



Better Off LED

Reducing energy and maintenance costs through exterior HID to LED conversions. By Louis DiDomenico

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In today's economy, reducing energy and maintenance costs are two significant ways that facility managers can help reduce their company's operational costs and increase profitability. This can be accomplished by replacing or retrofitting current lighting applications with new and improved lighting technology. With advances in LED technology over the last couple of years, LED lighting fixtures are becoming an attractive alternative to HID lighting. The LED lighting systems being manufactured in the United States have overcome the thermal problems that plagued earlier foreign LED lighting fixtures.

Initial studies have shown that the exterior lighting applications will give you the quickest return on investment. A municipality in Ellwood City (Allegheny County), Pennsylvania, replaced their existing HID streetlights with new LED street lighting fixtures and has already recognized a considerable cost savings. Prior to replacing their HID streetlights with the LED fixtures, the municipality reportedly

spent in excess of \$86,000 annually in 2007 for electricity. A study conducted by the Pennsylvania Department of Environmental Protection projects that their 2008 annual utility bill for LED street lighting is estimated to be approximately \$8,000. This is an annual savings of more than \$70,000!

LED lighting fixtures are now ready for broad deployment across general lighting applications such as parking lots, under canopies, wall packs, streetlights and other outdoor installations. Indoor directional lighting and down lighting solutions are also available. According to the University of California, Santa Barbara, widespread deployment of LED-based lighting could save \$280 billion in electricity costs in the U.S. alone by 2025. The U.S. Department of Energy (DOE) has heralded LED lighting applications as the future of lighting. According to the DOE, LED lighting has an extremely long life span when compared to incandescent lighting — in many cases, it lasts 20 times longer. LED lighting consumes consid-

erably less energy and is clean burning, thus reducing carbon emissions significantly. For example, a typical HID parking lot light fixture with 400-watt metal halide lamp consumes 458 total system watts each. The more energy-efficient LED lighting alternative consumes 91 total system watts with equivalent light levels providing an 80% energy savings.

(See Figure 1 below.)

Today, a more efficient and cost-effective white LED light is revolutionizing the lighting world. The white power LED, based on a blue LED chip coated with a phosphor, is bright and efficient enough to be used in general illumination. Fixture manufacturers are making LED-based products for outdoor street, walkway, parking and indoor-down lighting applications.

Parking lots can represent a challenging environment for lighting solutions. The lighting must economically accommodate vehicular and pedestrian traffic, must endure harsh environments and must address public safety considerations. Parking lot lighting

Figure 1. A per unit KWh savings comparison.

Per 100W HID				Per 150W HID			
	LED	HID	Savings		LED	HID	Savings
Connected Load	7w	130w	123kw	Connected Load	16w	188w	172kw
Energy Usage	32kwh	585kwh	82.95/yr	Energy Usage	72kwh	846kwh	116.10/yr
Per 250W HID				Per 400W HID			
	LED	HID	Savings		LED	HID	Savings
Connected Load	70w	294w	224/kw	Connected Load	91w	458w	367kw
Energy Usage	315kwh	1323kwh	151.2/yr	Energy Usage	410kwh	2061kwh	247.65/yr

Figure 2. Retrofit Comparison HID to LED

	15 Parking Lot Lights		15 Wall Pack Lights		
	400 Watt HID	LED	150 Watt HID	LED	Total Year Savings
Energy Consumption					
Year1	\$3,710.00	\$567.00	\$1,904.00	\$162.00	\$4,885.00
Year2	\$3,710.00	\$567.00	\$1,904.00	\$162.00	\$4,885.00
Year3	\$3,710.00	\$567.00	\$1,904.00	\$162.00	\$4,885.00
Year4	\$3,710.00	\$567.00	\$1,904.00	\$162.00	\$4,885.00
Year5	\$3,710.00	\$567.00	\$1,904.00	\$162.00	\$4,885.00
Total Energy Savings		\$15,715.00		\$8,710.00	\$24,425.00
Maintenance Cost	Lamps Ballast and Labor		Lamps Ballast and Labor		
	400 Watt HID	LED	150 Watt HID	LED	
	\$3,089.00	\$0.00	\$5,126.00	\$0.00	
Total Maint. Savings		\$3,089.00		\$5,126.00	\$11,290.00
Total Location 5-Year Savings					\$35,715.00

is an excellent application for LED lighting for several reasons:

- Most parking lot lights burn 12 to 18 hours a day — during peak electrical rates.
- The vibration from vehicle traffic creates a harsh environment for traditional light sources.
- Public safety concerns favor white light and a high color rendering index (CRI), and failed lamps create safety hazards.

LED lighting addresses these realities and also provides other benefits, including:

- Long lifetimes and highly reliable service, greatly reducing maintenance costs.
- Not affected by most vibrations and typical temperature variations.
- Highly efficient light source potentially reducing electricity consumption by up to 50% or more.
- White light available in color temperatures from “warm” to “cool” with high CRI providing high-quality white light.
- Fixtures can be supplied with motion sensors and photoelectric controls to further reduce electricity consumption.

The following illustrates a typical restaurant’s exterior lighting and the

energy and maintenance savings that can be attained by retrofitting to LED lighting

(See Figure 2 on next page.)

All types of electric light sources experience lumen depreciation, defined as the decrease in lumen output that occurs as a lamp is operated. The causes of lumen depreciation in incandescent lamps are depletion of the filament over time and the accumulation of evaporated tungsten particles on the bulb wall. This typically results in 10% to 15% depreciation compared to initial lumen output over the 1,000-hour life of an incandescent lamp.

In fluorescent lamps, the causes of lumen depreciation are photochemical degradation of the phosphor coating and the glass tube, and the accumulation of light-absorbing deposits within the lamp over time. Specific lamp lumen depreciation curves are provided by the lamp manufacturers. Current high-quality fluorescent lamps using rare earth phosphors will lose only 5% to 10% of initial lumens at 20,000 hours of operation. Compact fluorescent lamps (CFLs) experience higher lumen depreciation compared to linear sources, but higher quality models generally lose no more than 20% of initial lumens over their 10,000-hour life.

Lumen depreciation in LED lighting varies depending on package and


system design. The primary cause of lumen depreciation is heat generated at the LED junction. LEDs do not emit heat as infrared radiation (IR) like other light sources, so the heat must be removed from the device by conduction or convection. If the LED system design has inadequate heat sinking or other means of removing the heat, the device temperature will rise, resulting in lower light output. Clouding of the epoxy encapsulate used to cover some LED chips also results in decreased lumen output. Newer high-power LED devices use silicone as an encapsulant, which prevents this problem. LEDs continue to operate even after their light output has decreased to very low levels. This becomes the important factor in determining the effective useful life of the LED. The leading LED manufacturers have begun using the L70 language, stating that their white LEDs “are projected” to have lumen maintenance of greater than 70% on average after 50,000 hours when used in accordance with published guidelines.

How do the lifetime projections for LEDs compare to traditional light sources?

(See Figure 3 below.)

Given the long rated life of 10-plus years and low maintenance cost of LED fixtures, the idea of replacing HID fixtures should be a given. One determining factor is the cost of a

retrofit or replacement of the fixtures. Two factors have to be considered when evaluating a change to LED technology. LED lighting systems have a higher percentage of energy savings, and maintenance costs are drastically reduced over traditional lighting systems. Both of these factors must be calculated to see an appreciable return on investment.

To present an effective business case for migrating to LED lighting systems, have your lighting supplier do a cost analysis based upon your current lighting configuration including energy and maintenance costs for a 5-year period. Compare the cost to a lighting configuration using LED technology to see the cost savings over the next 5- and 10-year periods. The energy and maintenance savings are quite dramatic. 

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Figure 3. Lifetime Projection Comparison: LED v. Traditional Light Sources

Light Source	Range of Typical Rated Life (hours)* (varies by specific lamp type)	Estimated Useful Life (L ₇₀)
Compact fluorescent (CFL)	8,000-10,000	
Metal halide	7,500-20,000	
Linear fluorescent	20,000-30,000	
High-Power White LED		50,000-100,000