LEDs and bi-level controls deliver healthy 87% energy savings at the Contra Costa County Pittsburg Health Center parking lot

CASE STUDY SNAPSHOT

Contra Costa County reduced parking lot electricity use by 87% with a bi-level LED lighting retrofit project at the Pittsburg Health Center.

Building type: Parking lot

Size: 120,000 square feet, about 180 parking spaces

Annual energy savings: 187,800 kWh

Project cost (after rebate): $70,000

Simple payback: 2.2 years

Benefits:

- Annual electricity bill savings of $25,400
- Greenhouse gas emission reduction of 82 metric tons of CO_2e annually
- Lighting levels automatically adjust to high or low, based on occupancy
- Reduced fixture maintenance costs
- Improved light distribution reduces light/dark spots and increases security

Faced with increasing electricity costs and aging light fixtures, Contra Costa County's Pittsburg Health Center was in a dilemma familiar to many parking lot owners: What is the best way to ensure safety and comfort in a large parking lot with minimal night-time occupancy while keeping energy and maintenance costs down? The County had previously installed LED luminaires in a portion of its Juvenile Hall parking lot and was pleased with the quality and distribution of light. LED fixtures' long lifetimes and low rates of energy consumption also impressed the County. When the County learned that LED luminaires could also be equipped with occupancy sensors that enable a further reduction in energy consumption when the parking lot is unoccupied, it knew it had found a solution for the Pittsburg Health Center lot.

In January 2012, the County upgraded the Pittsburg Health Center parking lot with bi-level LED fixtures with occupancy sensors. The new lighting system saves on energy costs and maintenance, freeing up funds and staff resources at a time when both are in short supply. In addition to these benefits, the LED fixtures deliver better light distribution, improving public safety for the patients and staff who use the parking lot at night.

Facility Profile: Pittsburg Health Center Parking Lot

Contra Costa County's Pittsburg Health Center is a full-service health center serving residents during weekdays, evenings and weekends. The Health Center's 120,000 square foot parking lot includes approximately 180 parking spaces illuminated by 157 pole-mounted fixtures. In addition to serving the County's residents during normal business hours, the Health Center offers evening

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appointments two days a week and regularly holds evening educational seminars. Before the lighting retrofit, photocells controlled the 157 light fixtures, turning lights on in the evening and turning them off at dawn. To maximize public safety, the County illuminated all areas of the parking lot during evening hours, despite irregular and uneven occupancy. Leaving the lights on at full power, even when the lot was empty, racked up annual electricity bills of about $29,100.

Lighting Retrofit

The Pittsburg Health Center parking lot lighting upgrade included the replacement of 157 existing 250-watt high pressure sodium (HPS) fixtures with 70 high efficiency bi-level LED fixtures with occupancy controls. The electrical contractor completed the installation in about five days.

The bi-level fixtures provide two levels of light output, depending on occupancy. The fixtures maintain the lower, base level of light output at all times to meet security needs, but instantly brighten to the higher level of light output whenever pedestrians or cars are active in the lot. The high level mode delivers 10,191 lumens at 137 watts and the low level mode delivers 3,934 lumens at just 33 watts. Even in the high-level mode, the LED fixtures use far less energy than the HPS fixtures they replaced.

Bi-level switching reduces electricity use even further while continuing to provide a safe and comfortable environment for users.

Relative to other space types, parking lots require surprisingly little light. The Illuminating Engineering Society recommends an average of only 0.2 footcandles of light output for parking lots because the human eye is very adept at adjusting to lower light levels at night. Other metrics, such as color rendering and lighting uniformity, can be more important to the overall effectiveness of a lighting strategy in parking lots than the actual light output levels. Improved color rendering and distribution enables LED fixtures to provide superior light quality

① Prior to the retrofit, HPS lamps provided uneven illumination and cast an orange light. Note the dark area running through the center of the parking lot, left to right in the photo.

② The new LED bi-level fixtures operate at high light levels when an occupant is sensed. The new fixtures provide even illumination across the parking lot and improved color rendering.

③ During periods of no occupancy, the LED bi-level fixtures dim to a low light level, but still provide enough light to keep the lot secure.

④ LED Beta Edge Area fixtures with integrated occupancy sensors on a pole-mount (left) and close-up (right). Each fixture contains 60 LEDs.

> **"The upgrade from high pressure sodium lamps controlled by time clocks to high efficiency LED lamps controlled by occupancy sensors allows us to save energy, and improve lighting quality and coverage, while reducing maintenance costs. The Health Center's staff noticed the difference immediately. Thanks to financial incentives available from ETAP and PG&E, the project not only improved our facility and decreased maintenance costs, but also made a very compelling business case."**
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> Andy Green, Energy Program Manager, County of Contra Costa

even at lower average light levels than the HPS fixtures they replace.

The most significant design consideration for adequate parking lot lighting is establishing an adequate uniformity ratio. This ratio is a measure of the brightest and dimmest areas, and a key indicator of lighting quality. The lower the ratio, or difference between bright and dark patches, the better the lighting quality. Because light output from LEDs can be controlled and directed much more effectively than light from HPS or metal halide fixtures, parking lots using new LEDs often require fewer fixtures at lower wattages to achieve similar average light levels or better lighting uniformity across the entire parking lot than using non-LED fixtures.

The significant improvement in light distribution from the new LEDs made it possible for the County to reduce the total number of fixtures serving the Pittsburg Health Center lot. Before the retrofit, each pole in the parking lot supported either two or four HPS fixtures. For the retrofit, the contractor removed the old HPS fixtures and mounting arms and installed either one or two new LED fixtures per pole. As a result, the parking lot now features less than half the number of fixtures it had before – from 157 HPS fixtures down to 70 LED fixtures – yielding even greater energy savings.

Project Costs, Savings, and Financing

The parking lot fixture retrofit alone is estimated to reduce annual energy use by 173,400 kWh. The bi-level lighting controls add another 14,400 kWh in annual savings, for a combined estimated annual savings of 187,800 kWh. Post-project monitoring indicates that, on average, the new fixtures spend 88% of operating hours in low-power mode. This means that 88% of the time, each light pole is using 33 watts to power an LED fixture in low power mode compared to a basecase of 590 watts to power the old HPS lamps. The energy savings are expected to reduce the County's annual electricity expenditures at the Pittsburg lot by about $25,400.

The full cost of the project was approximately $88,700. The Energy Technology Assistance Program (ETAP) and Pacific Gas and Electric Company's (PG&E) Customized Rebate Program covered 21% of the project cost. Taking into account these rebates, as well as maintenance savings associated with the longer life of the LED lamps, the project has a 2.2 year simple payback; without incentives, the payback would have been 2.8 years.

Contra Costa County used PG&E's On-Bill Financing program to cover the balance of upfront project costs. Under on-bill financing, PG&E financed the project with 0% interest and the County will pay back the loan through its monthly utility bills. Making loan payments through the standard bill-paying process makes it simple for the County to institute this financing strategy.

PROJECT DATA

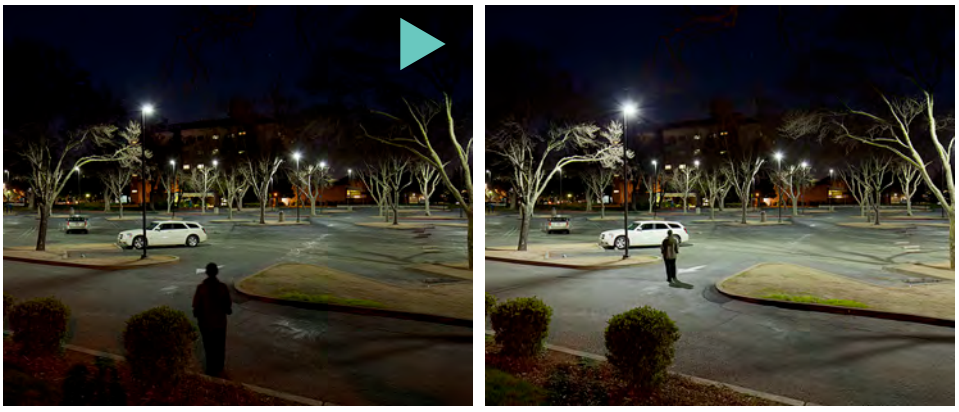
PROJECT SUMMARY
Site: Pittsburg Health Center parking lot
Location: 2311 Loveridge Road, Pittsburg
Size: 120,000 square feet, approximately 180 parking spaces
Built: 1977

ENERGY INFORMATION
Annual lighting electricity use before retrofit: 215,500 kWh
Annual electricity savings from LED fixture retrofit: 173,400 kWh
Annual electricity savings from bi-level controls: 14,400 kWh
Total annual electricity savings: 187,800 kWh

PROJECT ECONOMICS
Annual utility cost savings:
$25,400 or 87% of previous annual electrical lighting costs
Total project cost excluding rebates: $88,700
Utility & CEC Incentives:
- PG&E Customized Retrofit Program Rebate - $4,700
- Energy Technology Assistance Program Rebate - $14,000

Simple payback: 2.2 years (2.8 years without rebates)

EQUIPMENT INSTALLED
Basic project components: 70 LED Beta Edge Area fixtures (60 LED, 700/175, 137/33Watts) with integrated occupancy sensors
Fixture details: Each fixture contains 60 LEDs. The fixture uses 137 watts when the occupancy sensor is tripped and the fixture delivers a higher light level; the power drops to 33 watts during unoccupied periods when the light level is reduced.



◀ When occupancy sensors sense the approach of a pedestrian or car, the bi-level LED fixtures adjust from low light levels (on the left) to high light levels (on the right).

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TAKING THE NEXT STEP

Work closely with a lighting designer

Working closely with a lighting designer to select the most appropriate bi-level fixture technology and fixture configuration will help ensure that both low and high power modes meet the facility operator's necessary performance requirements. Lighting designers and fixture manufacturers are often capable of providing photometric modeling and other design services, which can help ensure a high quality project.

Additional case studies on bi-level lighting control projects

- **UC Davis Bi-level Fluorescent Parking Garage Luminaire Demonstration**
  http://cltc.ucdavis.edu/content/view/806/406/
- **UC Davis Bi-level Smart LED Parking Garage Luminaire Demonstration**
  http://cltc.ucdavis.edu/content/view/668/355/
- **UC Davis Bi-level Induction Parking Garage Luminaires Case Study**
  http://www.everlastlight.com/download/pdfs/everlast/pier_bilevel_induction_parking_garage_ucd.pdf
- **Application Assessment of Bi-level LED Parking Lot Lighting, prepared for the US Department of Energy by Pacific Gas and Electric Company**
  http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/gateway_raleys.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
- **City of Sacramento Downtown Parking Garage Bi-level Lighting Case Study**
  http://energy-solution.com/etap/case-studies/

Applicable utility incentives

Contact your utility representative for specific information for your utility. Incentives for bi-level lighting controls projects may include:

- Fixture retrofit programs offering standard per-fixture rebates or incentives based on project energy savings

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.