# EVALUATION OF KANSAS CITY POWER AND LIGHT'S BUILDING OPERATOR CERTIFICATION PROGRAM

**Final**

*Prepared for:*

KANSAS CITY POWER AND LIGHT

*Prepared by:*

OPINION DYNAMICS CORPORATION
230 Third Avenue
Third Floor
Waltham, MA 02451
(617) 492-1400
www.opiniondynamics.com

Contact: Bill Norton, Vice President
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# 1. EXECUTIVE SUMMARY

KCP&L, in cooperation with the Midwest Energy Efficiency Alliance (MEEA) and the Missouri Department of Natural Resources' Energy Center (MO DNR Energy Center), began offering a Building Operator Certification (BOC) program in July 2007. Between July 2007 and March 2009, four BOC Level I trainings have been offered, and 79 students have graduated from the program.

The evaluation of this program focuses on the four Level I BOC trainings offered between July 2007 and March 2009. The results of the process and impact evaluation suggest that the BOC training provides participants with actionable information regarding facility energy use, energy efficient measures, and operations and maintenance practices that can improve efficiency and save energy. Notable findings from our research are summarized below:

- Participant satisfaction with the BOC program is high: 93% rated the overall program very good or excellent.
- More than 75% of graduates believe they saved energy or reduced demand at their facilities (81%) or saved their facilities money (85%).
- Sixty-nine percent of graduates report having taken energy saving actions attributable to the program upon graduation.
- Average net energy savings as a result of the first four BOC trainings are estimated at 43,600 kWh per graduate and 0.02 kWh per graduate per square foot of building space.
- Average net demand savings as a result of the first four BOC trainings are estimated at 10.7 kW per graduate and 2.9 W per graduate per 1,000 square feet.
- Total program savings since 2007 are estimated to be 9.2 million kWh, 2,300 kW, and 35,000 therms.

Based on the findings from our evaluation activities, we recommend that KCP&L consider the following for the continued improvement of the program:

- Collect more detailed facility information from participants during the application process, including the size of the building under the direct responsibility of the participant and the types of systems the participant is responsible for.
- Use updated savings assumptions to estimate program savings.
- Seek ways to integrate cutting-edge practices and technologies into the training series.
- Continue to monitor participation levels and consider developing additional marketing strategies for upcoming program years.

# 2. Introduction and Methodology

KCP&L's BOC program began in July 2007. It is administered by MEEA and the MO DNR Energy Center. BOC is a competency-based training and certification program for operations and maintenance staff working in commercial, institutional, or industrial buildings. BOC achieves energy savings by training individuals directly responsible for the maintenance of energy-using building equipment and day-to-day building operations. Each course series takes approximately six months to complete, and enrollees receive an incentive of $575 from KCP&L if they successfully complete the training.

This report provides the findings from a process and impact evaluation of KCP&L's BOC program, led by Opinion Dynamics in partnership with Summit Blue Consulting. This evaluation is based on the following research tasks:

- A review of the program database;
- A review of program materials (i.e., the program plan, marketing materials, application form, KCP&L and MEEA's websites);
- In-depth interviews with Michelle McConnell, the KCP&L program manager, David Harrison of the MO DNR Energy Center, and Christina Pagnusat, program manager for MEEA;
- Telephone surveys with 26 program graduates; [1]
- In-depth follow-up interviews with 11 of the 26 telephone survey respondents; and
- A review of KCP&L and MEEA training evaluation forms, completed by program participants on the final day of the BOC training.

Opinion Dynamics interviewed 26 of 79 program participants that graduated from the KCP&L-sponsored BOC training. These participants completed one of the first four training sessions offered: July 2007 to January 2008, January 2008 to July 2008, May 2008 to November 2008, or September 2008 to March 2009. Phone survey respondents who reported having taken energy saving actions as a result of the BOC training were targeted with follow-up calls to collect more detailed information about their actions. Of the 26 phone survey respondents, 18 were eligible for a follow-up call (based on their energy saving actions and self-reported influence of the training), and 11 completed the follow-up interview.

[1] The telephone survey of program graduates was a census attempt. Therefore, no sampling was necessary, and standard tests of statistical significance do not apply.

Table 2-1: Program Participation July 2007-March 2009*

| Level I Session Dates | Graduates | Completed Phone Survey | Eligible for Follow-Up Interview | Completed Follow-Up Interview |
|---|---|---|---|---|
| July 2007 – Jan 2008 | 25 | 7 | 6 | 4 |
| Jan 2008 – July 2008 | 22 | 7 | 5 | 2 |
| May 2008 – Nov 2008 | 14 | 5 | 4 | 3 |
| Sept 2008 – Mar 2009 | 18 | 7 | 3 | 2 |
| TOTAL | 79 | 26 | 18 | 11 |

*Note: Program participant numbers reflect only KCP&L customers. Participants in Aquila service territory will be included in a separate evaluation effort.

The follow-up calls were used to verify information provided in the survey, identify details and circumstances not captured in the survey, and ask more detailed information about the specific actions taken and equipment affected. Based on the information collected in the follow-up calls, the Opinion Dynamics team estimated energy savings for 10 of the 11 respondents; one respondent had not taken any actions that would have resulted in energy savings.

This evaluation also draws upon surveys conducted by both KCP&L and MEEA on the last day of the training. Fifty-nine participants filled out the hard-copy survey administered by KCP&L while 87 filled out the MEEA survey. The KCP&L and MEEA surveys are used to gather participant feedback on the value of the course materials and to determine if participants have used or applied the methods or concepts taught in the courses.

# 3. Program Description and Accomplishments

## *Program Description*

The BOC program offers two levels of training and certification for building operations and maintenance professionals. Both levels are designed to improve job skills and lead to improved comfort and energy efficiency at the participant's facility or facilities. The Level I training series, which was the only one offered to KCP&L customers during the evaluation period, focuses on expanding knowledge of building systems and equipment. The Level II series provides students with experience in equipment maintenance and troubleshooting. KCP&L has subsequently offered the Level II training to its customers.

BOC Level I training consists of seven courses and covers topics related to energy transfer, air movement, heating systems and maintenance, motors, cooling, ventilation and control systems, lighting, electrical safety, environmental health, and safety and indoor air quality. The Level I curriculum is shown in Table 3-1.

**Table 3-1: Level I Curriculum**

| Course Name |
|---|
| BOC 101: Building Systems Overview |
| BOC 102: Energy Conservation Techniques |
| BOC 103: HVAC Systems and Controls |
| BOC 104: Efficient Lighting Fundamentals |
| BOC 105: Operation and Maintenance Practices for Sustainable Buildings |
| BOC 106: Indoor Air Quality |
| BOC 107: Facility Electrical Systems |

One course is held per month and each is structured to allow for lecture, work in small groups, the completion of tests and assignments, and the performance of work at one's own facility. In addition to attending classes and passing all tests and quizzes, students must complete a series of assignments specific to their facility. Projects include facility benchmarking using ENERGY STAR© Portfolio Manager and a lighting survey.

Participants who pass an exam at the end of each course and complete all coursework are eligible for certification. Level I certification must then be renewed each year by completing at least five hours of additional training. As outlined by NEEC, this training can be acquired through continued employment in the field of building operations, membership in relevant professional associations, enrollment in other courses on building operations and maintenance, or the completion of an energy efficiency project at one's facility among other actions.[2]

[2] Midwest Energy Efficiency Alliance. Certification Renewal Policy. http://www.boccentral.org/image/uploads/documents/BOC_Certification_Renewal_Application.pdf

KCP&L, MEEA, and the MO DNR implement the BOC Program in partnership. The MO DNR Energy Center is the BOC program administrator for the State of Missouri and is responsible for coordinating the training series schedule, securing classrooms, finding instructors, and generally managing program delivery. MEEA is the regional coordinator for the program. In this role, MEEA provides online registration for students, oversees the instructor recruitment process, and provides education materials to the MO DNR for distribution to instructors and students. Materials for the training series are licensed by MEEA from the Northwest Energy Efficiency Council (NEEC). MEEA also supplies a list of certified building operators to the Northwest Energy Efficiency Council (NEEC).

In its role as the program sponsor, KCP&L representatives attend training sessions, track progress, and issue tuition rebates to graduates. The rebate of $575 helps enrollees from customer facilities offset the cost of the training, which is currently $1,150. KCP&L also organizes a graduation ceremony for graduates of the program, a unique practice among utilities in the region.

Program marketing is done by both KCP&L and MEEA. The main channels by which customers have been informed about the program are KCP&L Energy Consultants, bill inserts, and newsletters such as Energy Talk. MEEA also raises awareness of the program by maintaining a presence at various conferences and events throughout the region. The organization also maintains the www.boccentral.org website, which contains course information and additional operations and maintenance resources.

## Reach of the Program

To date, KCP&L has offered four Level I trainings to their customers. The first Level II training began in May 2009. The program exceeded its participation goals in all Program Years. During the study period, all courses were held at the Discovery Energy Center, which is operated by the MO DNR. Table 3-2 provides the program goals and number of enrollees during each of the program years included in the evaluation period.

**Table 3-2: Level 1 Program Goals and Performance**

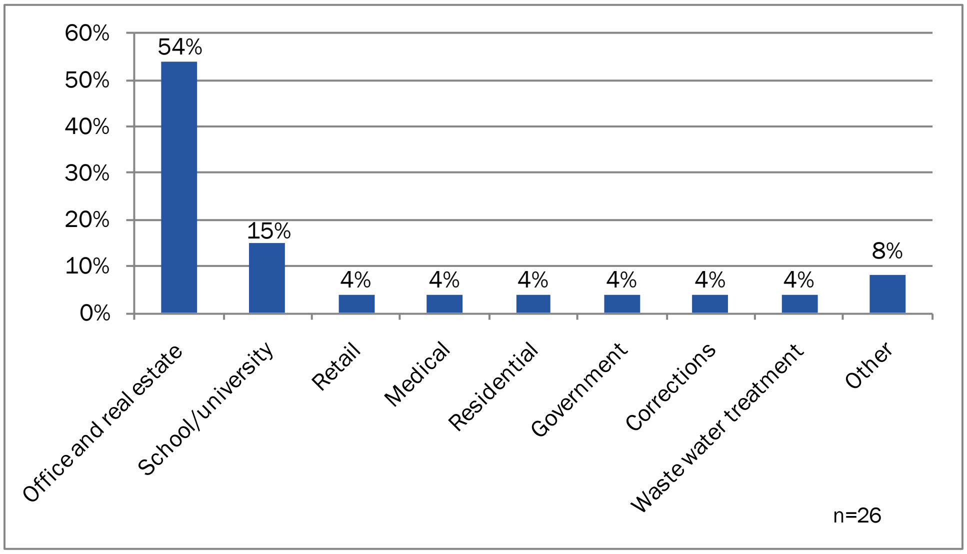
| Program Year | No. of Training Series | | Enrollment Numbers | |
|---|---|---|---|---|
| | Goal | Actual | Goal | Actual |
| 2007 | 1 | 1 | 20 | 26 |
| 2008 | 2 | 3 | 40 | 63 |
| 2009 | 1 | 1 | 20 | 21 |
| Total | 4 | 5 | 80 | 110 |

Note: Goals are drawn from a combination of the 2006 and 2009 Program Plans, in addition to interviews with program staff. Actual enrollment figures come from KCP&L and MEEA program tracking data. Not all enrolled participants completed the course; therefore the number of graduates is smaller than the number of enrolled participants.

Seventy-nine KCP&L customers graduated from the BOC Program by the end of the study period. In a number of cases, employers sent more than one employee to participate in the training. As a result, a total of 38 unique companies and organizations benefited from the program through the graduation of their employees.

As shown in Figure 3-1, the program's reach also extends to a variety of facility types, with the majority of participants working in offices (46%) and institutions of primary and secondary education (15%). The average amount of facility space that program graduates are responsible for is approximately 786,000 square feet.

**Figure 3-1: Participant Facility Types**




There is also a range of experience among graduates. Although almost half (46%) have worked in their current role for between five and ten years, 25% are in their first five years on the job, and 23% have been in their position for eleven to twenty years. In addition, while BOC graduates hold a variety of different job titles, 38% serve in a managerial capacity as their employers' operations, facility, or maintenance manager. Another 35% of graduates are engineers or engineer managers. A few individuals have specialized training in electrical or HVAC systems.

## Actions Taken

Of the 26 graduates who participated in the telephone survey, 18 reported that the training influenced them to complete energy efficiency projects or change the manner or frequency with which they perform maintenance on key building systems. Actions taken range from the installation of efficient lighting and other equipment to water conservation. Graduates who implemented projects or changed maintenance practices took an average of three actions as a result of the training.

As described in more detail below, the first four BOC trainings resulted in average energy savings of 43,600 kWh per graduate and 0.02 kWh per graduate per square foot of building space. Average net demand savings are estimated to be 10.7 kW per graduate and 2.9 W per graduate per 1,000 square feet.

# 4. PROCESS EVALUATION

The process evaluation included two key research activities: (1) a quantitative phone survey with BOC training graduates and (2) a review and synthesis of course evaluation forms completed by BOC participants and administered by MEEA and KCP&L. The following two subsections describe our findings from these two activities.

## 4.1 Participant Survey

As described earlier, the participant survey included 26 of 79 program participants that graduated from the KCP&L-sponsored BOC training. These participants completed one of the first four Level I training sessions offered:

- July 2007 to January 2008
- January 2008 to July 2008
- May 2008 to November 2008
- September 2008 to March 2009

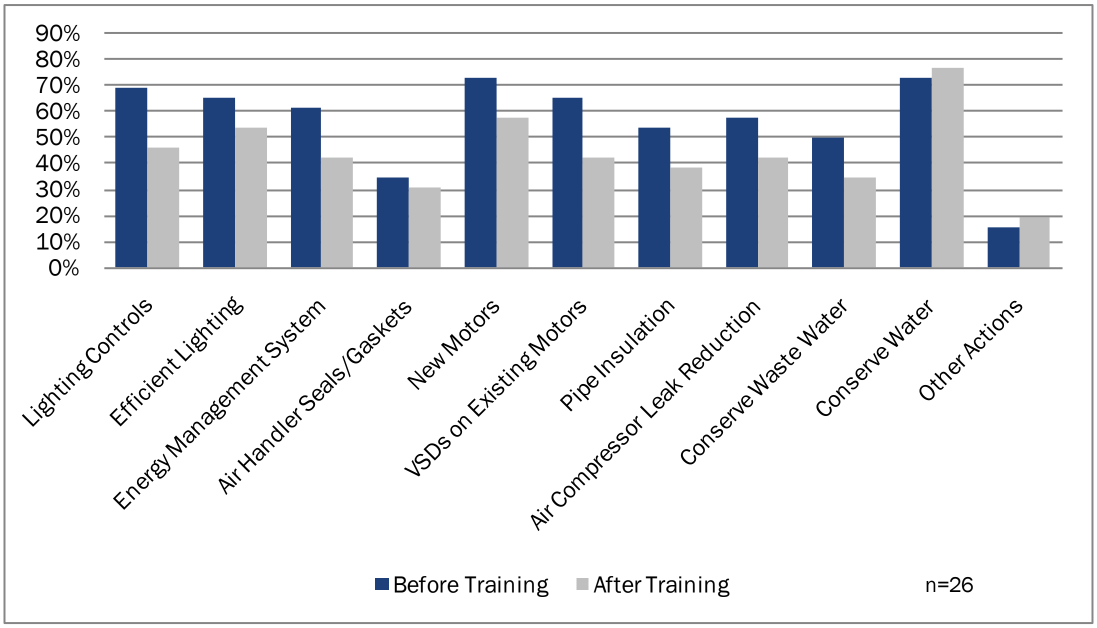
The participant survey collected information about energy savings activities conducted at participants' buildings before and after the BOC training and also included questions about benefits of the training, barriers to participation in the training and in implementing energy efficient actions, and best ways for program outreach.

### 4.1.1 Energy Saving Actions

Before completing the BOC training, a sizable percentage of students took energy saving actions at their facilities. The most frequent actions include installing new motors (73%), conserving water (73%), installing lighting controls (69%) or efficient lighting (65%), and installing variable speed drives (VSDs) on existing motors (65%). Many graduates also performed these activities after taking the training. Figure 4-1 summarizes those actions taken by the surveyed graduates.

Given the nature of the energy saving actions taken (in many cases, they only need to be completed every few years) and the relatively short amount of time between the BOC training and the survey, it is not surprising that graduates report more pre-training than post-training activities. Overall, 27% of graduates performed at least one energy saving action after the training that they had not already performed before; 15% performed two new actions post-training.

**Figure 4-1: Percent of Graduates Taking Various Energy Efficiency Actions Before and After the BOC Training**




### 4.1.2 Benefits of BOC Training

Many graduates report that the BOC training has helped them save their facility money (85%) and energy (81%), enhance occupant comfort (69%), and improve air quality (50%). Graduates working in offices (92%) and educational institutions (100%) are significantly more likely to say they have saved energy or reduced demand than their colleagues at other types of facilities (60%). Monetary savings are most commonly reported by schools and universities (100%) compared to offices (92%) and other facilities (70%).

Graduates were also asked if the training had any benefits on their own professional development. Considerably fewer graduates report changes in their job responsibilities (35%), their compensation (19%), or their job title (0%) since completing the training. Of those who do report these changes, most (80%) credit the BOC training with helping to bring about the changes.

Table 4-1 summarizes these findings.

**Table 4-1: Benefits of BOC Training**

| Benefits | Percentage of Respondents (n=26) |
|---|---|
| As a result of participating in the BOC training program, have you… | |
| saved your facility money? | 85% |
| saved energy or reduced energy demand at your facility? | 81% |
| enhanced occupant comfort? | 69% |
| improved indoor air quality? | 50% |
| Since completing the BOC training program… | |
| have your job responsibilities changed or increased? | 35%* |
| has your compensation increased? | 19%* |
| has your job title changed? | 0% |

*80% of graduates who report a change credit the BOC training with helping to bring about the change.

When asked about the magnitude of perceived savings at their facilities, few graduates were able to quantify energy (38%) or monetary (27%) savings as a result of taking the BOC training. Among those who could provide an estimate, approximately three quarters saved between 1% and 10% of their energy bill and half saved between $1,000 and $4,999.

### 4.1.3 Barriers to Participation and Energy Efficiency Improvements

BOC program graduates consider finding the time (46%) and the monetary resources (38%) the most significant barriers to participating in the BOC training. Several graduates also mentioned internal human resource issues such as restrictions on staff members, as well as the need to get approval and support from their supervisor.

Financing is also the single largest barrier (46%) associated with the implementation of operations and maintenance improvements at graduates' facilities. This obstacle is particularly acute among facilities that do not serve as offices or educational institutions (70%). Individual graduates also cite time constraints, lack of support from their management, and the absence of appropriate situations as barriers to implementing energy efficiency projects.

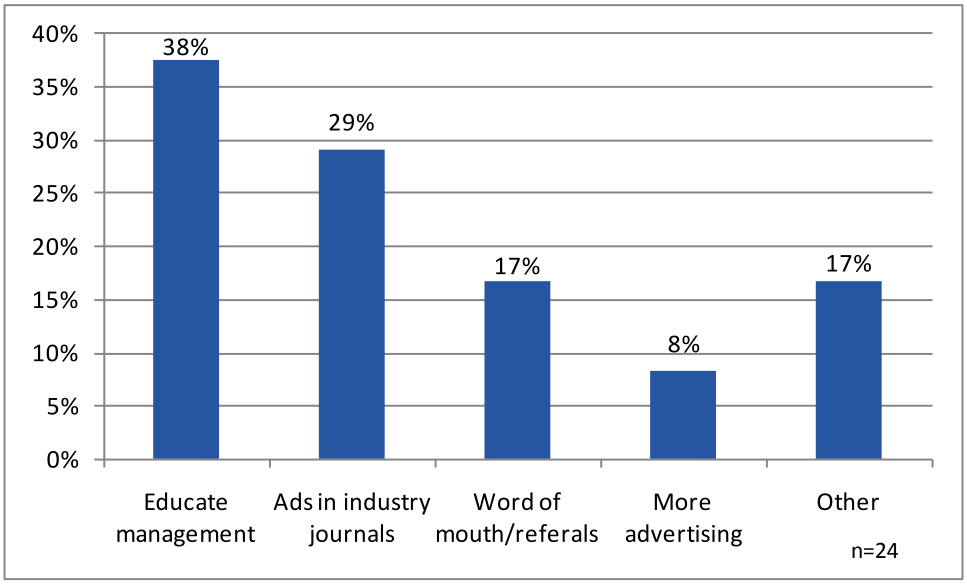
### 4.1.4 Program Outreach

Formal and informal professional networks are important channels for distributing information about the program. Thirty-eight percent of BOC graduates feel the best way to recruit future students is by educating their management about the program. Informal networks of past participants are also an important driver of program awareness. Not only do 17% of graduates think that informing people about the program by word of mouth and referrals is a good idea, 77% have recommended the BOC program to colleagues.

An additional 29% of graduates think advertising the program in industry journals is an effective way to attract participants. This approach is particularly popular among professionals who have been in the industry for less than five years (43%) and between five and ten years (25%) suggesting that industry journals have potential in terms of recruiting BOC enrollees that are newer to the field and may have a lot to learn in terms of energy efficiency practices.

Two graduates (8%) spoke more generally about increasing advertising for the program. Other suggestions related to participant recruitment included employer requirements that their staff receive certification (8%). Figure 4-2 presents graduate suggestions on how best to recruit program participants.

**Figure 4-2: The Best Way to Recruit Participants to the Program**
**(Multiple response; of graduates providing a response)**




## 4.2 KCP&L and MEEA Course Evaluations

This section summarizes results from the course evaluation forms administered by KCP&L and MEEA on the last day of the BOC training series. Fifty-nine participants filled out the hard-copy KCP&L evaluation form and 87 filled out the MEEA survey. The number of responses to the various questions varies, however, given that not all participants answered all of the questions contained in the evaluation forms. The questions contained in these documents are included in Appendix C.

### Sources of Information about the Program

The MEEA survey found that many participants find out about the program from their employers or supervisors (42%). In addition, 29% of participants learned about the program from KCP&L, with 5% getting the information directly from an account representative.

### Satisfaction and Recommendations

Satisfaction with the program among enrollees is high as indicated by the 54% percent of participants that rated the overall program “excellent”. Course instructors, materials, and facilities also received high marks.

**Table 4-2: Course Component Ratings**

| Rating | Overall Program (n=80) | Instructors (n=80) | Course Materials (n=80) | Facilities (n=80) |
|---|---|---|---|---|
| Excellent | 54% | 39% | 36% | 65% |
| Very good | 39% | 54% | 50% | 34% |
| Good | 6% | 6% | 11% | 1% |
| Fair | 1% | 1% | 3% | - |

Source: MEEA Evaluation Forms.

Among those who provided specific suggestions for improving the BOC program, 37% recommended more hands-on activities, 14% felt that course materials such as text books, needed to be updated or improved.

## Post-Training Activities

The KCP&L end-of-training surveys assess the actions that participants have taken or plan to take based on the knowledge acquired through the program. Based on these surveys, 80% of participants indicate that they used or applied concepts learned through their training. When asked specifically if they had taken new operations and maintenance (O&M) actions as a result of the training, 53% said yes and another 6% mentioned that they plan on doing so in the future. Replacing old equipment with newer and more energy efficient equipment was the most frequently cited O&M change that participants listed as a result of the training series.

Program participants were also asked to rate their agreement or disagreement with a list of statements about potential outcomes from completing the BOC training series. The following table presents the percentage of participants who strongly agree with each statement (a rating of 8 or higher on a 10-point scale). As expected, gains in knowledge are the most prominent outcomes followed by the ability to play a concrete role in project decision making.

**Table 4-3: Participant Reporting of Select Training Outcomes**

| As a result of the training… | Percentage that strongly agree* |
|---|---|
| I have increased my knowledge of how I can use energy efficiency measures and occupational practices to reduce energy expenses. (n=20) | 90% |
| I have increased my knowledge of what to look for when repairing or replacing equipment. (n=21) | 86% |
| I have increased my knowledge of how to calculate the payback of energy savings associated with purchasing options. (n=21) | 71% |
| I have undertaken, recommended or influenced energy efficiency projects at my facility. (n=52) | 71% |
| I have increased my knowledge of equipment operations or replacement. (n=57) | 67% |

| As a result of the training... | Percentage that strongly agree* |
|---|---|
| I have or will be able to create reports for management that justify energy efficiency capital expenses intended to produce O&M savings. (n=21) | 62% |
| I have or will be able to save my facility money. (n=54) | 59% |
| I have or will be able to save energy or reduce energy demand at my facility. (n=53) | 57% |
| I have had or anticipate having more productive interaction with contractors. (n=51) | 55% |
| I have or will be able to enhance the comfort of the facilities' occupants. (n=54) | 41% |

Source: KCP&L Post-Training Survey.

*Note: Percentages represent scores of 8, 9 or 10 on a 10-point scale.

# 5. Impact Evaluation

A three-step process was used to estimate the energy savings associated with the BOC program.

1. The Opinion Dynamics Team computed gross kWh, kW, and therm savings for each action at the 10 sites that reported energy saving actions during the call-back interviews (the sample).
2. Gross savings were converted into net savings by taking into the account the level of influence of the BOC training on the actions taken.
3. Total savings from the 10 sites were extrapolated to the broader participant population and used to compute a range of representative statistics.

This remainder of this section describes the impact estimate approach and summarizes the results of the analysis.

## 5.1 Gross Savings for Sample

Gross savings are first calculated for specific energy saving actions undertaken by the 10 sample sites. These figures are then aggregated to the site level. The following two subsections present these calculations.

### 5.1.1 Gross Savings for Specific Actions

The 10 graduates who reported energy saving actions during the call-back interviews identified 14 different energy and demand saving actions (measures) that were at least partially influenced by the BOC training.[3]

Table 5-1 lists the actions taken as a result of the BOC training, the number of respondents who took each action, and the estimated gross savings.

[3] Respondents were asked to rate the influence of the BOC training on each action taken, on a scale of 0 to 10. Actions with an influence rating of less than 3 are assumed to be only marginally influenced by the BOC training; no savings are credited to the program for these actions. See also discussion in Section 5.2.

**Table 5-1: Summary of Energy Saving Actions of Sample Sites**
**(based on Follow-up Interviews)**

| Action | # of Respondents with Action | Gross Savings | | |
|---|---|---|---|---|
| | | kWh | kW | therms |
| Equipment Installations | | | | |
| 1. Lighting Controls | 2 | 11,444<br>14,472 | -<br>3 | -<br>- |
| 2. Energy Efficient Lighting | 3 | 12,400<br>34,587<br>8,224,834 | 4<br>10<br>2,146 | (24)<br>-<br>(8,367) |
| 3. High Efficiency Motors | 2 | 20,265<br>33,775 | 4<br>7 | -<br>- |
| 4. Variable Speed Drive Controls | 1 | 24,056 | 5 | 1 |
| 5. Air Handler Seals | 2 | 62,103<br>20,024 | 36<br>5 | 789<br>- |
| 6. Insulated Pipes | 1 | 3,620 | 1 | 4,124 |
| O&M Changes | | | | |
| 7. Conserved Water Resulting in Energy Savings | 1 | - | - | 58 |
| 8. Improved Maintenance on Cooling Equipment | 3 | 4,820<br>187,153<br>411,500 | 4<br>1<br>179 | -<br>-<br>- |
| 9. Improved Maintenance on Heating Equipment | 2 | 5,957<br>411,500 | -<br>179 | 15,180<br>- |
| 10. Improved Motor Maintenance | 1 | 40,691 | 8 | - |
| 11. Improved Air Compressor Maintenance | 3 | 15,895<br>31,790<br>2,116 | 5<br>10<br>2 | -<br>-<br>- |
| 12. Improved Air Handler Maintenance | 2 | 86,944<br>282,797 | 38<br>- | 1,105<br>- |
| 13. Improved Lighting Controls Maintenance | 3 | 9,000<br>656,320<br>22,500 | -<br>168<br>4 | -<br>-<br>- |
| 14. Adjusted HVAC or EMS Controls | 2 | 205,750<br>3,338 | -<br>- | -<br>118 |

## Savings Calculations

The Opinion Dynamics team used a variety of resources, combined with engineering analyses, to estimate energy and demand impacts for the various actions taken by the sample sites. Although not the focus of this evaluation, natural gas savings were included in the analyses where appropriate.

- Baseline lighting and HVAC load intensities (kWh and therms) were primarily determined from the Commercial Buildings Energy Consumption Survey (CBECS)[4] and adjusted to match the specifications of individual sites.
- The ratio of energy savings to demand savings (kWh/kW) for specific end-uses were estimated based on baseline energy savings to demand savings from the California Commercial End-Use Survey (CEUS);[5] data of this type for the KCP&L territory was not available.
- Secondary literature and the Database of Energy Efficiency Resources (DEER)[6] were used to estimate energy savings from non-weather sensitive measures such as lighting and lighting controls (adjusted by interaction factors appropriate to the Kansas City climate).
- Engineering analysis was used directly to estimate energy savings from motor and compressed air measures.

The following subsections describe the savings estimate approach for each of the 14 actions identified in the follow-up interviews.

### *Installed Lighting Controls*

Two graduates reported installing occupancy sensors; one in lobby and office space and the other in office space. The following parameter values were assumed:

- *Post-measure Lighting Intensity (kWh/sq. ft)* - the average CBECS lighting intensity for 1970s vintage office spaces in the West North Central Division (Division 4, which includes the KCP&L territory) was assumed post-measure. A lighting intensity of 2/3 of the CBECS average was used for lobby spaces.
- *Pre-measure Lighting Intensity (kWh/ sq. ft)* – Open-ended responses of the graduates were used to estimate the percentage lighting on-time reduction (and therefore lighting intensity reduction). For one participant, lighting reductions of 50% (lobby spaces) and 35% (office spaces) were assumed; for the other, lighting reductions of 15% (office spaces) were assumed.
- *Ratio of energy (kWh) to demand (kW) savings* – Open-ended responses of the graduates were used to estimate the ratio of energy to demand savings. One participant stated that savings were primarily after business hours; no demand savings were attributed to this respondent. The other respondent stated that much of the savings came during business hours; for this respondent, the DEER ratio of kW to kWh savings for similar measures in office buildings of this vintage was used, but scaled down by a 0.85 coincidence factor (DEER values are non-coincident peak) and

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[4] Commercial Buildings Energy Consumption Survey 2003, Public Use Microdata, U.S. Department of Energy, Energy Information Administration. http://www.eia.doe.gov/emeu/cbecs/contents.html

[5] California Commercial End-Use Survey (CEUS), sponsored by the California Energy Commission. Results from the Sacramento region were used (primarily for kWh/kW ratios). Sacramento was chosen for its similarity in proportion of cooling and heating seasons.

[6] Database for Energy Efficient Resources, sponsored by the California Energy Commission and California Public Utilities Commission. http://www.energy.ca.gov/deer/

scaled up by 1.1 interaction factor to account for cooling savings from reduced internal loads.

For these measures, energy savings were taken as the difference in post-measure and pre-measure lighting intensities, multiplied by the number of square feet affected. Demand savings were taken as the product of energy savings and the demand to energy savings ratio.

### *Installed Energy Efficient Lighting*

Three graduates reported replacing existing lighting with more energy efficient lighting; the retrofits reported were incandescent to CFL and T12/magnetic ballast linear fluorescent to T8/electronic ballast linear fluorescent.

- *Percentage load reduction* – this was determined from DEER
- *Ratio of kW to kWh savings* – this was determined from DEER
- *Ratio of therm savings to kWh savings* – this was determined from DEER
- *Pre-measure Lighting Intensity (kWh /sq. ft)* – lighting intensities from CBECS were used and were adjusted to account for less than average efficiencies of incandescent lamps.
- *Pre-measure Lighting Intensity (kWh /sq. ft)* – For one respondent who reported replacing incandescent lamps with CFLs in 10,000 square feet of corridor space, the following algorithm was used to estimate baseline lighting intensity:

$$Intensity = \frac{W / fixture}{lumens / fixture} \times \frac{FC \times Oversize}{CU \times LLF}$$

Where:

- *Intensity* is the lighting energy intensity (kWh/sq. ft.)
- *W/fixture* is the watts per fixture (60)
- *Lumens/fixture* is the lumens per fixture (1500)
- *FC* is the foot candle specification recommended by IESNA for public spaces (3)
- *Oversize* is the ratio of recommended to actual brightness (based on respondent claims)
- *CU* is the coefficient of utilization (assumed 40%)
- *LLF* is the light loss factor (assumed 75%)

Energy savings were then calculated as the product of pre-measure intensity, percentage load reduction, and square feet of affected floor space. kW and therm savings were calculated as the product of energy savings and kW/kWh and kW/therm ratios, respectively.

## Installed High Efficiency Motors

Two respondents stated that, as a result of the training, they now specify high-efficiency motors, rather than standard efficiency motors when purchasing new motors. Energy savings for this measure were computed from the following equation:

$$kWh = HP * EFLH * \left(\frac{kW}{HP}\right) * \left(\frac{1}{\eta_{standard}} - \frac{1}{\eta_{high}}\right)$$

Where

- *kWh* is the annual kWh savings
- *EFLH* is the equivalent full load hours of the motor (4000, based on respondent applications and U.S. DOE guidelines[7])
- *kW/HP* is the conversion factor from HP to kW
- $\eta_{standard}$ is the motor efficiency of a new standard efficiency motor. (0.93, U.S. DOE guidelines)
- $\eta_{high}$ is the motor efficiency of a new high-efficiency motor. (0.95, U.S. DOE guidelines)

Demand savings were then calculated using the following equation:

$$kW = \frac{kWh}{EFLH} * Coinc$$

Where *Coinc* is the coincidence factor, here assumed to be 80%.

## Installed Variable Speed Drive Controls

One respondent reported installing variable speed drives on air handler fan motors and on hot water and chilled water pump motors. DEER 2005 energy (962 kWh per HP), demand (0.211 kW per HP), and gas (0.027 therms per HP) savings for variable frequency drives on variable air volume fans (Measure ID D03-051) for office buildings were assumed for this measure.

## Replaced Air Handler Seals

Two respondents reported being more diligent about maintaining air handler seals and gaskets. The measure was assumed to reduce entire HVAC loads by 2% relative to baseline (from CBECS, kWh/kW ratios from DEER) loads.[8] One of the two respondents had more

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[7] U.S. Department of Energy, Energy Efficiency and Renewable Energy, Federal Energy Management Program website. http://www1.eere.energy.gov/femp/technologies/technologies.html

[8] Conservative estimate based on Piper, J., "HVAC Maintenance and Energy Savings", Building Operating Management, March 2009, http://www.facilitiesnet.com/hvac/article/HVAC-Maintenance-and-Energy-Savings--10680.

detailed information about the motor sizes and usage hours; the following equation was used for this respondent.

$$kWh = HP * EFLH * \frac{kW}{HP} * \frac{1}{\eta} * SavingsPercent$$

Where

- *kWh* is the annual energy savings
- HP *is the combined horsepower of the fan motors in the air handler*
- *kW/HP* is the ratio of kW to HP
- $\eta$ is the motor efficiency (0.88, assumed)
- *SavingsPercent* is the estimated savings, as a percent of baseline load.

### Insulated Pipes

Two respondents reported insulated chilled and/or hot water pipes. The thermal energy transfer simulation software 3E Plus was used to determine the heat gain (chilled water) and heat loss (hot water) per foot of insulated and uninsulated pipe, assuming typical chilled and hot water loop temperatures and ambient temperatures. Coincident peak demand savings were computed for chilled water pipes assuming that the difference between chilled water and ambient temperatures was three times as great at system peak times (ΔT = 60 °F) as at the annual average temperature(ΔT = 60 °F).

### Conserved Water Resulting in Energy Savings

One respondent claimed hot water savings from fixing minor plumbing leaks. The estimated hot water savings from this measure were 1% of the baseline hot water load. Baseline hot water loads were determined by multiplying the respondent's estimate of annual natural gas consumption by the ratio of hot water to total natural gas consumption for similar buildings (schools, 0.26) in the Commercial End-Use Survey.[9]

### Improved Maintenance on Cooling Equipment

Three respondents reported improved cooling equipment maintenance practices such as replacing filters and cleaning coils. Baseline cooling loads were determined from CBECS. The ratio of kW to kWh savings was determined from DEER. Energy savings from this action were assumed to be 2.5% of baseline cooling loads.

[9] California Commercial End-Use Survey (CEUS), sponsored by the California Energy Commission. Results from the Sacramento region were used (primarily for kWh/kW ratios). Sacramento was chosen for its similarity in proportion of cooling and heating seasons.

## Improved Maintenance on Heating Equipment

Two respondents reported improved heating equipment maintenance practices. One respondent reported generally improved heating equipment maintenance; 2.5% savings from baseline heating load were assumed. The other respondent underwent a thorough optimization of the building heating system and observed a 40% reduction in natural gas consumption. The reported savings were used as the gas savings estimate.

Furthermore, this second respondent noted that the improved heating system no longer resulted in certain areas receiving too much heat; some occupants had responded to overheating by turning on window air conditioning units (although most simply opened windows). Therefore, electricity savings from reduced winter air conditioning were also computed. Five percent of the thermal load reduction was assumed to have been previously removed by window air conditioning units, and the units were assumed to have a coefficient of performance of 2.8. The electricity savings were computed from the following equation:

$$kWh = \frac{therms * \eta_{boiler} * ACFraction}{COP}$$

Where

- *kWh* is the annual kWh savings
- *Therms* is the annual natural gas savings
- $\eta_{boiler}$ is the thermal efficiency of the boiler (assumed 0.80)
- *ACFraction* is the fraction of excess heat that was removed by air conditioning (5%)
- *COP* is the coefficient of performance of the window units (2.8)

## Improved Motor Maintenance

One respondent reported improved motor maintenance as a result of the training. The following equation was used to estimate energy savings from this measure:

$$kWh = HP * EFLH * \left(\frac{kW}{HP}\right) * \left(\frac{1}{\eta}\right) * SavingsPercent$$

Where

- *kWh* is the annual kWh savings
- *HP* is the total HP of affected motors
- *EFLH* is the equivalent full load hours (4000 hours, based on respondent application and U.S. DOE guidelines)
- *kW/HP* is the conversion factor from HP to kW (0.745)
- $\eta$ is the motor efficiency of a typical motors (0.88, estimate)

- *SavingsPercent* is the assumed percentage savings over baseline consumption from improved motor maintenance practices (1%)[10]

### Improved Air Compressor Maintenance

Three respondents reported reducing leaks in air compressor systems. This was assumed to reduce motor loads by 5%.[11] The following equation was used to estimate energy savings from this measure:

$$kWh = HP * EFLH * \left(\frac{kW}{HP}\right) * \left(\frac{1}{\eta}\right) * SavingsPercent$$

Where

- *kWh* is the annual kWh savings
- *HP* is the total HP of affected compressor motors
- *EFLH* is the equivalent full load hours (2000 to 2500 hours, based on respondent application and U.S. DOE guidelines)
- *kW/HP* is the conversion factor from HP to kW
- $\eta$ is the motor efficiency of a typical motors (0.88, estimate)
- *SavingsPercent* is the assumed percentage savings over baseline consumption from minor leak reduction (5%)

These systems were assumed to run consistently throughout the year; therefore demand savings were computed by dividing the kWh savings by EFLH.

### Improved Air Handler Maintenance

Two respondents reported improving air handler maintenance. Energy savings of 1% over baseline loads were assumed.[12] Baseline intensities (kWh/square foot and therms/square foot) were determined from CBECS and square footage affected was specified by the respondents. The ratio of kWh to kW for air handler loads was obtained from CEUS.

### Improved Lighting Controls Maintenance

Three respondents reported improved maintenance of lighting controls. Two identified a specific application: adjusting timeclocks in a parking garage and replacing malfunctioning

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[10] Drivepower Technology Atlas (Volume IV), eSOURCE. This reference indicates that optimal operations and maintenance practices can save 3 to 10% of all drive power, compared to very poor maintenance practices.

[11] EnergyStar, U.S. Department of Energy and U.S. Environmental Protection Agency. This reference indicates that 20 to 30% of a compressor's output may be wasted by leaks. All respondents indicated that the leaks that they repaired were relatively minor. http://www.energystar.gov/ia/business/industry/compressed_air3.pdf

[12] Conservative estimate based on Piper, J., "HVAC Maintenance and Energy Savings", Building Operating Management, March 2009, http://www.facilitiesnet.com/hvac/article/HVAC-Maintenance-and-Energy-Savings--10680.

photocell controls on street lights. One respondent reported a more general improvement in maintaining lighting controls.

For the parking garage, the following savings calculation was used:

$$kWh = PowerDensity * CarArea * CarCapacity * SavingsPercent$$

Where

- *kWh* is the annual energy savings
- *PowerDensity* (W/square foot) is the International Energy Conservation Code (IECC) maximum for parking structures (0.3),
- *CarArea* is the estimated garage square footage per car (300, based on literature review)
- CarCapacity is the capacity of the parking garage
- *SavingsPercent* is the percentage energy savings (determined in the follow-up interview).

No demand savings were assumed from this measure because the controls adjustment only affected night-time lighting.

For the street light photocells, the following savings calculation was used:

$$kWh = Lamps * Wattage * Hours$$

Where

- *kWh* is the annual energy savings
- *Lamps* is the number of lamps affected (stated by the respondent)
- *Wattage* is the estimated wattage per fixture (300 W, assumed, based on a 250 W cobra style high pressure sodium street light with ballast).
- *Hours* is the estimated number of unnecessary hours that the fixtures were on prior to repair/replacement.

Demand savings for this respondent were calculated using the percentage of lights that the respondent estimated were on during peak hours prior to sensor repair/replacement, the lamp count that the respondent stated, and the 300W fixture assumption used above.

For the respondent who reported general lighting controls maintenance, a 2.5% savings over baseline lighting intensity (CBECS data) was used.

## Adjusted HVAC or EMS Controls

Two respondents reported adjusting HVAC or EMS setpoints. One respondent reported modifying controls to perform building pre-cooling in the morning, using ventilation (outside air). The other respondent reported modifying setpoints to avoid simultaneous heating and cooling of air during spring and fall seasons.

For building outside air pre-cooling, a 5% savings over baseline cooling and ventilation loads (CBECS intensities used) was assumed.[13] No demand savings were assumed, as this measure did not affect summer peak-time loads.

For avoiding simultaneous heating and cooling, an annual savings of 1.5% over baseline loads (from CBECS) was assumed. This percentage savings is approximately equal to the savings seen from similar measures in the DEER database.

### 5.1.2 Gross Savings for Sample Sites

Savings from the specific actions reported by the respondents to the follow-up survey were aggregated to the site level. A total of 10 graduates reported having taken energy saving actions at least partially influenced by the training. In two cases, the call-back interviews were conducted with respondents working on the same site or suite of buildings. To avoid double-counting of energy savings, we aggregated the reported actions and savings into a single site-wide analysis (see Sites 1 and 4 in Table 5-2 below). As a result of this aggregation, savings were computed for eight unique sites.

In addition, our interview with Site 6 revealed that 12 other employees from the same company and location had graduated from one of the four BOC trainings and that the actions reported by the Site 6 respondent were carried out by all 13 graduates collectively.[14] To account for this overlap among the graduates and to avoid double-counting, total site savings were divided by 13 when calculating savings per graduate and savings per square foot per graduate for this site.

The following metrics were computed (separately for kWh, kW, and therm savings) for each of the eight sites.

- **Estimated Savings** – This metric represents the total savings at a site.
- **Savings per graduate** – This metric estimates savings per graduate at a site, taking into account instances where more than one program graduate works at the same site.
- **Savings per square foot per graduate** – This metric provides a normalized savings estimate, accounting for both the size of the participant building and the number of program graduates from the site. This metric is useful for comparing program results to baseline energy intensities or regional savings potential estimates, which are typically reported as savings per area. This is the most accurate metric to use for extrapolation of savings to the population as well as a default value to apply to future program participants. (KCP&L is currently collecting all inputs for this metric.)

We also computed a weighted average of savings per graduate (weighted by the number of graduates at the site) and savings per square foot per graduate (weighted by the square footage of the site as well as the number of graduates).

[13] "Using Off-Peak Precooling", Kurth Roth, John Dieckmann, and Jamred Brodrick. ASHRAE Journal, March 2009.

[14] The interviewee is the manager of the other 12 participants. After taking the BOC training himself, he decided to send his employees to the training as well.

Table 5-2 summarizes the results of these calculations.[15]

**Table 5-2: Gross Savings by Sample Site**

| Site | Square Feet | Graduates at Site | Estimated Savings | Savings/ Graduate | Savings/Sq Ft/ Graduate |
|---|---|---|---|---|---|
| Energy Savings (KWh) | | | | | |
| 1 | 7,000,000 | 2 | 468,323 | 234,162 | 0.03 |
| 2 | 4,000,000 | 1 | 31,790 | 31,790 | 0.01 |
| 3 | 64,000 | 1 | 10,777 | 10,777 | 0.17 |
| 4 | 750,000 | 2 | 306,641 | 153,320 | 0.20 |
| 5 | 2,275,000 | 1 | 187,153 | 187,153 | 0.08 |
| 6 | 4,000,000 | 13 | 1,479,320 | 113,794 | 0.03 |
| 7 | 100,000 | 1 | 81,753 | 81,753 | 0.82 |
| 8 | 750,000 | 1 | 49,059 | 49,059 | 0.07 |
| | | | Weighted Average | 118,855 | 0.035 |
| Demand Savings (KW; W/1,000 Sq.Ft./Graduate) | | | | | |
| 1 | 7,000,000 | 2 | 97.5 | 48.8 | 7.0 |
| 2 | 4,000,000 | 1 | 10.2 | 10.2 | 2.5 |
| 3 | 64,000 | 1 | 4.5 | 4.5 | 69.7 |
| 4 | 750,000 | 2 | 3.7 | 1.9 | 2.5 |
| 5 | 2,275,000 | 1 | 0.7 | 0.7 | 0.3 |
| 6 | 4,000,000 | 13 | 526.0 | 40.5 | 10.1 |
| 7 | 100,000 | 1 | 17.2 | 17.2 | 171.9 |
| 8 | 750,000 | 1 | 12.5 | 12.5 | 16.6 |
| | | | Weighted Average | 30.6 | 7.2 |
| Gas Savings (Therms) | | | | | |
| 1 | 7,000,000 | 2 | 6,019 | 3,010 | 0.43 |
| 2 | 4,000,000 | 1 | - | - | - |
| 3 | 64,000 | 1 | 15,238 | 15,238 | 238.10 |
| 4 | 750,000 | 2 | (24) | (12) | (0.02) |
| 5 | 2,275,000 | 1 | - | - | - |
| 6 | 4,000,000 | 13 | - | - | - |
| 7 | 100,000 | 1 | 118 | 118 | 1.18 |
| 8 | 750,000 | 1 | - | - | - |
| | | | Weighted Average | 971 | 0.97 |

[15] Note that the estimated savings for Site 1 exclude one large lighting retrofit project. This project was considered unusual and is therefore presented separately in the discussion of program savings (see Section 5.4).

## 5.2 Net Savings for Sample Sites

Gross savings represent the savings from actions taken after the BOC training, but do not take into account the level of influence that the BOC training had on these actions.

As a result, respondents were asked to rate the influence of the BOC training on each action taken, using a scale of 0 to 10, where 0 means no influence and 10 means great influence. Actions with an influence rating of less than 3 (i.e., 0, 1, or 2) are assumed to be only marginally influenced by the BOC training; therefore, no savings are credited to the program for these actions.[16] For actions with ratings of 3 or greater, the percentage of savings attributed to the training was estimated to be ten times the stated influence score. For example, if a respondent assigned an influence score of 6 to a particular action, then 60% of the gross savings from that action were attributed to the training and credited to the BOC program.

Net impacts were calculated by multiplying gross impacts by the influence percentage. That is, the net impact of the program on a particular action ("i") for a particular respondent ("s") was computed as:

$$Net\ Savings_{i,s} = Gross\ Savings_{i,s} * Influence\ Percentage_{i,s}$$

Table 5-3 presents the savings estimates for the eight sample sites on a net basis. As above, the figures exclude the large lighting retrofit project conducted at Site 1.

[16] These actions are not included in the gross savings estimation in Section 5.1

**Table 5-3: Net Savings by Sample Site**

| Site | Square Feet | Graduates at Site | Estimated Savings | Savings/ Graduate | Savings/Sq Ft/ Graduate |
|---|---|---|---|---|---|
| Energy Savings (KWh) | | | | | |
| 1 | 7,000,000 | 2 | 299,066 | 149,533 | 0.02 |
| 2 | 4,000,000 | 1 | 31,790 | 31,790 | 0.01 |
| 3 | 64,000 | 1 | 8,139 | 8,139 | 0.13 |
| 4 | 750,000 | 2 | 150,840 | 75,420 | 0.10 |
| 5 | 2,275,000 | 1 | 168,438 | 168,438 | 0.07 |
| 6 | 4,000,000 | 13 | 739,660 | 56,897 | 0.01 |
| 7 | 100,000 | 1 | 40,876 | 40,876 | 0.41 |
| 8 | 750,000 | 1 | 24,529 | 24,529 | 0.03 |
| | | | Weighted Average | 66,515 | 0.029 |
| Demand Savings (KW; W/1,000 Sq.Ft./Graduate) | | | | | |
| 1 | 7,000,000 | 2 | 66.7 | 33.3 | 4.8 |
| 2 | 4,000,000 | 1 | 10.2 | 10.2 | 2.5 |
| 3 | 64,000 | 1 | 3.1 | 3.1 | 48.8 |
| 4 | 750,000 | 2 | 1.1 | 0.6 | 0.7 |
| 5 | 2,275,000 | 1 | 0.6 | 0.6 | 0.3 |
| 6 | 4,000,000 | 13 | 263.0 | 20.2 | 5.1 |
| 7 | 100,000 | 1 | 8.6 | 8.6 | 86.0 |
| 8 | 750,000 | 1 | 6.2 | 6.2 | 8.3 |
| | | | Weighted Average | 16.3 | 4.4 |
| Gas Savings (Therms) | | | | | |
| 1 | 7,000,000 | 2 | 5,325 | 2,662 | 0.38 |
| 2 | 4,000,000 | 1 | - | - | - |
| 3 | 64,000 | 1 | 12,191 | 12,191 | 190.48 |
| 4 | 750,000 | 2 | (7) | (4) | (0.00) |
| 5 | 2,275,000 | 1 | - | - | - |
| 6 | 4,000,000 | 13 | - | - | - |
| 7 | 100,000 | 1 | 59 | 59 | 0.59 |
| 8 | 750,000 | 1 | - | - | - |
| | | | Weighted Average | 799 | 0.79 |

The overall net-to-gross ratio, representing the average influence of the program on participants' actions, can then be estimated by dividing total net savings for the sample sites by total gross savings:

$$Net\text{-}to\text{-}Gross\ Ratio = \frac{\sum Net\ Savings_{i,s}}{\sum Gross\ Savings_{i,s}}$$

Based on this algorithm, the overall influence score, across all energy saving actions conducted at the sample sites is estimated at 0.56. That is, on average, 56% of estimated gross savings can be attributed to the BOC training.

## 5.3 Average Savings for the Program

The gross and net savings presented above are based on only those graduates who indicated quantifiable savings in both the screening survey and the call-back interviews. In order to develop a savings estimate for the program overall, graduates who reported that they have not taken any energy saving actions have to be taken into account.

To reflect these graduates, the Opinion Dynamics team developed a factor that represents the proportion of the graduate population with quantifiable savings. Similar to the gross savings estimates above, this factor was developed on a site basis, rather than a participant basis. The factor is the product of (1) the proportion of sites in the sample that indicated quantifiable savings and (2) the proportion of sites eligible for call-back that actually reported quantifiable savings. That is, the estimated proportion of the participant population with quantifiable savings is:

$$p_{savings} = \frac{N_{eligible}}{N_{sample}} x \frac{N_{savings}}{N_{called\_back}}$$

Where

- $p_{savings}$ is the estimated proportion of the participant population with quantifiable savings.
- $N_{eligible}$ is the number of sites in the sample that were eligible for a call-back, i.e., indicated quantifiable savings (14 sites).
- $N_{sample}$ is the number of sites in the sample (19 sites).
- $N_{savings}$ is the numbers of sites that received a call-back and reported quantifiable savings (8 sites).
- $N_{called\_back}$ is the number of sites the received a call-back (9 sites).

Based on this equation, the Opinion Dynamics team estimated that 65% of participating sites have quantifiable savings. This percentage was applied to the weighted average gross and net savings presented above, to derive the overall average savings for the population (presented in Table 5-4).

**Table 5-4: Average Savings for the Population**

| | Gross | Net |
|---|---|---|
| Energy Savings* | | |
| kWh/Graduate | 77,847 | 43,566 |
| kWh/Sq. Ft./Graduate | 0.023 | 0.019 |
| Demand Savings* | | |
| kW/ Graduate | 20.0 | 10.7 |
| W/1000 sq. ft./Graduate | 4.7 | 2.9 |
| Gas Savings* | | |
| Therms/Graduate | 636 | 523 |
| Therms/1000 sq. ft./Graduate | 0.63 | 0.52 |

*Savings estimates are weighted averages.

### Comparison with Current Program Assumptions

The average numbers estimated for the first four Level I BOC trainings differ from those currently used by KCP&L to estimate program savings. KCP&L currently uses 12,500 kWh and 5 kW per participant. However, it is undetermined how these values were derived and what assumptions they are based on.

Another savings estimate referenced by KCP&L – used by MEEA and developed by the Northeast Energy Efficiency Partnership (NEEP)[17] – is 0.35 kWh/square foot per enrollee (including savings from rebated actions) and 0.18 kWh/square foot per enrollee (excluding rebated actions). Two primary reasons for the difference between these values and the ones estimated for the KCP&L program (0.019 kWh/square foot per graduate) are: (1) The NEEP values are based on a smaller average building size (90,000 square feet) compared to the average building size reported by KCP&L BOC graduates (786,000 square feet), resulting in a higher value per square foot per enrollee. (2) NEEP's estimates are *gross* savings estimates and therefore do not consider that the energy saving actions might only have been partially influenced by the program. However, on a per participant basis, the values for the KCP&L program (43,566 kWh) and NEEP's value (31,500 kWh) are substantially closer.

## 5.4 Site 1 Lighting Project

In addition to the savings presented in Table 5-2 and Table 5-3, Site 1 also completed one large lighting retrofit project. This project generated savings significantly different from the types of actions typically taken as a result of the BOC training and was therefore not included in the averages developed above. However, since the project was influenced by the BOC training, it should be included in the overall program savings.

Table 5-5 summarizes the gross and net savings estimated for this project.

**Table 5-5: Site 1 Lighting Project**

| Energy Savings | Gross Savings | Net Savings |
|---|---|---|
| kWh | 8,224,834 | 5,757,384 |
| kW | 2,146 | 1,503 |
| Therms | (8,367) | (5,857) |

## 5.5 Total Program Savings

Based on program participation and the averages estimated above, the Opinion Dynamics team estimated total program savings for the four BOC trainings offered between July 2007 and March 2009. This was done by multiplying the average net savings per graduate (43,566 kWh; 10.7 kW; and 523 therms) by the number of BOC graduates (79). In addition, savings from the Site 1 Lighting project were added.

[17] RLW Analytics, "Impact and Process Evaluation – Building Operator Certification (BOC) Program – Final Report", prepared for Northeast Energy Efficiency Partnerships. June 2005.

Table 5-6: Total Program Net Savings

| | kWh | kW | Therms |
|---|---|---|---|
| Population Savings | 3,441,685 | 846 | 41,317 |
| Site 1 Outlier Savings | 5,757,384 | 1,503 | (5,857) |
| Total Program Savings | 9,199,069 | 2,348 | 35,460 |

# 6. SUMMARY AND RECOMMENDATIONS

To date, the BOC Program has met its attendance targets for all of its training sessions, and satisfaction with the program is high. Program graduates also report having obtained knowledge and hands-on training necessary to have an impact on the operations and maintenance practices at their facilities. Several interviewed graduates reported that since the training they have started to think about energy and cost, not only about keeping their facilities running.

Program graduates report taking a number of energy saving actions as a result of the BOC training. These actions have resulted in estimated savings of 9.2 million kWh, 2,300 kW, and 35,000 therms since the program began in July 2007.

As the program matures and continues to be offered in KCP&L's service territory there are a number of issues that program implementers may want to keep in mind. The following is a list of recommendations related to the program:

### *Collect more detailed information related to participant facilities*

Currently, the BOC program uses an average savings per participant assumption to determine the energy savings from the BOC program. However, given the variation of potential savings for facilities of different sizes, an average number normalized by the square footage serviced would be a better value to use. This type of indicator is common in the evaluation literature and is also used by MEEA.

While the program currently collects information on the square footage of participants' buildings, it appears that this information is often based on the company/facility as a whole, rather than the area under the responsibility of the participant. For example, based on the program database, the average square footage of the 26 interviewed graduates is 2.9 million. In contrast, the same 26 graduates reported in the survey that they are responsible for an average of 786,000 square feet. As a result, the square footage information collected at present is too uncertain to be used to estimate program savings.

In addition, the impact evaluation came across several instances where multiple staff from the same facility participated in the BOC program. Based on the program data, it was difficult to assess whether energy saving actions might be double-counted as a result of including multiple staff from a single site.[18] In addition to collecting the addresses of the facilities at which their work is performed, it might be useful to also request information about the types of systems the participant is responsible for.

### *Update savings assumptions for program savings*

The program currently uses saving assumptions of 12,500 kWh and 5 kW per participant. These numbers appear low, relative to the actions reported by BOC graduates and the resulting estimated savings. We recommend using revised values of 43,600 kWh and 10.7

[18] The current impact evaluation only assumes overlap of energy saving actions where this was confirmed in the follow-up interviews. This, however, might underestimate overlap of actions at other sites.

kW per graduate for future program savings estimates. We also recommend considering moving to default values based on savings per graduate per square foot, as additional facility information is collected.

These default values should be revisited and adjusted as necessary in future program evaluations.

### *Seek ways to integrate cutting-edge practices and technologies into the BOC training*

Currently the course content is based on materials from NEEC. MEEA provides these materials to the MO DNR for use in each course. Some of these materials are difficult to keep up-to-date or might not be fully representative of the conditions in KCP&L's service territory. While it is not feasible to make significant changes to the BOC curriculum, KCP&L might consider reviewing the materials and ensuring that they are cutting edge to the industry in order to ensure that they are offering customers a valuable service through the trainings. Notably, some other areas of the country have built their own courses from the ground up, which offers tailored subjects to the course, and allows the instructors to be more invested in keeping the materials up to date.

### *Develop additional marketing strategies for upcoming program years*

After initial efforts to get the program running, marketing is currently rather limited, and recruitment of new participants relies heavily on referrals by past participants. This strategy appears to be successful for the time being, as the program has been meeting or exceeding its participation goals. Administrators do not expect to see interest in the program slowing down in the near future.

KCP&L should continue monitor interest in the program and plan to increase marketing efforts, as necessary, in future years. The development of new marketing strategies to reach the managers and supervisors of potential participants is one approach KCP&L should consider. Thirty-eight percent of students believe this to be the most effective way of recruiting participants as it targets those who make the decisions about who participates in the training.

# Appendix A: Select Topline Survey Results

BOC Follow-Up Survey: Facility and Demographics Topline

*Interviewing dates: June 17, 2009 – June 26, 2009*

*Sample size: n=26*

FACILITY INFORMATION

D2. What type of business is run at your facility?

| | |
|---|---|
| (Office) | 46% |
| (School/University) | 15% |
| (Real Estate/Property Management) | 8% |
| (Retail) | 4% |
| (Hospital/Medical) | 4% |
| (Residential/Apartment Building) | 4% |
| (Government) | 4% |
| (Corrections/Jail) | 4% |
| (Waste Water Treatment) | 4% |
| (Other) | 8% |

F1. What is the approximate size, in square feet, of your building or buildings?

| | |
|---|---|
| (Less than 100,000) | 8% |
| (100,000-499,999) | 31% |
| (500,000-999,999) | 19% |
| (1,000,000 or more) | 31% |
| (Don't know) | 12% |

F1A. What percentage of this space are you responsible for?

| | |
|---|---|
| (Less than 100,000) | 8% |
| (100,000-499,999) | 31% |
| (500,000-999,999) | 23% |
| (1,000,000 or more) | 27% |
| (Don't know) | 12% |

F2. What is the primary heating fuel used in your facility?

| | |
|---|---|
| (Gas) | 31% |
| (Oil) | - |
| (Electric) | 62% |
| (Other) | 8% |

F2A. What is the primary heating system type?

| | |
|---|---|
| (Central Furnace) | - |
| (Room heater, wall, or floorboard) | 8% |
| (Hot water coils (radiator loop)) | 27% |
| (Space heaters) | - |
| (Heat pump, air source) | 4% |
| (Heat pump, ground source) | - |
| (Boilers) | 23% |
| (Forced air) | - |
| (Steam) | 4% |
| (Fan power boxes) | 4% |
| (Radiant heat) | 4% |
| (Heating coils) | 12% |
| (Other) | 15% |

F3. Do you have a secondary heating system?

| | |
|---|---|
| Yes | 15% |
| No | 85% |

**(IF F3 IS YES, n=4)**
F3A. What is the secondary heating fuel?

| | |
|---|---|
| (Gas) | 25% |
| (Oil) | - |
| (Electric) | 75% |

**(IF F3 IS YES, n=4)**
F3B. What is the secondary heating system type?

| | |
|---|---|
| (Central furnace) | - |
| (Room heater, wall or floorboard) | 25% |
| (Hot water coils (radiator loop)) | 50% |
| (Space heaters) | - |
| (Heat pump, air source) | - |
| (Heat pump, ground source) | - |
| (Other) | 25% |

F4. What is the cooling system type at your facility?

| | |
|---|---|
| (Packaged unit – cooling only) | - |
| (Packaged unit – cooling and heating) | - |
| (Chiller) | 77% |
| (Evaporative cooler) | 4% |
| (Air cooled heat pump) | 8% |
| (Geothermal heat pump) | - |
| (Window units) | - |
| (Fans) | 4% |
| (Cooling coils) | 4% |
| (Other) | 4% |

F5. What is the primary fuel used for water heating at your facility?

| | |
|---|---|
| (Gas) | 23% |
| (Electric) | 73% |
| (Oil) | - |
| (Solar) | - |
| (Steam) | 4% |

## DEMOGRAPHICS

D1A. What is your current job title?

| | |
|---|---|
| (Operations/facilities operations manager) | 19% |
| (Maintenance manager) | 12% |

| | |
|---|---|
| (HVAC supervisor/technician) | 8% |
| (Engineering manager) | 12% |
| (Facilities manager) | 8% |
| (Engineer) | 12% |
| (General contractor) | 4% |
| (Building management specialist) | 8% |
| (Other engineering position) | 12% |
| (Other manager/team leader/supervisor) | 8% |

D1B. How many years have you worked in this role?

| | |
|---|---|
| (Less than 5 years) | 27% |
| (5-10 years) | 46% |
| (11-20 years) | 23% |
| (Over 20 years) | 4% |

D3. How many hours per week is your site open for business?

| | |
|---|---|
| (40 hours) | 15% |
| (41-80 hours) | 46% |
| (81-100 hours) | 4% |
| (101-167) | 8% |
| (168) | 27% |

D4. What is your site's estimated total annual energy costs?

| | |
|---|---|
| (Less than $50,000) | - |
| ($50,000-$99,999) | 8% |
| ($100,000-$499,999) | 4% |
| ($500,000 or more) | 19% |
| (Don't know) | 65% |
| (Refused) | 4% |

D5. What is your site's estimated total electricity cost?

| | |
|---|---|
| (Less than $99,999) | 8% |
| ($100,000-$499,999) | 12% |
| ($500,000 or more) | 8% |
| (Don't Know) | 69% |
| (Refused) | 4% |

D6. What is your site's estimated total natural gas cost?

| | |
|---|---|
| No natural gas | 31% |
| Less than $99,999 | 8% |
| $100,000-$499,999 | 8% |
| $500,000 or more | 0% |
| Don't Know | 50% |
| Refused | 4% |

# APPENDIX B: PARTICIPANT TELEPHONE SURVEY

**BUILDING OPERATOR CERTIFICATION, LEVEL 1**
**6-9 MONTH FOLLOW-UP SURVEY**

Hello may I please speak to [NAME]? My name is _______________ and I am calling from Opinion Dynamics on behalf of KCP&L. According to our records, you participated in the Building Operator Certification Training Program in Kansas City. We are conducting an evaluation of the program and would like to ask you some questions regarding your experience. The survey will take about 10 minutes. Is now a good time?

[If not a good time, schedule call back]

[IF PERSON IS NO LONGER WITH COMPANY RECORD THIS IN DISPOSITION]
Z1. Can you tell me where [NAME] is working now? [OPEN END; probe for company name, city, state, phone number; RECORD]

SCREENER

S1. Do you recall participating in the BOC Level 1 training program from [CLASS DATES]?
1. Yes
2. No [THANK AND TERMINATE]
8. (Don't know) [THANK AND TERMINATE]
9. (Refused) [THANK AND TERMINATE]

S2. Do you conduct or manage operations or maintenance activities at your facility?
1. Yes [SKIP TO D2]
2. No
8. (Don't know)
9. (Refused)

[ASK IF S2=2]
S3. Why did you enroll in the Level 1 training program? [OPEN END; 98=DK, 99=Ref]

S4. At the time of the BOC training, what was your position or title? [OPEN END; 98=DK, 99=Ref]

S5. Did you find the training useful given your reason for taking it?
1. Yes
2. No
8. (Don't know)
9. (Refused)

S6. Why was it useful/not useful? [OPEN END; 98=DK, 99=Ref]

*Thank and terminate.*

## FACILITY INFORMATION

D2. What type of business is run at your facility? [MULTIPLE RESPONSE, UP TO 3]

1. (School/University)
2. (Office)
3. (Retail)
4. (Restaurant)
5. (Hospital/Medical)
6. (Grocery)
7. (Warehouse)
8. (Process Industrial)
9. (Other Industrial)
10. (Residential/Apartment Building)
11. (Hotel/Motel)
12. (Mixed Use)
13. (Government)
14. (Real estate/property management)
15. (Corrections/Jail)
16. (Waste water treatment)

00. (Other, specify)
98. (Don't know)
99. (Refused)

F1. What is the approximate size, in square feet, of your building or buildings? [NUMERIC OPEN END, UP TO 9,999,999; DK, Ref]

F1a. What percentage of this space are you responsible for?
[NUMERIC OPEN END, UP TO 100%; DK, Ref]

F2. What is the primary heating fuel used in your facility?

1. (Gas)
2. (Oil)
3. (Electric)
4. (Other, specify)

8. (Don't know)
9. (Refused)

F2a. What is the primary heating system type?

1. (Central furnace)
2. (Room heater, wall or floorboard)
3. (Hot water coils (radiator loop))
4. (Space heaters)
5. (Heat pump, air source)
6. (Heat pump, ground source)
7. (Boilers)

8. (Forced air)
9. (Steam)
10. (Fan power boxes)
11. (Radiant heat)
12. (Heating coils)
00. (Other, specify)
98. (Don't know)
99. (Refused)

F3. Do you have a secondary heating system?
1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF F3=1 ELSE SKIP TO F4]
F3a. What is the secondary heating fuel?
1. (Gas)
2. (Oil)
3. (Electric)
4. (Other, specify)
8. (Don't know)
9. (Refused)

F3b. What is the secondary heating system type?
1. (Central furnace)
2. (Room heater, wall or floorboard)
3. (hot water coils (radiator loop))
4. (Space heaters)
5. (Heat pump, air source)
6. (Heat pump, ground source)
00. (Other, specify)
98. (Don't know)
99. (Refused)

F4. What is the cooling system type at your facility?
1. (Packaged unit - cooling only)
2. (Packaged unit – cooling and heating in the same unit)
3. (Chiller)
4. (Evaporative cooler)
5. (Air cooled heat pump)
6. (Geothermal heat pump)
7. (Window units)
8. (Fans)
9. (Cooling coils)
00. (Other, specify)
98. (Don't know)

99. (Refused)

F5. What is the primary fuel used for water heating at your facility?

1. (Gas)
2. (Electric)
3. (Oil)
4. (Solar)
5. (Steam)
00. (Other, specify)
98. (Don't know)
99. (Refused)

## IMPACTS

I1. I'm going to run through a list of possible projects to improve the energy efficiency of your facility. For each type of project, I'll be asking if you have done this BEFORE as well as AFTER participating in the BOC training program. [ASK YES=1, NO=2, DK=8, REF=9 FOR EACH]

A1. BEFORE the training: Had you installed any lighting controls?
A2. How about AFTER the training?
B1. BEFORE the training: Had you installed efficient lighting?
B2. How about AFTER the training?
C1. BEFORE the training: Had you installed an Energy Management System or thermostat?
C2. How about AFTER the training?
D1. BEFORE the training: Had you installed air handler seals and/or gaskets?
D2. How about AFTER the training?
E1. BEFORE the training: Had you installed new motors?
E2. How about AFTER the training?
F1. BEFORE the training: Had you installed new VSDs on existing motors?
F2. How about AFTER the training?
G1. BEFORE the training: Had you installed pipe insulation?
G2. How about AFTER the training?
H1. BEFORE the training: Had you performed air compressor leak reduction?
H2. How about AFTER the training?
I1. BEFORE the training: Had you made efforts to conserve waste water?
I2. How about AFTER the training?
J1. BEFORE the training: Had you made efforts to conserve water?
J2. How about AFTER the training?
K1. BEFORE the training: Had you taken any other energy conservation efforts not mentioned in the list we just reviewed?
K2. How about AFTER the training?

[ASK IF I1K1 = YES]
I1k3. What other energy conservation efforts did you undertake BEFORE the training? [OPEN END; 98=DK, 99=Ref]

1. (Window insulation)

2. (Efficient roof top system)
3. (Sealing of ceiling cracks)

[ASK IF I1K2 = YES]
I1k4. What other energy conservation efforts did you undertake AFTER the training? [OPEN END; 98=DK, 99=Ref]

1. (Heating system improvement)
2. (Lighting)
3. (Efficient roof top system)

[ASK IF MORE THAN 1 I1a2-k2 = Yes]
I2a. Were the projects you implemented AFTER taking the training done at the same facility?

1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[ASK IF ONLY ONE OF I1a2-k2 = Yes OR IF I2A=1]
I2b. What is the address of the facility? [OPEN END; 8=DK, 9=Ref]

**Lighting Controls**
[ASK IF I1a2=1 ELSE SKIP TO I6a]
I5a. You mentioned that you installed lighting controls after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to install lighting controls?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I5b-f IF I5a<3]
I5b. What is the square footage of the area that new lighting controls were installed in? [NUMERIC OPEN END, UP TO 9,999,999; DK, Ref]

I5c. Did you receive a rebate from KCP&L for the installation of new lighting controls?

1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[SKIP I5d-f IF I5c=1]
I5d. Please describe the function of your new lighting controls [OPEN END; 98=DK, 99=Refused].

1. (Motion sensors)
2. (Timers)
3. (Night lighting)

I5e. What are the estimated energy savings from installing lighting controls as a PERCENTAGE of total lighting load? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I5f. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Efficient Lighting**
[ASK IF I1b2=1 ELSE SKIP TO I7a]
I6a. You mentioned that you installed energy efficient lighting after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to install efficient lighting?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | | Very much | | | |

[SKIP I6b-e IF I6a<3]
I6b. What is the square footage of the area that new efficient lighting was installed in? [NUMERIC OPEN END, UP TO 9,999,999; DK, Ref]

I6c. Did you receive a rebate from KCP&L for the installation of new efficient lighting?

1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[SKIP I6d-e IF I6c=1]
I6d. What are the estimated energy savings from installing energy efficient lighting as a PERCENTAGE of total lighting load? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I6e. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**EMS/Thermostats**
[ASK IF I1c2=1 ELSE SKIP TO I8a]
I7a. You mentioned that you installed an Energy Management System or thermostat after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to install an Energy Management System or thermostat?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I7b-e IF I7a<3]
I7b. What is the square footage of the area that the Energy Management System or thermostat controls? [NUMERIC OPEN END, UP TO 9,999,999; DK, Ref]

I7c. Please describe the function(s) of your new Energy Management System or thermostat [OPEN END, 98=DK, 99=Ref].

1. (On and off schedule)

2. (Does everything)
3. (Keeps AC pressure up)

I7d. What are the estimated energy savings from installing the Energy Management System or thermostat as a PERCENTAGE of total HVAC load? [NUMERIC OPEN END, DK, Ref]

[ASK IF QI2a=2]
I7e. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Air Handler Seals and Gaskets**
[ASK IF I1d2=1 ELSE SKIP TO I9a]
I8a. You mentioned that you installed air handler seals and/or gaskets after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to install air handler seals and/or gaskets?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I8b-d IF I8a<3]
I8b. What is the square footage of the area that is affected by the air handler seals and/or gaskets that were installed?
[NUMERIC OPEN END, UP TO 9,999,999; DK, Ref]

I8c. What are the estimated energy savings from installing air-handler seals or gaskets as a PERCENTAGE of total HVAC load? [NUMERIC OPEN END, DK, Ref]

[ASK IF QI2a=2]
I8d. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Motors**
[ASK IF I1e2=1 ELSE SKIP TO I10a]
I9a. You mentioned that you installed new motors after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to install new motors?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I9b-g IF I9a<3]
I9b. What is the horsepower of the new motors? [NUMERIC OPEN END, UP TO 9,999; DK, Ref]

I9c. Did any of these new motors have VSDs?
1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

I9d. Did you receive a rebate from KCP&L to install the new motors?
1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[SKIP I9e-g IF I9d=1]
[ASK IF I9c=1]
I9e. Did you receive a rebate from KCP&L to install the VSDs?
1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[SKIP I9f-g IF I9e=1]
I9f. What are the estimated energy savings from replacing motors as a percentage of total motor load? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I9g. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**VSDs**
[ASK IF I1f2=1 ELSE SKIP TO I11a]
I10a. You mentioned that you installed new VSDs on existing motors after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to install new VSDs?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I10b-f IF I10a<3]
I10b. How many VSDs did you install?
[NUMERIC OPEN END, UP TO 100; DK, Ref]

I10c. What is the average horsepower of motors controlled by the new VSDs?
[NUMERIC OPEN END, UP TO 99,999; DK, Ref]

I10d. Did you receive a rebate from KCP&L to install new VSDs?
1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[SKIP I10e-f IF I10d=1]
I10e. What are the estimated energy savings from installing VSD(s) as a percentage of total motor load? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I10f. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Pipe Insulation**
[ASK IF I1g2=1 ELSE SKIP TO I12a]
I11a. You mentioned that you installed pipe insulation after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to install pipe insulation?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I11b-f IF I11a<3]
I11b. How many linear feet of pipe did you insulate?
[NUMERIC OPEN END, UP TO 99,999; DK, Ref]

I11c. What is the R-value of the insulation you used?
[NUMERIC OPEN END, UP TO 99; DK, Ref]

I11d. Did you insulate water heating pipes or heating system pipes?
1. (Yes, water heating pipes (DHW))
2. (Yes, heating system pipes)
3. (Yes, I insulated both)
4. (No)
8. (Don't know)
9. (Refused)

[ASK I11e IF I11d=1,2,3]
I11e. What are the estimated energy savings from pipe insulation, as a PERCENTAGE of total [READ: "water heating load" IF I11d=1; READ: "heating load" IF I11d=2; READ "heating and hot water load" IF I11d=3] [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I11f. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Air Compressor**
[ASK IF I1h2=1 ELSE SKIP TO I13a]
I12a. You mentioned that you performed air compressor leak reduction after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to perform air compressor leak reduction?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I12b-d IF I12a<3]
I12b. What is the total horsepower of the motor(s) in the air compressor system?

[NUMERIC OPEN END, UP TO 99,999; DK, Ref]

I12c. What are the estimated energy savings from compressor leak reduction, as a PERCENTAGE of total compressed air system load? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I12d. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Waste Water Conservation**
[ASK IF I1l2=1 ELSE SKIP TO I14a]
I13a. You mentioned that you made efforts to conserve waste water after taking the BOC training. On a scale from 0 to 10 where 0 is “not at all” and 10 is “very much”, how much did the training affect your decision to conserve waste water?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I13b-e IF I13a<3]
I13b. What specific actions did you take to conserve waste water?
[OPEN END, 98=DK, 99=Ref]
1. (Installed waterless urinals)
2. (Replaced toilet and faucet parts)

I13c. What kind of waste water treatment do you perform on-site?
[OPEN END, 98=DK, 99=Ref]
1. (None)

I13d. What are the estimated energy savings from waste water reduction as a PERCENTAGE of all energy consumed to treat waste water? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I13e. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Water Conservation**
[ASK IF I1j2=1 ELSE SKIP TO I15a]
I14a. You mentioned that you made efforts to conserve water after taking the BOC training. On a scale from 0 to 10 where 0 is “not at all” and 10 is “very much”, how much did the training affect your decision to conserve water?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I14b-d IF I14a<3]
I14b. What specific actions did you take to conserve water?
[OPEN END, 98=DK, 99=Ref]
1. (Recycle water)
2. (Irrigation)

3. (Motion sensors)
4. (New parts or pipes)
5. (Low flow meters for urinals)

I14c. What are the estimated energy savings from water conservation as a PERCENTAGE of all energy consumed to heat water on site? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I14d. Can you give me the address of the facility where you did this project? [OPEN END; 8=DK, 9=Ref]

**Other Efforts**
[ASK IF I1K2=1 ELSE SKIP TO I116a]
I15a. You mentioned that you took other energy conservation steps after taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to take those steps?

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
| Not at all | | | | | | | | Very much | | | | |

[SKIP I15b-d IF I15a<3]
I15b. Did you receive a rebate from KCP&L to undertake any of these actions?
1. (Yes)
2. (No)
8. (DK)
9. (Refused)

[SKIP I15c-e IF I15b=1]
I15c. What are the estimated energy savings from this measure as a PERCENTAGE of total site energy consumption? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI2a=2]
I15d. Can you give me the address of the facility where you took these other actions? [OPEN END; 8=DK, 9=Ref]

I3. Now I'd like to ask you about changes in maintenance activities you may have implemented at your facility SINCE TAKING THE BOC TRAINING. For each of the following activities, please indicate if you have performed them DIFFERENTLY or MORE FREQUENTLY since participating in the BOC training. [ASK YES=1, NO=2, DK=8, REF=9 FOR EACH]
a. maintenance on the cooling system equipment?
b. maintenance on the heating equipment?
c. motor maintenance, including belt alignment?
d. maintenance on air compressors?

[ASK IF MORE THAN 1 I3a-d = Yes]
I4a. Did you make these changes at the same facility?
1. (Yes)
2. (No)

8. (Don't know)
9. (Refused)

[ASK IF ONLY ONE OF I3a-d = Yes OR IF I4a=1]
I4b. What is the address of the facility where you made these changes? [OPEN END; 8=DK, 9=Ref]

**Cooling system**
[ASK IF I3a=1 ELSE SKIP TO I17a]
I16a. You mentioned that you have changed how you perform maintenance on cooling system equipment since taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to change your maintenance practices?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I16b-d IF I16a<3]
I16b. How many tons is the cooling system equipment that you performed maintenance on? [NUMERIC OPEN END, UP TO 9,999; DK, Ref]

I16c. What are the estimated energy savings from performing maintenance on the cooling system, as a PERCENTAGE of total cooling system load? [NUMERIC OPEN END, DK, Ref]

[ASK IF QI4a=2]
I16d. Can you give me the address of the facility where you made these changes? [OPEN END; 8=DK, 9=Ref]

**Heating equipment**
[ASK IF I3b=1 ELSE SKIP TO I18a]
I17a. You mentioned that you have changed how you perform maintenance on heating equipment since taking the BOC training. On a scale from 0 to 10 where 0 is "not at all" and 10 is "very much", how much did the training affect your decision to change your maintenance practices?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | | | | | | | | Very much | | | | |

[SKIP I7b-d IF I7a<3]
I17b. How many square feet does the heating system that maintenance was performed on affect? [NUMERIC OPEN END, UP TO 9,999,999; DK, Ref]

I17c. What are the estimated energy savings from performing maintenance on the heating system, as a PERCENTAGE of total heating system load? [NUMERIC OPEN END, DK, Ref]

[ASK IF QI4a=2]
I17d. Can you give me the address of the facility where you made these changes? [OPEN END; 8=DK, 9=Ref]

**Motor Maintenance**

[ASK IF I3c=1 ELSE SKIP TO I19a]

I18a. You mentioned that you have changed how you perform motor maintenance since taking the BOC training. On a scale from 0 to 10 where 0 is “not at all” and 10 is “very much”, how much did the training affect your decision to change your maintenance practices?

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
| Not at all | | | | | | | | Very much | | | | |

[SKIP I18b-e IF I18a<3]

I18b. How many motors did you perform maintenance on?
[NUMERIC OPEN END, UP TO 999; DK, Ref]

I18c. What is the average horsepower of the motors you performed maintenance on?
[NUMERIC OPEN END, UP TO 99,999; DK, Ref]

I18d. What are the estimated energy savings from more frequently performing motor maintenance as a PERCENTAGE of total motor load? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI4a=2]

I18e. Can you give me the address of the facility where you made these changes? [OPEN END; 8=DK, 9=Ref]

**Air Compressor Maintenance**

[ASK IF I3d=1 ELSE SKIP TO B1]

I19a. You mentioned that you have changed how you perform maintenance on air compressors since taking the BOC training. On a scale from 0 to 10 where 0 is “not at all” and 10 is “very much”, how much did the training affect your decision to change your maintenance practices?

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DK | Ref |
| Not at all | | | | | | | | Very much | | | | |

[SKIP I19b-d IF I19a<3]

I19b. What is the total horsepower of the air compressor motor(s)?
[NUMERIC OPEN END, UP TO 99,999; DK, Ref]

I19c. What are the estimated energy savings from air compressor maintenance, as a PERCENTAGE of total of compressed air system load? [NUMERIC OPEN END; DK, Ref]

[ASK IF QI4a=2]

I19d. Can you give me the address of the facility where you made these changes? [OPEN END; 8=DK, 9=Ref]

Now I would like to ask you some questions about the program more generally.

## BARRIERS

B1. What do you think is the best way to recruit building operators to participate in the training? [MULTIPLE RESPONSE, UP TO 3]

1. (Educate management about the program)
2. (Advertise in industry journals)
3. (Provide financial support for attendance)
4. (More advertising)
5. (Word of mouth/referrals)
6. (Distribute materials at supply stores)
7. (Certification: offer or require)

00. (Other, specify)
98. (DK)
99. (Refused)

B2. What do you think are the barriers to getting building operators to participate in the training? [MULTIPLE RESPONSE, UP TO 3]

1. (Cost)
2. (Time)
3. (Not aware of it)
4. (Getting authorization/approval)
5. (Not enough time)
6. (Supervisor support)
7. (Staffing restrictions)
8. (None)

00. (Other, specify)
98. (DK)
99. (Refused)

B3. What kind of barriers have prohibited you from implementing O&M improvements to your facility? [MULTIPLE RESPONSE, UP TO 3]

1. (Money)
2. (Time)
3. (Lack of support from management)
4. (No appropriate situations)
5. (No barriers)

00. (Other, specify)
98. (DK)
99. (Refused)

## ADDITIONAL IMPACTS

A1. Please indicate if you have accomplished any of the following AS A RESULT OF PARTICIPATING IN THE BOC TRAINING PROGRAM. Have you… [ASK YES=1, NO=2, DK=8, Ref=8 FOR EACH]

a. saved energy or reduced energy demand at your facility.

b. saved your facility money.

c. enhanced the comfort of your facility's occupants.
d. made any changes that have improved the Indoor Air Quality of your facility.

[ASK IF A1a=1 ELSE SKIP TO A3]
A2. Approximately, as a percentage of your energy bill, how much energy did you save? [NUMERIC OPEN END, UP TO 100%; DK, Ref]

1. (None)
2. (5% or less)
3. (6%-10%)
4. (11-25%)
5. (Over 25%)

[ASK IF A1b=1 ELSE SKIP TO A4]
A3. Approximately, how much money on average did you save on your energy bill per month? [NUMERIC OPEN END, UP TO $999,999; DK, Ref]

1. ($1,000-4,999)
2. ($5,000-9,999)
3. ($10,000-19,999)
4. (Over $20,000)

[ASK IF A1D=1 ELSE SKIP TO A5]
A4. What did you do to improve indoor air quality? [OPEN END, 98=DK, 99=Ref]

1. (Filtration system)
2. (Improvement in filters)
3. (Changing filters)
4. (Control of outside air flow)

A5. Since completing the BOC training program has your job title changed?

1. (Yes)
2. (No)
8. (DK)
9. (Refused)

A6. Since completing the BOC training program has your compensation increased?

1. (Yes)
2. (No)
8. (DK)
9. (Refused)

A7. Since completing the BOC training program have your job responsibilities changed or increased?

1. (Yes)
2. (No)
8. (DK)
9. (Refused)

[ASK IF ANY A5-A7=1 ELSE SKIP TO O1]

A8. Do you think your completion of the BOC training program helped bring about these changes?

1. (Yes)
2. (No)
8. (DK)
9. (Refused)

**OTHER**

O1. Have you recommended the BOC training program to colleagues?

1. (Yes)
2. (No)
8. (DK)
9. (Refused)

O2. Do you plan to enroll in the BOC Level 2 program?

1. (Yes I plan to)
2. (Yes I have already signed up)
3. (Maybe)
4. (No)
5. (Yes, already enrolled)
8. (DK)
9. (Refused)

**DEMOGRAPHICS**

D1a. What is your current job title?
[OPEN END, 98=DK, 99=Ref]

1. (Operations/Facilities operations manager)
2. (Maintenance manager)
3. (HVAC supervisor or technician)
4. (Engineering manager)
5. (Facilities manager)
6. Engineer)
7. (Maintenance manager)
8. (General contractor)
9. (Building management specialist)
10. (Other engineering position)
11. (Other manager, team leader, supervisor)

D1b. How many years have you worked in this role?
[NUMERIC OPEN END, UP TO 50 YEARS; DK, Ref]

1. (Less than 5)
2. (5-10)
3. (11-20)
4. (Over 20)

D3. How many hours per week is your site open for business? [NUMERIC OPEN END, UP TO 168; DK, Ref]

1. (40 hours)
2. (41-80)
3. (81-100)
4. (101-167)
5. (168)

D4. What is your site's estimated total annual energy cost (electricity and natural gas) ($/year).

1. (Less than $50,000)
2. ($50,000-99,999)
3. ($100,000-499,999)
4. ($500,000 or more)

D5. What is your site's estimated total electricity cost ($/year). [NUMERIC OPEN END, UP TO 999,999; DK, Ref]

D6. What is your site's estimated total natural gas cost ($/year). [NUMERIC OPEN END, UP TO 999,999; DK, Ref]

*Those are all the questions I have for you.*
*Thank you for your time and participation in this survey.*

# Appendix C: Course Evaluations

## MEEA Survey

**Q1**: Overall, how would you rate the:

a) Program
b) Instructors
c) Course materials
d) Facilities

**Q2:** How did you learn about the BOC program?

**Q3:** What are the most valuable concepts that you learned in BOC training?

**Q4:** Describe any energy efficiency or environmental quality projects you have started at your facility as a result of BOC training and list their measurable impacts.

**Q5:** How can we improve the BOC program?

## KCP&L Survey

**Q1:** How did you learn about the BOC training?

**Q2:** Have you used or applied any concepts you learned in the training? Please describe what you did.

**Q3:** Have you taken any new O&M actions as a result of the training? If yes, what were these actions?

**Q4:** Do you take some O&M actions more often as a result of the training? Please describe what was done before training and what was done after.

**Q5:** Since completing the BOC training have you participated in a utility sponsored program?

**Q6:** What were the most valuable concepts learned in the training?

**Q7:** How will or how has the BOC training add to your job position?

**Q8:** Would you recommend the training to others in your field?

**Q9:** Do you have any suggestions for improving training?

**Q10:** On a scale of 1-10 where 1 is not at all likely and 10 is very likely; how likely is it that you will sign up for BOC Level 2 training?

**Q11:** On a scale of 1-10 where 1 is completely disagree and 10 is completely agree; please rate your agreement with the following statements.
As a result of the training…

a) I have or will be able to save energy or reduce energy demand at my facility
b) I have or will be able to save my facility money
c) I have or will be able to enhance the comfort of the facilities occupants
d) I have increased my knowledge of equipment operations or replacement
e) I have had or anticipate having more productive interaction with contractors
f) I have undertaken recommended or influenced energy efficiency projects at my facility
g) I have increased my knowledge of how I can use energy efficiency measures and occupational practices to reduce energy expenses
h) I have or will be able to create reports for management that justify energy efficiency capital expenses intended to produce O&M savings
i) I have increased my knowledge of what to look for when repairing or replacing equipment
j) I have increased my knowledge of how to calculate the payback of energy savings associated with purchasing options

**Q12:** Please indicate if you are planning to make any changes to or replace any of the following equipment or change your maintenance practices within the next three months, six months, or year.

a) HVAC equipment
b) Lighting equipment
c) Motors/VSD's
d) Compressed air systems
e) Water heating equipment
f) Operations practices