SSL Postings
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Lessons in Exterior Lighting at Princeton University

With a sustainability commitment that acknowledges the need for research and education as well as implementation, Princeton University has taken an incremental approach to the adoption of solid-state lighting that builds on lessons learned and parallels the evolution of DOE's GATEWAY program as well as of the technology itself. Recognizing SSL's potential benefits early on, Princeton has, in effect, used its campus as a very instructive test bed and demonstration site. A new GATEWAY report shows how the school's approach to solid-state lighting has evolved as its knowledge has broadened and as the products available on the market have improved in performance and sophistication. The report describes four exterior SSL projects that have been completed at Princeton since the school installed its first such system and that, collectively and individually, contribute to our knowledge of how to make the most effective use of this promising technology:

- In 2008, Princeton completed its first LED exterior lighting project by replacing seven high-pressure sodium (HPS) luminaires with LED luminaires along a pedestrian walkway. The upgrade reduced energy use by more than 60%, saving about 2,500 kWh annually, and more students began using the walkway because it felt safer than before. This early project allowed the school to test the new LED technology in a small-scale installation and showed that substantial energy savings were possible with LED luminaires, and that the improved optical performance and color quality compared to HPS enabled better light distribution without compromising perceived visibility. The installation also posed a number of implementation challenges that proved instructive.

- Princeton's first parking-lot project, completed in mid-2012, replaced 68 HPS luminaires with LED luminaires in four adjacent lots. In addition to the standard dusk-to-dawn control that keeps the luminaires turned off during daylight hours, each LED luminaire also has an integral motion detector and dims to 20% when no motion is detected. The project has resulted in 64% energy savings from the reduced wattage of the LED luminaires, with further savings from the bi-level control based on motion detection. Among other things, it showed Princeton that overall energy savings are greatly increased through the use of motion-based dimming, especially for parking lots with little activity during long periods of the night.

- The incumbent lighting in Princeton's West Parking Garage combined 252 metal halide (MH) luminaires that operated after dark with fluorescent luminaires that operated during daylight hours. In early 2013, the MH luminaires were replaced one-for-one with LED luminaires that provided lighting both during the day and at night. Since a new system often initially provides more light than needed, the power of the LED luminaires was set to 90% of the maximum, with the idea that this luminaire power could be increased over time to maintain the luminaire light output as the LEDs depreciated. The LED system saves more than 143,000 kWh annually from the reduction in power during nighttime operation alone — a 66% savings compared to the MH system — with additional savings achieved through the use of controls. This project showed Princeton that the inherent controllability of LEDs provides opportunities for multiple levels of control during daytime and nighttime.

- Early in 2014, 41 new LED luminaires were installed in two Princeton parking lots as part of a major renovation, and saved more than 60% of the energy that would have been used by a conventional HPS system, with additional savings achieved through the use of controls. Each LED luminaire has an integral photocontrol and motion detector, but rather than individual control, the luminaires are grouped into zones using a wireless network. This allows an area of the parking lot to dim to 20% whenever no motion is detected, but brings the luminaires to full output whenever motion is detected by any one of the sensors in that zone. This can increase perceived safety, compared to having controls on the individual luminaires, where an adjacent area to a person who is entering his or her car may remain dim.

From both an economic and a carbon-reduction standpoint, the SSL experiences at Princeton have been highly successful and informative. For the four exterior SSL projects described in the new GATEWAY report, the expected annual energy savings just from the reduced power total 195,445 kWh, but DOE estimates that with the controls solutions that were implemented, these annual savings increase to 246,995 kWh. Through these initial projects, Princeton has learned important lessons about SSL and gained experience dealing with the rapidly changing lighting landscape. These lessons and experiences continue to be applied through the school's ongoing commitment to SSL implementation, and several additional exterior lighting projects have been completed since those covered in the report, with a number of interior projects completed or underway, and still more to come.

For full details on the four projects, see the report.

As always, if you have questions or comments, you can reach us at postings@akoyaonline.com.