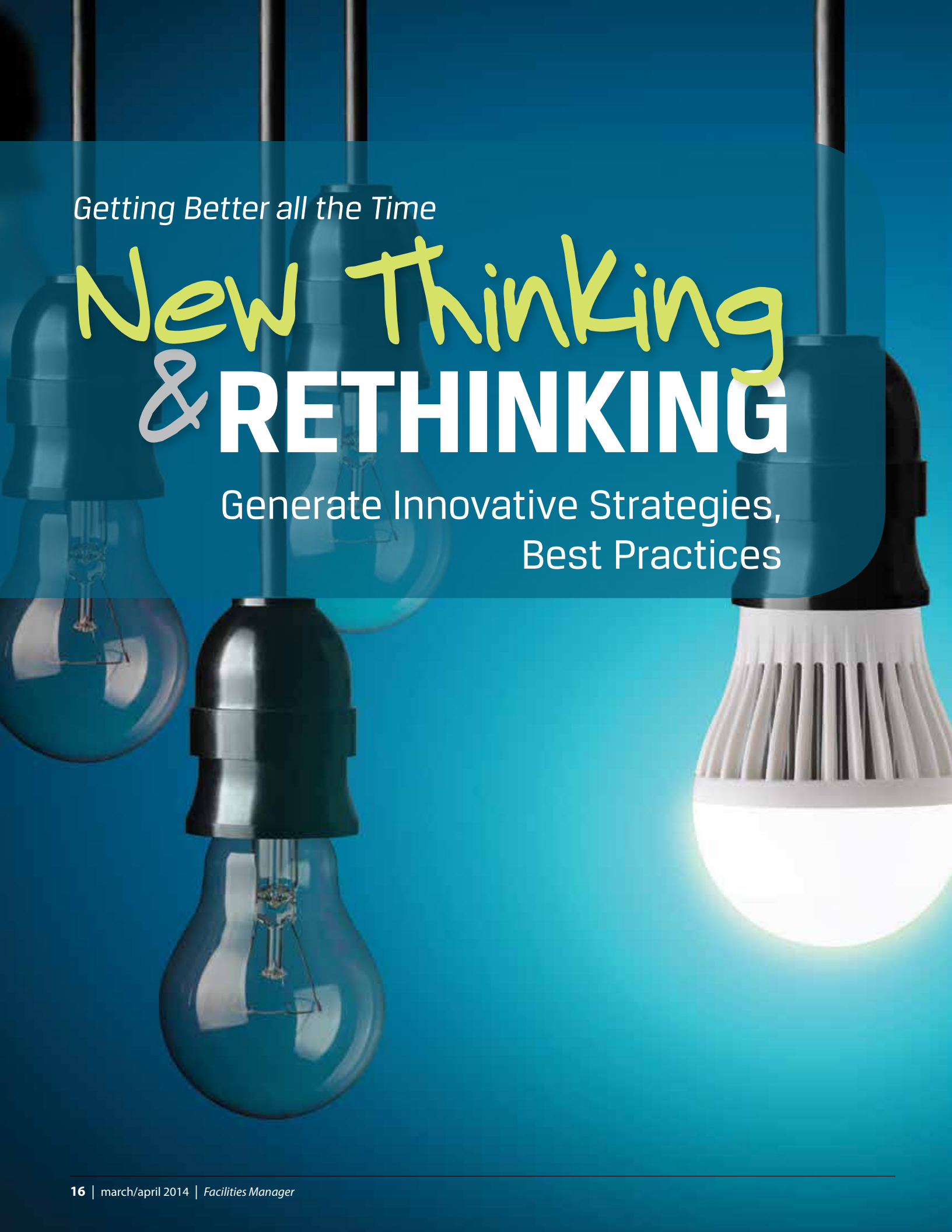


Getting Better all the Time

New Thinking & RETHINKING

Generate Innovative Strategies, Best Practices

By Anita Blumenthal

The mission is to meet high standards of operation and customer service while working to save energy, lower utility bills, optimize space, shrink the carbon footprint, conserve water, and work safely and efficiently. APPA members accept this Mission Almost Impossible every day and have developed thoughtful, innovative, and even unique ways to respond—and often they improve results by engaging the rest of the university community. Here are just a few examples.

LET THERE BE LED

Lighting upgrades, mainly to LED lighting, are ubiquitous on many campuses and use far less energy than older systems. Often, the startling savings and innovations are due only partly to new or improved fixtures and more to the technology of the control systems.

For example, **California State University, San Bernardino** is completing the largest nonmunicipal exterior LED fixture with wireless controls project in North America. Senior Director for Facilities Services Tony Simpson explains that, between calendar year 2013 and early 2014, 1765 exterior HID fixtures were retrofitted with new LED fixtures and integrated wireless controls. On the one hand, the majority of exterior lighting system is Dark Sky Compliant, respecting the viewing rights of the adjacent astronomical observatory. On the other hand, the police department is happy with the brightness and clarity of the lights for identification and safety.

Tony Simpson, California State University, San Bernadino

The integrated wireless controls add the wow factor. Simpson explains that all the new pole-mounted and parking structure LED fixtures will be controllable from mobile devices, giving the university the ability to change lighting schedules and brightness (saving energy where feasible and safe), provide energy usage data down to the fixture level, let facility maintenance and parking services staff know within seconds if there is a system operating problem—and enable them to fix it virtually from wherever they are. Further, campus security and the police department have the ability to override fixture timing or turn lights on instantaneously, giving first responders instant mobile control.

Aerial view of CSUSB after completionof LED retrofit.

Simpson says that the system will reduce annual energy costs by $237,000, maintenance costs by $154,000, and CO_2 emissions by 9,883 metric tons. The overall payback period is 6.5 years.

Meanwhile, **Mississippi State University** (MSU) is putting its own signature on a large-scale project that they expressly limited to indoor lighting upgrades, 80 percent LED. "We wanted to cherry pick, designing the requests for proposals specifically to attract companies with expertise in lighting, auditing, design, and retrofitting capabilities," Interim Associate Director of Utilities J.D. Hardy explains. "Each company who wanted to participate was given half a million square feet to audit and on which to produce detailed proposals. That way the proposer did a lot of the footwork," Hardy says. He used MSU staff, along with consulting engineers, to evaluate proposals. "It's important to recognize when to use in-house expertise and when to add outside expertise and labor as well to evaluate companies and filter through what the best technology and fit would be," he says.

As for the retrofitting process itself, Hardy says, "Most of the time, with large-scale projects of this kind, all users/occupiers are moved out and the building is handed over to the contactor." But this time, no one is being displaced. "Although lighting change is very invasive, we are doing it without interrupting any schedules," Hardy says. "We work around occupied times and do night work. We work with coordinators in the buildings and in the administration, daily updating the usage schedules of individual spaces."

Nor were customer preferences lost in the process. For example, the library contained certain areas with a museum-like look that the staff there wanted to retain. Working with an energy efficiency firm, Hardy found that advances in the LED market had made important variations possible; therefore he was able to have LEDs rebuilt to go into existing fixtures and to emit a more traditional color.

SOLAR SAVINGS

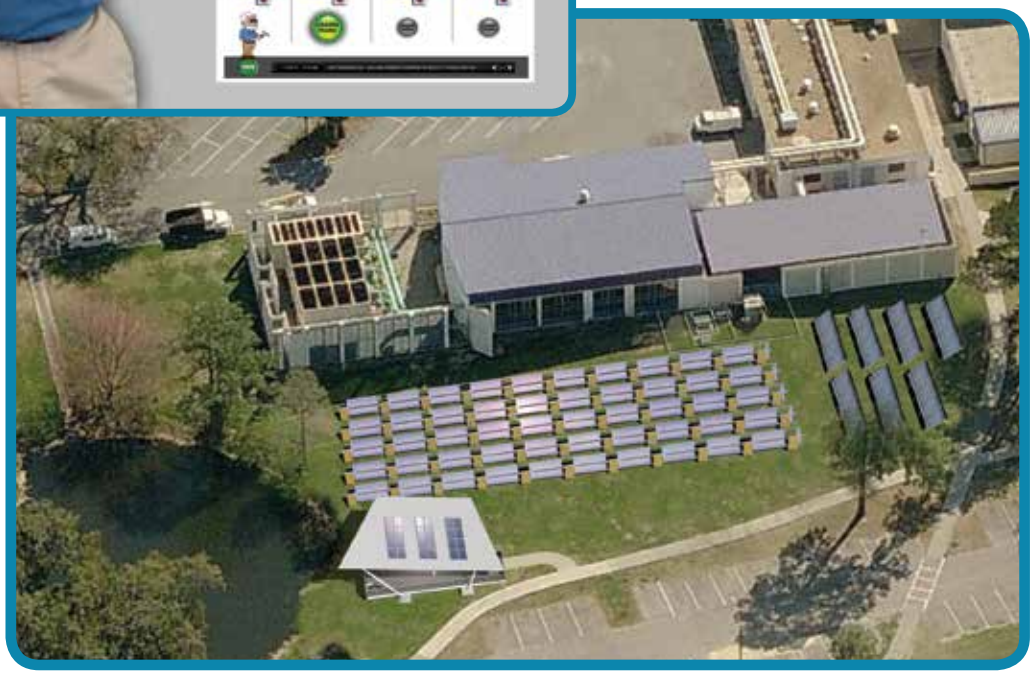
Solar power can be a very good deal for facilities, sometimes with no capital outlay. For example, CSU San Bernardino leases five acres of spare ground to a third party, who installed—and who maintain—their own solar panels under a power purchase

PHOTO CREDIT: MEGAN BEAN/MISSISSIPPI STATE UNIVERSITY

J.D. Hardy, energy and mechanical engineer with Mississippi State University, stands in the Central Chiller Plant, which currently is being upgraded to include more than 1,000 tons of ice storage capacity to help the university save on the high cost of electrical demand while increasing its ability to supply campus cooling.

Left: Bill Reese, Santa Fe College, Gainsville, FL

Below: Renewable Energy Accessible Laboratory (REAL)



agreement. The university spends no capital but buys 1.4 kW of clean solar energy from them for 9 cents /kWh, far less than utilities would charge. Then, when a utility asked to site a fuel cell on campus (not to be used for university power), Simpson negotiated a deal. "We do not get the electricity produced by the fuel cell," he says, "but we do get the waste heat, which goes into our boilers located near the fuel cell to pre-heat hot water. This saves $120,000 per year in natural gas."

Taking another approach, **Santa Fe College**, Gainesville, Florida, is running two photovoltaic and two thermal solar systems. For the photovoltaic energy produced, the public utility pays Santa Fe 32 cents/kWh. That revenue, along with two state rebates, will enable the college to halve the amount of time needed to realize a payback. But simply having the solar power was not enough for Associate Vice President for Facilities Bill Reese; he wanted the students to understand how it worked, thus bringing facilities management into the educational enterprise.

He explains that no one could really see the roof-mounted system, so he sought a hands-on learning lab concept. His department created the Renewable Energy Accessible Laboratory (REAL), set to open in August 2014. REAL has functioning photovoltaic evacuated tube and parabolic trough collectors in a ground-mounted installation. The solar collectors are in full view from a pavilion where an interactive media program explains the concept and theory of photovoltaic and solar thermal systems. To lead the students through the program, the department's contract engineers created an on-screen guide, Professor Payback, who happens to look a lot like Reese.

This stress on linking projects to education of the students is a thread throughout the facilities management department at Santa Fe. "In the process of designing and constructing buildings, there are many learning opportunities," Reese says. For example, during building construction, we put up safe walking paths so that students can see the process, from the subfoundations on up."

NEW HEATING, COOLING, PUMPING STRATEGIES

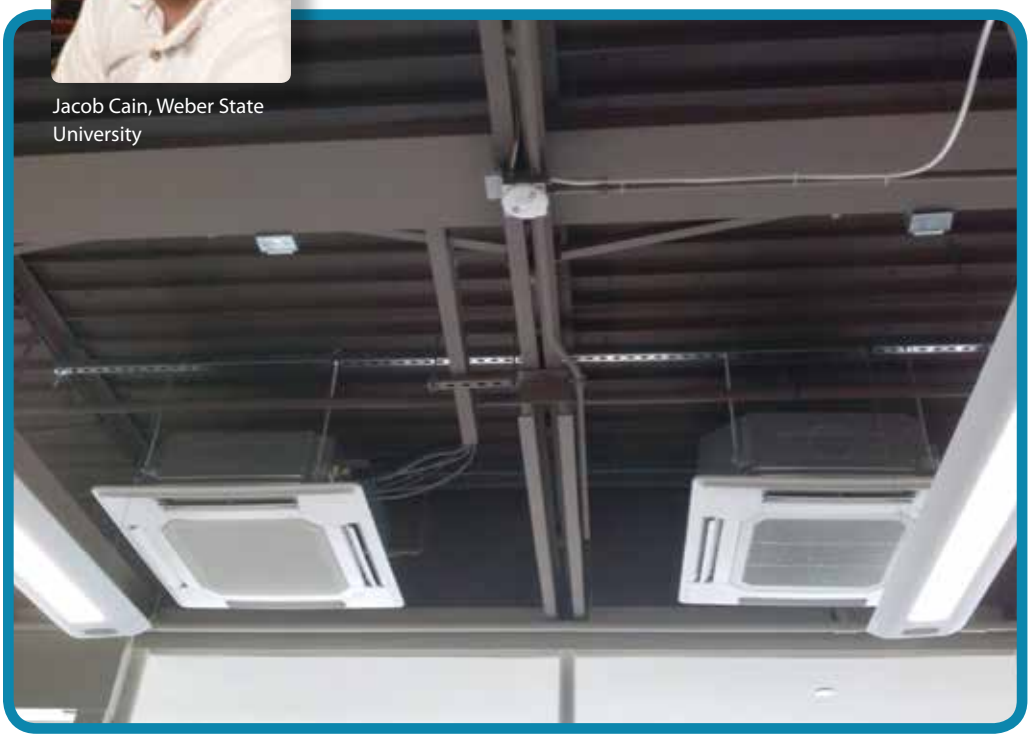
Weber State University, Ogden, Utah, and USC San Bernardino are questioning the conventional wisdom of conventional systems. Weber is not combining but separating heat and power systems, shutting down the heating plant in the summer and reducing the heating load. Energy and Sustainability Manager Jacob Cain explains that Weber is using a water-cooled variable refrigerant flow (VRF) system for heating and cooling a building, employing a condenser loop that transfers heating and cooling between spaces, using less energy.

The VRF system can use water between 50 and 90 degrees for

cooling. "The cooling tower is very efficient to cool water down to 65," Cain says. "It's the chiller that is not efficient to get down to 55. VRF can use 60-to-70-degree water for cooling, so we can get rid of chillers. In the case of heating, the water loop heats up the building, but if water loop gets too cold, small boilers can inject heat, or ground source systems can be used to provide heating capacity." This system is operating in one building and in design stage for two more.

Also thinking outside the box, CSU San Bernardino has improved its campus-wide chilled water distribution by improving its controls and changing normal pumping strategies. Simpson explains, "The operators and chief engineer have developed a Most Open Valve strategy (MOV) where building pumps will only operate at the absolute minimum speed to satisfy cooling loads based on demand rather traditional methods. The effect is exponential savings from reduced pumping power." Further, he says, "cooling coil performance was increased beyond capacities with fractional flow rates." Because they leave chilled water longer in buildings, getting as much cooling out of it as they can before returning it to be re-chilled, there is now a far greater difference between the temperature of the chilled water leaving the plant and the water coming back (delta T). "In older buildings, which had design delta Ts of 14 to 16 degrees, the MOV strategy produced delta Ts in excess of 24 degrees," Simpson says, "and newer buildings see a delta T of almost 40 degrees." The water is re-chilled at night using variable-flow chillers, when electrical rates are lowest, and stored in thermal energy storage tanks. Simpson says that this entire approach has reduced utility costs well over the original projected savings of $340,000 a year. He adds that other ancillary savings include reduced maintenance costs.

Jacob Cain, Weber State University



Terminal units in an office area running on water-cooled VRF at Weber State.

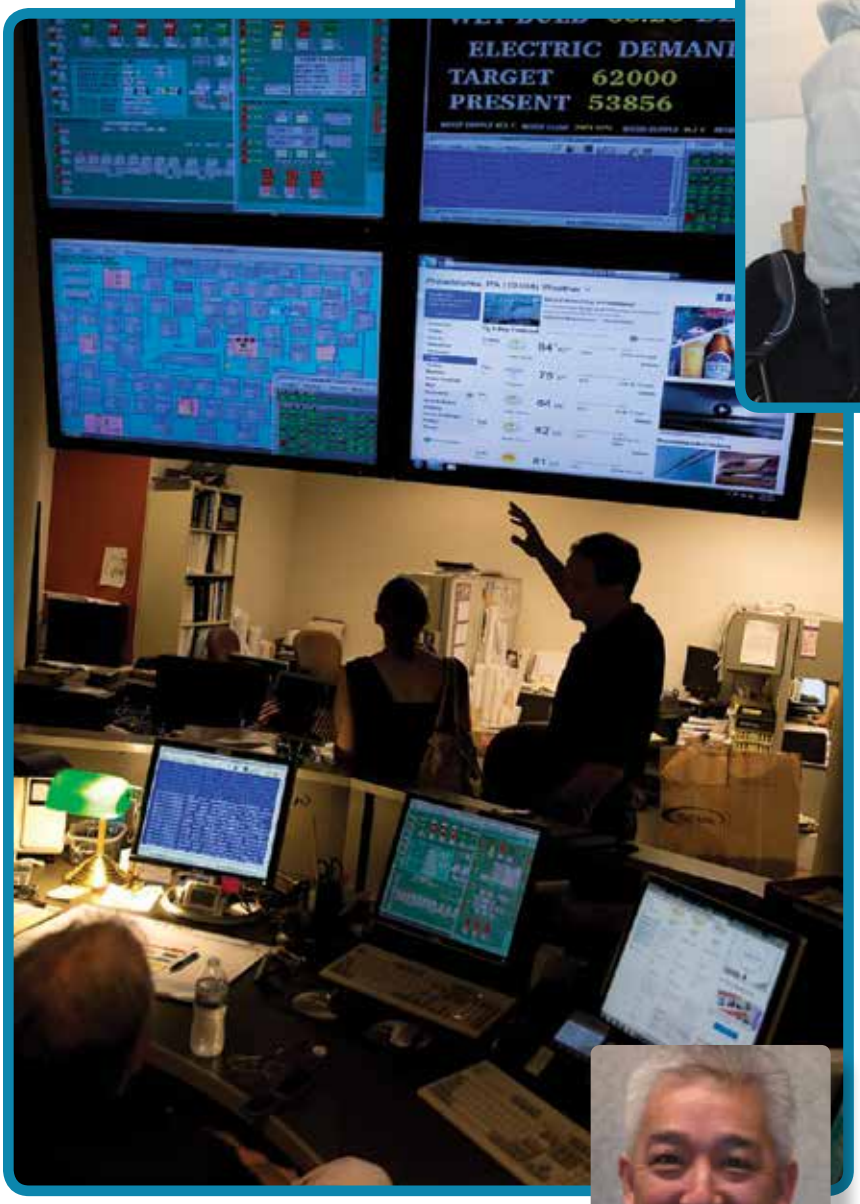
POWER TO DO GOOD

When a campus does not generate its own power, savings and conservation initiatives take a different form. Ken Ogawa, executive director of operations at the **University of Pennsylvania** in Philadelphia, explains that public utilities provide both electricity and steam for the campus, and Penn, as a large consumer, has been able to negotiate a good rate for both. One recent example included an arrangement whereby the campus' steam provider replaced two oil-burning boilers with state-of-the-art efficient natural gas units, and made improvements to the distribution pipelines. "The result," Ogawa says, "was a reduction in the utility's carbon footprint by over 25 percent—for all steam users in Philadelphia, not just at Penn. Penn's ability to influence the public utility to take action was good for entire city."

When electricity was fully deregulated in 2011, Penn managed supply costs by becoming a load-serving entity to purchase wholesale electricity. Ogawa explains that Penn also helps create a stronger regional market for wind and other renewables by buying large amounts of Renewable Energy Credits (RECs). Penn has been the number one purchaser of RECs among American colleges and universities for a number of years, and its initial investment in wind energy in the early 2000s provided the revenue to allow the construction to move forward on a 12-turbine wind farm in rural Pennsylvania.

INITIATIVES INVOLVE THE ENTIRE UNIVERSITY

Facilities managers and others are increasingly reaching out to encourage the rest of the campus to take part in conservation efforts. More than 200 students, staff, and faculty participate in Penn's Eco-Reps programs, providing sustainability leadership to their peers and advocating greener practices. Over 70 Penn offices (representing over 1200 staff) have completed a voluntary Green Office Certification, documenting their commitment to



The University of Pennsylvania's Operations Command Center where staff manages campus facilities with the aid of an advanced Supervisory Control and Data Acquisition (SCADA) system that receives approximately 280,000 data points of information.

Ken Ogawa, University of Pennsylvania

University of Pennsylvania staff working on maintenance shop process improvement using LEAN Six Sigma methodologies.

sustainable office management, and students living in college residences have established a similar "Green Living Certification" program for their dorm rooms.

Public online dashboards, such as those at Weber State (*http://buildingdashboard.net/weber/#/weber)* and **University of California Berkeley** (*http://mypower.berkeley.edu/)* show electricity usage by building over time. The Weber site also shows money saved and pounds of CO_2 diverted and is rich in such features as a "click-to-commit" section where individuals can promise to take energy-saving steps (e.g., wash clothes in cold water). Such transparency at universities quickly spawns healthy competition.

Berkeley's operational excellence program has a unique twist. First, the university created a database of how much electricity each building used in 2012. Then, going into 2013, the users of each building were told, "Here's how much your electricity cost last year. Whatever you save in electricity over the next year, we will return to you, in cash." With the first year of the incentive program recently ended, Assistant Vice Chancellor Chris Christofferson reports, "We've just sent out $900,000 in checks. The thinking behind the incentive program is, if we are going to be paying for electricity that is wasteful to utilities, let's focus on encouraging building users to save energy." There is no increase in cost to the university, he says, "and we will have saved electricity and improved the carbon footprint. At 10 cents/kWh, we have saved the utility eight to nine million kW over the previous year.

Chris Christofferson, University of California Berkeley

"Most campuses do not know how much their individual buildings consume in utilities," Christofferson says. "The bill arrives on campus; it's taken care of. From the point of view of the building users, it's a free good; no cost, no value." The incentive program changes that. However, the refund checks won't all be pocketed. For example, Christofferson reports that the occupants of one building decided to use their $14,000 check to fund other energy conservation measures suggested by the occupants themselves.

Sometimes facilities managers focus conservation strategies on specific departments. At the **University of California San Francisco**, Associate Director of Engineering Services Winifred Kwofie wanted to promote water conservation in research labs (water conservation being especially critical in California). "Research is water intensive," she says, "but in the past, telling researchers, 'Here is what we are going to do' did not sit well with them." However, she remembered some advice: Anytime you have to work with researchers, take a look at what they do. Approach your problems the way they approach their research.

So she did. To maintain their equipment, the researchers used service contractors, whom they trusted. Kwofie had the contractors perform an assessment of all services, including their experience in fixing equipment, how much excess water was used, and what improvements could be made, especially to the newer equipment. She called a meeting for the contractors to share their analyses with the researchers and show the benefits of various actions.

"Then the contractors left the room," Kwofie says, "and the researchers said, 'We want to do this.' Moreover, the researchers had not known how much was being invested in repairs to keep some of the 'worst offenders' operating; they realized they needed new, more efficient, equipment." Kwofie stressed the importance of using psychology. "Understand why a group is not doing what you want," she says. "Make your pitch in line with what they do. Give the best thinking, look at solutions, and have trusted people present demonstrations and give data."

SEE, KNOW, USE THE WHOLE BUILDING

Winifred Kwofie, University of California San Francisco

"Space in golden," Kwofie declares, but universities often have problems in making the most of the space they have. Her own challenge initially was how to improve the energy efficiency of the major institutional research building on campus: 440,000 square feet, 16 stories, two towers, occupied 24/7, built in 1960. Over the years, research changed and so did floor and building uses. Some spaces became more isolated; some became too hot or too cold. Rather than just focus on energy issues, Kwofie stepped back and did a comprehensive facility assessment, looking at all infrastructure and at how people

are currently using the space. A consultant made a complete assessment of every system, performing functional testing to see what was broken and what worked. "We found many spaces were not effectively utilized," she says.

All findings were documented. Then, she asked, "How should this building operate?" Mechanical engineers mapped out components of different research needs, "and we considered how much we should be putting into what. This is a concept any campus can adopt," Kwofie says. "Gather enough data to understand the whole building as a whole system."

Thomas Becker, Philadelphia University

Then she went an important step further and wrote a design guidance document. "If in the future someone wants to make changes, this guide shows what we have," Kwofie says. "If you want to remodel, here are the things you need to do. If you see it is good for research, that should guide future decisions."

INSIDE THE DEPARTMENT—INNOVATIONS IN PROCESSES, POLICY, CUSTOMER SERVICE

In the daily functioning of the facilities management department, innovations and initiatives can make a big difference. In a "lean processes" initiative at Penn, Ogawa explains that staff members devoted hours every week over several years to work through workflow protocols in the different maintenance shops. Aided by a Penn faculty member acting as a consultant, all 21 shops have been "leaned" – streamlined in terms of request processing, work steps, and adding value to outputs – resulting in a 50 percent reduction in the time to complete an average repair request. In the electrical shop, it used to take 124 steps to get one request completed; now it takes 11. Currently, the initiative is moving on to housekeeping.

Thomas Becker, associate vice president of operations at **Philadelphia University**, describes an important change in maintenance staff policy. "We had a large day shift maintenance staff because we thought it best to have most of the staff where they could be closely supervised," he says. "Then, we took a big leap of faith and moved more of the staff onto the second and third shifts. We trusted them to be productive—they are scheduled and held accountable. Besides, now they are available for customer service." The system works. "Repairs in classrooms take place when students are not there," he says, "and if concerns arise during evenings and nights for our residents, our multi-skilled tradespersons are immediately available. " Now, the day shift focuses on residence halls and on longer-duration tasks.

At **Soka University of America** in Aliso Viejo, California, Chief of Operations Tom Harkenrider is the only university-employed facilities manager. The services are outsourced, but he stresses that all the contract staff are encouraged to feel like part of the campus. Their uniforms have the Soka logo, and they are all invited to attend the annual board of trustees luncheon and seasonal celebrations and to participate in the service recognition ceremonies. This promotes careful work and initiative. Also encouraging quality work is the nature of Soka's contract. The fee-for-service providers have an at-risk contract based on performance. There is a key performance indicator (KPI) component of the contract (which includes safety, employee turnover, customer satisfaction, and cycle times), and this component of the fee is distributed to employees in an incentive bonus program.

In the daily functioning of the facilities management department, innovations and initiatives can make a big difference.

Tom Harkenrider, Soka University of America

High on the list of best practices is not reinventing the wheel—and knowing where to go to learn what has already been done. For example, Harkenrider wanted to improve response to customer satisfaction surveys. He looked at the highly effective customer satisfaction analysis form of a hospital in San Diego—a fellow participant in the Baldrige-based California Council for Excellence—and studied how they structured their market segments. "We decided to internally assess our campus-wide survey by market segments: student housing, athletic, academics, administration," he says. The results showed that some things that were important to one segment were not so important to another. For example, he learned that grounds keeping schedules were an issue for student housing, where students were inclined to sleep later. So now, landscape workers mow and trim there later in the day.

Becker notes that effective practices must include pragmatism, and APPA's operational guidelines in housekeeping, grounds management, and maintenance can be invaluable. "Understand limitations, commit to run at the best level reasonable, and strive to surpass your commitments," he says. "For example, we are small, tuition-driven, and private, with the desired ability to be nimble. We're not heavily endowed but are committed to sound financial management. It's vital to understand which standards must be reached and which are not practical. So, given our resources, it is not the University's priority to be a showplace facility, but everyone from the president on down to staff must agree on the established expectations. APPA's tables of standards are invaluable," he said. "They show everyone involved what the best practices and expectations should be for an institution operating at a desired level. For maintenance we commit to Level 3, managed care, and strive for Level 2, comprehensive stewardship. In grounds we adopted and customized the APPA tables creating a campus plan with mapped maintenance zones, detailing services, and we categorized every plant as native, invasive or non-native/non invasive (*www.philau.edu/plant/documents/CurrentCampusMaintenanceZones_3-1-12.pdf*). Our costs are level, but we're getting more bang for the buck," Becker says. "We're practicing sustainability, keeping some spaces more meadow-like with native plants, but our greens are sharp, and our highest impact areas are showplaces."

Innovations, initiatives, and best practices on APPA member campuses encompass myriad bright—even offbeat—ideas, but they are tethered to clear-eyed practicality. So they work.

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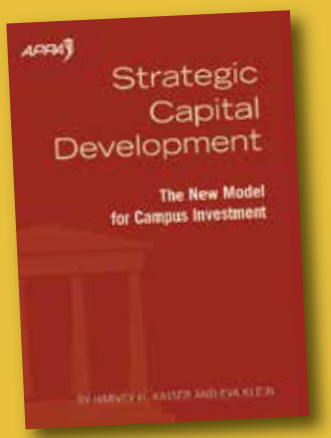

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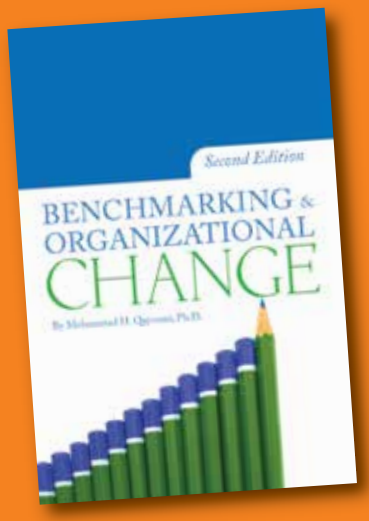

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