic preferences. Because the authors drew on their prior experience to develop this report, is unclear what reference conditions they used for each NEI—for example, installation hassle may be a factor no matter the equipment efficiency and therefore would not be an NEI of efficient equipment specifically. Future NEI studies of efficient products programs should carefully consider the counterfactual scenario.

- **Residential Sector – HVAC:** Research on negative NEIs from residential HVAC programs is rare. We identified several studies discussing the aesthetic barriers to ductless mini-split heat pump adoption specifically. As these measures grow in popularity, we expect to see growing literature on their NEIs.

  - ARIES (2014): In a feasibility study conducted on ductless mini-split heat pumps (DMSHPs) in multifamily retrofit programs, findings suggest that aesthetic preferences were a participation barrier for some consumers. For example, Efficiency Maine provided incentives for the installation of MSHPs through their Low-Income Multifamily Weatherization program. Interviews with Efficiency Maine revealed that some residential owners were not interested in DMSHPs due to their dislike of the appearance of the outdoor compressors or line sets.

  - IBACOS, Inc. (2017) analyzed heat pump performance and market conditions needed to support uptake. Authors noted aesthetic barriers to DMSHPs, noting that "although the "high-performance story" can convince some buyers to overlook the aesthetics of the [indoor air handling] units, many buyers are deterred from purchasing houses with this equipment installed."

  - Cadmus (2016) As part of on-site participant visits to support an impact evaluation of DMSHPs in Massachusetts and Rhode Island, researchers learned of several positive non-energy impacts for customers replacing window air conditioners (e.g., regained use of windows for ventilation and daylighting, increased security from locking windows, less outdoor noise, and others) and those choosing a ductless system instead of installing a new central cooling system (e.g., avoided ductwork installation costs). Authors do not note whether respondents were asked about any potential negatives, but none are reported.

- **Residential Sector - Multifamily:** In addition to measure-specific outcomes discussed above, property managers may experience general increases or decreases in O&M effort and cost based on the nature of

the upgrades. While several studies assess both positive and negative NEIs, effects tend to be net positive from the property manager and tenant perspectives.

- NMR (2011): In an NEI evaluation of Massachusetts low income and market rate multifamily energy efficiency programs, this study surveyed building owners and managers about the presence and value of non-energy impacts. Some of the managers noted that tenants felt the new equipment was noisier (4%) or less reliable (11%), that lighting was too bright or too dim (4%), or that lighting took too long to come on (4%, n=27). When asked about the overall impact of the NEIs discussed during the survey, 4% of property staff reported negative changes in the durability of the property, while 12% noted increased tenant complaints and 17% reported that other changes were negative on balance. None reported negative changes in rental unit marketability, turnover, property value, or equipment maintenance (n=26). No interviewees perceived a net negative impact of all NEIs together (n=26). Overall, the study found that NEIs are net positive for the multifamily program, equating to about 10% to 18% of energy savings, depending on the impact category.

- NMR (2016): The process evaluation of the effectiveness of the HES and HES-IE programs in Connecticut also conducted in-depth interviews with participating landlords and property managers in part to determine the prevalence of non-energy impacts of the program. Among the 29 HES-IE landlords and property managers that were interviewed, only one respondent found the net non-energy impacts to be negative while one respondent found the net impacts to have no effect. The remaining 27 of 29 respondents reported net positive impacts. Two of 29 respondents reported tenant safety concerns tied to the difficulty of opening windows or latching exterior doors post-air sealing (2 of 29 respondents). Other reported effects related to CFLs, which most program administrators no longer offer.

- Opinion Dynamics (2019): In a draft memo to Ameren Illinois, our evaluation team explored the potential for positive and negative NEIs among multifamily property owners. We did not identify a strong potential for negative NEIs. Two-thirds of property managers plan to market the new energy-efficient upgrades they received through the Initiative to potential tenants (n=15). Most tenants (95%) said they are more or just as likely to renew their lease since receiving upgrades (n=75). These trends suggest it will be easier, rather than harder, to find new tenants. At turnover, most property managers (81%) reported they anticipate having to complete the same (81%) or fewer (19%) amount of unit repair and cleaning activities after the upgrades (n=16).

- **Residential Sector – Weatherization:** Weatherization is generally understood to positively benefit indoor air quality. However, researchers have occasionally found that weatherization reduces air ventilation and that participants observed increased indoor humidity, asthma, allergy symptoms, or home maintenance costs. As NMR (2011) noted, “This is particularly the case if a pollutant source, such as mold or pests, is not removed, so that exposure levels are in effect increased by reducing air infiltration, due to changes in the home made by the efficiency program.” Such negatives and added costs may be limited to weatherization projects where the work was not completed to quality standards, as weatherization upgrades that seal and insulate the building shell should also ensure adequate indoor-outdoor ventilation.

  - NMR (2011). This study surveyed recent renters and owner-occupant participants in the Massachusetts residential energy efficiency home upgrade programs, finding that while some participants experienced negative NEIs, all felt that their projects had a net positive effect. Of the market rate and low-income renters and owners who participated, 80% of low income respondents (n=213) and 88% of non low income respondents (n=209) reported that their project had only resulted in positive impacts. A few respondents (2% to 4% by impact type) reported negative impacts after the program including draftiness, dissatisfaction with lighting, hot water that takes too long to heat, ice dams or snow accumulation on the roof, leaks in the attic, ineffective weather stripping, and increased

equipment noise. It seems possible that some of these effects could be due to improper installations, while others may be due specifically to the efficient equipment. On net, only 2% of low income respondents and none of the non low income respondents judged the overall change in non-energy impacts to be negative.

- Efficiency Vermont (2018): Efficiency Vermont conducted a post-participation survey (n=318) of qualified customers of the Home Performance with ENERGY STAR program. Efficiency Vermont sought to understand participants' perspectives regarding NEIs of the program. At least one year following receiving energy efficiency improvements on their homes, 3% of respondents (11 of 318) reported in a post-participation survey that they experienced some negative NEIs since the project. Of this small number of respondents, their primary concerns were related to ventilation and humidity, including indoor moisture accumulation. Participants reported that aspects of their home or health had become either 'a little worse' or 'much worse' since receiving energy efficiency improvements, including their home's comfort, home maintenance, noise levels, safety, quality of sleep, allergies, colds/flus, sleep apnea, COPD, and asthma. It is difficult to fully attribute these changes to the weatherization because the study did not use a comparison group to control for non-program factors that could have contributed to these changes. Overall, these effects are rare and appear to be outliers relative to typical participant experience.

- Vermont Department of Health (2018): This literature review analyzed the existing evidence of potential negative and positive health impacts of building weatherization strategies. The preponderance of evidence (17 of 19 studies) suggests that weatherization produces positive impacts on indoor climate and occupant health. In the 19 quantitative studies reviewed for the study, none reported negative effects on indoor temperature, mold, overall indoor air quality, pests, general occupant health, upper respiratory symptoms, cardiovascular health, neurological symptoms, infectious disease, accidental injury, mental health, productivity, financial health, and health care utilization and costs.[45] However, some studies identified negative impacts on indoor humidity (1 of 11 studies) and asthma symptoms (1 of 9 studies). When these impacts did appear, they were attributed to either insufficient ventilation after the project was completed or projects that had vented in humid air without dehumidifying it. Findings suggest that these negative impacts can be avoided through the "appropriate" design of an energy-efficient ventilation system and implementation of a dehumidifier, if needed. The authors review findings by Willand et al. (2015), who acknowledge that concerns exist regarding the potential to create negative health impacts by "over-tightening" a house or unintentionally reducing air circulation below a healthy level. However, if industry standards for ventilation are met, the risk is minimal and will likely maximize the health benefits of weatherization.

- NEEP (2017): This synthesis report identifies that challenges in measuring NEIs can stem from the difficulties in determining net impact in cases where a program generates both negative and positive non-energy impacts. An example of this is the weatherization of a home in a high radon zone, because it could result in negative, positive, or both negative and positive impacts on the home and its occupants.

- LBNL (2014). This 33-state study measured indoor conditions at 514 homes in the one month before and one month after participants received DOE Weatherization Assistance Program upgrades, including 189 homes randomized into a control group. Researchers measured air quality (carbon monoxide, radon, formaldehyde, humidity), temperature, and visual moisture issues over time. Nearly all measurement happened during the heating season.

[45] The authors reviewed between 1 and 14 studies per type of impact.

- On average, weatherization increased indoor radon levels in proportion to the reduction in natural ventilation that results from air-sealing work. Authors noted two caveats. Because the study included an over-sample of homes in high-radon regions, results may not apply to all regions of the United States. Also, the study was conducted before DOE updated its program ventilation standards to ASHRAE 62.2; authors suggest the observed effects may not apply to programs providing ventilation at the time of weatherization.[46] Notably, ventilation systems installed in 21 of the study homes often reduced radon concentrations.

- No increases in the other metrics were detected post-weatherization, but authors caution that small sample sizes and research limitations may have prevented them from detecting any effects.

Research Methods for Negative NEIs

Policymakers call for more information about NEIs in an effort to rebalance cost-effectiveness testing, which has historically skewed towards participant costs and is generally understood to have omitted a number of known but hard to measure benefits, such as health and environmental NEIs. Perhaps given this context, most of the NEI research we have reviewed—save for the studies discussed above—have an implicit focus on capturing new non-energy *benefits*. This appears to have inadvertently created a gap in the understanding of added economic, comfort, health, or other costs of energy efficiency. Although negative outcomes do appear to be rare, to avoid repeating the imbalanced approaches of prior research, we recommend explicitly researching the potential for both added non-energy costs as well as added non-energy benefits when conducting NEI studies. The primary tools for assessing NEIs include participant interviews and surveys (with or without a comparison group) as well as economic and health science models. Benefits and drawbacks of these methods are discussed below:

- **In-Depth Interviews:** In-depth interviews are an ideal method to explore detailed and nuanced information about NEIs, such as where NEIs are likely to be complex and variable based on program- or region-specific issues (e.g., program procedures designed to avoid increasing radon levels within weatherized homes) or individual participants' measures and experiences (e.g., custom business programs). Interviewers have the flexibility to guide the conversation to focus on the most important topics in each interview. In-depth interviews are also suitable if the participant population is small and hard to reach. That said, in-depth interviews are a lengthier and costlier way to collect data (relative to web surveys), do not offer the sense of anonymity from a survey, and are better suited for qualitative research than for quantitative research.
- **Participant Surveys**: Web or phone surveys can cost-effectively gather data from a relatively large sample of respondents and are best suited to capturing NEI metrics which can be assessed with standardized closed-ended responses. Surveys could be used for both a high-level screening effort (i.e., adding several questions to a survey already planned to support annual program evaluation) or for a detailed large study (i.e., Opinion Dynamics' upcoming standalone survey of Income Qualified participant health, comfort, and safety NEIs). Used for these purposes, surveys are likely to be more cost-effective at scale than interviews. But, because the respondent takes the survey unassisted, there is no opportunity to ask clarifying questions or probe for effects that may not be top-of-mind. For this reason, surveys may be less valuable in cases where researchers want to explore what new or additional types of NEIs may exist, beyond ones that have been documented before.
- **Modeling Software:** A variety of pre-packaged tools exist to model the societal effects of energy efficiency programs on the economy (e.g., economic impact modeling and jobs analysis tools such as

[46] US DOE guidance on protecting and improving indoor air quality during weatherization counsels providers to install precautionary measures in EPA Radon Zones 1 and 2 (such as Illinois), where there is a high likelihood that radon may be present and increase without proper ventilation provided alongside weatherization.

IMPLAN and others), the environment (e.g., US EPA's AVERT tool, which models changes in air emissions due to changes in power production), and public health (e.g., EPA's CoBRA tool, which models changes in adverse health effects due to changes in air emissions from AVERT). Published tools like the ones cited here are peer-reviewed and ready-to-use. Tools are suitable for societal or macroeconomic NEIs that cannot be assessed through participant and non-participant self-report; i.e., because effects are too rare or the pathway between intervention and effect is too complex. Tools could be further vetted based on the developer's source assumptions and documentation. That said, tools are only available for some types of NEIs, and a drawback of using these tools is that researchers may be constrained to pre-set levels of granularity and analytic assumptions; they should consider whether model limitations are acceptable for their research needs or policy and regulatory context. Software that allows sensitivity analysis or offers multiple settings may be better set up to capture a range of potentially positive or negative NEIs.

In 2020, the Opinion Dynamics team plans to assess the potential for negative and positive NEIs of the following AIC initiatives: Standard (including SBDI), Custom, and Income Qualified (single- and multi-family), as well as the regional effects of the Residential and Business Programs at large (societal health effects and through continued involvement in regional economic impact modeling).

References

Cadmus (2016). Ductless Mini-Split Heat Pump Impact Evaluation. Prepared for The Electric and Gas Program Administrators of Massachusetts and Rhode Island. Retrieved from http://ma-eeac.org/wordpress/wp-content/uploads/Ductless-Mini-Split-Heat-Pump-Impact-Evaluation.pdf

CPUC Energy Division Staff, & Vine, E. (2011). Addressing Non-Energy Benefits in the Cost-Effectiveness Framework. Retrieved from https://library.cee1.org/system/files/library/9734/CEE_EvalNEBCostEffect.pdf

Dentz, J., Varshney, K., & ARIES Collaborative. (2014). Mini-Split Heat Pumps Multifamily Retrofit Feasibility Study. Retrieved from https://www.nrel.gov/docs/fy14osti/61620.pdf

Gaston, K. J., Davies, T. W., Bennie, J., & Hopkins, J. (2012). Reducing the ecological consequences of night-time light pollution: options and developments. Journal of Applied Ecology. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/23335816

IBACOS, Inc. (2017). Mini-Split Heat Pump Evaluation and Zero Energy Ready Home Support. Prepared for The National Renewable Energy Laboratory. Retrieved from https://www.nrel.gov/docs/fy17osti/64855.pdf

Malmgren, I., Capps, L., & Efficiency Vermont. (2018). Non-Energy Benefits of Efficiency Vermont's Home Performance with ENERGY STAR Program. Retrieved from https://www.efficiencyvermont.com/Media/Default/docs/white-papers/efficiency-vermont-non-energy-benefits-home-performance-white-paper.pdf

NEEP. (2017). Non-Energy Impacts Approaches and Values: an Examination of the Northeast, Mid-Atlantic, and Beyond. Retrieved from https://neep.org/sites/default/files/resources/NEI Final Report for NH 6.2.17.pdf

NESP. (2017). The National Standard Practice Manual for Energy Efficiency. Retrieved from https://nationalefficiencyscreening.org/national-standard-practice-manual/

NMR Group. (2011). Massachusetts Special and CrossSector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation. Prepared for the Massachusetts Program Administrators. Retrieved from http://ma-eeac.org/wordpress/wp-content/uploads/Special-and-Cross-Sector-Studies-Area-Residential-and-Low-Income-Non-Energy-Impacts-Evaluation-Final-Report.pdf

NMR Group. (2016). Project R4 HES/HES-IE Process Evaluation and R31 Real-time Research. Retrieved from https://www.energizect.com/sites/default/files/R4_HES-HESIE Process Evaluation, Final Report_4.13.16.pdf

Lawrence Berkely National Laboratory [LBNL]. (2014). Weatherization and Indoor Air Quality: Measured Impacts in Single-family Homes under the Weatherization Assistance Program. Report Number ORNL/TM-2014/170. Retrieved from https://weatherization.ornl.gov/wp-content/uploads/pdf/WAPRetroEvalFinalReports/ORNL_TM-2014_170.pdf

Tetra Tech. (2012). Final Report - Commercial and Industrial Non-Energy Impacts Study. Retrieved from https://library.cee1.org/system/files/library/9929/CEE_DNV_KEMA_FinalMA_NEI_Rpt_29Jun2012.pdf

Tetra Tech, NMR Group, & DNV-GL. (2018). Non-Energy Impact Framework Study Report. Retrieved from http://ma-eeac.org/wordpress/wp-content/uploads/NEI-Framework-Study-Report.pdf

Thomson, H., Thomas, S., Sellstrom, E., & Petticrew, M. (2013). Housing improvements for health and associated socio-economic outcomes (Review). Cochrane Database for Systematic Review, (2). Retrieved from https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD008657.pub2/epdf/full

Skumatz, L., & SERA. (2014). Non-Energy Benefits / Non-Energy Impacts (NEBs/NEIs) and Their Role & Values in Cost-Effectiveness Tests: State of Maryland. Retrieved from https://assets.ctfassets.net/ntcn17ss1ow9/7hSd2GZVRtPoZKuks9WxDc/99f7076a6561f1fb44644756e6bf5707/2014__NEBs_report_for_Maryland.pdf

Vermont Department of Health. (2018). Weatherization Health: Health and Climate Change Co-Benefits of Home Weatherization in Vermont. Retrieved from https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_CH_WxHealthReport.pdf

https://ilsag.s3.amazonaws.com/AIC-Negative-NEI-Literature-Review-Findings-FINAL-2020-02-10.pdf

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