SSL DEMONSTRATION:

Parking Garage Lighting, Washington, DC

The energy savings from switching to LED lighting in a parking garage can be increased significantly by the intelligent use of occupancy-sensor controls.

LED luminaire in low state (10% full power) | LED luminaire in high state (100% full power)

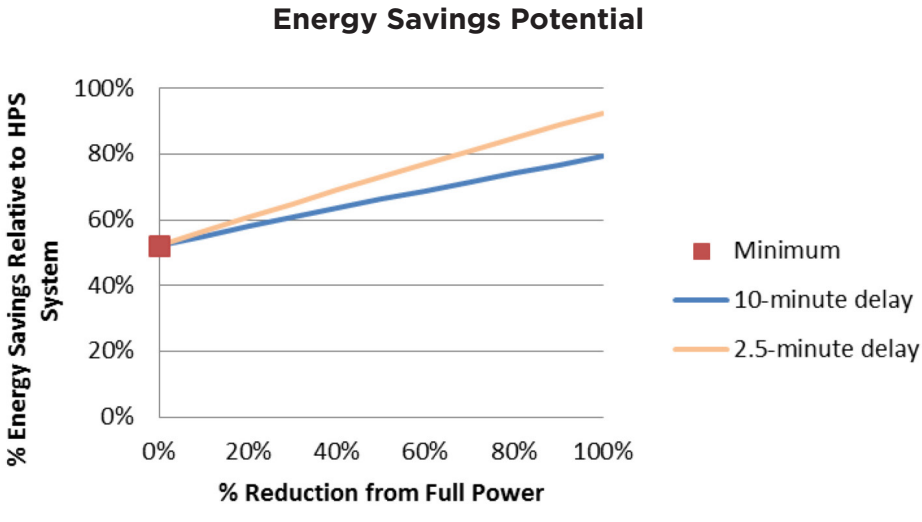
Parking garages often present attractive energy-saving opportunities when safety and security demand that they be lighted 24/7, regardless of actual building use. Like many commercial office buildings, the headquarters of the U.S. Department of Labor (DOL), in Washington, DC, has a fairly predictable use pattern, with most of the activity in its two dedicated sub-terranean parking garages occurring between 8 a.m. and 6 p.m. on weekdays, and much lower and more sporadic use at other times. Energy efficiency is a particular focus of the facilities staff; in 2008 the building received an ENERGY STAR® rating, which requires a continued reduction in energy use from year to year in addition to the 30 percent reduction in energy intensity (compared to 2005 levels) required of all federal agencies by 2015.

An Opportune Site

These factors combined to make the DOL Headquarters' parking garages ideal for a U.S. Department of Energy (DOE) GATEWAY demonstration, which was initiated in 2010. The garages were previously lighted entirely by about 300 high-pressure sodium (HPS) fixtures; 19 of these were replaced one-for-one with LED luminaires in one section of a middle floor for this study. These LED luminaires, which each have an integral occupancy sensor that can control their output through bi-level dimming, were monitored over more than one year to evaluate their performance.

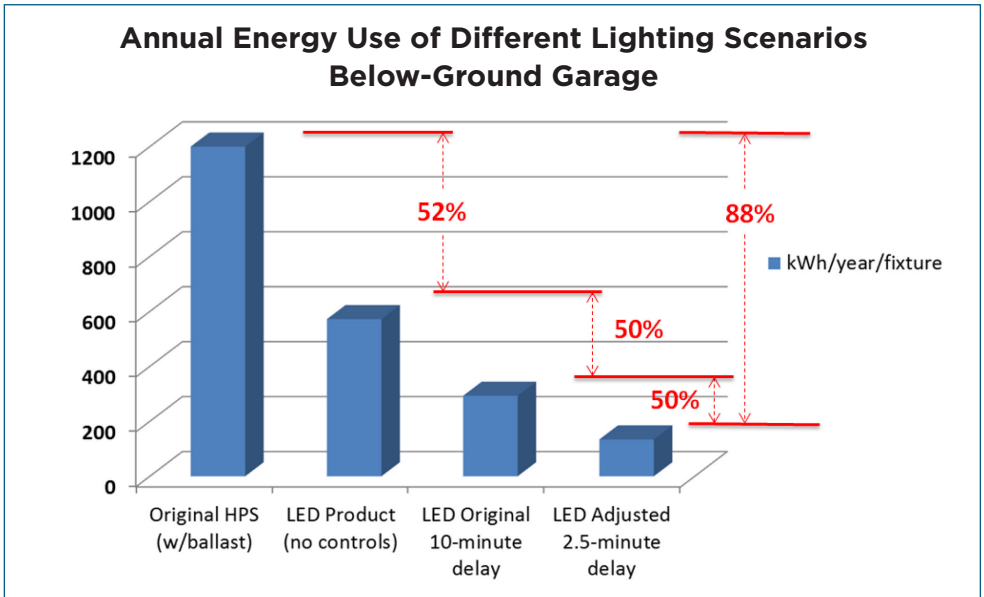
The results showed energy savings of 52 percent from the initial conversion of HPS to the LED product, due solely to the reduction in power draw (129.5W for HPS vs. 61.8W for LED). These savings were increased substantially with the use of the occupancy-sensor controls, which reduced the luminaire power draw to 10 percent (6.2W) while in the low state—amounting to a 95 percent reduction over the incumbent HPS system.

Moreover, after the first few months of operation, it was determined that the motion sensors' default delay setting (i.e., the time between the last detected motion and switching to the low state) of 10 minutes was much longer than necessary and was leaving potential energy savings on the table. The delay setting only needs to be long enough to cover the typical time required for a vehicle to enter the area and park, and perhaps a short additional period while occupants gather their things before exiting the vehicle.



Energy savings potential from the use of occupancy sensors at different delay settings at the DOL parking garage

When the time delay was reduced from the default setting down to 2.5 minutes, it was found that the average period of high-state operation among the metered luminaires decreased by approximately two-thirds—from about 60 percent down to 25 percent or less during the work week. The energy savings of the LED luminaires in combination with the occupancy-sensor controls, relative to the incumbent HPS system, amounted to 76 percent at the 10-minute setting, but increased to 88 percent at the 2.5-minute setting. More notably, this simple adjustment of delay setting cut the previous energy use of the LED system by another half (see figure), at virtually no cost other than the small amount of labor required to make the adjustment. No complaints about the shorter delay setting have been received from users, possibly because few have even noticed the change.



Estimated annual energy use and relative savings from different lighting scenarios

False Tripping

More than half of the metered luminaires exhibited anomalous behavior at times, switching to a high state of illumination and remaining there for extensive periods. However, in all but a few cases this behavior was infrequent, appearing in as little as a single incident for a given luminaire during the period monitored. Furthermore, after the time delay was reduced to 2.5 minutes, this abnormal behavior diminished dramatically. No definitive cause for it was identified, but one of the more plausible explanations offered by the manufacturer was that high air flow from a nearby air handler could have caused false tripping in a few of these cases. Overall, false tripping did not have a significant negative impact on the final results, contributing less than 5 percent to the cumulative energy use.

Because of the relatively high cost of the LED luminaires in this project, the simple payback periods were 6.5 years and 4.9 years for retrofit and new-construction scenarios, respectively. Staff at DOL Headquarters reported high satisfaction with the operation of the LED product.

Conclusions

Because occupancy sensors are a relatively recent addition to the parking-facility lighting market, some amount of growing pains is expected. Nonetheless, the DOL installation encountered few challenges while offering several advantageous conditions for a combined LED/occupancy sensor approach. The use of occupancy sensors at this site produced substantial energy savings while successfully demonstrating the incremental levels of savings available from different control settings.

It's clear that the combination of occupancy detection and bi-level dimming systems with efficient lighting equipment can significantly increase energy savings. But it must also be recognized that the potential energy and cost savings from upgrades to the lighting system are finite. Different approaches to achieving them often compete with one another in a form of zero-sum game. Installing a higher-efficacy luminaire, for example, means that less energy use is subsequently available to generate savings by adding a control system. In the end, making the most of an occupancy sensor-based system is a balancing act between numerous elements, all of which need careful attention to maximize the performance and savings achieved from the investment.

Final reports on GATEWAY demonstration projects are available for download at ssl.energy.gov/gatewaydemos_results.html.

GATEWAY Demonstrations

GATEWAY demonstrations showcase high-performance LED products for general illumination in commercial, municipal, and residential applications. Demonstrations yield real-world experience and data on the performance and cost effectiveness of lighting solutions. For more information, see ssl.energy.gov/gatewaydemos.html.

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy
BUILDING TECHNOLOGIES OFFICE

June 2013 • DOE/EE-0931
Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post-consumer waste.