Bi-level LED Parking Garage Luminaires

California State University, Sacramento

The Problem

Most parking garages use high intensity discharge (HID) light sources that operate continuously regardless of lighting needs. These facilities typically do not employ energy-saving control strategies, and no considerations are made for lighting control based on garage occupancy. Garage lighting, designed to only a single static level, wastes energy and contributes to peak demand during the day and light pollution at night.

The Solution

The PIER program sponsored development of bi-level parking garage luminaires that integrate intelligent controls with bi-level electronic drivers or ballasts to control light output based on garage occupancy. Luminaires operate at a reduced level during vacancy and switch to full light output upon occupancy. Many of the products may be combined with traditional photocontrols to maximize energy savings.

Savings are achieved by combining broad spectrum sources such as LED with fixture-integrated occupancy and daylighting controls that reduce light levels based on actual garage occupancy and general lighting conditions. The use of broad-spectrum, white light source may allow for reductions to the overall demand size (watts) of the luminaire, in addition to savings from fixture-integrated controls. In retrofit applications, bi-level LED luminaires generally achieve 30–60% savings over most incumbent parking garage technologies.

The product highlighted in this case study is Beta LED's The Edge™ Parking Garage Luminaire with integrated occupancy sensor and two-level light control. This technology employs the adaptive lighting strategies and intelligent controls championed by recent PIER-sponsored projects.

Features and Benefits

- Bi-level light output based on garage occupancy
- Instant light level changes; no warm-up or hot restrike limitations
- Long-life light source reduces operating and maintenance costs
- Rugged design, vandal resistant

FIGURE 1: BI-LEVEL LED PARKING GARAGE LUMINAIRES
Garage 1, California State University, Sacramento

- No hazardous waste; minimal recycling requirements
- Good color rendering, high color temperature, white light

Technology Costs and Incentives

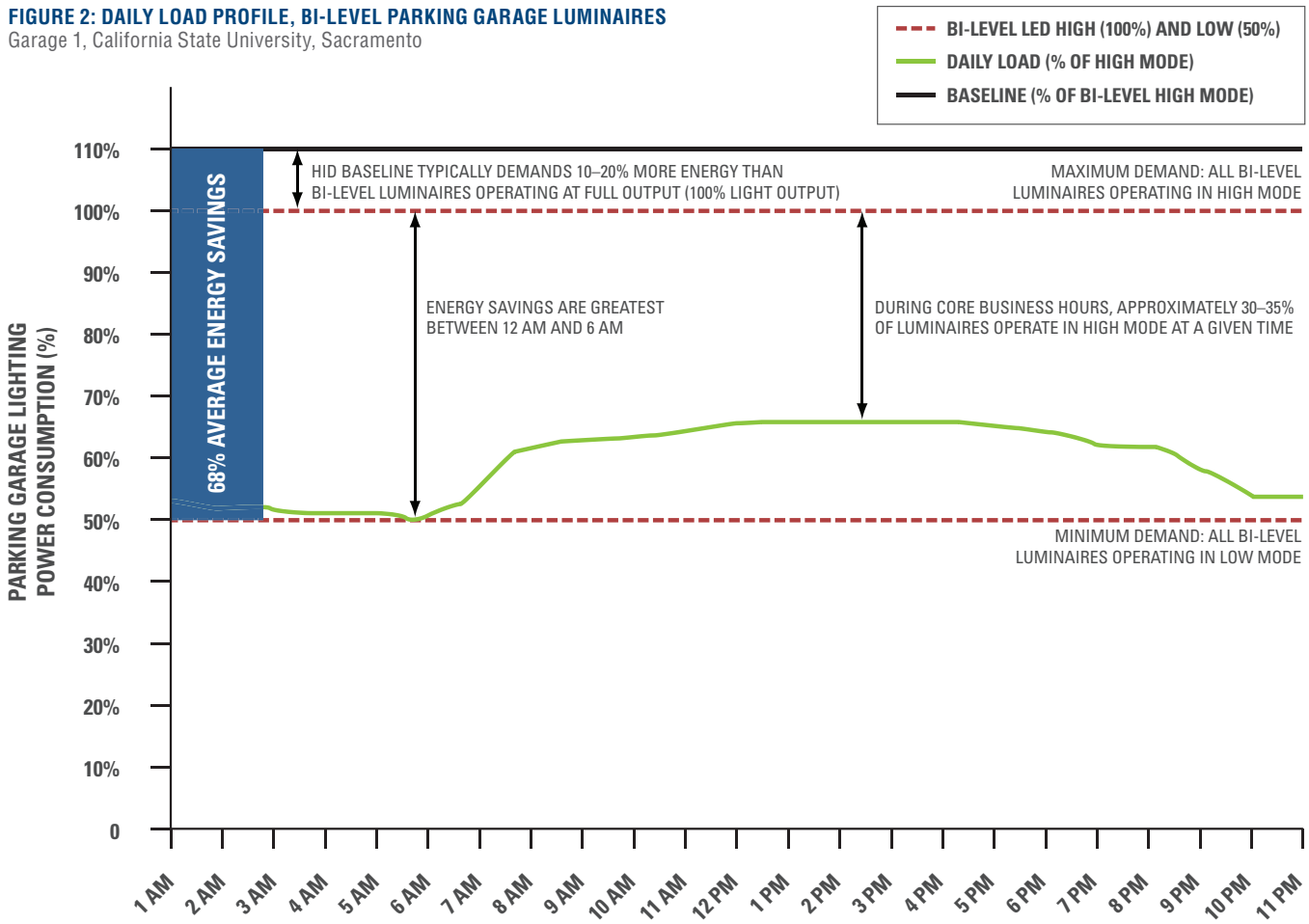
Installation is identical to other typical deck-mounted luminaires, and replacement scenarios are generally one-to-one in retrofit applications. Equipment costs may be two to three times higher than common garage luminaires, but this cost may be offset by maintenance savings and utility rebates. Many California utilities offer one-time incentives ranging from 5–15 cents per kWh saved, plus up to $100 per kW reduced, based on energy savings of the new technology compared to incumbent technologies or other energy regulations.

Demonstration Results

California State University, Sacramento

California State University, Sacramento (CSUS), in partnership with the Sacramento Municipal Utility District (SMUD) and the PIER demonstration program, retrofitted 30 high pressure sodium (HPS) luminaires on the third floor of its Garage 1 parking structure with The Edge LED Parking Garage Luminaires. The new luminaires included integrated sensors that switched light levels between high and low modes based on garage occupancy. Incumbent HPS luminaires consumed 189 W each. The LED replacements consume 165W in high mode and 77 W in low mode.

FIGURE 2: DAILY LOAD PROFILE, BI-LEVEL PARKING GARAGE LUMINAIRES
Garage 1, California State University, Sacramento



The new luminaires are expected to last at least 50,000 hours before maintenance is required. The CSUS facility extinguishes perimeter luminaires during the day, which reduces the average annual operating hours to about 7,880 hours. At this rate, the new luminaires will not require maintenance for more than six years, and this may be a conservative estimate as low mode operation will extend LED source life.

Light level monitoring of the new LED luminaires yielded the following results:

- Nearly all LED luminaires operated in low mode (77W) between midnight and 6 a.m., resulting in 78% energy savings compared to incumbent HPS technology during this time
- During daytime and evening hours, only about 30% of LED luminaires operated in high mode, resulting in 65% energy savings compared to incumbent HPS technology
- Overall, average energy savings for this demonstration was 68%

A daily load profile for the facility is provided in Figure 2. This data represents 20 monitored LED luminaires operating over a four-week period. Data include weekdays and weekends.

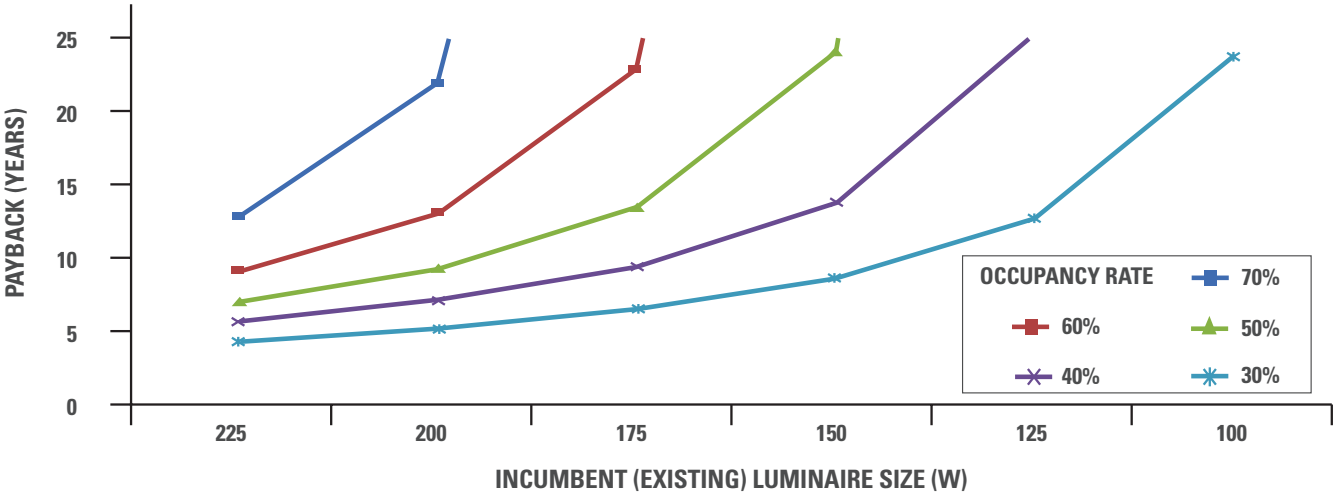
For the CSUS demonstration, simple payback was calculated to be 16 years. Project payback terms will vary considerably depending on site-specific parameters including demand size (watts) of existing technology, energy cost, garage occupancy rates, and regional variance in equipment costs. The site-specific economic parameters in Table 1 influenced calculation of project payback terms.

TABLE 1: CSUS ECONOMIC PARAMETERS FOR LED PARKING GARAGE LUMINAIRE

Luminaire Cost	$800.00
Utility Incentive Rate ($/kWh)	$0.05
Energy Rate ($/kWh)	$0.128
Average Annual Operating Hours	7,880
Average High-Mode Operating Rate	60%
High Mode (W)	165
Low Mode (W)	77

Using these values, Figure 4 demonstrates the range of project payback terms based on variance in garage occupancy rates and baseline (existing) luminaire size. Most projects with similar economic factors may expect a simple payback for an LED parking garage retrofits project between five and 15 years.

FIGURE 4: SIMPLE PAYBACK, BI-LEVEL PARKING GARAGE LUMINAIRES
Garage 1, California State University, Sacramento
LED luminaire 165W high mode and 77W low mode



Product Availability

The Edge Parking Garage Luminaire is offered by Beta LED. More information may be found online at www.betaled.com. Bi-level LED parking garage luminaires are also offered by Wide-Lite at www.widelite.com and LED Era at www.led-era.com.

What's Next

CLTC continues to install and monitor demonstrations of bi-level smart parking garage luminaires as part of the PIER program. A demonstration project is in progress at the city of San Marcos Civic Center garage using the Wide-Lite VizorLED parking and undercanopy luminaire. It is expected to be completed in summer 2010.

Collaborators

This project was a collaboration between CLTC, SMUD, the California Energy Commission, and California State University, Sacramento.

For More Information

Cori Jackson, Senior Development Engineer
California Lighting Technology Center, UC Davis
cmjackson@ucdavis.edu, www.cltc.ucdavis.edu

- To read more about Bi-level LED Parking Garage Luminaires, visit cltc.ucdavis.edu/content/view/668/355
- More information on demonstrations is available at www.pierpartnershipdemonstrations.com

TABLE 2: ENERGY AND MAINTENANCE COST AND SAVINGS
Demonstration Summary, California State University, Sacramento

TECHNOLOGY	SYSTEM SIZE (W)	ANNUAL ENERGY CONSUMPTION (kWh)	ANNUAL ENERGY COST	ANNUAL MAINTENANCE COST	TOTAL ANNUAL COST	LIFECYCLE ENERGY COST	LIFECYCLE MAINTENANCE COST	TOTAL LIFECYCLE COST
HPS	189	1,489	$190.63	$16.55	$207.18	$2,419.20	$210.00	$2,629.20
LED	165	1023	$130.92	$11.82	$142.74	$1,661.44	$150.00	$1,811.44

Years of use: ~13
Energy cost: $0.128/kWh
Annual hours of use: 7,880
Occupancy: 60%
Cost of labor: $100/hour
HPS lamp cost: $20
Time to replace lamp: 0.5 hrs
LED lamp cost: $100

About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

Arnold Schwarzenegger, *Governor*

California Energy Commission

For more information, see www.energy.ca.gov/research

Chair: Karen Douglas *Vice Chair:* James D. Boyd
Commissioners: Jeffrey D. Byron, Anthony Eggert, Robert Weisenmiller