BEST PRACTICES 2013

Cal State Fullerton Campus-Wide Lighting Retrofit

CSU Fullerton's ambitious campus-wide lighting retrofit tackled interior and exterior fixtures while geographically mapping fixtures and fixture properties. An integrated wireless control system accessible by iPad gives facility staff broad access to adjust controls in the field and diagnose problems.

Award Category
Lighting Design/Retrofit

Green Features
Integrated wireless controls for outdoor fixtures

Outdoor fixtures controlled to be off during the day and tuned for specific location

iPad control application

Replaced 70,000 32 W lamps with 25 W lamps

Bi-level exterior LED fixtures with integrated occupancy sensing

Hybrid bi-level LED/T8 stairwell fixtures

490 kW peak demand reduction

Size
Campus-wide

Cost
$2.2 million

Annual Energy and Cost Savings
3.3 million kWh (estimated)

$445,000 (estimated)

Completion Date
2013

What began as an investigation of available LED technologies led to a comprehensive upgrade of campus lighting at California State University, Fullerton (CSUF). Sustainability and facilities staff were in the process of evaluating several new "beta" LED products in terms of lighting quality, efficacy, and ease of installation and maintenance. As they learned of promising new products, they began assembling a portfolio of potential applications for the products, which evolved into a proposal for an extensive campus-wide lighting retrofit. The overarching goal of the project was to greatly reduce energy use by integrating LED fixtures with advanced lighting controls, and also to involve students in the project's implementation in ways that would support the school's educational mission.

New LED pedestrian fixture at CSUF. Image: Doug Kind.

By using campus staff and students to design and complete the retrofit, CSUF built its on-campus knowledge base. Staff members now proactively propose lighting projects to reduce energy use.

The campus-wide project was staged in 13 phases over 18 months, to better manage the retrofit process and to maximize available incentives. In many cases the project team did not simply replace fixtures one for one, but also made changes to optimize the overall system design. For example, for the replacement of pedestrian lighting the pole spacing was increased from 50 to 70 feet, the existing 150-watt metal halide (MH) fixtures were replaced with 70-watt LED fixtures, and integrated wireless controls that allow a full range of dimming were added. These changes resulted in 70 percent energy savings and also provided improved lighting uniformity. The campus also addressed roadway and parking lighting, replacing 250-watt MH fixtures with 140-watt LED fixtures with full dimming capability. When integrated with pole-mounted wireless controls, this resulted in a 75 percent energy savings. The integrated pole-mounted fixtures include controllers that enable advanced energy saving approaches including "high-end trim," "light level tuning," and "curfew dimming." These control capabilities allow lights to be "trimmed" to a maximum light level needed for each space, which may be at less than the 100 percent light level of a fixture, and tuned for the specific needs of occupants. Curfew dimming reduces nighttime light levels to the illumination required, including reductions not visible to the eye.

In parking structures, where safety is a particular concern, a total of 9000 32-watt T8 fixtures were replaced with 1800 70-watt LED fixtures with bi-level occupancy sensors to provide 50 percent dimming; this change yielded 67 percent energy savings. The student response to the new lighting has been so positive that the parking department has expanded the retrofit scope to include additional parking structures on campus. Other exterior lighting improvements included replacement of 100-watt high pressure sodium (HPS) wall mounted fixtures with LED fixtures having integrated bi-level occupancy sensors, allowing the new fixtures to operate at 10 or 30 watts, with an energy savings of 77 percent.

The project team also tackled outdated interior lighting systems. They replaced 32-watt T8 fixtures in stairwells with LED "hybrid" stairwell lighting. These bi-level lights use 3-watt LEDs when the stairwell is unoccupied, and turn

2013

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Team

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Student Team Leader, Green Campus Program: Jerome Terrell

LED Fixtures: Visionaire Lighting BetaLED

Wireless Lighting Control System: Exergy Controls

More Information

http://calstate.fullerton.edu/inside/2011sp/Lighting-Retrofit.asp

http://calstate.fullerton.edu/news/2012su/Gym-Retrofit.asp

http://news.fullerton.edu/2013sp/Lighting-Upgrades-Pay-Off.asp

on 25-watt T8 lamps when occupied. These hybrid fixtures are more cost effective than an all-LED fixture and still result in an estimated 75-95 percent energy savings. Facilities staff also replaced 70,000 existing 32-watt T8 lamps with 25-watt T8 lamps inside campus buildings, while still maintaining the same illumination levels.

Combined, all the retrofit actions have led to a campus-wide peak demand reduction of 490 kW.

A significant effort was made by all team members to record detailed information about the retrofit to provide the campus with accurate records. As the project progressed, facilities staff kept detailed records of the spaces retrofitted, and electricians tracked installation of outdoor fixtures. Graduate students working with geographic information systems (GIS) mapped all exterior circuits and fixtures, noting information such as circuit identification, voltage, pole type, lamp color, wattage, and date of installation. Doug Kind, CSUF's Engineering and Sustainability Manager, explains that students from the CSUF chapter of Power Save Green Campus also measured light levels before and after the retrofit to document and analyze the changes.

During the implementation of the project, iPads became available, and were seen as an opportunity for the project team. With input from campus sustainability staff, the controls system manufacturer, Exergy, developed an iPad application for CSUF. The interface is capable of displaying information about each exterior fixture including on/off status, dimming level, energy usage, and the nature of failures when they occur. Sustainability staff persuaded campus officials to authorize iPad purchases for campus electricians, giving each technician the ability to test each exterior light fixture and adjust controls using the secured intranet web-based interface.

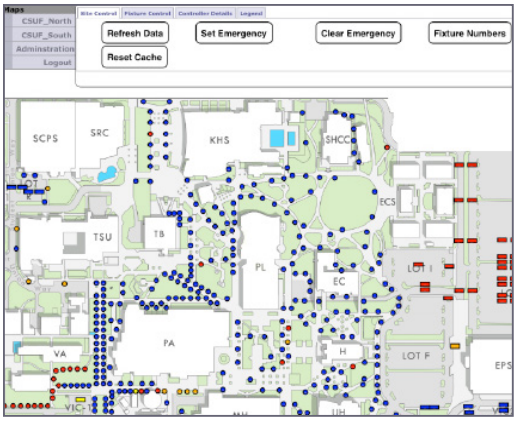

Image of iPad wireless lighting control interface. Image: Douglas Kind.

LESSONS LEARNED

Doug Kind explains that the decision to do the project with on-campus maintenance workers and electricians was made in part to retain staff during a period of funding cuts at the state level. In hindsight it's apparent that this approach has led to ongoing benefits. He notes that "staff are often coming forward with new project ideas," because there is now a significant knowledge base on campus. The advantages provided by GIS mapping of the lighting system attributes resulted in the approval for campus to hire one of the student team members, who will maintain and expand the GIS system going forward.

Staff also had major success working with the manufacturers of the fixtures and controls. Several of the fixtures used in the lighting project were brought to market based on the significant feedback provided by the project team, including the LED pedestrian fixture, the LED "hybrid" stairwell fixture, and the LED wall pack fixture. The project team's success using an iPad app for lighting controls has led to a new standard that will require tablet applications for other control systems implemented on campus in the future, and the use of iPads in the field is now expanding to the other trades.

Best Practices case studies are coordinated by the Green Building Research Center, at the University of California, Berkeley.

The Best Practices Competition showcases successful projects on UC and CSU campuses to assist campuses in achieving energy efficiency and sustainability goals. Funding for *Best Practices* is provided by the UC/CSU/IOU Energy Efficiency Partnership.