Maintenance Economics: How LEDs Improve the Bottom Line for Commercial and Industrial Users

By Tracy Earles, VP, Marketing and Sales, Albeo Technologies

It's not just about the kilowatts.

Most people are now aware of one key benefit of LED lighting - its efficiency. LED lighting long ago surpassed incandescent efficiency and is now approaching and even surpassing the efficiency of linear fluorescent and metal halide. However, there are many other benefits to LEDs including lasting five to 10 times longer than fluorescents, consuming less energy while on, are fully dimmable, contain no hazardous mercury, are nearly unbreakable, are free of annoying flicker and buzz and are safer, operating on low voltage DC, with no glass or vacuum.

Facilities that are already implementing LED systems are likely not doing so in general illumination applications. LEDs are no longer just for task or accent lighting or color-changing architectural effects, but are now being built into fixtures that are tackling some of the most challenging applications in general lighting, and they're competing with very-efficient linear fluorescent and very-bright HID. Some LED performance examples include parking garage fixtures from multiple suppliers that deliver more than 6,400 effective lumens while consuming 77 watts, high bay fixtures with 18,000 usable lumens that consume about 190 watts and troffers with 5,000 effective lumens that consume just over 50 watts.

Maintenance Economics - The Missing Link

Though the LED fixture performance is attractive, the key characteristic of LEDs that has the biggest impact on the business case for LED lighting is frequently not efficiency, but their impact on maintenance costs, especially in lighting retrofit applications.

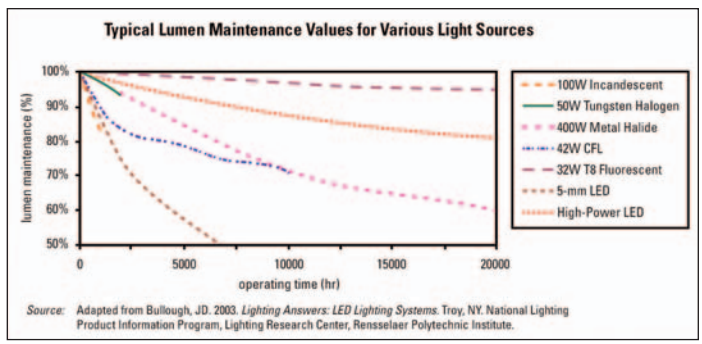
There are several aspects to consider when looking at lighting maintenance economic including lifetime, revenue-generating down time, fragility and toxicity.

Lifetime

High brightness white LEDs are commonly specified to last 50,000 to 60,000 hours at maximum operating conditions. When operated below these maximum conditions, they can last well in excess of 70,000 hours. Well-designed fixtures that minimize the lifetime limitations of other system components can take advantage of LED longevity to deliver terrific reliability.

In order to understand the value that this lifetime delivers to lighting users, first one must understand lifetime as defined by LEDs versus traditional light fixtures. LED fixture manufacturers define fixture end of life as a 30 percent reduction in output. This is contrasted with traditional lighting like fluorescent, which typically suffers complete lamp failure. Because fluorescent lamp lifetime is defined as an MTBF, half of the lamps are dead and require replacement by the lifetime rating.

Lamp Type	Typical Rated Life (hours)	Estimated Useful Life (hours)
Incandescent	750 to 2,000	
Halogen Incandescent	3,000 to 4,000	
Compact Fluorescent	8,000 to 10,000	
Metal Halide	7,500 to 20,000	
Linear Fluorescent	20,000 to 30,000	
High-Power White LED		50,000-60,000 component >70,000 fixture



Source: Adapted from Bullough, JD. 2003. *Lighting Answers: LED Lighting Systems.* Troy, NY. National Lighting Product Information Program, Lighting Research Center, Rensselaer Polytechnic Institute.

Clearly, fluorescent has the least amount of lumen degradation over time at about 5 percent, followed by high-power LED. Both of them are significantly superior to any other lamp type.

In the lifetime of the LED fixture, a fluorescent fixture will probably have required many complete relampings. This hits lighting operators particularly hard if replacing lamps impacts other aspects of their operations. Examples include lighting over operating machinery, lighting in difficult-to-reach or public areas.

For many companies the cost of maintaining their lighting weighs much more heavily on their P&L than does the cost of the associated energy. LEDs' dramatic lifetime advantage can have much greater impact on these companies.

What kinds of companies care more about lighting maintenance than energy? Companies that have lighting installed in difficult-to-reach places, in public areas, or both. Consider a typical convention center, where many of the light fixtures are in public areas installed in locations that are difficult to reach. Some lamps are 40 feet or even 90 feet in the air, requiring a very tall scissor lift and a two-man crew to service, making them very expensive to replace. These relampings frequently cost $150 or more per lamp.

Not only is it difficult to reach those lamps, but they typically cannot be replaced when the facility is being used, so scheduling maintenance can be very difficult. On the other hand, a convention center cannot afford to have burned-out lamps. If the facility does not look pristine, their trade show and conference business will go to another venue.

Revenue Down Time

For some companies, it's not only about the cost of changing lamps. What happens when revenue-generating machinery has to be shut down in order to replace the lamps above them? A large carpet manufacturer states that to change a lamp over one of their looms, they have to shut down the revenue-generating loom. When the electrical maintenance crew is doing that, they're not fixing broken looms, so lighting maintenance is not only a cost impact, but it reduces capacity utilization and revenue.

In addition to the convention center and heavy manufacturing examples discussed above, there are several other commercial and industrial segments that face potentially high lighting maintenance costs.

• **Offshore drilling platforms.** The harsh and hazardous environment of drilling rigs where vibration is the major cause of failure for traditional light sources is a perfect fit for LEDs, which contain no filaments or glass to break. In addition, all goods must be brought to the platform by sea or air, and the lightweight bulkiness of fluorescent lamps makes that transport uneconomical.

• **Hazardous chemical plants.** Fluorescent lighting fixtures in some chemical plants are sealed in cases to prevent sparks from being exposed to volatile chemicals in the air. This makes both their purchase and maintenance unusually expensive.

• **Nuclear power plants.** Nuclear plants typically only ensure radiation safety from the floor up to seven feet. Above that (where the fluorescents reside) a radiation survey crew must first test the environment before an electrical maintenance crew can change a lamp. Also, post-September 11 security requirements have dramatically increased the cost of bringing any material into, or removing any material from, a nuclear plant. Finally, the hazardous material disposal activities nuclear plants are subject to heavy scrutiny, so discarded fluorescents are not deposited in landfills.
• **Underground mines.** Similar to chemical plants, fluorescent fixtures are made explosion-proof. Also, all new lamps must be brought down into the mine from the surface and the old lamps taken back out, making lamp replacement expensive.
• **Shopping malls and airports**. Large commercial or municipal facilities with heavy foot traffic and high ceilings present a challenge for lighting maintenance. Maintenance staff must typically use a lift to reach open area light fixtures. This forces them to either perform lighting maintenance only at night and incur the added expense of higher labor rates, or to disrupt business during the day.

Fragility and Toxicity

All traditional forms of energy-efficient lighting use mercury. When these lamps are thrown away, they introduce that mercury into landfills and ultimately into our water supply. This growing mercury contamination problem has led to new government regulation. A fluorescent lamp that costs $5 can cost $2 to recycle.

LEDs contain no mercury. In fact, as a result of recent global efforts in the electronics industry, LED fixtures also contain no lead and dramatically reduced amounts of other hazardous materials. In essence, they are inherently greener than any other form of lighting in terms of all hazardous materials.

Because LEDs have no filaments and glass to break, there is no waste due to breakage, and valuable machinery lit from above is not at risk.

Retrofit Market Size

In 2008, the industry will see 100 lumens/watt LEDs built into fixtures. When combined with ever-increasing brightness and falling prices, LEDs will replace all forms of traditional lighting in the next couple of decades.

The industrial LED retrofit market is in its infancy and has been largely ignored by market researchers. The most recent LED market surveys, including Cree's Mindwave Research study of April 2006 and Strategies Unlimited's 2007 LED market data, which included a very broad range of application segments, did not speak significantly of the industrial application at all, much less retrofits. The Cree study said that only 4 percent of respondents identified industrial applications as the project "next big application" for LED (architectural was the winner) and the Strategies Unlimited study did not mention industrial at all.

On the other hand, in June 2006, Freedonia stated that 30 percent of the 2006 $6 billion (growing to $8.2 billion in 2010) US commercial and industrial lighting market was retrofit business. That's $1.8 billion of retrofits in 2006, or $2.5 billion in 2010. The smallest LED segment in Strategies Unlimited study in 2010 was Outdoor Area at $8.2 million.

Albeo is convinced that LED industrial retrofits will be much larger in 2010 than $8.2 million. There are now commercial and industrial retrofit products from multiple suppliers. The maintenance economics, combined with corporate 'green' campaigns and energy efficiency advantages in the face of accelerating energy inflation, will drive this segment of the market to become increasingly significant in the next couple of years. Examples of currently achievable payback periods include data center operator (1.9 years), convention center (2.4 years), textile mill (1.7 years) and cold storage warehouse (1.5 years).

As LED performance continues its march forward, these paybacks will continue to fall, getting down to a year or less by 2010. The transition to LED in the industrial and commercial retrofit market has begun, and will only accelerate.

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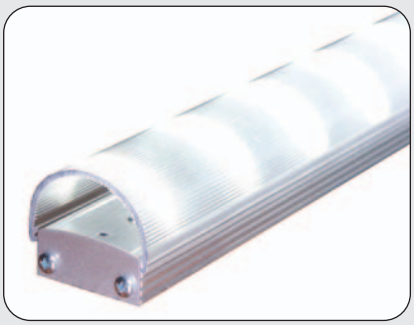

Why LED Retrofit is Better than LED 'Drop-In' Replacement

For years, fluorescent lighting consumers have been seeking solutions to their lighting problems, and many recognize that existing troffer performance can be greatly improved by conversion to LED. The troffer user is faced with two choices for making such a conversion: installing LED 'drop-in' replacement tubes that operate with the existing fluorescent ballast; or retrofitting the troffer with Albeo's easily-attached LED light bars and replacing the existing ballast with an LED-optimized transformer. Albeo's T8LED Retrofit Kit goes beyond drop-in LED fluorescent solutions to provide the long-term lighting solution that fluorescent consumers have been seeking.

"Albeo's Retrofit Kit uses patent-pending TEMPR Technology to efficiently pull heat away from the high power LEDs and dissipate it through the large thermal footprint of the troffer housing, enabling it to outperform drop-in replacements in terms of efficacy, light output, and reliabilit," said Albeo's Tracy Earles. "While the drop-in option appears easy, it is an incomplete solution that leaves the consumer with an old ballast of unknown quality, thermally-compromised LED performance and lifetime, and a high voltage safety issue."