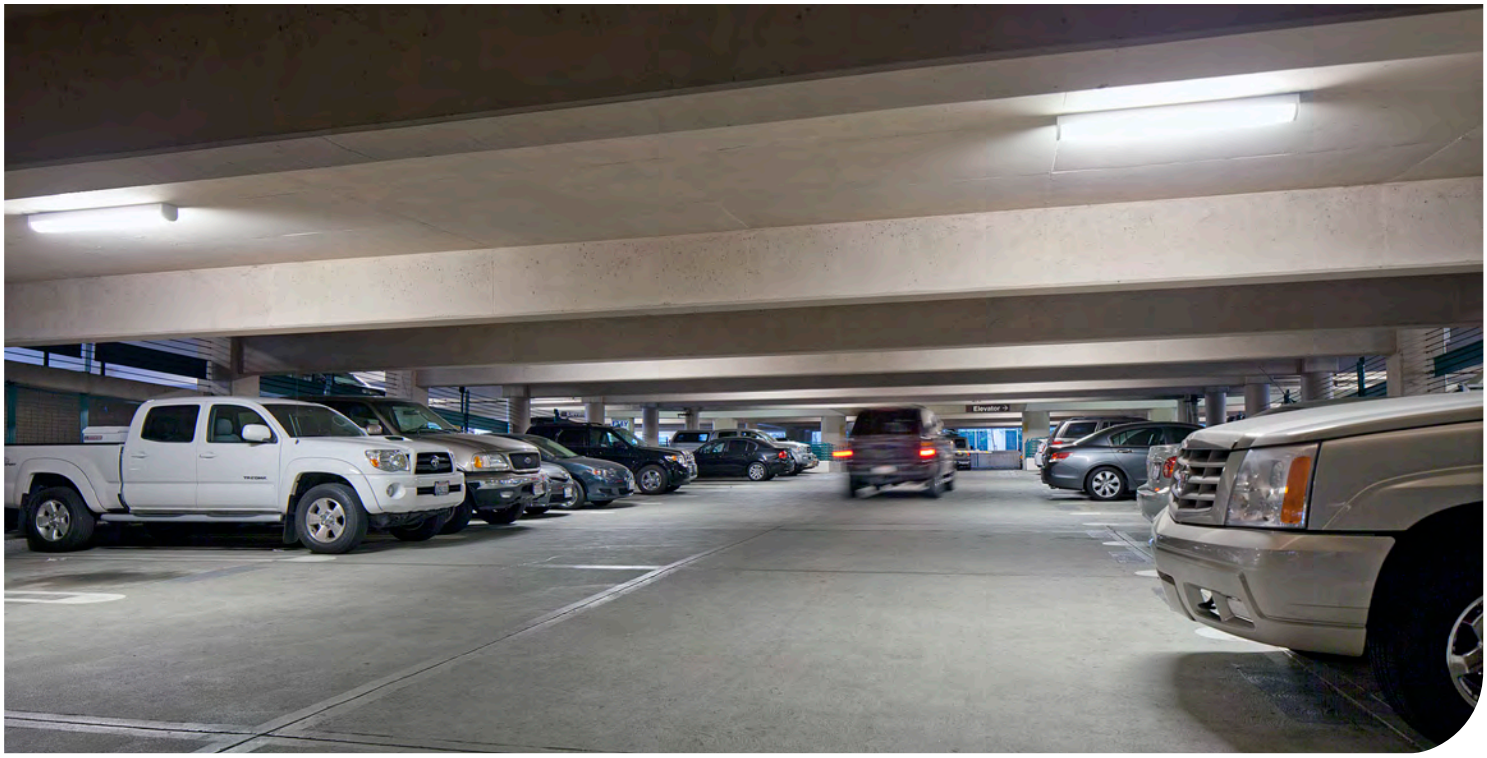
San Mateo County drives down electricity costs in parking garage by 67% with efficient T8 lamps and wireless lighting controls



CASE STUDY SNAPSHOT

San Mateo County cut lighting energy use by 67% through a lighting retrofit with wireless controls at the parking garage serving the County's administrative campus.

Building type: 6-level parking garage

Size: 312,150 square feet, 904 parking spaces

Project: 279 HPS fixtures (150W) replaced with bi-level linear fluorescent fixtures (44-73W)

Annual energy savings: 248,200 kWh

Peak load reduction: 22.3 kW

Project cost: $144,700

Simple payback: 3.8 years

Benefits:

- Lighting energy use automatically adjusts based on occupancy and availability of natural daylight
- Programmed lighting schedule can be adjusted remotely
- Easier lamp and ballast changes, lower cost lamps, and fewer different lamps kept in stock
- Potential for participating in utility demand response peak load reduction programs
- Flexible lighting controls system, accessible via login from the internet

With six levels and over 900 parking spaces occupied daily, San Mateo County's County Center Parking Garage supports the commutes of hundreds of employees and visitors, and houses a fleet of County vehicles. Unfortunately, with most of their inefficient high pressure sodium (HPS) lamps operating 20 to 24 hours per day, seven days a week, paying the monthly $46,000 electric bill for this facility was no joyride.

At the time the decision to retrofit the garage lighting was made, the County had two key priorities for the upgrade: (1) to improve the quality and color rendition of the lighting, and (2) to have better control of lighting energy use while maintaining or improving safety in the garage. County staff knew from experience the benefits of high lumen dimmable T8 lamps, so when they heard about the option of pairing wireless lighting controls with efficient light fixtures, they immediately recognized the potential for achieving their aims for the parking garage upgrade.

Facility Profile:
County Center Parking Garage
The County Center Parking Garage houses 45 county vehicles, provides daily parking for 738 employees who work various shifts around the clock, and includes 121 public metered spaces. The garage includes one underground level with scant natural light, and five above-ground levels that receive natural perimeter day lighting, but require electric lighting at the central core of the garage. Prior to the lighting retrofit, the parking garage utilized 297 150-watt HPS fixtures, each of which required 188 watts to power the lamp and ballast.

Most of the lighting fixtures installed in the underground level were on 20 to 24 hours per day, seven days per week. The perimeter lighting was controlled using a basic seven day timeclock that turned the lights on at a preset hour at dusk. The clock had to be manually adjusted throughout the year as daylight hours changed, leaving open the possibility of shorter or longer run times than was necessary.

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Lighting Retrofit & Controls Installation

The County of San Mateo's retrofit project at the parking garage included a bi-level lamp and ballast retrofit and the installation of a wireless lighting control system. Project installation was completed in about one month, with an additional month required for controls programming and commissioning.

Five of the garage's six levels underwent a one-for-one fixture replacement. The 279 existing 150-watt HPS lamps and fixtures were replaced with 279 new fluorescent fixtures, each of which houses two four-foot T8 lamps, a bi-level step-dimming ballast, and the Adura Wireless Light Controller. The light controllers control the light output based on input from occupancy sensors or an astronomical timeclock if the fixture is located in a daylit area.

The rooftop parking lot level originally had 18 pole-mounted 150-watt HPS lamps and fixtures. However, as part of a photovoltaic installation that occurred before this project, the County replaced the HPS fixtures with 42 efficient linear fluorescent lighting fixtures installed on the underside of the solar canopy. For the current project, the rooftop parking lot level required only the addition of the Adura Wireless Light Controllers.

The bi-level ballasts in the garage were programmed to allow two light levels: 100% light output, which uses 73 watts per fixture, and 60% light output, which uses 44 watts per fixture. The dual-ballasted under-canopy fixtures on the roof also allow two light levels: 23% (22 watts) and 100% (96 watts).

The Adura Technologies Wireless Lighting Control System was also installed, the components of which are listed in the Project Data box on the following page.

Adura engineers configured the occupancy sensors, established time schedules, and adjusted the baseline light levels to the proper light output. Adura also trained County facility staff to use the system and controls software effectively.

Daylighting Control

Perimeter lighting in the garage is automatically controlled by the Adura system by an astronomical timeclock built into the Adura Wireless Light Controller. The Adura system uses local sunrise/sunset times throughout the year to turn perimeter lighting on or off, and automatically adjusts daily for longer summer days and shorter winter days.

Occupancy Control

Occupancy sensors were strategically placed in driving lanes and locations where pedestrians are expected to be walking (for example, near stairwells and elevators on each floor). Light fixtures were organized into occupancy control zones, each of which generally includes 6 to 12 fixtures. The occupancy sensors send wireless signals to the light controllers in their control zones, and the fixtures vary their brightness (and energy usage) according to occupancy.

Motion detected by any of the occupancy sensors in the control zone results in all of the lights operating at full brightness. The occupancy zones allow for predictive lighting, so that a vehicle or pedestrian traveling through the garage will trigger a "pathway" of lights in front of the occupant. When all of the sensors in a zone are vacant for five minutes, the lights in the zone dim to 60% light output. On the upper floors, half of the light fixtures are programmed to turn off completely after an additional 10 minutes of vacancy, resulting in an average of 30% power output.

Why Wireless Lighting Controls?

Wireless lighting controls offer the same or better functionality as traditional wired controls systems at a lower cost and with less invasive, easier installation. Wireless controls systems generally do not require modifications to the existing electrical wiring or addition of new control wiring and can be easily modified to adapt to changing space needs, schedules, or energy reduction strategies through reprogramming.

The County was quick to recognize how wireless lighting could help improve their control of lighting energy use while maintaining safety in the garage. Their system delivers bi-level control, occupancy detection, day lighting, smart scheduling, and astronomical scheduling to control light levels in different areas. The wide range of controls options, in combination with individually controlled zones, allows the County to maximize savings without compromising occupant safety in the garage. In addition, the system provides energy use tracking and monitoring, automated maintenance notifications, and load shedding capability.

◀ Pre-retrofit 150-watt HPS lamps were replaced with a T8 fixture. The HPS lamp/ballast combination drew 188 watts per fixture.

▲ Retrofit lighting fixture, including two T8 GE High Lumen 3500K lamps enclosed and gasketed with a spread beam Miro reflector, and a two-lamp F32T8 GE UltraMax 1.18 ballast factor programmed-start dimming ballast.

▲ Light levels in each parking garage zone are controlled by occupancy sensors. Depending on the occupancy state (occupied vs. not occupied), and length of state, the light level is 100%, 60% or 30%.

"The new lighting fixtures provide a more appealing light that appears brighter and makes it easier to see. I can actually see the true color of my car! The way the lights come on and create a well-lit path as you walk through the garage makes it feel comfortable and secure, even in the middle of the night."

Jaime D. Young, Public Safety Communications Director

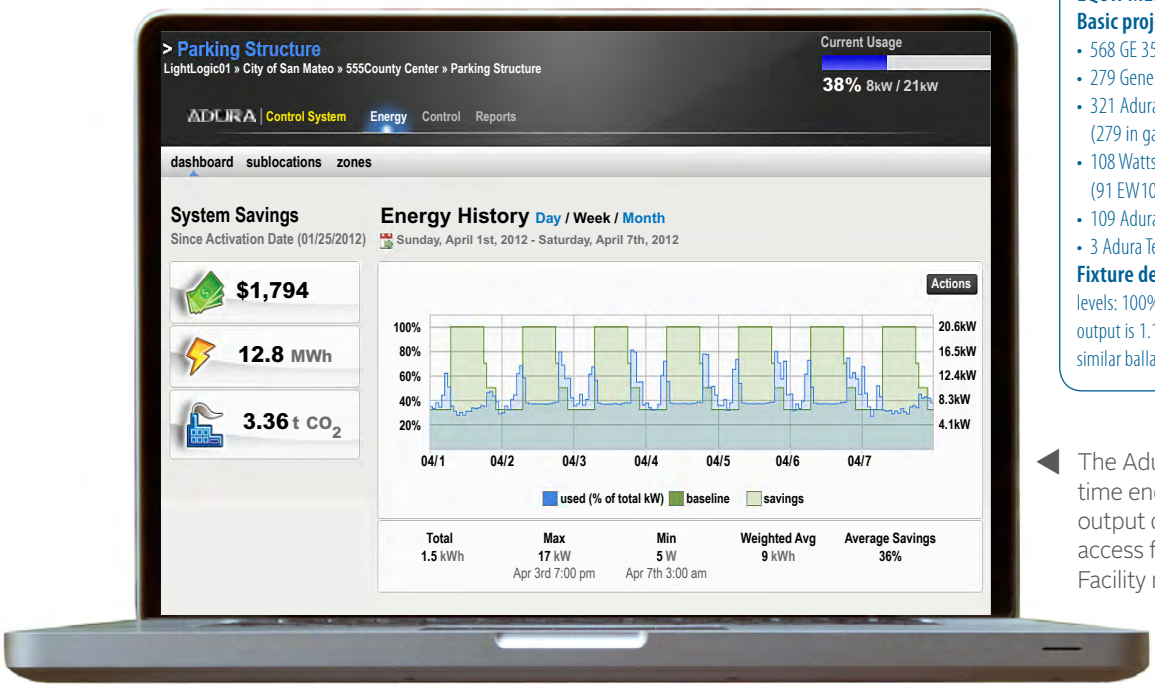
Project Costs and Savings

The County Center Parking Garage's fixture retrofit alone is estimated to reduce annual energy use by 213,200 kWh (58% of total lighting electricity use in the garage) and peak demand by approximately 21.6 kW. The Adura Controls System is expected to reduce annual energy use by an additional 35,000 kWh, or 23% savings relative to the new baseline for the T8 fixturers (155 kWh/yr). On average, the controls result in all fixtures operating in low power mode during 45% of the operating hours. The full cost of the project was $224,200 (36% labor, 64% equipment). The Energy Technology Assistance Program covered 20% of the project cost and Pacific Gas & Electric's Customized Rebate Program covered 15% of the project cost. The County used general funds earmarked for energy efficiency upgrades to cover the balance of the project cost. Net of program rebates, the project will have a 3.8 year simple payback.

Adura Wireless Lighting Control System

The Adura Technologies Wireless Lighting Control System can control both newly installed fixtures and most types of pre-existing fixtures. The core of the Adura system is the light controller, which communicates wirelessly with system components such as occupancy sensors, photosensors, switches, and individual fixtures equipped with light controllers. The light controller integrates the inputs of all components and modifies the lighting environment accordingly in order to achieve desired light levels and maximize energy efficiency. The system is universally compatible with standard, commercially available occupancy sensors, photosensors and switches.

Control and management of the lighting system is provided with the Adura Enterprise Application, a customized, browser-based dashboard that uses a secure login to access graphical and data screens showing each light and occupancy sensor. The software displays real-time energy use of the building lighting as a whole and can also allow for analysis of individual fixtures.



The Adura Enterprise Application displays real-time energy usage and individual fixture light output data. The web-based platform allows access from any internet-connected computer. Facility managers can turn lights off and on, establish automated schedules, and respond to demand response events from any computer.

PROJECT DATA

PROJECT SUMMARY

Site: 555 County Center Parking Garage
Location: 555 County Center, Redwood City, CA
Size: Six level garage including one underground level, 904 parking spaces, 312,150 square feet
Built: 1993

ENERGY INFORMATION

Annual lighting electricity use before retrofit: 368,100 kWh
Annual electricity savings from fixtures: 213,200 kWh
Annual electricity savings from controls: 35,000 kWh
Total annual electricity savings: 248,200 kWh
Peak demand savings: 22.3 kW

PROJECT ECONOMICS

Annual electricity cost savings: $33,500 or 73% of previous annual electrical lighting costs
Total project cost: $224,200
Utility & CEC incentives: $79,500
- PG&E Customized Retrofit Program Rebate - $34,600
- Energy Technology Assistance Program Rebate - $44,900

Total project cost after incentives: $144,700
Simple payback: 3.8 years (6 years without rebates)

EQUIPMENT INSTALLED

Basic project components:
- 568 GE 3500 high lumen F32T8 lamps
- 279 General Electric GE232MAX90-S60, step dimming ballasts
- 321 Adura Technologies Light Controllers (279 in garage and 42 on roof)
- 108 Wattstopper passive infrared (PIR) motion sensors (91 EW100 in garage and 17 FS305 on roof)
- 109 Adura Sensor Interfaces
- 3 Adura Technologies Wireless Gateways

Fixture details: The ballasts were programmed to allow two light levels: 100% and 60% light output. The ballast factor at 100% light output is 1.18 and at 60% light output, it is 0.71. Note that there are similar ballasts that can be programmed for continuous dimming.

"Holy light savings, we saved almost $2,800 in the first month of operation! At this rate, our project will pay for itself in four years. The combination of high efficiency T8 lamps and wireless controls allows us to maximize lighting savings throughout the garage, and the web-based user interface offers even more opportunities. We plan to set up a macro so we can hit one button and reduce the light levels to a predetermined level for demand response events."

Gary Behrens, Facilities Services Manager, Public Works, County of San Mateo

TAKING THE NEXT STEP

Selecting a contractor

The California Advanced Lighting Controls Training Program (CALCTP) trains C-10 electrical contractors and state certified general electricians on the installation and operation of advanced lighting controls systems, including wireless controls. A list of CALCTP certified lighting contractors is available at www.calctp.org.

Additional case studies on wireless lighting controls and bi-level lighting projects

- **PIER Wireless Integrated Photosensor and Motion Sensor Demonstration at UC Santa Barbara** http://cltc.ucdavis.edu/images/documents/case_studies/Pier_UCSB_WIPAM.pdf
- **PG&E Emerging Technologies Assessment of Advanced Lighting Controls for Energy Efficiency** http://aduratech.com/pdf/ETWirelessControl_EE.pdf
- **City of Pleasanton Public Library Wireless Lighting Controls Case Study** http://energy-solution.com/etap/case-studies/
- **Additional case studies and independent technology assessments regarding Adura Technologies controls are available at:** http://www.aduratech.com/case-studies/index.php
- **UC Davis Bi-level Fluorescent Parking Garage Luminaire Demonstration** http://cltc.ucdavis.edu/content/view/806/406/
- **City of Sacramento Downtown Parking Garage Bi-level Lighting Case Study** Note: This case study references additional bi-level lighting resources. http://energy-solution.com/etap/case-studies/
- **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

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

- Fixture retrofit programs offering standard per-fixture rebates or incentives based on project energy savings
- Demand response (DR) programs paying incentives based on the amount of kW load a building can shed when called upon to do so
- Automated DR programs providing additional incentives for customers that automate their equipment's response to a requested load shedding event

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.