Integrated Office Lighting Systems: Making It Personal

The Problem

Conventional office lighting typically consists of bright fluorescent overhead and undercabinet lights combined with incandescent or fluorescent task lights. This approach is not very energy-efficient and often introduces uncomfortable glare. Conventional lighting systems also provide higher levels of ambient light than needed, and the task lights inefficiently illuminate the work plane.

The Solution

A two-pronged system known as an "integrated office lighting system" (IOLS) has been developed for better workplace lighting. It combines lower levels of ambient overhead lighting with an efficient personal lighting system (PLS) (**Figure 1**). The lower overhead lighting levels—achieved in retrofit applications by delamping—result in lower power consumption. The PLS, which features light-emitting diode (LED) luminaires from Finelite, adds highly efficient task and undercabinet lights that provide glare-free illumination only where it is needed. An optional occupancy sensor results in even lower system power draw. In all, this integrated lighting scheme cuts lighting power density by at least half, to about 0.50 to 0.65 watts per square foot (ft^2). Design guidelines for new construction based on this approach will be released in late 2007. Meanwhile, a full line of LED task lights became commercially available in August 2007 from Finelite (www.finelite.com).

Figure 1: Integrated workspace lighting

In this example of an integrated lighting system, overhead lighting is reduced and three light-emitting diode (LED) task lights (two desk lamps and one undercabinet fixture) are used to illuminate only the area in use. The power draw of the integrated system is less than half the level recommended by current building codes.

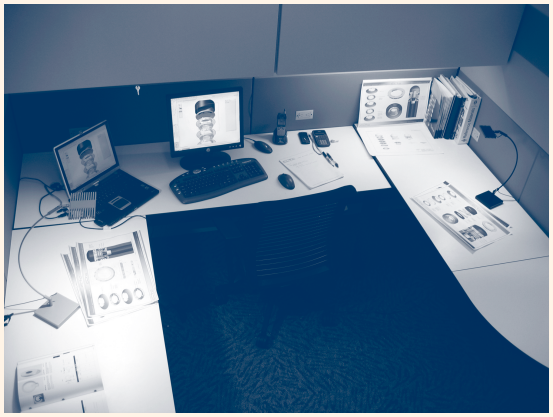

Table 1: Traditional versus integrated office lighting

Researchers compared a typical office with one that uses a personal lighting system. Note that these figures do not take into account the additional energy that would be saved if the office also included an occupancy sensor.

	Traditional system		Integrated system	
	Total watts	Watts/ft^2	Total watts	Watts/ft^2
Overhead lights	120	1.00	36	0.30
Task lamp	50	0.42	12	0.10
Undercabinent	32	0.27	6	0.05
Total	**202**	**1.69**	**54**	**0.45**

Assumptions: 120 square feet (ft^2) of space; traditional system with incandescent task lamp.

Features and Benefits

The IOLS provides efficient, user-friendly, high-quality lighting with a number of benefits.

Reduced waste from fluorescent lights. Fluorescent overhead and undercabinet lights often provide too much light, illuminate areas where no work is conducted, and are rarely switched off when employees leave their workspace. By reducing the number and brightness of fluorescent overhead lights and relying on LEDs for undercabinet and task lighting, the IOLS offers substantial energy savings (**Table 1**).

LEDs draw less power. A typical 8-by-8-foot PLS-equipped workstation would have a pair of 6-watt LED desk lamps that are free-standing and moveable and another 6-watt LED undercabinet light to provide uniform lighting throughout the task area. The 18 watts of LED lighting would replace 50 or more watts consumed by traditional office task and undercabinet lights.

Occupancy sensors further reduce waste. By integrating an occupancy sensor into a PLS-equipped workstation, an already-efficient lighting system can save even more energy. If an employee leaves the office and forgets to shut off the lights, an occupancy sensor can power them down, leaving only the low-intensity overhead lights still illuminated. And the overhead lights can also be controlled by occupancy sensors and set to shut off if an office is empty.

LEDs offer new lighting opportunities. Task lamps can be easily moved around to increase illumination or reduce glare. The lamps can also provide side or bottom illumination and can

be turned off for low-light applications or in spaces with abundant natural light.

Integrated office lighting is also more cost-effective than traditional alternatives. Though workspaces vary, overhead lights can generally be reduced from their normal levels of 1.0 to 3.0 watts/ft^2 to as little as 0.3 watts/ft^2. And the power supply for LED task lights in a typical workstation is limited to 21 watts. In all, the system cuts energy use by at least 50 percent and requires only an initial investment in LED desk and undercabinent lamps, all while providing more flexibility and higher-quality light.

Applications

Virtually any existing office can be retrofitted with an IOLS. Payback time for retrofits can vary substantially, from 3 to 4 years in offices that already have bilevel light switches to 10 or more years if an office requires substantial electrical work to upgrade outdated fixtures or delamp. In new construction, the need for fewer overhead fixtures results in reduced labor costs and a favorable payoff time. Meanwhile, the task lamps are very easy to install because they use simple low-voltage wiring. The task lamps have additional appeal because LEDs have a substantially longer lifetime than incandescent or compact fluorescent lamps.

Codes and Standards

Current California Title 24 requirements (2005) call for lighting to draw no more than 1.2 watts/ft^2, with task lighting assumed at 0.2 watts/ft^2. ASHRAE (the American Society of Heating, Refrigerating and Air-Conditioning Engineers) standards advise no more than 1.0 watts/ft^2 for ambient lighting alone. The Leadership in Energy and Environmental Design (LEED) Green Building Rating System requires that builders reduce lighting power to less than 0.85 watts/ft^2 in new construction (0.95 watts/ft^2 in remodels) to earn any certification points. An IOLS using a PLS will consume between 0.50 and 0.65 watts/ft^2, including task lighting. This means it will more than satisfy any of these standards.

What's Next

Field tests of about 100 PLS-equipped offices are underway and scheduled for completion by the end of 2007. The tests are monitoring energy consumption and user satisfaction. Plans are under consideration for even larger field tests in 2008 that would include several thousand PLSs in California universities, community colleges, state buildings, and local municipalities. California utilities are planning their own parallel field tests as well.

Collaborators

The organizations involved in this project include the California Lighting Technology Center, Finelite Inc., and Watt Stopper/Legrand.

For More Information

Reports documenting this project and providing more details may be downloaded from the California Lighting Technology Center web site (http://cltc.ucdavis.edu/content/view/83/85/).

For information on this product and other lighting research activities, please visit the Lighting Portal at http://thelightingportal.ucdavis.edu/index.php.

To view Technical Briefs on other topics, visit www.esource.com/public/products/cec_form.asp.

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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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CEC-500-2007-108-FS
November 2007

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