BEST PRACTICES 2013

UC Davis Adaptive Controls for Exterior Lighting

UC Davis's exterior adaptive controls project has broken new ground in lighting retrofits. The project integrates existing infrastructure with custom combined technology specifications, resulting in an energy cost savings of approximately $100,000 per year, and showcasing campus/industry collaboration.

Award Category
Lighting Design/Retrofit

Green Features
Improved light quality and visual acuity

Occupancy sensors and centralized network system

Created new industry specification with three integrated technologies

Replaced over 1400 luminaires

Dark-sky compliant fixtures

Lamps have longer lifespan and reduced maintenance

Post-occupancy survey confirms sense of security and sufficient light levels

Annual Energy and Cost Savings
1000 MWh

$100,000

Size
70 percent of campus roadways and pathways

Cost
$950,000

Completion Date
June 2012

The Smart Lighting Initiative (SLI), UC Davis's energy efficiency program, is on track with a goal of meeting 60 percent lighting energy savings across the campus. The first phase of this project is the Institutional-Level Adaptive Controls (ILAC).

ILAC is a payback-focused lighting retrofit project funded by the University of California's Strategic Energy Partnership Program and third-party incentives such as the CEC-administered Energy Technology Assistance Program, funded by the American Recovery and Reinvestment act of 2009. Since the SLI emphasizes projects that capitalize on energy efficiency and swift payback periods, one of the first opportunities identified was retrofitting exterior luminaires on campus with highly efficient fixtures and incorporating an advanced networked lighting control system.

Lighting along pedestrian and bike paths retrofitted with dimmable LEDs that respond to users' direction of travel. Photo: Kathreen Fontecha, CLTC/UC Davis.

The exterior lighting retrofit covers 70 percent of campus pedestrian pathways, bike lanes and roadways. The team emphasized the re-use of existing materials in these lighting renovations where feasible, and produced solutions for integrated and efficient pathway lights, roadway lights, area lights, decorative light posts, also known as "post tops," and building-mounted facade lighting, commonly referred to as "wall packs." A total of 1200 street and area lights, 100 post-top luminaires and 100 wall packs were replaced during 2011 and 2012.

For the post top retrofits, the team selected the 45-watt EcoSwap Phillips Candela LED light engine with zero to ten-volt dimming. This product is rated with a 54,000-hour lifespan, which is 4.5 times the lifespan of the existing high-intensity discharge lamps. The use of dimmable LED luminaires result in both energy reductions and reduced maintenance costs. The project team also replaced the high-intensity discharge (HID) wall packs luminaires with more efficient LEDs by Philips, which use 14 watts in low mode and 45 watts in high mode, less than one-third of the electricity used by the original luminaires.

The lighting retrofit improved the visual acuity of the spaces and is responsive to environmental conditions and users' travel patterns.

The project also focused on meeting dark-sky requirements by designing the pathway and roadway fixtures to focus light downward, and distributing light following an efficient pattern described by the IES standard for "Type II" distribution. This approach most effectively illuminates the space, increases the distance between posts, and prevents light from spilling over property lines.

The project also changed the operation of all the retrofitted exterior lights from a dusk-to-daylight timer to a sensor-based network of occupancy sensors provided by WattStopper and wireless radio frequency controls by Lumewave. The post tops integrate two 180-degree WattStopper occupancy sensors, and the wall packs have one 270-degree sensor. The Lumewave module, installed at each light fixture, utilizes wireless radio frequency communication with a centralized real-time interface, which integrates roadway and pathway fixtures and allows for dynamic

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More Information

http://cltc.ucdavis.edu

http://campus-care.ucdavis.edu/stories/energy-savings-program.shtml

http://police.ucdavis.edu/events/campus-safety-lighting-walk

adjustments such as operation and dimming schedules, or deference to integrated daylight sensors. It also allows neighboring lights to communicate with each other, enabling direction-of-travel control that triggers lights to brighten in front of an approaching user. While most exterior lights are programmed to be turned off in the daytime, the monitoring system verifies this, and allows for utility grade power monitoring for demand response events. The wireless network monitors energy performance at the fixture level, and will alert staff of maintenance issues. According to Pedram Arani, Associate Development Engineer at the California Lighting Technology Center (CLTC), the team also calculated the energy savings of the project using this control network to track the energy use of the luminaires pre- and post-retrofit.

Replacing "wall pack" luminaires with dimmable LEDs and incorporating a motion-sensitive control system has reduced energy in these fixtures by 89 percent.

The CLTC collaborated with Phillips, WattStopper and Lumewave to integrate three products — LED, occupancy sensor and wireless control — into one watertight system adapted to the existing post top infrastructure, creating a "first-of-its-kind" specification. This retrofit and network strategy is readily scalable on the UC Davis campus, and the post-top "collar" specification with an integrated occupancy sensor is transferable to lighting retrofit projects on other campuses.

A post-occupancy study confirmed that the new fixtures are functioning as designed. Students in an energy policy class surveyed users who experienced spaces when the fixtures were at 10 and 25 percent power levels, and the group reported unanimously that they had a sense of security at these settings. The minimum and maximum power settings are accordingly set to 20 and 100 percent to meet industry standards.

UC Davis campus dimmable LED wall packs. Photo: Kathreen Fontecha, CLTC/UC Davis.

According to Scott Arntzen, UC Davis Senior Project Manager, the campus also conducts ongoing campus safety lighting walks that include students, facilities staff and campus police to evaluate the efficacy of exterior lighting on campus and identifying areas for improvement. The feedback from this group has also been positive, and suggested implementing similar strategies for additional areas not included in the retrofit.

LESSONS LEARNED

As the first application of network-based lighting control at UC Davis, the team overcame a steep learning curve in its set up and maintenance. One issue that emerged was related to zone control. At the outset all lights were controlled as a single zone, with data to and from all lights (occupancy sensor triggers, interaction with neighboring lights, etc.) being routed through the central control system, which unnecessarily overloaded the network. This has been addressed by dividing the lights into multiple zones, and the team plans to add additional gateways to further ease data communication traffic. The team will also implement a premeditated organization pattern to avoid this issue in future iterations of the network controlled lighting system.

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.