

Comprehensive Review of Non-Residential Training and Education Programs, with a Focus on Building Operator Certification

Final Report in the Cross-Cutting Research Areas of
Behavior and Education

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Executive Summary

This evaluation provides a comprehensive review of education and training programs that may produce savings for the eight Massachusetts program administrators (PAs). The focus was on Building Operator Certification (BOC), with these main objectives:

1. Identify how to increase the number of and share of PA customers who achieve BOC certification with assistance of PA-provided training subsidies,
2. Develop a better understanding of the factors influencing BOC savings, and
3. Update the MA TRM savings estimate for BOC.

For the first objective, the evaluation team members analyzed indicators of BOC market penetration to compare penetration in Massachusetts with the rest of the country and interviewed: 14 BOC program managers and one contractor for the PAs in Massachusetts and elsewhere; two contacts for a regional BOC implementer; and 24 Massachusetts BOC participants. For the second and third objectives, the evaluation team reviewed 11 studies reporting BOC savings estimates. The research also included a review of 16 other adult energy efficiency (EE) education and training programs offered by PAs, private organizations, and governmental entities to identify other opportunities to promote and support energy efficiency.

Current Massachusetts BOC Program

Of the eight Massachusetts PAs, three currently offer BOC training subsidies, claiming energy savings for subsidized students who achieve the BOC certification. Two PAs (National Grid and Cape Light Compact) have provided subsidies in the past two years. For National Grid, the ability to claim savings has been limited by the low number of subsidized students: nine of 70 certified students in 2013-2014 received a subsidy from National Grid. For Cape Light Compact, the main impediment was the low certification rate among subsidized students: 32% in 2013-2014 and 51% across all program years. Overall, the certification rate for Massachusetts is at about the 25th percentile among all states for which the evaluation team could calculate certification rates.

Estimated BOC Savings Values for PA Planning

Table 1 summarizes the evaluation team's estimates of BOC electric and gas savings per square foot per student, appropriate for use in PA planning. These estimates are based on weighted averages of recent evaluations conducted for program administrators outside of Massachusetts that also offer BOC, which included both Level 1 and Level 2 students. The table distinguishes savings for operations and maintenance (O&M) exclusively and savings from O&M plus non-incented capital improvements students attributed to their BOC training.

Table 1. Estimated Per-Student Energy Savings, O&M-Only and Total BOC-Related

	Electricity (kWh/SF/student)	Gas (therm/SF/student)
O&M-Only	.178	.007
Total (O&M plus Capital Upgrades)	.364	.011
O&M-Only as Percentage of Total	49%	65%

Most of the existing studies included both Level 1 and Level 2 students, and there is insufficient data to produce separate reliable separate savings estimates for those Level 1 and Level 2 students. Therefore, the above estimates represent the mean savings for BOC graduates, including both Level 1 and Level 2 students.

Is There Room for Greater Penetration of BOC in Massachusetts?

The analyses of market penetration suggest that there is room for expanded BOC penetration in Massachusetts: out of the 36 states with BOC training Massachusetts ranks 17th on the mean yearly number of BOC graduates per large employer. The greatest potential for penetration may be in National Grid’s service territory, which covers part or all of eight Massachusetts counties that together account for three-quarters of the large employers in the state.¹

What Factors Affect Uptake of BOC Training?

Our research did not identify any barriers to BOC uptake that are unique to Massachusetts workers. Moreover, the cost of BOC training and certification was not a consideration for trainees, as none were responsible for paying their training tuition and all received their salary while in training. Feedback from the interviewed students indicated the tuition subsidy may have a moderate influence on employer decisions to send someone to take BOC training, suggesting that training cost may be a moderate factor for employers.

Findings also suggest that the level of effort put into promoting BOC affects training uptake – and that Massachusetts PAs may not employ sufficient promotion efforts. PAs that employ multiple outreach channels to promote BOC and the training subsidy – for example, e-blasts to all eligible commercial customers, direct outreach by account executives, and personal appearances at public events – had greater success at recruiting BOC students. While the contacts for PAs outside of Massachusetts reported up to four promotion channels, all of the Massachusetts contacts reported either one or two channels. Moreover, while several outside-Massachusetts PAs send e-blasts to *all* eligible customers, the only report of e-blasts by a Massachusetts PA was to a more restricted subscriber list.

¹ Source: U.S. Census Bureau, County Business Patterns (<http://censtats.census.gov/cgi-bin/cbpnaic/cbpcomp.pl>). The team calculated the number of large buildings from the U.S. Energy Information Administration’s (EIA’s) 2003 Commercial Buildings Energy Consumption Survey (CBECS). http://www.eia.gov/consumption/commercial/data/archive/cbecs/cbecs2003/detailed_tables_2003/2003set2/2003html/a3.html

What Prevents Massachusetts BOC Students from Achieving Certification?

BOC students' primary motive for taking the BOC training is to master the subject material, and obtaining the BOC credential itself does not appear to be a high priority for most students. Interviewed students who did not obtain the certification (all from Cape Light Compact service territory) reported that other emerging job demands took priority over completing the requirements for certification. Several factors differentiated these students from those who achieved certification: they reported broader and more general responsibilities that covered multiple buildings; they tended to have greater work tenure; and they tended more to describe the effect of BOC training on their jobs in terms of how they interact with others rather than how they interact with equipment. These findings suggest that most of those students are removed from day-to-day O&M activity. For such individuals, certification may not be a high enough priority to be placed ahead of other emerging work demands.

What Prevents BOC Students from Applying for the Tuition Subsidy?

In contrast to the Massachusetts PAs, many of the outside-Massachusetts PA contacts reported that high percentages of students applied for tuition subsidies. These contacts generally reported a subsidy application process that places little or no burden on the applicant. Several distribute applications during class; others do not require a separate application process, but rather pay the subsidy to all qualifying students based on information collected by the training implementer.

What Factors Are Important in Quantifying BOC Savings?

The studies we reviewed on BOC energy savings varied considerably in their assessment approaches, what they included in their calculation of energy savings and how they reported them, what they reported the savings to be, and how they assessed the portion of total energy savings that were attributable to BOC. The most recent studies appeared to be more rigorous than earlier studies; they also reported higher energy savings – particularly electric savings – than earlier, less rigorous studies. Even the most recent and rigorous studies produced variable estimates of savings, however, suggesting that a reasonable and conservative approach is to take a mean of the estimates from the most recent studies.

In addition to the question of the mean level of savings to claim per subsidized BOC graduate, we identified the following related considerations:

- 1) The existing empirical evidence suggests that the equipment-specific responsibilities of multiple BOC operators at a given site overlap by about one-third on average, suggesting that they are *not* completely redundant sources of energy savings, as some have suggested;
- 2) There is some evidence that Level 2 BOC certificants generate more energy savings than Level 1 certificants, but there is insufficient evidence to conclude that the greater energy savings were *caused by* the Level 2 training;
- 3) The “measure life” over which PAs claim energy savings from subsidizing a worker’s BOC training varied across the PAs and ranged from one year to up to five years following *expiration* of certification;
- 4) Some evidence exists that BOC operators achieve different levels of energy savings in different building end-uses, with schools possibly providing the lowest savings and government-owned buildings the highest.

In addition to the above, most PAs do not appear to consider the question of free-ridership in determining the amount of energy savings to claim for BOC certification. The team did not find any strong evidence to address the question of whether PAs should claim energy savings for workers who took the BOC training with PA support but did not complete the requirements for certification.

What Are the Other Opportunities to Save Energy Through Education and Training?

In recent years, a variety of energy efficiency education and training programs have emerged that variously aim to promote adoption of equipment-specific efficiency opportunities among equipment operators; adoption of organization-wide continuous improvement processes relating to energy use; increase attention among building occupants to energy use and efficiency; engage municipalities in energy efficiency; and increase workforce the energy efficiency skills. Many of these programs have demonstrated the potential to generate energy savings.

Conclusions and Recommendations

Based on the findings from this evaluation, the evaluation team offers the following recommendations:

- **The Massachusetts PAs should employ multiple channels to promote BOC and the subsidies** – for example, sending e-blasts to all eligible commercial customers, conducting direct outreach by account executives, and making appearances at trade events to promote BOC and the training subsidy. Based on the experience of PAs elsewhere, this should help increase registration rates. This applies in particular to National Grid’s, whose service territory covers part or all of eight Massachusetts counties that have more than 200 large employers (those with at least 100 employees), which together account for three-quarters of the large employers in the state.² There is benefit to tailoring promotional efforts to the different audiences – managers and operators. The promotional efforts should include coordination with the BOC certifying organization to ensure that the program collateral, website, and registration system serving the Northeast are clear to prospective participants, especially concerning the subsidies.
- **The PAs should craft BOC messaging that conveys the value proposition of certification and maintenance of certification to high-level managers.** Frequently, it is these managers that authorize staff training. The value proposition should include that energy savings more than likely offset the training cost, and should identify additional benefits documented in BOC evaluations, such as reduced emergency failures and more effective use of maintenance contractors.
- **The PAs should encourage high-level managers who take the training to also send their operators with day-to-day O&M responsibilities.** Point out that doing so will help ensure that the directions they give with respect to O&M actions will be understood and implemented correctly, thus achieving the desired energy savings, as well as empowering staff to make good decisions.
- **The PAs should promote BOC to participants of other energy efficiency programs.** This may increase BOC registration and certification rates, resulting in more claimed savings.
- **The PAs should claim savings for each subsidized customer for eight years from the initial year of certification – that is, for the year of certification plus seven additional years.** For

² Source: U.S. Census Bureau, County Business Patterns (<http://censtats.census.gov/cgi-bin/cbpnaic/cbpcomp.pl>).

example, if someone becomes certified in 2015, then the PA should claim savings for the years 2015 through 2022. As reported above, the nationwide median tenure of BOC certification is three years, and the available evidence suggests that savings do not degrade over the period of time during which someone maintains certification (the tenure of certification) or even after expiration of certification. Therefore, claiming savings for the median tenure of certification plus five additional years – eight years, total, is reasonable. Nationwide BOC data show that a very small percentage of customers take Level 2 certification before taking Level 1 certification or even without Level 1; for such customers, the year of Level 2 certification should count as the first year of certification, and PAs should claim savings for that year plus seven additional years, regardless of whether or when the customer takes Level 1 certification.

- **The PAs should *not* claim additional savings for an individual’s Level 2 certification beyond those claimed for Level 1 certification.** Most Level 2 certification tenure overlaps to a large degree with Level 1 tenure, and so it would be impractical to attempt to track the two certification levels and assign savings separately. Moreover, our estimate of BOC savings is based on research that includes a blend of both Level 1 and Level 2 certificants that is close to the blend of Level 1 and Level 2 years that are found, on average, in the first eight years of certification. Therefore, claiming our estimated savings levels for eight years following certification accounts for the expected number of Level 2 graduates. In other words, our estimated savings reflects the average savings from certificants over the first eight years. Nationwide BOC data show that a very small percentage of customers take Level 2 certification without taking Level 1 certification; PAs should claim the same savings for such customers as for those who take Level 1 certification.
- **The PAs should claim two-thirds of the recommended per-operator savings for a second subsidized operator at a given workplace.** We base this recommendation on our finding (from NEEA_2014 data) that multiple operators at a workplace have overlapping responsibilities for about one-third of equipment types. This means that, on average, the savings from about one-third of the equipment responsibilities of a second subsidized operator will have been accounted for by the first subsidized operator, but about two-thirds of the savings from the second subsidized operator will be unique to that operator. However, if a second subsidized operator for a given employer has a different work location (i.e., works in a different building or location) from the first subsidized operator, the PAs should claim full savings for that second operator. Further, if the second operator obtains certification at least eight years after the first one, then the PAs should claim full savings for the second operator regardless of whether or not the two operators share the same workplace.
- **The PAs should consider designing and implementing additional adult efficiency education/training programs.** Opportunities exist for end-use specific training, strategic energy management, and occupant and municipal engagement programs. In addition, the PAs should keep abreast of education and training efforts stimulated by federal efforts.

1. Introduction

The evaluation team conducted a comprehensive review of education and training programs that may produce savings for the eight Massachusetts program administrators (PAs). The focus is on Building Operator Certification (BOC) but includes review of other adult energy efficiency (EE) education and training. There are two main drivers of this study:

1. PA customer participation in BOC, and application for tuition reimbursement, has been lower than expected
2. PAs wish to develop a better understanding of how to quantify BOC savings

Three of the eight Massachusetts PAs (National Grid, Unitil, and Cape Light Compact) currently support or have recently supported BOC training through tuition reimbursement. Others have provided tuition support in the past or are contemplating doing so in the future. The Massachusetts PAs are permitted to claim energy savings for students who received a tuition subsidy for BOC training from one of the PAs and received the BOC credential. Although National Grid also provides a direct annual subsidy to the regional BOC implementer, it does not claim savings based on that direct subsidy.³

The Massachusetts PAs would like to be able to increase the number of BOC students for whom they can claim savings. Of 70 individuals working in the National Grid Massachusetts territory receiving certification in 2013 and 2014, nine (13%) received a subsidy from National Grid. Cape Light Compact was the only other PA that paid subsidies in 2013 and 2014. For that PA, a slightly different issue limited the ability to claim savings. Cape Light Compact sponsors classes for municipal employees and pays a subsidy to all students who take the classes but claims savings only for those who certify at the end. In 2013 and 2014, Cape Light Compact paid the subsidy to 15 students in sponsored classes, of whom eight did not complete the work required to graduate and receive certification. Thus, Cape Light Compact claimed savings for about one-half the students to whom it paid subsidies.

In the research reported here, the evaluation team sought information that might enable the Massachusetts PAs to increase their claimed savings. The evaluation team sought to learn whether increased uptake of tuition subsidies might drive increased BOC registration and graduation, thereby increasing energy savings in Massachusetts. As part of this question, the team investigated how Massachusetts compares to other parts of the country in overall BOC uptake. The team also sought to learn what factors might stand in the way of completing the requirements for certification among subsidized trainees and what could lower those barriers so that PAs can claim savings for more of the trainees they subsidize.

Another goal of this evaluation was to better understand and quantify the BOC's operations and maintenance (O&M) and equipment savings as reported by other studies.

³ It was beyond the scope of this evaluation to determine whether the Massachusetts PAs should claim savings for subsidies that are not tied to the certifications of specific individuals. For further discussion of other PAs' support for BOC, and their motives for providing that support, see Section 4. .

The remainder of this report is organized as follows:

- Chapter 2. Methodology
- Chapter 3. Massachusetts Market Potential for BOC
- Chapter 4. Program Administrator Support for BOC
- Chapter 5. Students' Motives, Influences, and Experiences
- Chapter 6. Quantifying BOC Savings
- Chapter 7. Review of Other Energy Efficiency Education and Training Programs
- Chapter 8. Conclusions and Recommendations

2. Methodology

The evaluation consisted of the following major activities:

- In-depth interviews with Massachusetts PA BOC staff, a BOC contractor, PA BOC staff and regional BOC implementers outside of Massachusetts, and Massachusetts BOC course participants
- Analysis of the national BOC database to compare BOC uptake in Massachusetts with other areas
- Review of published BOC savings estimation studies
- Review of literature and programs to identify new and additional approaches to adult EE education/training

This section describes the evaluation team's approach to each task.

2.1 In-Depth Interviews with PA BOC Staff, a BOC Contractor, Regional Implementers, and Course Participants

The evaluation team conducted in-depth interviews with three Massachusetts PA BOC program managers; one contractor that assists National Grid with BOC marketing and recruitment and its sponsorship agreement with BOC; 11 BOC program managers for PAs outside of Massachusetts; a regional BOC implementer; and 24 course participants. For all groups, the team developed interview guides based on research questions established in discussions with the PA evaluation contacts and those identified in the evaluation plan. The following sections provide specifics regarding each interviewed group.

2.1.1 Massachusetts PA Program Managers and BOC Contractor

National Grid, Cape Light Compact, and Unitil are the only Massachusetts PAs that currently offer a BOC tuition subsidy to their customers, and only National Grid and Cape Light Compact have provided any subsidies in the past two years. Unitil follows National Grid's lead in deciding whether or not to offer BOC tuition subsidies and so has offered the subsidy but has not had any requests for the subsidy in two years. The team conducted in-depth interviews with the program managers for these three Massachusetts PAs as well as one contractor supporting one of the PA's BOC activities.

The interviews covered the types of BOC support that the PA provides in addition to tuition subsidies; who the PA targets the subsidies to and how it promotes them; what the PA's objectives are in supporting BOC, if any, beyond generating claimable savings; and what the barriers might be for the uptake of training or the subsidy or to completion of the requirements for certification. Interviews were conducted in January and February 2015, and took 30 to 60 minutes each.

The discussion of interview findings identifies common themes as well as issues specific to each PA.

2.1.2 PA BOC Program Managers Outside of Massachusetts

The team conducted in-depth interviews with 13 BOC program managers of PAs outside of Massachusetts. The team identified PAs to interview through the national BOC website, an online search, and referrals by staff of the Northwest Energy Efficiency Council (NEEC), the national BOC implementer, and the Midwest Energy Efficiency Alliance (MEEA), the BOC regional implementer for ten Midwestern states. The team prioritized utilities with relatively large service territories but also interviewed contacts for some smaller utilities.

The interviews covered the same topics as those with the Massachusetts PAs: the types of BOC support that the PA provides in addition to tuition subsidies; who the PA targets the subsidies to and how it promotes them; what the PA’s objectives are in supporting BOC, if any, beyond generating claimable savings; and what the barriers might be for the uptake of training or the subsidy or to completion of the requirements for certification. The interviews also addressed how long the PA had supported BOC and how long it expected to continue supporting it; how the PA coordinated activities with the regional BOC implementer; the application process for subsidies, if offered; and whether and how the PA claimed savings for the support. Interviews were conducted in January and February 2015, and took 30 to 60 minutes each.

A member of the evaluation team content-coded the interview responses into a spreadsheet, allowing summary of the main themes and comparison across interviewees.

The PAs were well-distributed across the country (Table 2). Most were investor-owned utilities (IOUs), but the sample also included public utilities and independent PAs funded by utility public benefits fees and represented both electric and gas service. The PAs had supported BOC training for up to 16 years, with a median of six years, and the number of trainees they supported per year varied from one to more than 100.

Table 2. Program Administrator Characteristics

Region, Number of Years Supporting BOC, Trainees per Year					
Region	Count	No. Years	Count	Trainees/Year	Count
Midwest	6	Minimum	1	< 20	3
Northwest	3	Median	6	20 to 50	5
Pacific	3	Maximum	16	> 50	2
Southwest	1			Don't know	3
Type of Entity					
Type	Total	Electric	Gas	Both	
IOU	9	7	5	3	
Public Utility	2	2	2	2	
Other	2	2	1	1	

2.1.3 BOC Implementer Interview

The team interviewed two staff members of MEEA: the BOC program manager, who oversees the program in all ten MEEA states, and a second staff member that works directly with ten utilities in four states. The interview covered the respondent's perspective on utility support for BOC, including how many of the ten utilities offer tuition subsidies and other types of support and how many claim energy savings from their support; what they do to promote BOC and the subsidies; what impact their support has had on BOC uptake; testing and certification processes; and potential barriers to taking and completing the training. Interviews were conducted in February 2015, and took 30 to 60 minutes each.

2.1.4 BOC Course Participant Interviews

The evaluation team interviewed 24 course participants—18 course graduates⁴ and six non-graduates—to explore reasons for attending training, employer support, successful completion and certification rates, and reasons for applying or not applying for tuition rebates.

2.1.4.1 Sample Development

The evaluation team conducted the sampling and interviewing in two waves. The first wave consisted only of BOC graduates—that is, those who received the certification. After clarifying Cape Light Compact's specific evaluation interest in interviewing some BOC students that completed the course but did not receive certification, the team carried out a second wave of interviews with non-certifying students from that PA's service territory.

To select the sample for the first wave, the evaluation team obtained a listing of all Massachusetts BOC graduates from NEEC. NEEC could not provide a graduate's contact information without the student's permission. Therefore, the team drew an initial sample of 80 graduates for NEEC to seek permission to share contact information. Since the interview addressed the tuition subsidy, one goal in selecting the sample was to complete at least half of the interviews with students from the service territories of PAs that provide tuition subsidies. Other goals were to achieve a good distribution by employer type, facility size, and geographic area. The student listing did not show the utility service territory, but it did show the employer zip code. The evaluation team cross-matched the zip codes against lists of zip codes in the service territories for National Grid and Cape Light Compact to identify graduates from those territories. The majority of graduates so identified were from National Grid territory, so the list was divided between National Grid graduates and others.

The evaluation team then randomly selected 40 graduates from National Grid territory and 40 from other territories. The distribution of the 80 selected graduates was compared based on employer type, facility size, and geographic area against the distribution in the total list. The sample matched the overall list well (Table 3).

⁴ Throughout this report, graduate refers to a BOC student that completed the requirements to graduate the BOC training and receive certification. Those requirements include a final examination and a work-related energy saving project using principles learned in the class.

Table 3. Sample Distribution Compared to Target Distribution

Category	Population <i>N</i>	Population %	Target Sample <i>n</i>	Actual Sample <i>n</i>
Totals	196	100%	80	80
Employer Type				
Government	60	31%	25	24
College/University	42	21%	17	18
Manufacturing	29	15%	12	12
K-12 School	20	10%	8	8
Other	45	23%	18	18
Facility Size (sq. ft.)				
Unknown	13	7%	5	4
Less than 101K	46	23%	19	19
101-450K	42	21%	17	19
451-1 million	48	24%	20	19
>1 million	47	24%	19	19
Geographic Area				
Western MA	22	11%	9	12
Central MA	51	26%	21	19
Northeast MA	39	20%	16	16
Boston area	60	31%	24	24
Southeast MA	24	12%	10	9
BOC Certification Level				
Level 1	171	87%	70	69
Level 2	25	13%	10	11

Of the 80 BOC students in the sample, 79 gave permission to use their contact information. The evaluation team randomized each half of the sample (National Grid students, other students), and a member of the team called through the list and completed 18 interviews. Of the 18 graduates, the evaluation team identified 11 as being in National Grid’s service territory, with the other seven located elsewhere.

Selecting the sample for the second wave of interviews—with the non-graduates—was similar to but simpler than for the first wave. The evaluation team obtained a list of all Massachusetts BOC students that did not graduate from NEEC. In that list, 33 students were identified in the Cape Light Compact service territory. That PA targets municipal and public school employees for training, and the list showed 15 municipal and 18 school employees. The evaluation team sorted the list into the two groups and randomized each group. A member of the team called through the list and completed six interviews.

2.1.4.2 Interview Content

The interview covered how the participant learned about BOC; the influences on their decision to take the training; whether the training was a job requirement; what financial or other support the employer provided to take the training; their perceptions of the training, testing, and certification requirements; how the training affected how they do their job, if at all, and any benefits realized from the training; and whether they or their employer received a tuition rebate and how that might have influenced decisions regarding the training. The interview also addressed employer and workplace characteristics, specifically building end-use, total workplace size, number of operations staff employed, and how many have BOC training.

A member of the evaluation team content-coded the interview responses into a spreadsheet, allowing a summary of the main themes and comparison across interviewees.

2.1.4.3 Respondent and Workplace Characteristics

The graduates represented a range of employer types, generally consistent with the distribution in the BOC population (Table 4). All non-graduates worked for municipalities or school districts, the employer types that represent the focus of Cape Light Compact's recruitment efforts. The respondents' workplaces or areas of responsibility⁵ ranged in size from 60,000 to several million square feet. More than half of the respondents had overall facility or property management responsibility, and this was by far the most common job category for both the graduates and non-graduates.

⁵ Several respondents reported being responsible for multiple buildings. In such cases, it may not make sense to refer to the total area of their responsibility as their workplace. On the other hand, respondents who have more direct technical maintenance responsibilities may report the area of their workplace, but their actual area of responsibility may be some subset of that workplace. For the purposes of this evaluation, determining the exact area of each person's responsibility was not important.

Table 4. Respondent and Workplace Characteristics

Category	Count
Employer Type (Counts)	
Government/municipality	7
K-12 school	4
College/university	4
Manufacturing	4
Medical	2
Other	3
Position (Counts)	
Owner	1
Facility/property manager or supervisor	14
Senior technical staff	3
Maintenance technician	5
Other	1
Work Tenure (Counts)	
Up to 10 years	16
More than 10 years	6
Missing	2
Total Workplace Area (Counts)	
Up to 250,000 square feet	6
250,001 to 500,000 square feet	7
More than 500,000 square feet	6
Don't know	5
Number of O&M Staff (Means)	
Total O&M staff	29

2.2 Analysis of National Database of BOC Graduates

A goal of this research is to provide information on how to increase BOC uptake in Massachusetts—in particular through increasing uptake of tuition subsidies. To provide context for evaluating the relative potential for BOC growth in Massachusetts, the evaluation team examined how the state compares with other states and areas of the country in terms of penetration indices. To account for differences among states in the length of time that BOC training has been available (training tenure) and the size of the target market, the evaluation team compared Massachusetts with other states and areas on the mean

yearly number of BOC students and graduates per large employer and total large building area rather than simply on total number of students or graduates.⁶

The evaluation team calculated the number of large employers, defined as employers with at least 100 employees, from the U.S. Census Bureau's 2012 *County Business Patterns* data.⁷ The team calculated the number of large buildings from the U.S. Energy Information Administration's (EIA's) 2003 Commercial Buildings Energy Consumption Survey (CBECS).⁸ The EIA has published preliminary data from the 2012 CBECS, but they do not provide the level of detail needed for the current analysis. Therefore, the analyses that used data from the 2003 should be interpreted with some caution.

The evaluation team also examined certification rates for those states where NEEC implements BOC training: the several New England states as well as California and Washington. For those states, the national BOC data obtained lists all students, including those that did not graduate. The national BOC data does not exhaustively list non-graduates for states where partner organizations implement the training. Therefore, calculating certification rates for those states was not possible.

2.3 Review of Published BOC Savings Estimation Studies

The evaluation team reviewed prior BOC savings estimation studies to identify the O&M, incented equipment, and non-incented equipment savings, as well as the comprehensiveness (number of measures) included in each. The review explored the relationship between the study methodology and the resulting savings estimates.

The team identified studies to review through several sources: a prior review Research into Action conducted in 2011 for Consumers Energy in Michigan; work Research into Action performed for the Northwest Energy Efficiency Alliance (NEEA); soliciting suggestions from the PAs and BOC regional implementers interviewed; searching conference proceedings over the last several years; and general online searches. From these sources, the project team identified and reviewed the following 11 studies, listed in reverse chronological order:⁹

- *Focus on Energy MEEA Training Program Evaluation*. Prepared for Public Service Commission of Wisconsin by The Cadmus Group, Inc., January 2015. [MEEA_2015]
- *Evaluation of Illinois Energy Now Building Operator Certification Program – June 2012 through May 2013*. Prepared for Illinois Department of Commerce Economic Opportunity by ADM Associates, Inc., June 2014. [ILDCEO_2014]

⁶ The total number of BOC graduates in each state correlated significantly with the number of years in which BOC training has been offered ($r = 0.51$) and number of large employers (those with more than 100 employees; $r = 0.62$), so states with relatively long training tenure and many large employers would be expected to have more total graduates, all other factors held equal, than other states. The evaluation team estimated each state's training tenure from the first year in which the state had at least ten BOC graduates.

⁷ Source: <http://www.census.gov/econ/susb/>

⁸ Source: http://www.eia.gov/consumption/commercial/data/archive/cbeecs/cbeecs2003/detailed_tables_2003/2003set2/2003html/a3.html.

⁹ The five PA contacts interviewed all identified one of two studies (NEEA_2014 and MEEA_2011) as the basis of their savings claims.

- *Impact Evaluation of the California Statewide Building Operator Certification Program*. Prepared for California Public Utilities Commission by Opinion Dynamics Corporation, February 2014. [CPUC_2014]
- *BOC-Expansion Initiative Market Progress Evaluation Report #1*. Prepared for Northwest Energy Efficiency Alliance by Research Into Action, Inc., February 2014. [NEEA_2014]
- *Impact and Process Evaluation of NorthWestern Energy 2007-2011 Demand Side Management Programs*. Prepared for NorthWestern Energy by SBW Consulting, Inc. in association with Research Into Action, Inc., New Horizon Technologies, Inc., and Ridge & Associates, January 2013. [NWE_2013]
- *Program Year 3 DCEO Building Operator Certification (BOC) Program Evaluation*. Prepared for The Illinois Department of Commerce and Economic Opportunity (DCEO) by Navigant Consulting, May 2012. [ILDCEO_2012]
- *Evaluation of MN BOC Training*. Prepared for Midwest Energy Efficiency Alliance and Minnesota Office of Energy Security by Navigant Consulting, Inc., March 2011. [MEEA_2011]
- *Evaluation of Kansas City Power and Light's Building Operator Certification Program*. Prepared for Kansas City Power and Light by Opinion Dynamics Corporation, September 2009. [KCPL_2009]
- *Impact and Process Evaluation: Building Operator Training and Certification (BOC) Program*. Prepared for Northeast Energy Efficiency Partnerships, Inc. by RLW Analytics, June 2005. [NEEP_2005]
- *Evaluation of the Building Operator Training and Certification (BOC) Program in the Northeast*. Prepared for Northeast Energy Efficiency Partnerships, Inc. by Research Into Action, Inc., September 2002. [NEEP_2002]
- *Market Progress Evaluation Report: Regional Building Operator Certification, No. 7*. Prepared for Northwest Energy Efficiency Alliance by Research Into Action, Inc., September 2001. [NEEA_2001]

Of the 11 studies listed above, one (MEEA_2015) did not provide detailed information on its research methodologies, and thus the evaluation team was unable to determine how it established its estimates and whether the estimates were reasonable. The sample for that study consisted of 33 BOC graduates, which was the second smallest of all the reviewed studies. Therefore, it was excluded from further analysis. The team also excluded a second study (ILDCEO_2014), which assessed savings for capital projects undertaken by BOC students but did not assess O&M-related savings. Finally, a third study (NWE_2013) was excluded, which did not establish independent estimates of BOC savings but instead used the values from another of the reviewed studies (MEEA_2011).

For each of the remaining eight studies, the review covered: whether savings were calculated solely based on O&M or included capital improvements and how O&M savings were assessed, including what equipment types were included; whether and how the studies assessed attribution of savings to BOC training; the metrics in which savings are reported; whether savings were reported separately for — or could be differentiated for — Level 1 and Level 2 BOC graduates; and the reasonableness of savings estimates based on a desk review.

2.4 *Review of Other Adult Energy Efficiency Education/Training Programs*

The team conducted a review of literature and programs to identify opportunities for adult EE education/training in Massachusetts that might lead to greater energy efficiency uptake, participation in programs, or anything else that might provide channels for additional savings claims.

Based on prior and ongoing program evaluation experience, the evaluation team identified the following specialized training and/or certification programs:

- End-use-specific technical programs
- Strategic Energy Management (SEM) programs
- Occupant engagement programs

For each program, the team attempted to find the following facts:

- The organizations sponsoring and delivering the trainings
- The groups targeted by the training
- Available information on the training topics and curricula
- Training objectives
- Training design inputs (for example, Building Performance Institute Multifamily Building Operator standards and certification, greening of building O&M practices)
- Estimates of savings achievable or savings claimed from the training
- Available information on training uptake
- Training cost
- Third-party support available, including by energy efficiency PAs

3. Massachusetts Market Potential for BOC

A primary goal of this research is to provide information on how to increase the number of Massachusetts workers achieving the BOC credential with the assistance of the PAs' tuition subsidies, thereby increasing energy savings. To provide context for interpreting findings from other data sources, the project team examined evidence for the potential for growth in the overall number of BOC students and graduates in Massachusetts.

3.1 Indices of Market Penetration

The evaluation team compared Massachusetts with other states and areas on the mean yearly number of BOC students (for NEEC-implemented states) and graduates per large employer (those with more than 100 employees) and total area in large buildings (those with at least 25,000 square feet of floor space).¹⁰ Table 5 shows where Massachusetts falls in training tenure, number of large employers, and certification rate within the 15 states with the most BOC graduates.

Among all states with BOC training, Massachusetts ranks seventeenth on the mean yearly number of BOC graduates per large employer (not shown in table), with about half or less the ratio of Hawaii, Maine, Washington, and Montana and about two-thirds those of Kansas, New York, California, and Missouri (Figure 1, upper chart). Similarly, Massachusetts lags behind the Pacific states and the rest of New England in the number of BOC graduates per year relative to total floor space in large buildings (Figure 1, lower chart).¹¹ Together, **these findings suggest that there is room for expanded BOC penetration in Massachusetts**, confirming the PAs' concerns.

The greatest potential for penetration may be in National Grid's service territory, which covers part or all of eight Massachusetts counties that together account for three-quarters of the large employers in the state.¹²

¹⁰ This provides a more meaningful comparison than comparing on total number of students, as states vary in training tenure and size of market.

¹¹ The evaluation team's data source for building floor space (CBECS) does not break the data down by state, so it was compared across census divisions. To compare Massachusetts with the rest of New England, the team estimated the floor space for each based on the allocation of large employers between them.

¹² Source: U.S. Census Bureau, County Business Patterns (<http://censtats.census.gov/cgi-bin/cbpnaic/cbpcomp.pl>).

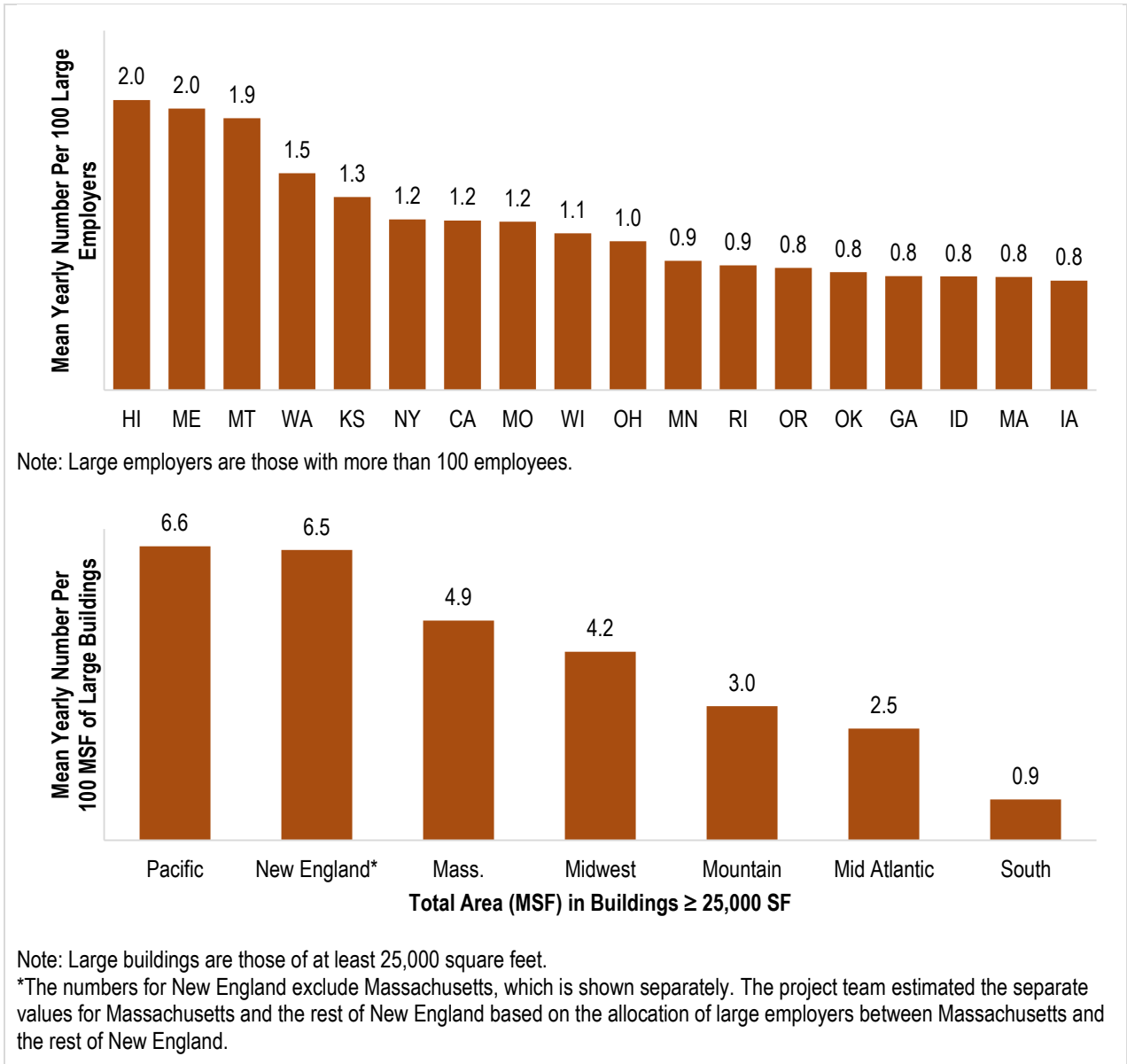
Table 5: Fifteen States with Most BOC Graduates—Compared on Training Tenure, Number of Large Employers, Certification Rate (Where Available), and Mean Yearly Number of Graduates

State, Ranked by Number of BOC Graduates	Total Number of BOC Graduates	Tenure of BOC Training (Estimated) ¹		Large Employers (>100 Employees)		Graduation (Certification) ²		Mean Yearly Number of Graduates	
		Number of Years	Rank	Number	Rank	Rate	Rank	Mean	Rank
California	2,715	13	7	17,716	1	71%	5	209	1
New York	1,819	13	7	11,793	3	--	--	140	2
Washington	1,467	17	1	5,723	13	65%	7	86	4
Ohio	1,072	12	13	8,625	6	--	--	89	3
Illinois	930	12	13	10,371	4	--	--	78	5
Massachusetts	758	15	4	6,421	11	70%	6	51	9
Wisconsin	740	13	7	5,224	17	--	--	57	8
Missouri	644	10	17	5,497	14	--	--	64	6
Oregon	528	16	3	3,883	19	--	--	33	13
Minnesota	491	10	17	5,459	15	--	--	49	11
Connecticut	442	15	4	3,919	18	79%	1	29	18
Maine	383	12	13	1,630	28	72%	3	32	14
Kansas	344	7	20	3,663	21	--	--	49	10
Montana	323	13	7	1,315	31	--	--	25	20
Georgia	314	5	23	7,916	7	--	--	63	7

¹Based on the first year in which there were at least ten graduates.

²Not shown in table: New Hampshire (77%, rank 2), Rhode Island (72%, rank 4), Vermont (63%, rank 8).

Figure 1. Top Ten Mean Yearly Number of BOC Students and Graduates per 100 Large Employers and per 100 MSF of Large Building Area



3.2 Certification Rates

Certification rates were a concern for the Massachusetts PAs, particularly as the PAs can claim energy savings only for subsidized BOC students that complete the requirements for graduation and certification. The evaluation team’s analysis of national BOC data supports this concern, showing that **Massachusetts, with a 70% certification rate, ranks sixth out of the eight states for which the team could calculate certification rates.** Although the certification rate for Massachusetts is close to that for three of those states, it is seven to nine percentage points lower than two other New England states, Connecticut and New Hampshire. Recall that the evaluation team had certification rates for only eight of the 36 states where BOC training occurs. If those states are representative of the population, then

approximately nine states would have certification rates that exceed that of Massachusetts by that many percentage points.

Certification rates were a particular concern expressed by Cape Light Compact. The contact for that PA reported that two-thirds of the BOC students it subsidized in 2013 and 2014 did not graduate and receive certification, so it could not claim savings for those students. The evaluation team compared certification rates for Cape Light Compact and National Grid territories (the two PAs that have provided subsidies in the past two years) with the rest of Massachusetts. Table 6 shows that **Cape Light Compact’s recent certification rate is somewhat lower than its overall certification rate across all the years that BOC has been offered and is lower than the rate for other Massachusetts PAs** (primarily National Grid).

Table 6. BOC Certification Rates: Massachusetts Compared to Pacific Northwest

PA or Territory	Number of BOC Students	Number of BOC Graduates	Certification Rate
2013 to 2014			
Cape Light Compact	22	7	32%
All Years			
Cape Light Compact	92	47	51%
National Grid	668	499	75%
Rest of Massachusetts	367	235	64%

The database analysis confirms that the low certification rate, particularly in the last two years, is the primary barrier to achieving greater claimable energy savings for Cape Light Compact, given that certification is required to claim savings. **These results suggest that improving the certification rate may result in more claimable savings for all Massachusetts PAs and not just Cape Light Compact.**

In summary, the results of the analyses of the national BOC data show that Massachusetts lags behind several other states in achieving uptake of BOC training by large employers. Further, certification rates for the Massachusetts PAs are likely lower than in many other states, exacerbating the low penetration rates. Taken together, these results suggest that increasing both training uptake and certification by those taking the training may be important for achieving more claimable savings.

4. How Program Administrators Support BOC

Given the evidence for potential for increased penetration of BOC training and certification in Massachusetts, what could Massachusetts PAs do differently to tap that potential? Information on how and why PAs support BOC sheds lights on this question.

4.1 Types of Support Provided

The types of training subsidies that program administrators provided varied both within and outside of Massachusetts. National Grid provides a 50% tuition subsidy for its Massachusetts certificants, while the other two Massachusetts PAs provide up to a 100% subsidy for municipalities and other selected groups and 50% to other customers.¹³

Outside of Massachusetts, most of the interviewed PAs provide a partial scholarship, ranging from about 40% to about 75% of the market cost of tuition, while two provide a full scholarship and the two California utilities provide a subsidy directly to BOC (upstream subsidy) to buy down the cost from what one contact estimated would be a market cost of about \$3,000 per person. However, the buy-down cost for customers in those two utility territories is about the same as the unsubsidized cost of training in most other jurisdictions—that is, the California utility customers pay at least as much as most other customers would pay without the subsidy. Table 7 summarizes the types of support provided.

Table 7. Types of Training Subsidy Provided

Subsidy Type	Training Fee	Count	Details
MA Program Administrators			
Partial scholarship	~1,700	1	National Grid: 50% across the board.
Partial or full scholarship		2	Unitil: Up to 100% for municipalities or state agencies; 50% for others. Cape Light Compact: 100% for municipalities and schools; 50% for others.
Program Administrators Outside MA			
Partial scholarship (~40%-75%)	~\$1,100 to ~\$1,700	9	All nonresidential customers (6 PAs) Small to mid-sized businesses (1 PA) Must manage ≥ 50,000 square feet (1 PA) Need based (1 PA)
Full scholarship	\$1,200 to \$1,375	2	Schools, nonprofit hospitals, government* (1 PA) Half awarded on graduation; half awarded after completion of rebated equipment upgrade (1 PA)
Upstream	\$1,495 to \$1,695	2	Buys down cost from about \$3,000 to \$1,495 for utility customers and \$1,695 for all other CA residents.

¹³ National Grid provides a 100% tuition stipend for certificants of Rhode Island trainings.

*This utility works with the state Department of Environmental Quality to arrange scholarships for those who do not qualify for utility scholarships.

Most of the PAs outside of Massachusetts provide the scholarship (or upstream buy-down) to all nonresidential customers in their service territory, but four of them apply various additional eligibility requirements. There was no consistent pattern to the additional requirements: one targeted the scholarship to workers at large facilities ($\geq 50,000$ square feet), one to small businesses, one to certain business types, and one based on need.

4.2 PAs' Purposes in Supporting BOC

All three PA contacts indicated that claiming energy savings for BOC graduates is not the only reason they subsidize the training but that general energy efficiency education is a goal. The Unitil contact went further to state that any savings claimed from BOC subsidies were a secondary goal. For that PA, the primary goal was to increase the number of customers who understand the value of energy efficiency and, hence, the claimable savings from incented retrofit projects.

Most (eight of 13) of the interviewees from outside of Massachusetts reported that they do not claim energy savings based on their BOC subsidies. Interviewees said that beyond claimable energy savings they supported BOC to achieve good customer relations or to encourage EE or bring about market transformation. In the case of the California utilities, support for BOC is considered a non-resource program for which they have regulatory goals.

4.3 Marketing, Promotion, and Recruitment

The Massachusetts PA program managers reported varying channels for promoting BOC and their subsidy consistent with the size of their territories and their overall recruitment strategies. The National Grid contact reported e-blasts to subscriber lists, augmented by personal outreach by that PA's sales team. The Unitil contact reported that promotion was limited to personal outreach by account executives during onsite visits to identify savings opportunities. With fewer than 100 large commercial customers, Cape Light Compact specifically targets municipalities and schools, its primary constituency, through regular interaction with municipalities, boards of selectmen, and chambers of commerce.¹⁴

While early reports to the evaluation team were that the PAs' efforts to recruit BOC students was filling classes, one of the PA contacts noted that they had had to cancel some classes due to lack of interest.

Given the evidence that Massachusetts lags behind several other states in uptake of BOC training by large employers, a need may exist for more aggressive marketing of BOC training and tuition subsidies.

Respondents outside of Massachusetts also reported a range of BOC promotion activities that overlapped those the Massachusetts PAs reported: e-blasts, direct outreach, and event appearances. However, the evaluation team noticed two differences between the promotion activities as described by the Massachusetts and outside-Massachusetts PAs. First, while all of the Massachusetts contacts

¹⁴ Cape Light Compact is not a utility but a municipal aggregator operating within the NSTAR (now, Eversource) distribution territory. According to the contact for that PA, it was formed to aggregate the electricity loads for Cape Cod and Martha's Vineyard to leverage collective purchasing power.

reported one or two channels of promotion, those outside Massachusetts reported up to four channels. Second, five of the outside-Massachusetts contacts reported sending e-blasts to all eligible customers, while National Grid’s e-blasts went to a more restricted subscriber list. Table 8 summarizes the promotion channels that contacts reported.

Table 8. BOC Promotion Channels Reported by Massachusetts and Other PAs

Outreach Channel	PAs Outside Massachusetts (n = 11)	Massachusetts PAs (n = 3)
E-blasts to customers	8	1
All eligible customers	5	0
Special email lists*	3	1
Through industry association newsletters	3	0
Direct outreach (for example, by account executives)	6	2
Event appearances (for example, at trade association meetings)	3	1
Written collateral	2	0
Minimum outreach channels identified	1	1
Maximum outreach channels identified	4	2

*E.g., subscriber lists, customers who participated in other utility-sponsored classes, or customers that had used other utility services.

The number of outreach and promotion channels used may be important, as it appeared to be related to the reported average yearly number of students (Table 9). The small sample and the fact that two of the respondents did not know how many students they had subsidized prevents drawing firm conclusions. However, this provides at least suggestive evidence that **using several outreach and promotion activities may be important for maximizing BOC training recruitment.**

Table 9. Relationship between Number of BOC Promotion Channels and Mean Yearly Number of Students

Reported Mean Yearly Number of Students	Number of Channels Reported	
	Two or Fewer	Three or more
More than 33 (median)	2	3
33 or fewer	6	0
Total	8	3

No respondent reported any coordination with the regional BOC implementer in their outreach and promotion efforts other than using implementer-developed collateral. This is consistent with what the interviewed BOC implementer contacts reported.¹⁵

¹⁵ The BOC implementer executes a detailed marketing plan each year with emails and mailers.

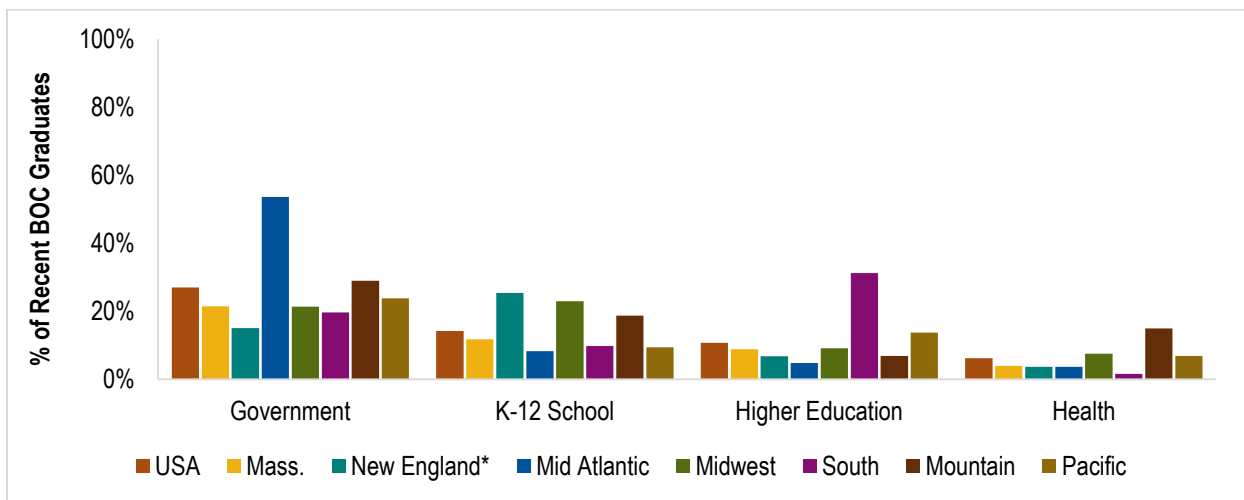
Four of the 13 respondents reported specific recruitment challenges: difficulty recruiting students in a low-population area of the state; lack of success recruiting from the military; difficulty recruit students during hunting season; and confusion in the market because of competing sources of similar training (such as the International Facility Management Association). The issue of recruiting in low-population areas may be the closest to a general concern, as one of the BOC implementer contacts also mentioned it. In particular, that contact noted that they work at finding instructors in target locations, as that is important for increasing the training’s penetration.

4.4 Targeted Groups

To provide additional insight on how PA efforts to promote BOC may affect uptake, the evaluation team investigated whether PAs target certain groups or industries for recruitment into BOC training. Five of the respondents reported targeting specific industries in their outreach, most commonly healthcare (three respondents). Two respondents each identified manufacturing and lodging as target industries, and one identified multifamily residences as a possible future target.

The team examined the distribution of BOC graduates by industry for Massachusetts and other parts of the country (and for the country as a whole) to provide context for the above findings. Figure 2 shows some regional variability in the focus of BOC recruitment (most notably, a high proportion of Mid-Atlantic BOC students work for some level of government and a high proportion of those in the South are in higher education), but **Massachusetts is comparable to most other areas in the distribution of BOC students across industry types**. In fact, Massachusetts appears to more closely resemble the country as a whole than do several other areas.

Figure 2. Percentage of BOC Students by Industry



*The figure for New England excludes Massachusetts, which is shown separately.

4.5 Administration of BOC Support

The Massachusetts PAs differ in the process by which they administer the BOC tuition subsidy. Cape Light Compact provides the subsidy to all customers that take the course, regardless of whether they complete the requirements for certification, and does not require a separate application process. By contrast, National Grid customers must complete the requirements for certification and submit an

application for the subsidy—and a large majority (87%) of National Grid Massachusetts BOC students who received certification did not apply for a tuition subsidy.

Nearly all the outside-of-Massachusetts contacts reported that all trainees in their jurisdictions apply for the subsidy.¹⁶ The two exceptions reported that “at least 80%” and 95% apply for the subsidy. Of those 11 contacts, **most described a process that places little or no burden on the applicant.** Five indicated that applications are distributed during class, one of whom indicated the process is “automatic at completion” of the course. The other contacts indicated that no specific application is involved. In four cases, the training implementer collects the applicable information from the trainees and submits it to the utility, which either reimburses the implementer or sends a check to the trainee (or the trainee’s employer). Two simply reported either that “the certification paperwork is the application” or that the only requirement for receiving the subsidy was “successful completion of the course.”

Implementers were involved in the subsidy application process only with PAs that claim savings (Table 10). It is not immediately clear why this should be the case, and it is possible that this is a statistical anomaly.¹⁷ However, perhaps PAs that claim energy savings are more likely to work closely with their local BOC implementer to ensure that they capture the information needed to claim the savings.

Table 10. Relationship between Savings Claim and Implementer Involvement in Subsidy Application

Claim or Do Not Claim Energy Savings	Implementer Involvement	
	Implementer Submits Trainee Information to Utility	No Implementer Involvement Reported
Claim energy savings	4	1
Do not claim energy savings	0	6

¹⁶ This excludes the contacts for the California PAs, which do not provide a direct subsidy to students.

¹⁷ The finding was statistically significant by chi-square ($X^2 = 12.44, p < 0.001$). However, the small sample size may be cause for caution (see, for example, <http://allenfleishmanbiostatistics.com/Articles/2012/01/13-p-values-in-small-samples/>). This was not a true random sample of all PAs, and so it is possible that a larger sample would show a different trend.

5. Students’ Motives, Influences, and Experiences

Chapters 3. and 4. show that penetration of BOC training among large employers could be higher than it is in Massachusetts, that certification rates are low in the Commonwealth, and that the majority of BOC students do not apply for the tuition subsidy when a separate application is required. All three of these factors limit the energy savings that the Massachusetts PAs may claim for their support of BOC.

To shed light on these impediments, the evaluation team sought feedback from Massachusetts BOC trainees (graduates and non-graduates) on motives for taking the training, how training costs and the subsidy affected decisions, the training and testing experience, and other topics. The scope of this evaluation did not include surveying BOC trainees from outside of Massachusetts, but the team asked the various PAs about any information they had on the challenges of BOC training, which was compared with the Massachusetts students’ feedback.

5.1 Students’ Motives for Taking BOC Training

Just over half the respondents said they took the BOC training to learn more about energy efficiency or the specific technologies involved (Table 11). Those respondents spoke about their interest in energy efficiency in general or about getting an update on or a more comprehensive understanding of O&M. Somewhat fewer said they took the training at least in part because their boss had recommended or arranged the training (although no respondent reported that the BOC training was a job requirement). Fewer respondents said the certification itself was a reason for taking the training. For those, achieving the BOC credential would highlight the importance or visibility of maintenance in the company, help their town get labeled a Green Community,¹⁸ help them maintain another certification, or otherwise benefit them professionally; most of those respondents also cited learning as a motive.

Table 11. Reasons for Taking BOC Training

Reason	Count
Primary Reason	
To learn about energy efficiency or specific technologies	14
Boss had recommended or arranged the training	11
To obtain the certification	5
Additional Considerations	
To provide career opportunities outside the workplace	4
To increase the chance of a promotion	2

¹⁸ Green Communities is a Massachusetts Department of Energy Resources program to help Massachusetts cities and towns find clean energy solutions by providing technical assistance and financial support for municipal energy efficiency and renewable energy initiatives (<http://www.mass.gov/eea/energy-utilities-clean-tech/green-communities/>).

In response to questioning by evaluation staff, five of the 24 respondents said that influences to take the training included either the possibility of a promotion or of career opportunities outside their current workplace. Those motives overlapped with the certification-for-its-own-self motive—that is, three of the five respondents who cited promotion or career opportunities also had indicated the certification was a motive for taking the training.

Graduates and non-graduates cited similar motives for taking the training.

5.2 Role of Training Costs and the Tuition Subsidy

The evaluation team sought information on whether factors affecting training costs influenced decisions about training. Cost was not a consideration for trainees, as none were responsible for paying their training tuition, all received their salary while in training, and the only out-of-pocket expenses were local transportation costs, which in most cases were reimbursed.

The evaluation team inquired about the influence that a PA tuition subsidy had on the employers' decision to send the respondents to the training. Of the 18 graduates, 12 reported either that they were unaware of whether or not their employer received a tuition subsidy or that their employer had not received a subsidy and so they could not comment on the possible influence a subsidy had on the decision. Of the six remaining graduates and the six non-graduates, eight reported that the subsidy was or may have been influential in the decision to send the respondent to BOC training.

Few of those eight respondents indicated, however, that the subsidy had an absolute or strong influence. For example, one reported that the subsidy was “a piece of” the decision. Three said that the subsidy “probably” influenced the decision, all of whom also said that the employer “would have” or “might have” paid the tuition cost if the subsidy had not been available.

The evaluation team asked all 24 respondents whether they thought a tuition subsidy would influence their employer's decision to send another member of the O&M staff to BOC training. Of the 24 respondents, 13 indicated that a subsidy likely would have an influence.

Taken together, **these results suggest that the tuition subsidy may have a moderate incentive effect on BOC registration.** Put another way, it appears that somewhere between one-third and perhaps two-thirds of subsidized trainees would have taken the training without the subsidy.

5.3 Assessment of the Training and Testing Experience

A large majority of the interviewees indicated that the BOC training met or exceeded their expectations or that they had no expectations but found the training useful (Table 12). Respondents commented on what they liked about the course, most commonly that the topics were appropriate or that they conveyed useful information in general. Seven respondents made positive general comments on the quality of instruction or on specific aspects of the training that they liked (“class participation,” “practical”).

Table 12. Respondents’ Comments about Training and Testing

Comment	Count
Met or exceeded expectations/training useful	21
Course topics appropriate/conveyed useful information	16
Specific topics: tracking utility usage and costs, energy audits, HVAC, electrical	3
Good quality of instruction	7
Did not meet expectations	2

The two respondents who said that the training did not meet expectations were both facilities managers with 20 to 30 years of O&M experience. The first, who took the training because he was “rusty” on EE issues, said 75% to 80% of the course was “redundant” and it mainly “filled in the blanks” but that it probably would influence his upgrade decisions (discussed below). The second respondent, who took the training mainly for an additional certification, also said the training had provided information on capital upgrades.

Three-quarters of the respondents indicated that the training and testing requirements were not particularly challenging and that the testing was appropriate to their level. Those who indicated some level of challenge to the training typically provided some qualification, such as that only some parts of the training were challenging (particularly those not job related) or that the training was challenging “but not beyond comprehension.” Two respondents said that the testing was “challenging,” but further comments indicated that it was not inappropriately so: for one, it “required putting in time and doing homework,” the other “got through it.”

The reports from the Massachusetts students are consistent with what the outside-Massachusetts PA contacts reported. No PA contact reported hearing from students that the training or testing requirements were generally difficult, and one contact even indicated that the examination “may be too easy.” Two contacts specifically noted that the instructors “taught to the test,” one further elaborating that the PA staff and instructors work with students to ensure that they pass. Of eight contacts who reported pass rates, all indicated pass rates above 80% and four reported rates from 97% to 100%.¹⁹

Two PA contacts respondents noted that the degree of challenge depended on the students’ level of work experience or whether or not they had attended college (as the latter influenced test-taking skill) — in particular, students lacking computer experience found energy benchmarking to be the most challenging aspect of training. Again, these reports are consistent with what the evaluation team heard from Massachusetts students.

Taken together, the Massachusetts students’ comments indicate that they did not have particular difficulty with course or test requirements. Thus, **difficulty of training or testing does not likely suppress registration or certification to a significant degree.**

¹⁹ Specific responses were: at least 80%; well above 80%; 85% to 90%; and 87%.

5.4 Reasons for Not Certifying

When asked why they did not obtain certification, four of the six non-graduates indicated lack of time because of competing work obligations and one said that certifying was not “100% relevant” to his work. The last respondent reported the belief that he had certified but that his certification probably had expired.²⁰

In this context, it may be significant that the non-graduates were more likely than the graduates to report having facility or property management responsibility (Table 13). Moreover, while graduates with that type of responsibility were most likely to give their title or position as “facility manager,” non-graduates gave titles with seemingly more general or broad duties (for example, “conservation agent for towns,” “head of department of principal projects and operations,” “building manager for town buildings,” “manager of building trades”). This is consistent with the facts that a higher proportion of the non-graduates than graduates reported having been in their position for more than ten years and that all non-graduates reported having responsibility for multiple buildings.

Table 13. Comparison of Graduates and Non-Graduates on Job Title and Work Tenure

Category	Graduate	Non-Graduate	Total
Title or Position (Counts)			
Owner	1	0	1
Facility/property manager or supervisor	9	5	14
Senior technical staff	3	0	3
Maintenance technician	5	0	5
Other	0	1	1
Work Tenure (Counts)			
Up to 10 years	13	3	16
More than 10 years	3	3	6
Missing	2	0	2

The view of non-graduates as having broader, more general responsibilities is further consistent with the fact that three of them described the impact of training completely in terms of how they interact with others: giving information to the custodial staff; working more with coworkers “on training-related stuff”; communicating with and managing contractors; and improving planning and troubleshooting. None of the graduates described the training impact in similar terms.

The fact that non-graduates appeared to have longer-term and broader responsibilities than graduates, with greater distance from the day-to-day O&M activities, is consistent with the idea that they may have taken the BOC class mainly to understand better what the building O&M staff do and to make more informed executive decisions. For such individuals, certification may not be a high enough priority to be placed ahead of other emerging work demands.

²⁰ The project team followed up with NEEC, the national BOC program implementer, about this case. NEEC confirmed that the respondent had never certified.

5.5 Effect of Training on Students' Work

It was not a goal of this research to assess the impacts of BOC training in any quantitative fashion. However, the evaluation team did ask respondents about the effects that BOC training had on their work to gauge the types of effects.

The respondents varied in the effects they said that BOC training had on their work, with 16 of the 24 respondents indicating that the training had had some effect on O&M activities. Examples include checking correct heating, ventilation, and air conditioning (HVAC) sizing or resetting HVAC controls, pushing to re-commission equipment, carrying out a computerized sequencer upgrade of air compressors, and changing filters. Some responses were less concrete, such as references to more aggressive and comprehensive preventive maintenance, troubleshooting, having more understanding of equipment lifestyle or a greater knowledge base to draw on, looking at things from “theoretical” rather than a “purely mechanical” perspective, and simplifying operating procedures.

Respondents also reported how BOC training affected upgrade decisions. While five graduates and one non-graduate indicated that they were not involved in upgrade decisions, 15 of the remaining 18 respondents reported some positive effect (or likely future effect) of BOC training on upgrades. Eight respondents specifically cited upgrades to lighting, HVAC, chillers, and fans. The others were more general. The evaluation team did not observe any difference between graduates and non-graduates in terms of the types of upgrades described or the level of detail provided.

Three respondents identified barriers to applying what they had learned in BOC training to equipment upgrades or O&M improvements. One noted that he cannot carry out equipment upgrades he learned about because of the building's lease. Another noted that some of the energy-saving O&M activities he learned about in BOC training would require shutting building systems down, which was not possible because of the age of the building. A third respondent said that the constant need to respond to maintenance demands made it difficult to plan and implement changes to O&M practices. This respondent likened the job of building maintenance to “shoveling [waste] against the tide” and said that the building occupants “break stuff faster than we can fix it.”

5.6 Familiarity with and Interest in Level 2 Training

Most of the interviewees (17 of 24), including all six of the non-graduates, were not very familiar with BOC Level 2 training. Four graduates reported moderate familiarity, two reported high familiarity, and one did not report the familiarity level.

After hearing a brief description of Level 2 training, respondents indicated how likely they would be to take the training. Twelve said they were likely to take the training, of whom three indicated they definitely would or were very likely to take it. Two additional respondents said that they would take the training if they received their PA's subsidy. The remaining ten respondents either said they were unlikely to take it or did not know.

The Level 2 topics of greatest interest were preventive maintenance and advanced training in building commissioning and automation systems, but about half the respondents indicated interest in all other topics (Table 14).

Table 14. Interest in BOC Level 2 Topics

Level 2 Topic	Count	Percent
Preventive maintenance	17	71%
Advanced training in...		
Building commissioning	15	63%
Automation systems	14	58%
HVAC	13	54%
Motors	12	50%
Electrical systems	11	46%
Water systems	11	46%

5.7 Summary and Key Findings from BOC Students

The 24 interviewed BOC students tended to be facility or property managers who took the BOC training largely because they were interested in the content or because their boss had recommended or arranged the training. The students in general did not have particular difficulty with either course or test requirements. Half of the students said they were likely to take Level 2 training.

The tuition subsidy may have had a moderate incentive effect on BOC registration, but it appears that between one-third and perhaps two-thirds of subsidized trainees might have taken the training without the subsidy.

Most of the respondents who had input in upgrade decisions, graduates as well as non-graduates, reported that the training influenced them to make energy efficient upgrades, including ones that qualified for the PAs’ rebates. Thus, BOC training may induce savings beyond those from changes in O&M practices and non-incented upgrades—those normally attributed to the training.

The interview findings shed some light on the differences between graduates and non-graduates that may have some implications for the PAs. All non-graduates reported having responsibility for multiple buildings, and most of them reported job titles that indicated high-level and broad responsibilities, with perhaps less direct involvement in day-to-day building operations and maintenance activities as the graduates. This interpretation is consistent with the fact that non-graduates tended more likely to indicate that the training affected O&M practices indirectly, through their interactions with those who actually perform those activities. The fact that none of the non-graduates reported even moderate familiarity with Level 2 training further suggests a level of removal from direct O&M activity.

Four of the six non-graduates said that competing work obligations were what had kept them from certifying. The evaluation team cannot know whether these respondents really had busier work schedules than those who graduates. Some graduates may have had just as busy work schedules but had greater motive to accommodate the certification requirements. The aforementioned student who described the difficulties of staying abreast of emerging maintenance requirements was a BOC graduate, for example. Follow up research with interview questions designed specifically to investigate this particular issue may be valuable.

6. Quantifying BOC Savings

In this Chapter the evaluation team reports the results of the full review of eight studies that quantify BOC savings and discusses the implications for the Massachusetts PAs. Several additional factors that the Massachusetts PAs may wish to consider in determining how to claim savings for BOC training are also discussed.

6.1 Variability of Reviewed Studies' Methodologies

As Table 15 shows, the studies varied considerably in their sample size and makeup, how they collected the data, whether they reported energy savings based only on O&M practices or based on both O&M practices and capital upgrades, how extensively they assessed energy savings actions, and how they calculated net energy savings (that is, energy savings attributable to BOC).

Most studies used telephone surveys to collect data on energy savings actions, but the two most recent studies used online surveys. Those two studies also had two of the three largest samples and, as described below, seem to have used the most rigorous O&M assessment batteries.

Five of the eight studies used close-ended questions to assess O&M practices. That is, they asked respondents whether they had taken specific actions (for example, adjusted equipment set points, tuned up equipment) and how frequently they carried out specific maintenance activities (for example, replacing filters, replacing steam traps). The other three studies assessed O&M practices through open-ended questions—that is, asking what energy-saving measures they had taken, but not whether or not they had taken any specific measure. At least one study asked what energy-saving measure they respondents had taken with specific equipment types, but, again, the questions were open-ended.

For the five studies that used close-ended questions, the evaluation team counted the actual number of questions in the survey instrument that addressed specific O&M actions, including how frequently actions were carried out as well as questions to identify the impact of the action (for example, percentage of floor space affected, horse power or efficiency level of equipment involved). The evaluation team excluded questions that simply identified whether or not the respondent was responsible for a type of equipment. As seen in Table 15, the two most recent studies employed more detailed O&M assessment batteries than did the earlier studies that employed close-ended question, possibly because the online assessment method makes it easier to present a detailed listing of actions to the respondent.

Table 15. Comparison of Research Methodologies of Reviewed BOC Savings Studies

Study	Sample Size	Sample as Percentage of BOC Population	Survey Mode	Level 2 Students as Percentage of Sample	Types of Savings Estimates Reported ¹	O&M Assessment Method ²	Size of O&M Battery ³	Net Savings Assessment Method
NEEA_2014	212	19%	Online	37%	O&M-only and Total	Close-ended	57	0-10 influence scale ⁴
CPUC_2014	77	14%	Online ⁵	Not reported	O&M-only	Close-ended	74	Counterfactual and influence ⁶
ILDCEO_2012	43	52%	Phone	19%	O&M-only and Total	Open-ended	n/a	0-10 influence scale (0-2 = 0)
MEEA_2011	50	DK	Phone	20%	O&M-only and Total	Open-ended	n/a	0-10 influence scale (0-2 = 0)
KCPL_2009	26	33%	Phone	0%	Total	Open-ended	n/a	0-10 influence scale (0-2 = 0)
NEEP_2005	94	13%	Phone	24%	Total	Close-ended	17	Dichotomous influence ⁷
NEEP_2002	49	29%	Phone	Not reported	Total	Close-ended	24	Control group ⁸
NEEA_2001	107	28%	Phone	12%	Total	Close-ended	24	Control group

- ¹ O&M-only means the reported energy are savings based only on reported O&M practices. Total means the reported energy savings are based on O&M practices and non-incented capital upgrades. One published report (NEEA_2014) shows only O&M-only savings, but the study also assessed total electricity savings, which are reported here.
- ² Typically, those studies identified as open-ended assessed O&M actions by asking one or more open-ended questions about respondents' energy-saving measures. In at least one case (KCPL_2009), the researchers asked several such open-ended questions, each one specific to an equipment type. The evaluation team identified a study as using close-ended assessment if it used close-ended questions regarding specific actions (did the respondent perform the actions, how frequently, using what method, and so forth).
- ³ The team counted the actual number of questions in the survey instrument that addressed specific O&M actions, including how and how frequently actions were carried out, as well as questions to identify the impact of the action (for example, percentage of floor space affected, horse power or efficiency level of equipment involved). The team did not count questions that established whether or not the respondent was responsible for a particular equipment type.
- ⁴ Most studies calculated net savings by having respondents rate BOC's influence on energy saving measures with a 0-10 scale, converting the ratings to percentages (for example, a rating of zero equals 0%, a rating of 100 equals 100%), and applying the percentages to gross savings. Three studies counted any influence rating below three (0 to 2) as equal to 0%.
- ⁵ The authors conducted onsite inspections to verify measures for 15 of the 77 respondents.
- ⁶ This study assessed respondent reports of whether they would have taken a given measure absent BOC participation as well as ratings of BOC influence, and applied an algorithm to those assessments to calculate respondent-specific net-to-gross ratios (NTGRs), which they applied to each respondent's gross savings.
- ⁷ This study assessed BOC influence on energy savings measures as a dichotomous variable (influenced or did not influence), and counted only savings from BOC-influenced measures in net savings.
- ⁸ Two studies assessed net savings by subtracting savings assessed for a control group of non-BOC operators from the gross savings assessed for the BOC operators.

All of the reviewed studies used assessed gross savings by assigning a savings value to each identified energy savings measure (O&M practice or upgrade), but they varied somewhat in the exact approach taken. Two approaches illustrate the range of variation.

- The NEEA_2014 researchers assigned a percentage to each identified measure representing the energy savings relative to standard practices, based on measure libraries developed from building retro-commissioning, building tune-up, and O&M program implementation work.
- The ILDCEO_2012 and MEEA_2011 researchers assigned a ratio representing the estimated rigor of each respondent's energy savings actions to a particular equipment type.²¹ They applied the resulting equipment-specific ratios to the estimated maximum savings percentages obtainable through O&M for the various equipment types. This yielded a gross savings ratio for each respondent, which they applied to the respondent's building's estimated baseline consumption.

Finally, **the various studies used a range of methods to assess net savings**—that is, to identify that portion of BOC operators' average energy savings that are attributable to the BOC training. Six of the eight studies used some form of respondent self-report to determine a net-to-gross ratio (NTGR) to assign to the gross savings. The most common of those was to use a 0-to-10 scale to assess BOC influence on energy saving measures and to base the NTGR on the ratings. One study assessed BOC influence on energy savings measures as a dichotomous variable (influenced or did not influence), and counted all (and only) savings from BOC-influenced measures in net savings. Another study incorporated ratings of BOC influence together with respondent self-reports of whether they would have taken a given measure absent BOC participation. It is difficult to assess whether or to what degree the various methods described above affected the final reported net savings results (see below), as about half of the studies reported only net findings and did not report the NTGRs.

Two studies (NEEP_2002 and NEEA_2001) assessed net savings by subtracting savings assessed for a control group of non-BOC operators from the gross savings assessed for the BOC operators. While this would generally be considered the most methodologically pure way to assess net savings, these two studies did not directly assess energy saving actions by the control group. Instead, they based the assessments of those actions on surveys with the supervisors of non-BOC operators. The authors of those studies note the possibility that the supervisors might have over-reported the energy saving actions of their supervisees based on what they expected them to do rather than on what they actually did.

6.2 Reviewed Studies' Savings Estimates

Given the variability in the research methodologies employed, it is not surprising that the studies reported a range of savings values. Table 16 shows the net electricity and gas savings reported among the eight reviewed studies, together with the study sample size and mean building area that the respondents represented.

²¹ The authors of the ILDCEO_2012 report refer to various end-uses, but the project team uses the phrase equipment type to maintain consistent usage in this report.

Table 16. Net BOC-Related Electricity and Gas Savings Reported by Eight Reviewed Studies

Study	Sample Size	Mean Building Area (Square Feet)	Net Electricity Savings (kWh/SF/student)		Net Gas Savings (therm/SF/student)	
			O&M Only	With Capital Upgrades	O&M Only	With Capital Upgrades
NEEA_2014 ^{1,4}	212	432,768	0.315	0.541	0.014	
CPUC_2014 ²	77	Not reported	0.061		0.001	
ILDCEO_2012	43	508,100	0.118	0.374	0.001	0.001
MEEA_2011 ^{3,4}	50	194,500	0.058	0.237	0.006	0.013
KCPL_2009	26	786,000		0.029		0.790
NEEP_2005	94	616,045		0.180		0.007
NEEP_2002	49	671,804		0.180		0.020
NEEA_2001	107	645,461		0.140		

- ¹ The value shown in this table for net electricity savings (0.541 kWh/SF/student) is not in the published report for this study. The value for O&M-only gas savings (0.014 therm/SF/student) is a revised value, not shown in the originally published report but included in a revised version of the report (available at: <http://neea.org/docs/default-source/reports/boc-expansion-initiative-market-progress-evaluation.pdf?sfvrsn=6>).
- ² The researchers reported only savings per BOC student and did not report mean building area per student as they did not consider the reported building size data from their study to be sufficiently precise. To provide an estimate of savings per square foot, the evaluation team divided the study's savings per student by the mean building size (weighted by sample size) from the other seven studies.
- ³ It is possible that this study underestimated mean building size. Ten of the 50 surveyed respondents did not provide data on building size. According to the study authors, those ten respondents "represent university campuses, municipal school districts or casinos — all site types that frequently have multiple buildings and/or with large operator staffs with shared and overlapping responsibilities."
- ⁴ The five PA contacts interviewed all identified one of two studies (NEEA_2014 and MEEA_2011) as the basis of their savings claims.

In addition to the methodological differences described above, other there are other factors to consider in interpreting the findings from the reviewed studies:

1. **The studies vary regarding whether they report savings based only on O&M activities, or savings that include capital upgrades, or both.** Only three studies report both for electricity and only two report both for gas. This makes it difficult to assess whether there is a consistent ratio between savings based on O&M and those based on capital upgrades.
2. **There appears to be a trend for increasing estimates of electricity savings over time, especially when capital upgrades are considered.** This trend is more difficult to evaluate with gas savings and with O&M-only electricity savings because fewer studies report on those metrics. Furthermore, only the most recent studies report O&M-only savings.
3. **Assessment of savings from capital upgrades poses a special issue that does not apply to assessment of O&M-related savings.** O&M activities are "regular" or "day-to-day" activities — they can be assessed on a basis of how or how often they are performed "usually," but capital upgrades cannot be assessed on that basis. A given capital upgrade occurs once. Large upgrades must be planned for, sometimes over several years, and so do not occur annually. Assessment of annual BOC savings, therefore, must be based on average annual savings from capital upgrades.

Given the variable timing of capital upgrades, producing a reliable estimate of average annual savings from capital upgrades would require large samples and/or assessment of upgrades over a multi-year period. None of the reviewed studies assessed upgrades over a multi-year period, and most have sample sizes that are probably too small to produce a reasonably reliable estimate of average annual savings from capital upgrades.²²

Given the above considerations, the evaluation team believes that a weighted mean of the various savings estimates from the four most recent studies provides a reasonable estimate to use. Note that the five PA contacts interviewed all identified one of two studies (NEEA_2014 and MEEA_2011) as the basis of their savings claims, both of which were among the four studies that comprise the weighted mean.

Table 17 shows the weighted mean estimates.²³ The overall approach was to weight the mean savings values by the studies' sample sizes, so that studies with larger sample sizes had greater weight. This is a reasonable approach, all other things equal, since a larger sample produces a more reliable result. However, we determined that weighting on sample size alone would not be satisfactory. Among the four most recent studies (indeed, among all studies), the sample size correlated positively with the percentage of Level 2 students in the sample. Therefore, weighting by sample size tends to produce a bias toward more Level 2 students. Since the percentage of Level 2 students in the sample also correlated positively with the studies' mean savings values, weighting by sample size also tended to bias results toward higher mean savings values.²⁴ To correct for this bias, we first weighted the studies' sample sizes by the percentage of Level 2 students before using the sample sizes to calculate weighted mean savings values.²⁵

Table 17. Weighted Mean Estimates of O&M-Only and Total BOC-Related Energy Savings from Four Most Recent Studies

	Electricity (kWh/SF/student)	Gas (therm/SF/student)
O&M-Only	.178	.007
Total (O&M plus Capital Upgrades)	.364	.011
O&M-Only as Percentage of Total	49%	65%

²² It is difficult to estimate the sample size required, or the precision likely to occur with a sample of a given size, without some assumptions about how frequently upgrades of various sizes occur.

²³ Three of the four most recent studies provided both O&M-only and Total (O&M plus capital upgrade) savings estimates for electricity and two provided both types of estimates for gas. From those, the evaluation team calculated the mean ratio between O&M-only and Total savings estimates (weighted by sample size) and used that ratio to estimate one or the other type of estimate in the three instances where there was no estimate of a type.

²⁴ Based on national BOC data, about 18% of BOC graduates have Level 2 certification. Two of the four most recent studies reported similar levels of Level 2 students in their samples, while 37% of the sample in the largest study (NEEA_2014) had Level 2 certification. Therefore, weighting purely on sample size appears to produce results that may not be representative of the overall population of BOC students.

²⁵ For each study, we calculated the sample size weight as the unweighted overall mean percentage of Level 2 students divided by the percentage of Level 2 students reported for that study. One study did not report the percentage of Level 2 students. For that study, we assigned a weight of 1.0.

6.3 Additional Considerations

Based on input from Massachusetts PAs, our review of the studies, and past evaluation experience, the evaluation team has identified the following issues that the PAs may wish to consider in determining how to claim BOC savings:

- Whether and how to account for multiple BOC-trained operators at a given site;
- Whether BOC Level 2 certification produces more savings than Level 1 certification;
- How many years of energy savings might be claimed for subsidizing someone's training;
- Whether certification (as opposed to just course completion) is a reasonable requirement for claiming savings for subsidizing someone's training;
- Whether different savings estimates might apply based on building end-use; and
- What proportion of the estimated training-related savings a PA might reasonably claim for subsidizing the training.

6.3.1 Accounting for Multiple BOC Operators at a Site

With regard to the first issue, the question is whether adding BOC-trained operators to a site produces additional energy savings and, if so, by what increment? Authors of at least two of the reviewed studies (KCPL_2009 and NEEP_2005) reported methods to account for having multiple BOC-trained operators at a given site in estimating per-square-foot savings and/or extrapolating savings estimates to the population. However, this does not speak to the issue of whether or not the savings per square foot are greater in those sites with multiple BOC operators than in those with a single operator, nor of the incremental increase in savings, if any. This remains an empirical issue.

There are reasons to believe that increasing the number of BOC-trained operators at a site could increase the overall savings at that site. First, it is not necessarily the case that all operators at a given site have the same equipment responsibilities. In re-analyzing data from NEEA_2014, the evaluation team identified 48 sites that contributed more than one survey respondent.²⁶ For each of those sites, the team calculated an overlap coefficient as the number of equipment types for which more than one survey respondent indicated responsibility divided by the number of equipment types for which at least one respondent indicated responsibility. The mean overlap coefficient across the 48 sites was .37, indicating that the various respondents for a site, on average, shared responsibility for about one-third of the equipment types. This suggests that additional trained operators may contribute unique savings.

Second, even if multiple operators are responsible for a given equipment types, having additional BOC-trained operators may help O&M staff overcome barriers to implementing the energy saving measures that BOC training teaches. MEEA_2011, KCPL_2009, and NEEP_2005 all reported that respondents cited time constraints as a barrier to implementing energy efficiency measures. As described in Section 5.5 , above, several of the BOC participants the evaluation team interviewed also identified time constraints as a barrier to implementing changes. It is conceivable that increasing the number of BOC-trained operators could create greater momentum for implementing practices learned in BOC training.

²⁶ Each site was represented only once in the energy savings estimates. Thus, the sample size for energy estimates shown in Table 16, above, is 212 work sites, but the evaluation team actually had 329 survey respondents.

In addition, multiple certified operators increase the likelihood that savings persist as operators change employers or retire.

6.3.2 The Number of Years of Savings Claimed

Massachusetts and other PAs vary in the number of years over which they claim savings for subsidizing BOC training. National Grid claims savings only for the year that a subsidized student becomes certified, while Cape Light Compact claims savings for five years, starting from the year of certification (that is, they claim savings for a five-year measure life for BOC-training-induced savings). PAs outside of Massachusetts were similarly split between those claiming energy savings one versus five years for each subsidized student.

It is reasonable to believe that if BOC training induces changes in upgrade decisions and O&M practices that result in energy savings, then those changes likely persist beyond the year in which the training occurred, generating continued savings. At least two of the reviewed studies on BOC savings (NEEA_2014 and NEEP_2005) examined the issue of persistence of savings from BOC training, both finding evidence of persistence. On the basis of the NEEP_2005 study, NEEA established a five-year measure life for BOC certification.

The NEEA formula for claiming savings over a five-year measure life differs from the approach described by the PA contacts interviewed for the present evaluation. All interviewed PA contacts who indicated they claimed savings for five years reported that the five years started at the initial certification. By contrast, for NEEA, the five-year life does not begin until the *expiration* of certification—which, if a certified operator maintains certification through the annual renewal process, may occur many years after initial certification. In other words, so long as someone continues to renew certification (either Level 1 or Level 2)²⁷, the five-year “clock” never starts. Given that the annual renewal process requires continuing education, it is reasonable to expect that savings-generating changes in upgrade decisions and O&M practices will persist while certification is maintained. The NEEA_2014 study supported the NEEA practice of counting savings for five years *after* expiration of certification.

Analysis of the national BOC database showed the median tenure of certification to be about three years nationwide, and about five years in Massachusetts.²⁸ Therefore, by the NEEA formula, the median measure life for BOC certification, among those who remain in the workforce, is about eight years nationally and about ten years for Massachusetts. This means that counting savings for some set period of time (five years, for example) for each subsidized customer would under-count savings.

²⁷ For BOC, obtaining Level 2 certification automatically renews Level 1 certification.

²⁸ The evaluation team determined this by calculating the number of all BOC graduates who remained certified for a given number of years as a percentage of all those who *could have* been counted as having remained certified for that number of years. (The database shows certification tenures to 2016, so a graduate could have been counted as having remained certified for seven years only if that graduate received certification in 2009 or earlier; therefore, only graduates who received certification in 2009 or earlier went into that calculation; and so forth for other calculations.) Nationwide, 53% of graduates who received certification in 2013 or earlier remained certified at least three years, so the team determined that the median is about three years. The team determined the median for Massachusetts in a similar fashion.

6.3.3 Claiming Different Savings Amounts for Level 1 and Level 2 Certification

There may not be sufficient information to answer the question of whether it is reasonable to claim a higher level of savings for subsidizing BOC Level 2 certification than for Level 1 certification. Most of the reviewed studies included Level 2 students in their samples, but none reported savings estimates separately for those students. (The sample sizes would have been too small for anything approaching a reliable estimate.) However, the percentage of Level 2 students in the study sample correlated positively with the studies' mean savings values. Moreover, the evaluation team re-analyzed data from NEEA_2014 and found that the mean estimated energy savings for the 74 sites represented by Level 2 BOC students were higher than for those represented by Level 1 students: 80% higher for electricity and 87% higher for gas.

The team cannot conclude, however, that it was the additional training that produced the greater savings. It is possible that the operators who take Level 2 training are more experienced, on average, than those who do not take Level 2 training, and so would have produced greater savings than other operators even if they had not taken the Level 2 training.²⁹ What is needed to answer this question is either to assess savings for some group of operators before and after they take Level 2 training or to statistically control for every difference between Level 1 and Level 2 trainees that might likely account for a difference in energy savings.

In any case, this issue of assigning different savings for Level 1 and Level 2 may be moot for two reasons. The first is a practical consideration. Most of those who take Level 2 certification do so soon after they have taken Level 1 certification. From the BOC national database, we calculated that two-thirds of Level 2 students took that certification within one year after their Level 1 certification, and more than 90% did so within three years after Level 1 certification. Therefore, most Level 2 certification tenure overlaps to a large degree with Level 1 tenure. This means that assigning different savings values to Level 1 and Level 2 certification would require tracking the number of years each BOC graduate has each level and assigning the appropriate savings level. This may be impractical for many PAs.

The second reason is that, since the mean savings values from the existing studies – and from our weighted mean of the most recent ones – represent a blend of Level 1 and Level 2 students, then they are most meaningfully applied to a blend of Level 1 and Level 2 students. That is, the findings from the reviewed studies do not support assigning different savings values to Level 1 and Level 2 students. From the national BOC database, we calculated that about 15% of Level 1 years (over the first eight years following certification) are also Level 2 years.³⁰ This is close to the composition of Level 2 students in our weighted mean estimate of BOC savings. Therefore, our estimate is a good representation of the mix of Level 1 and Level 2 graduates over the first eight years following Level 1 certification.

²⁹ In fact, the Level 2 respondents in NEEA_2014 were responsible for more equipment areas, on average, than were the Level 1 respondents (5.8 vs. 4.9), but that 20% difference in number of equipment areas would not by itself explain the at least 80% advantage in savings. Nor was the difference attributable to differences in the types of equipment they were responsible for – about 10% to 30% more of the Level 2 than Level 1 respondents reported responsibility for all equipment types.

³⁰ To calculate this, we multiplied the total number of Level 1 graduates by eight (the number of years for which we are recommending claiming savings) to produce the denominator. The numerator was the total number of Level 2 graduates multiplied by eight minus the mean lag between Level 1 and Level 2 certification.

6.3.4 The Importance of Certification, Per Se

The Massachusetts PAs that subsidize BOC training claim energy savings only for those trainees who complete the requirements for certification. This seems to be a reasonable and conservative practice. The additional certification requirements (such as a work-related project) conceivably could help reinforce the information presented in the classroom, to ensure that the students will apply it in their jobs. Moreover, absent any other information, it may be reasonable to assume that the effort to complete the certification requirements itself signals the intention to apply the learning more strongly than does merely completing the classes.

It should be noted, however, that the evaluation team did not identify any empirical evidence that certified operators actually save more energy than do those who did not complete the certification requirements. Most or all of the reviewed studies on BOC savings surveyed all or mainly certified operators to provide the information for the savings estimates.³¹ Even among those few that did not specify that all survey respondents were certified operators, none reported any differences between certified and non-certified operators in energy-saving actions.

In the present evaluation, the interviewed graduates (certified) and non-graduates (non-certified) did not appear to differ qualitatively in their descriptions of how BOC training influenced their equipment upgrade decisions (see Section 5.5). However, the non-graduates appeared more removed from day-to-day O&M practices, which could conceivably translate to less actual influence on how those practices are performed.

6.3.5 Claiming Different Savings Amounts for Different Building End-Uses

One thing that is relevant to a discussion of how to claim energy savings for support of BOC training is whether the same savings estimate should be applied for all market subsectors. Most of the reviewed research did not attempt to assess savings levels specific to particular subsectors; in fact, most did not have adequate sample sizes to do so reliably. Two studies, however, provide some evidence that BOC-trained operators who work in schools may not achieve quite as much savings as those that work elsewhere.

NEEP_2005 found that the BOC electricity savings (kWh/square foot/graduate) in schools ($n = 45$) were 65% the savings in other types of end-uses ($n = 49$), when savings from capital upgrades were included. Schools had 75% the O&M-only savings of non-schools. By contrast, NEEP_2005 found almost the exact opposite results for gas savings: when capital upgrades are included, non-schools had 72% the gas savings (therms/square foot/graduate) that schools had; they had 80% the O&M-only savings.

The project team re-analyzed data from NEEA_2014 and found results that were similar to the NEEP_2005 electricity results—specifically, the O&M-only electricity savings in schools ($n = 54$) were

³¹ While some of the reports specified that all survey respondents were certified, others did not make that clear. However, any of the studies carried out in the Midwest likely would have had all or mainly certified operators, given the very high certification rates in that area.

72% of those in all other end-uses combined ($n = 156$). In contrast to NEEP_2005, however, the team found that schools also had lower gas savings than non-schools (87% as much).

The NEEA_2014 sample had enough cases from several subsectors (government, higher education, health care) to provide at least somewhat reliable data on differences in savings levels. Table 18 shows the relative differences in BOC energy savings among those groups, together with the NEEP_2005-reported differences between non-schools and schools. To facilitate comparisons, the evaluation team shows the savings for each non-school group as a percentage of the savings for schools.

Table 18. Relative Differences in BOC Energy Savings among Market Subsectors

Type	Non-School Savings as Percentage of School Savings					
	NEEA_2014			NEEP_2005		
	<i>n</i>	Electricity	Gas	<i>n</i>	Electricity	Gas
K-12 Schools	54	100%	100%	45	100%	100%
Non-Schools	156	139%	115%	49	133%	80%
Government	60	295%	217%			
Higher education	25	160%	159%			
Health care	30	125%	77%			
Other	41	58%	91%			

The above analysis again shows that non-schools appear to have greater BOC-related energy savings than schools, but it goes even further to show that savings in government-owned buildings appear to be the greatest of all groups. This may reflect policy-driven decisions in government-owned buildings or the ability to make decisions based on longer-term paybacks than are often considered for commercially owned buildings. Note that hospitals show the lowest relative savings levels, which is consistent with the frequently reported observation that healthcare buildings face specific challenges to achieving energy efficiency in addition to the general challenges other building types face.³²

6.3.6 The Proportion of BOC-Induced Savings to Claim

A final consideration in determining how to claim BOC-induced savings might be the proportion of a given subsidized student’s savings that are attributable to the subsidy. This might be a particular concern if a PA claimed savings for a multiple-year measure life for BOC training. In such a case, it may not be reasonable to claim all of the savings that subsidized students produce if they would have produced some portion of those savings without the subsidies. Recall, however, that even claiming savings for five years from the year of certification may not represent the full measure life for BOC training (see *The Number of Years of Savings Claimed*, above). It does not seem reasonable to discount the savings claimed by a PA that is claiming fewer years of savings than the BOC training likely is producing.

³² For example: Singer, B.C. and Tschudi, W.F. (2009). *High Performance Healthcare Buildings: A Roadmap to Improved Energy Efficiency*. Prepared for the California Institute for Energy and the Environment by the Ernest Orlando Lawrence Berkeley National Laboratory, Report LBNL-2737E. Accessed on March 23, 2015 at: <http://hightech.lbl.gov/documents/healthcare/lbnl-2737e.pdf>.

7. Review of Other Energy Efficiency Education and Training Programs

Through implementation of the BOC program, program administrators in Massachusetts have developed a capacity to provide adult education and training focused on energy efficiency. To identify opportunities for program administrators to expand on this capacity in other areas, the evaluation team conducted a review of industry literature. This review sought to identify programs targeting the nonresidential sector, for which education and training was a key program activity. This review drew on industry literature including conference papers, evaluation reports, and program websites.³³

The programs identified through this review fall into three broad categories based on the actors they target and the objectives they hope to achieve, as described in Table 19.

Table 19. Types of Non-Residential Programs Incorporating Adult Education and Training

Program Type	Target Population	Objectives
End-Use-Specific Technical Programs	Equipment operators	Adoption of efficiency opportunities regarding a specific type of equipment
Strategic Energy Management (SEM)	Operations staff and organization leadership	Organization-wide adoption of continuous improvement processes to monitor energy use and increase energy efficiency
Occupant Engagement Programs	Building occupants	Increased attention to energy use and adoption of efficient behaviors among building occupants
Municipal Engagement Programs	Municipal facility managers; departments of planning, building code enforcement, and sustainability	Reduce municipal facility building energy use; reduce community energy consumption in both new and existing buildings
Federal Education and Training Efforts	Energy efficiency workforce	Increase workforce energy efficiency skills

The following sections describe these three program types and programs reviewed.

7.1 End-Use-Specific Technical Programs

This category of programs provides classroom and onsite training and coaching to enable equipment operators to identify and implement energy-saving opportunities for specific types of equipment. The three end-use-specific programs reviewed focus on refrigeration systems, which have specialized maintenance needs. The programs offer training or certification to refrigeration operators to ensure ongoing operational efficiency and appropriate equipment maintenance, as well as to encourage retrofit upgrades. Two of the programs address industrial refrigeration and one addresses commercial refrigeration

³³ Comprehensive list of references is provided at the end of the report.

7.1.1 Energy Trust of Oregon: Refrigeration Operator Coaching

The Energy Trust of Oregon launched its Refrigeration Operator Coaching (ROC) program in 2011. The program trains and supports companies that operate large industrial refrigeration systems — generally those consuming over 3.5 million kWh per year for refrigeration — to make low- and no-cost O&M improvements that result in measurable energy savings.

Energy Trust requires participating companies to appoint an executive- or management-level “sponsor” (for example, a plant or maintenance manager) as well as a “refrigeration energy champion.” The sponsor ensures adequate budget, staff, and other resources are available to implement and report on ROC efforts. The sponsor also works with the energy champion to develop realistic ROC goals and timelines. The champion attends all ROC training sessions, and implements, manages, and tracks ROC efforts.

ROC combines classroom-style learning at host facilities — there are six half-day workshops over an eight month period — with onsite technical support, whole-facility energy modeling, and energy performance tracking. Workshops cover compressor, condenser, evaporator, and defrost optimization; energy performance tracking and controls; and savings persistence. The attendance of representatives from multiple companies at the workshops enables peer-to-peer learning since the workshops emphasize attendee participation in the discussions. Workshop attendees tour the host facilities. They are expected to take the low- and no-cost O&M information they glean from each session, apply it to their own facility, and report back to the group during the next workshop. ROC sends an experienced refrigeration technician to each participant’s facility each month to provide the energy champion with tailored assistance in implementing O&M improvements discussed at the workshops. ROC also provides two years of web-based, (nearly) real-time energy performance tracking support.

ROC assists participants in developing energy use baselines, and then uses regression modeling to calculate energy savings. Participants in the 2011 and 2012 ROC programs averaged 12.6% refrigeration system savings and 6.7% facility-wide savings, primarily through implementing ongoing maintenance and adjusting set points and equipment staging.

7.1.2 Northwest Energy Efficiency Alliance: Certified Refrigeration Energy Specialist

A recently launched certification offering is the Certified Refrigeration Energy Specialist (CRES), which began in 2013. Northwest Energy Efficiency Alliance contributed to the development of and supports the certification through its CRES initiative. The certification itself is offered by the Refrigerating Engineers & Technicians Association (RETA), which also offers two safety-focused certifications. To achieve CRES certification, participants must achieve a score of 70% or greater on a test comprised of 135 multiple-choice questions covering topics including refrigeration basics, energy efficiency basics, refrigeration best practices, best practices for other systems, and overall facility energy management. To receive the certification, participants must also complete and document five activities to improve energy efficiency in a refrigeration facility over the 18 months following the test. In the three years following the test, the participant must complete and document six more activities to improve energy efficiency and complete at least 12 professional development hours. The test costs \$495 for members of RETA and \$670 for non-members.

According to a baseline study by Research into Action, CRES certification is projected to save from 3% to 12% of energy costs through low and no-cost operations and maintenance measures. Owing to the relatively recent start of the program, there are no current data on the training uptake.

7.1.3 Northwest Energy Efficiency Alliance: Grocery Initiative (Commercial Refrigeration)

Through its BetterBricks effort, NEEA offered education and training services to design architects, refrigeration designers, and grocery chains, and refrigeration service providers to improve refrigeration energy efficiency in grocery stores. As part of this effort, BetterBricks contracted with a refrigeration service consultant to conduct in-store refrigeration tune-up demonstrations and classroom seminars to train refrigeration service providers in energy efficiency maintenance services. The refrigeration expert conducted trainings within stores (accomplishing a system tune-up while educating chain staff and their refrigeration service providers) and seminars in locations that were attended by contractor service provider firms. One participating grocery store achieved 9% energy savings through one of the refrigeration tune-ups.

7.2 Strategic Energy Management (SEM)

Strategic Energy Management (SEM) programs encourage large commercial or industrial customers to actively manage their energy consumption. SEM is a holistic approach to managing energy use as part of a continuous improvement processes. These programs typically support customers in monitoring their energy use and identifying opportunities for efficiency improvements in systems operations, maintenance activities, equipment upgrades, and – for some programs – occupant behavior changes. Some SEM programs reference, support, or assist organizations in achieving ISO 50001 certification, an organization-wide standard for energy management systems.

Because SEM programs seek to identify solutions tailored to the facility and organization, seeking ultimately to establish an internally driven continuous improvement process within the participant's organization, activities to engage, train, and support to key individuals constitute a central role in SEM offerings. SEM programs target multiple levels of employees within an organization, including executives and facility managers, and focus on improving processes and behaviors more than capital project implementation.

Given that program administrators can offer several different programs under the banner of their SEM program, it is most instructive to examine the programs categorized by administrator.

7.2.1 Bonneville Power Administration: Energy Smart Industrial

Bonneville Power Administration's SEM program, called Energy Smart Industrial (ESI), has three key energy management components: Energy Project Manager (EPM) Co-funding, Track and Tune, and High Performance Energy Management (HPEM). Participants can use each component individually or in any combination depending on the needs of the organization.

The EPM component of the program seeks to establish an individual to represent management and act as an energy champion responsible for energy savings at participating facilities. This person also acts as the primary contact point for other parts of the ESI program with which the company engages. BPA subsidizes the salary of the energy project manager working in participant organizations at \$0.025 per kWh saved through the individual's efforts, up to the full salary of the project manager.

The Track and Tune program component focuses on low- and no-cost operations and maintenance improvements. Program consultants perform focused audits and make improvements based on the results of the audit. The consultants work closely with facility staff. In addition to their immediate improvements, the consultants collaborate with facility staff to develop an action plan for additional improvements the facility will implement. The program also provides funds to install a system that will allow the participant to track their energy performance if one is not already present. The program provides participants incentives based on their initial energy savings, as well as measured sustained savings for up to five years.

HPEM is the most comprehensive component of BPA's strategic energy management program, providing training and support to organizations interested in establishing a continuous improvement system for energy management. The program delivers monthly training sessions to cohorts of representatives from different types of industrial facilities. These trainings help participants to engage management and create an energy efficiency plan. If the management commits to the plan, a HPEM trainer assists the organization in implementing the action plan for the first three to six months. The participating firms track progress and at the end of the year to reassess their efforts and continue the process. The program offers incentives based on the energy savings a facility achieves.

7.2.2 Efficiency Vermont: Continuous Energy Improvement

Like BPA's HPEM offering, Efficiency Vermont's Continuous Energy Improvement (CEI) program pilot, which launched in 2014, works with cohorts of commercial and industrial participants. Participants attend four workshops over the course of one year and have monthly check-in meetings with a subset of their cohort. The program seeks to engage its participants in energy savings at all levels of the organizational structure, with participants assigning a corporate sponsor to their energy management efforts. CEI has four key components: capital upgrades, process improvements, maintenance, and employee engagement. Unlike many other SEM programs, CEI does not offer performance based incentives, but subsidizes the cost of software and metering, training by staff or third party contractors, and some capital projects.

7.2.3 Focus on Energy: Practical Energy Management

Wisconsin's Focus on Energy developed its Practical Energy Management (PEM) program to encourage participants to identify and implement efficiency opportunities on an ongoing basis. Participants attend three two-hour training sessions over a five-week period, covering ways to track and report energy use, identify energy savings opportunities, create an energy team, and set energy savings goals and performance indicators. There are three variants of PEM training focusing on different sectors: Commercial, Industrial, and Schools. PEM gives program participants samples of documents, procedures and strategies to support establishing energy management processes. A 2015 Cadmus evaluation found that PEM participants, on average, achieved first-year savings of 42,603 kWh and 217 therms.

7.2.4 Energy Trust of Oregon: Industrial Energy Improvement and Commercial Strategic Energy Management

Energy Trust of Oregon offers a SEM program for industrial customers called Industrial Energy Improvement (IEI) and one for commercial customers called Commercial Strategic Energy Management (CSEM). In both programs, participants attend workshops and receive individual assistance over the course of a year as members of cohorts of companies. Energy Trust organizes cohorts with firms that are

not in the same markets and do not compete with each other. The workshops walk participants through the process of establishing a strategic energy management system within their organization, including assessing opportunities and monitoring their progress. To help gain buy-in for recommended improvements across the participant's organization, Energy Trust requires each participant to designate both an energy champion, who will lead the facility's energy management efforts, and an executive sponsor. Both programs offer an incentive of \$0.02/kWh and \$0.20/therm. The first cohort of IEI participants in 2010 was able to reduce their total consumption by 7.9% from the baseline.

7.2.5 NEEA Commercial Real Estate (CRE) Initiative

Since 2007, the Northwest Energy Efficiency Alliance (NEEA) has encouraged the Northwest's commercial real estate firms to engage in SEM, currently through its Commercial Real Estate Initiative (CRE), and previously through CRE's predecessor, the BetterBricks Initiative.

Five components characterize SEM for NEEA's CRE participants:

1. Adoption of a management-approved energy performance improvement goal at the firm, portfolio, and/or building level;
2. Documented planned activities to achieve the goal;
3. Allocation of resources (staff and training, capital, or both) toward the goal;
4. Implementation of planned activities;
5. Regular management review of progress achieved toward energy performance goal and effectiveness of SEM practices.

The CRE Initiatives incorporates four subcomponents: the Market Partners Program (MPP), participants in which NEEA refers to as its MPP cohort; office energy efficiency competitions, with participants termed the Office Competition (OC) cohort; industry education and training; and additional marketing communications.

NEEA engages Northwest commercial real estate firms with portfolios of properties to join the MPP cohort to receive over a several year period organizational coaching and additional training and support. In contrast to the individual support provided to MPP participants, any firm can access CRE's industry education and training efforts, which build skills within the sector through professional seminars and workshops delivered by market allies. Past workshops have addressed integrated design, building commissioning, sustainable design, advanced building guidelines, and multiple lighting topics, including retrofits, emerging technology, office lighting, and daylighting.

The office competitions promote the adoption of operations and maintenance best practices, benchmarking, goal setting, energy management action planning, and reporting on results. The competitions engage individual facilities in reducing annual consumption; facilities can participate for a single year or in successive competitions. Evaluations of the competitions indicate they have resulted in significant energy savings for the region. NEEA has delivered the competitions in partnership with market allies such as Building Owners and Managers Association (BOMA).

In addition to MPP, OC, and training specific to the commercial real estate sector, CRE develops and provides case studies, analytic tools, and templates to encourage and facilitate the adoption of energy efficiency continuous improvement.

NEEA partnered with BOMA at the outset of its commercial real estate activities. BOMA had recently begun offering webinar trainings on energy efficiency that it continues to offer today: the BOMA Energy Efficiency Program (BEEP) trainings. BEEP trainings include an introduction to energy performance and covered energy performance benchmarking, energy efficient audit concepts and economic benefits, no- and low-cost operational adjustments to improve energy performance, valuing energy enhancement projects and financial returns, and building an energy performance awareness program. NEEA partnered with BOMA by subsidized and helping to execute the BEEP series as in-person training at several cities in the region; attendance exceeded the normal webinar attendance.

7.3 Occupant Engagement Programs

In contrast to end-use specific and SEM programs, which focus on the facility managers who operate and maintain a building, occupant engagement programs focus on a building's occupants. These programs tailor their implementation to the design, specific uses, and operations of each participating building. In addition to communicating desired energy-saving behaviors to building users, these programs target occupant groups like office workers by engaging senior management and other staff. The programs provide these staff members with training, incentives, and campaigns to encourage—and build social norms supporting—more energy-efficient behaviors. Trainings in energy-efficient (and sometimes other sustainability) practices are typically offered to a small number of people from each participating office, or building. The programs anticipate that these trained workers will share the information they glean from the trainings with coworkers, establish continuous feedback and communication mechanisms, and potentially initiate contests and other occupant engagement efforts.

7.3.1 Duke Energy: Smart Energy Now

Duke Energy administered the Smart Energy Now (SEN) pilot program in partnership with Charlotte, North Carolina's Envision Charlotte³⁴ program, with the goal of achieving operational efficiencies in participating buildings. The program offers "energy champion" trainings for office staff, which is coordinated with a succession of targeted conservation campaigns. The program expects that trained energy champions will help to deliver the program's messages in their respective offices. The program also provides continuous feedback on participants' energy use at the building-level and facility operator professional development. SEN initially targeted commercial buildings in Charlotte's urban core over 10,000 square feet, with at least 50% of the space used for offices. Recognizing that the program was applicable to a wider variety of commercial buildings, Duke Energy expanded the program in 2014 to office buildings throughout North Carolina with at least 10,000 square feet of office space.³⁵

An impact evaluation prepared for Duke Energy in 2014 showed the program resulted in net electricity savings of 6.2%. The evaluation found the greatest savings in larger buildings: buildings with at least 100,000 square feet averaged net electricity savings of 6.4%, and buildings under 100,000 square feet averaged 1.1% net electricity savings. An earlier evaluation of the program found that older buildings and those that had not recently been renovated realized the greatest savings. In 2014, Duke Energy

³⁴ Envision Charlotte is 501(c3) charitable organization. Its board is composed of representatives from local government agencies, businesses, universities, and non-profit organizations.

³⁵ As of July, 2014, due to the program's success, Duke Energy was also considering rolling SEN out in its Florida, Indiana, Ohio, and Kentucky service areas.

received approval from the North Carolina Utilities Commission to move the SEN pilot program into a full-scale program called Smart Energy in Offices.

7.3.2 BC Hydro: Workplace Conservation Awareness

BC Hydro's Workplace Conservation Awareness (WCA) initiative encourages participating commercial customers to promote specific energy-saving behavioral changes to their staff members, with the long-term goal of cultivating a workplace ethic of energy savings. The initiative targets large public and private sector commercial customers. By 2013, the program had expanded from a base of ten organizations in 2007 to include 30 large customers that collectively represented over 300 buildings. Participants span six building types: higher education, K-12 schools, healthcare, municipalities, property management (office buildings), and retail/hospitality.

Under WCA, BC Hydro assigns a consultant to each program participant to help with planning, implementing, and reporting their efforts. Participants are required to obtain buy-in from senior management; assemble energy champions and a green team to plan, implement, and evaluate (using pre- and post-activity surveys) WCA activities throughout the year; and submit quarterly progress reports to BC Hydro. WCA targets behaviors such as turning off lights, computer equipment, and other office equipment when not in use, enabling equipment power-saving settings, adjusting artificial and natural lighting levels to match lighting needs, and adjusting window coverings to retain heat in the winter and deflect heat in the summer.

An evaluation the 2011 and 2012 WCA initiatives estimated gross electricity savings of 3.1% and 1.3%, respectively.³⁶ Participants reported they appreciated the consultant assistance, were excited about promoting energy-saving behaviors, and thought their participation in WCA had a positive effect on other environmental initiatives underway at their organizations.

7.4 Municipal Engagement Programs

Both New York and California are engaging municipalities in energy efficiency by providing education, training, peer-to-peer learning and other types of support in addition to technical assistance and incentives.

- **Community Partnership Program**, a new initiative still in the pilot stage, is sponsored by the New York State Energy Research and Development Authority (NYSERDA), the New York Power Authority (NYPA), and the New York State Governor's Office. The program provides the state's municipalities and constituency-based organizations with support to meet greenhouse gas (GHG) emission reduction goals, create green jobs, and decrease energy use, among other goals. The program offers information on opportunities, guidance on approaches, and assistance with execution.
- **California Statewide Local Government Partnership Programs** support local governments (cities, counties, and collaborations of municipalities) in three areas:

³⁶ The evaluation authors, however, noted that the savings estimates were not precise because the savings were small relative to participants' total consumption, occupancy and other site-specific information was not available for all participants, and there were a small number of participants for some building types.

- Conducting municipal retrofits, including technical assistance for retrofit projects and enhanced incentives to offset project costs.
- Conducting community programs, including community outreach and education; technical assistance for program management, training, and audits; small business and municipal direct install activities; and promoting utility offerings.
- Supporting the California's *Long Term Energy Efficiency Strategic Plan*, including developing building energy codes that "reach" beyond the state's minimums, supporting code compliance, encouraging communities to create and adopt Energy Action Plans and Climate Action Plans, providing peer-to-peer support, providing guidance documents, and providing community financing (PACE).

7.5 Federal Education and Training Efforts

At the federal level, the U.S. Department of Energy (DOE) has taken steps to support energy efficiency education and training through the Better Buildings Workforce (BBW) initiative, a division of its Better Buildings Program. These projects seek to promote methods and standards to approach energy efficiency projects in commercial environments. BBW currently has four ongoing projects:

- **Better Buildings Workforce Guidelines (BBWG)** promotes the development of credentials for key building energy related jobs based on uniform standards. Currently BBWG is working with the National Institute of Building Sciences to promote voluntary national standards for credentialing Building Energy Auditors, Building Commissioning Professionals, Energy Managers, and Building Operations Professionals.
- **Building Re-tuning Training (BRT):** DOE developed BRT curriculum in partnership with Pacific Northwest National Laboratory. The curriculum is focused on re-tuning commercial buildings both with and without building automation systems. The DOE's objective is to spread the program throughout the country using a train-the-trainers approach. There are currently six organizations offering the training.
- **American National Standards Institute (ANSI) Energy Efficiency Standards Collaborative:** The Energy Efficiency Standards Collaborative is tasked with gathering technical standards for the energy efficiency industry. EESC is intended to make an inventory of standards, perform a gap analysis, and develop a roadmap for future standardization needs, but not to develop its own standards or commission the creation of such.
- **Energy Performance Based Acquisitions Training (EBPAT):** According to the DOE website, EBPAT "incorporates energy performance goals, language, and incentives into the planning, design, construction, and operation of a building." DOE has developed a how-to guide, case studies, a fact sheet, and other resources to support these efforts.

7.6 Discussion

Many of the programs examined in this review shared common elements.

- 1) Multiple program administrators have found that a cohort approach, in which participants attend multiple workshops as part of a group of participants whose companies do not compete with each other, has been successful. This approach seeks to give participants an opportunity to share ideas and learn from the experience of others seeking to make similar efforts to improve their energy efficiency.

- 2) Programs seeking to achieve broader changes to practices within an organization, whether through SEM or changes to individual occupants' behaviors, seek or indeed require participant buy-in at multiple levels within the participant organization. For many of these programs, executive support was required. At lower levels of the organization, programs worked with an energy champion or a green team.
- 3) The programs encourage participants to incorporate energy efficiency into many organizational activities—operations, maintenance, procurement, retrofit, and occupant behaviors.
- 4) The programs provide a variety of support, including technical training, participant-specific (including on-site) technical assistance, coordination/managerial support, and financial assistance.

8. Conclusions and Recommendations

This evaluation found that Massachusetts lags behind several other states in the number of BOC graduates relative to the number of large employers and the total large building square footage, two indices of penetration of the target market. These findings suggest there is room for expanded BOC penetration in Massachusetts. Further, certification rates for the Massachusetts PAs are likely lower than in many other states, exacerbating the low penetration rates. Taken together, these results suggest that increasing both training uptake and certification by those who take the training may be important for achieving more claimable savings.

Interviews with BOC students did not identify any barriers to BOC uptake that are unique to Massachusetts workers. One factor that may be keeping BOC penetration low is lack of aggressive outreach and promotion. Feedback from PA contacts suggests that those that have been most successful in recruiting BOC students tend to employ multiple outreach channels—for example, sending e-blasts to all eligible commercial customers, conducting direct outreach by account executives, and making appearances at trade events to promote BOC and the training subsidy.

Obtaining the BOC credential itself does not appear to be a high priority for most students. Rather, the primary motive is to master the subject material. In Cape Light Compact territory (and possibly others), BOC students that have broad and general responsibilities and are removed from day-to-day O&M decisions may have even less motive to get certification and may prioritize other emerging job demands. Requiring certification for the subsidy may increase certification rates, but there is evidence that the subsidy may have no more than a moderate effect on the decision to take the training, and that may be even less so for higher-placed individuals. Developing the value proposition for certification itself may be challenging: the evaluation team did not identify any research, through the review of BOC savings studies, comparing the energy savings of those who certified and those who took the training but did not certify.

One approach to increasing certification rates might be to require or recommend BOC certification for participation in other programs that are aimed at producing whole-building savings. Three examples are available from the Pacific Northwest: Snohomish Public Utility District and Puget Sound Energy both provide funds for large customers to hire a resource conservation manager (RCM) and require that the RCM must go through one of several approved training program, which includes BOC; Seattle City Light requires that customers take BOC training to participate in its retro-commissioning program; yet another possible approach would be to provide a bonus on retrofit incentives for applicants with BOC credentialed operators.

The research showed that it may be possible to increase the number of students who apply for the tuition subsidy by adopting a process that places little or no burden on the applicant such as by distributing applications during class or even doing away altogether with a separate application process and simply have the training implementer collect the applicable trainee information and submit it to the PA. This approach would create free-ridership in some cases, but it conceivably could attract some students who otherwise might not register because they want to avoid the bother of applying for the subsidy. The project team cannot speculate whether that might offset the free-ridership created.

Research estimating savings from BOC training has become more methodologically rigorous over time, and the increased rigor may be producing higher estimates of savings. Still, the most recent and rigorous studies produced variable estimates of savings. The evaluation team's review of the research, together with experience evaluating the Northwest Energy Efficiency Alliance BOC Expansion initiative, led to two key ancillary conclusions: 1) that many if not all PAs do not claim savings over the full BOC certification "measure life"; and 2) that policies to subsidize or claim savings for one operator per workplace are not necessarily justified.

In recent years, a variety of energy efficiency education and training programs have emerged that variously aim to promote adoption of equipment-specific efficiency opportunities among equipment operators; adoption of organization-wide continuous improvement processes relating to energy use; increase attention among building occupants to energy use and efficiency; engage municipalities in energy efficiency; and increase workforce the energy efficiency skills. Many of these programs have demonstrated the potential to generate energy savings.

Based on the above conclusions, the evaluation team offers the following recommendations:

- **The Massachusetts PAs should employ multiple channels to promote BOC and the subsidies**— for example, sending e-blasts to all eligible commercial customers, conducting direct outreach by account executives, and making appearances at trade events to promote BOC and the training subsidy. Based on the experience of PAs elsewhere, this should help increase registration rates. This applies in particular to National Grid's, whose service territory covers part or all of eight Massachusetts counties that have more than 200 large employers (those with at least 100 employees), which together account for three-quarters of the large employers in the state.³⁷ There is benefit to tailoring promotional efforts to the different audiences – managers and operators. The promotional efforts should include coordination with the BOC certifying organization to ensure that the program collateral, website, and registration system serving the Northeast are clear to prospective participants, especially concerning the subsidies.
- **The PAs should craft BOC messaging that conveys the value proposition of certification and maintenance of certification to high-level managers.** Frequently, it is these managers that authorize staff training. The value proposition should include that energy savings more than likely offset the training cost, and should identify additional benefits documented in BOC evaluations, such as reduced emergency failures and more effective use of maintenance contractors.
- **The PAs should encourage high-level managers who take the training to also send their operators with day-to-day O&M responsibilities.** Point out that doing so will help ensure that the directions they give with respect to O&M actions will be understood and implemented correctly, thus achieving the desired energy savings, as well as empowering staff to make good decisions.
- **The PAs should promote BOC to participants of other energy efficiency programs.** This may increase registration and certification rates, resulting in more claimed savings.
- **The PAs should claim savings for each subsidized customer for eight years from the initial year of certification – that is, for the year of certification plus seven additional years.** For

³⁷ Source: U.S. Census Bureau, County Business Patterns (<http://censtats.census.gov/cgi-bin/cbpnaic/cbpcomp.pl>).

example, if someone becomes certified in 2015, then the PA should claim savings for the years 2015 through 2022. As reported above, the nationwide median tenure of BOC certification is three years, and the available evidence suggests that savings do not degrade over the period of time during which someone maintains certification (the tenure of certification) or even after expiration of certification. Therefore, claiming savings for the median tenure of certification plus five additional years – eight years, total, is reasonable. Nationwide BOC data show that a very small percentage of customers take Level 2 certification before taking Level 1 certification or even without Level 1; for such customers, the year of Level 2 certification should count as the first year of certification, and PAs should claim savings for that year plus seven additional years, regardless of whether or when the customer takes Level 1 certification.

- **The PAs should *not* claim additional savings for an individual’s Level 2 certification beyond those claimed for Level 1 certification.** Most Level 2 certification tenure overlaps to a large degree with Level 1 tenure, and so it would be impractical to attempt to track the two certification levels and assign savings separately. Moreover, our estimate of BOC savings is based on research that includes a blend of both Level 1 and Level 2 certificants that is close to the blend of Level 1 and Level 2 years that are found, on average, in the first eight years of certification. Therefore, claiming our estimated savings levels for eight years following certification accounts for the expected number of Level 2 graduates. In other words, our estimated savings reflects the average savings from certificants over the first eight years. Nationwide BOC data show that a very small percentage of customers take Level 2 certification without taking Level 1 certification; PAs should claim the same savings for such customers as for those who take Level 1 certification.
- **The PAs should claim two-thirds of the recommended per-operator savings for a second subsidized operator at a given workplace.** We base this recommendation on our finding (from NEEA_2014 data) that multiple operators at a workplace have overlapping responsibilities for about one-third of equipment types. This means that, on average, the savings from about one-third of the equipment responsibilities of a second subsidized operator will have been accounted for by the first subsidized operator, but about two-thirds of the savings from the second subsidized operator will be unique to that operator. However, if a second subsidized operator for a given employer has a different work location (i.e., works in a different building or location) from the first subsidized operator, the PAs should claim full savings for that second operator. Further, if the second operator obtains certification at least eight years after the first one, then the PAs should claim full savings for the second operator regardless of whether or not the two operators share the same workplace.
- **The PAs should consider designing and implementing additional adult efficiency education/training programs.** Opportunities exist for end-use specific training, strategic energy management, and occupant engagement programs. In addition, the PAs should keep abreast of education and training efforts stimulated by federal efforts.

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Appendix A. Interview Guides

Massachusetts Program Administrator Program Managers

Script to Schedule Interview

Hello, my name is ____ from Research Into Action. We are on the Navigant team that is evaluating Massachusetts energy efficiency programs. I understand that [name] from [PA] has let you know that I would be contacting you to arrange a time to interview you about your utility's program supporting BOC training and certification. The main purpose is to gain information about efforts to increase program-supported enrollment of BOC students. Is there some time in the next week when we can talk? It will take about 45 minutes.

[If respondent wants to proceed, the interviewer may skip to "Background." Otherwise, schedule time.]

Script for Scheduled Interview

Hello, this is ____ from Research Into Action. Is this still a good time to talk about your utility's program supporting BOC training and certification?

[If yes, proceed with "Background." Otherwise, reschedule.]

Background

- Q1. First tell me a little about yourself and your role with BOC-related activities?
- Q2. How long have you been in this role?
- Q3. About how many utility staff work on the program?
- Q4. What types of roles do they have?

Program History and Goals

- Q5. How long has [NAME OF PA FIRM] been supporting BOC training? *[Probe about MASS SAVES Whole Building Assessment Initiative. See [BOMA presentation](#)]*
- Q6. And what types of support do you provide? How long have you been providing each?
PROBES: marketing, tuition subsidy
- Q7. What were your initial goals and objectives in supporting BOC?
PROBES
Was it in response to a request from BOC?
What was the relative importance of claiming savings for your organization versus other motives?
- Q8. How long do you expect to support the program?
[IF NOT MENTIONED] Do you expect the program to eventually mature and not need your support?

Q9. Are there any estimates of the impact of your BOC support over time – that is, do you have any evidence that the numbers of people taking training has been increasing in your service territory?

PROBE

Is this something the BOC organization does or should do in your view?

Q10. When you started offering the tuition subsidy, what percentage of the BOC trainees did you expect to apply for it?

Q11. Are tuition subsidies available to all trainees or do certain criteria need to be met?

[IF CRITERIA APPLY] Please describe the basic eligibility criteria?

Q12. Why do think higher numbers of trainees haven't applied?

Marketing and Recruitment

Now I'd like to learn more about the way you market BOC.

Q13. Who have you targeted in your marketing?

[PROBE ABOUT: Employers, operators, specific end-user types, etc.]

Q14. How do the methods and/or messaging strategies vary by target group, if at all?

[PROBES:]

What messages, if any, include benefits that may accrue to employer?

What benefits do messages promote to employees?

Q15. Have you found any specific messages or marketing channels to be effective at recruiting trainees who are unwilling or unable to pay the full tuition? Please describe.

Q16. And how do you promote your training subsidy? When and to whom?

Q17. How, if at all, do you coordinate marketing and outreach with the regional BOC implementer?

[PROBES:]

How has that worked out?

In what areas would you like see improvements made in your collaboration?

In terms of promoting the program, how does their role differ from yours?

Q18. Who can fill out the rebate application form?

[PROBES:]

Trainee, employer, anyone else?

Q19. How do these people typically get the tuition reimbursement form?

Q20. When does this typically happen?

[PROBES:]

- When they apply for training, while attending training, after the training concludes?
- Q21. How do you decide who will receive the subsidy – employee, employer?
- Q22. Have your goals, objectives, methods, or messaging changed over the time your utility has supported BOC? If so, how?
- Q23. Do you have any plans to change your marketing messages or approach in the coming year? How is that?
- Q24. Are you aware of any factors that might distinguishes trainees who apply for a training subsidy from those who don't?

[PROBES:]

For example, first employee to be trained in the firm, those newly employed versus those with more one-the-job experience, younger versus older, those working in any specific types of firms, or other factors?

- Q25. *[IF NOT AWARE OF DISTINGUISHING FACTORS:]* What could you do to gather useful background information for targeted marketing purposes?

Barriers

We understand that overall turnout for BOC training has been good and that most of the trainees so far have not needed the tuition support.

- Q26. What types of things might get in the way or prevent other building operations workers from taking advantage of the tuition support to attend BOC training?
- [PROBES: Length of training, access/location, cost, employer support, others]*
- Q27. What have you heard from students in Massachusetts about the level of difficulty of course requirements, testing, and certification?
- Q28. *[IF ANY DIFFERENCES OR DIFFICULTIES NOTED:]* What have you been able to do to minimize the impact of these challenges?
- Q29. How might you be able to address these types of challenge the future?

Conclusion

- Q30. Is there anything else about your utility's BOC program that we have not discussed that you think should be mentioned?
- Q31. What would you like to learn from our research?

That's all of the question I have. Thank you for helping out.

Outside of Massachusetts Program Administrator Program Managers

Script to Schedule Interview

Hello, my name is _____ from Research Into Action. We are on a research team that is evaluating behavior-and-education-based energy efficiency programs, including programs supporting Building Operator Certification, for the Massachusetts utilities. As part of this research, we are talking with managers of similar programs outside of Massachusetts to learn how their experiences may differ or may provide valuable lessons for the Massachusetts programs. Is there some time in the next week when we can talk? It will take about 45 minutes.

[If respondent wants to proceed, the interviewer may skip to "Background." Otherwise, schedule time.]

Script for Scheduled Interview

Hello, this is _____ from Research Into Action. Is this still a good time to talk about your utility's program supporting BOC training and certification?

[If yes, proceed with "Background." Otherwise, reschedule.]

Background

- Q1. First tell me a little about yourself and your role with BOC-related activities.
- Q2. What types of support does your utility provide for BOC training and certification?
[PROBE ABOUT: marketing, tuition subsidy, providing training space, providing trainers, etc.]
- Q3. How long has [NAME OF PA FIRM] been supporting BOC training?
[PROBE ABOUT: each type of support.]

[IF OFFERS A TUITION SUBSIDY FOR BOC TRAINING, ASK Q4 THROUGH Q6; ELSE SKIP TO Q9]

- Q4. What are your long-term plans for continuing this support – do you have any end date in mind?
- Q5. And what criteria apply, if any, to trainees seeking the tuition subsidy?
- Q6. About what percentage of the BOC trainees in your utility's service territory have applied for the tuition subsidy?
- Q7. About what percentage of these applicants pass the training class?
- Q8. What challenges, if any, have you had with uptake? How have you addressed those challenges?

Marketing and Recruitment

Now I'd like to learn more about the way you market BOC.

- Q9. What groups do you target in marketing your utility's support for BOC?
[PROBE ABOUT: Employers, operators, specific end-user types, etc.]
- Q10. How do the methods and/or messaging strategies vary by target group, if at all?

- Q11. Have you found any specific messages or marketing channels to be effective at recruiting trainees who are unwilling or unable to pay the full tuition? Please describe.
- Q12. How, if at all, do you coordinate marketing and outreach with the regional BOC implementer?

[IF OFFERS A TUITION SUBSIDY, ASK Q13 THROUGH Q17; ELSE SKIP TO Q18]

- Q13. Who can fill out the tuition rebate application form?

[PROBES:]

Trainee, employer, anyone else?

- Q14. How do these people typically get the tuition reimbursement form?

- Q15. When does this typically happen?

[PROBES:]

When they apply for training, while attending training, after the training concludes?

- Q16. How do you decide who will receive the subsidy – employee, employer?

- Q17. Are you aware of any factors that might distinguish trainees who apply for a training subsidy from those who don't?

[PROBES:]

For example, first employee to be trained in the firm, those newly employed versus those with more one-the-job experience, younger versus older, those working in any specific types of firms, or other factors?

Savings Claims

- Q18. Does your utility have approval from your regulator to claim savings from your support for BOC training and certification?

[IF HAS APPROVAL TO CLAIM SAVINGS, ASK Q19 TO Q20. ELSE SKIP TO QUESTION Q21]

- Q19. How does your utility claim savings for its support of BOC training and certification?

[PROBES:]

Certain savings value per operator, per square foot per operator, or something else?

How, if at all, does the amount claimed depend on the type of support provided? [For example, is there one formula for operators that receive tuition subsidies and another formula for operators that attended a class that was supported in some other way?]

How did your utility establish the per-unit (per-operator, per-square-foot, etc.) savings to claim?

Do you claim different levels of savings for Level 1 and Level 2 certificants? If so, how?

- Q20. How much savings did your utility claim last year?

PROBE about both gas and electric savings

Barriers

Finally, I'd like to ask just a couple of questions about factors that might affect overall turnout for BOC training.

Q21. What types of things might get in the way or prevent other building operations workers from taking advantage of the tuition support to attend BOC training?

[PROBES: Length of training, access/location, cost, employer support, others]

Q22. What have you heard from students in [STATE] about the level of difficulty of course requirements, testing, and certification?

That's all of the question I have. Thank you for helping out.

Massachusetts BOC Students - Certified

Script to Schedule Interview

Hello, my name is _____ from Research Into Action. I understand that Melanie Danuser from BOC contacted you recently to get your permission to include you in a survey of BOC graduates. Is that correct?

IF YES:

That's great. I'd like to schedule a time in the next week or so to ask you about your experience and any impact the training has had on your job. Our main purpose is to gain information that may help the Massachusetts utilities determine whether and how to support BOC. Is there some time in the next week when we can talk? It will take about 30 minutes.

IF NEEDED:

We are on a research team that is evaluating programs supporting Building Operator Certification, for the Massachusetts utilities. Our findings will help the utilities identify ways they can best serve their commercial customers.

All of your responses will be confidential to the extent permitted by law, and any analyses will not identify individuals or firms.

[If respondent wants to proceed, the interviewer may skip to "Background." Otherwise, schedule time.]

Script for Scheduled Interview

Hello, this is _____ from Research Into Action. Is this still a good time to talk about your experience with BOC training and certification?

[If yes, proceed with "Background." Otherwise, reschedule.]

Background

- Q1. First tell me a little about yourself and your role on the job?
- Q2. How long have you been in this role?
- Q3. Has your employer or job changed since you became BOC certified? If so, how?

Awareness

- Q4. Thinking back, how did you hear about the BOC training opportunity?

[PROBES:]

Was it through your employer, your utility company, colleagues or contractors, a professional organization, a vendor, BOC website or some combination of sources?

- Q5. What things influenced your decision to pursue the training?

[PROBE, IF NOT ADDRESSED IN RESPONSE:]

Was BOC training and/or certification a requirement of your current job?

Was the possibility of promotion or salary increase at your company a consideration? If so, how?

How about the possibility of career opportunities outside your current company?

Did utility staff talk to you or your employer about the benefits of BOC training? If so, what influence did that have?

[IF MENTIONED UTILITY OR BOC MESSAGING] What marketing message or messages did you find appealing?

Employer Support

Q6. Did your employer pay the BOC training fee or reimburse you for it?

How about travel expenses?

Did your employer pay your salary/wages while you attended the training or did you have to take the training on your own time?

[INTERVIEWER INSTRUCTION: BE SURE TO ASK NEXT QUESTION SLOWLY AND CLEARLY]

Q7. Some of the Massachusetts utilities and other organizations currently or have in the past offered subsidies or rebates covering some or all of the cost of BOC tuition. Did you or your employer receive any BOC tuition subsidy or rebate from your utility or other organization?

[IF YES:] who provided the subsidy?

[IF NOT]

Q8. Why not?

[IF EMPLOYER APPLIED FOR SUBSIDY/REBATE AND PROVIDED SUPPORT]

Q9. How do you think the availability of tuition subsidies affected your employer’s decision to support your BOC training?

[ALL]

Q10. [IF “LIKELY UTILITY” = NGRID, ASK VERSION A, ELSE ASK B]

A. How do you think the availability of tuition subsidies would affect your employer’s decision regarding whether or not to support other employees in getting BOC training?

B. If such a subsidy were available in your area, how do you think that would affect your employer’s decision about supporting other employees in getting BOC training?

Q11. What could encourage other employees in your organization to take this training?

Employee Expectations

Q12. How did the BOC training compare to your expectations?

[PROBE ABOUT]

Topics covered, assumptions about prior knowledge or experience, level of difficulty, what they actually learned

- Q13. And what about the testing and certification processes, how did they compare to expectations?
- Q14. In what ways, if any, has your BOC training affected how you do your job?

[PROBES]

Can you give me any examples of how decisions about equipment upgrades may have been influenced by your BOC training?

How about the day to day operations and maintenance stuff – has your BOC training affected that?

- Q15. And how, if at all, has your BOC training benefitted you at work?
- Q16. How familiar are you with BOC Level II training? Would you say: Not at all familiar, A little familiar, Pretty familiar, or Very familiar

- Q17. [IF NOT VERY FAMILIAR, READ BRIEF DESCRIPTION] Level II training covers best practices in facilities management and preventive maintenance and troubleshooting as well as advanced training in specific building systems. Which of the following Level II training topic areas might you be interested in learning more about?

- Preventive maintenance and troubleshooting
- Advanced training in...
- Electrical systems
- HVAC
- Motors
- Water efficiency
- Building commissioning
- Automation

- Q18. How likely are you to take BOC Level II training in the next two years? Would you say: Not at all likely, somewhat likely, very likely, [don't know]
- Q19. [IF NOT VERY LIKELY] What might keep you from taking the Level II training?

Barriers

- Q20. What types of things might get in the way or prevent other building operations workers from taking advantage of the tuition support to attend BOC training?

[PROBES: Length of training, access/location, cost, employer support, difficulty, others]

Firmographics

Q21. [IF NOT AVAILABLE FROM BOC RECORDS] How would you characterize the principal business or activity performed at the buildings for which you have responsibility? [DON'T READ CHOICES; SELECT ONE, PROBE WELL]

1. grocery store
2. government/community services (churches/courthouses/museums)
3. hospitality
4. medical
5. office building (including government offices)
6. residential (apts/condos)
7. restaurant
8. retail
9. schools/colleges/universities
10. chemicals/petroleum/plastics/rubber
11. electronics and equipment
12. food processing
13. heavy industry/fabrication
14. high technology (facilities with clean rooms)
15. warehouse
16. Other (SPECIFY) _____
99. DK/Refused

Q22. Is this the same type of work that you were doing when you first got BOC certified?

IF NO: What type of business or activity best characterizes what you were doing then?
[Use above list to probe or clarify]

Q23. [IF NOT AVAILABLE FROM BOC RECORDS] And about how many square feet of conditioned space are there in the building or buildings where you work?

Q24. And, including yourself, about how many O&M staff are there in the building or buildings where you work?

Q25. And how many of those are BOC certified?

Conclusion

Q26. Is there anything else about your BOC training or your utility's BOC program that we have not discussed that you think should be mentioned?

That's all of the questions I have. Thank you for helping out.

Massachusetts BOC Students – Not Certified

Script to Schedule Interview

Hello, my name is _____, calling on behalf of Cape Light Compact. Cape Light and several Massachusetts utilities hired our research team to evaluate programs supporting Building Operator Certification, and as part of that evaluation, Cape Light would like to understand more about the BOC training experiences of its customers.

Do you have some time right now or in the next few days to answer a few questions about your experience and any impact the training has had on your job? All of your responses will be confidential to the extent permitted by law, and any analyses will not identify individuals or firms.

IF ASKED FOR MORE INFORMATION ON THE PURPOSE:

The main purpose is provide information to Cape Light Compact to use in planning its future support for BOC.

IF ASKED HOW LONG IT WILL TAKE:

Most of the people I've spoken with took about 15 minutes or less.

IF ASKED FOR MORE DETAILS ABOUT US:

The company I work for is Research Into Action. We are part of a research team led by Navigant Consulting, Inc.

[If respondent wants to proceed, the interviewer may skip to "Background." Otherwise, schedule time.]

Script for Scheduled Interview

Hello, this is _____ from Research Into Action. Is this still a good time to talk about your experience with BOC training and certification?

[If yes, proceed with "Background." Otherwise, reschedule.]

Background

Q27. First tell me a little about yourself and your role on the job?

Q28. How long have you been in this role?

Q29. Has your employer or job changed since you became BOC certified? If so, how?

Awareness

Q30. What things influenced your decision to pursue the BOC training?

[PROBE, IF NOT ADDRESSED IN RESPONSE:]

Was BOC training and/or certification a requirement of your current job?

Was the possibility of promotion or salary increase at your company a consideration? If so, how?

How about the possibility of career opportunities outside your current company?

Did Cape Light Compact staff talk to you or your employer about the benefits of BOC training? If so, what influence did that have?

Employer Support

- Q31. Did you have any unreimbursed out-of-pocket expenses related to the training?
- Q32. Did your employer pay your salary/wages while you attended the training or did you have to take the training on your own time?
- Q33. I understand that Cape Light Compact subsidized the cost of BOC tuition. How, if at all, do you think that tuition subsidy affected your employer's decision to have you take the BOC training?
- [IF NEEDED] Would your employer have paid for the training if there were no tuition subsidy?
- Q34. Are there any other facilities staff where you work that might benefit from BOC training?
- Q35. [IF YES] How do you think the availability of tuition subsidies would affect your employer's decision about having any of them take BOC training?
- [IF NEEDED] Would your employer pay for them to take the training if there were no tuition subsidy?

Employee Expectations

- Q36. What did you expect to get out of the BOC training?
- [PROBE ABOUT]
- What topics would be covered, what the training would assume about prior knowledge or experience, level of difficulty, how much they would learn
- Q37. How did the BOC training compare to your expectations?
- Q38. And what about the testing and certification processes, how did they compare to expectations?
- Q39. In what ways, if any, has your BOC training affected your day-to-day operations and maintenance practices or the practices of those you supervise?
- [IF NEEDED] I mean the decisions made about equipment settings, or when or how often you conduct regular maintenance activities, or how you perform the maintenance.
- Q40. Can you give me any examples of how your BOC training may have influenced decisions about equipment upgrades?
- Q41. And how, if at all, has your BOC training benefitted you personally at work?
- [IF NEEDED] For example, increased pay or responsibility or more recognition.
- Q42. My understanding is that you completed the course, but did not complete all requirements for the certification. Why did you decide not to complete the certification?

Q43. How familiar are you with BOC Level II training? Would you say: Not at all familiar, A little familiar, Pretty familiar, or Very familiar? Don't read: DK.

[PLEASE HIGHLIGHT OR UNDERSCORE THE RESPONSE]

Q44. [IF NOT VERY FAMILIAR, READ BRIEF DESCRIPTION] Level II training covers best practices in facilities management and preventive maintenance and troubleshooting as well as advanced training in specific building systems.

Which of the following Level II training topic areas might you be interested in learning more about?

Preventive maintenance and troubleshooting

Advanced training in...

Electrical systems

HVAC

Motors

Water efficiency

Building commissioning

Automation

Q45. How likely are you to take BOC Level II training in the next two years? Would you say: Not at all likely, somewhat likely, or very likely? Don't read: DK.

[PLEASE HIGHLIGHT OR UNDERSCORE THE RESPONSE]

Q46. [IF NOT VERY LIKELY] What might keep you from taking the Level II training?

Barriers

Q47. What types of things do you think might prevent other building operations workers from attending BOC training?

[PROBES: Length of training, access/location, cost, employer support, difficulty, others]

Firmographics

Q48. About how many square feet of conditioned space are there in the building or buildings where you work?

Q49. Including yourself, about how many O&M staff are there in the building or buildings where you work?

Q50. And how many of those are BOC certified?

Conclusion

Q51. Is there anything else about your BOC training or your utility's BOC program that we have not discussed that you think should be mentioned?

That's all of the questions I have. Thank you for helping out.