

Commercial Lighting Trends

Massive Savings to be made for commercial lighting solutions in office, retail and hospitality environments

Facility executives are aware that saving energy and improving the quality of light in the workplace is a complex task. Fortunately, manufacturers in the lighting and energy industries are constantly seeking ways to improve products and services related to conservation and output.

The latest innovations include: better lamp maintenance procedures (to upgrade the appearance of the lighted space), manual dimming at the work station (to accelerate savings and boost worker satisfaction), and a rapidly developing technology (which may result in enough energy savings to power the states of Arizona, Colorado, and Mississippi). It is indeed the dawning of a new age in the lighting industry.

The Dirty Facts

A recent study conducted by the Des Moines, IA-based International Association of Lighting Management Companies (NALMCO) and funded by the Environmental Protection Agency (EPA) sheds new light on energy management of existing lighting systems. The results may have a dramatic impact on the future of lighting design.

As a lighting system ages after installation, the study found that dirt and dust collect on the surfaces of lamps and fixtures. This causes the devices to absorb rather than transmit or reflect light. Meanwhile, lighting designers typically over design lighting systems to account for this gradual depreciation of performance.

The NALMCO study also indicates that existing light loss related to dirt and dust build-up on fixture surfaces has been overestimated in industry best practices. While a seemingly small factor in lighting planning, the "dirt" issue could help facility professionals re-evaluate existing lighting systems for redesign and retrofit opportunities. And if the depreciation cushion can be reduced in new installations, fewer fixtures can be specified, installed, and operated to generate initial and operating cost savings.

"In very clean locations, the test results indicate that about 8%-10% fewer fixtures are required to provide a target light level; this is compared to design calculations based on earlier dirt depreciation values," says Norma Frank, CLMC, vice president of Denver, CO-based Colorado Lighting. "Renovation projects in older facilities would result in the order of 15% to 20% fewer fixtures if this new data is realized."

Planned Maintenance

Additional savings can be achieved through the adoption of planned maintenance practices. The two major planned maintenance techniques are group relamping and fixture cleaning.

Group relamping entails replacing all lamps in a large lighting system at periodic intervals—typically at 60%-80% of rated life—when lamp failures begin to escalate. By replacing all the lamps at that time, even if they are still operating, facility managers can economize on labour and minimize disruptions for spot-relamping.

Fixture cleaning entails washing all fixtures during the group relamping (and possibly in between) to keep the fixture surfaces as reflective as possible. If dirt and dust are absorbing rather than reflecting light, then each month the facility manager is paying a percentage of the light bill for nothing. The ideal fixture cleaning interval is when the cost of the wasted light matches the cost of cleaning the fixtures.

"A regular maintenance plan allows facilities to operate at peak efficiency while still saving substantially on monthly operating costs," says Tom Grover of Danvers, MA-based Sylvania Lighting Services. "Lighting maintenance is a budgeted, controlled, and predicted expense."

Manual Dimming: A Bright Idea

According to the California Energy Commission, automatic lighting controls generate typical energy savings of 35% to 45% in commercial and institutional buildings. And with proper application and calibration, they are very reliable.

What's interesting, however, is that manual dimming in private offices can accelerate energy savings while increasing occupant satisfaction and enhancing the value of the space. Consequently, this approach warrants a good look.

"Employees like to have control over their work environment," says A.J. Glaser, president of Fort Collins, CO-based HUNT Dimming and vice president of the Lighting Controls Association. "Using manual dimming devices gives occupants the chance to tune light levels according to their preferences and needs, which increases their satisfaction while saving energy."

Several years ago, the Lighting Research Centre (LRC) sought to evaluate the effectiveness of automatic and manual lighting controls in private offices. The LRC chose the National Centre for Atmospheric Research (NCAR), a three-building, 250,000-square-foot complex in Boulder, CO.

During the study, 58 private offices were monitored for eight weeks. Each office was equipped with two 2x4 recessed troffers with a parabolic louver and three 32W T8 lamps powered by dimmable electronic ballasts. Each also had manual controls for window blinds (so study participants could control the amount of daylight entering the space). Lighting controls included a manual switch mounted on the wall next to the door, which provided on-off and dimming; a portable manual dimmer mounted on the occupant's desk; and a PIR occupancy sensor mounted in a room corner for automatic switching.

During the study, the LRC recorded energy savings of 61%. Occupancy sensors accounted for 43% of the savings by automatically turning the lights off in unoccupied offices. But 6% of the savings came as a result of manual dimming. (See Figure Three.)

Three out of four occupants used the manual dimmers at least once. And by a ratio of 6:1, they preferred the dimmers on the desktop rather than at the door. They also used their manual controls to turn the lights off so they could work under diffused daylight coming through the window blinds.

About half of the occupants cited "computers" as the reason they dimmed the lights. They also indicated they wanted to "compensate for daylight," "read printed text," (about one-fifth of respondents) and "create an atmosphere for work" (about one out of 10).

Just as significant was the impact the manual controls had on the occupants. According to the LRC: "Employees...preferred manual lighting controls to automatic controls because the manual controls allowed them to tailor the lighting to their needs."

Revolutionary LEDs

Over the past decade, a number of innovations in the lighting field have been introduced. The rate of growth is actually quite extraordinary, given the lighting industry's previous history of being slow-moving and low-tech.

Researchers, however, are now seeing light-emitting diodes (LEDs) as a new energy-saving light source that could challenge the supremacy of conventional light sources and more than double the efficiency of general lighting systems. LEDs are very small solid-state devices that generate light by passing current across layers of a semi-conductor material housed in a chip.

Red LEDs have made significant inroads into traffic lights and exit signs. Today, LEDs represent more than 50% of the exit sign retrofit market. In fact, according to the LRC, LEDs are the primary light source in about 80% of new exit signs sold in the U.S.

However, the most exciting LED development arrived in the mid 1990s—the white LED. Advances in technology now allow visible white light to be produced by using blue LEDs with a phosphor that converts some of the output into yellow. The result is a cool, bluish-white light. This offers the most promise for general lighting. (See Figure Five.)

White LEDs could revolutionize lighting in a way unseen since the advent of the incandescent lamp. According to the U.S. Department of Energy, LEDs are expected to more than double the efficiency of general lighting systems, thereby reducing the nation's electric bill by \$98 billion over the next 20 years. Other benefits of LEDs include design flexibility due to their small size; colour mixing; ruggedness; instant start (even at temperatures as low as -40°C); dimming and control; and safety due to low-voltage start-up and operation.

While currently suitable for small lighting applications (such as cove or recessed areas), white LEDs are not yet ready for mainstream applications (such as overhead office lighting). However, major players in the lighting and semiconductor industries are partnering to develop white LEDs. By all accounts, a white LED light source that is competitive with fluorescent, incandescent, and HID lighting systems should be available by 2010 (or possibly as soon as three to five years, according to one estimate).

"White LED technology now appears more feasible for general lighting than before," says Dr. N. Narendran, director of research and a research associate professor at the LRC. "Advances in the technology have produced high-power white LEDs with better efficacy, lumen output, and lumen maintenance. If the industry can maintain its rate of development, solid-state lighting could gain significant market penetration within five to 10 years."

Another primary benefit of white LEDs is maintenance. LEDs have the potential to last 100,000 hours—five to 10 times longer than conventional light sources

"LEDs have a great energy story and a great maintenance story," says Keith Scott, business development manager for San Jose, CA-based Lumileds, a joint venture between Philips Lighting and Hewlett-Packard's Agilent Technologies. "Since the LED-based light source lasts so much longer than a conventional light source, there is no need to replace the light source—reducing or even eliminating ongoing maintenance costs and periodic relamping expenses."

Right now, white LEDs do have their drawbacks. They do not produce enough light, offer low to medium colour quality, and raise questions regarding service life. As the light source continues to develop, however, facility executives will begin to see white LEDs make inroads into general lighting applications.

At the same time, customers should be on the lookout for entirely new approaches to lighting. With the flexibility of LEDs, fixtures can be created in virtually any shape or size. They can edge-light plastic or glass panels to create sheets of light. And they can also be intelligently controlled, with coloured LEDs changing the colour temperature of the white light produced according to time of day.

One type of solid-state lighting in development, organic light-emitting diodes (OLEDs), will provide flexible luminous sheets that could be described as "lighting wallpaper." OLEDs enable unprecedented integration of light sources with architectural materials, from walls to floors to ceiling to furniture and curtains.

While these innovations sound extremely appealing, facility professionals should be cautious when adopting any new technology and judge it according to standardized testing procedures in readily understood terms: service life, colour temperature (appearance of the light), colour rendering; colour stability (how consistent the colour appears over time and at various viewing angles), lumen (light) output, efficacy (units of light output per unit of electrical input), and energy savings potential (wattage savings, payback, return on investment).

New light sources like those mentioned here promise to change general lighting completely. However, facility professional can consider more traditional approaches—automatic dimming, manual controls, and regular maintenance—when evaluating cost savings and energy conservation options.

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