



IMPACT EVALUATION OF THE CALIFORNIA STATEWIDE BUILDING OPERATOR CERTIFICATION PROGRAM

CALMAC STUDY ID: CPU0069.01

Final

Prepared for:

CALIFORNIA PUBLIC UTILITIES COMMISSION

Prepared by:

OPINION DYNAMICS CORPORATION

1999 Harrison Street
Oakland, CA
510-444-5050

www.opiniondynamics.com

Contact: Megan Campbell, Project Director

February 2014

Acknowledgements

This project was a collaborative effort under contract to Itron. We would like to thank Itron and the CA Commission Staff and Advisors for guidance and input throughout the project planning and execution. We would also like to acknowledge the support from the Northwest Energy Efficiency Council (NEEC) who provided critical program and participant data, reviewed survey instruments and assisted with participant recruiting and incentive efforts. Finally we would like to thank the BOC participants who took the time to support this study by responding to survey efforts and assisting with on-site visits at their facilities.

Legal Notice

This report was prepared as an account of work sponsored by the California Public Utilities Commission. It does not necessarily represent the views of the Commission or any of its employees except to the extent, if any, that it has formally been approved by the Commission at a public meeting. For information regarding any such action, communicate directly with the Commission at 505 Van Ness Avenue, San Francisco, California 94102. Neither the Commission nor the State of California, nor any officer, employee, or any of its contractors or subcontractors makes any warrant, express or implied, or assumes any legal liability whatsoever for the contents of this document.

TABLE OF CONTENTS

- 1. EXECUTIVE SUMMARY 1**
- 2. INTRODUCTION 5**
 - 2.1 Evaluation Research Questions 5
 - 2.2 Description of the 2010-2012 Building Operator Certification Program 6
 - 2.3 Evaluation Report Layout 9
- 3. METHODOLOGY..... 10**
 - 3.1 Gross Impacts 10
 - 3.2 Net Impacts 19
- 4. BOC PROGRAM PARTICIPANT CHARACTERISTICS 23**
- 5. GROSS IMPACTS 29**
 - 5.1 Onsite Audit Sites 29
 - 5.2 Extrapolating Findings to Surveyed Population..... 33
 - 5.3 Program Gross Impacts 34
- 6. NET IMPACTS 36**
- 7. SUMMARY OF FINDINGS 38**
- 8. RESEARCH AREAS FOR FUTURE CONSIDERATION 40**
- A. SUMMARIES FOR ONSITE AUDITED SITES 42**
- B. MEASURES INCLUDED IN INTERNET SURVEY AND THOSE AUDITED 59**
- C. MEASURES BY EQUIPMENT OR O&M 62**
- D. INTERNET DATA COLLECTION INSTRUMENT 65**
- E. DETAILED SURVEY RESULTS..... 95**
- F. ATTRIBUTION QUESTIONS FROM THE PARTICIPANT SURVEY 115**

**G. 2010-2012 BUILDING OPERATOR CERTIFICATION PROGRAM EVALUATION
PLAN..... 117**

TABLE OF TABLES

Table 1. Level I and II BOC Program Curriculum	7
Table 2. Level I Revised BOC Program Curriculum	8
Table 3. Population and Sample Sizes	11
Table 4. Internet Survey Disposition	12
Table 5. Internet and Non-Responder Survey Methods and Outreach	13
Table 6. Onsite Audit Disposition	15
Table 7. Unique Companies within BOC Program Participants.....	18
Table 8. Measure Categories Included in the Free Ridership Analysis	19
Table 9. Unique Company by Sector – Population and Internet Survey.....	23
Table 10. BOC Participants – Facility and Actions.....	24
Table 11. Number of Facilities Overseen (If Manager of a Facility).....	24
Table 12. Measures Implemented by Category (Self-Report in Survey).....	29
Table 13. Measures Implemented by Category (Used within Gross Impact)	30
Table 14. BOC Action Type by Unique Measure Category (Equipment Purchase and Operations & Maintenance)	31
Table 15. Measure Action Types in Gross Impact Analysis.....	32
Table 16. Average Annual Savings by Measure Category	32
Table 17. Number of Measures in Surveyed Population.....	33
Table 18. Surveyed Respondents Gross Impacts.....	34
Table 19. 2010-2012 BOC Program Gross Impacts	34
Table 20. BOC Program NTGR Results	36
Table 21. Comparison of Select BOC Program NTGRs with DEER Values	36
Table 22. 2010-2012 BOC Program Net Impacts	37
Table 23. Summary of Research Questions and Answers	38
Table 24. Measures Stated to be Implemented and Audited.....	59
Table 25. BOC Participant Characteristics	97
Table 26. Facility Manager Job Titles (Internet Survey).....	98

Table 27. Market Sector/Type of Business in Facility (Internet and Phone)	98
Table 28. BOC Certified Employees at Facility (Internet Survey)	99
Table 29. CA Energy Training Centers courses (Internet Survey)	99
Table 30. CA Energy Training Centers courses (Internet Survey, multiple response)	99
Table 31. Number of Facilities Overseen	100
Table 32. Facility Ownership (Internet Survey)	100
Table 33. Facility Size (Internet Survey)	100
Table 34. Annual Facility Energy Cost (Internet Survey).....	100
Table 35. Annual Facility Energy Cost – Gas vs. Electric Ratio (Internet Survey)	101
Table 36. Hourly Load Shape Monitoring (Internet Survey)	101
Table 37. Facility Managers: Incidence of Taking Action	101
Table 38. Facility Managers who Took Action by Training Year	102
Table 39. Reasons for Not Taking Action	102
Table 40. Incidence of Actions Taken After BOC Training.....	102
Table 41. Boiler or Domestic Hot Water changes.....	103
Table 42. Chiller / Chilled Water System Changes.....	103
Table 43. Cooling Tower Optimization	104
Table 44. Domestic Hot Water changes.....	104
Table 45. Economizer & Ventilation Control changes	104
Table 46. HVAC Equipment Scheduling or Space Temperature changes.....	105
Table 47. Fan optimization/Air Distribution upgrades	105
Table 48. Lighting changes	106
Table 49. Water Pump optimization changes.....	106
Table 50. Other Action Types Taken among Internet Survey Respondents (n=17)	107
Table 51. Perceived Magnitude of Energy Savings	108
Table 52. Reasons for BOC Attendance – Facility Managers	108
Table 53. Most Important Skills or Topics Learned in the BOC Courses (Internet Survey, multiple response).....	109
Table 54. Ways BOC Training Affected Attendees (Internet Survey)	109

Table 55. Influence of Non-BOC Factors on Decision to Take Actions (Internet Survey)	110
Table 56. Program Influence on Actions Taken (Internet Survey)	110
Table 57. Whether Participants Would Have Taken Action Without Training (Internet Survey)	111
Table 58. Internet Survey Respondents Agreeing Follow Up	111
Table 59. BOC Participants – Facility and Actions.....	112
Table 60. Facility Managers who Took Action by Training Year	112
Table 61. Market Sector/Type of Business in Facility (Internet Survey and Phone)	112
Table 62. Number of Facilities Overseen	113
Table 63. Reasons for BOC Attendance – Facility Managers (multiple response).....	114
Table 64. Level I and II BOC Curriculum.....	119
Table 65: Level I Revised BOC Curriculum.....	120
Table 66. Summary of BOC Programs Reviewed.....	122
Table 67. PY2010-2012 BOC Participants by Market Sector (Level I and II)	125
Table 68. PY2010-2012 BOC Participants across State and IOUs	126
Table 69. Unique PY2010-2012 BOC Participants Over Time.....	126
Table 70. Percent of PY2010-2012 BOC Participants with Contact Information (Unique information)	126
Table 71. PY2010-2012 BOC Participants by Program Year.....	126
Table 72. Self-Reported Square Footage of PY2010-2012 BOC Participants.....	127
Table 73. BOC Participants by Unique Company and Address by IOU	127
Table 74. BOC Participants by Unique Company and Address Over Time	127
Table 75. Checklist of Needed Items for Gross Energy Estimations by Approach	130
Table 76. Basis of Savings Quantified by BOC Program	141
Table 77: Proposed Evaluation Budget	144
Table 78: BOC 2013 Program Level I Start Date.....	145
Table 79: BOC Course Observations.....	147

TABLE OF FIGURES

Figure 1. Comparison of California Impacts with Other BOC Program Impact Reports.....2

Figure 2. Overarching BOC Research 10

Figure 3. Number and Percent of Measures within Survey and Audited^a 15

Figure 4. NTGR and Free Ridership Calculation for BOC Program (By Measure Category)..... 21

Figure 5. Actions Taken Before and After BOC Program Training..... 27

Figure 6. Comparison of California Impacts with Other BOC Program Impact Reports..... 35

Figure 7: Current Data Collection Efforts..... 123

Figure 8: Timeline of Evaluation Activities..... 143

1. EXECUTIVE SUMMARY

The Building Operator Certification (BOC) program is a series of classes offered through California's Statewide Workforce Education and Training program. It provides in-depth and hands-on experience to professionals in the building operations and maintenance (O&M) field, with the goal of training professionals so they build skills that enable them, or others in their company, to reduce energy use in their commercial facility or facilities.

To date, the California Investor-Owned Utilities (IOUs) have implemented this program as a non-resource program, which means that the savings from this program are not counted directly in the energy-savings claims by the utilities. However, with IOUs and Commission staff have been discussing, the possibility of the Commission transitioning this to a resource program sometime in the future." These discussions are due, in part, to the fact that past studies have documented large quantities of savings that occur as a result of California's Workforce Education and Training program efforts. To date, however, estimates of these savings have not met the required level of rigor needed to ensure that savings can be claimed.

This evaluation effort sought **to better understand savings and whether there are methods that would allow for a higher level of rigor when estimating savings from training programs**. Specifically, the BOC program (or series of courses) was looked at as a case study for possible future opportunities to document savings and develop information that could be used in an ex ante work paper process.

Unlike rebate programs, this course does not have a database of the measures installed by participants. Because it is a training effort, participants are taught about various equipment, measures, and operations that can save them energy in their facilities, but the program does not record energy-saving actions taken as a result of the BOC program. This makes estimating energy savings as a result of the program challenging. In total, the course teaches students about 103 different actions (measures, operations and maintenance procedures), and because of the heterogeneity of the measures and the pre-existing equipment in each facility, it is difficult to accurately determine program-wide savings.

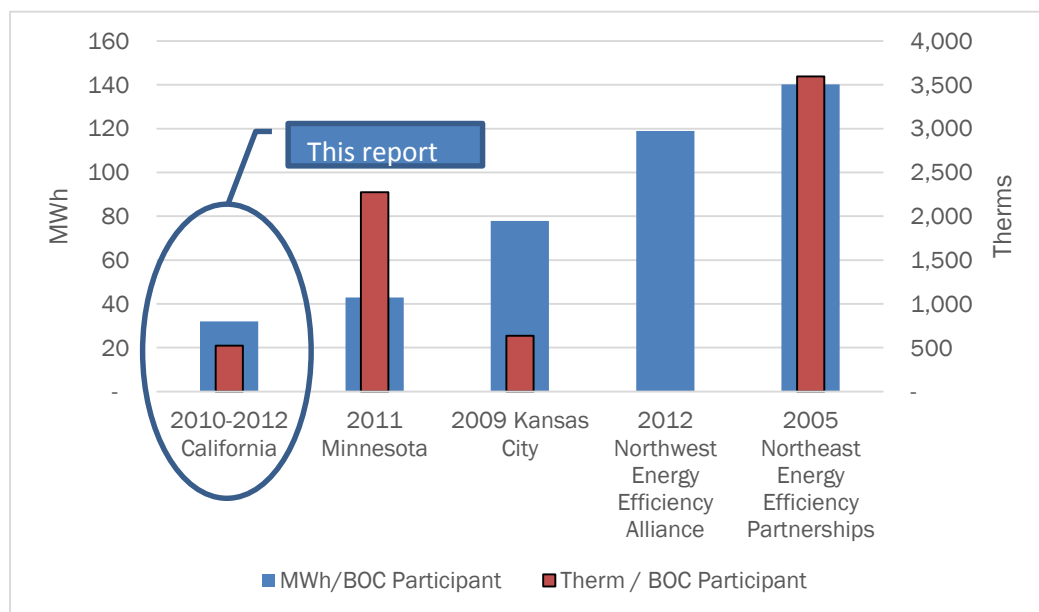
In order to overcome the measurement obstacles our study needed a multi-step process built upon existing program databases and course information. We interviewed participants through a mixed-mode effort, and supplemented this with site visits. These efforts allowed us to first understand who was taking action, what actions were being taken and then estimate the energy savings from these actions.

Overall, the findings from our study are as follows:

- 80% of all BOC program participants who become BOC certified are in a position to save energy, because they directly manage a facility or conduct maintenance operations. The large majority of participants, therefore, are the correct target for the BOC program because they are in a position to start saving energy for a specific facility. Other participants included, students, unemployed, some have switched careers since the training and some are in other maintenance-related positions such as plumbers.
- Participant comments and responses demonstrated the value of the BOC program with more than half (58%) of participants stating that they took some energy-saving action post-program.

- In total, 543 people participated in the BOC program and received certification for building operation between 2010 and 2012. The savings from these participants' facilities totaled approximately 17.4 GWh, 2.43 MW, and 285,000 therms in net impacts per year.
 - The BOC program, therefore, resulted in an average per-student net savings of 32 MWh/year, 4.5 kW/year, and 525 therms/year.
 - The most frequent actions taken included lighting measures (most commonly sensors, replacing linear fluorescents with T8's and incandescents with CFLs), HVAC equipment scheduling, and fan optimization/air distribution actions.
- The estimated impacts from this program are in the middle of what other evaluations have found for therms, and lower than three of the other four reports in terms of electric energy savings. There may be several factors contributing to the difference in savings across jurisdictions. Among them, this study incorporated on-site visits to verify the actions taken and quantify savings while most other studies mainly relied upon self-reported surveys. Further, savings in CA may generally be lower given that CA's climate is more temperate than other jurisdictions.

Figure 1. Comparison of California Impacts with Other BOC Program Impact Reports



- We found minimal channeling between the BOC program and IOU energy efficiency rebate programs, which was surprising given that part of the training is dedicated to making participants aware of IOU rebate programs. Only 12 of 392 actions taken by BOC respondents (3.1%) were also found in the database of 2010-2012 Energy Efficiency paid measures. We removed these measures prior to gross impacts so do not double-count them. However, if left in, they would account for an additional 11% of MWh, 12% of MW, and 8% of kTherm impacts. This somewhat disproportionate savings is because half of the incented measures were lighting where the savings per measure is highest. If this minimal amount of channeling is true then the BOC program may be inducing more direct savings that are not accounted for in other programs than previously thought.

- In addition to documented saving opportunities, several parts of our study pointed to additional energy savings that could not be quantified. These indicators of additional savings include the following:
 - There were sites where we could not document savings due to security issues (government or military restrictions) or lack of time and resources on the part of the building staff. As such, our savings among the analyzed group is underestimated.
 - Non-respondents were more likely to work in multiple facilities, so if these individuals also realized savings, the potential for savings could be greater. As such, our savings may be underestimated.
 - It often takes time to implement projects or install equipment that could save a facility energy. Our study only examined a three-year period. Additionally, through conversations with facility managers, we recognize that further savings will occur following our efforts. As such, our savings values are most likely underestimated.

Our approach was able to document savings for the BOC program. The rigor of our approach was higher than in prior studies conducted for the BOC program in other parts of the country, but there are still limitations to our study. Key methodological findings from this study include the following.

- Past efforts to estimate energy savings for BOC in other parts of the country relied largely on survey efforts without on-site verification. Our results indicate that surveys alone do not provide a sufficient level of rigor to allow the program to build a database of actions from which to calculate savings. Frequently, we found that the measures reported from survey results were not installed as reported—just over one-third of measures claimed from survey results were actually verified as implemented. And when we went onsite, we found other newly installed energy-saving measures that had not been reported in the surveys.
- Savings found in this research most likely are representative of actions taken after the BOC program and, unless the trainings change dramatically, could be transferable to participants who become certified in future trainings. Applying savings only to certified participants is important because not all participants in the courses complete all courses and become certified.
 - The research is based on three years of participants across various sectors. Savings came from both equipment purchases and O&M actions across the spectrum of measures upon which the building operators were trained.
 - While we expect that there would be some savings variation given the possible population of participants trained and their ability to affect change within the buildings they oversee, the values in our research are similar (albeit lower) than findings in other evaluations. While those other evaluations (from research between 2005 and 2012) used only surveys and secondary data for estimating savings, the fact that our findings are closely aligned points to actions taken by BOC program participants that are not very different across time.
- The research for BOC program savings is grounded in primary data collection at the sites, but due to budget, savings are not calibrated by site energy use. As such, while savings are reasonable, the methodology may be less rigorous than desired by those involved in the workpaper process. However, some consideration should be given to whether gaining greater precision for this program is feasible given the nature of the program, the wide variety of actions that each participant could take and the wide variety of facilities they oversee.

- The analytical approach for determining net savings, while obtaining values comparable to resource-acquisition programs, is limited by the magnitude and heterogeneity of possible actions taken. A self-report approach that we chose to use is most likely the only viable method for this program.¹ However, the typical battery of self-report free ridership questions within California are not feasible, even if desired. As such, our approach uses alternate questions with values that apply to broad categories of measures.

¹ Quasi-experimental approaches to obtain net savings that use comparison groups would suffer from lack of matched groups and an inability to tease out actions taken at sites that have no relationship to the information gained during the BOC program.