

Energy-efficient LED Downlights

Bidwell Mansion Visitor Center Chico, CA



PIER Buildings Program

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The Problem

Recent studies estimate more than 800 million recessed downlights are in operation in the United States, split nearly equally between residential and commercial applications, with about 83% still using incandescent lamps.

Inexpensive compact fluorescent lamp (CFL) downlights are commercially available, but most of these units are not dimmable, which is a desired attribute for many downlight applications. Therefore, energy-saving CFLs often are overlooked in lieu of the functionality of incandescents.

This conflict creates a significant market opportunity for an energy-efficient, dimmable light source designed for the recessed downlight market. Significant energy savings potential exists for long-life LED replacements, as much as 81 trillion watt hours (TWh).¹

The Solution

Cooper Lighting and the California Lighting Technology Center (CLTC) partnered on this PIER-sponsored project to create an LED recessed downlight suitable for both retrofit or new construction markets that met ENERGY STAR requirements, provided high-quality, broad spectrum light, and could successfully dim on standard analog dimmers. The culmination of this partnership venture was the successful launch of the HALO® LED downlight offered by Cooper Lighting.

Features and Benefits

- The HALO LED recessed downlight is the first ENERGY STAR-rated LED downlight and exceeds the high efficacy requirements set by California's Title 24 energy regulations
- High color rendering and warm white color temperature: 80 CRI at 3045 K
- Delivers light equivalent to many standard incandescent sources used in recessed downlight applications
- Up to 25 times longer lamp life than incandescent lamps, lasting up to 68 years in most residential applications and 15 years in typical commercial applications²

¹ DOE, Energy Savings Estimates of Light Emitting Diodes in Niche Lighting Applications, prepared by Navigant Consulting, September 2008.

² Residential applications assume two hours of use per day. Commercial applications assume nine hours of use per day.

FIGURE 1: COOPER HALO® LED DOWNLIGHT
Bidwell Mansion Visitor Center, Chico, CA



- Dimmable to 15% of total light output with standard AC incandescent dimmers, 5% with low-end trim adjustment
- Multiple trim options available designed to minimize glare and increase aesthetic appeal, including those for wet applications

Technology Costs and Incentives

Installation of LED downlights in retrofit and new construction situations is almost identical to typical incandescent or CFL recessed downlights. The exception is that many LED downlight housings—for example, the HALO product by Cooper Lighting—can be in direct contact with insulation. Replacement scenarios generally are one-to-one in retrofit applications. Equipment costs range from \$100–300 depending on the manufacturer and distributor, but costs may be offset by maintenance savings and utility rebates.

Demonstration Results

Bidwell Mansion Visitor Center

The Bidwell Mansion Visitor Center (BMVC) in Chico, CA, is the first stop for people visiting Bidwell Mansion, a Victorian mansion built in the late 1800s and operated by the California State Department of Parks and Recreation. The BMVC contains a gift shop, museum, and theater, and is used to host seminars and workshops for the public, local agencies,

TABLE 1: TOTAL PROJECT ENERGY ANALYSIS
Pre- and post-retrofit downlight technologies at Bidwell Mansion Visitor Center

	Luminaire Type	Qty.	Watts per Luminaire	Total Load (W)	Fixture Efficiency	Total Delivered Lumens	Annual Energy Consumption (kWh)	Savings
Existing	10" fluorescent downlight	25	28	700	45%	15,300	1,417.5	
	3' T12 Strip	1	80	80	70%	1,400	162.0	
New	HALO LED downlight	27	14.8	400	99%	17,508	809.19	
Savings							770.31	49%

FIGURE 2: BIDWELL MANSION & VISITOR CENTER, CHICO, CA



and parks personnel. Approximately 35,000 people visit the park each year, and this high visibility made it an ideal location to demonstrate the Cooper HALO LED recessed downlight.

The BMVC was retrofitted in two installments by CLTC through the State Partnership in Energy Efficiency Demonstrations (SPEED) Program. The first phase focused on the foyer and restroom, where 16 LED recessed downlights were installed. In the foyer, 14 downlights with a 10" aperture that operated with two 13 W bi-pin CFL lamps and magnetic ballasts were replaced. In the bathroom, a 3' T12 fluorescent strip light was replaced. Before the retrofit, illuminance levels, at grade, varied from about 1 footcandle (fc) to 25 fc. Average maintained illuminance levels for the foyer and restroom were 14 fc and 9 fc.

In the second phase in the audio/visual room and over the information desk, 11 downlights were replaced with the new LED downlights. Illuminance levels in this area were 5–10 fc.

Post-retrofit illuminances were taken in the evening via a handheld illuminance meter. The average illuminance level was 12.1 fc, with a minimum illuminance level of 4.8 fc.

FIGURE 3: COOPER HALO LED DOWNLIGHT



The combined retrofits resulted in a 49% energy savings, which translates to about 770 kWh of energy saved annually. The energy savings represent an annual carbon emissions reduction of 1,080 pounds annually.

Product Availability

LED downlights currently are available from multiple manufacturers. In particular, some now offer ENERGY STAR-rated products, including Cooper Lighting, Cree, Inc., Juno Lighting, EEMA Lighting Group, Elite LED, Intematix, Lithonia Lighting, Neo-Neon International Ltd., Philips Lighting, Prescolite, Inc., Progress Lighting, and Renaissance Lighting, Inc.

For more information on specific ENERGY STAR LED downlights, please visit www.energystar.gov and follow the links to solid-state residential lighting products. LED downlights generally can be purchased at contractor or electrical supply centers.

TABLE 2: OPERATING AND MAINTENANCE ANALYSIS
Comparison between technologies projected over 11 years of use

Technology	System Wattage	Lamp or Fixture Lifetime (hrs.)	Qty. of Lamps	Relamp Cost	# of Relamps	Lifetime Maintenance Cost	Lifetime Energy Cost	Total Lifetime E & M
Incandescent	60	2,000	1	\$11	25	\$275	\$600	\$875
CFL	28	10,000	2	\$12	5	\$60	\$175	\$235
HALO LED	14.8	50,000	0	0	0	0	\$92.50	\$92.50

Analysis assumptions:

- The downlights are in operation 4,380 hours annually
- The time to replace a lamp is 0.2 hours
- The cost of labor is \$50/hour
- The cost of energy is \$.0125 per kWh

What's next

CLTC continues demonstrations of energy-efficient LED downlights as part of the SPEED Program and is seeking new demonstration host sites for this technology. Contact CLTC for more information for more information on how to participate in the program.

Collaborators

This research project is a collaboration between the California Department of Parks and Recreation, California Energy Commission, California Lighting Technology Center, Cooper Lighting, Lighting California's Future (LCF), Public Interest Energy Research (PIER) Program, and State Partnership in Energy Efficiency Demonstrations.

For More Information

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- To read more about LED downlights, visit cltc.ucdavis.edu/content/view/423/316
- More information on PIER demonstrations is available at www.pierpartnershipdemonstrations.com
- More information on the Cooper HALO LED recessed downlight is available at www.haloltg.com

FIGURE 4: COOPER HALO® LED DOWNLIGHT
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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
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