

Integrated Office Lighting System

Department of Motor Vehicles
Sacramento, CA



PIER Buildings Program

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The Problem

California's 2005 Building Energy Efficiency Standards (Title 24) stipulates a maximum lighting power density of 1.2 W/ft² for office lighting. California's 2008 Building Energy Efficiency Standards, effective January 1, 2010, reduces the allowed lighting power density by 25% to 0.9 W/ft². Office lighting traditionally is provided by overhead fluorescent troffers or pendants, with additional task lighting provided by energy-intensive fluorescent undercabinet fixtures and desk lamps. Achieving significant energy savings to meet code requirements requires both the general lighting and task lighting loads be reduced without sacrificing occupant satisfaction and visual comfort.

The Solution

California Lighting Technology Center (CLTC) partnered with Finelite, Inc. to develop a task lighting system powered by energy-efficient light emitting diodes (LEDs). The resulting commercial product, called the Personal Lighting System (PLS), consists of a suite of luminaires in 3, 6, and 9 W undercabinet and desk lamp styles that can be combined to create custom task light systems (Figure 1). The luminaires typically are connected to a single power supply that operates up to 21 W of task lighting and may be controlled by an optional occupancy sensor. CLTC has demonstrated that the PLS in combination with reduced general (overhead) lighting can achieve unprecedented energy savings and a total integrated office lighting power density (LPD) as low as 0.6 W/ft². This combination is called the Integrated Office Lighting System (IOLS). Early IOLS studies calculated energy savings at three demonstration sites: the California Department of Mental Health (18 users), the California Department of Motor Vehicles (11 users), and Gexpro (54 users). Average savings at these sites was 45%.

Features and Benefits

- High-quality ambient and task lighting for an aesthetically pleasing office environment
- Energy-efficient LED task light components that can be customized to the individual workspace
- Optional personal occupancy sensor to control task lights

FIGURE 1: PERSONAL LIGHTING SYSTEM

LED task lighting at Department of Motor Vehicles, Sacramento, CA



- High user satisfaction for the IOLS retrofit compared to baseline scenarios (average satisfaction of 50 users in five offices was 92%)
- Significant energy savings ranging from 25–59% with lighting power densities as low as 0.6 W/ft²

Technology Costs and Incentives

Task-ambient lighting provides an estimated 40–50% energy savings over current energy codes. It has the potential for 600–700 MW demand reduction statewide, and 2,000–3,000 GWh annually. It should provide an annual energy savings of about 15–25 cents per square foot of building space, meaning \$300 million to \$400 million annual energy savings for California. The simple payback is immediate to one year when used in new construction projects. It has a four- to seven-year simple payback in retrofit projects.

Demonstration Results

Department of Motor Vehicles, Sacramento, CA

Integrated office lighting design is applicable to most of California's 1 billion square feet of commercial office space. The PLS product and associated design strategy is moving quickly from research-sponsored demonstrations to real-world applications. The Department of Motor Vehicles (DMV) implemented the IOLS in a planned multiyear renovation of its 520,000-square-foot headquarters in Sacramento, CA.

FIGURE 2: PRE-RETROFIT LIGHTING

DMV, Sacramento, CA



Lionakis Architects designed the new headquarters with electrical engineering by Ken Rubitsky and Associates. The original lighting goal was to provide more uniform task lighting and higher visual comfort. Original designs fell short of these goals. The IOLS, in contrast, met design objectives and increased energy savings.

“We were doing layouts with troffers and we weren’t getting the uniformity that we were looking for; we had a lot of light and dark spots,” Ken Rubitsky said. “At first, I was concerned about designing at the lower ambient light levels using linear indirect/direct, but I knew that the task lighting was going to be productive and that would address the 30 foot-candles that we were looking for at the task level. We had originally specified three- and four-foot fluorescent undercabinet fixtures in the space, but we switched to the 6 and 9 W Finelite LED fixtures to save energy.”

The 5th floor of the headquarters, the first to be renovated, originally was specified with recessed fluorescent troffers and fluorescent undercabinet task lights. This design achieved a lighting power density of 1.2 W/ft²,

FIGURE 3: POST-RETROFIT LIGHTING

DMV, Sacramento, CA



a 39% energy reduction compared to baseline conditions, but failed lighting uniformity requirements. This design was changed to the IOLS, which uses suspended indirect/direct pendants with zonal occupancy controls, and PLS task light systems. The IOLS design achieved all project design goals and resulted in a 54% energy savings compared to baseline conditions, an increase of 25% over the original proposed renovation.

While these savings are impressive, other applications may achieve even lower lighting power densities, as seen in the early demonstration projects. The DMV was limited by minimal usable daylight in the building and six-foot cubicle walls, which dictated higher general light levels than typical buildings.

Product Availability

The Integrated Office Lighting System is a lighting design approach. Various products may be used to achieve energy savings from task-ambient lighting. The products used in this demonstration include suspended pendants and LED task lighting provided by Finelite, Inc.

What's next

CLTC continues demonstrations of task-ambient lighting as part of the PIER State Partnership in Energy Efficiency Demonstrations (SPEED) program.

Upcoming demonstration projects are slated for the University of California, Santa Barbara, and the California National Guard in Sacramento. Energy savings from implementation of task-ambient lighting solutions at these locations is estimated at 50–70%.

Collaborators

The IOLS research project is a partnership with CLTC, Finelite, Inc., and the California Energy Commission through the PIER Program. The Sacramento Municipal Utility District provided incentives to offset a portion of the renovation cost.

For More Information

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- The reports on the Integrated Office Lighting System project are available at cltc.ucdavis.edu and www.energy.ca.gov/research/reports_pubs.html
- More information on demonstrations is available at www.pierpartnershipdemonstrations.com

TABLE 1: COMPARISON OF PRE-RETROFIT TO POST-RETROFIT LIGHTING

5th Floor, DMV Headquarters, Sacramento, CA

	EXISTING BASELINE	TITLE 24 REQUIREMENT	IOLS RETROFIT	IOLS – SAVINGS OVER BASELINE	IOLS – SAVINGS OVER TITLE 24
Ambient Lighting	Fluorescent Troffers		Fluorescent Pendants		
Task Lighting	Fluorescent		LED task lighting		
Ambient LPD	1.50 W/ft ²	1.0 W/ft ²	0.8 W/ft ²	47%	20%
Task LPD	0.44 W/ft ²	0.2 W/ft ²	0.1 W/ft ²	77%	50%
Total LPD	1.94 W/ft ²	1.2 W/ft ²	0.9 W/ft ²	54%	25%
kWh Per Year¹	408,571 kWh	258,205 kWh	179,080 kWh	52%	24%
Yearly Cost (\$0.092/kWh)	\$37,589	\$23,755	\$18,026	\$19,563	\$5,729
Lighting Retrofit Cost²		\$315,000	\$330,000		
Incremental Cost to Implement IOLS³		\$15,000	Simple Payback on Incremental Cost		2.6 Years

¹ Assumes 3,012 hours of operation per year for ambient lighting, 2,008 hours of operation per year for task lighting, and a 10% savings from the addition of an occupancy sensor. Calculation for 5th floor only (75,640 ft²).

² Estimated cost for general lighting component, actual cost for task lighting.

³ Incremental cost for energy-efficient lighting includes an \$8,000 utility incentive from the Sacramento Municipal Utility District.

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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