Opinion Dynamics

Boston | Headquarters

617 492 1400 tel
617 497 7944 fax
800 966 1254 toll free

1000 Winter St
Waltham, MA 02451

Massachusetts Cross-Cutting

Eversource On-Site Facilities Training Program Report FINAL

December 8, 2022

Opinion Dynamics

Table of Contents

1. Executive Summary 1
   - 1.1 Evaluation Activities and Study Limitations 1
   - 1.2 Findings and Recommendations 2
2. Research Methods 4
   - 2.1 Evaluation Objectives 4
   - 2.2 Evaluation Framework 4
   - 2.3 Summary of Evaluation Activities 5
     - 2.3.1 Development of Program Materials 5
     - 2.3.2 Interviews with Program Staff 6
     - 2.3.3 Review of Training Materials and Training Observations 6
     - 2.3.4 Participant Reaction Surveys 6
     - 2.3.5 Participant Knowledge Assessments 6
     - 2.3.6 In-Depth Interviews with Training Participants 6
     - 2.3.7 Engineering Analysis 6
   - 2.4 Study Limitations 7
3. Evaluation Findings 8
   - 3.1 Training Observations 9
   - 3.2 Participant Reactions 9
   - 3.3 Participant Learning and Behavior Change 10
   - 3.4 Summary of Ex Ante Savings 12
4. Findings and Recommendations 17

Appendix A. OFTP Program Theory and Logic Model 19

Appendix B. OFTP Process Map 20

Appendix C. Measures Crosswalk 21

Opinion Dynamics

Table of Tables

Table 1. Summary of Ex Ante Energy Savings 1
Table 2. Summary of Research Activities and the Associated Kirkpatrick Levels 5
Table 3. Summary of Ex Ante Energy Savings 8
Table 4. Participant Satisfaction (n=10) 10
Table 5. Participant Score on Knowledge Assessments 11
Table 6. Ex Ante Savings Summary for Site A 13
Table 7. Ex Ante Savings Summary for Site B 13
Table 8. List of BEMS Improvements in the 2021 Pilot Report and their Status as of September 2022 for Site A 14
Table 9. List of BEMS Improvements in the 2021 Pilot Report and their Status as of September 2022 for Site B 15

1. Executive Summary

Eversource's On-Site Facility Operator Training Program (OFTP) is a multi-faceted offering designed to optimize the energy performance of existing commercial facilities. Through the program, OFTP staff trained facility management professionals in participating buildings to optimize building energy performance by continuously commissioning facilities under their management. The program included several key components:

- **Facility Audit**: Program staff conducted walk-throughs of participating facilities to identify potential energy conservation measures (ECMs) and training opportunities for staff managing each participating facility.
- **Energy Conservation Measures:** The OFTP team worked closely with the participating organization to implement various ECMs recommended through the facility audits.
- **Training**: Program staff held two sessions (two days each) to train facilities staff about each facility's energy-using equipment, the implemented ECMs, and building energy management systems (BEMS) to enable the staff to operate and maintain the facility's systems in a manner that would sustain occupant comfort without compromising the energy performance of the facility.
- **Follow-Up Visits**: Program staff conducted several follow-up visits after the training to ensure the implemented improvements were still in effect.

Eversource recruited and enrolled one large non-residential participant into the program and, in coordination with the training contractor, facilitated the implementation of ECMs and custom trainings at two separate facilities. In total, 15 facilities staff members received trainings through the program. Based on ex ante savings analyses completed by the OFTP team, Eversource estimated the combination of ECMs and trainings implemented at both sites reduced between 9% and 15% of their annual energy consumption (Table 1).[1]

Table 1. Summary of Ex Ante Energy Savings

Participating Site	Estimated Annual kWh Savings	Estimated Percent of Annual Consumption
Site A	444,856	14%
Site B	448,000	9%

Source: Rethinking Power Management LLC. September 30, 2021. *2021.03.30 EV Pilot Report.pdf*

1.1 Evaluation Activities and Study Limitations

The evaluation team conducted a series of targeted research activities aimed at helping to support the development of a new program, assessing the success of the program's training components, and validating energy savings resulting from the program. Research activities included facilitating the development of materials documenting the program's design, conducting interviews with program staff, reviewing the training materials, fielding a set of knowledge assessments completed by participants, and completing in-depth interviews with participants at different intervals after they had completed the trainings. We also completed a review of ex ante savings and characterized how those savings may have been affected by conditions at both

[1] As described in Section 2.4, Opinion Dynamics was unable to obtain data from either participating site and therefore cannot verify ex ante savings estimates and did not produce ex post savings estimates through this evaluation.

participating sites after the trainings. For complete discussions of our research methods and activities, see Section 2.

Ultimately, lack of responsiveness on the part of the single participant in the program greatly inhibited our ability to successfully execute several of the key research activities (see Section 2.4). In particular, we were unable to complete an impact evaluation as originally intended—that is, to develop ex post savings estimates using BEMS and consumption data from both participating sites. Additionally, our team had very little success reaching training participants to complete in-depth interviews after they had completed their respective trainings. As such, we present the findings and recommendations detailed in this report based on, in some cases, a small number of observations and ex ante impact estimates that we were unable to fully verify.

1.2 Findings and Recommendations

- **Finding 1:** The OFTP team had considerable difficulty finding Eversource customers that both met their participation qualifications (see Section 3) and were willing to participate. Early on in the development stages of the program, the team engaged with several municipalities (e.g., public schools, municipal office buildings, etc.) as these customers both had BEMSs and have staff that could benefit from facility management training due to a number of factors (e.g., facility management is a part of their role or has been added to their responsibilities over time). However, due to a number of mitigating factors (e.g., turnover of key staff at prospective organizations, limited buy-in from key decision makers), the team was unable to generate sufficient interest. After considerable effort, the team recruited a single participant, a large healthcare system in their service territory, and identified two separate buildings to test the program design.
- **Finding 2:** Overall, the trainings were effective and provided value to participants in their daily roles. All the respondents to the satisfaction survey reported they agreed or strongly agreed that they were satisfied with the training, overall. Additionally, respondents reported they were satisfied with the format, instructors, and the material covered in the training. These positive experiences translated to positive learning outcomes. On average, participants performed twelve points better on the post-training knowledge assessments compared to the pre-training assessments. Interviewed participants reported valuable learnings related to the facility BEMS, as well as specific equipment controlled through the BEMS. Some respondents also reported broader learnings, such as an increased understanding of what their organization was trying to achieve through their energy management practices, and how their day-to-day work impacts these outcomes. Lastly, in some cases, we were able to document examples of these positive learning outcomes manifesting in changes to how participants executed to their daily tasks. For example, one respondent reported that prior to the training they would regularly override the BEMS and make adjustments based on occupant requests. This respondent said they no longer override the BEMS based on what they learned in the training and so maintain schedules designed to optimize building energy usage.
- **Finding 3:** Providing customized trainings based on a comprehensive energy audit and retro-commissioning project provided a unique means of allowing facility staff to learn about the specific needs of their buildings. In this case, participants learned to operate the selected buildings with the goal of maintaining energy saving improvements while also meeting occupant needs based on their current use. They also learned the implications of continuously commissioning buildings as their uses change over time. Some participants in the trainings did not work directly with their BEMS daily, worked at other facilities that were not the subject of either training, or were only in a temporary role. As such, their ability to maintain the savings resulting from the specific ECMs that the customer implemented (see Table 1) may have been limited. However, staff responsibilities may change over time (e.g., one participant took over primary management of one of the participating buildings due to staff turnover),

and training professionals that work in the building management industry can have broader benefits to the community.

- **Recommendation 1:** Consider providing an optional customized training for facility managers, similar to the trainings developed for the OFTP, as a companion offering to a retro-commissioning program. Participating facility staff found value in the training and saw some benefit in terms of their ability to understand how building systems interacted and ultimately how to maintain savings from ECMs and changes to BEMS set points. However, there may be limited interest in a standalone customized training offering as demonstrated by Eversource's inability to recruit participants into the program. As such, there may be opportunities to provide customers that are interested in retro-commissioning offerings with an optional add-on technical training that is specific to their building, rather than a more generalized facility manger training.
- **Recommendation 2:** Consider facilitating participation in existing more general facility operator trainings offered by other organizations. Eversource may have other avenues where they facilitate or help encourage participation in the more general Building Operator Certification training programs and certification. Additionally, Eversource might consider sponsoring facilities operator trainings offered based on different non-residential building segments or building use-cases (e.g., K-12 schools, health care, converted office buildings, etc.). These trainings could be more specific based on the needs of different building types, yet general enough to recruit staff from many different customers that operate similar buildings.

2. Research Methods

The evaluation team conducted a series of targeted research activities aimed at helping support the development of a new program, assessing the success of the program's training components, and validating energy savings resulting from the program. Ultimately, lack of responsiveness on the part of the single participant in the program greatly inhibited our ability to successfully execute several of the key research activities (see Section 2.4). In the remainder of this section, we present evaluation objectives and descriptions of the activities completed as part of this evaluation.

2.1 Evaluation Objectives

The evaluation team aimed to achieve the following research objectives to assess the effectiveness of the OFTP:

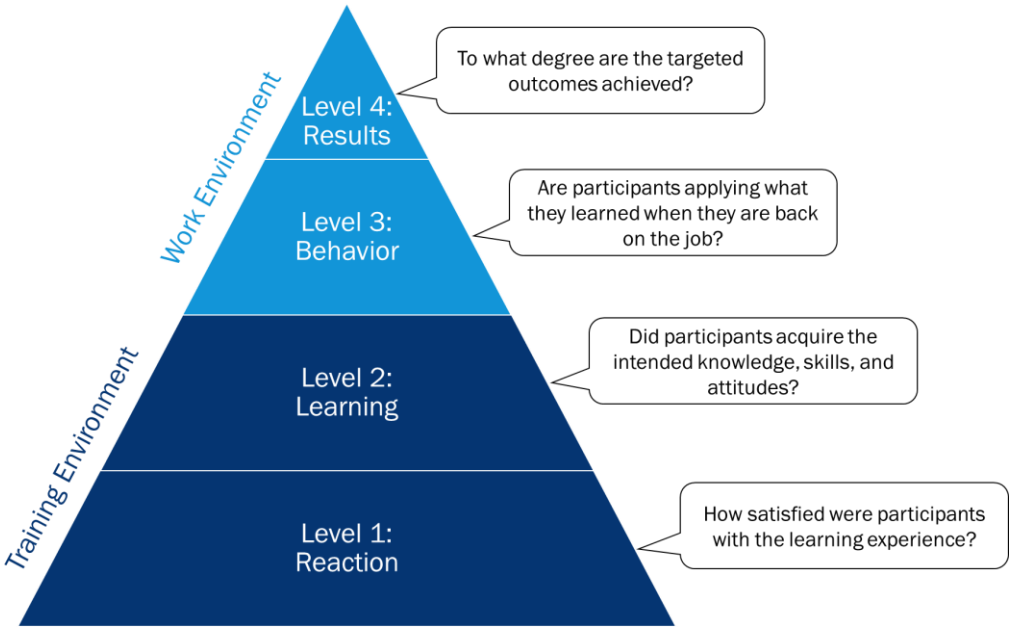
- Develop a program theory and logic model (PTLM), a process map, and a crosswalk between energy conservation measures and evaluation methods
- Review training materials and learning objectives
- Assess the baseline knowledge that participants possessed prior to the training
- Explore whether participants achieved the key learning objectives of each training
- Determine the level to which behaviors of participating facilities staff changed in the six months following the initial learning intervention
- Determine whether the OFTP produced measurable energy savings attributable to the program

2.2 Evaluation Framework

The evaluation team used the Kirkpatrick Model for evaluating adult learning interventions as the guiding framework to design the evaluation. As illustrated below, Kirkpatrick's Framework consists of four levels:

- **Level 1: Reaction**: Measures how participants feel about the learning experience. The value of Level 1 is that a good training experience improves knowledge transfer.
- **Level 2: Learning**: Measures the degree to which participants change attitudes, increase knowledge, or enhance skills as a result of the learning experience. The value of Level 2 is to demonstrate that learning occurs as a result of the training.
- **Level 3: Behavior**: Measures the degree to which participants apply what they have learned outside of the learning environment. The value of Level 3 is to demonstrate whether trainees take the information they learn and apply it.
- **Level 4: Results**: Measures the degree targeted outcomes are achieved system-wide. In this study, we sought to measure the program's overall impacts and tangible results, such as energy savings, improved quality, and increased productivity. The value of measuring Level 4 is to inform the return on training investment realized from the endeavor.

Figure 1. Kirkpatrick Model



To measure the four levels of learning, we aimed to conduct several research activities targeted at specific stages of the training process (Table 2).

Table 2. Summary of Research Activities and the Associated Kirkpatrick Levels

Research Activity	Level 1	Level 2	Level 3	Level 4
Reaction Surveys	✓			
Knowledge Assessments		✓		
In-Depth interviews		✓	✓	
Engineering Analysis				✓

2.3 Summary of Evaluation Activities

2.3.1 Development of Program Materials

The evaluation team coordinated with program staff to develop three program documents: a program theory and logic model (PTLM) (Appendix A), a process map describing program delivery (Appendix B), and measures crosswalk (Appendix C). The goal of developing these materials was to generate a common understanding of program implementation and identify evaluation objectives. Our team developed each of these materials based on several interviews with different members of the OFTP team (i.e., different members of the Eversource and training contractor teams). The PTLM documented the key theories of change the program sought to spur, as well as the barriers, key metrics, activities, outputs, and outcomes of the implementation team's approach. The evaluation team developed a high-level process map to define the key parties involved in program delivery, touchpoints between parties, and the objectives of each interaction (e.g., meeting with customers to define goals and gain buy-in; hand-off points between customers, training consultants, engineering, and evaluators; etc.). Lastly, the outcomes crosswalk identified the specific measure categories that would be addressed through the program and the methods used to quantify the savings for improvements.

2.3.2 Interviews with Program Staff

The evaluation team completed semi-structured interviews with both the OFTP administrative team at Eversource and the training contractor during different phases of the program's development and implementation. The goals of these interviews were to understand the program design, delivery, and the various challenges that different members of the OFTP team faced when trying to recruit participants and implement the program.

2.3.3 Review of Training Materials and Training Observations

The evaluation team reviewed lesson plans, training modules, and handouts prior to the training sessions to ensure the training contractor had established appropriate learning objectives and that those objectives were reflected in each of the training modules. Additionally, a member of the evaluation team attended each of the trainings to observe training delivery and participant engagement.

2.3.4 Participant Reaction Surveys

The evaluation team designed a reaction survey to be fielded at the end of each of the trainings. This survey covered topics including participant satisfaction with the material and instructors, the applicability of the material in the participant's day-to-day role, and the training format and delivery approach. The evaluation team analyzed the results of this survey to understand participant reactions to the training (Kirkpatrick Level 1).

2.3.5 Participant Knowledge Assessments

The evaluation team also reviewed questions developed by the training contractor designed to illustrate the degree to which participants retained the key concepts discussed during each module (Kirkpatrick Level 2). The training contractor created a series of questions related to each topical area covered in the trainings and fielded the questions both before and after each corresponding module. The evaluation team analyzed the results of these knowledge assessments to assess changes in participant knowledge.

2.3.6 In-Depth Interviews with Training Participants

The evaluation team attempted to interview training participants twice after the trainings at different intervals, once one-month post-training and again six months after completing the trainings. The evaluation team's primary goal in conducting these interviews was to assess if and how participants had changed their behavior in the course of their daily responsibilities as a result of the trainings (Kirkpatrick Level 3). We also used both opportunities to gather additional information related to participant satisfaction with the trainings (Kirkpatrick Level 1) and how well participants retained the information they learned during the trainings (Kirkpatrick Level 2). Of the 15 facilities staff members who participated in both trainings, the evaluation team was only able to reach two for the one-month post-training interviews and four for the six-month post-training interviews (5 unique individuals total).

2.3.7 Engineering Analysis

Opinion Dynamics' evaluation plan for conducting an impact analysis of the OFTP included a review of the program team's proposed ECMs for both participating sites and their calculation workbooks as a benchmark for the final analysis of approved and implemented improvements. To develop ex post savings estimates, we planned to complete engineering desk reviews, using post-retro-commissioning data from the participating

sites' BEMS, including equipment setpoints and operational trend data. We also planned to calibrate savings using whole-building billing data from participating sites. As noted in Section 2.4 below, we were unable to complete an impact evaluation as originally intended. As such, we present ex ante savings in this report, discuss our understanding of how the savings may have persisted at each site, and how any changes to set points (or other adjustments) may impact ex ante savings estimates.

2.4 Study Limitations

The evaluation team encountered several study limitations due to a number of different factors, several of which impacted the success of the program more broadly. First, the OFTP administration and implementation teams faced considerable challenges recruiting adequate participants for this program. Initially, the program team targeted municipal buildings within their service territories (e.g., schools and local government buildings), as they would have satisfied the more technical criteria for participating (e.g., high energy use intensity, square footage, BEMS, etc.). Additionally, municipal facilities tend to have difficulty hiring and training staff with BEMS and facility management experience. Due to staff turnover and other factors at a few different municipal buildings initially targeted by the program team, none of the municipal customers continued through the program. Once the OFTP team had successfully recruited and onboarded the participant for this effort, the COVID-19 pandemic limited the team's ability to get on site and provide the types of hands-on trainings they had initially envisioned.

Finally, the evaluation team had limited to no success reaching the staff members who participated in the trainings. In total, we interviewed five of the fifteen training participants; three of these participants had limited roles in the facilities covered in the trainings and one was a temporary employee. We know that at least two of the trainees left the organization shortly after participating in the training and were therefore unavailable to participate in any post-training interviews. Other members of both cohorts did not respond to our requests for interviews after our team made multiple attempts to contact them and offered monetary incentives to encourage their participation. Further, after several months of attempts, the evaluation team was unable to obtain any data from the BEMS at either participating site.[2] As such, we were unable to validate any energy, gas, or demand savings that resulted from the updates to each site's BEMS, or the subsequent trainings. As such, all savings results presented in this report are ex ante savings developed by the program team prior to completing the training, which were validated by the program team after completing the trainings.

[2] The Opinion Dynamics team sent multiple data requests to the participant directly. We also attempted to request data through other avenues by working with trusted sources (i.e., the training contractor and Eversource key account managers).

3. Evaluation Findings

Eversource's On-Site Facility Operator Training Program (OFTP) is a multi-faceted offering designed to optimize the energy performance of existing commercial facilities. Through the program, OFTP staff trained facility management professionals in participating buildings to optimize building energy performance by continuously commissioning facilities under their management. The program team sought to test the program design on a large customer with the goal of exploring additional customized training offerings for future implementation. Eversource targeted customers with a minimum of 2.9 million kWh in annual consumption or minimum of 70,000 square feet of space. Additionally, Eversource required that participating customers had a BEMS, interval meters, a variety of energy-using systems, and high energy use intensity.

Eversource contracted with one third-party training contractor to complete facility audits, develop site-specific energy savings recommendations, and administer custom trainings for facilities staff at each participating building. The training contractor also worked with each decision makers at participating facility and outside controls vendors to implement several ECMs which would serve, in part, as the focus for each of the trainings. Specifically, the trainings served to teach staff about the different ECMs and how their roles as facility managers could help maintain the savings that resulted from the various improvements. Eversource recruited one participating organization into the program, a large healthcare system within Eversource's service territory. In close coordination with the training contractor, Eversource worked with the participating organization to identify two separate buildings that would be the focus of the trainings. After the participating organization implemented the recommended ECMs at both facilities, the training contractor administered two separate two-day trainings that included 15 facilities staff members total. The trainings took place on January 13 and 14, 2021, at Site A (a rehabilitation facility converted to an office building) and January 27 and February 3, 2021, at Site B (a building containing primarily laboratory space). The training contractor covered various topical areas (i.e., air side systems, water side systems, steam systems, chiller operations, and demand reduction strategies), and delivered separate modules for each over a two-day period at each facility.

As described, prior to each training, the OFTP team worked with decision makers at each facility and third-party controls vendors to implement several ECMs identified through the OFTP facility audits. **Error! Reference source not found.** summarizes the ex ante energy savings estimates resulting from the ECMs implemented at each participating site.[3]

Table 3. Summary of Ex Ante Energy Savings

Participating Site	Estimated Annual Electric Savings (kWh)	Estimated Percent of Annual Electric Consumption	Estimated Annual Gas Savings (therms)	Estimated Percent of Annual Gas Consumption	Estimated Annual Steam Savings (Mlb)	Estimated Percent of Annual Steam Consumption
Site A	444,856[a]	14%	N/A	N/A	2,269[a]	26%
Site B	448,000	9%	17,664	7%	N/A	N/A

Source: Rethinking Power Management LLC. September 30, 2021. *2021.03.30 EV Pilot Report.pdf*

[a] Values do not match those in source report due to minor calculation error discovered during evaluation review.

[3] As described in Section 2.4, Opinion Dynamics was unable to obtain data from either participating site and therefore cannot verify ex ante savings estimates and did not produce ex post savings estimates through this evaluation. During review of the ex ante calculation workbooks, Opinion Dynamics discovered a calculation error and subsequently corrected for Site A.

3.1 Training Observations

The participating staff received training on each facility's BEMS and controls relating to the mechanical, steam, and water systems, as well as demand management strategies across those systems (with emphasis on reducing load during peak hours). The goals of the trainings were to utilize the various modules to inform the staff about each site's different systems, ECMs implemented alongside this program, and enable them to effectively manage each facility with an eye towards maintaining the various improvements. Specifically, the modules aimed to teach staff to

- Manage the facility's demand effectively;
- Adjust equipment settings for one-time events and return them to the original settings to optimize efficiency and demand management over time;
- Identify their facility's load profile and which loads had the potential to be shifted to off-peak hours;
- Recognize the greatest opportunities for efficiency improvements moving forward; and
- Acknowledge which parts of the organization need to be involved in decisions about equipment and efficiency investments.

In general, the staff seemed engaged during each training. Based on our team's observations, longer tenured staff seemed to be less engaged than newer staff. That said, throughout the training, participants demonstrated recollection of material presented earlier in the discussion, the comprehension to apply the concepts in real-world scenarios, and the ability to identify issues, which were then addressed in the BEMS. The training contractor was forced to deliver all of the material virtually due to the COVID-19 pandemic. The virtual delivery of the training appeared to impact the level of engagement and attention from some participants and introduced some challenges to facilitating robust discussion of the material. However, overall participants were satisfied with the training content and delivery (see Section 3.2).

Some participants seemed to prefer spatial and object teaching styles. For example, during one discussion related to the hot water system, the participants identified components of the system by their location on the BEMS screen, noting that the hot water return was on the right side of the screen. In another discussion, the participants discussed how an indicator flag changed color to indicate different issues. Conversely, in part due to the virtual format, the training primarily consisted of detailed, lecture-style presentations, which were heavy in text.

3.2 Participant Reactions

Overall, participants were satisfied with the trainings they received through the program. When asked about their satisfaction with different aspects of the program immediately following the trainings all participants reported moderate or high levels of satisfaction. Seven of ten respondents reported they "agreed" and three reported they "strongly agreed" when they were asked if they were satisfied with the training as a whole. Additionally, five respondents "agreed" they would recommend the training and five respondents "strongly agreed." As illustrated in Table 4, respondents reported high levels of satisfaction with the format and delivery of the training, the material covered in the training, and the instructors.

Table 4. Participant Satisfaction (n=10)

	Agree	Strongly Agree
Satisfied with onsite format	3	7
Instructor made it easy to be actively involved	4	6
Would recommend training	5	5
Material was easy to understand	5	5
Satisfied with content	5	5
Instructor knew a great deal	6	4
Satisfied with training, overall	7	3
Will be able to immediately apply content in role	7	3
Satisfied with instructor	7	3
Satisfied with the material	8	2
Material will help in me in my role	8	2

Participants echoed these sentiments in the in-depth interviews we conducted following the trainings. We interviewed five participants in total; two approximately one month after the conclusion of the training, and four approximately six months after the conclusion of the training.[4] All five respondents reported they found value in the trainings. Two respondents mentioned that the instructors were informative and were open to answering questions throughout the different modules. The same two respondents also reported they felt the structure of the trainings was effective, though one respondent said they would have preferred to have an in-person training with more hands-on activities. One respondent specifically mentioned they liked the approach of organizing the training by system. Conversely, two respondents reported they felt the training sessions were too long and that the instructors moved from one subject to the next too quickly. These respondents would have preferred to have more trainings of a shorter duration, to allow them time to absorb and experiment with the material and return to the next training with questions. These two respondents also reported challenges focusing on the training. They mentioned that their teams were small, and most team members participated in the trainings. This meant that they still needed to listen for calls and fulfill their work duties, at least to a limited extent, during the trainings.

> IF I SEE A HIGH STATIC PRESSURE [IN AN AIR-HANDLER UNIT], I'M LIKE, "OH, MAYBE WE SHOULD LOOK AT THE DUCT WORK, SOMETHING IS WRONG IN THERE". ALSO, I WOULD SAY FOR THE SCHEDULES, IT'S HELPED ME LOOK MORE AT WHETHER OR NOT [THE AIR-HANDLER UNITS] NEED TO BE RUNNING AS LONG, AND IF THEY CAN SAVE A SIGNIFICANT AMOUNT OF ENERGY [BY] CHANGE THE SCHEDULE.
>
> Respondent

3.3 Participant Learning and Behavior Change

For the participants we interviewed, positive reactions to the trainings appeared to translate to knowledge gain and changes in behavior.

Participant Knowledge Gain

Participants completed knowledge assessments before and after each training module. Thirteen of

[4] One participant completed both the one-month and six-month post-training interviews.

the fifteen participants who participated in the trainings filled out the pre- and post-training knowledge assessments. The assessments consisted of multiple-choice questions where multiple responses were correct in some cases and only a single response option was correct in others. As such, participants received full, half, or no credit for their responses based on whether they had provided all of the correct responses for multiple response questions. For questions where more than one response option was correct (e.g., all of the above) participants received partial credit if they provided some, but not all, of the correct responses as well. Overall, participants performed an average of twelve points better on the post-training knowledge assessments compared to the pre-training knowledge assessments. Table 5 shows the average pre- and post-training scores for each participant. All but two saw an overall improvement in their post-training scores.

Table 5. Participant Score on Knowledge Assessments

Participant	Pre-Training	Post-Training	Difference
Participant #1[a]	43%	54%	11%
Participant #2	39%	44%	6%
Participant #3	57%	56%	-2%
Participant #4	41%	50%	9%
Participant #5	41%	52%	11%
Participant #6	38%	62%	23%
Participant #7 [a]	39%	44%	6%
Participant #8	55%	70%	15%
Participant #9 [a]	33%	56%	22%
Participant #10	47%	68%	22%
Participant #11 [a]	56%	56%	0%
Participant #12 [a]	31%	50%	19%
Participant #13	58%	68%	10%
Average	**45%**	**57%**	**12%**

[a] Participant did not complete all the knowledge assessment fielded during the training.

Beyond learnings about specific systems, two respondents to our post-training interviews reported that some of their more valuable takeaways from their trainings were broader in nature. These two respondents mentioned the trainings helped them to appreciate and better understand what their organization was trying to accomplish through its efforts to update their BEMS. Both stated the trainings helped them understand how much energy their facilities consumed and the impact that seemingly small changes can produce.

We asked respondents whether any specific topics from the trainings were particularly useful to them in their daily roles. All five respondents reported they learned more about the facility BEMS, which allowed them to utilize the system more effectively and discuss scheduling and setpoint changes. Specifically, the respondents highlighted an increased understanding of equipment setbacks (n=2), scheduling equipment based on facility occupancy (n=2), air handler unit sequencing (n=1), damper operations (n=1), free cooling (n=1), and chiller operations (n=1).

Throughout the interviews, we attempted to explore specific concepts from the trainings in the interviews to assess participant comprehension and retention of key material. We found mixed results. However, it is unclear whether these results are indicative of the trainings, or the limited number of respondents we were able to interview. Additionally, three of the five interview respondents primarily worked in facilities not highlighted in the training—only assisting to a limited degree with operations of the facilities covered in the trainings. As a result, these respondents may not have had the opportunity to apply their learnings, which can

deepen comprehension of key material and aid in knowledge retention. Only one of the five interview respondents was a full-time employee at one of the facilities highlighted throughout the trainings, and this participant experienced large changes to their role following the trainings. The remaining respondent worked predominantly in one of the facilities highlighted in the trainings, but they were in a temporary role.

Participant Behavior Change

Three interview respondents reported making specific changes to how they executed their day-to-day responsibilities. One participant, who previously did not regularly work in the facilities highlighted in the trainings, began assisting with the HVAC operations at one of the facilities due to staff turnover. This respondent reported reviewing equipment operations closely each morning, including running trend reports to identify any issues. A second respondent mentioned they were given a task following the training to investigate the run times of their facility's air-handler units. The respondent mentioned they we able to look closely at the occupancy trends for the floors to assist with optimizing the scheduling of the units as a result of the training. This respondent also mentioned exploring the possibility of reducing static pressure in the units. Lastly, one respondent reported they no longer override the BEMS due to what they learned in the training. This respondent mentioned that prior to the training, if an occupant reported a comfort issue, the respondent would manually override the system to satisfy the occupant's needs. Now, the respondent does not override the system and instead informs the occupants about the ability to adjust the temperature of local thermostats by two degrees.

Notably, two participants reported it was difficult to understand the impacts of changes they made to the BEMS because they did not have direct access to building energy consumption data. A third participant mentioned a new BEMS was going to be installed in their facility soon so they were not making as many changes to the current BEMS as they otherwise might. This participant noted that the equipment scheduling and setpoints would be set during the transition to the new system. The participant also noted they would receive in-depth training on the new system, reducing the need and impact of exploring parts of the existing BEMS.

> I FELT LIKE I LEARNED MORE ABOUT WHAT THEY'RE TRYING TO DO WITH THE ENERGY [MANAGEMENT]...SOMETIMES IN CERTAIN SITUATIONS, WE'D HAVE TO OVERRIDE A PIECE OF EQUIPMENT BECAUSE WE'RE NOT GETTING WHAT WE NEED FOR TEMPERATURES, [BUT] OVERRIDING KIND OF [DEFEATS] THE WHOLE PURPOSE ...NOW WE TRY TO LET THE COMPUTER MAKE ITS DECISIONS AND CONTROL THE EQUIPMENT A LITTLE BETTER AND JUST TRY TO MAKE LITTLE ADJUSTMENTS INSTEAD OF BIG ADJUSTMENTS.
>
> Respondent

3.4 Summary of Ex Ante Savings

Opinion Dynamics conducted a review of the ex ante calculation workbooks used to estimate savings resulting from the ECMs implemented in conjunction with the OFTP trainings. Our team was prevented from validating any savings estimates or conducting ex post analyses as neither participating site responded to our BEMS data requests (see Section 2.4).[5] During our team's review of the ex ante calculation workbooks, however, we discovered an error in Site A's calculations, where the air flow rate for rooftop unit 1 (RTU-1) was used to calculate the hourly

[5] The Opinion Dynamics team sent multiple data requests to the participant directly. We also attempted to request data through other avenues by working with trusted sources (i.e., the training contractor and Eversource key account managers).

demand of the RTU-2 and air handler unit 1 (AHU-1). We corrected the calculations and that single change reflected in the ex ante savings estimates included in this report. Table 6 and Note: During review of the ex ante calculation workbooks, a calculation error was discovered by Opinion Dynamics and subsequently corrected for Site A. The corrected results for that site are reported in this report.

Table 7 show the ex ante savings reported by the implementation team, broken out by end-use at Site A and by ECM at Site B, mirroring how each ex ante calculation workbook reported savings.

Table 6. Ex Ante Savings Summary for Site A

End-Use	Estimated Annual Electric Savings (kWh)	Estimated Annual Steam Savings (Mlb)
Supply and Return Fans	314,142	0
Space Cooling	130,715	0
Reheat	0	2,174
Space Heating	0	94
Total	**444,856**	**2,269**

Note: During review of the ex ante calculation workbooks, a calculation error was discovered by Opinion Dynamics and subsequently corrected for Site A. The corrected results for that site are reported in this report.

Table 7. Ex Ante Savings Summary for Site B

Energy Conservation Measures	Estimated Annual Electric Savings (kWh)	Estimated Annual Gas Savings (therms)
Exhaust Fan Manometer & Fan Operation	257,117	0
Unoccupied Air Changes	147,569	8,845
Reduced Occupied Hours	43,313	2,123
Humidifier Steam	0	4,572
Condensing Boiler Reset Schedule	0	2,125
Total	**448,000**	**17,664**

We worked with the training contractor to understand the factors that may have impacted the persistence of certain ECMs as well as factors that limited the participant's ability to share the BEMS data our team would have needed to complete validation or ex post savings analyses. Staff turnover at both facilities shifted priorities of remaining staff away from continuing engagement with the evaluation team and training contractor. Staff were impacted by an expansion of job responsibilities and a need to learn BEMS components previously managed by others on the team. Additionally, introduction of a new BEMS software at Site A inhibited easy extraction of pre-training data. Lastly, at both facilities, the implications of the COVID-19 pandemic on building energy use patterns prevented billing regression analysis or use of billing data in calibrating energy models.

Without post-retro-commissioning data, the evaluation team determined the best path forward to reporting energy savings was to rely on the post-training savings analyses, which the training contractor reported in the

pilot report dated September 30, 2021[6], and, based on interviews with the training contractor and participants, highlight where set points or controls may have been modified after the pilot report.

Confirmation of ECMs and Potential Impact to Savings

To assess savings resulting from the ECMs and associated trainings, Opinion Dynamics reviewed the OFTP team's energy savings calculation workbooks. We confirmed that the BEMS improvements in the analysis aligned with the trainings and to those improvements implemented prior to the training contractor produced the summary pilot report on September 30th, 2021. The formulas used to calculate savings were consistent with engineering analysis of mechanical systems. The evaluation team also met with the training contractor to confirm whether any BEMS setpoints or controls had been adjusted approximately one year after the pilot report had been published. Table 8 and Table 9 list the BEMS improvements in the pilot report and their status (e.g., confirmed or adjusted) as of September 27, 2022.

Table 8. List of BEMS Improvements in the 2021 Pilot Report and their Status as of September 2022 for Site A

BEMS Programmatic Input	Equipment	September 2021 Pilot Report	September 2022 Status
BN08 Alarm and Reporting	Whole Building	Review BN08 report at start of shift to ensure BEMS setpoints and operations are correct to programming.	Modified to meet/exceed recommendation
Outside Air Damper Schedule	AHU-1	Enabled mixed outside air (OA) damper minimum during mechanical cooling	Confirmed as modified, but were unable to confirm new OA minimum setpoint
		Disabled 100% open OA damper during unoccupied (UNOCC) hours	
Static Pressure Sensors	Supply and Exhaust Fans	1.0" WC – OCC	Confirmed
		0.5" WC – UNOCC	
		Installed building pressure sensors relative to OA sensors throughout building to balance supply and return fan speeds	
		Exhaust fans turn off during UNOCC	
Air-Cooled Condensing Unit (ACCU) Compressors	ACCU-1 and ACCU-2	Staged ACCU compressors	Adjusted shoulder and winter months' delay set to 20–25 min.
		Added 15-minute delay to prevent short-cycling	
Morning Warm-Up Routine	Steam (off-site district steam)	Eliminated morning warm-up routine	Confirmed
Set Back Mode for Terminal Boxes	AHU-1, RTU-1, RTU-2, and terminal boxes	During UNOCC hours: ▪ 0.5" WC static pressure setpoint ▪ Terminal box valves closed ▪ All perimeter heating units shut off ▪ Night setback temperatures reset to 78°F in summer and 64°F in winter	Confirmed

[6] Rethinking Power Management LLC. September 30, 2021. *2021.03.30 EV Pilot Report.pdf*

BEMS Programmatic Input	Equipment	September 2021 Pilot Report	September 2022 Status
Supply Air Temperature Reset Optimization	Direct Digital Controls	Reset temperature dead bands to 82°F in summer and 58°F in winter.	Confirmed
		Shut OA damper and open return air (RA) damper during UNOCC	

At Site A, several critical changes were made following the pilot report, but central to those changes was the introduction of a new BEMS software, replacing the system for which the facility operators had received training. One outcome of installing the new system was the setting of daily system reporting on alerts and system setpoints that exceeded the original recommendation asking operators to manually check the BN08 report at the start of each day. The potential implication of this change is that drifting setpoints and other system alerts are more quickly seen and resolved by the facility operators, in theory reducing energy waste.

Other changes at this facility included unknown adjustments to the outside air damper schedule and the extension of shoulder and winter months' air-cooled condensing unit (ACCU) operating delay from 15 minutes to 20–25 minutes. A slightly longer ACCU operating delay will have a positive impact on energy savings since those systems will run a few minutes less each day. We could not determine the extent to which the outside air damper schedule had changed; therefore, we cannot provide an assessment of the impact on energy savings.

Table 9. List of BEMS Improvements in the 2021 Pilot Report and their Status as of September 2022 for Site B

BEMS Programmatic Input	Equipment	September 2021 Pilot Report	September 2022 Status
Building Occupancy Schedule	Whole Building	8AM to 8PM – OCC	Confirmed
		8PM to 8AM – UNOCC and Weekend	
Exhaust Static Pressure Setpoint	EAU-1 and EAU-2	2 “WC	Confirmed
Supply Duct Static Pressure Setpoint	AHU-1 and AHU-2	1.5 “WC	Confirmed
Supply Air Temperature Setpoint	EAU-1 and EAU-2	Outdoor Air (OA) 40°F = 60°F	Confirmed
		OA 60°F = 55°F	
Supply Air Relative Humidity Setpoints	AHU-1 and AHU-2	Range: 20% to 80%	Confirmed
Return Air Relative Humidity Setpoint	AHU-1 and AHU-2	30% RH – OCC	Confirmed
		20% RH – UNOCC and Weekend	
Hourly Air Changes	AHU-1 and AHU-2	6 ACH – OCC	Ran into issues with program communication; recommended a minimum of 5 ACH
	EAU-1 and EAU-2	4 ACH – UNOCC and Weekend	
AHU Humidifier Valve	AHU-1 and AHU-2	Valve Closed when outside enthalpy exceed 27 BTU/lb. or unit is off	Confirmed
Hot Water Return Temperature (RWT)	Boiler	RWT 100°F when OA dry bulb between 0°F and 50°F	Confirmed
Hot Water Temperature (HWT) Reset	Boiler	OA -10°F = HWT 110°F	Confirmed
		OA 0°F = HWT 100°F	
		OA 10°F = HWT 80°F	

BEMS Programmatic Input	Equipment	September 2021 Pilot Report	September 2022 Status
		OA 20°F = HWT 65°F	
Chilled Water Setpoint	CH-1 and CH-2	Min = 42°F	Confirmed
	(synchronous)	Max = 48°F	
Automated Heat Exchanger – Free Cooling	PHE-1	CHWST exceeds 2°F for 30 minutes; 38F	Confirmed

For Site B, the only notable deviation from the pilot report is to the minimum hourly air change rate (ACH). Due to technical issues associated with program communication, the training contractor recommended adjusting the minimum hourly air change from 4 ACH to 5 ACH. This impacts the scheduled setpoint during unoccupied (UNOCC) and weekend hours. An increase in ACH leads to increased space conditioning, predominately in winter and summer months when outside temperatures do not allow for economizing. The result is an overall increase to energy consumption. Moreover, because UNOCC and weekend hours represent more than 60% of the year, the increased energy use is not insignificant.

While this approach allows us to identify the specific improvements implemented and gauge their potential impact on energy savings, it carries a notable assumption. This approach assumes the operating schedule and system setpoints remain unchanged by the facility operators and function as intended to reduce the building energy usage. In effect, this approach ignores the training's efficacy on educating facility operators on the BEMS by not evaluating whether the operating schedule and setpoints are properly managed.

Facility Operator Perspectives on the Unintended Consequences of ECMs

One of the interviewed participants reported some of the ECMs implemented through the program resulted in unintended consequences that led to the reversal or adjustment of the measures. In one instance, facility occupants complained of poor odors after adjustments were made to bathroom fan operations. In response, the facility staff adjusted the fan runtimes to resolve these complaints. In another case, the reduced equipment operations over the weekend created negative pressure in the facility. This negative pressure pulled open several fire dampeners on the roof of the building, which pulled in outdoor air at below freezing temperatures and significantly decreased the temperature in parts of the facility.

4. Findings and Recommendations

In this section, we detail several findings and associated recommendations from the OFTP evaluation.

- **Finding 1:** The OFTP team had considerable difficulty finding Eversource customers that both met their participation qualifications (see Section 3) and were willing to participate. Early on in the development stages of the program, the team engaged with several municipalities (e.g., public schools, municipal office buildings, etc.) as these customers both had BEMSs and have staff that could benefit from facility management training due to a number of factors (e.g., facility management is a part of their role or has been added to their responsibilities over time). However, due to a number of mitigating factors (e.g., turnover of key staff at prospective organizations, limited buy-in from key decision makers), the team was unable to generate sufficient interest. After considerable effort, the team recruited a single participant, a large healthcare system in their service territory, and identified two separate buildings to test the program design.
- **Finding 2:** Overall, the trainings were effective and provided value to participants in their daily roles. All the respondents to the satisfaction survey reported they agreed or strongly agreed that they were satisfied with the training, overall. Additionally, respondents reported they were satisfied with the format, instructors, and the material covered in the training. These positive experiences translated to positive learning outcomes. On average, participants performed twelve points better on the post-training knowledge assessments compared to the pre-training assessments. Interviewed participants reported valuable learnings related to the facility BEMS, as well as specific equipment controlled through the BEMS. Some respondents also reported broader learnings, such as an increased understanding of what their organization was trying to achieve through their energy management practices, and how their day-to-day work impacts these outcomes. Lastly, in some cases, we were able to document examples of these positive learning outcomes manifesting in changes to how participants executed to their daily tasks. For example, one respondent reported that prior to the training they would regularly override the BEMS and make adjustments based on occupant requests. This respondent said they no longer override the BEMS based on what they learned in the training and so maintain schedules designed to optimize building energy usage.
- **Finding 3:** Providing customized trainings based on a comprehensive energy audit and retro-commissioning project provided a unique means of allowing facility staff to learn about the specific needs of their buildings. In this case, participants learned to operate the selected buildings with the goal of maintaining energy saving improvements while also meeting occupant needs based on their current use. They also learned the implications of continuously commissioning buildings as their uses change over time. Some participants in the trainings did not work directly with their BEMS daily or worked at other facilities that were not the subject of either training. As such, their ability to maintain the savings resulting from the specific ECMs that the customer implemented (see Table 1) may have been limited. However, staff responsibilities may change over time (e.g., one participant took over primary management of one of the participating buildings due to staff turnover), and training professionals that work in the building management industry can have broader benefits to the community.
  - **Recommendation 1:** Consider providing an optional customized training for facility managers, similar to the trainings developed for the OFTP, as a companion offering to a retro-commissioning program. Participating facility staff found value in the training and saw some benefit in terms of their ability to understand how building systems interacted and ultimately how to maintain savings from ECMs and changes to BEMS set points. However, there may be limited interest in a standalone customized training offering as demonstrated by Eversource's inability to recruit

participants into the program. As such, there may be opportunities to provide customers that are interested in retro-commissioning offerings with an optional add-on technical training that is specific to their building, rather than a more generalized facility manger training.

- **Recommendation 2:** Consider facilitating participation in existing more general facility operator trainings offered by other organizations. Eversource may have other avenues where they facilitate or help encourage participation in the more general Building Operator Certification training programs and certification. Additionally, Eversource might consider sponsoring facilities operator trainings offered based on different non-residential building segments or building use-cases (e.g., K-12 schools, health care, converted office buildings, etc.). These trainings could be more specific based on the needs of different building types, yet general enough to recruit staff from many different customers that operate similar buildings.

Appendix A. OFTP Program Theory and Logic Model

We have attached the final OFTP program theory and logic model below.

OFTP Logic Model_FINAL.pdf

Appendix B. OFTP Process Map

The evaluation team developed this map of the OFTP process prior to Eversource recruiting a qualified participant. As such, the process for delivering the program to the single participants differed somewhat from how the program team initially envisioned delivery.

OFTP Process Map_FINAL.pdf

Appendix C. Measures Crosswalk

Measure	Methods	Description	Source #1	Source #2	Source #3
Domestic Hot Water	▪ Baseline O&M Questionnaire ▪ Post-Participation O&M In-Depth Interview ▪ Engineering Analysis (O&M only)	▪ We recommend, as part of the initial operational assessment, to include a basic questionnaire to assess the baseline O&M practices of the building operators. ▪ To assess changes in O&M practices, we recommend conducting a brief semi-structured interview post-participation. From these data, we would be able to use engineering analyses to estimate energy savings the participant would be able to expect from the change in O&M practices (using appropriate technical references).	CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Lighting			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Package/Split-System HVAC			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Boiler/Hot Water/Steam System			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Economizer/Ventilation Controls			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Water Pump Optimization			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
HVAC Equipment Scheduling/Space Temperature			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Chiller/Chilled Water Systems			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Fan Optimization/Air Distribution			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Cooling Tower Optimization			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Motors			MA Review of Training and Education Programs	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Building Commissioning			MA Review of Training and Education Programs	MA TRM 2016–2018 Plan Version	Uniform Methods Project
Other			CA BOC Impact Evaluation	MA TRM 2016–2018 Plan Version	Uniform Methods Project

For more information, please contact:

Paul Wasmund
Director

617-301-4626 tel
pwasmund@opiniondynamics.com

1000 Winter Street
Waltham, MA 02451