

BOC Bulletin

A Newsletter for BOC Graduates, Enrollees and their Employers



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WINTER/SPRING 2012

Hawai'i: Looking to Push the Energy Challenge Envelope

The Aloha State of Hawai'i, with its dazzling sun and extraordinary beauty, has a unique position in our nation. A collection of Pacific islands, the state has the climate and resources that, one would think, would be sufficient to make it fairly self-sufficient in energy needs: lots of sun, ocean winds, geothermal options, and even the potential to harness tidal flows. All these represent renewable and sustainable means of sourcing energy.

And yet currently, Hawai'i is almost exclusively dependent on oil to fuel its energy needs, with an estimated 90% of the state's energy – from transport fuel to electricity – sourced from oil, according to the Hawai'i Clean Energy Initiative (HCEI). Electricity usage has almost tripled since 1970, kWh prices are now approaching 35 cents, the highest in the nation – and even higher on Neighbor Islands. Even gas prices are typically about 25 percent higher than those on the mainland.

The population of the state was at about 1.38 million as of the 2010 census. About seven million tourists visit yearly (tourism, along with the military, make up 50% of Hawai'i's total economy), which ups the ante for energy needs. HCEI also notes that more than 60% of energy used is for transportation and nearly 40% is used in buildings.

The Hawai'i State Energy Office estimates that \$4 billion a year is spent on



The Pacific Guardian Center high rise and the historic Dillingham Transportation Building, both entries in the EPA's 2011 National Building Competition. (Photo by Ryan Rutenschroer.)

oil imports, which would mean that per capita spending on oil is close to \$2,900 annually. This figure, adding 10% to account for other energy sources, is actually under the US state per capita average expenditure on energy, which is an estimated \$3,460 (US Department of Energy statistics). But while states on the mainland have the option of other energy sources such as coal, natural gas and nuclear, the skew to oil is so strong that Hawai'i finds itself at the mercy of volatile oil prices. Its remote location also make

the island state vulnerable to oil supply shortages, perceived or otherwise, since shortages tend to send sellers to larger markets where profits will be more favorable.

Efforts to reduce this dependency led to an aggressive campaign in 2008 by the state, its Department of Business, Economic Development and Tourism, the State Consumer Advocate, and Hawai'i electric companies, that led to an accord with the U.S. Department of Energy which set a goal of having 70% of energy loads met with energy efficiency and renewable energy by 2030. 30% is to be gained from energy efficiency measures and 40% of this will target the development of locally generated sources of renewable energy, harnessing Hawai'i's natural assets. In essence, the island is in a position to be a perfect testing ground for renewable energy options.

The Push to Building Efficiency

In 2010, Hawai'i became the 23rd state to join the BOC program and graduated its first of many classes at the University of Hawai'i at Maui College administered by the college's Sustainable Living Institute of Maui (SLIM). As noted above, buildings represent almost 40% of the state's energy use, and so BOC principles of no-cost/low-cost efficiency measures fit right into the state goal of a 30% reduction in energy use achieved by these means.

The initial program was funded by American Recovery and Reinvestment Act (ARRA). University of Hawai'i Outreach College, located on the island of Oahu, began offering BOC classes later the same year. One of the graduates is Ryan Rutenschroer, lead technician with Hawai'i Building Maintenance in Honolulu, the state's largest facilities management company.

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Energy Challenge (Continued from page 1)

Rutenschroer has a passion for buildings and their contribution to a better life through a better environment. The specific facility under his operation is the Pacific Guardian Center, which comprises over 630,000 of high-end retail and commercial office space. In the past, he wasn't a big fan of high-rises. "I used to really dislike them, but now I understand that it is really the only way we here in Hawai'i can preserve the beauty of the island," he observes. "By going up instead of out, we are able to save much of the land that would otherwise be developed."

With this realization and a commitment to efficiency, Rutenschroer has thrown himself into the task of making buildings work as they should. He has been using ENERGY STAR's Portfolio Manager since 2003 at the center and entered the facility into the Environmental Protection Agency's (EPA) 2011 National Building Competition, the "Battle of the Buildings," achieving an

energy cost savings of \$24,350 at Pacific Guardian Center. The center was built in 1979 to be an energy efficient building and improvements continue to be made and discussed with the facilities management team. "Buildings change as new tenants come in and adjustments are made, such as zones changes, which can alter the building system needs. You really have to stay on top of things," says Rutenschroer.

He and his colleagues look for potential projects.

"We have one building that uses a million gallons of water monthly but 75% of that is used by the cooling tower. Recycling that water would be a huge step in reducing water usage. There is always something to investigate and try to improve," states Rutenschroer. He developed a "sustainability maintenance plan," which broke all monitoring functions down by task and section to make the collection of data easier and more efficient. "We take measures daily. Numbers are important. You need to be armed with data because sometimes you have to spend money to save it."

"We take measures daily. Numbers are important. You need to be armed with data because sometimes you have to spend money to save it."

— Ryan Rutenschroer

Rutenschroer has continued his studies in sustainable building management and is also taking courses in architecture to learn more about effective and efficient design. He has created a web site to promote his thoughts on building efficiency and design, and their contribution to building environment health, and thus, occupant health (www.ArchitectureforHealing.com).

Encouraging All Options

Rutenschroer's attitude of a well-rounded, whole approach to energy efficiency is reflective of what the state's aggressive goal of 70% renewable energy by 2030 is trying to achieve. The goal encourages both efficiency and exploration of new energy sources using the natural gifts Hawai'i enjoys.

The Hawai'i Clean Energy Initiative's web site offer practical tips for individuals and businesses to cut energy use and take ownership of the fact that it is in everyone's interest to act responsibly.

In the drive for new energy sources, HCEI emphasizes that the state should "harness what we have wisely."

And there have been a number of encouraging developments. In December, Governor Neil Abercrombie

and the state's Department of Education announced that fifteen schools on Kauai would be the first step in a full conversion of the state's schools to solar energy with the installation of photovoltaic systems. Work started in January 2012 with completion targeted for the summer of 2014. Ultimately the goal is to have all schools using solar energy within a decade.

Hawai'i currently has over 65 renewable energy projects on tap, in collaboration with a variety of partners worldwide, such as Japan and China, who recognize



Ryan Rutenschroer seen on the roof at the Pacific Guardian Center.

the state's beneficial situation as a testing ground for renewable energy options.

These projects are exciting and promising, but the state doesn't shortchange efficiency measures. Just last month, Senator Mike Gabbard, the chair of the Senate Committee on Energy and Environment, together with several other state departments, announced the Capital 10 Energy Challenge, which is based on the EPA's Battle of the Buildings competition, where the ten buildings in the Capital 10 District are challenged to reduce energy consumption by \$100,000 for this calendar year. The focus will be on behavioral change – turning off lights, unplugging energy-sucking appliances when not in use – to, once again, emphasize individual responsibility for the sake of the ultimate goal of efficiency and decreased energy use.

Progress for Better Living

The incredible beauty of Hawai'i makes it seem like a paradise, but even paradise uses energy and a situation where 90% of the state's energy is sourced from oil was simply not tenable. To address this, Hawai'i has narrowed its focus to two goals for a more energy-independent state, as set forth by the HCEI: Conserve and Convert. While this is certainly the goal of many other states and, indeed, countries, Hawai'i's aggressive goals will not only bring it closer to sustainability, but will also highlight its status as a testing ground for the renewable energies of the future. **BOC**

BOC Grads Making a Difference

A Growing Passion for Efficiency Western Massachusetts Department of Mental Health (DMH)



Rae Ann Frenette
Director of Property
Management

Rae Ann Frenette began her career at the Western Massachusetts Department of Mental Health (DMH) 33 years ago, starting as a domestic aide for the then-Northampton State Hospital and working her way up to be assistant director to the

facilities manager. "While I didn't have a background in the technical side of facilities operations, working with facilities management encouraged me to get out 'in the field' to see what was actually going on," says Frenette.

Mentored by her predecessor, Robert Mielke, Frenette dove into the task of helping manage the area's nine DMH buildings. She joined the Massachusetts Facilities Managers Association (MAFMA), networking with other facilities people for ideas on how to improve efficiency and save money. In 2002, she succeeded her retiring mentor as the director of property management, a position she has held ever since.

In 2005, the Massachusetts Division of Capital Asset Management (DCAM), which is responsible for promoting efficiency in public buildings, forwarded an email to MAFMA members about BOC to gauge the level of interest. "Several of my colleagues at MAFMA familiar with BOC thought it would be perfect for me," says Frenette. "They said it would give me a great overall technical view of the different building systems and an understanding of how they interacted. I really wanted the basic knowledge it offered."

Interest was strong and when DCAM ultimately decided to sponsor a series and grant a number of subsidies to the state's FM personnel for the training, Frenette was one of the first in line, graduating from level I in January of 2008 and then level II just this past May.

Her initial participation in the program coincided with the state governor's announcement of Executive Order No. 484 – Leading by Example: Clean Energy and Efficient Buildings – in April 2007. Among other goals, the order set targets to reduce energy consumption in public buildings by 20% by fiscal year 2012, with a

baseline year of 2004, and 35% by 2020. "The training just made me want to jump right in and get our buildings to E0-484 standards."

BOC lends itself to the type of buildings Frenette has under her purview, mostly 1950s-era constructions with plenty of room for improvement. "The lighting in most of the buildings was very outdated and made a good target for savings," she notes.

Part of the training emphasizes using local utilities as a resource for the various incentives they offer. Working with Western MA Electric, her team retrofitted the Gandara Mental Health Center in Springfield, replacing all T12 4' and magnetic ballasts with T8 fixtures for an annual savings of \$1,918. With Western MA Electric's incentive at about 45% of the project's cost, payback for the recent retrofit is 3.5 years. Also at Gandara, the exterior lighting in a parking lot that used 250W metal halide fixtures was upgraded to 80W new induction fixtures, providing a significant decrease in wattage.

In Greenfield, the Sitterly Building was similarly retrofitted. Some of the lighting in the building's offices was inefficiently situated and partially obscured by valances. Because of this it was determined that the 4 T12 fixtures per office could be retrofitted using only 2 Ts, providing better light with fewer and more efficient fixtures. A \$50 rebate from the Mass Save Lighting Incentive program applied to each fixture purchased.

DMH contracted out for service to have sensors installed in the lobby area of Haskell Building. These sensors are set at a light threshold point so that the level of light is relatively constant and fixtures shut off when natural light is sufficient – a big asset in the case of the Haskell lobby. This project was completed in December of 2011. Motion-activated sensors were also installed in the hallways and bathrooms throughout the building.

Also at Haskell, there was a lighting upgrade for all fixtures in the offices/rooms. Local utility National Grid was offering incentives through a small business energy efficiency program. With the utility contributing almost 70% of the project's cost, payback is an impressive 20 months, with an annual dollar savings of \$2,300.

Another big energy saver was replacing the exit signs throughout the system's buildings. Exit signs are designed to run 24/7 so replacing old incandescent or even the more efficient fluorescent/CFL options reduces kWh use by

87% and 68%, respectively (according to an ENERGY STAR analysis of exit sign energy use).

Learning that utilities could be a good source of information and savings was one benefit Frenette gleaned from the training. The other was a network. "It was so helpful to meet with the other people in the class and exchange ideas. I still keep in touch with so many of them and that exchange still flows," she observes.

Frenette has many distinctions in her facilities management career. Last year she was awarded MAFMA's Facilities Manager of the Year. In addition to her duties as Western Massachusetts' DMH director of property management, she is also the area's emergency management coordinator, a huge responsibility over the past year with Hurricane Irene, tornados, and a freak snow storm hitting the area.

In 2010, she was among the first to graduate from MAFMA University's training program, newly-established by DCAM for state staff to both improve their skill set and to provide CEU credits for the BOC program. She was one of fifty graduates in the state, the only one from DMH and one of only two women to complete the studies. At the time, her colleagues at DMH highlighted her accomplishment in their newsletter, citing her favorite quote from Aldous Huxley: Experience is not what happens to you. It's what you do with what happens to you.

Rae Ann Frenette certainly knows how to make things happen!

Team Principles Don't Change

Gunderson Dettmer, Menlo Park, CA



Matt Thomson
Facilities Manager

Four years ago, BOC graduate **Matt Thomson** was profiled in the BOC Bulletin about taking on a small but unusual project at his company, Gunderson Dettmer, in the Menlo Park, California office location. The project was to convert a 600 square foot room that had housed

a law library to a multi-purpose space and to make it comfortable and energy efficient. Thomson was facilities coordinator at that time and, working with a team, completed the project to great success. At the time he

(Continued on page 4.) BOC GRADS.

BOC GRADS (Continued from page 3)

noted, "The sheer pleasure of the results, and the first-hand experience of the installation for our facilities personnel, has strengthened our small but friendly core group in ways that are best achieved through simple hands-on work. In short, we had fun, our results have been warmly acknowledged, and we strongly feel our team has added value to the firm."

The company eventually outgrew the Menlo Park space and, in 2010, relocated to Redwood City. The new location is a three-story building with 98,000 square feet of space. "It's a fantastic space and has Automatic Logic digital controls, T8 or T5 lighting throughout the building – a real pleasure to manage," says Thomson. As both a BOC level I and level II graduate, he does recognize, however, that the controls can only perform best when properly maintained and regularly monitored.

Thomson is now facilities manager at Gunderson Dettmer, a promotion received just over a year ago. The new position has meant more responsibilities within a more specific role. It also meant that inter- and intra-departmental cooperation is essential, especially since the law firm has three locations in addition to Redwood City: Boston, San Diego, and New York City.

While Thomson's new role is that of facilities manager in Redwood City, where he is responsible overall procedures for the nuts-and-bolts of daily operation as well as troubleshooting, there is cooperation among the four offices when skill sets need to be exchanged. "The term 'facilities manager' can be pretty broad-based. With my new position in the company, I see myself more as a troubleshooter when there is an issue at any of the locations since I really like the problem-solving aspect of the job," says Thomson. "But we operate as a team, looking to each other for suggestions and new ideas."

There was just such an issue at the Redwood City location. The compressor for the main air-handler unit that provides A/C for the entire building was "short-cycling." Rescheduling didn't work and neither did manual operation. It was a puzzle and required investigation into the equipment manuals, contacting manufacturers' vendor representatives, and even working with an outside HVAC consultant, who Thomson says was extremely supportive and helpful. Everyone pitched in ideas.

It was a haul, but Thomson states that, "Ultimately, we relied heavily on experience, research of building documents, information from suppliers, manufacturers, vendors, friends, professional contacts and dream-time. A combination of modern and primitive application of

vision, hearing, multi-meter readings, software readings, trending logs, hand-touch, common sense and intuition and perseverance led to confirm an accurate diagnosis."

The team's extensive research indicated that it was likely the whole system had never really been fully commissioned. Things worked, but not well. Thomson explains, "One major issue was revealed by the trending software showing maximum allowable short-cycling of all compressors on a daily basis. Our team's diligent, objective observations and testing showed that solenoid loading and unloading had incorrectly been connected, presumably using a wiring diagram for a different model of compressor. Because of the asset value, we were extremely cautious when making corrections and evaluating results. In the end, looking back, we made all the right choices, even though it took a long time for final implementation."

Results were immediate, with radically decreased start cycles and corrected loading and un-loading sequencing promising smoother operation, increased occupancy comfort, and markedly reduced energy use. Of the ultimate savings, Thomson observes that, "Unfortunately, the energy savings realized is coupled with other changes to the operating sequences. One estimate is a 50% decrease in energy use, but that may be high. Still, our trending with the Energy Star system should be revealing in another few months."

Thomson has been in the field for almost three decades now, starting in medical facilities and moving to office buildings in the late 90s. He says he still loves the work and its team-building and problem-solving aspects and does credit BOC with helping him in his work. "BOC training focuses your knowledge base just enough to learn that reaching out to others will have constant beneficial gains. The program recognizes strengths of individuals, while promoting team work and knowledge development."

His next move is to delve into the use of thermography at the various locations, using the technology to discover potential problem areas, determining their severity and prioritizing them as action items for the local facilities' teams. The 2007 project in Menlo Park used a team approach for the small space renovation. Thomson continues to promote that team concept across multiple locations for their many other projects. He's finding that the team principles still stand him in good stead.

(The original story mentioned above, published in the Winter/Spring 2008 edition of the BOC Bulletin, can be found at www.theBOC.info, as can many other previous newsletters and case studies.)

Finding Resources – Both Analytical and Financial

Providence Little Company of Mary (LCM) Medical Center – San Pedro, California



Devin Hugie
Manager of Facility and Security Services

For over five years, **Devin Hugie** has been the manager of facility and security services for Providence Little Company of Mary (LCM) Medical Center in San Pedro, California. Prior to that, Hugie was on the technical side of facilities maintenance for 17 years. He sits on the board of the

Los Angeles chapter of the California Society of Healthcare Engineers (CSHE) and has an intimate knowledge of the particular problems of managing and maintaining medical buildings, particularly hospitals which operate 24/7.

Hugie had heard about the program but did not know many details until he went to a CSHE trade meeting at which BOC was represented by Greg Funke, one of the training coordinators in California. "Greg explained so much more about what the program actually entailed and it seemed as if it would be a good fit for me and, possibly, some of my staff as well," says Hugie. He went on to complete level I in 2009 and level II in 2010.

Four of his staff completed training last year and he intends to have at least two of these graduates complete level II this year. Hugie also intends to send two more people to level I so he obviously found it useful. "After they go through the training, people return to their work with a much broader perspective on how to approach building management situations."

One of the main takeaways from the training for Hugie was the realization of the vast number of resources available, both financial and analytical, and knowing where to look and who to ask. One of the analytical resources he found was consulting company Water Savers Solutions (WSS), who agreed to do an analysis of the water use at Providence LCM San Pedro and suggest ways to improve the numbers.

Their analysis was that with some updates and modifications, especially to the older faucets and toilets, a saving of about 4.6 million gallons of water could be achieved, which would translate to a 56% reduction in water use over the previous year's consumption (8.17 million) for devices that were retrofitted. "Water isn't one of our biggest expenses and most people don't

think about it when looking at efficiency. But water is precious, especially in California. Using it as efficiently as possible is being socially responsible and it's just the right thing to do," concludes Hugie.

The survey also included information on applicable rebates available from local utilities. A program at the Los Angeles Department of Water and Power for instance was providing rebates on urinals from \$250 to \$500, depending on the fixtures' savings. Rebates from \$50 to \$150 were available as well for updated toilets. Southern California Gas Company's (SoCal Gas) Business Incentive Program was providing rebates in the neighborhood of \$10 per sink for installation of laminar flow devices or flow control valves.

WSS also suggested the *Water Efficiency Manual* from the State of North Carolina as one of their favorite (and free) resources for facilities such as Providence LCM San Pedro, planning to implement a water conservation program. (This is probably most easily downloaded from www.savewaternc.org/bushome.php/.) An essential part of a successful program is getting buy-in from building occupants by convincing them that the lower-flow fixtures were either just as effective as their predecessors or needed minimal routine changes. Communicating to people just how dramatic the savings actually are highlights that each individual has a responsibility to do his or her part to get results and makes change a positive part of the culture.

The report was completed in January 2011. Hugie and his team worked with WSS to implement the changes, which was a fairly quick process starting in mid-May of 2011 and ending in early June.

In another arena, the Providence LCM San Pedro team also did a lighting retrofit of the Little Mary Hospital garage, two stories of above-ground parking and one subterranean. Using new T8 technology with low-wattage, extended-life lamps and high performance electronic ballasts, they completely changed the look of the garage floors, giving a much brighter environment, with the added bonus of annual estimated savings of \$6,027. Payback for this project is about 21 months, including rebates from Southern California Edison (SCE). In the underground area of the garage they used a reflector conversion kit to enhance the light. "The savings were good but really, most of the feedback we got from people was that they just felt so much safer with the new lighting, which is especially important when your facility is running 24/7 and people are always coming and going," says Hugie.

Hospitals are huge consumers of energy and so being able to find resources to help curb use is crucial. Because of the nature of what they do, hospitals can't really take advantage of adjusting their operations to off set peak demand rates. "When you have a critical care situation, you can't make those changes so we really have to conserve strategically," says Hugie. "It's very beneficial being in BOC classes to hear how others solve their issues. You start thinking out of the box in areas you can control and that's not only satisfying but gets results."

Using Technology to Best Advantage
One MetroTech - Brooklyn, New York



Thomas Klein
*Building Engineer/
Facilities Manager*

A building engineer at One MetroTech since it was constructed in 1992, **Thomas Klein** has been in facilities management since 1980, with a little time off to try construction. As a member of the International Union of Operating Engineers Local 94, he was one of many union members who have taken advantage of BOC training sponsored by the partnership between the union and the CUNY Institutes for Urban Systems Building Performance Lab. He earned BOC level I certification in 2011.

One MetroTech, part of the MetroTech Center, a business, educational, and events complex encompassing a 16-acre block in the heart of downtown Brooklyn, New York provides many challenges for Klein and his colleagues. The building is not that old at two decades, but equipment wears down and technology advances, a situation that has its advantages but has to be carefully addressed to achieve the best results.

One major problem arose following a chiller replacement project. The original three chillers, two 1,000 tons and one at 500 tons, were replaced over a period of three years starting in 2003. The two 1,000-ton chillers required

flow was 3,000 gpm for condenser water and 2,000 gpm for chiller water, while the new 700-ton machines required only 2,250 gpm and 1,500 gpm maximum, respectively. So far so good.

Unfortunately, the original chilled water and condenser pumps associated with each chiller were not replaced and were oversized for the new chillers. The facilities staff realized the problem and attempted a workaround by throttling valves to reduce water flow to accommodate the new chillers. While this did adapt to the chiller requirements, it had no impact on the power used by the pumps so energy costs stayed the same.

Klein presented the problem to BOC instructor Zach Stern. At the conclusion of their discussion they determined that the pumps would run more efficiently with the installation of variable frequency drives (VFDs). Instead of valving to reduce water flow, the drives would slow the rate of the pumps themselves to supply the lesser flow needed by the new chillers.

It was a good solution, but it was expensive at \$12,500 per VFD. But there was help to be had and together, the building owners and facilities teams are working with the New York State Energy Research and Development Authority (NYSERDA) to determine the final amount of incentive funding NYSEDA will provide to offset overall project costs. The project was a go.

Once John Coffey, One MetroTech's chief engineer, and his building engineers team had installed the two drives for the two pumps on the first chiller, they found that the VFDs reduced the rotational speed from 60 hertz during the day, to a range of 30 to 40 hertz. On off hours, the range was reduced to 30-32 hertz, reducing daily pump energy usage by approximately 30% while maintaining comfortable overall building temperature.

The results were so dramatic and quick in coming that they went to work on the second 700-ton chiller, installing two more VFDs by year's end. A proposal is in the works for the final set of pumps, which Klein anticipates they

	# OF LOBBY LIGHTS	WATT RANGE	# OF ARCADE LIGHTS	WATT RANGE
OLD	44	300-160	52	300-100
NEW	44	150-23	52	65-23
% kWh DECREASE	61%		77%	

(Continued on page 6.) BOC Grads.

BOC Grads (Continued from page 5)

will be able to install this year. The building also has the capacity to switch from electricity to natural gas and they monitor pricing so that when natural gas prices were comparatively low last year, they made the switch. "It's hard to pin down the various savings factors, internal and external, but there was a four month period last year where energy dollar saving was about \$100,000 for the building," estimates Klein.

Klein and his team have also undertaken a series of lighting retrofits with great results. "When this building was constructed, everything was T12 bulbs with magnetic ballasts so there's a lot of potential for improvement, especially at the pace the technologies advance." The building's exterior arcade had 52 hanging or downlight fixtures that operate 12 hours a day. The arcade leads to the main lobby where the 44 lights, running 24/7 were also replaced. The chart on page 5 details the results.

Decreases like these are hard to argue with and usually have attractive payback periods. The replacement of the garage lighting with a T5 or T8 fluorescent and possibly LED fixtures has an estimate of 1.9 years, depending on the choices and rebate incentives, and Klein believes that the upcoming replacement of all the lighting in the stairways – a significant number in a 28-story building – will also yield similar results. "Each stairway has a T12 at every landing and we're going with a T8 or less. A T8 fixture it will save about 6000 kWh in each staircase per year," explains Klein.

As Klein sees it, the city standards are getting more and more demanding and the BOC training helps to highlight ways these standards can be met or, even bested, by efficiencies such as consistent monitoring BAS systems and scheduling to obtain peak performance. He likes to pass on what he's learned to his fellow operators and while participation in BOC training is voluntary for Local 94 members, he believes it should be mandatory because it gets results. He also says that even after all his years in facilities maintenance, it's something of an eye-opener. "I've been in the commercial side of FM my entire career and the main thing was always HVAC. Many of the people taking the class have such different issues to focus on, like boilers at a manufacturing plant and how to use the steam as a resource to power machines. There's such a range of issues to be dealt with and it's so interesting to listen to other people's experiences and trade solutions," he notes.

New Website Lets You Highlight Your Building's Success

Deputy Director Nora Sherman of the CUNY Building Performance Lab is working on an initiative with Honest Buildings, an exciting new company that is a great resource for promoting BOC training efforts, showcasing successful projects by BOC graduates and connecting the community of BOC students, instructors, and graduates. Honest Buildings has already partnered with the Department of Energy, Environmental Defense Fund, Con Edison's C&I Energy Efficiency Program, and the U.S. Green Building Council, and hosts over 50,000 buildings (10 billion sq. ft.), including every LEED certified and ENERGY STAR certified building in the U.S.

The platform "connects occupants, owners, and building service providers to the buildings where they work and live, and to each other," explains Sherman. The site has been in private beta but goes live in early February.

The partnerships with DOE and USGBC mean that many of your buildings are already on the site! The Honest Buildings team is also in the process of adding the first batch of energy benchmarking data released by the City of New York. There are already a number of BOC projects on the site, which can be viewed on the Projects page under the "BOC" tag.

Sherman is working with members of the BOC national office to engage BOC graduates across the country to use Honest Buildings. A CUNY intern is helping graduates create profiles for themselves, their buildings, and their projects. To take part in the project, contact Sherman at nora@honestbuildings.com or simply sign up for free at www.honestbuildings.com. Be sure to tag your profiles with "BOC."

"In the same way that companies proudly display their LEED plaques, the Honest Buildings site will allow efficient buildings to display a BOC badge," says Sherman, adding, "We imagine a nationwide map of BOC graduates, projects, and buildings that really showcases the positive impact the program has had on our country's built environment." We hope you'll join in the effort.

On a side note, CUNY BPL interns Carol Britto and Lalaberg Khan, with the help of BOC instructor Zach Stern, prepared a case study on progress at One MetroTech, which is the basis of a BOC graduate profile on page 5 of this newsletter. We thank them for their work! To see the case study, visit the CUNY BPL web site at: www.cunyurbansystems.org.

College and University Building Operators Flock to BOC in North Carolina!

Four community colleges across the state received American Recovery and Reinvestment Act (ARRA) funds for BOC training through the North Carolina Department of Energy (NCDOE), administrator of the state's energy-oriented ARRA funds. The funding supports training for the state's college and university facilities maintenance staff to earn the Building Operator Certification.

Through the North Carolina Community College System (NCCCS), the NCDOE contracted with the community colleges that were already offering the training: Asheville-Buncombe Technical Community College, Caldwell Community College & Technical Institute, Durham Technical Community College, and Edgecombe Community College.

Durham Technical alone has already graduated 43 students over the past year, with an additional 21 due to finish up in February 2012. This is great news for these North Carolina's colleges and we expect to be able to report some great success stories in future BOC Bulletin issues!

Empowering Employees with Training

Virginia Mason Medical Center (VMMC) hosted a BOC training series for 17 of its facilities maintenance staff onsite at the center, designed to enhance the skills of its FM staff, giving them the tools to initiate energy efficiency projects at the center. Partnering as a sponsor of the training was Crothall Services Group, the employment company that provides personnel to the center. In all, 23 facilities personnel participated in the training, with 17 of those from VMMC. Six were from another area medical facility. Crothall is requiring its building engineers to go through BOC training and negotiated an agreement with VMMC to give an hourly wage increase to those participants who successfully complete BOC level I. The engineers are eligible for a second increase should they complete level II.

Mike Olson, a VMMC participant and now a BOC level I graduate, says of the training, "It provided information about lighting and building envelopes that I was unaware of. Since the class was here on campus, being in our own environment was very comfortable. Also, most of us had never used ENERGY STAR® Portfolio Manager before and it was informative. It was good training for all of us and the instructors were helpful with any and all questions."

The Sound Energy Efficiency Development (SEED) project partially supported the training at VMMC by providing tuition assistance. SEED is a grant project funded by an American Recovery and Reinvestment Act (ARRA) from the Department of Labor. The project covers a five-county area (King, Kitsap, Clallam, Snohomish and Pierce) in Washington and worked to provide training to help workers succeed in a variety of energy efficiency-related jobs.

We applaud the training initiative and success at VMMC!

BOC Graduate Receives Environmental Achievement Award

Pace Dairy Food, Co. in Rochester, Minnesota recently received the 2012 Environmental Achievement Award from Olmsted County and Rochester Public Utilities (RPU) for outstanding environmental achievement in energy conservation. The maintenance supervisor at Pace Dairy, Tim Hunsucker, is a BOC graduate from the November 2008 Rochester training series.

This award is given annually by Olmsted County and RPU to recognize businesses, organizations and individuals who have made positive improvements to the environmental quality of the local community. The award was officially presented at the Olmsted County/RPU Environmental Achievement Awards banquet on January 26, 2012. We would like to commend Tim for his efforts to use and build upon the knowledge earned through the BOC program and for his continued contributions to energy efficiency. We also plan to detail the efficiency achievements of the Rochester division's facilities management team in our next issue.

Benchmarking the Benchmarks in New York

A consortium of BOC stakeholders in New York City has been spearheading an initiative to get BOC level I training and certification for as many government-sector facilities maintenance personnel as possible. Since the spring of 2009, the City University of New York's Building Performance Lab and School of Professional Studies has partnered with the city's Division of Citywide Administrative Services (DCAS) to train facilities managers in several city agencies including Corrections, Fire, Police and Sanitation. In fall 2010, an effort designed to train 1,050 facilities personnel within the Department of Education (DOE) was initiated. Large scale training initiatives such as this DOE project don't happen that often, so the partners are taking advantage of this opportunity to evaluate the impact of the

BOC content against energy consumption in the buildings of BOC level I completers.

The evaluation initiative will: analyze the employees' skills developed through BOC level I training; examine how changes in employee behaviors in the facility management processes and in new technology have been implemented in city schools; and determine whether or not the behaviors, processes or technologies have resulted in measurable energy savings.

As L. Patrick Dail, project director of Energy Management Training CUNY SPS explains it, "320 facility managers completed BOC level I training with us in June 2011. We are going to

evaluate this group, in particular, to understand which behaviors taught in the course are actually being practiced in their buildings, the behaviors that 'stuck' and the content that has been most impactful, and figure out how to project energy savings attributable to the training program." The study methodology was constructed in the fall 2011, with a planned start of January 2012. Part of what they will be doing is, in essence, to benchmark the new benchmarks. The goal is to put a dollar number on the overall savings as a result of BOC level I training.

Watch for the findings of this exciting study in the summer/fall issue of the BOC Bulletin!

National Conferences & Symposiums 2012

International Summit on Health Facility Planning, Design & Construction

Phoenix, Arizona
March 4 -7, 2012
More info: www.ashe.org/PDC/

National Facilities Management & Technology Conference/Expo

The Baltimore Convention Center
Baltimore, Maryland
March 13 -15, 2012
More info: www.nfamt.com

Association of Energy Engineers (AEE) Conferences & Technology Expos

Globalcon 2012
Atlantic City, New Jersey
March 7 - 8, 2012

West Coast Energy Management Congress (EMC)

Seattle, Washington
May 23 - 24, 2012
More info: www.aeecenter.org/Shows/

IFMA Facility Fusion

Sheraton Chicago Hotel & Towers
Chicago, Illinois
April 11 - 13, 2012
More info: www.ifma.org

National School Plant Management Association 17th Annual Conference

Embassy Suites at Kingston Plantation
Myrtle Beach, South Carolina
March 13 - 15, 2012
More info: www.nspma.org

American Public Power Association (APPA) National Conference & Public Power Expo

Seattle, Washington
June 16 - 20, 2012
More info: www.publicpower.org/National-Conference/

BOMA 2012 International Conference & The Every Building Show

Washington State Convention Center
Seattle, Washington
June 24 - 26, 2012
More info: www.boma.org

American Society for Healthcare Engineering (ASHE) 49th Annual Conference

San Antonio, Texas
July 15 - 18, 2012
More info: www.ashe.org/annual

GovEnergy 15th Annual Workshop and Trade Show

St. Louis, Missouri
August 19 - 22, 2012
More info: www.govenergy.com

Labs 21 2012 Conference

San Jose, California
October 2 - 4, 2012
More info: www.i2sl.org

GreenBuild International Conference & Expo

San Francisco, California
November 13 - 16, 2012
More info: www.greenbuildexpo.org

Building Operating Management's Facility Decisions Conference & Expo

Mirage Event Center
Las Vegas, Nevada
October 2 - 3, 2012
More info: www.facilitydecisions.com

IFMA World Workplace 2012

San Antonio, Texas
October 31 - November 2, 2012
More info: www.ifma.org/events/

Take Good Care of Airside Economizers to Realize Free Cooling Benefits

By Dave Moser

Airside economizers are simple, effective systems that significantly reduce cooling energy use and improve indoor air quality. They increase the energy efficiency of the HVAC system so much that most energy codes require them for most commercial applications. Yet these systems are often neglected and, over time, can degrade to the point that they don't operate correctly, resulting in energy waste. A little periodic maintenance can help keep them operating correctly.

Sometimes referred to as "free cooling," an airside economizer system consists of a set of outside and return air dampers that operate together to reduce the load on the mechanical cooling system. When outside air conditions are cool enough, the mechanical cooling can be shut off completely and the system can use outside air to cool the building, thus reducing the overall energy use of a facility. Indoor air quality is increased during airside economizer operation because more ventilation air is provided to the occupied spaces in this mode.

Airside economizers come in various forms (e.g., temperature-based or enthalpy-based) and are typically more cost-effective for larger buildings. They may not make much sense in some climates, especially hot, humid ones. Design considerations are important and have to be addressed, but design is only one side of the equation of making airside economizers effective. If you already have an airside economizer system, how can you maintain it to keep energy costs down and indoor air quality high? The principles involved apply to small packaged HVAC systems as well as larger built-up air handling systems.

Airside economizers operate behind the scenes so that it might not be apparent if the system is working correctly or not. If it's not, the main consequence is higher energy bills.

How do airside economizers typically fail? What contributes to sub-optimal operation? What can building operators do to maintain proper performance? There are many methods of maintaining airside economizer performance, from periodic testing to trend data analysis. Here are some of the key issues to consider.

Most airside economizer damper systems are intended to operate as follows:

- **When outside air conditions are very cold:** The unit is in heating mode. Mechanical cooling is off, economizer dampers are at minimum outside air position, and the heating coil operates to maintain supply air temperature setpoint.
- **When outside air conditions are cold:** The unit is in economizer cooling mode. The heating coil is off, mechanical cooling is off, and economizer dampers modulate to maintain supply air temperature setpoint.
- **When outside air conditions are cool:** The unit is in "integrated economizer" and mechanical cooling mode. Heating coil is off, economizer dampers are at 100 percent outside air position, and mechanical cooling operates to maintain supply air temperature reset.
- **When outside air conditions are hot:** The unit is in mechanical cooling mode. The heating coil is off, economizer dampers are at minimum outside air position, and mechanical cooling operates to maintain supply air temperature setpoint.

This general description applies to most systems. The specific type of system, climate and control sequence will dictate how a system is intended to perform for actual installations.

Common Problems in Airside Economizer Design and Construction

Some airside economizer systems are essentially doomed from the start, whether from sub-optimal design or improper construction. This is especially common for buildings that were not initially commissioned during construction. Common issues include:

- **Improper sensor type.** In theory, enthalpy-based control of airside economizers is more energy efficient than temperature-based since enthalpy controls account for humidity. In practice, enthalpy sensors are prone to drift out of calibration – assuming they were calibrated properly to begin with – which can result in energy waste. Recent studies indicate that it may be more cost-effective to use temperature-based control when operation costs,

maintenance costs and sensor error are considered along with energy benefits.

- **Oversized return air dampers.** For proper control, return air dampers need adequate air velocity. This is especially true for systems that use return fans instead of relief fans. Measure the air velocity across the return air damper during minimum outside air mode, when the return air dampers are 100 percent open. If it's much less than 1,500 fpm (a rule of thumb), consider blanking off some of the return air dampers to increase performance. (See picture on page 9.)
- **Inadequate building pressure relief.** During economizer operation, adequate pressure relief must be available to avoid building over-pressurization issues such as doors standing open and reduced supply airflow. If the difference between the indoor and outdoor pressure during economizer operation is much greater than a tenth of an inch, investigate the relief air system for adequate airflow path and proper control.
- **Poor sensor placement.** Temperature and enthalpy sensor placement is crucial for proper economizer operation. Verify that the outside air sensor is in a good, representative location (e.g., no direct sun, not too close to air outlets), and make sure the mixed air sensors are located logically as well. Averaging sensors are the best choice for mixed air temperature.

A recent PECE (Portland Energy Conservation, Inc.) study showed that optimizing the performance of airside economizer systems is one of the most common and most cost-effective measures implemented as part of an existing building commissioning process, usually with a simple payback of less than one year. For more information, go to www.peci.org/documents/annex_report.pdf.

Fixes for Common Airside Economizer Operational Problems

According to a PECE study on existing building commissioning, air handlers typically have more performance issues than any other type of equipment. Air handler maintenance is complex and can easily be overlooked or deferred. The Building Owner and Managers

Association's (BOMA's) recently updated preventive maintenance guide, "Preventive Maintenance: Best Practices to Maintain Efficient and Sustainable Buildings," suggests preventive maintenance tasks for air handlers, which include quarterly and semiannual preventive maintenance tasks for airside economizer systems. Here are some common maintenance-related issues and periodic checks that can be done.

- **Stuck dampers or broken linkages.** Economizer dampers, especially outside air dampers, can seize in place due to entrained debris, humid conditions, and is especially for salty, corrosive marine environments. Also, the linkages, which connect the actuator to the damper, can fail. Cycle your dampers open and closed periodically and verify that they operate as intended. This often requires one person at the control system operator workstation, and another person on site actually observing that damper operation aligns with what the system signals.
- **Actuators not adjusted for full closure.** A slight opening in the "closed" return air dampers during integrated economizer and mechanical cooling mode (100 percent outside air) can significantly reduce the efficiency of the system due to increased mechanical cooling load. The pressure characteristics are typically such that a slight opening in the return air damper translates to a significant amount of airflow. Command your return dampers closed, and then verify that they close completely by feeling for leakage. If they are not closed completely, adjust the actuator/linkage connection. When closing the return dampers, be sure the outside air dampers are open, to prevent the plenum walls from collapsing inward.
- **Worn blade and jamb seals.** Blade and jamb seals help reduce damper leakage when the damper is closed. With no seals, leakage can be as much as 10 percent of rated damper airflow. Inspect your blade and jamb seals for leaks by feeling around the damper blades when they're closed, and if your dampers don't have seals, consider installing them to increase the efficiency of your system through reduced return damper leakage during 100 percent outside air mode.
- **Sensors out of calibration.** As previously mentioned, temperature and enthalpy sensors are prone to drift out of calibration, especially enthalpy sensors. Develop and implement a sensor calibration program that can help keep these sensors

calibrated to maintain the overall performance of the system. [This is good to do for other HVAC sensors too, especially those used as inputs to control sequences, such as measuring chilled water flow for a chiller staging sequence.]

For more information on airside economizer fundamentals, methods of control, and test procedures, consult the Functional Testing and Design Guides at www.peci.org/ftguide. Always consider the effects on other systems and include necessary precautions in any test procedures.

Fixes for Common Issues With Airside Economizers and Control Systems

Airside economizer damper control requires close coordination and integration with the system's heating and cooling systems to maximize the energy efficiency of the system. Common controls-related issues, and their corresponding fixes, include:

The economizer is not integrated with mechanical cooling. It's beneficial to operate the system in full economizer mode (100 percent outside air) when the outside air conditions are just a bit cooler than inside conditions and the system is asking for mechanical cooling. This helps reduce the mechanical cooling load by keeping the cooling coil's inlet air (mixed air) temperature as low as possible. Take a look at your air handler control sequences, and observe system operation during these cool outside air conditions (e.g., 55° F to 65° F outside air, depending on the control sequence) to verify you're getting the full benefit of airside economizer operation.



Return air dampers too big? Blanking them off may improve performance.

Economizer control disabled. Some buildings have disabled their airside economizers in reaction to a performance issue where the economizers weren't the main culprit or due to a lack of understanding of the system's benefits and performance. If you've disabled your airside economizers, consider re-enabling them, but also address any outstanding performance issues.

Reduced economizer effectiveness. Past existing building commissioning projects have uncovered many control strategies that reduce the efficiency of the system. Two examples: a 30 percent minimum return air damper setpoint rather than a zero percent setpoint, and a low economizer changeover setpoint (the point at which the system changes from economizer mode to non-economizer mode, usually around 70° F outside air temperature). Review your control sequences to see if there are any opportunities for increased energy efficiency.

In general, first determine the intended operation of the airside economizer system. Review the original construction documents and consult with your operating staff to see how the system is currently programmed to operate. Investigate and implement optimization opportunities based on this exercise. Then, periodically test the system to determine if it's performing as intended and take corrective action when it's not. When testing the control sequences, be sure to test them in all operating modes (heating, economizer cooling, integrated economizer and mechanical cooling, and mechanical cooling with minimum outside air).

As a final note, your building automation system (BAS) can be a powerful tool to help monitor the performance of the economizer system. Periodically collecting and analyzing BAS trend data can be a good way of viewing system performance. X-Y scatter plots are often more telling than time-series plots, which can be confusing. Neither will show what problem exists, only that there is a problem requiring investigation. Be sure to filter the data to show "fan on" operation only, and also be sure that your BAS temperature and enthalpy sensors are calibrated.

Airside economizers can save a significant amount of energy, but they need to be maintained for their "free cooling" energy benefits to be realized.

Dave Moser, P.E., is a senior engineer at PECEI and also a BOC instructor. He provides engineering services for a diverse range of projects and programs at PECEI, all centered on building energy efficiency.

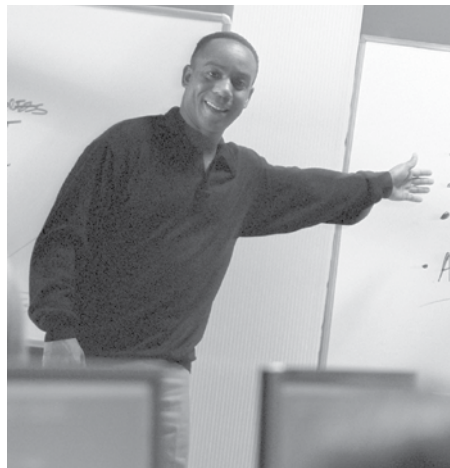
This edited article is reprinted with permission. For the complete version of "Take Good Care of Airside Economizers to Realize Free Cooling Benefits" please visit the FacilitiesNet site at www.facilitiesnet.com and look for it in the HVAC section. Also, you can earn 1 hour of credit towards your BOC renewal by taking a quiz on the material in this article at www.theBOC.info.

Call for Feedback and Projects!

Our publication aims to highlight new technologies, relate success stories of graduates and get the word out about new ideas in the facilities management industry. We are open to suggestions: What would you, as readers, like to hear about?

All readers are encouraged to submit their thoughts on content they would like to see, technologies that spark their interest, or their own personnel successes as energy-efficient facilities personnel.

Please, submit your ideas to email address: news@theBOC.info. You can also submit your own successful project story at the BOC web site (www.theBOC.info) under the "For Graduates" section. We'd love to hear from you.



Check out BOC's Technical Webinar Series!

The BOC web site (www.theBOC.info) offers webinars, both live and prerecorded (available for viewing at your convenience). Register and receive a link, with log-in and password information. Successful completion of each webinar and its accompanying quiz earns you 1.5 continuing education hours towards maintaining your BOC certification.

The LIVE webinars offered in 2012 will be a four-part series on High Performance HVAC Equipment. Sessions will be held from 1PM to 2PM Central Standard Time on the following dates:

- February 15**.....*Condensing Boilers*
- March 14**.....*Ground Source Heat Pumps*
- July 19**.....*Heat Recovery Chillers*
- September 19**.....*Heat/Energy Recovery Ventilation*

Information on fees and registration is available at the BOC web site listed above. A link to the webinar details can be accessed on the home page.

BOC Graduate Numbers Continue to Grow!

As BOC expands across the country, the number of graduates grows as well, with over 9,000 nationwide. Graduates from this year and last hail from Idaho to Rhode Island, from Minnesota to Hawaii, and represent companies in education, government, manufacturing, health care and beyond – just about every sector you can name.

BOC Certification Renewal

To maintain BOC certification, graduates must accumulate continuing education (CE) hours each year following a full calendar year after their graduation. Level I renewal requires five CE hours each year and Level II requires ten. For renewal at both levels, a total of 15 hours is needed. Hours may be earned as follows:

- **Continued employment in building operations**.....*2 hours / year*
- **Continuing education in building operations**.....*Actual hours of classroom time*
- **Energy efficiency projects completed at your facility**.....*Up to 11 hours / year*
- **Membership in a building operations membership association**.....*1 hour / year*
- **Offices held in membership associations**.....*2 hours / year*
- **Awards received for efficient building operations***2 hours / award*
- **BOC newsletter tech article quiz – (see page 3 for details)**.....*1 hour / passed quiz*
- **Completion of an energy consumption benchmark for the previous 12 month period using ENERGY STAR® Portfolio Manager or alternative energy accounting tool**.....*3 hours / year*
- **Enroll in a BOC webinar and complete its quiz (see webinar announcement on first column this page)** *1.5 hours / passed quiz*

You will be notified by mail when your certification is up for renewal (anniversary date appears on your wallet card). Once you have received a renewal notice, complete the application form and return it to your program administrator as instructed. Renewal fees are \$55 for each level. If you would like to renew for both level I and level II, there is a combined rate of \$85.

Please note that if your request for renewal is received after the March 31, 2012 deadline, there will be an additional fee of \$25. Those received after June 30, 2012 will be charged an additional \$50 late fee. Late renewal will require an extension form that can be found on the BOC web site (www.theBOC.info) under the "For Graduates" section.

New to BOC?

Listen to a FREE Informational BOC Webcast:

BOC® Informational Webcasts are for newcomers to the program. Learn about Level I and Level II course topics, schedules and certification requirements in detail. Listen in and find out who benefits by attending BOC training and how graduates are improving their facilities.

Live webcasts are held four times a year. Pre-recorded webcasts can be downloaded from the BOC website 24/7.

Informational webcasts last approximately one hour, starting at:

- 8:30AM - 9:30AM (PST)**
- 9:30AM - 10:30AM (MST)**
- 10:30AM - 11:30AM (CST)**
- 11:30AM - 12:30PM (EST)**

Scheduled webcasts for 2012 will be held on **February 8th, March 7th, July 11th, and September 12th.**

To sign up go to: www.theBOC.info

If that date is not convenient, the site also provides a prerecorded informational webcast.



Find A BOC Training In Your Area

There are currently over 9,000 BOC graduates throughout the country and that number will continue to grow because the need for educated facilities operations & maintenance personnel is stronger than ever. BOC training is offered in twenty-four states and that number continues to grow as well.

BOC Level I Certification

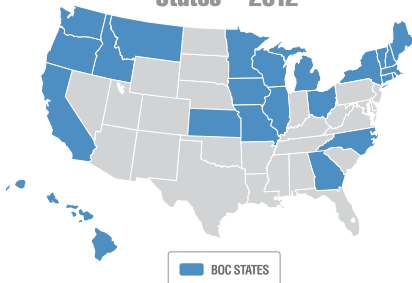
The Level I series comprises 74 hours of training and project work in building systems maintenance. Courses include: Building Systems Overview, HVAC Systems and Controls, Facility Electrical Systems, Indoor Environmental Quality, Operation & Maintenance Practices for Sustainable Buildings, Efficient Lighting Fundamental and Energy Conservation Techniques.

BOC Level II Certification

Level II has 61 hours of training and project work in equipment troubleshooting and maintenance. Courses include four core classes and two supplemental classes. The four core classes include: Preventive Maintenance & Troubleshooting Principles, Advanced Electrical Diagnostics, HVAC Troubleshooting & Maintenance, HVAC Controls and Optimization. See the website for supplemental class topics.

To find and register for a Level I or Level II training in your area, please visit the BOC website at www.theBOC.info. Training is available from Maine to California – and now, even Hawai'i!

Building Operator Certification States – 2012



Certification Renewal Reminder: Due March 31, 2012

For those BOC graduates whose certification expired January 1, 2012, the renewal process began in the first week of this year. You should have received an application at that time but remember, the deadline for application submissions is March 31, 2012. You will need Continuing Education credit to renew your level of certification so don't wait too long! See page 10 for details of renewal requirements for both Levels I and II.

Continuing Education Opportunities for Certification Renewal Credit

Below you will find listings for the web sites of various national organizations that offer continuing education courses that are applicable to annual BOC certification renewal. Check out the Education, Professional Development and Events Calendars at these sites.

APPA:
The Association of Physical Plant Administrators
www.appa.org

ASHE :
The American Society for Healthcare Engineering
www.ashe.org/learn/

BOC: Building Operator Certification
Live and recorded seminars at
www.theBOC.info/m-live-webinars.html

BOMA:
Building Owners & Managers Association
www.boma.org/TrainingAndEducation/BEEP/

BOMI:
Building Owners & Managers Institute
www.bomi-edu.org

ENERGY STAR®:
Live web conferences, pre-recorded trainings, self-guided presentations
www.energystar.gov/index.cfm?c=business.bus_internet_presentations

FEMP:
Federal Energy Management Program Workshops & Conferences
www.eere.energy.gov/

FacilitiesNet:
Federal Energy Management Program Workshops & Conferences
www.facilitiesnet.com

FMLink:
US Green Building Council
www.fmlink.com

GreenBuild:
US Green Building Council
www.usgbc.org

HVACR Education:
On-Line Learning for the HVACR Industry
www.hvacreducation.net/

IFMA:
International Facility Management Association
www.ifma.org
The International Facility Management Association has several regional chapters, all of which can be accessed from the association's main web site address as above. Be sure to check out the site for the variety of learning options available, both online and via seminar.

Utility Energy Training Centers:
www.dsireusa.org
Your local utilities may offer energy education events and their sites are sources for training opportunities as well. Regional industry associations also offer a number of options for further education. The link below brings you to a database of state incentives for renewables and efficiencies.

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