

**Impact and Process Evaluation  
Building Operator Training and Certification  
(BOC) Program**

**Final Report**

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**Northeast Energy Efficiency Partnerships**

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## Impact and Process Evaluation

### NEEP Building Operator Training and Certification (BOC) Program

## 1 Executive Summary

This report summarizes the activities that have been completed in support of an impact and process evaluation of the Building Operator Training and Certification (“BOC”) program. RLW Analytics, Inc. (RLW), NEEP and sponsors involved in the evaluation kicked off this study on February 11, 2005; including Northeast Utilities, South Jersey Gas Company, Cape Light Compact, Unitil, United Illuminating, National Grid, Long Island Power Authority, Efficiency Maine, NSTAR and NYSERDA. Some organizations such as KeySpan, PSNH, and VEIC were involved in the BOC Program during the time period evaluated, but did not participate in the study. At this kickoff meeting, key objectives of the study were clarified, schedules were established and study methodologies were discussed. The importance of schools to the program was discussed, along with the data available on program activity, data available from sponsors, and individuals appropriate for interviews; among other items.

### 1.1 Program Description

The BOC Program began in 2000 and is one of a number of market transformation programs NEEP currently has in operation at this time. The BOC course is a competency-based training and certification program for building operators designed to improve the energy efficiency of commercial buildings. Certification can be earned by attending training sessions and completing project assignments in their facilities. It is offered at two levels: Level 1 (BOC 100 Series) emphasizes energy efficient building systems maintenance, while Level 2 (BOC 200 Series) focuses on equipment troubleshooting. Each level of the BOC Program is comprised of seven courses that address a specific topic related to operations and maintenance (O&M). Table 1 details the courses for each level. For Level 2 completion, each student must complete four core classes and two elective classes. Both levels also require open book exams and job related or assigned projects. A total of 878 students from the Northeast have been certified since the inception of BOC through the end of 2003.

<b>BOC 100 Series</b>	<b>BOC 200 Series</b>
BOC 101 - Building Systems Overview	BOC 201 <sup>c</sup> – Preventative Maintenance & Operations
BOC 102 – Energy Conservation Techniques	BOC 202 <sup>c</sup> – Advanced Electrical Diagnosis
BOC 103 – HVAC Systems and Controls	BOC 203 <sup>c</sup> – HVAC Troubleshooting & Maintenance
BOC 104 – Efficient Lighting Fundamentals	BOC 204 <sup>c</sup> – HVAC Controls and Optimization
BOC 105 – Maintenance and Related Codes	BOC 210 – Advanced Indoor Air Quality
BOC 106 – Indoor Air Quality	BOC 220 – Energy Audit
BOC 107 – Facility Electrical Systems	BOC 231 – Advanced Lighting Applications

<sup>c</sup> indicates a core course

**Table ES- 1: BOC Courses**

## 1.2 Study Objectives

The following bullets summarize the objectives of this study:

- Estimate costs associated with O&M activities undertaken by enrollees.
- Assess the perceived value of the course among participants and the persistence of program-induced activities from 2000/2001 participants.
- Estimate energy savings and identify non-energy benefits of the coursework.
- Update the program performance indicators.
- Examine process-related issues, including barriers and marketing approaches.
- Develop appropriate conclusions and recommendations.

## 1.3 Study Methodology

To achieve the objectives listed above, there were five primary activities undertaken as part of this study. Each of these individual data collection activities are synthesized in the results section of this report by study objective. By using multiple techniques and data collection activities, our evaluation was able to draw a more in-depth picture of the NEEP BOC program and its effects on O&M practices in the region. The five activities undertaken include the following:

- The review of program literature; including curriculums for Level 1 and Level 2 courses.
- The performance of 9 interviews of program administrators, instructors, and staff members to gain an understanding of program strengths and weaknesses and other process issues.
- The performance of 45 school and 49 non-school enrollee surveys and 17 of their supervisors to gather inputs for O&M cost and energy impact estimates and to gain an understanding of non-energy benefits that are experienced as a result of program participation.
- The performance of interviews with 45 non-participants to assess program awareness, value, and interest.
- The performance of interviews with 17 individuals who were interviewed in the 2002 study to assess the persistence of program influence.

## 1.4 Conclusions and Recommendations

The conclusions and recommendations below are provided by evaluation objective.

### 1.4.1 Conclusions

The following conclusions are comprised of a paragraph or two summarizing the results of each objective, followed by key summary bullets. It is important to note that the analysis of O&M costs and energy savings resulting from the BOC coursework was based upon self reported activity gathered via a phone survey and assumed savings per unit estimates. It is important to bear these study limitations in mind when interpreting these results. The team sought to minimize these limitations through use of a rigorous

phone survey that gathered all necessary inputs and a series of savings estimates per unit that was verified via previous O&M impact evaluation work performed in the Northeast.

### O&M Cost Conclusions

Most enrollees who reported a program influenced efficiency measure installation or activity were unable to estimate the cost associated with that measure/activity. However, we believe enough estimates were made to provide a reasonable approximation of O&M costs undertaken. This analysis was performed at the measure level and aggregated to provide an average cost of O&M activities undertaken per enrollee of \$105,539. Efficient lighting installations were calculated to be the most expensive O&M activity undertaken, averaging almost \$36,500 per enrollee. As a sanity check against these estimates, secondary research on the costs associated with retro-commissioning was performed; which provided further evidence of their reasonableness.

- The estimated cost associated with all O&M activities undertaken by the enrollees surveyed is \$9,920,480; or \$105,539 per enrollee. Using the average conditioned square footage of enrollees surveyed (616,045), this calculates to a per square foot cost for each enrollee of \$0.17/sq ft.
- This estimate compares reasonably well with retro commissioning costs per square foot which would represent the optimization of all electromechanical facility systems. These retro commissioning costs range from approximately \$0.05/sq ft to \$0.70/sq ft.

### Perception of Program Value Conclusions

In this study, we have approached the determination of the prospective value of the BOC program as being reflected in data gathered from enrollees, enrollee supervisors, and informed non-participants. The following results suggest a moderate sense of perceived value in the coursework as evidenced by its desirability and interest among non-participants, importance and satisfaction among enrollee supervisors, and its usefulness to enrollees in their operator position. However, it should be noted that the retail cost of the coursework (\$1,400) is higher than many non-participants are willing to pay despite most enrollees reporting that the coursework is worth that cost after attending the classes. The following bullets present highlights of this assessment of program value.

- 45% of informed non-participants reported certification in building operations and maintenance as important or very important. Those non-participants that reported certification as important also rated certifications that are transferable and competency based very highly; each of these are characteristics of the BOC Program.
- Non-participant interest in BOC courses was particularly high for energy conservation techniques, facility electrical systems, and preventative maintenance. Overall, on a one (not at all interested) to five (very interested)

scale, enrollees rated usefulness of the Level 1 and Level 2 courses were both high; particularly for school enrollees. On a 1 (not at all useful) to 5 (extremely useful) scale, Level 1 courses were rated 3.9 by school and non-school enrollees and Level 2 courses were rated 4.3 and 3.8 by school and non-school enrollees, respectively.

- 80% of enrollees and 40% of enrollee supervisors indicated they had recommended the program to others.
- 80% of enrollee supervisors were either satisfied or extremely satisfied with the course, although no level 2 enrollee supervisors were extremely satisfied.
- Only 22.2% of informed non-participants reported a willingness to pay \$1,400 for the course, although the actual experienced price is often lower due to sponsor subsidies. Most enrollees and enrollee supervisors contacted, however, reported the course was worth \$1,400. When asked for suggestions on how to add program value, many enrollees and enrollee supervisors were unable to provide any.

### Persistence Conclusions

Gathered and calculated for individual measures/actions, no single measure experienced less than 100% persistence in impacts. There was a moderate level of new activities undertaken by 2000-2001 enrollees since the 2002 study. The estimated savings generated by program influence among 2000-2001 enrollees suggests a five year 'lifetime' assumption of program savings is reasonable as evidenced by the following results;

- Electric savings (kWh) was calculated to have a persistence rate of 114.2%.
- Oil and Gas savings (MMBTU) was calculated to have a persistence rate of 108.5%.
- Water savings (gallons) was calculated to have achieved 100% persistence.

### Energy Savings and Non-Energy Impact Conclusions

Due to the high level of school activity in the program and its interest among NEEP and the sponsors, energy savings impacts are provided separately in this report for schools vs. non-schools. Impacts without rebated measures are provided for school and non-school as well as overall so sponsors have the ability to tailor their BOC savings estimates according to their unique program offerings and approach to estimating net effects. The program is generating meaningful energy savings as a result of program induced energy efficiency actions undertaken by enrollees. Water savings and waste water savings also appear to be conserved as a result of the program, although there was not sufficient information to estimate waste water savings. The following bullets highlight the results relating to energy savings. Including rebated activities, the 2003 program is estimated to save:

- 33,298 MWh of school and 86,245 MWh of non-school annual electric energy, or an overall estimate of 0.35 kWh per enrollee per square foot,

- 149,194 MMBtu of school and 91,751 MMBtu of non-school annual energy, or an overall estimate of 0.74 MMBtu per enrollee per square foot, and
- 50,124,000 gallons of water in non-schools, or 0.14 gallons of water per enrollee per square foot.

Removing measures for which rebates were received, the 2003 program is estimated to save:

- 19,013 MWh of school and 42,808 MWh of non-school annual electric energy, or an overall estimate of 0.18 kWh per enrollee per square foot,
- 141,853 MMBtu of school and 87,250 MMBtu of non-school annual energy, or an overall estimate of 0.71 MMBtu per enrollee per square foot, and
- 50,124,000 gallons of water in non-schools, or 0.14 gallons of water per enrollee per square foot.

Enrollees and their supervisors reported experiencing numerous non-energy benefits as a result of their participation in the BOC Program. These non-energy benefits range from those that affect the facility to those that affect the specific job or career of the individual who participated in the course. The bullets below highlight these results.

- 84% of enrollees and 67% of their supervisors reported an improvement in occupant comfort since program participation.
- 85% of enrollees and 67% of their supervisors reported that the program helped them save energy at their facility.
- 46% of enrollees and 87% of their supervisors reported that the program has helped them save money on labor and materials at their facility.
- 17% of enrollees and 13% of enrollee supervisors reported that they have experienced an increase in compensation since completing the BOC coursework.
- 60% of enrollees reported making indoor air quality improvements since they participated in the BOC Program.

### Performance Indicator Conclusions

The program performance indicators are intended to reflect the program's history of accomplishments to date and have generally improved since the 2002 study was performed. The average number of students per class has increased for Level 1 classes and remained the same for Level 2 classes since the 2002 study. There has been an increase in the number of program sponsors over the last couple of years and substantially more institutions giving academic or CEU credit for BOC certification. Through the 2003 calendar year, there have been nearly 1,200 students enrolled in the Level 1 coursework and 185 enrollees in Level 2. The bulleted items below highlight the improvements in the indicators of program performance.

- Level 1 certifications have almost doubled since the 2002 study from 268 at the end of 2001 to 526 thru the end of 2003.

- Level 2 certifications have more than tripled from 19 at the end of 2001 to 65 thru the end of 2003.
- The program drop-out rate, which was 4% in 2000-2001, was 0% in 2003.
- In 2000-2001 only one institution gave academic or CEU credit for BOC coursework, while at the end of 2003, 7 institutions did.
- The number of organizations sending staff through the BOC program has more than tripled from 143 at the end of 2001 to 502 thru the end of 2003.

### Process Related Issue Conclusions

Program marketing received a lot of discussion in the interviews and generated a diverse set of opinions regarding the best approach. Some BOC staff, instructors, and program managers felt that NEEP should market the program, while others felt that leveraging the relationships utility account representatives have already established with customers would be an effective marketing strategy. Still others felt that using past participants to market the program would be effective, as hearing about a positive program experience from a "peer" may help potential recruits understand how the program can benefit them. The items below present some of the key marketing results.

- Approximately 40% of enrollees and 40% of their supervisors heard about the program through their boss or a co-worker.
- 31% of non-school enrollees were made aware of the program through utility representatives or energy efficiency organizations.
- 22% of school enrollees came to know about the program through trade associations/publications.
- 29% of informed non-participants and 26% of enrollees feel that mailings are the best way to recruit people into the program.

As the following bullets show, responses relating to participation and implementation barriers and considerations when deciding to attend training were consistently centered on time and staff availability and a lack of financial resources.

- From 2002-2003 there were 699 Level 1 enrollees of which 526 were certified (75% certification rate) and 114 Level 2 enrollees of which 65 were certified (57% certification rate).
- 47% of non-school and 40% of school enrollees reported time and staff availability as a major consideration when deciding to send staff to training.
- Time and staff availability was mentioned as the greatest barrier to participation by 51% of informed non-participants, 39% of enrollees, and 47% of enrollee supervisors.
- Cost was mentioned as the greatest barrier to participation by 18% of informed non-participants, 47% of enrollees, and 60% of enrollee supervisors.
- Financial resources were cited as the greatest barrier that inhibits O&M improvements by 70% of enrollees and 87% of their supervisors.

The class schedule structure was a process-related issue that has been cited as a barrier to participation concern and was recently adjusted.

- Program instructors feel that offering the classes on consecutive days allows them to establish better relationships with the students and may be easier for them to attend.
- 58% of informed non-participants preferred classes that were offered on two consecutive days over classes offered on single days for several months, which were preferred by only 38%.

#### 1.4.2 Recommendations

The following recommendations are made based upon data provided in the body of this report as well as the primary conclusions presented above. Some of these recommendations may have been implemented prior to the publication of this report as this study has been performed concurrent with ongoing program operations, which includes the pursuit of continuous program improvements by NEEP and the sponsors.

1. NEEP presence at the courses was reported to have dropped off since the outset of the BOC Program. NEEP should consider sending a NEEP representative to at least a segment of all classes. This increased presence can be used to better follow homework assignments, track attendance rates and improve overall interaction with enrollees regarding coursework that needs to be completed for certification. We anticipate that this effort will provide a single presence in all courses that emphasize projects that need to be completed to become certified as well as track attendance in the interest of proactively encouraging those who do not attend to return to the next course. To ensure these efforts are having the desired effect, we further recommend monitoring the certification rates of Level 1 and Level 2 enrollees over time.
2. The results from this study suggest that using more trusted (utility representatives, professional and civic organizations, etc.) and personal (direct contact to boss through utility representative) methods to recruit potential participants will maximize participation rates. That is, the greatest program marketing successes related in the interviews and data appear to be through account representatives, grass roots marketing to local chambers of commerce and civic associations, and marketing to previous participants (which is where most enrollees and supervisors reported hearing of the program). We believe under the current circumstances, both NEEP and the sponsors should continue marketing the program to different markets through unique means. This would be a complimentary system in which the utilities leverage trust in account representatives to solicit enrollees and NEEP handle marketing to previous enrollees, associations, and other professional groups that might also be interested in program sponsorship. As part of this process, we recommend monitoring where intake is from in the interest of assessing those

channels that generating the most enrollees and determining when an appropriate time is for utilities to diminish their efforts without risking course attendance rates.

3. Related to the recommendation above, we suggest that NEEP establish a system of using past students to market the program to others as well as a system of contacting and encouraging current students who stop attending the courses to re-connect with the coursework. Several interviewees suggested that previous students who have experienced the value of the course can be valuable recruiters for other enrollees (or to provide NEEP names of others that can be direct marketed to) and the participant survey indicated a great deal of interest on the part of students who have dropped out of the coursework to begin attending the courses again; pending future opportunities.
4. NEEP has staff currently on board to assist in BOC marketing; specifically, they have 1-2 people with marketing backgrounds that have been recently trained to become resources available for program operation. While not all sponsors anticipate NEEP taking over program marketing, we believe NEEP is currently staffed to take more of this responsibility. These NEEP staff members can target organizations at a regional level for program sponsorship, as well as enrollee recruitment into the BOC courses. Organizations cited as plausible targets for these activities include the International Association of Facility Managers (IFMA), Building Owners and Managers Association (BOMA), the Associated Industries of Massachusetts (AIM) and the Association for Facility Engineering (AFE). As part of this process, NEEP should consider gathering associations of enrollees in the course in the registration form to further inform potential targets for these activities in the region or in local areas.
5. Most sponsors currently subsidize the course fee of \$1,400 for enrollees, including some that cover half the course fee and some that cover the full course fee for certain enrollee types (municipal operators for instance). Indeed, many non-participants surveyed indicated an unwillingness to pay \$1,400 and courses in one state that was marketed via direct mail with the course at full price had difficulties with filling courses. Under these conditions, it is difficult to determine the viability of the program in the marketplace under its current price structure. Under the new staffing resources available at NEEP that have marketing backgrounds, we recommend testing customer response to the retail price in conjunction with NEEP marketing to assess customer willingness to enroll under the designed 'retail' program operations.
6. NEEP should consistently track square footage controlled by enrollees via the registration forms. There is currently a place for the enrollee to provide this information on the form, but it is not consistently gathered. This information can be used to estimate program impacts via the savings per square foot results provided in this report as well as track penetration of program influence (i.e., the amount of square feet the program has touched). In the event that this is not gathered,

however, there are also savings estimates per enrollee provided in this report that can be used to estimate future program impacts. Other information that would be useful to carry would include the number of years in their current job and the sponsor territory they operate in.

7. The current definition of drop out rates used in the performance indicator table reflect the rate in which students enrolled in the program attend initial courses, drop out of those courses and are not interested in attending future courses. We recommend changing this drop out rate definition to reflect the rate at which enrollees become certified. This value can be calculated from existing sources as the program moves forward (the program database) and is more meaningful as an indicator of program progress and success.
8. The per square foot estimates of energy savings per enrollee calculated in this study are relatively consistent with those of the 2002 study, particularly for electric impacts. Due to these convergent estimates, we recommend using these impact values to predict program savings as the BOC moves forward. We have provided an approach for using this data in this report for this purpose; including a formula for calculating impacts and various impact values for consideration depending upon sponsor determination of whether to include rebated savings or not include rebated savings. As discussed earlier, we further recommend that NEEP track the sponsor territory each enrollee comes from to facilitate the calculation of any utility level impacts desired by program sponsors.
9. The persistence rates calculated in this study suggest program influences to perform O&M activities taught in the coursework extends up to at least four years. In the 2002 report, the life of program influence was assumed to be five years. Based upon these points, it does seem reasonable to assume a measure lifetime for BOC savings of five years. As more program activity becomes available to test persistence in longer windows of time, future studies should be conducted to further assess and refine this assumption.
10. As part of this study, we acquired some course surveys and questionnaires performed with enrollees that provide feedback on each course, the instructors, the courses usefulness, and other points of interest; however, this data collection did not appear to be implemented consistently. We recommend regularly surveying students with a standard instrument to assess the courses, perhaps including a pre/post test to provide information on knowledge learned. This information would be useful for instructors, students, and sponsors as a mechanism to continually refine the courses and provide feedback on instructor effectiveness.
11. A primary barrier to course participation is that of operator staff availability to attend the courses. NEEP has recently implemented a new course schedule intended to make it easier for staff to attend the courses; two consecutive days a month for 3- 4

months as opposed to one day a month for 7-8 months. Non-participants indicated favorability for this class schedule and instructors believe this schedule will be more 'friendly'. We recommend monitoring whether this schedule results in a decrease in drop out rates between enrollees registering for the course and their subsequent attendance and certification.

12. Another primary barrier noted to impede O&M improvements is that of available financial resources or money. In the Energy Conservation Techniques course, students are encouraged to contact their local utility for financial and technical assistance. While this may invite policy concerns regarding attribution of program savings in these instances, promoting the availability of utility conservation funds regularly in the coursework can be expected to improve the efficient equipment installations and O&M activities reflected in the BOC coursework.

## **Impact and Process Evaluation**

### **NEEP Building Operator Training and Certification (BOC) Program**

## **2 Introduction**

This report summarizes the activities that have been completed in support of an impact and process evaluation of the Building Operator Training and Certification (“BOC”) program. RLW Analytics, Inc. (RLW), NEEP and sponsors involved in the evaluation kicked off this study on February 11, 2005; including Northeast Utilities, South Jersey Gas Company, Cape Light Compact, Unitil, United Illuminating, National Grid, Long Island Power Authority, Efficiency Maine, NSTAR and NYSERDA. Some organizations such as KeySpan, PSNH, and VEIC were involved in the BOC Program during the time period evaluated, but did not participate in the study. At this kickoff meeting, key objectives of the study were clarified, schedules were established and study methodologies were discussed. The importance of schools to the program was discussed, along with the data available on program activity, data available from sponsors, and individuals appropriate for interviews; among other items.

### **2.1 Program Description and Activity**

The BOC Program began in 2000 and is one of a number of market transformation programs NEEP currently has in operation at this time. The BOC course is a competency-based training and certification program for building operators designed to improve the energy efficiency of commercial buildings. Operators earn certification by attending training sessions and completing project assignments in their facilities. The certification provides a credential for their professional development while offering employers a way to identify skilled operators. Certification is offered at two levels: Level 1 (BOC 100 Series) emphasizes energy efficient building systems maintenance, while Level 2 (BOC 200 Series) focuses on equipment troubleshooting.

Each level of the BOC Program is comprised of seven courses that address a specific topic related to operations and maintenance (O&M). Table 1 details the courses for each level. For Level 2 completion, each student must complete four core classes and two elective classes. Both levels also require open book exams and job related or assigned projects. A total of 878 students from the Northeast have been certified since the inception of BOC through the end of 2003.

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<sup>c</sup> indicates a core course

**Table 1: BOC Courses**

Data were provided to RLW early in this evaluation process regarding participation levels in 2002 and 2003. Since a primary objective of this study was to assess energy savings, 2004 enrollees were not included as they have not had enough time to implement coursework practices. Table 2 presents the number of enrollees<sup>1</sup> by course level and state across program years. It is important to note that variations in enrollment by state may be due to some states having the benefit of more experience with the BOC Program (such as Massachusetts) as well as some states having more multiple organizations feeding program enrollment. In addition, it is important to note that in 2003, the NJ utilities ceased program marketing due to budgetary impacts. In this summary, if an individual participated in both Level 1 and Level 2 they are included in each level. It is evident from this table that, consistent with information discussed at the kickoff meeting, schools are an important part of the BOC enrollee base. Utility staff represented 36 and 18 of the Level 1 and Level 2 enrollees, respectively.

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<sup>1</sup> Enrollees were placed into the year in which the first class was held for the Level One or Level Two courses they were enrolled in.

State	BOC 1 Enrollees				BOC 2 Enrollees			
	Utility	School	Other	Total	Utility	School	Other	Total
<b>2002</b>								
CT	0	0	15	15	0	0	0	0
MA	6	10	83	99	11	0	18	29
ME	1	69	10	80	0	0	0	0
NH	8	3	16	27	0	0	0	0
NJ	3	11	44	58	0	0	0	0
NY	0	0	0	0	0	0	0	0
RI	0	14	10	24	0	0	0	0
2002 Total	18	107	178	303	11	0	18	29
<b>2003</b>								
CT	2	5	22	29	0	0	0	0
MA	2	31	86	119	0	4	17	21
ME	1	12	32	45	0	0	0	0
NH	1	28	0	29	0	0	0	0
NJ*	0	0	0	0	0	0	0	0
NY	10	80	59	149	5	8	21	34
RI	2	3	20	25	2	22	6	30
2003 Total	18	159	219	396	7	34	44	85
<b>Cum. Total</b>	<b>36</b>	<b>266</b>	<b>397</b>	<b>699</b>	<b>18</b>	<b>34</b>	<b>62</b>	<b>114</b>
* All marketing for the BOC Program ceased in New Jersey in 2003 per a Board of Public Utilities (BPU) directive.								

**Table 2: School and Non-School Enrollees by State**

Table 3 below presents the total number of unique enrollees<sup>2</sup> for 2002 and 2003. Unlike the counts in Table 2, if an individual enrolled in both Level 1 and Level 2 within a program year, they are only counted once. There were no such cases in 2002 so the totals presented are simply the sums of the Level 1 and Level 2 counts from the table above. In 2003, however, there were 2 school enrollees and 13 "other" or non-school enrollees that signed up for both Level 1 and Level 2 courses. The 2003 counts of 191 school and 250 non-school enrollees are used to calculate program level savings impacts in Table 28 and Table 29, which shows the total 2003 program savings based upon per student savings impacts.

Enrollee	2002	2003
Utility	29	23
School	107	191
Other	196	250
<b>Total</b>	<b>332</b>	<b>464</b>

**Table 3: Unique Students by Year**

Table 4 presents and Table 5 present the Level 1 and Level 2 courses offered by state and number of certified enrollees by state from 2002-2003, respectively. Like the

<sup>2</sup> Enrollees are defined as individuals who signed up for and participated in Level 1 and/or Level 2 coursework within the timeframe of interest.

enrollee data presented in Table 2 above, the majority of course activity and certified enrollees was in Massachusetts, followed by New York.

State	BOC 1 Courses	BOC 2 Courses
CT	2	0
MA	8	2
ME	5	0
NH	2	0
NJ	3	0
NY	6	1
RI	3	1
Total	29	4

**Table 4: 2002-2003 Courses by State**

State	BOC 1 Certified	BOC 2 Certified
CT	39	0
MA	153	30
ME	101	0
NH	40	0
NJ	47	0
NY	116	21
RI	30	14
Total	526	65

**Table 5: 2002-2003 Certified Participants by State**

## 2.2 Core Researchable Objectives

The BOC Program had been evaluated in 2002; with its own set of objectives and researchable issues. This study has some objectives that are similar to those of the 2002 study along with several other unique objectives. The primary researchable issues of the current study as gathered from the original RFP and refined at the kickoff meeting are presented in the following table.

Obj #	Study Objective
1	An assessment of the estimated costs associated with operations and maintenance actions taken by students (for example, obtain cost estimates for representative actions from secondary sources).
2	An assessment of participants' perception of the value of the program segmented into views on level one courses and views of those who have taken level 2 courses. (for example, inclusion of some survey questions related to willingness to pay for BOC training). Include an informal assessment of persistence - i.e. whether early (2000/2001) participants have continued and expanded practices they acquired from the BOC training.
3	A robust analysis to estimate energy savings and other benefits attributable to the program broken down by building and industry type to the extent possible (with a particular focus on schools)... while electric and gas savings are the primary focus, oil, water, and sewer savings should also be estimated. Indications of other non-energy impacts of particular interest are: labor cost impacts (labor savings and promotions/salary increases), building maintenance savings, improved worker safety, etc. Savings per participant are also desired.
4	Update the set of performance indicators such as annual kWh savings, market awareness, and number of students certified that reflect the program's history of accomplishments and that can be tracked going forward to document program activity and market transformation results.
5	Examination of other process-related issues. These include examining the discrepancies between the number of enrolled and certified students to provide an understanding of drop-out rates, an assessment of how long BOC enrollees stay in their role; and to what extent operating budget constraints inhibit student's actions.
6	Recommendations for modifications or improvements to the program including identifying priority market segments for BOC to serve, and identifying program successes, including: Examination of what strategies for recruiting participants in BOC have been successful to date (and transfer lessons among sponsors, if possible), in the Northeast states, what barriers might be limiting the success of recruitment efforts or participation, and recommendations on how to increase participation going forward.

**Table 6: Researchable Objectives as Refined from RFP**

### 3 General Methodology

The following tasks were performed in support of this study and are discussed in detail in Section 3.1 below.

- 1) Review program material and perform literature review.
- 2) Conduct interviews utilizing past evaluation instruments to the extent possible with students, supervisors, staff, instructors and non-participants.
- 3) Analyze energy savings and other benefits of the program.
- 4) Update performance indicators from the previous study<sup>3</sup>.
- 5) Examine other process-related issues and recommend modifications.

#### 3.1 Detailed Task Methodologies

The individual data collection activities undertaken as part of this study are synthesized in the results section of this report by study objective. By using multiple techniques and data collection activities, our evaluation can draw a more in-depth picture of the NEEP BOC program and its effects on O&M practices in the region. Each task undertaken in this study is further described below.

##### 3.1.1 Task 1: Program Material and Secondary Literature Review

The first step in the evaluation was to gain an understanding of the programs by reviewing some key program materials. RLW reviewed the following information for use in this task.

- Level 1 and Level 2 Curriculums, available student evaluations, and previous marketing plans.
- Full contact information and registration form information for students in 2003 classes, including student name, series attended, title, address, phone number and email, company name, address and phone number, and class location.

These materials were reviewed to better understand program status and participant activity in addition to providing some of the information needed to update the BOC performance indicators from 2002. Student course evaluations were also reviewed to provide direction for researchable process issues. We explored secondary literature sources to identify cost estimates for O&M improvements undertaken by students. The primary source identified for possible use in this task was the 2005 RS Means "Facilities Maintenance and Cost Repaid Data" publication. In pulling the data together from this resource, it was noted that the cost estimates did not align well with the various measures and actions of interest in the survey. Therefore, our approach was refined, and is based upon asking enrollees to estimate the amount of time and the approximate cost of materials associated with actions taken due to the BOC program. The information gathered and reviewed as part of this task is used to help provide a

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<sup>3</sup> "Final Report: Evaluation of the Building Operator Training and Certification (BOC) Program in the Northeast", *Research Into Action Inc. and GDS Associates, Inc.*, September 6, 2002. <http://www.putnamprice.com/pdf/NEEPBOCEvaluation.pdf>.

foundation of knowledge for the study in addition to informing objectives 1 and 4 in Table 6.

### 3.1.2 Task 2: Interview Performance

Three primary groups were interviewed as part of this study. They are students who have participated in the certification program and their supervisors, BOC staff and instructors, and non-participants. Each of these are discussed below.

#### Task 2a Student and Supervisor Interviews

To support the performance of student and supervisor interviews, we selected a sample of 2003 school and non-school enrollees for determining energy and non-energy impacts and a group of 2000/2001 participants to inform persistence of actions learned through BOC. We used the information provided by NEEP on 2003 enrollees as the sample frame for this sample design. The sample design recognizes the interest and focus on schools in the program and allows information to be gathered for schools independently. The sample of 2000/2001 participants was randomly selected from the group of students that were interviewed in the 2002 study.

Table 7 presents RLW's categorization of the enrollees in the 2002-2003 BOC Program into SIC Code Divisions, with utility attendees broken out. This process involved categorizing enrollees by company name when its industry was known, and using an electronic database of SIC codes (ProPhone) to identify and categorize the remaining enrollees. This table also presents the # of firms in each SIC code division in the states where the program is operated. While the enrollee counts by code is not exact, it appears that outside of services (of which the majority is schools) there are no other code divisions that stand out with a significant amount of enrollee activity. In terms of program enrollee coverage of the various SIC code divisions; the program has proportionally more public administration facilities than the 2002 economic census of the states involved in the program and less retail and wholesale trade.

Division/Group	Enrollees		# of firms, 2002 Economic Census <sup>1</sup>	
	#	% of total	#	% of total
Utility	52	6.7%	675	0.1%
A – Agriculture, Forestry, Fishing	1	0.1%	2,654	0.3%
B – Mining	0	0.0%	715	0.1%
C – Construction	6	0.8%	675	0.1%
D – Manufacturing	73	9.5%	50,213	5.9%
E – Transport, Communication, Electric	26	3.4%	23,841	2.8%
F – Wholesale Trade	17	2.2%	67,505	7.9%
G – Retail Trade	25	3.2%	131,019	15.3%
H – Finance, Insurance, Real Estate	89	11.5%	80,806	9.4%
I – Services (Including Schools)	379	49.1%	488,627	57.0%
J – Public Administration	90	11.7%	1,138	0.1%
K – Unclassifiable	14	1.8%	8,685	1.0%

<sup>1</sup> <http://www.census.gov/csd/susb/stsect02.xls>. Census values presented show only states involved in the program.

**Table 7: 2002-2003 Enrollees by SIC Code Division**

Table 8 presents the final student interview sample design. A target precision of  $\pm 10\%$  at the 90% level of confidence was used in the calculations in the 2003 sample for both schools and non-school enrollees. We decided to target schools separately as schools are a sub segment of particular interest among sponsors. This sample was pulled randomly within the school and non-school dimensions (excluding utility attendees who we assume have little or no savings associated with them). At least 6 enrollees were from each state that had enrollees in the 2003 population. It is important to note that all enrolled non-utility students are included in the sample frame, regardless of their ultimate certification status. The final school and non-school enrollee sample sizes are 45 and 49, respectively.

The persistence sample, drawn from surveys completed in the 2002 evaluation, was pulled randomly. RLW re-interviewed 17 of the 49 respondents acquired from the 2000 study, although only 16 of these interviews were required to reach the desired relative precision. In the final sample, we also conducted 15 surveys with a subset of supervisors of the students contacted. These supervisor contacts were gathered as part of the 2003 participant interviews. All of the surveys were used to gather information that feeds several of the primary study objectives.

Program Level	Final sample
Schools Enrolled in 2003	45
Non-Schools Enrolled in 2003	49
Level 1 and 2 Certified in 2000/01	16
	110

**Table 8: Enrollee Interview Sample Design**

The final sample of enrollee interviewees is provided in Table 9. The majority of enrollees surveyed attended Level 1 courses in 2003 and had not yet attended any

Level 2 courses. Enrollees who attended Level 2 courses in 2003 and did not attend Level 1 courses were the second largest group.

<b>Coursework Attended</b>	<b>Number in Final Sample</b>
Level 1 and Level 2 in 2003	4
Level 1 in 2002, Level 2 in 2003	6
Level 1 in 2003, Level 2 in 2004	2
Level 1 in 2003 only	71
Level 2 in 2003 only	11
Total	94

**Table 9: Coursework Attended by Final Enrollee Sample**

The instruments used in this study for participants and supervisors were founded upon those developed in the 2002 evaluation; although they were reviewed and altered as needed to assure that all specific NEEP objectives for this evaluation year were covered. The final survey is included as an appendix to this report.

*Task 2b: BOC Staff, Instructors and Program Managers*

The BOC Administrator, staff, and instructor interviews are primarily used to inform objectives 5 and 6. These interviews were conducted early in the evaluation process and were used to gather background program information in addition to an understanding of potential process issues, course content (including those O&M changes most focused on in the classroom), recruitment strategies pursued and their success, and overall program delivery before finalizing the other data collection survey instruments. Other topics that were explored in the interviews include the direction of future BOC offerings, strengths and weaknesses of the current curriculum, experience with the coursework, the primary reasons why some students do not get certified, and their perception of niches in the market being served by BOC and opportunities that could be served in future offerings.

A total of 9 interviews were performed, four BOC staff and instructors and five BOC program administrators. The table below provides more detail on the organizations from which the interviewed individuals were selected.

<b>Interviewee Type</b>	<b>Organization</b>
Instructor	Independent Energy Engineer and Consultant
Instructor	Canterbury Engineering Associates
Instructor	Turner Building Science
BOC Staff	Northeast Energy Efficiency Partnerships
Program Administrator	Long Island Power Authority (New York)
Program Administrator	Jersey Central Power and Light
Program Administrator	Cape Light Compact (Massachusetts)
Program Administrator	Efficiency Maine
Program Administrator	National Grid (Rhode Island)

### Task 2c: Non-Participants

RLW contacted 45 randomly selected non-participants from across the sponsors involved in the study able to provide data on individuals marketed to but who chose not to participate. In this regard, these interviewees are informed non-participants, and therefore are not a true sample of all C&I organizations in the regions served. The sample was targeted to achieve quotas within each sponsor, but was selected randomly from within each sponsor. These brief interviews collected information on such topics as whether they had heard of the BOC initiative, reasons why they have not participated in it (and what would induce or encourage them to participate), willingness to pay for the training, other training services they are using as an alternate to the BOC training (if any), and the most effective way to get information on the program to potential participants.

Table 10 presents the total non-participants in the final population, as well as the number of completed interviews in the sample, by sponsor. In instances where several individuals in the same organization were marketed to, we made an effort to select a single individual to represent that organization. We did this to avoid having the same organization represented more than once in the sample frame. In addition, efforts were made to remove individuals associated with an organization that did have an enrollee in the BOC program under the presumption that the organization is not truly a non-participant; rather they selected a different individual to attend the course. In the final non-participant sample, the average non-participant has been in building operations and maintenance for 19.5 years, with experience ranging from 1 year to 40 years.

Sponsor	# Non-participants in Population	# Non-participants in final sample
NYSERDA	587	8
LIPA	437	9
New Jersey (PSE&G)	423	8
National Grid	76	8
NSTAR	56	8
Cape Light Compact	6	3
Unitil	2	1

**Table 10: Non-Participant Population and Sample**

Table 11 shows some demographics of the final non-participant sample surveyed. By business type, most respondents were operators of manufacturing companies or schools, with each accounting for one-third of the sample. The average facility was 632,727 square feet and had approximately 3 supervisors and 7 operators.

Facility Type	Sample Size	Avg. # of Supervisors/ Location	Avg. # of Operators Under Supervision	Avg. Square Footage
Manufacturing	15	2.1	6.1	275,267
School/College	15	2.5	8.1	163,227
Retail	3	4.3	4.0	1,519,644
Office	2	1	4.0	8,000,000
Printing	2	6	5.5	96,500
Bio-Tech	2	14.5	13.5	139,176
Other <sup>1</sup>	6	2	6.6	144,167
Overall Wgtd Avg.	45	3	6.9	632,727
<sup>1</sup> Transportation Company, Warehouse, Moving Company, Public Works Facility, Waste Water Treatment Plant, and Commercial Realty.				

**Table 11: Average Number of Building Operators and Average Square Footage**

### 3.1.3 Task 3: Estimate Energy and Non-Energy Benefits

The energy and non-energy benefits of the 2003 enrollees in the BOC program are calculated from surveys with participants. Our general approach to determining impacts is similar to that used in 2002 with some key improvements. That is, savings are calculated using student level interview results of the incremental impact of the program on their building maintenance practices. This information was gathered among 17 actions believed to be the most likely to occur as a result of the coursework. Savings for these actions are developed on a square foot, horsepower, tonnage, or facility level basis using the 2002 study estimates as a beginning point and refining those estimates based upon our impact evaluation work performed in the region on utility O&M Programs. More information on the approach and results of this work can be found in Section 4.4.

Persistence results were calculated from the performance of 17 interviews with certified students contacted in the 2002 evaluation survey. We then used the rates of continued O&M actions for each measure and action from that survey to provide a sense of persisted actions and savings since 2002. These results are contained in Section 4.3.

#### 3.1.4 Task 4: Update Performance Indicators

In the 2002 report, a table presented indices of program activity over time. The indices in the table range from the average students per class, the number of students certified, and market awareness to the typical demographics of the facilities operated by BOC students. As part of this study, each of the performance indicators in this table has been updated with any appropriate interpretation of indicator movement. The only indicator that has not been updated is the market awareness indicator, which was originally informed via a survey with true non-participants. This study did not collect data from this group.

#### 3.1.5 Task 5: Examine Process-related Issues and Recommend Modifications

The RFP suggested several process related issues to be examined as part of this study. Many of the issues of interest were explored across data collection activities, ensuring that numerous perspectives cover many issues of interest. As part of this reporting process, RLW has synthesized all of the process information into each primary objective of interest. Following all results, we provide suggestions for improvement that we believe can be converted to actionable goals that are specific, measurable, and realistic to implement.

## 4 Results

This results section is primarily comprised of sections dedicated to each of the researchable objectives presented earlier. Within each section, we synthesize the results of all pertinent data collection activities to provide a full and comprehensive overview of each objective based upon the various perspectives available. We begin with an overall perception of the program as gathered from the staff, instructor, and several sponsor interviews in the interest of providing a broad sense of sponsor and staff desires and opinions of the program, followed by the results of each study objective.

It is important to note that the analysis of O&M costs and energy savings resulting from the BOC coursework was based upon self reported activity gathered via a phone survey. In addition, the energy savings also included the use of assumptions of per unit savings estimates (per sq. ft., per ton, per horsepower) that were applied to the self reported activities using a spreadsheet analysis. It is important to bear these study limitations in mind when interpreting these results. The team sought to minimize these limitations through use of a rigorous phone survey that gathered all necessary inputs and a series of savings estimates per unit that was verified via previous O&M impact evaluation work performed in the Northeast.

### 4.1 Staff, Instructor and Sponsor Interviews

Where appropriate, the staff, instructor, and sponsor interview results are incorporated into the results of each RFP objective. However, there were several items discussed in the interviews that provide additional program perspectives and experiences that are helpful to put the remainder of the results in context.

#### Program Goals

The interviewed sponsors reported that the program is not constrained by regulatory bodies; each sponsor reported being able to govern the program in concert with NEEP. There were few cited quantifiable goals in terms of number of enrollees, energy savings or courses held; rather most goals provided by sponsors were related to providing a service of value to assist operators in increasing efficiency awareness and opportunities. In this regard, the goals of the program across sponsors cited consistent themes, highlighted by the following bulleted items:

- To get enrollees to have an energy awareness and implement cost savings,
- To get enrollees to see their building as a whole system with maintenance opportunities,
- To get enrollees to network with one another,
- To have the program sustain itself at some point in the future,
- To improve energy efficiency of economy and assist publicly funded organizations to reduce energy costs, and
- To provide an opportunity to market other programs.

When asked about the perceived degree to which the program has met its goals, program administrators provided diverse responses. Some administrators felt they do not have enough information to characterize the programs success. Others anecdotally reported they believe people save energy and that the program meets the needs of enrollees; one sponsor piggybacked the 2002 study with their own assessment of estimated energy savings and found a moderate amount of savings. Other program administrators characterized program achievement of goals in more temperate terms, by indicating the program is “moving in the right direction”, is “being promoted by some attendees on their own” and one sponsor who had attended some classes said “people are satisfied and appear genuinely interested in what is going on”.

### Administration

Administratively, the program was reported to be running well. Concerns about program administration were directed at the level of resources involved in the program, including the need to support a long-term program manager and the assignment of a specific marketing person to help with program recruitment. This latter suggestion was made by two sponsors, one of which said “I believe more time and energy need to be dedicated (to marketing) by NEEP.” NEEP staff acknowledged this issue in their interview indicating that manpower has been difficult recently as the region they are covering is very large and NEEP has been transitioning BOC resources recently.

The process of setting up courses and managing instructors was cited to be well established by most interviewees. The location of courses is primarily determined by the availability of space at no cost; typically at utilities. The courses are not moved around much as experience has shown that having a central location that is consistently used works better for enrollees than moving courses around. Instructors reported overall satisfaction with NEEP’s administration of the program from their point of view; with one indicating “the NEEP program administrator is terrific.” The only concerns were regarding class logistics from an instructor that indicated his biggest problem is “sweating out whether the projector is going to be there” and the need to track square footage controlled better which was suggested by a sponsor.

NEEP handles the certification process, grades the work, issues certifications, and maintains the list of certified enrollees on the BOC website. A NEEP manager attends some of the courses, including the final course of each series, to communicate with students regarding assignments missed and projects that need to be completed for certification. Although this was not cited as a major concern, one interviewee indicated that NEEP used to attend all courses offered and that some communication with students is lost as a result of attending fewer courses.

### Instructors and Course Content

A common strength of the course related by interviewees was the instructors. NEEP has approximately 20 active instructors available for the courses and seeks new

instructors all of the time; although they reported not being in need of instructors at this time. Each of the instructors we interviewed has substantial experience in their field, including many years of teaching the BOC coursework. Instructors are matched up with their areas of expertise so the information conveyed is from an authoritative source that can add detail and real life experiences to the curriculum. Training of instructors has only occurred occasionally and has not been firmly established in the program; rather the program tends to rely upon matching up instructor specialty with courses as a way to ensure they are prepared to teach their assigned class. While most interviewees did not cite a concern with this approach, one indicated they felt a training session with instructors would ensure they are all teaching the same material.

Course content is updated regularly, and the 4<sup>th</sup> edition of several courses is coming out at this time. While the broad series of topics covered in the coursework was cited as a program strength by several interviewees, it was suggested by one instructor that the codes course is not directly applicable for many building operators and indeed is not consistent among the states in the region. It was suggested that perhaps a specific audience course in the Level 1 series directed at schools, hospitals or similar building segments would be more useful in place of the codes course. Another instructor also suggested more focus on water conservation -- which is important to operators in New England -- in the coursework. Two other isolated comments on the curriculum were regarding the need for more detail and the suggestion to add more pictures and graphics to the course presentation.

Two instructors expressed some concern about the type of students signing up for the class. As one instructor said, it's "been a problem keeping entry level people out of the audience, but it is hard to do something about this when getting people to sign up at all is so difficult." Another interviewee estimated that 25% of the enrollees were not primed for the class. This could be a function of non-technical supervisors attending the course to assess whether to send operator staff, although one interviewee suggested the problem is substantial enough to warrant consideration of a basic operator course to ensure familiarity with terms and systems before the full blown course.

### Program Strengths and Weaknesses

Interviewee reported strengths and weaknesses are highlighted if more than one interviewee reported it or if a single interviewee focused on it as a substantial program characteristic. Interviewee reported program strengths seemed to focus on a few general themes. One common theme was related to the comprehensiveness and applicability of the coursework, which one interviewee summed up by saying the "program areas cover valuable topics with powerful knowledge and the topics are wide ranging." The diversity of topics also prompted some interviewees to suggest that the coursework encourages enrollees to think about the building more holistically in addition to learning the perspectives of other trade professionals that operate in their facility. Secondary impacts of these strengths were noted to be better communication among facility staff as well as better communication with management.

The networking opportunities in the courses was also suggested as a program strength by several interviewees, including one that said “the networking among students and the instructor is a real program plus.” Other strengths suggested included the use of the course materials as reference tools after the course, the fact that the courses are endorsed and sponsored by the utilities, and the tie in between the BOC course and continuing education credits. The use of experienced and specialized instructors was also highlighted by two interviewees as a notable program asset.

Program weaknesses were focused on four primary issues. These included:

- Program marketing, which was characterized as having low levels of coordination between NEEP and the utilities and not being aggressive enough in its follow-up with students that have dropped out and with students who have completed the course and could market the program on behalf of NEEP and the sponsors.
- A literacy problem with students who are new to the field and attending the course. It was noted that the program is not generating enough interest to turn away people not primed for the course, although NEEP does have an info session that could be used to present information on course items that attendees will be exposed to.
- The Level 2 curriculum was cited as a weakness by two interviewees, although specific information on what could be improved was not provided.
- The performance and completion of projects and homework needed for certification by enrollees.

#### **4.2 Objective 1: Estimated O&M Costs**

The original RFP for this study asked for an assessment of the estimated costs associated with operations and maintenance actions taken by students. The information used to inform this task was gathered primarily through the enrollee interviews. That is, when an enrollee indicated that the BOC Program had influenced the performance of an efficient O&M activity at their facility, they were asked to estimate the costs associated with it. These costs were gathered as either in-house hour and material costs or the cost incurred to have a subcontractor perform the work.

Table 12 shows an analysis of this information. Enrollees were able to provide costs for about 25% of the activities asked about. In Table 12, column A shows the number of enrollees who informed the average cost per unit calculated in column B. Column C contains the total number of enrollees who reported having been influenced by the program to perform each activity and column D is the total affected area reported by these enrollees. Columns E and F show the total and average cost calculated for each activity based upon the information in the first four columns. Calculated in this way, the 94 enrollees who were interviewed are estimated to have spent almost \$10 million on O&M activities, or approximately \$105,500 per enrollee. This estimate is likely a

little conservative, as four enrollees who reported installing waste water saving measures and eight who reported installing water savings measures were unable to provide any cost estimates. Therefore, these two measures are not included in this table.

Also provided in this table is the average cost per installation/activity performed, which is calculated by dividing the sum of the total cost in column E (\$9,920,480) by the total number of installations/activities performed in column C (229). This results in an average cost of \$43,321 per installation/activity.

Measure/Activity	A	B	C	D	E=D*B	F=E/94
	# of enrollees providing cost estimates	Avg. cost per unit for enrollees providing cost estimates	Total # of enrollees installing/performing due to program	Total affected units of all program affected installations/activities	Total Cost	Avg. Cost per enrollee (n=94)
Lighting Controls	9	\$0.30/sf	22	1,910,560 sf	\$573,168	\$6,098
Efficient Lighting	11	\$0.96 /sf	32	3,566,964 sf	\$3,424,285	\$36,429
EMS/Thermostat	4	\$0.14/sf	15	2,841,714 sf	\$397,840	\$4,232
Door Gaskets & Damper Seals*	3	\$0.46/sf	16	4,072,778 sf	\$1,873,478	\$19,931
Unitary Equipment Maintenance	2	\$185.00/ton	19	4,899 tons	\$906,315	\$9,642
Chiller/ Clg. Tower Maintenance	3	\$386.36/ton	14	3,113 tons	\$1,202,739	\$12,795
Economizer Maintenance	2	\$0.24/sf	14	2,878,125 sf	\$690,750	\$7,348
New Motors	10	\$173.34/hp	22	713 hp	\$123,591	\$1,315
VFDs	5	\$975.00/hp	13	212 hp	\$206,700	\$2,199
Motor Maintenance	1	\$40.00/hp	18	3,263 hp	\$130,520	\$1,389
Pipe Insulation	2	\$5.00/lf	13	26,577 lf	\$132,885	\$1,414
Boiler Maintenance	1	\$0.04/sf	16	4,342,725 sf	\$173,709	\$1,848
Air Compressor Leak Repair	3	\$0.06/sf	6	1,041,667 sf	\$62,500	\$665
Air Compressor Maintenance	1	\$200.00/hp	9	110 hp	\$22,000	\$234
<b>Total Cost of All O&amp;M Activities Performed By Sample</b>					<b>\$9,920,480</b>	
<b>Average Cost Per Enrollee Interviewed (Total of Column E divided by 94)</b>						<b>\$105,539</b>
<b>Average Cost Per Installation/Activity Performed (Total of Column E divided by Total of Column C or 229)</b>						<b>\$43,321</b>

\* Information on air handler door gaskets and damper seals was gathered separately, but every enrollee that installed one also installed the other so they are presented together.

**Table 12: Enrollee Reported O&M Cost Estimates**

In considering the final estimate of O&M costs undertaken by enrollees, it is difficult to assess how reasonable the estimate is without a point of reference. To provide this point of reference, RLW has examined secondary information on retro-commissioning. Retro-commissioning refers to the process of fine tuning the electromechanical systems of an existing building so their performance is optimal. While the systems included in a comprehensive retro-commissioning would exceed the 14 included in our 'bottom-up' cost estimate calculation, the cost per square foot for retro-commissioning provides a comparative estimate of costs.

In the current study, the average conditioned area reported by the 94 enrollees who were interviewed was 616,045 square feet. Taking the average cost per enrollee from

the table above (\$105,539) and dividing it by the average square footage provides a cost estimate of approximately \$0.17/square foot. This value represents the cost per square foot of performing multiple activities at the same facility. Table 13 below provides this estimate, along with retro-commissioning cost estimates per treated square foot from 5 studies identified by RLW. It is important to note that retro-commissioning encompasses many more activities than were assessed in this study. Therefore, it is reasonable to expect that the average cost per square foot would fall in the lower range when compared to these retro-commissioning studies. In consideration of all of the costs in this table, we believe the overall O&M costs calculated in this study appear reasonable.

Result	Study
Range: \$0.01/sf to \$0.16/sf	Seven low-cost case studies from three utility-funded studies and one government funded study performed by Portland Energy Conservation, Inc. (PECI) over the last six years. <sup>4</sup>
\$0.12/sf	Seventeen retro-commissioned buildings in California. <sup>5</sup>
<b>\$0.17/sf</b>	<b><i>Current BOC Evaluation: Cost per enrollee interviewed.</i></b>
Low: \$0.05/sf Medium: \$0.20/sf High: \$0.43/sf	Interviews of 100 leading owners and industry providers in the United States and Canada. <sup>6</sup>
\$0.27/sf	A meta-analysis of 224 commissioned buildings from 21 states. <sup>7</sup>
\$0.70/sf	Over 200 interviews of large/complex building industry contacts. <sup>8</sup>

**Table 13: Retro-Commissioning Study Costs per Square Foot**

#### 4.3 Objective 2: Perception of Program Value and Persistence of Influence

This section provides the results that pertain to the BOC Program's value, as perceived by informed non-participants, participants, and program staff/instructors. In this section we weave the results from these three groups together to render a cohesive sense of BOC coursework value. We believe informed non-participant feedback is valuable because it helps gauge the level of interest and perceived value of the provided BOC Program topics among individuals who have yet to participate. The examination of the value of the BOC among participants or enrollees is important as it bears on satisfaction with the course as well as the power of students to pitch and market the program to others; which is a part of the general marketing theme

<sup>4</sup> "Retro-commissioning's Greatest Hits", *Portland Energy Conservation, Inc.*, pp.1-12.

[http://www.peci.org/library/PECI\\_RCxHits1\\_1002.pdf](http://www.peci.org/library/PECI_RCxHits1_1002.pdf)

<sup>5</sup> "High Performance Commercial Buildings Systems: Evaluation of Persistence of Savings From SMUD Retro-Commissioning Program", *Lawrence Berkeley National Laboratory*, May 2004, pp. ii-iv.

[http://buildings.lbl.gov/hpcbs/pubs/FinalReport\\_SMUDrCx.pdf](http://buildings.lbl.gov/hpcbs/pubs/FinalReport_SMUDrCx.pdf)

<sup>6</sup> "Retro-commissioning: Existing Building Inventory", *National Energy Management Institute*, February 2002, p. 5 and p. 25.

[http://www.nemionline.org/download/hvac/2\\_Retro-Commissioning.pdf](http://www.nemionline.org/download/hvac/2_Retro-Commissioning.pdf)

<sup>7</sup> "The Cost-Effectiveness of Commercial Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts In Existing Buildings and New Construction In the United States", *Lawrence Berkeley National Laboratory*, December 2004, p. 1.

<http://eetd.lbl.gov/emills/PUBS/PDF/Cx-Costs-Benefits.pdf>

<sup>8</sup> "Building Commissioning Market Industry Analysis", *National Energy Management Institute*, November 2001, p. 1 and pp.18-19.

[http://www.nemionline.org/download/hvac/1\\_Building%20Commissioning.pdf](http://www.nemionline.org/download/hvac/1_Building%20Commissioning.pdf)

presented in the interviews. This section also includes an informal assessment of persistence and expanded practices undertaken by BOC course participants since 2002.

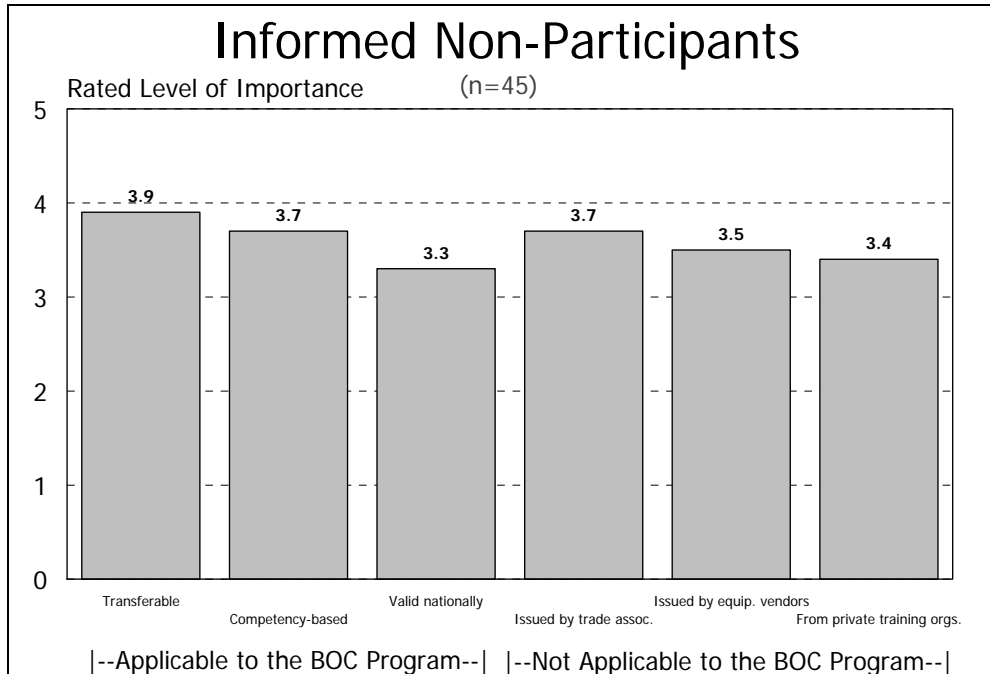
#### 4.3.1 Interest, Usefulness and Importance of Coursework

Table 14 below presents the informed non-participant ratings of the importance of certification in building operations and maintenance. The percentage of informed non-participants who feel that certification is important (4) or very important (5) is only slightly higher than it is for those who feel that certification is not important (2) or not at all important (1). These results present a level of importance that is generally lower than the importance of certification reported in 2002. The current and past ratings are not concentrated at either end of the scale; they tend to distribute all along the scale rather than cluster at certain points.

<b>Importance of Certification Rating</b>	<b>2004 Informed Non-Participants (n=22)</b>	<b>2002 Non-Participant Supervisor Results (n=280)</b>
5 (Very Important)	27%	35%
4	18%	20%
3	23%	20%
2	18%	10%
1 (Not at All Important)	13%	14%

**Table 14: Non-Participant Ratings of the Importance of Certification**

Using the same scale, all non-participant respondents who gave ratings of 3, 4, or 5 above, were asked to rate their level of interest in various types of certification. As shown in Figure 1, the highest level of interest was shown for certification that is transferable to other companies (3.93) and is competency based (3.73); which are both characteristics of the BOC certification. So although all types of certification offered to the respondent were rated highly, the BOC elements of transferability and competency-based are particularly important and valued. These were also two of the three highest rated in the 2002 study, in which the same question was posed to non-participating regional supervisors.



**Figure 1: Non-Participant Interest in Types of Certification**

Table 15 presents the percent of non-participants in the current study and the 2002 study who reported they were either 'interested' or 'very interested' in various courses provided in the BOC Program. The highest level of reported interest for both groups occurs for energy conservation techniques, one of the first courses in the 100 Series. Preventative maintenance, a 200 series course, and facility electrical systems, another 100 series course were also highly rated in terms of non-participant interest. HVAC systems and controls, energy auditing and refrigeration maintenance and troubleshooting received the lowest levels of interest; the latter likely due to less prevalence in facilities than other systems. When asked about other training topics of interest, non-participants mentioned safety management and water/wastewater management.

Class #	Course Topics	2004 % Interested (4) or Very Interested (5) (n=22)	2002 % Interested (4) or Very Interested (5) (n=280)
<b>BOC 100 Series</b>			
102	Energy conservation techniques	86%	68%
103	HVAC systems and controls	50%	56%
104	Efficient lighting fundamentals	55%	50%
105	Maintenance and related codes	64%	56%
106	Indoor air quality	68%	61%
107	Facility electrical systems	73%	58%
Overall 100 Series Average			
<b>BOC 200 Series</b>			
201	Preventative Maintenance	73%	74%
202	Electrical systems maintenance and troubleshooting	68%	58%
203	HVAC equipment maintenance and troubleshooting	64%	50%
220	Energy auditing	55%	43%
None	Refrigeration equipment maintenance and troubleshooting	59%	39%
Overall 200 Series Average			

**Table 15: Non-Participant Interest in Course Topics**

Enrollees of the program were asked about how valuable they felt the various courses were on a scale of 1 (not at all useful) to 5 (extremely useful). These results are provided in Table 16 by school versus non-school enrollees. Both groups reported receiving similar value from the level 1 courses, but participants from schools (4.32) found the level 2 courses more valuable than participants from non-schools (3.76). Although the presentation of the results in the 2002 study does not make them comparable in this table, the building systems overview, energy conservation techniques and indoor air quality courses also received high ratings by students.

Class #	Course Topics	2004 School Enrollees	2004 Non-School Enrollees
<b>BOC 100 Series: 1 (not at all useful) to 5 (extremely useful)</b>		<b>n=35</b>	<b>n=41</b>
101	Building system overview	3.91	3.88
102	Energy conservation techniques	4.26	3.80
103	HVAC systems and controls	4.09	4.05
104	Efficient lighting fundamentals	3.97	4.13
105	Maintenance and related codes	3.63	3.70
106	Indoor air quality	4.11	4.00
107	Facility electrical systems	3.70	4.00
Overall 100 Series Average Rating		3.95	3.94
<b>BOC 200 Series: 1 (not at all useful) to 5 (extremely useful)</b>		<b>n=11</b>	<b>n=10</b>
201	Preventative Maintenance	4.45	3.60
202	Electrical systems maintenance and troubleshooting	4.09	3.67
203	HVAC equipment maintenance and troubleshooting	4.27	3.60
204	HVAC Controls & Optimization	4.18	3.70
210	Advanced Indoor Air Quality	4.55	3.80
220	Energy auditing	4.36	4.00
231	Advanced Lighting Applications	4.36	4.00
Overall 200 Series Average Rating		4.32	3.76

**Table 16: Reported Usefulness of Courses by Enrollees**

In a related question, 80% of enrollees and 40% of enrollee supervisors indicated that they had recommended the course to others. This is consistent with the results of 2002 in which 78% of enrollees reported they had recommended the BOC course to other operators.

Three of four program staff and instructor interviewees reported perceived value in the course as observed from some of the following quotes. However, it should be noted that one interviewee indicated that the course had been tried previously with limited success and did not seem to be valuable enough to garner participation among their customers.

- "The whole class; they are getting good ideas. They are hearing others talk things out and have similar problems. They're learning about energy efficient lighting. A couple of times they want contact information from the sheet."
- "It is a very good course. Introduction occurs in many areas. Has great value in broadening the horizon of the employees. For example, teaches electricians indoor air quality."
- "Networking, atmosphere in class room experience for students, and the instructors make the program work and have value – they have great instructors."

In the enrollee supervisor survey, respondents were asked to rate their satisfaction with the BOC course attended by their employee. The scale of satisfaction extended from a 1 (not at all satisfied) to a 5 (extremely satisfied). Table 17 shows that 80% of respondents indicated they were satisfied with the course and no respondents indicated any level of dissatisfaction. These results are similar to those from the 2002 study, in which the vast majority of respondents indicated they were very satisfied with the course. Reviewing the 2004 results by Level 1 vs. Level 2 enrollee supervisors revealed that no Level 2 enrollee supervisors indicated they were 'extremely satisfied' although the vast majority were 'satisfied'.

Satisfaction with BOC Course	2004 Enrollee Supervisors			2002 Supervisor Results (N=13)
	Overall (N=15)	Level 1 (N=11)	Level 2 (N=4)	
5 (extremely satisfied)	40%	55%	0%	23%
4 (satisfied)	40%	27%	75%	61%
3 (neither)	20%	18%	25%	15%
2 (not satisfied)	0%	0%	0%	0%
1 (not at all satisfied)	0%	0%	0%	0%

**Table 17: Supervisor Satisfaction with Course**

Each responding non-participant was asked whether they were planning on attending or sending staff to training or continuing education classes in the next 12 months. Twenty four (53%) reported they were. Table 18 presents the types of training that these informed non-participants plan on participating in within the next year, along with the results from this question provided in the 2002 study. Approximately two-thirds of those who will attend some type of training within the next year will attend an in-house training. More than half of these individuals also reported plans to attend vendor workshops and trade shows or use training videos. Although training generally does not seem to be as popular as it was in 2002, the types of training that interviewees reported planning on attending in this study are consistent with the planned training reported in 2002.

Type of Training (n=24)	% Plan to Attend In Next Yr	2002 Results (N=150)
In-House Training	67%	79%
Vendor Workshop	58%	59%
Trade Shows or Professional Conferences	58%	76%
Training Videos or Other Materials	54%	77%
Government Regulation Training (e.g. OSHA)	46%	59%
Training by Private Organizations	38%	45%
BOMA Certification Course	25%	19%
Community or Technical College Course	25%	31%
Operating Engineers Training Course	13%	17%

**Table 18: Training Plans for the Next Year**

#### 4.3.2 Willingness to Pay for BOC Coursework

All informed non-participants who reported an interest in sending staff through the BOC Program were asked how much they would be willing to pay for the course. Table 19 shows these results. Eight respondents reported that they were willing to pay an average \$1,081 dollars for the course.

Respondent Type	Not Sure or Would Not Consider Attending Course	Don't Know How Much They Would Be Willing to Pay	Amount Willing to Pay (n)
School (n=15)	5	6	\$600 (4)
Non-school (n=30)	11	15	\$1,563 (4)*
Overall (n=45)	16	21	\$1,081 (8)

\* One Non-school respondent reported a willingness to pay \$2,250 for the course; removing this outlier results in an average of \$1,000.

**Table 19: Informed Non-Participant Open-Ended Amount Willing to Pay for BOC**

After the open-ended question, interviewees who expressed an interest in attending the course (the respondents falling into the two rightmost columns in Table 19) were asked if they would pay \$1,400, and then \$1,600, to participate in the BOC Program. These results are tabulated in Table 20. Ten of these individuals reported a willingness to pay \$1,400 to participate after having heard a brief description of the program, while only 6 agreed to pay \$1,600. This low level of interest in paying the full course fee is consistent with an experience in one of the sponsor states where a major mailing recruitment effort in which the course was offered at full price met with few registrations.

It is apparent in the table that schools are less interested in paying the full course cost of \$1,400 than non-schools. It should be noted that in the interviews it was learned that most sponsors help subsidize the cost of the course for attendees in their region;

including some that cover the full cost for municipal workers who attend; so the listed price of \$1,400 is often not the price experienced by the customer.

<b>Respondent Type</b>	<b>Would You Pay \$1,400?</b>	<b>Would You Pay \$1,600?</b>
School (n=10)	2	1
Non-school (n=19)	8	5
Overall (n=29)	10	6

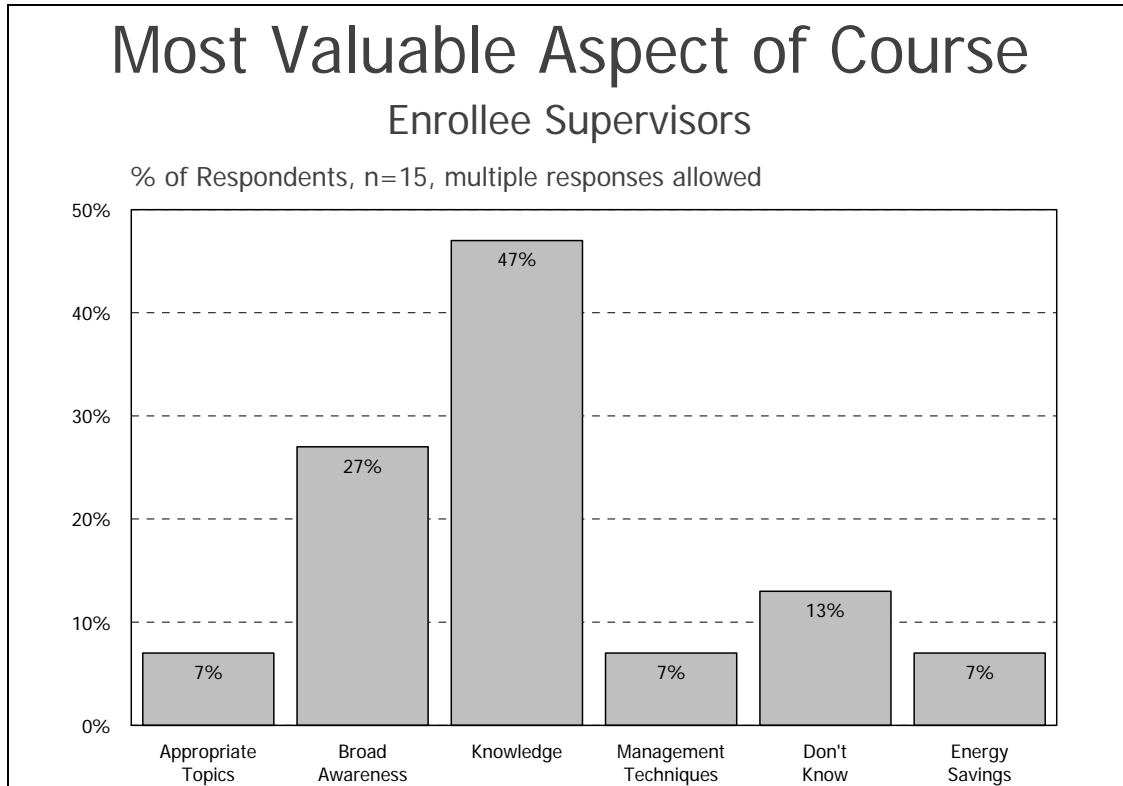
**Table 20: Informed Non-Participant Willingness to Pay for BOC at Various Price Levels**

Interviewed enrollees and enrollee supervisors were asked similar questions about whether they believe the course was worth \$1,400 after having experienced it. Overall, 85% of supervisors and 88% of enrollees felt it was worth the price. It is also notable that although the sample sizes were small, 91% of supervisors of Level 1 enrollees thought the course was worth \$1,400 while only half of Level 2 supervisors thought the course was worth \$1,400. So while less than a quarter of non-participants are willing to pay \$1,400 for the course (Table 34), the vast majority of participants who have experienced the course perceive it as worth the cost of \$1,400.

<b>Respondent Type</b>	<b>Was Worth \$1,400</b>
<b>Enrollee Supervisors</b>	
Overall (n=13)	85%
School (n=5)	100%
Non-School (n=8)	75%
Supervises Level One Enrollee (n=11)	91%
Supervises Level Two Enrollee (n=4)	50%
<b>Enrollees</b>	
Overall (n=93)	88%
School (n=45)	89%
Non-School (n=48 <sup>1</sup> )	88%
Level One Enrollee (n=70)	87%
Level Two Enrollee (n=16)	94%
<sup>1</sup> One individual who had signed up to participate was not able to attend any classes so far because of a new construction project at his facility that required his presence.	

**Table 21: Enrollee and Supervisor Coursework**

Figure 2 presents the most valuable aspects of the BOC coursework as reported by enrollee supervisors. Almost half of the sample felt that the knowledge provided by the coursework was its most valuable aspect, while 27% felt that the awareness provided on a broad range of topics was most valuable.



**Figure 2: Most Valuable Aspect from Supervisors**

Enrollees and their supervisors were asked about things that could be done to improve the value of the program. Table 22 shows the categories for which multiple responses were given; although responses of less than 3% are not shown. Providing more advanced coursework, more hands-on activities, and more detail garnered the most responses among enrollees, although 43% of enrollees and 87% of enrollee supervisors of the sample felt that the program was fine as it is. In 2002, students were also asked to suggest changes to the course series. Like the current results, suggestions were minimal and focused on more detail in the courses and handouts and more hands-on activities.

<b>Ways to Add Value</b>	<b>Enrollees (N=94)</b>	<b>Supervisors (N=15)</b>
None	43%	87%
Advanced coursework	7%	0%
More hands-on activities	7%	0%
More detail	5%	0%
Closer locations	3%	7%
Don't know	3%	0%
Less time between classes	3%	0%
More marketing	3%	0%
Consider providing online	0%	7%

**Table 22: Enrollee and Supervisor Suggestions to Add Program Value**

#### 4.3.3 Persistence of Program Influence on O&M Practices

The performance of an informal assessment of the persistence of program influence on 2002 participants is included as a researchable task in objective 2. To fulfill this objective and assess the persistence of BOC impacts, RLW interviewed 17 individuals who had participated in the BOC Program in 2000 or 2001 and were interviewed as part of the 2002 study. As part of the 2002 study, these participants provided information on whether they had performed particular O&M activities including boiler maintenance, HVAC controls, etc. In this study they were asked about their performance of each potential activity, i.e., whether they are performing each activity initially asked about in the 2002 study.

Table 23 provides an estimate of 2004 savings resulting from participants who participated in 2000 or 2001 and were interviewed in 2002. To calculate the persistence of program influence for each measure, the percent of interviewed 2000/2001 participants performing each activity in 2004 (column D) was subtracted from the percent of these individuals performing that activity in 2002 (column C). This difference (column E) is multiplied by the estimated incremental program impact from the 2002 study (column A) to calculate how much of this difference is due to program participation or influence (column F). This program influenced difference in activity (column F) is added to the estimated incremental impact from the 2002 study (column A) to provide an adjusted incremental impact (column G). This sum was then multiplied by the average savings per facility (column B) from the 2002 study to generate savings estimates deemed to have persisted for 2000/2001 participants due to the program influence.

As the table shows, we estimate that all of the water savings, over 114% of the kWh savings, and almost 109% of the MMBtu savings estimated in the 2002 study are continuing due to the program influence. It should be noted, however, that there appears to have been an error in the average savings per facility estimate for boiler maintenance from the 2002 study. Table 23 uses the corrected value in its calculation of persisted savings. The per student kWh per square foot based upon the 11-measure

estimator approach saved was determined to be 0.18 in the 2002 study, and this study estimates that approximately 0.21 kWh of savings per square foot per student is being realized. The 2002 MBTU per student per square foot estimate from the based upon the 11-measure estimator approach was determined to be 1.95. In this study we estimate that 2.12 MBTU per student per square foot is being realized.

The high rate of persistence is related to the duration an enrollee remains in their position. In the final enrollee sample, the average enrollee had been in their current position for 10 years. In the 2002 report, the assumption regarding the duration of the program influence was estimated to be 5 years. Based upon this analysis, savings actually increases slightly in the first four years of enrollee activity in their facility due to the program influence. However, without having estimated persistence at the five year mark we believe assuming 100% persistence for the first five years after enrollment is reasonable.

Measure/Action	A	B	C= # of original performers/17	D=(C+new performers)/17	E=D-C	F=A*E	G=A+F	Estimated 2002 Savings After 4 Years From 11 Measures		
	2002 Study Est. Incremental Impact	Avg. Savings/Facility from 2002 Report	% Performing in 2002 (n=17)	% Performing in 2004 (n=17)	Difference in Performance from 2002 to 2004	Difference in Performance from 2002 to 2004 Attributable to the Program	Adjusted Incremental Impact of 2002 Activities Plus New Activities	kWh (M)=(G)*(L)	MMBtu (N)=(G)*(L)	Gallons (O)=(G)*(L)
Boiler Maintenance	40%	2,015 <sup>1</sup>	52.9%	58.8%	5.9%	2.4%	42.4%		853	
Air Handler Door Gaskets Replacements	7%	6,718	5.9%	17.6%	11.8%	0.8%	7.8%	526		
Air Handler Damper Seal Replacements	4%	40,308	5.9%	29.4%	23.5%	0.9%	4.9%	1,992		
HVAC Controls (kWh)	19%	356,056	29.4%	41.2%	11.8%	2.2%	21.2%	75,610		
HVAC Controls (MMBtu)	19%	3,359	29.4%	41.2%	11.8%	2.2%	21.2%		713	
Chiller/Cooling Tower Maintenance	7%	104,400	52.9%	58.8%	5.9%	0.4%	7.4%	7,738		
Economizer Maintenance	3%	416,518	47.1%	47.1%	0.0%	0.0%	3.0%	12,496		
Motor Maintenance	3%	9,048	64.7%	94.1%	29.4%	0.9%	3.9%	351		
Motor Replacement	4%	19,520	58.8%	76.5%	17.6%	0.7%	4.7%	919		
Variable Frequency Drives (VFD)	21%	123,710	35.3%	64.7%	29.4%	6.2%	27.2%	33,620		
Air Compressor Maintenance	5%	68,000	76.5%	88.2%	11.8%	0.6%	5.6%	3,800		
Water Savings Measures	7%	1,551,207	58.8%	58.8%	0.0%	0.0%	7.0%			108,585
							2005 Total	137,050	1,567	108,585
							2002 Total	119,968	1,444 <sup>2</sup>	108,585
							Persistence of Program Influence	114.2%	108.5%	100.0%

<sup>1</sup> There was a calculation error in the 2002 study where this value was 1,680.

<sup>2</sup> Due to the boiler maintenance calculation error, this value was reported as 1,310 in the 2002 study.

**Table 23: Estimated Persistence of Program Influence from 2000/2001 Participants**

Related to persistence, 2003 enrollees were asked to provide five things they recall having learned through the program. Table 24 shows the five most frequently mentioned split between schools and non-schools. Indoor air quality, lighting, and HVAC were the most common mentions across both groups. This is consistent with instructor interviews, in which it was reported that indoor air quality and lighting in particular get a lot of focus during classroom time.

<b>Top Five Mentions</b>	<b>Schools (N=45)</b>	<b>Non-Schools (N=48<sup>1</sup>)</b>	<b>Overall (N=93)</b>
Indoor Air Quality	53.3%	39.6%	46.2%
Lighting	35.6%	52.1%	44.1%
HVAC	28.9%	45.8%	37.6%
Electrical	8.9%	22.9%	16.1%
Controls	11.1%	10.4%	10.8%
Efficiency/conservation	11.1%	10.4%	10.8%
Motors	8.9%	12.5%	10.8%

<sup>1</sup> One individual who had signed up to participate was not able to attend any classes so far because of a new construction project at his facility that required his presence.

**Table 24: Topics Participants Recall Learning Through the BOC Program**

#### **4.4 Objective 3: Estimated Energy Savings and Non-Energy Impacts**

In the survey, interviewees were asked three primary questions for a series of 17 activities to determine whether they had undertaken an activity due to the BOC Program for which savings were achieved. The purpose of this is to calculate energy savings that are generated from program induced efficient O&M activities on a per enrollee and per enrollee per square foot level. These estimates are being calculated as they are easy to apply to gathered tracking data inputs and can generate reasonably accurate impact estimates as the program moves forward.

To accomplish this, enrollees were first asked if they had performed any of the activities in the two years before their participation in the BOC Program (in 2003). Second, they were asked if they had performed any of these activities within a given time frame. For all maintenance-type activities except air compressor maintenance and leak reduction, this time frame was approximately one year (since January 2004) as these activities typically need to be performed at least once a year. Air compressor maintenance and leak reduction should be performed at least twice a year so interviewees were asked if they have performed either since July 2004. Any activity that involved the installation of new efficient equipment was given an approximate two-year window (since January, 2003), which was selected to assure that the program receives credit if a participant performed an efficient equipment retrofit at any point since their participation.

The third question asked if the BOC coursework affected their decision to perform these activities. This allows the program to receive credit if a respondent performed equipment retrofits prior to program participation and has performed more since then.

That is, this question allowed credited savings as a result of an enrollee that has taken advantage of an opportunity for a particular measure or practice above and beyond what might have been performed before the coursework.

If an interviewee indicated that their participation in the BOC Program had influenced the performance of any of the 17 O&M activities in the survey, we gathered information such as the area or capacity affected (sq. ft., hp, or tons) and the fuels impacted (gas or oil for boilers, unitary and other HVAC controls) for each measure of interest. To generate facility-level savings for each of these measures, the affected area/capacity was multiplied by the appropriate savings estimate from Table 25. To further refine the savings estimates per person, we provided each interviewee with a list of names of other participants from the respondents' facility who also participated in the BOC program in 2003. Each respondent was then asked to specify how many of these individuals also oversee the maintenance of the various systems in question. This information was used to divide the savings calculated from the respondent to account for other operators trained through the program that could also claim the same calculated savings.

Measure/Action	Savings 2002	Savings 2005	Unit of Savings	Savings Assumption Notes
Boiler Maintenance	0.003	0.003	MMBtu/sf	This value is based upon an estimate of 50,000 Btu/sqft/yr and an assumed savings of 5%. At this time, we cannot find information to provide a more refined estimate, and will use this value.
Air Handler Door Gasket Replacements	0.01	0.01	kWh/sf	RLW has studied the repair of air handler dampers and seals in a previous O&M study, and the savings estimates used in the 2002 study appear reasonable.
Damper Seal Maintenance	0.06	0.06	kWh/sf	
HVAC Controls (EMS, thermostats in kWh)	0.53	0.41	kWh/sf	RLW evaluated three sites with HVAC controls in previous O&M impact work and believes 0.41 kWh/sf is a more accurate impact estimate.
HVAC Controls (EMS, thermostats in MMBtu)	0.005	0.005	MMBtu/sf	Estimate based heating assumed to be 50,000 btu/sf/yr for control savings at 10%. We believe this is reasonable for use in this study.
Chiller system/cooling tower maintenance	80	85.6	kWh/ ton	RLW evaluated six sites with various chiller maintenance and cooling tower maintenance in previous O&M impact work and believes 85.6 kWh/ton is a more accurate impact estimate.
Economizer Maintenance	0.62	0.62	kWh/sf	RLW has performed limited evaluations of sites with economizer maintenance savings and the 0.62 value appears larger than we might expect. However, this value will be used in this study in the absence of a more definitive estimate.
Motor Maintenance	24.52	24.52	kWh/hp	This value is from a national study reported through ACEEE. RLW was unable to acquire a more refined estimate for the 2005 study.
Replacement Motors	52.9	191	kWh/hp	RLW reviewed 21 previous motor replacement projects in previous impact work and believes 191 kWh/hp is a more accurate impact estimate.
Variable Frequency Drives	937.2	937.2	kWh/hp	RLW has studied the installation of VFDs in previous retrofit studies, and the savings estimates used in the 2002 study appear reasonable.
Air Compressor Maintenance	68,000	22,440	kWh/facility	RLW has performed multiple evaluations of sites with compressed air maintenance, and leak repair typically returns twice as much savings as maintenance. Although the 68,000 value appears smaller than we might expect, it is derived from national IAC data that is believed to be a reasonable estimate. Therefore, we estimate that leak repair generates two-thirds of the savings estimated from the 2002 study and maintenance the other third.
Air Compressor Leak Repair	-	45,560	kWh/facility	
Water Savings Measures	1,551,207	1,551,207	Gallons/facility	This estimate is based the estimated savings per facility from the 2002 study; although a battery of questions probing typical water savings activities was asked in the current study, no participants were able to provide estimates of gallons saved due to their actions.
Waste Water Savings Measures	-	Unknown	Gallons/facility	This estimate is not able to be quantified as although some participants indicated performing activities to reduce wastewater, none were able to provide estimates of wastewater gallons saved due to their actions.
Lighting Controls	-	1.22	kWh/sf	Based upon data from 17 efficient lighting projects, using W/Sf savings and logger hours of use.
Efficient Lighting	-	4.21	kWh/sf	Based upon data from 31 lighting control projects, using W/Sf savings and logger hours of use.
Unitary Equipment	-	50.5	kWh/ton	Based on an average of 5 studies, assuming an average of 3 years operation between tune-ups.
Pipe Insulation	-	1.48	MMBtu/lf	Based on 6 inch pipe with 2 inches of insulation added for 180°F hot water system in a large building.

**Table 25: Savings per Unit**

As an example, if an interviewee indicates that their participation in the BOC Program influenced their decision to install lighting controls in a 100,000 square foot area, the facility-level lighting control savings for this site would be calculated as follows:

$$(100,000 \text{ sf}) * (1.22 \text{ kWh saved per square foot}) = 122,000 \text{ kWh saved}$$

If this same respondent indicates that one other 2003 BOC participant from their facility also oversees the 100,000 square feet of space where these controls were installed, the enrollee-level lighting control savings for this site would be calculated as:

$$(122,000 \text{ kWh saved}) / (2 \text{ enrollees}) = 61,000 \text{ kWh saved/enrollee}$$

After similar calculations are performed for all measure level instances of program-induced efficient O&M behavior, the participant-level savings were added together to provide an overall savings for each fuel type (electric, gas, oil) and water. This value was then divided by the total enrollees surveyed to provide a per enrollee estimate of impacts. To calculate the per enrollee per square foot impact estimates, the per enrollee savings estimates were divided by the average square footage controlled by all surveyed enrollees.

The following tables show the savings estimated from the enrollee interviews for schools and non-schools separately. As indicated in Table 25, none of the enrollees who installed water or waste water savings measures was able to provide estimates of how much water savings these measures generated. Water savings are therefore calculated using the 2002 study per facility estimate. Waste water savings, however, were not assessed in the 2002 study. In an attempt to come up with an estimate for these measures, RLW performed an exhaustive search of secondary resources, including the national IAC database, but was unable to find any. As such, waste water savings are not provided in Table 27 for the four non-school facilities that reported installing such measures due to their involvement in the program.

As part of the survey, if an enrollee was determined to have taken an action due the coursework, they were asked whether that action was rebated. This information is also shown in table. It should be noted that as part of the BOC coursework, slides are presented that introduces enrollees to energy conservation programs offered by the sponsors.

To assist the sponsors in avoiding the double counting of savings between the BOC Program and other conservation efforts being undertaken in their territory, RLW has calculated the number of units affected both with and without rebated activities included. In deciding whether to utilize the savings with or without rebated activity, sponsors should consider the extent to which they operate rebate programs in their territory. In addition, sponsors should consider the method in which they calculate net savings as part of their traditional rebate drive energy conservation program. As might be expected, the majority of resource savings removed when rebates are taken into account is in electricity savings. It should be noted that the difference between including rebated savings and not including it typically falls in the electric savings estimates.

Table 26 presents the savings estimated from the 45 interviews performed with school enrollees. The average savings among schools with rebated savings included is calculated by summing up the savings by fuel type, dividing by the number of interviewees (45), and then dividing by the average total square footage (662,862 sq. ft.) of these enrollees. This calculates to be 0.26 kWh per enrollee per square foot and 1.18 oil and gas MBtu per enrollee per square foot. The average enrollee under this scenario saves 174,337 kWh and 781,124 MBtu.

The average savings among schools removing rebated savings is calculated to be 0.15 kWh per enrollee per square foot and 1.12 oil and gas MBtu per enrollee per square foot. The average enrollee saves 99,546 kWh and 742,689 MBtu.

Measure	Savings Per Measure	Unit of Savings	# of Enrollees Performing	Total Units	Total Savings (with rebated activity included)	# rebated	Total Units Without Rebated Activity	Total Savings Without Rebated Activity
Boiler Maintenance (Gas)	0.003	MMBtu/sf	4	1,650,000	4,950 MMBtu	0	1,650,000	4,950 MMBtu
Boiler Maintenance (Oil)	0.003	MMBtu/sf	1	1,000,000	3,000 MMBtu	0	1,000,000	3,000 MMBtu
Air Handler Door Gaskets	0.01	kWh/sf	6	1,520,000	15,200 kWh	2	1,390,000	13,900 kWh
Air Handler Damper Seals	0.06	kWh/sf	6	1,520,000	91,200 kWh	2	1,390,000	83,400 kWh
HVAC Controls (Electric)	0.41	kWh/sf	0	0	0	0	0	0
HVAC Controls (Gas)	0.005	MMBtu/sf	5	1,302,714	6,514 MMBtu	1	956,857	4,784 MMBtu
HVAC Controls (Oil)	0.005	MMBtu/sf	4	985,000	4,925 MMBtu	0	985,000	4,925 MMBtu
Chiller/Cooling Tower	85.6	kWh/ton	1	100	8,560 kWh	0	100	8,560 kWh
Economizer Maintenance	0.78	kWh/sf	4	800,000	624,000 kWh	0	800,000	624,000 kWh
Motor Maintenance	24.52	kWh/hp	3	230	5,640 kWh	0	230	5,640 kWh
New Motors	191	kWh/hp	6	387	73,917 kWh	2	87	16,617 kWh
VFDs	937.2	kWh/hp	4	35	32,802 kWh	1	30	28,116 kWh
Air Compressor Maintenance	22,440	kWh/facility	3	3	67,320 kWh	0	3	67,320 kWh
Air Compressor Leak Repair	45,560	kWh/facility	2	2	91,120 kWh	0	2	91,120 kWh
Water Savings	1,551,207	Gallons/facility	0	0	0	0	0	0
Lighting Controls	1.219	kWh/sf	14	1,058,750	1,290,616 kWh	8	226,000	275,494 kWh
Efficient Lighting	4.209	kWh/sf	14	1,294,150	5,447,077 kWh	8	767,000	3,228,303 kWh
Unitary Equipment	50.5	kWh/sf	7	1,935	97,718 kWh	2	735	37,118 kWh
Pipe Insulation (Electric)	433.8	kWh/lf	0	0	0	0	0	0
Pipe Insulation (Gas)	1.48	MMBtu/lf	2	450	666 MMBtu	0	450	666 MMBtu
Pipe Insulation (Oil)	1.48	MMBtu/lf	2	10,200	15,096 MMBtu	0	10,200	15,096 MMBtu
Waste Water Savings	N/A	Gallons/facility	0	0	0	0	0	0
				kWh saved/enrollee	174,337 kWh	-	-	99,546 kWh
				kWh saved/enrollee/sf	0.263 kWh	-	-	0.150 kWh
				Oil MBtu saved/enrollee	511,578 MBtu	-	-	511,578 MBtu
				Oil MBtu saved/enrollee/sf	0.771 MBtu	-	-	0.771 MBtu
				Gas MBtu saved/enrollee	269,546 MBtu	-	-	231,111 MBtu
				Gas MBtu saved/enrollee/sf	0.407 MBtu	-	-	0.349 MBtu
				Gallons water saved/enrollee	0	-	-	0
				Gallons water saved/enrollee/sf	0	-	-	0

Table 26: School Savings Estimates with and without Rebated Activity

Table 27 shows the estimated savings from the 49 interviews of non-school enrollees. Electric savings is higher among non-schools than schools due to the greater number of enrollees performing work on them due the program. The average savings among non-schools with rebated savings included is calculated by summing up the savings by fuel type, dividing by the number of interviewees (49), and then dividing by the average total square footage (854,360 sq. ft.) of these enrollees. This calculates to be 0.40 kWh per enrollee per square foot, oil and gas impacts are calculated to be 0.43 MBtu per enrollee per square foot, and water impacts are 0.23 gallons of water per enrollee per square foot. The typical enrollee saves 344,979 kWh, 367,006 MBtu, and 200,496 gallons.

The average savings among non-schools removing rebated savings is calculated to be 0.20 kWh per enrollee per square foot and 0.41 oil and gas MBtu per enrollee per square foot, and water impacts are 0.23 gallons of water per enrollee per square foot. The average enrollee saves 171,230 kWh, 349,000 MBtu, and 200,496 gallons.

Measure	Savings Per Measure	Unit of Savings	# of Enrollees Performing	Total Units	Total Savings (with rebated activity included)	# rebated	Total Units Without Rebated Activity	Total Savings Without Rebated Activity
Boiler Maintenance (Gas)	0.003	MMBtu/sf	7	1,185,500	3,557 MMBtu	0	1,185,500	3,557 MMBtu
Boiler Maintenance (Oil)	0.003	MMBtu/sf	4	507,225	1,522 MMBtu	0	507,225	1,522 MMBtu
Air Handler Door Gaskets	0.01	kWh/sf	10	2,552,778	25,528 kWh	2	2,299,778	22,998 kWh
Air Handler Damper Seals	0.06	kWh/sf	10	2,552,778	153,167 kWh	2	2,299,778	137,987 kWh
HVAC Controls (Electric)	0.41	kWh/sf	2	333,333	136,667 kWh	0	333,333	136,667 kWh
HVAC Controls (Gas)	0.005	MMBtu/sf	3	172,000	860 MMBtu	1	44,000	220 MMBtu
HVAC Controls (Oil)	0.005	MMBtu/sf	1	48,667	243 MMBtu	1	0	0
Chiller/Cooling Tower	85.6	kWh/ton	13	3,013	257,894 kWh	2	2,547	218,023 kWh
Economizer Maintenance	0.78	kWh/sf	10	2,078,125	1,620,938 kWh	4	731,250	570,375 kWh
Motor Maintenance	24.52	kWh/hp	15	3,033	74,363 kWh	1	1,433	35,137 kWh
New Motors	191	kWh/hp	16	326	62,204 kWh	9	165	31,515 kWh
VFDs	937.2	kWh/hp	9	177	166,299 kWh	3	137	128,396 kWh
Air Compressor Maintenance	22,440	kWh/facility	6	3.3	74,800 kWh	0	3.3	74,800 kWh
Air Compressor Leak Repair	45,560	kWh/facility	4	3	136,680 kWh	1	2	91,120 kWh
Water Savings	1,551,207	Gallons/facility	8	6.3	9,824,311 Gallons	0	6.3	9,824,311 Gallons
Lighting Controls	1.219	kWh/sf	8	851,810	1,038,356 kWh	4	543,334	662,324 kWh
Efficient Lighting	4.209	kWh/sf	18	2,272,814	9,566,273 kWh	10	641,334	2,699,375 kWh
Unitary Equipment	50.5	kWh/sf	12	2,964	149,676 kWh	1	2,781	140,441 kWh
Pipe Insulation (Electric)	433.8	kWh/lf	3	7,933	3,441,119 kWh	0	7,933	3,441,119 kWh
Pipe Insulation (Gas)	1.48	MMBtu/lf	5	5,322	7,876 MMBtu	0	5,322	7,876 MMBtu
Pipe Insulation (Oil)	1.48	MMBtu/lf	1	2,653	3,926 MMBtu	0	2,653	3,926 MMBtu
Waste Water Savings	*	Gallons/facility	4	4	-	0	4	-
kWh saved/enrollee					344,979 kWh	-	-	171,230 kWh
kWh saved/enrollee/sf					0.404 kWh	-	-	0.200 kWh
Oil MBtu saved/enrollee					116,137 MBtu	-	-	111,184 MBtu
Oil MBtu saved/enrollee/sf					0.136 MBtu	-	-	0.130 MBtu
Gas MBtu saved/enrollee					250,869 MBtu	-	-	237,816 MBtu
Gas MBtu saved/enrollee/sf					0.294 MBtu	-	-	0.278 MBtu
Gallons saved/enrollee					200,496 Gallons	-	-	200,496 Gallons
Gallons saved/enrollee/sf					0.235 Gallons	-	-	0.235 Gallons

\* Enrollees indicating that they had been influenced by the Program to install waste water measures were asked to provide estimates of savings. However, none were able to.

**Table 27: Non-School Savings Estimates with and without Rebated Activity**

To calculate ongoing program impacts from the data provided in this study, sponsors can use the following formula;

$$\text{resource savings} = \text{resource savings per enrollee per square foot} * \text{average square footage} * \text{unique number of enrollees.}$$

For example, to calculate the 2003 school savings with rebated savings included in the BOC estimate shown in Table 28, RLW used the following values;

$$\text{kWh savings} = \text{resource savings per enrollee per square foot (0.263 kWh)} * \text{average total square footage (662,862 sf)} * \text{unique number of enrollees (191)} = 33,298 \text{ MWh.}$$

Where,

- the resource savings per enrollee per square foot are gathered according to whether the population is for schools, non-schools, or general, and whether the sponsor chooses to use the savings with rebates or savings without rebates, and
- the unique number of enrollees refers to all enrollees for a program year regardless of how many course levels they were enrolled in.

Table 28 combines the estimates from the total savings with rebates from Table 26 and Table 27 and expands them to represent the total 2003 BOC Program enrollee population (without utility enrollees) using the per enrollee impacts and total enrollees participating. We estimate that total electric savings, with rebated activities included, from 2003 enrollees is 119,543 MWh, natural gas savings is 114,200 MMBtu, oil savings is 126,745 MMBtu and water savings is 50,124,000 gallons per year. The impacts from the 2000-2001 program activity with the deflating adjustment applied as presented in the 2002 study are also provided as a point of comparison.

Resource Saved	2003 School Savings (Enrollees=191 <sup>a</sup> )	2003 Non-School Savings (Enrollees=250 <sup>b</sup> )	2003 Total Savings (Enrollees=441)	2003 per Enrollee Impact	2003 per Enrollee per Square foot Impact	2002 per Enrollee per Square foot Impact
Electric (MWh)	33,298	86,245	119,543	271,073 kWh	0.35 kWh	0.36 kWh
Natural Gas (MMBtu)	51,483	62,717	114,200	287,405 MBtu	0.34 MBtu	1.38 MBtu
Oil (MMBtu)	97,711	29,034	126,745	258,958 MBtu	0.40 MBtu	
Water (Gallons)	0	50,124,000	50,124,000	113,660 Gallons	0.14 Gallons	0.11 Gallons

<sup>a,b</sup> These figures are taken from Table 3.

**Table 28: 2003 Total Estimated Program Savings with Rebated Activity**

Table 29 combines the estimates from the total savings without rebates and expands them to represent the total 2003 BOC Program enrollee population (without utility enrollees) using the per enrollee non-rebated impacts and total enrollees participating. We estimate that total non-rebated electric savings from 2003 enrollees is 61,821 MWh,

natural gas savings is 103,596 MMBtu, oil savings is 125,507 MMBtu and water savings is 50,124,000 gallons per year.

Resource Saved	2003 School Savings (Enrollees=191 <sup>a</sup> )	2003 Non-School Savings (Enrollees=250 <sup>b</sup> )	2003 Total Savings (Enrollees=441)	2003 per Enrollee Impact	2003 per Enrollee per Square foot Impact	2002 per Enrollee per Square foot Impact
Electric (MWh)	19,013	42,808	61,821	140,183 kWh	0.18 kWh	0.36 kWh
Natural Gas (MMBtu)	44,142	59,454	103,596	284,597 MBtu	0.31 MBtu	1.38 MBtu
Oil (MMBtu)	97,711	27,796	125,507	234,912 MBtu	0.40 MBtu	
Water (Gallons)	0	50,124,000	50,124,000	113,660 Gallons	0.14 Gallons	0.11 Gallons

<sup>a,b</sup> These figures are taken from Table 3.

**Table 29: 2003 Total Estimated Program Savings without Rebated Activities**

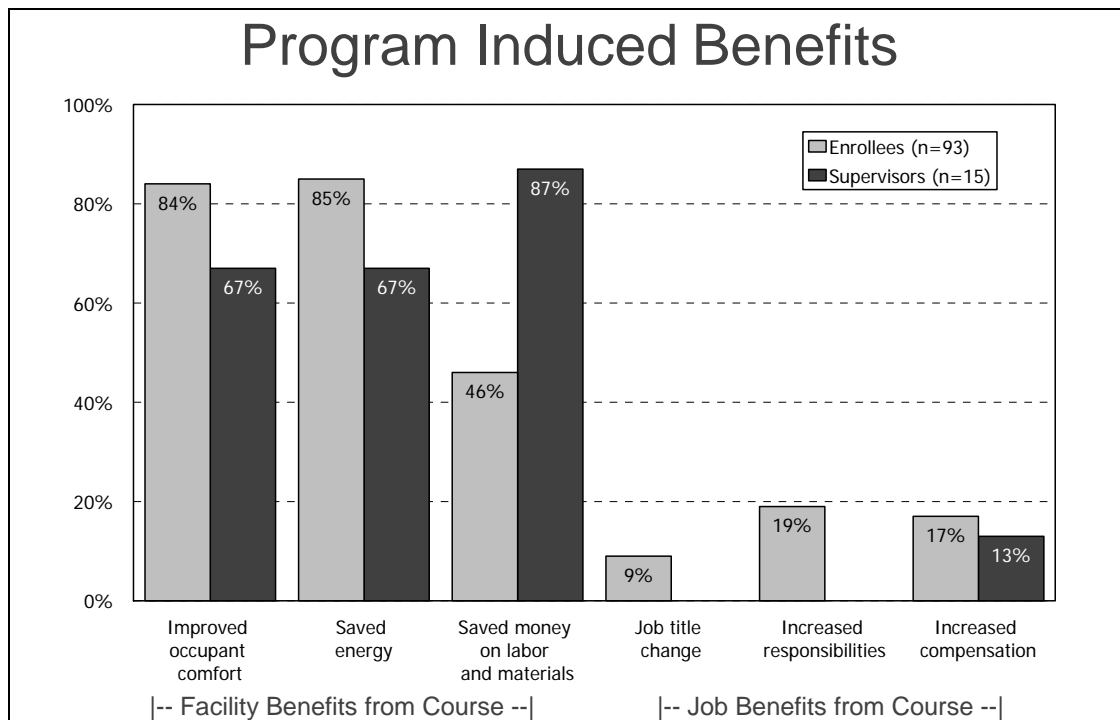
In the 2002 report, program influence was assumed to continue for five years beyond the point of BOC certification. Based upon our estimated persistence of program influence on 2000/2001 participant activities, we believe this assumption is reasonable to continue using until a five year persistence study can be performed. Therefore, to calculate total resource savings due to program influence, sponsors can estimate savings over the lifetime of program influence by multiplying the annual resource estimates by 5 (years).

Although not explicitly targeted in the savings estimates, an estimate of the impacts for Level 1 coursework vs. Level 2 coursework is interesting to consider. A review of available information from the Northwest, where nearly identical coursework is performed, turned up no estimates of impacts by Level 1 vs. Level 2. In reviewing the coursework performed in Level 1 vs. Level 2, it is apparent that systems such as lighting and HVAC are covered explicitly in Level 1 along with a course dedicated to energy conservation techniques. Level 2 courses also cover maintenance and trouble shooting of HVAC and lighting systems and introduce refrigeration maintenance, however, we believe the majority of program influence to perform energy savings activities springs from the initial introductions to these systems in the Level 1 coursework. Based upon these thoughts, we believe somewhere in the range of 75%-85% of the per unit savings estimates is generated as a result of Level 1 influence with the balance an outcome of Level 2 influence.

Figure 3 presents the proportion of enrollee and enrollee supervisors who reported experiencing various non-energy benefits since the BOC Program. These results are divided up by those non-energy benefits related to the facility and those related to the enrollees job. The majority of enrollees and supervisors reported that what they learned through the program has helped them to improve occupant comfort and save energy. This is consistent with the 2002 results in which the vast majority of students also reported improving these elements of their facility. Supervisors reported a high level of cost and labor savings due to a subordinate's participation in BOC; presumably

due to not having to contract out BOC taught activities. In another supervisor only question, it was noted that no supervisors reported experiencing a decrease in worker accidents due the program.

Although not asked of supervisors, the BOC was cited as an influence for 9% of enrollees who reported experiencing a job title change and nearly 20% of enrollees who reported an increase in responsibility since the program. In the enrollee supervisor survey, two of fifteen (13%) respondents reported that the enrollee they oversee experienced an increase in salary due to the coursework although none reported a promotion due to the program. In a related question posed to enrollees (not shown), nearly 78% indicated that they believed the BOC coursework will help them to further advance their current job or help them in attaining a new job.



**Figure 3: Facility and Job Program Induced Benefits**

Enrollees and supervisors were given an opportunity to discuss any additional benefits they have experienced as a result of their participation in the program. Table 30 summarizes their categorized responses. More than half (54%) of the enrollees and two-thirds of supervisors felt that they had already discussed all of the benefits they had experienced and did not add suggest more. Networking opportunities (16% of enrollees and 7% of supervisors) and more knowledge (10% of enrollees and 13% of supervisors) were the most common mentions among those who mentioned additional benefits. Responses that garnered less than 4% are not shown.

Other Benefits	Non-School Enrollees (n=49)	School Enrollees (n=45)	All Enrollees (n=94)	Supervisors (n=15)
None	43%	67%	54%	67%
Networking	18%	13%	16%	7%
More knowledge	14%	4%	10%	13%
Better understanding of systems	6%	4%	5%	7%
Don't Know	2%	9%	5%	7%
More self-confidence	2%	4%	3%	0%
Savings	6%	0%	3%	0%
Better understanding of O&M	4%	0%	2%	0%

**Table 30: Other Program Benefits**

In a similar question, enrollees were asked if they had made any changes to improve the indoor air quality in their facility since the program. Table 31 shows these results, along with the enrollee reported activity they performed. Overall, 60% of the enrollees surveyed reported making changes to improve the indoor air quality of the space they control. As Table 31 shows, purchasing better quality air filters and changing air filters regularly were the most common changes made by both schools and non-schools to improve the indoor air quality in their facility. Activities reported less than 4% overall are not shown.

Indoor Air Quality Changes	Non-School (n=48)	Schools (n=45)	Total (n=93)
Have you made an IAQ change since participation?	<b>58%</b>	<b>62%</b>	<b>60%</b>
<b>If yes, what have you done?</b>			
Better filters	25.0%	39.3%	32.1%
Changing filters regularly	21.4%	28.6%	25.0%
New ventilation	7.1%	17.9%	12.5%
Removed mold	17.9%	7.1%	12.5%
Inspections	10.7%	10.7%	10.7%
Awareness of indoor air quality issues	10.7%	3.6%	7.1%
Improved controls	0.0%	14.3%	7.1%
Economizer	7.1%	3.6%	5.4%
Added dehumidifier	7.1%	0.0%	3.6%
Air quality testing	3.6%	3.6%	3.6%
Cleaned filters	7.1%	0.0%	3.6%
Damper changes	7.1%	0.0%	3.6%

**Table 31: Program Induced Indoor Air Quality Changes**

#### 4.5 Objective 4: Performance Indicator Update

The following table reflects the program's history of accomplishments as presented in the 2002 report and updated as part of this current study. In this table, we provide the results through the end of the 2003 program year as well as cumulative results as appropriate. We further provide footnotes for several values that are intended to

provide detail on how those values were determined. The values in parenthesis under the EOY 2001 results reflect the per student per square foot estimate of savings after using the 2002 savings deflating factor used in that study to account for the fact that students are not responsible for all of a buildings' equipment.

PERFORMANCE INDICATOR	Baseline Results	2000-EOY 2001 Results	2002 - EOY 2003 Results	Cumulative Results
Market Awareness	0%	13%	N/A	N/A
Number of 100 Series Taught	0	21	29	50
Number of 200 Series Taught	0	4	4	8
Students Enrolled in 100 Series	0	435*	699	1,134
Students Certified for 100 Series	0	345*	526	871
Students Enrolled in 200 Series	0	87*	114	201
Students Certified for 200 Series	0	43*	65	108
Drop-Out Rate <sup>9</sup>	NA	4%, 7 in 2000 0 in 2001	0%	2.6%
Certification Rate for 100 Series	NA	79.3%	75.7%	76.8%
Certification Rate for 200 Series	NA	49.4%	57.0%	53.7%
States Participating	3	7	8 <sup>10</sup>	8
Utility/Other Sponsors	6	15	22 <sup>11</sup>	22
Professional Association Sponsors	0	0	2 <sup>12</sup>	2
Institutions Giving to Academic or CEU Credit for BOC	0	1	7 <sup>13</sup>	7
Newsletters Published	0	4	2 <sup>14</sup>	6
Case Studies Published	0	0	3 <sup>15</sup>	3
Average Number of Students per Class in 100 Series	0	21.3	23.3	23.9
Average Number of Students per Class in 200 Series	0	17	28.5	22.6
Planned Courses Cancelled Due to Lack of Registrants	NA	0	3 <sup>16</sup>	0
Number of Times Planned Start Date is Postponed	NA	Not tracked	2 <sup>17</sup>	2
Organizations Sending Staff to the BOC	0	143	502	645
Average Number of Staff Sent	0	1.4	1.4	1.4
Electric and Gas Utilities Sending Staff to the BOC	0	10	12	22
Average Size of Facility Space (conditioned)	NA	671,804 sf	616,045 sf	635,151 sf
Annual kWh Savings per Student per Square Foot of Space Student Operates.	NA	0.50 (0.36)	0.35	N/A
Annual MBtu (Gas, Oil) Saving per Student per Square Foot of Space Student Operates	NA	1.95 (1.38)	0.75	N/A
Annual Gallons Water Savings per Student per Square Foot of Space Student Operates	NA	0.16 (0.11)	0.14	N/A

**Table 32: Performance Indicator Table**

\* These are the 2000/2001 program numbers as they are reflected in the current database.

<sup>9</sup> Defined as students who enrolled that did not become certified according to enrollee list and NEEP website list of certifications as calculated from enrollee survey. We recommend a different drop out rate definition as part of the final study recommendations.

<sup>10</sup> New Hampshire, Connecticut, New Jersey, Maine, Massachusetts, New York, Rhode Island, and Vermont.

<sup>11</sup> As gathered from NEEP website, 2/14/04 and interviews: Concord Electric Company, Connecticut Light and Power Company, Conectiv Power Delivery, Exeter and Hampton Electric Company, Fitchburg Gas and Electric Light Company, Granite State Electric Company, Jersey Central Power and Light, KeySpan Energy Delivery, Long Island Power Authority, NSTAR Electric & Gas, National Grid, New Hampshire Electric Co-op, PSE&G, Public Service Company of New Hampshire, Western Massachusetts Electric Company, Burlington Electric Department, Vermont Gas Systems, Inc. Sponsoring non-utilities include: Maine Public Utilities Commission, New Hampshire Governor's Office of Energy and Community Services, New York State Energy Research & Development Authority, Cape Light Compact, Efficiency Vermont.

<sup>12</sup> Business and Industry Association of New Hampshire, Lake Champlain Chapter of the Association for Facility Engineering.

<sup>13</sup> International Facilities Manager Association (IFMA), Building Owners and Managers Institute (BOMI), National Association of Power Engineers (NAPE), University of New Hampshire, Drinking Water Operators Training Contact Hours, Waste Water Operators credits, University of Maine.

<sup>14</sup> Summer 2002 and Winter 2003 newsletters were published.

<sup>15</sup> Bayer, Northampton VA Medical Center, Pease International Airport.

<sup>16</sup> Three classes were cancelled in New Jersey in 2003, according to interviews.

<sup>17</sup> As gathered from interviews, two courses were postponed in the National Grid territory in 2002-2003.

#### 4.6 Objective 5: Process-Related Issues

This section provides various process results, including program marketing, barriers, enrollment versus certification rates, and other issues of interest.

##### 4.6.1 Program Marketing

From the BOC business plan in 2002, it is stated that the “ultimate goal of this program is to train O&M facility staff; BOC’s main target market is the operations and maintenance supervisors and managers of these staff.” In the business plan and among the interviewees contacted in this study, it was observed that there are several marketing activities being undertaken to generate building operator interest in the study. No single marketing approach is undertaken program wide; each sponsor seems to market the program in the way that best meets their needs. Some market very aggressively on their own independent of NEEP and some market very little; with NEEP providing their core program recruitment and marketing. The various marketing activities discussed in the interviews include direct marketing (mailed letters, cold calling), account representative marketing, marketing to organizations (associations, chambers of commerce, etc.) and marketing to institutions that requires CEUs to retain membership, such as IFMA. In addition, there are other less direct methods undertaken including the NEEP BOC website and the NEEP newsletter.

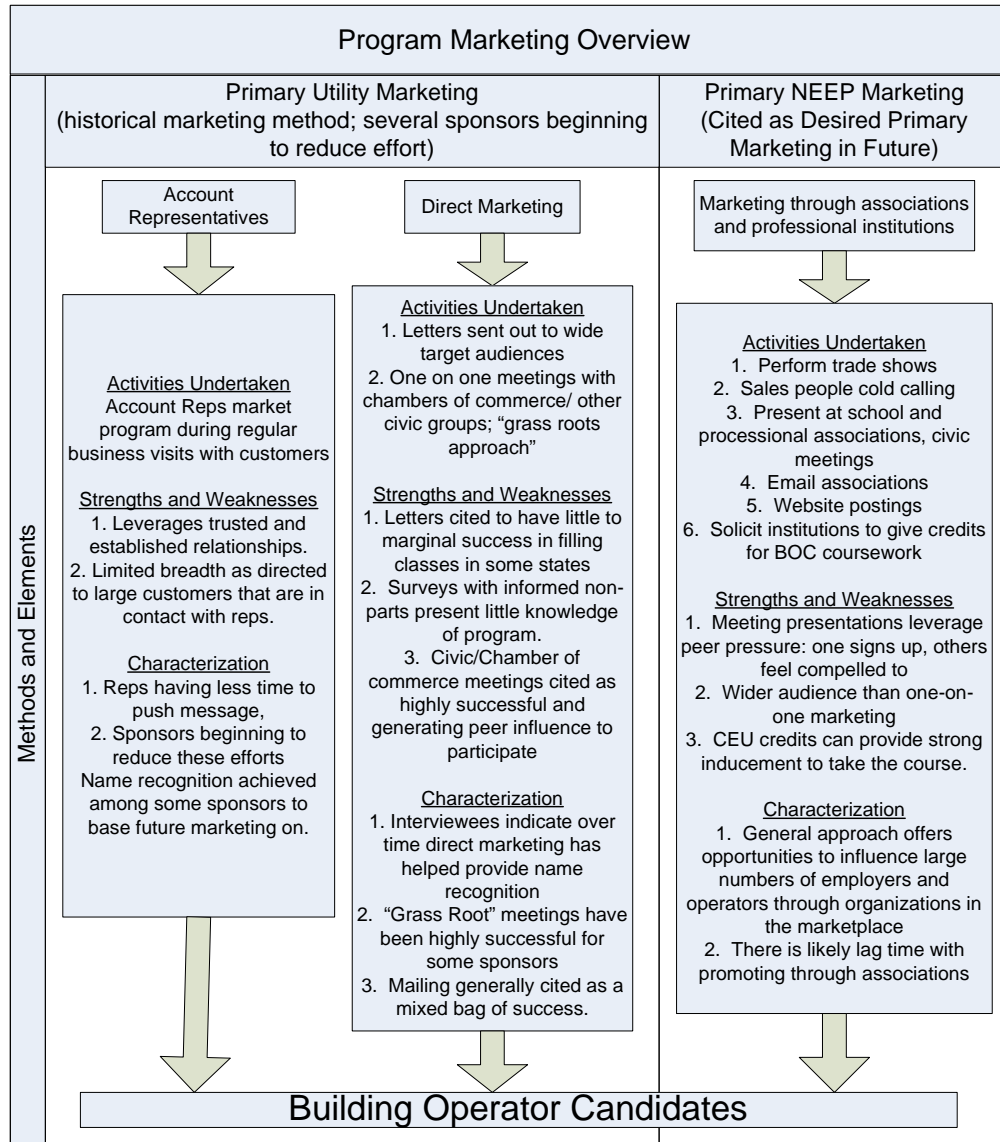
Figure 4 provides an overview of marketing as described in the interviews and gathered from secondary information. As described by several interviewees, BOC marketing has historically been a utility function but is evolving into more of a NEEP activity. As such, several sponsors related that account representatives are becoming less involved in marketing the program as NEEP has begun marketing through associations, trade shows, and other organizations that include memberships of building operators and/or building operator supervisors. The basic rationale behind this marketing strategy is that marketing through associations offers an opportunity to influence employers and operators through organizations they trust. In this regard, an established relationship with the right organizations can provide marketing that is targeted and trusted.

Interviewee comments on marketing activities can be illustrated by the following;

- Interviewees had general concerns that follow-up with participants is not aggressive enough with regard to getting dropouts to complete certification and to encourage certified students to solicit other enrollees from their organization. For example one interviewee indicated there is “not enough marketing and not enough follow-up”. Another interviewee suggested that a “formal database (be established) to market to people that have not attended after signing up” and two other interviewees reported “past participants are the best marketing tool” and “contacting previous graduates has also been successful.”
- Account managers were nearly always cited as a good marketing tool that has resulted in increased awareness of the program in the field, but many sponsors are beginning to use them less and less as NEEP picks up more marketing responsibility.

Sponsors that have not used account managers to market the program yet were recommended to by several sponsors who have used them.

- Some sponsors have successfully marketed to Chambers of Commerce in their region as well as principal associations, school associations and other local civic organizations. These sponsors report that these mechanisms have been highly successful in generating program interest.

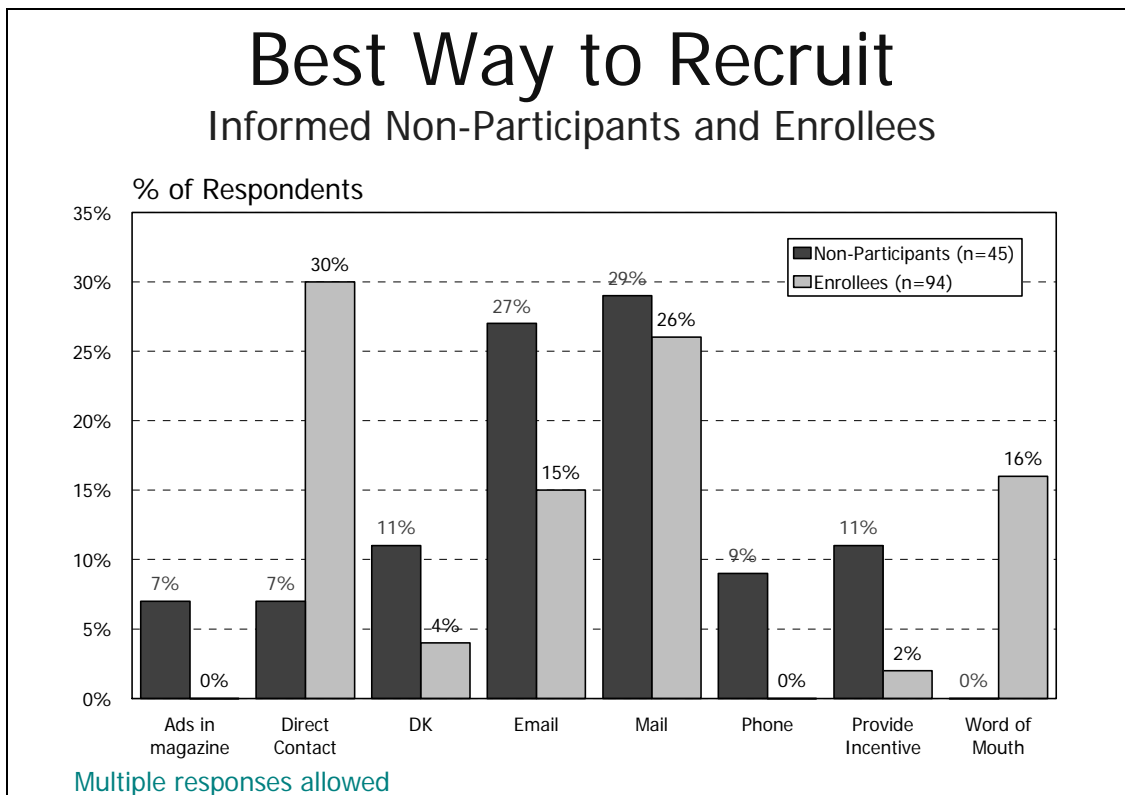


**Figure 4: Overview of BOC Marketing**

NEEP has a minimum attendance threshold for classes to be performed; although interviewees noted nominal incidence of class cancellations (3) and postponements (2). Course subscription rates as a result of this combination of marketing activities were reported to be reasonably high; one instructor estimated that he has an average of 20 students per class and according to the database of program activity the student per

class average has increased for both the 100 series and series. However, in one state in 2002, it was noted that a strict letter marketing approach was used to recruit enrollees for several courses. Specifically, at the full course cost, courses were established and offered solely through a mailing campaign that resulted in the cancellation of about half of the planned classes. The interviewee that related this story indicated that the lack of participation resulting from their mail marketing approach was a real concern and a lesson learned for future recruitment.

In the informed non-participant and enrollee survey, respondents were asked for their opinions on the best way to recruit from companies such as theirs into a program such as the BOC Program. Figure 5 presents these results. Direct mailings and emails received the most mentions among non-participants and direct contact and direct mail were the most frequent suggestions among enrollees. The email and mail channels heavily suggested by non-participants is contrary to the program staff and instructor interviewees who reported a mixed bag of success in soliciting participants through direct mail efforts in the past.



**Figure 5: Best Way to Recruit**

Four non-participants contacted had heard of the BOC Program, which is surprising given that the non-participants contacted were primarily meant to be informed customers that the program had been marketed to. All four of these respondents heard about the program through a mailing; three from a utility mailing and one through another type of mailing. Table 33 presents the ways that enrollees and enrollee

supervisors heard of the program. Approximately 40% of the enrollees and 40% of their supervisors were informed about the BOC Program by their boss or a co-worker. Utility representatives/energy efficiency organizations informed almost 31% of non-school participants, while professional or trade associations/publications were responsible for informing 22% of school participants. Other channels cited by less than 4% of the sample were not included in this table. In the 2002 study, utility representatives, supervisors, and colleagues were the top three means of students getting information on the program.

Hear of program	Enrollee Non-school (N=49)	Enrollee School (N=45)	Enrollee Total (N=94)	Enrollee Supervisor (N=15)
Boss or co-worker	42.9%	35.6%	39.4%	40.0%
Utility rep/energy efficiency org.	30.6%	11.1%	21.3%	20.0%
Professional or trade association/publication	2.0%	22.2%	11.7%	0.0%
Other, state organization	2.0%	13.3%	7.4%	13.3%
Utility mailing or advertisement	6.1%	2.2%	4.3%	20.0%
Other mailing/advertisement/flyer	0.0%	6.7%	3.2%	0.0%
Other, Local Insurance Agency	4.1%	0.0%	2.1%	0.0%

**Table 33: How Enrollees Heard of the BOC Program**

Non-participants that had not heard of the program were provided a brief description of the program, and then were asked if they would consider going or sending members of their staff to earn the Building Operators Certification. This same question was posed to enrollee supervisors. Table 34 shows the overall responses to these primary inquiries. Overall, about two-thirds of the non-participants and just over half of supervisors interviewed said they would consider sending staff members through the BOC Program. An average of just under two enrollees per respondent was predicted to participate in the training in the next 2-3 years. These results are generally consistent with the results from the 2002 study, in which 66% of non-participating supervisors contacted reported an interest in sending staff to a program like the BOC. In a follow-up question regarding what it would take to motivate the non-participants to participate and send staff, the most frequently offered responses related to the course's relevance, cost effectiveness, and ability to meet facility needs with information learned.

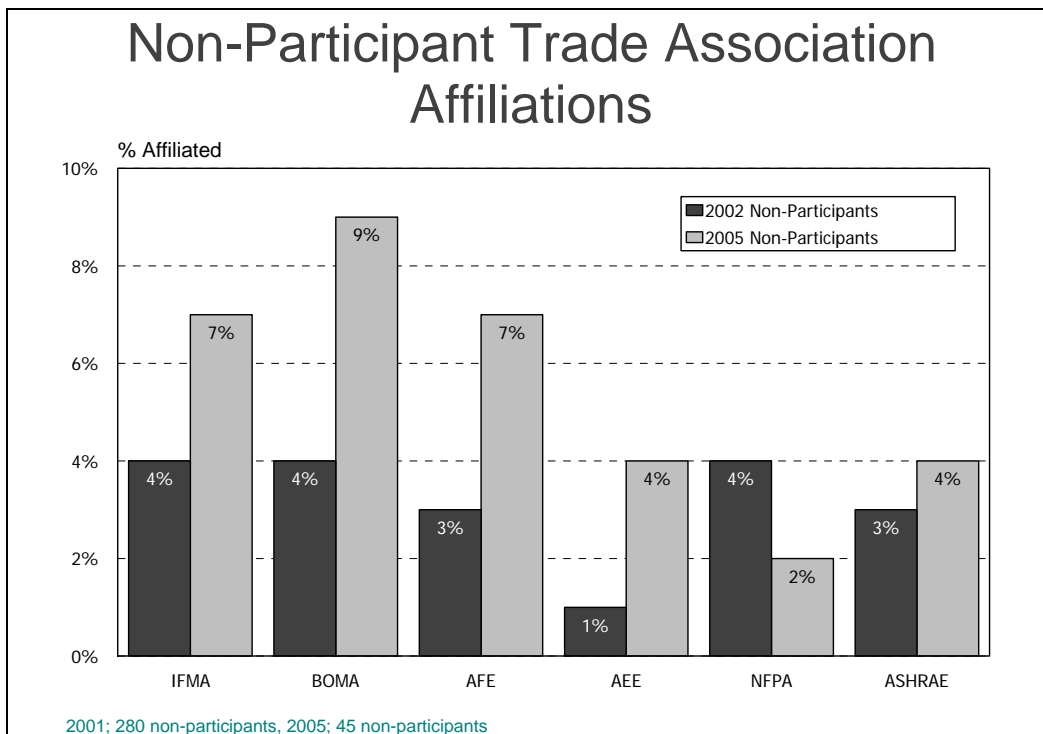
<b>Inquiry</b>	<b>Non-participant (N=45)</b>	<b>Enrollee Supervisors (N=14)</b>
Would Go or Send Staff Through BOC?	64%	53%
How Many Members In Next 2-3 Yrs (average)?	1.9	1.5

**Table 34: Potential BOC Enrollment**

As suggested earlier, marketing through professional and/or trade associations is an evolving strategy being used by NEEP and the sponsors to target the BOC market through existing channels to generate program interest. In the non-participant survey,

it was noted that 23% of schools and 40% of non-schools provided the name of a trade association they are affiliated with. Two organizations were specifically asked about, including the International Association of Facility Managers (IFMA) of which only 7% are affiliated and the Building Owners and Managers Association (BOMA) of which 9% are affiliated. Other organizations mentioned included the Association for Facility Engineering (AFE), and Association of Energy Engineers (AEE) with affiliation rates of 17% and 11%, respectively.

Figure 6 presents the 2002 reported non-participant trade association affiliations and the 2005 reported affiliations. While overall affiliation levels are relatively low, there is a general trend toward the non-participants surveyed in this study being involved in more affiliations now than in the last study. However, the low incidence of involvement in these trade associations also suggests that the non-participants currently being targeted by the sponsors are different from those that are involved in these various trade associations.

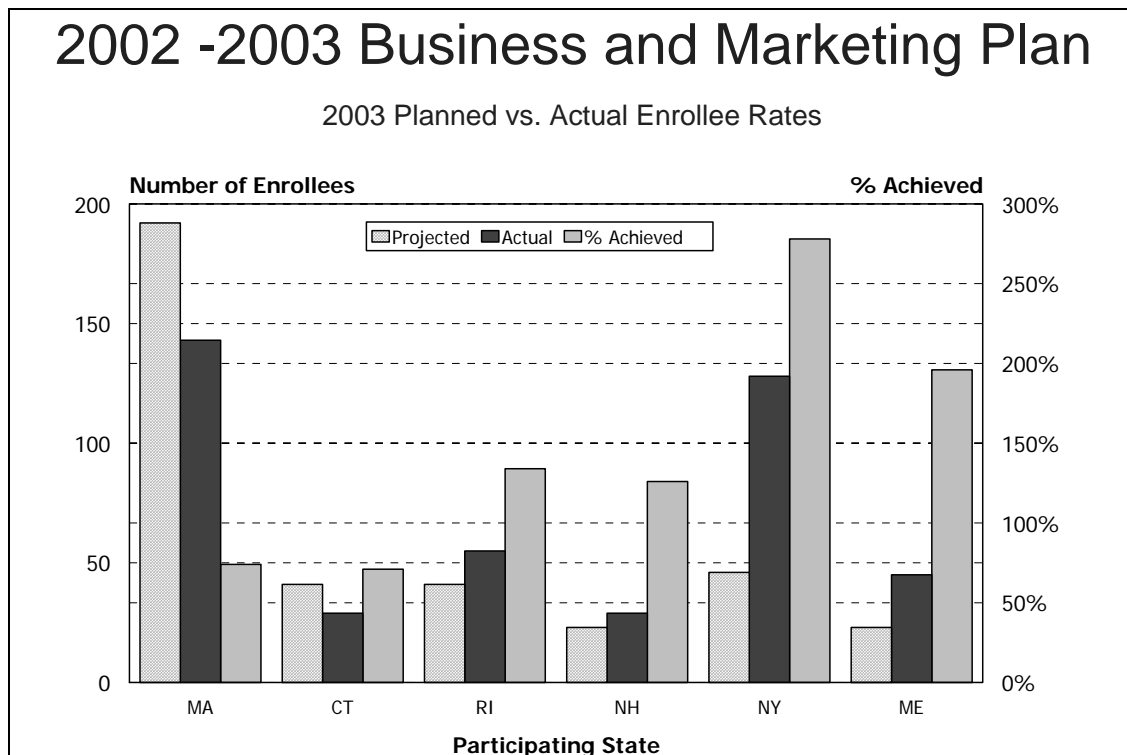


**Figure 6: Non-participant Trade Association Affiliations**

Figure 7 presents the number of 2003 enrollees targeted in the 2002-2003 NEEP business plan versus those actually completed. The left hand Y-axis presents the actual quantity of enrollees while the right hand Y-axis presents the percent of the goal achieved by state. Vermont and New Jersey had targeted 23 and 46 enrollees, respectively, but were ultimately not involved in the program in 2003; and therefore did not have any enrolled operators. Massachusetts had the most enrollees planned of all the states, and also had the most enrollees, achieving 75% of the number projected.

New York had 46 enrollees projected and actually had 128, nearly tripling their projection. Both Massachusetts and New York have the benefit of early experience with the program. Interviewees for Massachusetts sponsors suggests much of their marketing efforts in this timeframe was through account representatives. Much of the New York marketing during this time period was through BOCES (Board of Cooperative Educational Services); and was unique in that the courses were only held after enough interest was generated from within BOCES to have the course. In essence, course dates and locations in NY during this time were not established until they were already filled.

Maine nearly doubled their projected enrollment while Rhode Island and New Hampshire slightly exceeded their projections. Taken as a whole, enrollee rates appear to be fairly high as compared to projected rates with exceptions noted in Massachusetts and Connecticut.



**Figure 7: 2003 Business Plan Enrollee Goals versus Actual**

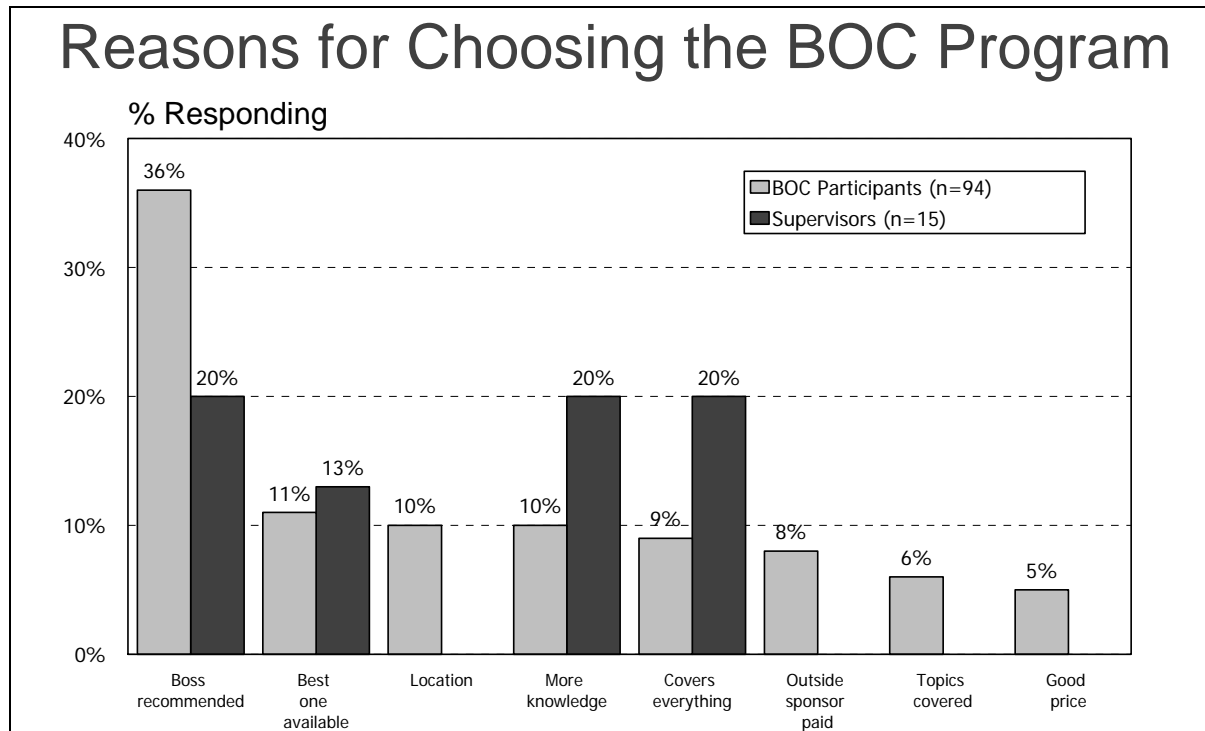
Table 35 presents respondent considerations for deciding whether or not to go to or send a staff member to training as calculated from the informed non-participants. Multiple responses were allowed and a total of 99 responses were provided among the 45 people contacted. Across the entire sample, time and staff availability and relevancy of subject matter were the top two considerations. This is consistent with interview results in which one interviewee summed up the feelings of several others when he indicated we "thought it would be easier for people to get away from the office, but most facilities are doing more with less and it is difficult for people to leave". When

reviewing the results between schools and non-schools, it is apparent that both reflect on time/staff availability most when considering whether to send staff to training. However, non-schools also highly consider the relevancy of the subject matter while schools also look closely at the cost of the training. Location, which is another important consideration, was also mentioned by interviewees as an important element in the successful scheduling and attendance of courses.

<b>Training Considerations</b>	<b>% of Respondents Mentioning (n=45)</b>	<b>% of Non-School Mentioning (n=30)</b>	<b>% of School Mentioning (n=15)</b>
Time/Staff Availability	44%	47%	40%
Subject Matter is Relevant	44%	53%	27%
Cost	31%	30%	33%
Location	27%	30%	20%
Gain/Benefit the Company	20%	17%	27%
Most up-to-date Info	11%	10%	13%
Quality of Course	11%	17%	0%
Subject Area	7%	10%	0%
Length of Training	7%	10%	0%
Person Needs the Training/Job Growth	4%	3%	7%
Don't Know	4%	3%	7%
Required by Law for Company	2%	3%	0%
Personal Interest	2%	3%	0%
Certification	2%	3%	0%
Difficult to get approval	2%	0%	7%

**Table 35: Considerations for Training Participation**

Figure 8 shows the categorized reasons enrollees and enrollee supervisors gave for choosing the BOC Program for O&M training. The most common response was because it was recommended by their superiors, which was mentioned by over 36% of the enrollee sample and 20% of the supervisor sample. Supervisors also cited such reasons as the BOC program providing the most knowledge (20%) and covering a wide range of areas of operation.



**Figure 8: Reasons for Choosing the BOC Program**

#### 4.6.2 Program Barriers

Through an open ended question, non-participants, enrollees, and enrollee supervisors were asked what the greatest barriers are to participating in a program such as the BOC. Table 36 shows the categorized responses. As expected, responses to this inquiry are fairly consistent; and closely reflect thoughts gathered in the interviews regarding barriers to the program. Among all groups contacted, time/staff availability and cost were the two most frequently mentioned barriers to course participation; particularly among school respondents. Program staff, instructor, and sponsor interviewees also consistently cited time as a barrier; including one interviewee that indicated that “the most difficult problem is freeing up people to attend.” Another interviewee related a story of attending classes where enrollees are called out via beepers or cell phones to handle emergencies during class time. In fact, the course is designed for people to be able to make up the class in the event one is missed, but anecdotally it was reported that it is often difficult for people to attend make-up classes as they can occur in different locations and months later.

Barriers	% of Non-part Respondents Mentioning (n=45)	% of Non-part Non-School Mentioning (n=30)	% of Non-part School Mentioning (n=15)	% of Part Mentioning (n=94)	% of Supervisors Mentioning (n=15)
Time/Staff Availability	51%	40%	73%	39%	47%
Cost	18%	20%	13%	47%	60%
Don't Know	11%	13%	7%	0%	13%
Gain/Benefit the Company	9%	10%	7%	2%	0%
Subject Matter is Relevant	4%	7%	0%	0%	0%
Difficult to Get Approval	4%	7%	0%	3%	20%
Location	2%	3%	0%	5%	0%

**Table 36: Greatest Barriers to Participation**

Participants and participant supervisors were both asked to describe any barriers they experience that inhibit their ability to make O&M improvements within their facility. Table 37 shows that over 70% of enrollees and nearly 87% of supervisors cited financial resources or money as the largest barrier. Most other responses provided were diverse in nature and included a lack of time, administrative barriers, and a business culture that is not conducive to O&M improvements.

Barrier	Enrollee Non-Schools (N=49)	Enrollee Schools (N=45)	Enrollee Total (N=94)	Supervisors (N=15)
Financial resources/money	61.2%	73.5%	70.2%	86.7%
Other	24.5%	6.7%	16.0%	6.7%
None	20.4%	8.2%	14.9%	0.0%
Time	22.4%	4.1%	13.8%	0.0%
Culture	6.1%	0.0%	3.2%	6.7%
Don't Know	2.0%	2.0%	2.1%	6.7%
<b>"Other Barriers"</b>				
Administration	12.2%	6.7%	9.6%	6.7%
Tenant comfort	4.1%	0.0%	2.1%	0.0%
Equipment standards	2.0%	0.0%	1.1%	0.0%
Not enough staff	2.0%	0.0%	1.1%	0.0%
Rebates	2.0%	0.0%	1.1%	0.0%
Security	2.0%	0.0%	1.1%	0.0%

**Table 37: Barriers That Inhibit O&M Improvements**

Related to this issue is the BOC class schedule. The BOC Program classes have historically been offered one day per month for 7-8 months. Recently, NEEP began scheduling classes on back-to-back days so that participants would complete the coursework in 3-4 months. In the staff and instructor interviews, instructors saw this as an improvement because they felt it allowed them to establish relationships better with the students and it is believed that back-to-back courses might be easier for people to

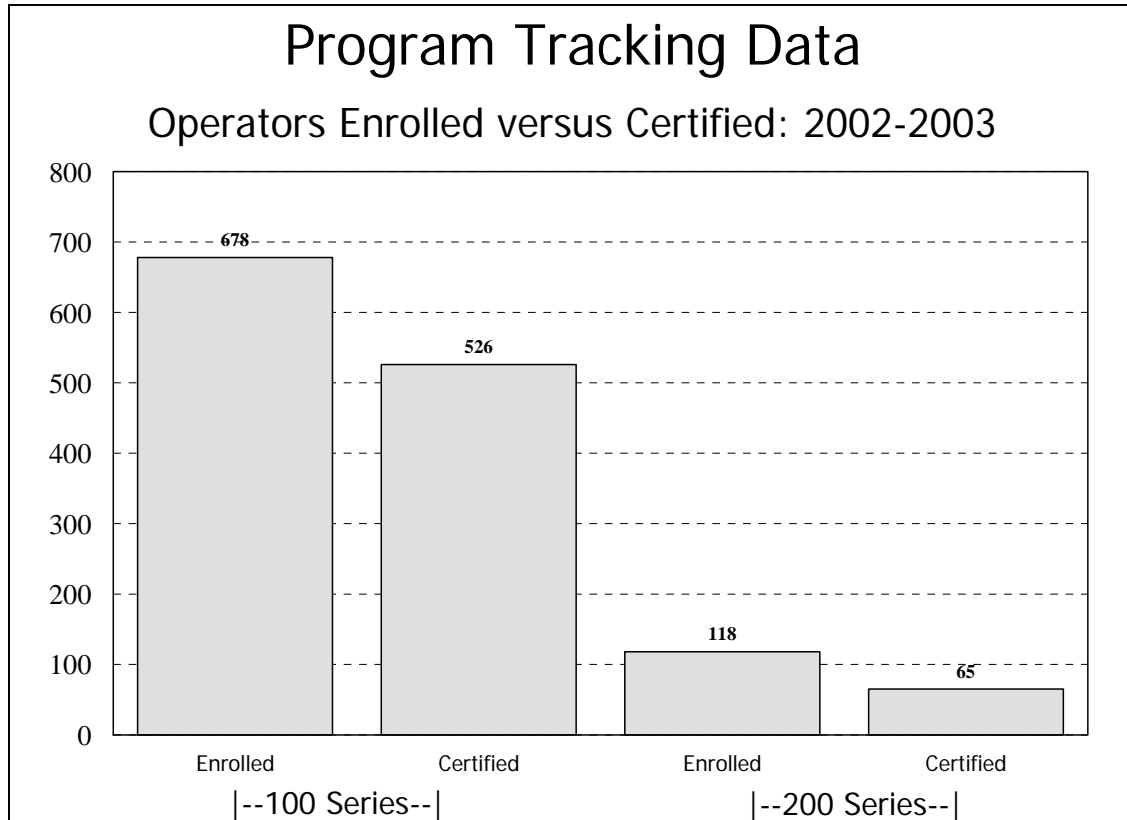
attend. As Table 38 below shows, the non-participants contacted in the study do prefer back-to-back class scheduling, as nearly 60% selected this class schedule. It should be noted, however, that respondents from schools reported only a marginal preference for this new schedule.

<b>Class Schedule</b>	<b>% of All Respondents (N=45)</b>	<b>% of Non-School (N=30)</b>	<b>% of School (N=15)</b>
Single Days for Several Months	38%	30%	53%
Two Consecutive Days for Fewer Months	58%	63%	47%
Indifferent	4%	7%	0%

**Table 38: Preferred Class Schedule**

Figure 9 presents the number of enrolled students in 2002 and 2003, along with the number of those enrollees that are now certified. We visited the NEEP BOC website to update the enrollee list with the most recent certification list available, so we believe this figure gives an accurate rate of certification rates among enrolled students. The calculated rate of certification relative to enrolled student is 78% in the 100 Series classes and 55% in the 200 Series classes.

Of the 94 enrollees interviewed from 2003, 73 were enrolled in Level 1, 17 in Level 2, and 4 were enrolled in both levels. The self-reported certification rates of these enrollees was slightly higher than that observed in the tracking system, with 68 (88%) of the Level 1 enrollees and 16 (76%) of the Level 2 enrollees becoming certified.



**Figure 9: 2003 Enrolled vs. Certified Operators**

Interview results with program administrators and BOC staff provide some insight on why some enrollees ultimately do not become certified. One instructor interviewed had actually performed an informal survey at one point with students who had stopped attending classes. Overall, this interviewee reported that the reasons were varied and nearly always were due to a personal conflict or job conflict and typically not due to dissatisfaction with the course itself. Other common theories provided on the rate of certification from the interviews included;

- Many enrollees get involved in the program to expand their knowledge and do not necessarily get involved to become certified.
- Many enrollees were reported to experience a likely disconnect between the need to complete their homework/projects and their ultimate certification. Several interviewees surmised that this may be due in part having multiple instructors encountered by the student that does not include a single presence throughout the coursework emphasizing the projects that need to be completed for certification.
- Interviewees reported that enrollees missing classes due to job emergencies has been a factor in getting students certified as it is often difficult for them to make up the class.

In the 2002 study, drop-outs were defined as students that had enrolled but had not completed all of the coursework in a level and had no intention of completing that coursework. In that study the drop out rate was 4%. In this study all of the participants who have yet to complete the coursework reported an intention to return at some point in the future to complete the BOC coursework.

#### **4.7 Objective 6: Conclusions and Recommendations**

The conclusions and recommendations are provided by evaluation objective, consistent with the previous results sections.

##### **4.7.1 Conclusions**

The following conclusions are comprised of a paragraph or two summarizing the results of each objective, followed by key summary bullets.

##### *O&M Cost Conclusions*

Most enrollees who reported a program influenced efficiency measure installation or activity were unable to estimate the cost associated with that measure/activity. However, we believe enough estimates were made to provide a reasonable approximation of O&M costs undertaken. This analysis was performed at the measure level and aggregated to provide an average cost of O&M activities undertaken per enrollee of \$105,539. Efficient lighting installations were calculated to be the most expensive O&M activity undertaken, averaging almost \$36,500 per enrollee. As a sanity check against these estimates, secondary research on the costs associated with retro-commissioning was performed; which provided further evidence of their reasonableness.

- The estimated cost associated with all O&M activities undertaken by the enrollees surveyed is \$9,920,480; or \$105,539 per enrollee. Using the average conditioned square footage of enrollees surveyed (616,045), this calculates to a per square foot cost for each enrollee of \$0.17/sq ft.
- This estimate compares reasonably well with retro commissioning costs per square foot which would represent the optimization of all electromechanical facility systems. These retro commissioning costs range from approximately \$0.05/sq ft to \$0.70/sq ft.

##### *Perception of Program Value Conclusions*

In this study, we have approached the determination of the prospective value of the BOC program as being reflected in data gathered from enrollees, enrollee supervisors, and informed non-participants. The following results suggest a moderate sense of perceived value in the coursework as evidenced by its desirability and interest among non-participants, importance and satisfaction among enrollee supervisors, and its usefulness to enrollees in their operator position. However, it should be noted that the retail cost of the coursework (\$1,400) is higher than many non-participants are willing to pay despite most enrollees reporting that the coursework is worth that cost after

attending the classes. The following bullets present highlights of this assessment of program value.

- 45% of informed non-participants reported certification in building operations and maintenance as important or very important. Those non-participants that reported certification as important also rated certifications that are transferable and competency based very highly; each of these are characteristics of the BOC Program.
- Non-participant interest in BOC courses was particularly high for energy conservation techniques, facility electrical systems, and preventative maintenance. Overall, on a one (not at all interested) to five (very interested) scale, enrollees rated usefulness of the Level 1 and Level 2 courses were both high; particularly for school enrollees. On a 1 (not at all useful) to 5 (extremely useful) scale, Level 1 courses were rated 3.9 by school and non-school enrollees and Level 2 courses were rated 4.3 and 3.8 by school and non-school enrollees, respectively.
- 80% of enrollees and 40% of enrollee supervisors indicated they had recommended the program to others.
- 80% of enrollee supervisors were either satisfied or extremely satisfied with the course, although no level 2 enrollee supervisors were extremely satisfied.
- Only 22.2% of informed non-participants reported a willingness to pay \$1,400 for the course, although the actual experienced price is often lower due to sponsor subsidies. Most enrollees and enrollee supervisors contacted, however, reported the course was worth \$1,400. When asked for suggestions on how to add program value, many enrollees and enrollee supervisors were unable to provide any.

### Persistence Conclusions

Gathered and calculated for individual measures/actions, no single measure experienced less than 100% persistence in impacts. There was a moderate level of new activities undertaken by 2000-2001 enrollees since the 2002 study. The estimated savings generated by program influence among 2000-2001 enrollees suggests a five year 'lifetime' assumption of program savings is reasonable as evidenced by the following results;

- Electric savings (kWh) was calculated to have a persistence rate of 114.2%.
- Oil and Gas savings (MMBTU) was calculated to have a persistence rate of 108.5%.
- Water savings (gallons) was calculated to have achieved 100% persistence.

### Energy Savings and Non-Energy Impact Conclusions

Due to the high level of school activity in the program and its interest among NEEP and the sponsors, energy savings impacts are provided separately in this report for schools vs. non-schools. Impacts without rebated measures are provided for school and non-

school as well as overall so sponsors have the ability to tailor their BOC savings estimates according to their unique program offerings and approach to estimating net effects. The program is generating meaningful energy savings as a result of program induced energy efficiency actions undertaken by enrollees. Water savings and waste water savings also appear to be conserved as a result of the program, although there was not sufficient information to estimate waste water savings. The following bullets highlight the results relating to energy savings. Including rebated activities, the 2003 program is estimated to save:

- 33,298 MWh of school and 86,245 MWh of non-school annual electric energy, or an overall estimate of 0.35 kWh per enrollee per square foot,
- 149,194 MMBtu of school and 91,751 MMBtu of non-school annual energy, or an overall estimate of 0.74 MMBtu per enrollee per square foot, and
- 50,124,000 gallons of water in non-schools, or 0.14 gallons of water per enrollee per square foot.

Removing measures for which rebates were received, the 2003 program is estimated to save:

- 19,013 MWh of school and 42,808 MWh of non-school annual electric energy, or an overall estimate of 0.18 kWh per enrollee per square foot,
- 141,853 MMBtu of school and 87,250 MMBtu of non-school annual energy, or an overall estimate of 0.71 MMBtu per enrollee per square foot, and
- 50,124,000 gallons of water in non-schools, or 0.14 gallons of water per enrollee per square foot.

Enrollees and their supervisors reported experiencing numerous non-energy benefits as a result of their participation in the BOC Program. These non-energy benefits range from those that affect the facility to those that affect the specific job or career of the individual who participated in the course. The bullets below highlight these results.

- 84% of enrollees and 67% of their supervisors reported an improvement in occupant comfort since program participation.
- 85% of enrollees and 67% of their supervisors reported that the program helped them save energy at their facility.
- 46% of enrollees and 87% of their supervisors reported that the program has helped them save money on labor and materials at their facility.
- 17% of enrollees and 13% of enrollee supervisors reported that they have experienced an increase in compensation since completing the BOC coursework.
- 60% of enrollees reported making indoor air quality improvements since they participated in the BOC Program.

### Performance Indicator Conclusions

The program performance indicators are intended to reflect the program's history of accomplishments to date and have generally improved since the 2002 study was

performed. The average number of students per class has increased for Level 1 classes and remained the same for Level 2 classes since the 2002 study. There has been an increase in the number of program sponsors over the last couple of years and substantially more institutions giving academic or CEU credit for BOC certification. Through the 2003 calendar year, there have been nearly 1,200 students enrolled in the Level 1 coursework and 185 enrollees in Level 2. The bulleted items below highlight the improvements in the indicators of program performance.

- Level 1 certifications have almost doubled since the 2002 study from 268 at the end of 2001 to 526 thru the end of 2003.
- Level 2 certifications have more than tripled from 19 at the end of 2001 to 65 thru the end of 2003.
- The program drop-out rate, which was 4% in 2000-2001, was 0% in 2003.
- In 2000-2001 only one institution gave academic or CEU credit for BOC coursework, while at the end of 2003, 7 institutions did.
- The number of organizations sending staff through the BOC program has more than tripled from 143 at the end of 2001 to 502 thru the end of 2003.

#### Process Related Issue Conclusions

Program marketing received a lot of discussion in the interviews and generated a diverse set of opinions regarding the best approach. Some BOC staff, instructors, and program managers felt that NEEP should market the program, while others felt that leveraging the relationships utility account representatives have already established with customers would be an effective marketing strategy. Still others felt that using past participants to market the program would be effective, as hearing about a positive program experience from a "peer" may help potential recruits understand how the program can benefit them. The items below present some of the key marketing results.

- Approximately 40% of enrollees and 40% of their supervisors heard about the program through their boss or a co-worker.
- 31% of non-school enrollees were made aware of the program through utility representatives or energy efficiency organizations.
- 22% of school enrollees came to know about the program through trade associations/publications.
- 29% of informed non-participants and 26% of enrollees feel that mailings are the best way to recruit people into the program.

As the following bullets show, responses relating to participation and implementation barriers and considerations when deciding to attend training were consistently centered on time and staff availability and a lack of financial resources.

- From 2002-2003 there were 699 Level 1 enrollees of which 526 were certified (75% certification rate) and 114 Level 2 enrollees of which 65 were certified (57% certification rate).

- 47% of non-school and 40% of school enrollees reported time and staff availability as a major consideration when deciding to send staff to training.
- Time and staff availability was mentioned as the greatest barrier to participation by 51% of informed non-participants, 39% of enrollees, and 47% of enrollee supervisors.
- Cost was mentioned as the greatest barrier to participation by 18% of informed non-participants, 47% of enrollees, and 60% of enrollee supervisors.
- Financial resources were cited as the greatest barrier that inhibits O&M improvements by 70% of enrollees and 87% of their supervisors.

The class schedule structure was a process-related issue that has been cited as a barrier to participation concern and was recently adjusted.

- Program instructors feel that offering the classes on consecutive days allows them to establish better relationships with the students and may be easier for them to attend.
- 58% of informed non-participants preferred classes that were offered on two consecutive days over classes offered on single days for several months, which were preferred by only 38%.

#### 4.7.2 Recommendations

The following recommendations are made based upon data provided in the body of this report as well as the primary conclusions presented above. Some of these recommendations may have been implemented prior to the publication of this report as this study has been performed concurrent with ongoing program operations, which includes the pursuit of continuous program improvements by NEEP and the sponsors.

1. NEEP presence at the courses was reported to have dropped off since the outset of the BOC Program. NEEP should consider sending a NEEP representative to at least a segment of all classes. This increased presence can be used to better follow homework assignments, track attendance rates and improve overall interaction with enrollees regarding coursework that needs to be completed for certification. We anticipate that this effort will provide a single presence in all courses that emphasize projects that need to be completed to become certified as well as track attendance in the interest of proactively encouraging those who do not attend to return to the next course. To ensure these efforts are having the desired effect, we further recommend monitoring the certification rates of Level 1 and Level 2 enrollees over time.
2. The results from this study suggest that using more trusted (utility representatives, professional and civic organizations, etc.) and personal (direct contact to boss through utility representative) methods to recruit potential participants will maximize participation rates. That is, the greatest program marketing successes related in the interviews and data appear to be through account representatives, grass roots marketing to local chambers of commerce and civic associations, and marketing to

previous participants (which is where most enrollees and supervisors reported hearing of the program). We believe under the current circumstances, both NEEP and the sponsors should continue marketing the program to different markets through unique means. This would be a complimentary system in which the utilities leverage trust in account representatives to solicit enrollees and NEEP handle marketing to previous enrollees, associations, and other professional groups that might also be interested in program sponsorship. As part of this process, we recommend monitoring where intake is from in the interest of assessing those channels that generating the most enrollees and determining when an appropriate time is for utilities to diminish their efforts without risking course attendance rates.

3. Related to the recommendation above, we suggest that NEEP establish a system of using past students to market the program to others as well as a system of contacting and encouraging current students who stop attending the courses to re-connect with the coursework. Several interviewees suggested that previous students who have experienced the value of the course can be valuable recruiters for other enrollees (or to provide NEEP names of others that can be direct marketed to) and the participant survey indicated a great deal of interest on the part of students who have dropped out of the coursework to begin attending the courses again; pending future opportunities.
4. NEEP has staff currently on board to assist in BOC marketing; specifically, they have 1-2 people with marketing backgrounds that have been recently trained to become resources available for program operation. While not all sponsors anticipate NEEP taking over program marketing, we believe NEEP is currently staffed to take more of this responsibility. These NEEP staff members can target organizations at a regional level for program sponsorship, as well as enrollee recruitment into the BOC courses. Organizations cited as plausible targets for these activities include the International Association of Facility Managers (IFMA), Building Owners and Managers Association (BOMA), the Associated Industries of Massachusetts (AIM) and the Association for Facility Engineering (AFE). As part of this process, NEEP should consider gathering associations of enrollees in the course in the registration form to further inform potential targets for these activities in the region or in local areas.
5. Most sponsors currently subsidize the course fee of \$1,400 for enrollees, including some that cover half the course fee and some that cover the full course fee for certain enrollee types (municipal operators for instance). Indeed, many non-participants surveyed indicated an unwillingness to pay \$1,400 and courses in one state that was marketed via direct mail with the course at full price had difficulties with filling courses. Under these conditions, it is difficult to determine the viability of the program in the marketplace under its current price structure. Under the new staffing resources available at NEEP that have marketing backgrounds, we recommend testing customer response to the retail price in conjunction with NEEP

marketing to assess customer willingness to enroll under the designed 'retail' program operations.

6. NEEP should consistently track square footage controlled by enrollees via the registration forms. There is currently a place for the enrollee to provide this information on the form, but it is not consistently gathered. This information can be used to estimate program impacts via the savings per square foot results provided in this report as well as track penetration of program influence (i.e., the amount of square feet the program has touched). In the event that this is not gathered, however, there are also savings estimates per enrollee provided in this report that can be used to estimate future program impacts. Other information that would be useful to carry would include the number of years in their current job and the sponsor territory they operate in.
7. The current definition of drop out rates used in the performance indicator table reflect the rate in which students enrolled in the program attend initial courses, drop out of those courses and are not interested in attending future courses. We recommend changing this drop out rate definition to reflect the rate at which enrollees become certified. This value can be calculated from existing sources as the program moves forward (the program database) and is more meaningful as an indicator of program progress and success.
8. The per square foot estimates of energy savings per enrollee calculated in this study are relatively consistent with those of the 2002 study, particularly for electric impacts. Due to these convergent estimates, we recommend using these impact values to predict program savings as the BOC moves forward. We have provided an approach for using this data earlier in this report for this purpose; including a formula for calculating impacts and various impact values for consideration depending upon sponsor determination of whether to include rebated savings or not include rebated savings. As discussed earlier, we further recommend that NEEP track the sponsor territory each enrollee comes from to facilitate the calculation of any utility level impacts desired by program sponsors.
9. The persistence rates calculated in this study suggest program influences to perform O&M activities taught in the coursework extends up to at least four years. In the 2002 report, the life of program influence was assumed to be five years. Based upon these points, it does seem reasonable to assume a measure lifetime for BOC savings of five years. As more program activity becomes available to test persistence in longer windows of time, future studies should be conducted to further assess and refine this assumption.
10. As part of this study, we acquired some course surveys and questionnaires performed with enrollees that provide feedback on each course, the instructors, the courses usefulness, and other points of interest; however, this data collection did

not appear to be implemented consistently. We recommend regularly surveying students with a standard instrument to assess the courses, perhaps including a pre/post test to provide information on knowledge learned. This information would be useful for instructors, students, and sponsors as a mechanism to continually refine the courses and provide feedback on instructor effectiveness.

11. A primary barrier to course participation is that of operator staff availability to attend the courses. NEEP has recently implemented a new course schedule intended to make it easier for staff to attend the courses; two consecutive days a month for 3- 4 months as opposed to one day a month for 7-8 months. Non-participants indicated favorability for this class schedule and instructors believe this schedule will be more 'friendly'. We recommend monitoring whether this schedule results in a decrease in drop out rates between enrollees registering for the course and their subsequent attendance and certification.
12. Another primary barrier noted to impede O&M improvements is that of available financial resources or money. In the Energy Conservation Techniques course, students are encouraged to contact their local utility for financial and technical assistance. While this may invite policy concerns regarding attribution of program savings in these instances, promoting the availability of utility conservation funds regularly in the coursework can be expected to improve the efficient equipment installations and O&M activities reflected in the BOC coursework.

## **5 Appendix A: Data Collection Instruments**

The following are the data collection instruments used to gather primary data in this study.

## 5.1 Enrollee Survey

### INTERVIEW GUIDE NEEP BOC PROGRAM: ENROLLEES

Name: \_\_\_\_\_

Class Series: \_\_\_\_\_ Location: \_\_\_\_\_ Year: \_\_\_\_\_

Title: \_\_\_\_\_

Company Name: \_\_\_\_\_ Phone Number: \_\_\_\_\_

Address: \_\_\_\_\_

**Introduction:** Hi, my name is \_\_\_\_\_. (Utility/Energy Efficiency Organization) gave me your name as a person who had enrolled in the Building Operator Certification Program. We are conducting an evaluation of the program and are following up with students to obtain their view of the program. Do you have time to talk for about 20 minutes?

*If recruitment discovers that the person is no longer in facility/company, ask where that individual went: State: \_\_\_\_\_ Are they still doing building/facility maintenance? Yes No*

#### Demographics

1. How long have you worked in your position as a building operator in this facility? \_\_\_Yrs.
2. What type of business is run in the building you operate? \_\_\_\_\_
3. *If records show the amount of controlled space, mention that this amount is what they reported being responsible for in 2003 and ask if it has changed:*  
In 2003, you indicated that your facility was \_\_\_\_\_ sf. Has this changed? If so, what is the new area in square feet? \_\_\_\_\_
4. What is the approximate size of the conditioned space at your facility? \_\_\_\_\_ SqFt.
5. What is the heating system type and fuel used at your facility?  
Primary: \_\_\_\_\_ Fuel: Electric Oil Gas Other: \_\_\_\_\_  
Secondary: \_\_\_\_\_ Fuel: Electric Oil Gas Other: \_\_\_\_\_
6. What is the cooling system type and fuel used at your facility?  
Primary: \_\_\_\_\_ Fuel: Electric Oil Gas Other: \_\_\_\_\_  
Secondary: \_\_\_\_\_ Fuel: Electric Oil Gas Other: \_\_\_\_\_
7. What is the primary fuel used by the hot water system at your facility?  
Fuel: Electric Oil Gas Other: \_\_\_\_\_
8. Do you have regular access to data on the energy consumption in your facility?
  - a. Yes
  - b. No

**Program Impacts**

9. Please indicate which of the following systems or equipment you have control or responsibility for in your facility. (place an 'x' in each column)
  
10. The following people participated in the BOC Program in 2003: (Name1, Name2, Name3, etc.). How many of these people have control over the same systems or equipment for which you have control in your building? (Enter # into each column).

People to ask about	Lighting System	HVAC controls	Heating Systems, including Boilers	Cooling Systems, including Chillers	Economizers	Motors and VSDs	Pipe Insulation	Air Compressors	Water Savings Eqt	Waste Water Savings Eqt
Enrollee										
Other										

11. In the following matrix, ask questions about each of the measures for which the respondent indicated he has control or responsibility for in Q9.

Question	A. Install Lighting controls	B. Install Efficient Lighting	C. Install EMS/T-stat	D. Install Air Handler Seals/Gaskets	E. Perform Maintenance on Unitary Eq.	F. Perform Maintenance on Chillers/ Cooling Towers	G. Perform Maintenance on Economizers	H. Install New Motors	I. Install VFD's	J. Perform Motor Maintenance, incl. belt alignment	K. Install Pipe Insulation	L. Perform Maintenance on Boilers, incl. replacing steam traps	M. Perform Air Compressor Leak Reduction	M. Perform Maintenance on Air Compressors, incl. filters and belts	N. Conserve Waste Water as a result of actions	O. Conserve Water as a result of actions
1. Between 2000-2002, (Prior to your participation in the 2003 BOC course) did your company (ask of each measure/action) in the portion of the facility you control?																
2. Have you (installed/performed maintenance on) this equipment since (use timeframe)? <b>If q2=no, go to next measure.</b>	1/04 y/n	1/04 y/n	2003 y/n	2003 y/n	1/04 y/n	1/04 y/n	1/04 y/n	2003 y/n	2003 y/n	1/04 y/n	2003 y/n	1/04 y/n	7/04 y/n	7/04 y/n	2003 y/n	2003 y/n
3. Did the BOC coursework affect your decision to (install/perform maintenance on) this equipment? <b>If q1 and q3=no, go to q4. If q1=yes and q3=no, go to next measure.</b>	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n
4. What is the approximate area/capacity affected by this equipment change/activity since (use timeframe)?	Square Feet															
	Tons															
	Horsepower															
	Linear ft. of piping insulated															
	R-value of insulation															
5. Did you receive a rebate for this installation/performance?	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n	y/n
6. Approximately how much money was spent on the materials necessary to perform this work? (dollars)																
7. How many hours were spent by your in house staff (installing/completing) this work? If contracted, ask approximately how much was spent for contractor to perform.	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$	In: C: \$
8. What is the piping/boiler system type and fuel used (see below)?																
9. Identify the types of water saving actions.																
10. Gallons saved by these actions. G/D, G/YR																

Q8 Detail: What type of piping: DHW Heating System

Q9 Detail: Water Savings Actions Mentioned (if applicable): Cooling tower overflow repair, Condensate return system installed or repaired, Low flow faucet or shower heads installed, Low flow toilets installed, Changed irrigation practices, Other (describe): \_\_\_\_\_

Q9 Detail: Waste Water Savings Actions Mentioned (if applicable): \_\_\_\_\_

**Marketing**

12. How did you hear about the Building Operators Certification Program? (Do not read choice; Write in below and record ONLY the first mention following interview).

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

- |  |                             |
|--|-----------------------------|
| a. Utility representative/energy efficiency org. | g. Conference or trade show |
| b. Utility/energy efficiency org. seminar        | h. Friend or relative       |
| c. Utility mailing or advertisement              | i. Internet                 |
| d. Other mailing/Advertisement/Flyer             | j. School/College           |
| e. Boss or co-worker                             | k. Other, specify _____     |
| f. Professional or trade association/Publication | l. Don't know/Refused       |

13. What other sources do you consider for Operations & Maintenance (O&M) training? \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

14. Why did you choose the BOC Program for O&M training? \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

15. What do you think is the best way to recruit people from companies such as yours into a program such as the BOC Program? \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Coursework**

16. (ask if enrolled in Level One, else skip to Q19) For each of the BOC Level 1 classes you attended, please rate how valuable you feel each class was on a scale of 1 (not at all valuable) to 5 (extremely valuable).

Course Topic	Usefulness to Student
a. Building system overview – BOC 101	Rating: _____ Did not take class
b. Energy conservation techniques – BOC 102	Rating: _____ Did not take class
c. HVAC system and controls – BOC 103	Rating: _____ Did not take class
d. Efficient lighting fundamentals – BOC 104	Rating: _____ Did not take class
e. Building maintenance codes – BOC 105	Rating: _____ Did not take class
f. Indoor air quality - BOC 106	Rating: _____ Did not take class
g. Facility electrical systems – BOC 107	Rating: _____ Did not take class

17. Did you receive your Level 1 certification?

- a. Yes → skip to Q19  
 b. No → what prevented you from completing the necessary requirements? \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_

18. (ask if enrollee attended some of the first courses then stopped) Why did you stop attending the courses? \_\_\_\_\_

a. Are you interested in getting information on courses offered in the future to begin the BOC process again? Yes No

19. (ask if enrolled in Level Two, else skip to Q22) For each of the BOC Level 2 classes you attended, please rate how valuable you feel each class was on a scale of 1 (not at all valuable) to 5 (extremely valuable).

Course Topic	Usefulness to Student	
a. Preventative Maintenance & Operations – BOC 201	Rating: _____	Did not take class
b. Advanced Electrical Diagnosis – BOC 202	Rating: _____	Did not take class
c. HVAC Troubleshooting & Maintenance – BOC 203	Rating: _____	Did not take class
d. HVAC Controls & Optimization – BOC 204	Rating: _____	Did not take class
e. Advanced Indoor Air Quality – BOC 210	Rating: _____	Did not take class
f. Energy Audit – BOC 220	Rating: _____	Did not take class
g. Advanced Lighting Applications – BOC 231	Rating: _____	Did not take class

20. Did you receive your Level 2 certification?

- a. Yes → skip to Q22
- b. No → what prevented you from completing the necessary requirements? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

21. (ask if enrollee attended some of the first courses then stopped) Why did you stop attending the courses? \_\_\_\_\_

a. Are you interested in getting information on courses offered in the future to begin the BOC process again? Yes No

22. What kinds of barriers do you think exist that inhibit companies such as yours from sending building maintenance staff to training programs such as the BOC? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

23. What are the top 5 things that you can recall having learned through the program?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_

24. Would you say that by applying things you learned from the course, you have been able to:

- a. Improve occupant comfort: Yes No Don't know/Refused
- b. Save energy at your facility: Yes No Don't know/Refused
- c. Save money on materials and labor: Yes No Don't know/Refused

25. Since completing the BOC, have any of the following changes occurred in your job?

- a. Change in job title: Yes No Don't know/Refused
- b. Increased responsibilities: Yes No Don't know/Refused

- c. Increased compensation:    Yes    No    Don't know/Refused

**If "Yes" to any of the above, Go to Q26, otherwise Go to Q27**

26. Do you think having the Building Operator Certificate helped you attain this/these changes?  
a. Yes  
b. No  
c. Don't Know/Refused
27. Do you think that having a Building Operators Certificate will be good for advancing your current job, or getting a new job if needed?  
a. Yes  
b. No  
c. Don't Know/Refused
28. Have you recommended the Building Operator Certification Program to other people that do the same type of work that you do?  
a. Yes  
b. No  
c. Don't Know/Refused
29. Have you made changes as a result of the BOC Program that has improved the IAQ of the space you control? No Yes → If yes, what have you done? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
30. Aside from those benefits we have already discussed, what other benefits have you identified as a result of your participation in the program?  
\_\_\_\_\_  
\_\_\_\_\_
31. What kind of barriers have you encountered that inhibit O&M improvements that you would like to implement in your facility? (check all that apply)  
a. Financial Resources/Money  
b. Time  
c. Culture  
d. Other (specify): \_\_\_\_\_
- 31b. If Financial Resources/Money is not mentioned above, ask: Has a lack of financial resources inhibited your ability to perform specific O&M activities at your facility?  
Yes → please explain: \_\_\_\_\_  
No  
Don't know/Refused
32. Is there anything that could be done with the program that would make it more valuable/ helpful to you? If so, what? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
33. Do you receive the NEEP BOC newsletter?  
a. Yes  
b. No → Go to Q36  
c. Don't Know/Refused

- 34. Do you believe the newsletter is informative?
  - a. Yes
  - b. No
  - c. Don't Know/Refused

35. How might the newsletter be improved? \_\_\_\_\_  
\_\_\_\_\_

36. In 2003, the course you attended cost \$1,400. Knowing what you now know about the program, do you believe the course was worth this cost?

37. In thinking about the value you have received the course, do you believe the course cost should be more, less, or the same amount of money to attend?

Who would be the best person at your company to ask about the value of the BOC training to your company as a whole, such as your supervisor?

Name and Title: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Do you have any additional comments about the BOC Program?

\_\_\_\_\_  
\_\_\_\_\_

**Closing**

That's all of the questions I have. Thank you for your time.

## 5.2 Persistence Survey

### INTERVIEW GUIDE NEEP BOC PROGRAM: PERSISTENCE OF 2000/2001 CERTIFIED PARTICIPANT ACTIONS

Name: \_\_\_\_\_

Class: \_\_\_\_\_ Location: \_\_\_\_\_ Year: \_\_\_\_\_

Title: \_\_\_\_\_

Company Name: \_\_\_\_\_ Phone Number: \_\_\_\_\_

**Introduction:** Hi, can I please speak with \_\_\_\_\_. Hi, my name is \_\_\_\_\_ and I'm with (utility). We are calling as a follow-up to a survey you completed in 2002 regarding your participation in the Northeast Energy Efficiency Partnership's (NEEP's) Building Operators Certification (BOC) Program. We would like to ask you some questions regarding your operation and maintenance (O&M) practices at your facility in relation to those you performed in 2002. Do you have time to talk for about 15 minutes?

If contact is no longer in the same position as that in 2002, ask whether they are still in the company and their current role. \_\_\_\_\_ Also gather what state they are operating in, in the event their location has changed. \_\_\_\_\_.

#### Building Size

1. If records show the amount of controlled space, mention that this amount is what they reported in 2002 and ask if it has changed. This is what they said: \_\_\_\_\_ sf. What is the approximate size of the conditioned space of the facility where you work?  
\_\_\_\_\_

2.a. The equipment that you work on, does it serve this whole space, or just a part?

- Whole → Go To Q3
- Part → Go To Q2b

b. Can you give me an estimate of the conditioned space served by the equipment that you work on? \_\_\_\_\_

#### Lighting Controls

3. In 2002, you indicated that you (installed/did not install) lighting controls; have you installed these measures since 2002?

- Yes → Go To Q6
- No
- Don't Know/Refused

4. Have you had an opportunity to install lighting controls since 2002?

- a. Yes
- b. No → Go To Q6
- c. Don't Know/Refused → Go To Q6

5. If you have not installed these measures since 2002, why did you not install them?

- d. No opportunity
- e. Budgetary considerations
- f. Unsatisfactory experience with prior installation
- g. Other \_\_\_\_\_

**Efficient Lamps and Fixtures**

6. In 2002, you indicated that you (installed/did not install) efficient lamps or fixtures; since 2002, have you replaced less efficient lamps or fixtures with more efficient ones (sometimes called a lighting retrofit)?

- Yes → Go To Q9
- No
- Don't Know/Refused

7. Have you had an opportunity to install efficient lamps or fixtures since 2002?

- h. Yes
- i. No → Go To Q9
- j. Don't Know/Refused → Go To Q9

8. If you have not installed these measures since 2002, why did you not install them?

- k. No opportunity
- l. Budgetary considerations
- m. Unsatisfactory experience with prior installation
- n. Other \_\_\_\_\_

**Thermostats/EMS**

9. In 2002, you indicated that you (installed/did not install) thermostats or an energy management system (also called an EMS); since 2002, have you installed thermostats or an energy management system to control the HVAC system?

- Yes → Go To Q12
- No
- Don't Know/Refused

10. Have you had an opportunity to install thermostats or an EMS to control the HVAC system since 2002?

- o. Yes
- p. No → Go To Q12
- q. Don't Know/Refused → Go To Q12

11. If you have not installed these measures since 2002, why did you not install them?

- r. No opportunity
- s. Budgetary considerations
- t. Unsatisfactory experience with prior installation
- u. Other \_\_\_\_\_

**Air Handler Door Gaskets/Damper Seals**

12. In 2002, you indicated that you (installed/did not install) air handler door gaskets and/or damper seals; since 2002, have you installed air handler door gaskets or damper seals?

- Yes → which (circle one)? Gaskets    Seals    Both → Go To Q15
- No
- Don't Know/Refused → Go To Q15
- Do not have an air handler → Go To Q15

13. Have you had an opportunity to install air handler door gaskets or damper seals since 2002?

- v. Yes
- w. No → Go To Q15
- x. Don't Know/Refused → Go To Q15

14. If you have not installed these measures since 2002, why did you not install them?

- y. No opportunity
- z. Budgetary considerations
- aa. Unsatisfactory experience with prior installation
- bb. Other \_\_\_\_\_

### **Unitary Equipment Maintenance**

15. In 2002, you indicated that you (performed/did not perform) unitary equipment maintenance, such as on air filters, belts, and coils; in the last twelve months, have you performed unitary equipment maintenance?

- Yes → Go To Q18
- No
- Don't Know/Refused
- Do not have unitary equipment → Go To Q18

16. Have you had an opportunity to perform unitary equipment maintenance in the last twelve months?

- cc. Yes
- dd. No → Go To Q18
- ee. Don't Know/Refused → Go To Q18

17. If you have not performed this maintenance in the last twelve months, why did you not perform it?

- ff. No opportunity
- gg. Budgetary considerations
- hh. Unsatisfactory experience with prior installation
- ii. Other \_\_\_\_\_

### **Chiller/Cooling System Maintenance**

18. In 2002, you indicated that you (performed/did not perform) chiller system or cooling tower maintenance; in the last twelve months, have you performed chiller system or cooling tower maintenance?

- Yes → Go To Q21
- No
- Don't Know/Refused
- Do not have chiller or cooling tower → Go To Q21

19. Have you had an opportunity to perform chiller system or cooling tower maintenance in the last twelve months?

- jj. Yes
- kk. No → Go To Q21
- ll. Don't Know/Refused → Go To Q21

20. If you have not performed this maintenance in the last twelve months, why did you not perform it?

- mm. No opportunity
- nn. Budgetary considerations
- oo. Unsatisfactory experience with prior installation

pp. Other \_\_\_\_\_

### Economizer Maintenance

21. In 2002, you indicated that you (performed/did not perform) economizer maintenance; in the last twelve months, have you performed economizer maintenance?
- Yes → Go To Q24
  - No
  - Don't Know/Refused
  - Do not have an economizer → Go To Q24
22. Have you had an opportunity to perform economizer maintenance in the last twelve months?
- qq. Yes
  - rr. No → Go To Q24
  - ss. Don't Know/Refused → Go To Q24
23. If you have not performed this maintenance in the last twelve months, why did you not perform it?
- tt. No opportunity
  - uu. Budgetary considerations
  - vv. Unsatisfactory experience with prior installation
  - ww. Other \_\_\_\_\_

### New Motors

24. In 2002, you indicated that you (installed/did not install) newly purchased efficient motors; since 2002, have you installed any newly purchased motors?
- Yes → Go To Q27
  - No
  - Don't Know/Refused
  - Do not have motors → Go To 33
25. Have you had an opportunity to install newly purchased efficient motors since 2002?
- xx. Yes
  - yy. No → Go To Q27
  - zz. Don't Know/Refused → Go To Q27
26. If you have not installed these measures since 2002, why did you not install them?
- aaa. No opportunity
  - bbb. Budgetary considerations
  - ccc. Unsatisfactory experience with prior installation
  - ddd. Other \_\_\_\_\_

### VFDs

27. In 2002, you indicated that you (installed/did not install) variable frequency drives (VFDs); since 2002, have you installed any VFDs?
- Yes → Go To Q30
  - No
  - Don't Know/Refused
28. Have you had an opportunity to install VFDs since the beginning of 2003?
- eee. Yes
  - fff. No → Go To Q30
  - ggg. Don't Know/Refused → Go To Q30

29. If you have not installed these measures since 2002, why did you not install them?

- hhh. No opportunity
- iii. Budgetary considerations
- jjj. Unsatisfactory experience with prior installation
- kkk. Other \_\_\_\_\_

### Motor Maintenance

30. In 2002, you indicated that you (performed/did not perform) motor maintenance; in the last twelve months, have you performed motor maintenance, including belt alignment?

- Yes → Go To Q33
- No
- Don't Know/Refused

31. Have you had an opportunity to perform motor maintenance in the last twelve months?

- lll. Yes
- mmm. No → Go To Q33
- nnn. Don't Know/Refused → Go To Q33

32. If you have not performed this maintenance in the last twelve months, why did you not perform it?

- ooo. No opportunity
- ppp. Budgetary considerations
- qqq. Unsatisfactory experience with prior installation
- rrr. Other \_\_\_\_\_

### Air Compressor Maintenance

33. In 2002, you indicated that you (performed/did not perform) air compressor maintenance; in the last six months, have you performed air compressor maintenance, such as working on filters, belts, and leaks?

- Yes → Go To Q36
- No
- Don't Know/Refused
- Do not have air compressors → Go To Q36

34. Have you had an opportunity to perform air compressor maintenance in the last six months?

- sss. Yes
- ttt. No → Go To Q36
- uuu. Don't Know/Refused → Go To Q36

35. If you have not performed this maintenance in the last six months, why did you not perform it?

- vvv. No opportunity
- www. Budgetary considerations
- xxx. Unsatisfactory experience with prior installation
- yyy. Other \_\_\_\_\_

### Boiler Maintenance

36. In 2002, you indicated that you (performed/did not perform) boiler maintenance; in the last twelve months, have you performed boiler maintenance, including replacing steam traps?

- Yes → Go To Q39
- No
- Don't Know/Refused

37. Have you had an opportunity to perform boiler maintenance in the last twelve months?

zzz. Yes

aaaa. No → Go To Q39

bbbb. Don't Know/Refused → Go To Q39

38. If you have not performed this maintenance in the last twelve months, why did you not perform it?

cccc. No opportunity

dddd. Budgetary considerations

eeee. Unsatisfactory experience with prior installation

ffff. Other \_\_\_\_\_

### Pipe Insulation

39. In 2002, you indicated that you (installed/did not install) insulation around pipes; since 2002, have you installed or added any pipe insulation?

Installed New → Go To Q42

Added → Go To Q42

No

Don't Know/Refused

40. Have you had an opportunity to install pipe insulation since 2002?

gggg. Yes

hhhh. No → Go To Q42

iiii. Don't Know/Refused → Go To Q42

41. If you have not installed these measures since 2002, why did you not install them?

jjjj. No opportunity

kkkk. Budgetary considerations

llll. Unsatisfactory experience with prior installation

mmmm. Other \_\_\_\_\_

### Water Savings

42. In 2002, you indicated that you (took/did not take) actions to save water; since 2002, have you taken any actions to save water?

Yes → Go To Q45

No

Don't Know/Refused

43. Have you had an opportunity to take any actions to save water since 2002?

nnnn. Yes

oooo. No → Go To Closing

pppp. Don't Know/Refused → Go To Closing

44. If you have not installed these measures since 2002, why did you not install them?

qqqq. No opportunity

rrrr. Budgetary considerations

ssss. Unsatisfactory experience with prior installation

tttt. Other \_\_\_\_\_

### Skip to Closing

45. Please identify the types of water-saving actions taken. (Do not read; open-ended; up to 6 responses; pre-codes follow; probe: anything else?)

Cooling tower overflow repair

Condensate return system installed or repaired

Low flow faucet or shower heads installed

Low flow toilets installed

Changed irrigation practices

Other (describe) \_\_\_\_\_

Don't know/Refused

46. What was the approximate water savings estimated to results from these actions? \_\_\_\_\_  
gallons per \_\_\_\_\_ (day, year, etc.)

**Closing**

That's all of the questions I have. Thank you for your time.

5.3 Non-Participant Survey

INTERVIEW GUIDE
NEEP BOC PROGRAM: NON-PARTICIPANTS
2004

First, are you a manager or supervisor of buildings operations and maintenance staff?

- Yes
No -> Ask to speak with someone who is.

- 1. How many building operators work under your supervision, not including yourself?
2. How many building operator supervisors are on staff at this location, including yourself?
3. Have you or any of your staff attended any training or education programs in the last three years?
4. Have you received certification from training in any area of building operations and maintenance?

5. What types of training or certification have you received? (Do not read choices; Write in below and circle all that apply following interview).

Blank lines for writing answers to question 5.

- a. Building Operators Certification
b. Operating Engineering Certification -> Go to Q7
c. Certified Energy Manager -> Go to Q7
d. Certified Energy Procurement Professional -> Go to Q7
e. Certified Indoor Air Quality Professional -> Go to Q7
f. Certified Indoor Air Quality Technician -> Go to Q7
g. Certified Testing, Adjusting, Balancing Professional -> Go to Q7
h. Asbestos -> Go to Q7
i. Boilers -> Go to Q7
j. BOMA -> Go to Q7
k. Building/Facilities Management -> Go to Q7
l. Electrical Certification/Electrician -> Go to Q7
m. Energy Audit -> Go to Q7
n. Energy Conservation -> Go to Q7
o. Energy Efficiency -> Go to Q7
p. Energy Maintenance/Management -> Go to Q7
q. EPA/Environment -> Go to Q7
r. Emergency Response/CPR/First Aid -> Go to Q7
s. Equipment Operation (Crane/Forklift) -> Go to Q7
t. Fire Safety/Alarm/Response -> Go to Q7
u. Hazardous Waste/HAZMAT -> Go to Q7
v. HVAC -> Go to Q7
w. OSHA -> Go to Q7
x. Refrigeration -> Go to Q7
y. Other, specify -> Go to Q7
z. Don't Know/Refused -> Go to Q7

- 6. Is your Building Operators Certification from (name of utility), which is working with the Northeast Energy Efficiency Partnership (NEEP), or is it from some other group?
Utility/NEEP -> Thank and Terminate interview
Other, specify
Don't Know/Refused

7. Have any of your staff ever received certification for training in any area of building operations and maintenance?

- Yes → how many have received certification? \_\_\_\_\_
- No → Go to Q10
- Don't Know/Refused → Go to Q10

8. What type of training or certification have they received? (Do not read choices; Write in below and circle all that apply following interview).

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- |  |  |
|--|--|
| a. Building Operators Certification                                | m. Indoor Air Quality → Go to Q10                              |
| b. Air Compressors → Go to Q10                                     | n. Maintenance (Facility, Equipment, Preventative) → Go to Q10 |
| Asbestos/Asbestos Inspector/Asbestos Removal/Abatement → Go to Q10 |  |
| c. Go to Q10   | o. Operating Engineering Certification → Go to Q10             |
| d. Boiler Operator/Boiler Certification/Boilers → Go to Q10        | p. Plumbing → Go to Q10  |
| e. Computer → Go to Q10  | q. Pool/Spa Operator → Go to Q10                               |
| f. Electrician/Electrical/Lighting → Go to Q10                     | r. Safety Management/Safety/Fire Safety → Go to Q10            |
| g. Energy Management Certification → Go to Q10                     | s. Supervisory/Management/Facilities Management → Go to Q10    |
|  | Water System/Water Operator/Waste Water                        |
| h. Equipment Operator (Forklift/Crane) → Go to Q10                 | t. Management/Backflow Abatement → Go to Q10                   |
| i. Gas (Natural/Medical/High Pressure) → Go to Q10                 | u. Welding/Cutting/Pipe Fitting → Go to Q10                    |
| j. Hazardous Waste/Material Handling Management → Go to Q10        | v. Other, specify _____ → Go to Q10                            |
| k. Herbicide/Insecticide → Go to Q10                               | w. Don't Know/Refused → Go to Q10                              |
| l. HVAC/Refrigeration/Freon Recovery → Go to Q10                   |  |

9. Is their Building Operators Certification from (name of utility), which is working with the Northeast Energy Efficiency Partnership (NEEP), or is it from some other group?

- Utility/NEEP → **Thank and Terminate interview**
- Other, specify \_\_\_\_\_
- Don't Know/Refused

10. Do you consider certification in building operations and maintenance important for building operations and maintenance staff? Please rate the importance you place on it using a scale of 1 (not at all important) to 5 (very important). RATING: \_\_\_\_\_ DK/Refused

**(If the rating provided in Q10 is a 1 or 2, Go to Q12)**

11. I am going to mention some possible types of certification. Please rate your level of interest in each using a scale of 1 (not at all interested) to 5 (very interested).

- |   |               |            |
|---|---------------|------------|
| a. Competency-based certification?                        | RATING: _____ | DK/Refused |
| b. Certification valid nationally?                        | RATING: _____ | DK/Refused |
| c. Certification that is transferable to other companies? | RATING: _____ | DK/Refused |
| d. Certification that is issued by trade associations?    | RATING: _____ | DK/Refused |
| e. Certification that is issued by equipment vendors?     | RATING: _____ | DK/Refused |
| f. Certification by private training organizations?       | RATING: _____ | DK/Refused |

12. Now I am going to read a list of course topics that might be offered for building operations and maintenance staff. Please rate your level of interest in each using a scale of 1 (not at all interested) to 5 (very interested).

- a. Energy conservation techniques? RATING: \_\_\_\_\_ DK/Refused
- b. HVAC systems and controls? RATING: \_\_\_\_\_ DK/Refused
- c. Maintenance and related codes? RATING: \_\_\_\_\_ DK/Refused
- d. Indoor air quality? RATING: \_\_\_\_\_ DK/Refused
- e. Facility electrical systems? RATING: \_\_\_\_\_ DK/Refused
- f. Efficient lighting fundamentals? RATING: \_\_\_\_\_ DK/Refused
- g. Energy auditing? RATING: \_\_\_\_\_ DK/Refused
- h. Preventative maintenance? RATING: \_\_\_\_\_ DK/Refused
- i. Electrical systems maintenance and troubleshooting RATING: \_\_\_\_\_ DK/Refused
- j. Refrigeration equipment maintenance and troubleshooting RATING: \_\_\_\_\_ DK/Refused
- k. HVAC controls maintenance and troubleshooting RATING: \_\_\_\_\_ DK/Refused
- l. Heating equipment maintenance and troubleshooting RATING: \_\_\_\_\_ DK/Refused

13. Are there any other training topics which you or your staff would be interested in that I have not mentioned?

- No
- Yes → Such as? (Do not read choices; Write in below and circle all that apply following interview).

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- a. ADA issues
- b. Air compressors
- c. Asbestos/Asbestos inspector/Asbestos removal
- d. Boilers
- e. Building maintenance (paint/clean/repair/plumbing)
- f. Building's automated controls (doors/locks/information systems/fire control panels)
- g. Computer skills (CAD/LAN/etc.)
- h. Earthquake/Structural safety/Inspections
- i. Electrical/Low voltage
- j. First aid/Blood born pathogens/Medical equipment
- k. Hazardous waste/Material handling management
- l. Hydraulics
- m. Maintenance (equipment/grounds)
- n. People skills/Communication skills/Handling personal issues
- o. Pumping
- p. Roofing
- q. Safety management/Safety/Fire Safety
- r. Water system/Water operation/Waste water management
- s. Don't Know/Not sure/Refused

14. Are you planning to attend or send any of your building and operations staff to any training or continuing education activities in the next 12 months?

- Yes
- No → Go to Q16
- Don't Know/Refused → Go to Q16

15. I'm going to describe some types of training. For each please tell me if you or at least one staff person plan to attend any of the following types of training activities in the next 12 months? (Circle one response for each activity).

- a. A Vendor workshop or seminar for a specific piece of equipment? Yes No Maybe/Don't Know/Refused
- b. Government regulation training course such as OSHA training? Yes No Maybe/Don't Know/Refused
- c. In-house training? Yes No Maybe/Don't Know/Refused
- d. Training videos or other materials? Yes No Maybe/Don't Know/Refused
- e. Trade shows or professional conferences? Yes No Maybe/Don't Know/Refused
- f. Training offered by private training organizations? Yes No Maybe/Don't Know/Refused
- g. A community or technical college course? Yes No Maybe/Don't Know/Refused
- h. BOMA certification courses? Yes No Maybe/Don't Know/Refused
- i. An Operating Engineers Training course? Yes No Maybe/Don't Know/Refused

16. What are some of the things you consider in deciding whether or not to send yourself or your staff to training?

- a. Money
- b. Person needs the training/Job growth
- c. Gain/Benefit to the company
- d. Subject area
- e. Time/Staff Availability
- f. Location
- g. Length of Training
- h. Required by law for company
- i. Instructor/Sponsor
- j. Personal interest
- k. Subject matter is relevant/Addresses our needs/Useful
- l. Most up-to-date information
- m. Certification
- n. Quality of course (what employee will benefit from it)
- o. Difficult to get approval
- p. Follow-up training or schooling
- q. Nothing/No need for training
- r. Don't Know/Not sure/Refused

17. Are you aware of the Building Operators Certification offered by (name of utility) and the Northeast Energy Efficiency Partnership (NEEP)?

- Yes
- No → Read **DESCRIPTION #1** and Go to Q20
- Don't know/Refused → Read **DESCRIPTION #1** and Go to Q20

18. How did you hear about the Building Operators Certification? (Do not read choice; Write in below and record ONLY the first mention following interview).

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- a. Utility representative
- b. Utility seminar
- c. Utility mailing or advertisement
- d. Other mailing/Advertisement/Flyer
- e. Boss or co-worker
- f. Professional or trade association/Publication
- g. Conference or trade show
- h. Friend or relative
- i. Internet
- j. School/College
- k. Other, specify \_\_\_\_\_
- l. Don't know/Refused

19. Why have you decided not to participate? \_\_\_\_\_

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**Skip DESCRIPTION #1 and Go to Q20.**

**DESCRIPTION #1**

Let me tell you a little more about (name of utility)'s program.

The Building Operator Certification offers two levels of certification. Level 1 includes seven courses that cover a variety of building systems topics such as HVAC, building maintenance codes and energy conservation techniques. Courses meet for EIGHT days scattered during a SEVEN month period. You are certified after the course work is complete.

Level 2 focuses on troubleshooting systems and requires Level 1 certification.

Now that you've heard a little more about the course...

20. Would you consider going yourself or sending any of your staff to earn this Building Operators Certification?

- Yes
- No → Go to Q25
- Don't know/Refused → Go to Q25

21. Including yourself, how many staff members do you think you might send in the next 2 to 3 years?

\_\_\_\_\_

**(If Q21 = 0, Go to Q25 otherwise Go to Q33).**

22. How much would you be willing to pay for ONE staff person to attend the 8-day Building Operators Certification's seven-course training series?

AMOUNT: \$\_\_\_\_\_ Nothing/Not willing to pay → Go To Q0 Don't know/Refused

**(If Q33 is less than \$1,400, Go to Q23)**

**(If Q33 is greater than \$1,400 but less than \$1,600, Go to Q24)**

23. Would you be willing to pay \$1,400?

- Yes
- No → Go to Q25
- Don't know/Refused → Go to Q25

24. Would you be willing to pay \$1,600?

- Yes
- No
- Don't know/Refused

25. What would inspire you to participate? \_\_\_\_\_

\_\_\_\_\_

26. What would be the best way to recruit people from companies such as yours into a program such as the BOC Program? \_\_\_\_\_

\_\_\_\_\_

27. What do you think are the greatest barriers to participation in a program such as BOC for organizations such as yours?

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28. Which type of schedule would you prefer, courses that occur one day each month for several months, or courses that run for two consecutive days for fewer months?

- Single days for several months
- Two Consecutive days for fewer months

29. Finally, I'd like to ask a few questions about you and your organization only as a means of grouping your answers with those from similar respondents. How long have you been in building operations and maintenance? \_\_\_\_\_ Don't know/Refused

30. Are you a member of the International Association of Facility Managers (IFMA) or the Building Owners and Managers Association (BOMA)?

- IFMA
- BOMA
- Both
- Neither
- Don't know/Not sure/Refused

31. Are you a member of any other professional or trade association? (Ask for entire name if only initials are provided). \_\_\_\_\_

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32. Is your organization a private sector or public sector entity?

- Private
- Public
- Don't know/Refused

33. What type of business is conducted at the facility you manage? \_\_\_\_\_  
(Do not read choice; Write in below and record ONLY the first mention following interview).

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- |                   |                             |
|-------------------|-----------------------------|
| a. Government     | i. Retail                   |
| b. Grocery        | j. School/College           |
| c. Lodging        | k. Shipyard                 |
| d. Manufacturing  | l. Transportation           |
| e. Medical        | m. Wholesale or Warehousing |
| f. Military       | n. Other                    |
| g. Office         | o. Don't Know/Refused       |
| h. Public Utility |                             |

34. Do you have regular access to data on the energy consumption in your facility?

- Yes
- No

- 35. Approximately, what is the square footage of the facility area you control? \_\_\_\_\_ sq. ft.
- 36. Approximately, what is the total capacity of the heating systems under your control? \_\_\_\_\_ MMBtu
- 37. Approximately, what is the total chiller tonnage under your control? \_\_\_\_\_ tons
- 38. Approximately, what is the total tonnage of the other cooling systems under your control? \_\_\_\_\_ tons
- 39. Approximately, what is the total motor HP under your control? \_\_\_\_\_ HP
- 40. Approximately, what is the total HP of the motors on VFDs under your control? \_\_\_\_\_ HP
- 41. Approximately, what is the total air compressor HP under your control? \_\_\_\_\_ HP
- 42. Comparing this year to a year or two earlier, how has the priority for considering energy efficiency in operation and maintenance at your facility changed?
  - Stayed the same
  - Became more important
  - Became less important
  - Don't know/Refused
- 43. Respondent gender:            Male            Female