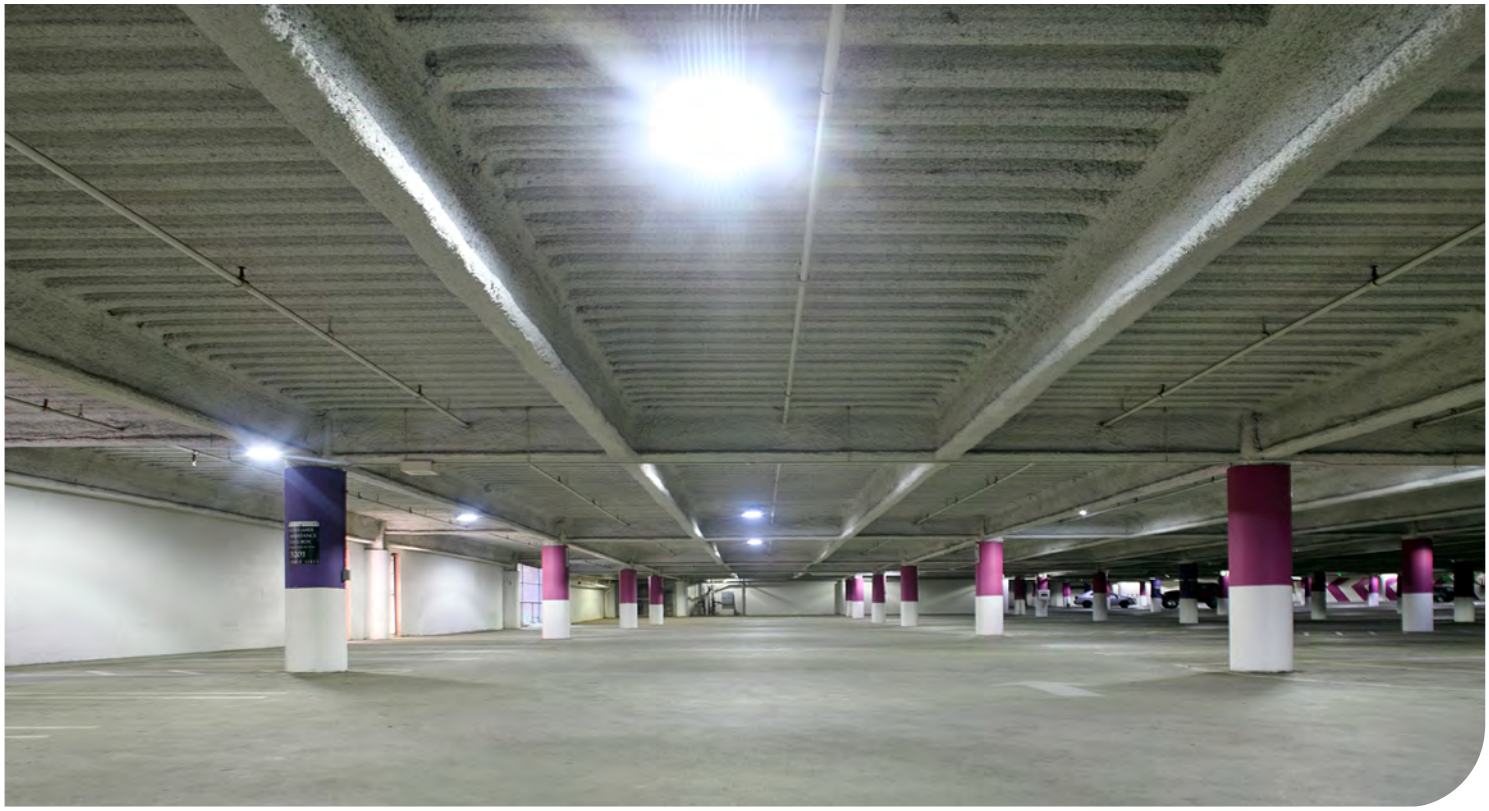
Dramatic energy savings for Sacramento with bi-level LED parking garage retrofits



CASE STUDY SNAPSHOT

The City of Sacramento retrofitted a 2-level downtown parking garage with 186 new bi-level LED light fixtures to cut per fixture electricity use by about 88%.

Building type: Parking garage

Size: 180,000 square feet

Project: 175 W Metal Halide fixtures replaced with 70 W bi-level LED fixtures

Annual energy savings: 310,000 kWh

Peak load reduction: 35 kW

Project cost: $115,000

Simple payback: under 2 years

Benefits:

- Annual electricity bill savings of $34,500
- Greenhouse gas emission reduction of 134 metric tons of CO_2e annually
- Improved light uniformity and color rendering
- Reduced fixture maintenance costs
- LED fixtures contain no mercury

Providing an inviting parking environment and saving energy are high priorities for the City of Sacramento's Parking Facilities Manager, Matt Eierman. "Our goal is for people to feel comfortable and secure in our parking garages, and to run those garages efficiently, reducing waste and cutting down on electricity costs. Good lighting really makes the difference in creating that positive feeling we try to maintain in all of our garages."

Finding the Right Lighting Technology

A little over five years ago, the annual electricity bill for eight of the City of Sacramento's parking garages was over $700,000 and climbing. As part of City-wide efforts to reduce energy use, Mr. Eierman, with help from City of Sacramento Engineer James Christensen, began looking for ways to save energy in the City's parking garages. They researched a number of lighting options to replace the City's aging metal halide and high pressure sodium fixtures. Initially, T8 fluorescent and induction fixtures seemed like the best options and were tested in a small pilot in their Downtown Central Garage. City staff appreciated certain features of the demonstration fixtures, but were hoping to identify an option that would require less maintenance and last longer.

Rapid improvements in LED technology attracted the City's interest, with new LED products promising a combination of low maintenance costs, long useful life, and good light quality. In 2009, with support from its electric utility, Sacramento Municipal Utility District (SMUD), the City retrofitted 25 metal halide fixtures with 25 LED fixtures with bi-level controls in a portion of the same garage.

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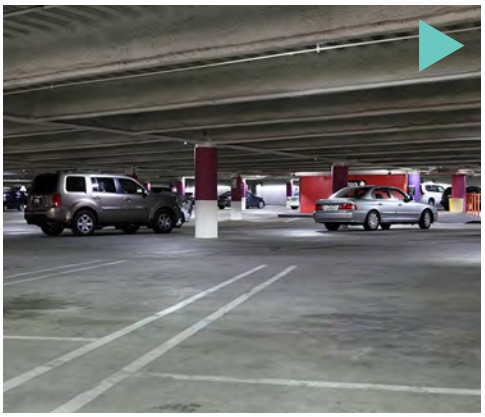
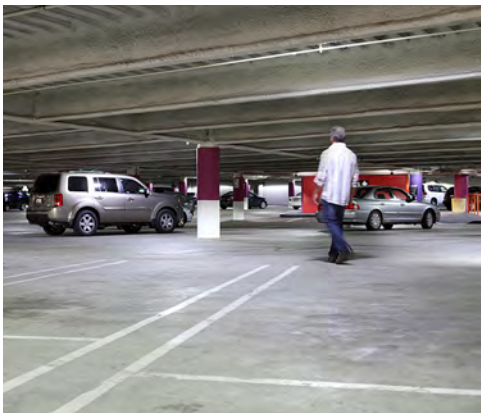
Case Study | City of Sacramento Parking Garage

After monitoring initial illumination and energy consumption levels for a month, the bi-level LED pilot showed energy savings of 67%, higher illumination levels, less glare, and less light pollution compared to the metal halide fixtures. These features, coupled with bright white light and excellent color rendering capability, motivated the City to scale up the pilot and retrofit all eight of the City of Sacramento's garages with a combination of bi-level and fixed output LEDs.





▲ Bi-level light fixtures utilize occupancy sensors to reduce light levels when the space around the fixture is unoccupied (image on left). When someone walks into the space, light fixtures automatically switch to 100% light output (image on right). This automated lowering and elevating of light levels depending on occupancy saves energy and increases fixture life.

Facility Profile: Downtown Central Parking Garage

Sacramento's Downtown Central Garage is located below grade with minimal natural daylight. The garage is operated and illuminated 24 hours a day, seven days a week. Prior to the retrofit there were no controls to turn off or reduce light output when areas were unoccupied. The two-level, 180,000 square foot garage, serves approximately 67,000 drivers and pedestrians annually, and typically is in greatest use between 10 am and 7 pm.

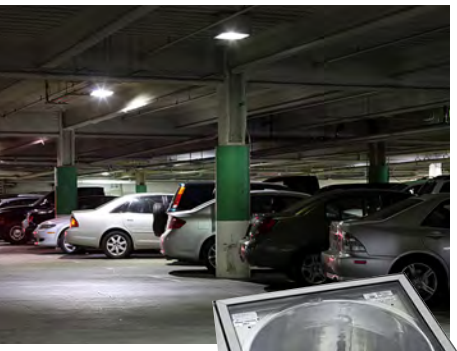
Project Costs and Savings

In summer 2011, the garage's 248 remaining 175-watt metal halide fixtures were replaced with 186 70-watt bi-level LED fixtures with integrated occupancy sensors and 62 70-watt fixed output LED fixtures without occupancy sensors. The fixed output fixtures are located near stairwells, elevators, ramps and entrance/exits. Additionally, approximately 90 smaller fixtures and exit signs were retrofitted to high efficiency LED or T8s as part of the project.

Post-installation monitoring of individual fixtures indicate the new bi-level LED fixtures will reduce peak power demand by approximately 35 kW and will save over 310,000 kWh of electricity annually, which represents electricity savings of 88% compared to the previous metal halide fixtures. The energy savings are expected to reduce the City's electricity expenditures by about $34,500 annually.

The cost of the bi-level LED portion of the project was about $110,000. Incentives from the Energy Technology Assistance Program and SMUD covered almost 50% of the project cost and resulted in a simple payback of 1.6 years. The City was also able to reduce project costs by doing the installation work with in-house staff.

The Energy Technology Assistance Program conducted a monitoring study at the garage after the installation of the bi-level fixtures. The study revealed that on average, the new fixtures spend 85% of the time in the low power mode.



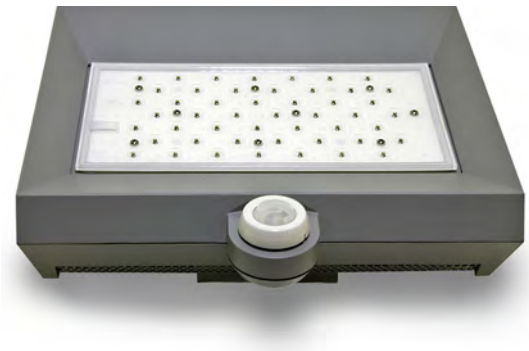
◀ Prior to the retrofit, the Downtown Central Garage was lit with 175-watt metal halide fixtures.

Scaling up the Savings

The City will retrofit the remaining seven garages in 2011-12 using installation contractors. The estimated payback period for all eight garages is less than three years. Once complete, the bi-level and fixed output LEDs in all eight garages will save more than 4 GWh annually and reduce annual electricity expenditures by approximately $470,000.

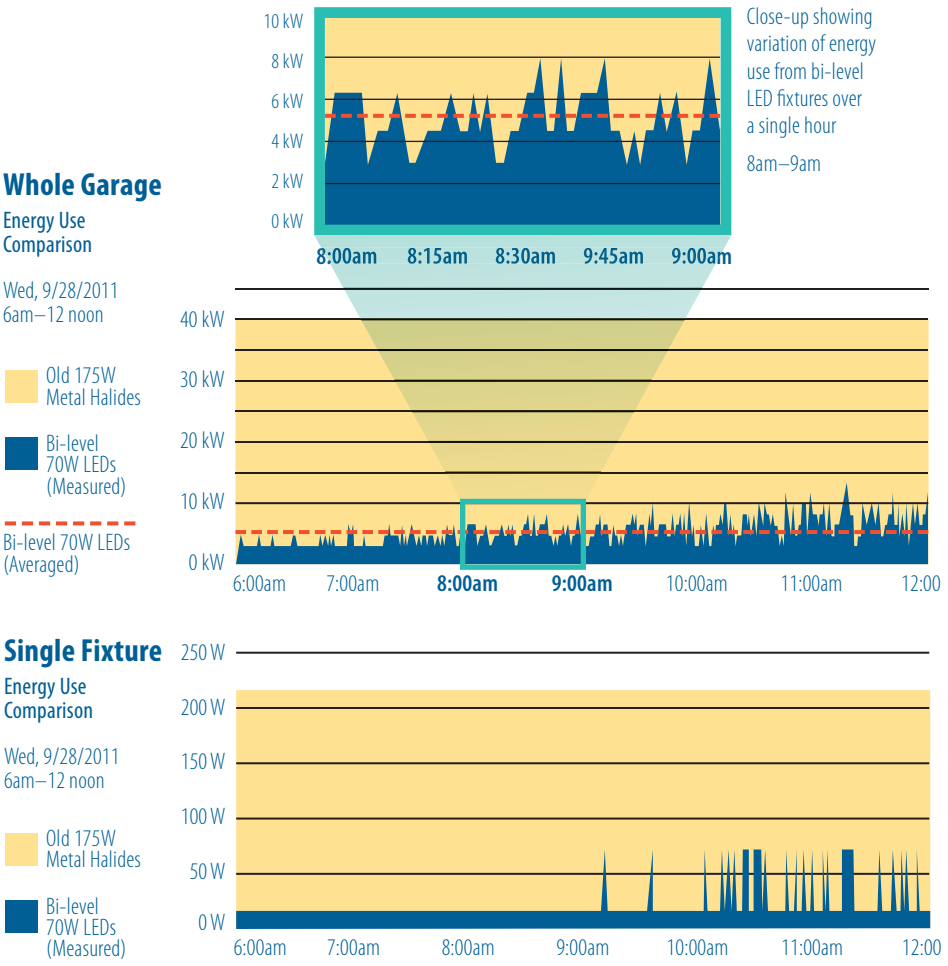
Why Bi-level Lighting Controls?

Parking facilities are often excellent candidates for an upgrade to bi-level lighting



◀ 70-watt bi-level LED Emco fixtures with integrated occupancy sensors replaced 186 metal halide fixtures in the Downtown Central Garage. The LED fixtures have a rated life of 100,000 hours, over five times greater than the metal halide fixtures being replaced. City Staff consider the fixture maintenance savings an added benefit of the new LEDs.

> "Initially I was leery about the bi-level feature. The idea of reducing light levels when no one is around makes a lot of sense because it saves energy, but I was concerned that at half power the area would appear dark and uninviting. The demo really changed my mind – at half power there was ample light and seeing the fixtures brighten in front of you as you walk in creates a really positive feeling."
>
> Matt Eierman, City of Sacramento Parking Facilities Manager



for two reasons: existing lighting is inefficient and there are often long periods of low occupancy. Retrofitting to high efficiency bi-level fixtures presents an opportunity to save energy by both reducing energy use at full light output and dimming light levels during unoccupied periods. Bi-level lighting can work in conjunction with occupancy sensors, photo sensors, wireless controls, and other scheduling or controls technologies.

Typical energy savings for parking lots and garages retrofitted with bi-level lighting are 60%-85% depending on occupancy patterns, daylight harvesting or scheduling savings, and the efficiency of existing and replacement fixtures.

PROJECT DATA

PROJECT SUMMARY

Site: Sacramento Downtown Central Parking Garage
Size: 180,000 square feet; 2 underground levels
Built: 1992
Floor to ceiling height: 9 ft.
Floor to bottom of beams: 7 ft. 5 in.

ENERGY INFORMATION

Annual electricity use before retrofit: 350,000 kWh
Annual electricity savings from bi-level LEDs: 310,000 kWh
Peak demand reduction from bi-level LEDs: 35 kW

BI-LEVEL LED PROJECT ECONOMICS

Annual utility cost savings: $34,500
Bi-level LED project cost: $110,000
Utility & CEC Incentives:
- SMUD Custom LED Lighting Incentives ~ $17,000
- Energy Technology Assistance Program – $37,200

Simple payback: under 2 years (about 3.2 years without rebates)

BI-LEVEL EQUIPMENT INSTALLED

Philips Gardco Emco LED Garage Luminaire Gen 2 – 70W, ELG2-MR-5-70LA-CW-UNIV-NP
Fixture-integrated sensors: Passive Infrared (PIR) Motion Sensor (Wattstopper FS-305)
Fixture details: Type V distribution; CCT: 6000K; CRI: 75 CRI
–High light level mode: 390 mA, 70 watts, 5658 lumens
–Low light level mode: Wattage reduced by 80% to about about 15 watts

LEDs – A Rapidly Evolving Market

The LED lighting industry is making rapid progress in improving the quality and diversity of products on the market. As a result of the fast pace of change, there is significant variability in price and quality of equipment available and it is recommended that consumers evaluate LED products carefully. Key considerations include equipment cost, rated useful life, suitability of light distribution properties for the intended application, and overall manufacturer reputation. Most LED manufactures have their products tested by independent laboratories to evaluate key performance metrics and can provide testing results on request.

Two useful entities involved in verifying LED manufacturer performance claims are ENERGY STAR™ (evaluates smaller interior LEDs) and the Design Lights Consortium (evaluates streetlights and larger, area-type fixtures such as parking lot and garage fixtures).

TAKING THE NEXT STEP

Work closely with a lighting designer

Parking facilities illuminated with bi-level fixtures must be well designed to ensure that expectations are met when operating at both low and high power modes. Customers interested in parking garage or lot fixtures with bi-level controls should work closely with a lighting designer to select the most appropriate technology and fixture configuration. Lighting designers and fixture manufacturers are often capable of providing photometric modeling and other design services which will ensure a high quality project.

Additional case studies on bi-level and LED lighting projects

- **SMUD Bi-level LED Lighting Systems Report**
  Highlights demonstration projects completed at the Downtown Central Parking Garage and another at Cal State Sacramento
  https://www.smud.org/en/business/save-energy/energy-management-solutions/documents/bi-level-LED-aug10.pdf
- **UC Davis Bi-level Fluorescent Parking Garage Luminaire Demonstration**
  http://cltc.ucdavis.edu/content/view/806/406/
- **UC Davis Smart LED Parking Garage Luminaire Demonstration**
  http://cltc.ucdavis.edu/content/view/668/355/
- **PIER Bi-level Induction Area Luminaries**
  http://cltc.ucdavis.edu/images/documents/case_studies/pier_bilevel_induction_area2.pdf
- **PIER Solutions for Parking Lots and Garages**
  Catalog that includes information from a variety of fixture manufacturers as well as PIER case studies on bi-level street and area lighting projects
  http://cltc.ucdavis.edu/images/documents/guides_reports/2010_pier_catalog_lots_and_garages.pdf

Applicable utility incentives

- Incentives for bi-level lighting and LED fixture retrofits are available from SCE, PG&E, SMUD, SDG&E and may be available from other electric utilities as well. Contact your local utility representative for more information.

Financing assistance

- California Energy Commission low interest loans for energy efficiency projects
- Utility on-bill financing
- Financing from energy service companies (ESCo)

ENERGY SOLUTIONS

Energy Solutions is an energy efficiency consulting firm working to create large-scale environmental benefits by developing and implementing innovative, market-based approaches to increase sustainability through energy efficiency, water efficiency, and renewable energy initiatives. Energy Solutions developed and implements the Energy Technology Assistance Program (2010-2012). Funding has been provided by the American Recovery and Reinvestment Act of 2009 and is administered by the California Energy Commission.