

BRIEF DESCRIPTION

A light-emitting diode (LED) uses a semiconductor diode to generate energy in the form of a photon (light). Low power LEDs are fractional wattage devices, typically 0.1 watt. They operate at low current and low voltage, and produce 2 to 4 lumens. High power LEDs are driven at much higher current and can produce 40-80 lumens per 1-watt package.

LEDs can be used for various indoor and outdoor applications. However, the currently available LED products vary widely in light output and efficacy and it is important to understand the specific lighting design requirements and the features of different LED products before using them. To achieve the expected energy savings, it is necessary to consult with lighting design experts who understand LED products and markets. Simple one-for-one replacement may lead to no payback, low lighting quality, or high maintenance cost.

Applications Recessed Downlights

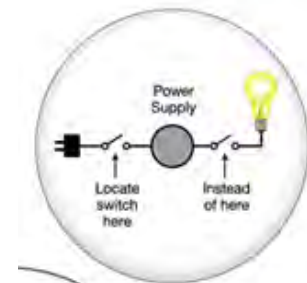
- Recessed downlights are used widely for general ambient lighting or accent lighting. Downlights using non-reflector lamps (such as A-type incandescent lamps and spiral CFLs) are typically only 50 to 60percent efficient, the directional feature of LED downlights make them good replacements at some of these applications. Replacement decision should be made on a case-by-case basis.



(Source: <http://www.lovelights.co.uk/led-lighting-17/sensio-led-recessed-light-12185.htm>)

Portable Desk/Task Lighting

- Portable desk and task lighting is a promising application for white LEDs. LED desk/task lighting is more efficacious than incandescent and halogen, but not as efficacious as some ENERGY STAR CFL task lamps.
- At this early stage of LED product development, evaluating the following luminaire features are important—fast heat mitigation, uniform color appearance, color quality, adequate light coverage of the full task surface, glare shield, minimum shadowing of objects, and avoiding off-state power consumption.



Off State Power
(Source: http://www1.eere.energy.gov/buildings/ssl/printable_versions/evaluating_desk.html)

Undercabinet Lighting

- Taking advantage of LED’s directionality and small size, undercabinet LED lighting is potentially a good application. The directionality of LEDs allows a larger proportion of the available light to be directed where it is needed, instead of lost within the fixture.
- LED undercabinet fixtures are more expensive than most other fixtures. The following product features need to be considered—heat mitigation, beam patterns, color quality, minimum shadowing.

Exit Signs

- Exit signs operate 24 hours and can consume a large amount of energy. Compared to older exit signs using incandescent or fluorescent lights, LED exit signs use ultra-low energy and are cost-effective.
- Longer lamp life also reduce the maintenance costs.

Exit Sign Energy Use by the Numbers				
Exit Sign Lighting Technology	Annual Energy Use	Annual Energy Cost	Lamp Service Life	Annual Carbon Dioxide (CO ₂) Pollution
<i>LED</i>	44 kWh	\$4	10+ Years	72 pounds
<i>Fluorescent/CFL</i>	140 kWh	\$11	10.8 months	230 pounds
<i>Incandescent</i>	350 kWh	\$28	2.8 months	574 pounds

(Source: http://www.energystar.gov/ia/business/small_business/led_exitsigns_techsheat.pdf)

Outdoor Area lighting

- Compared to metal halide and high-pressure sodium sources, which are the currently dominant outdoor lights, well-designed LED outdoor luminaires can provide required lighting levels using less energy and improve lighting uniformity. LED luminaires also have 1.5 to 3 times longer life with better lumen maintenance.



LED parking lot lights (left) compared to HPS lights (right) show different color appearance and more uniformed light distribution.

(Source: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/outdoor_area_lighting.pdf)

Design Notes Well-designed Luminaire

- LED product quality varies significantly among manufactures. It is important

to collect sufficient information of the product's long-term performance data besides energy savings. Information sources include CALiPER test results and GATEWAY demonstration program reports (available at www.netl.doe.gov/ssl)

- Given the current challenge in specifying quality LED indoor lighting products, this TechNote highlights a proven successful application of LED lighting – parking lots.

Outdoor Maintenance

- Optical chamber should remain clean to reduce maintenance.
- It is important to check the Ingress Protection (IP) rating for the condition in which the luminaire will be used and choose an appropriate rating for the intended application.
- A disconnect point between the light engine and the drivers will allow for field maintenance.

Related Technologies Light Pollution Reduction

References/Useful Resources:

[1] LED Application Series: Outdoor Area Lighting.

http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/outdoor_area_lighting.pdf

[2] Solid-State Lighting: LED Applications. http://www1.eere.energy.gov/buildings/ssl/app_series.html

Energy Savings

Lighting Energy

- When lighting is properly designed and LED products are carefully selected, LED lighting can significantly reduce indoor and outdoor energy consumptions. However, the savings cannot be generalized due to the variety of compared light sources and applications.

Cooling Energy

- Reduced lighting load yields to lower cooling energy use. The savings derive from the reduced need to remove heat from electric lighting and the reduced cooling necessary to condition ventilation air.

Guiding Principles¹

Optimize Energy Performance (Energy Efficiency)

- Reduce the energy use by 30 percent compared to the baseline building performance rating per ASHRAE Standard 90.1-2007.

Associated LEED Credits (NC 2009)²

EAc1: Optimize Energy Performance (1-19 points)

- Demonstrate a percentage improvement in energy performance compared to a baseline performance per ASHRAE/IESNA Standard 90.1-2007.

¹ Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings
www.wbdg.org/pdfs/hpsb_guidance.pdf

² USGBC LEED Reference Guide for Green Building Design and Construction, 2009 Edition

LED Parking Lights

[PRODUCT AND ECONOMICS]

NOTE: The product information is specifically for LED outdoor lighting.

Product Images



(Source: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/outdoor_area_lighting.pdf
<http://www.treehugger.com/files/2008/05/led-street-lights-lamps-germany.php>
http://www1.eere.energy.gov/buildings/ssl/outdoor_checklist.html)

Components Housing, Light subassembly, Electrical systems subassembly

Cost Range \$700 – \$1500 per fixture (Mounting pole is not included.)

Vendors GE LED outdoor lighting
https://secure.ge-lightingsystems.com/gels01/r2/productcentral/htmls/2_4.html

Gardco Lighting and Emco Lighting
<http://www.sitelighting.com/>

LuminosityLED™
<http://luminosityled.com/products/index.php/led-street-lighting.html>

Warranty

Info 3 – 5 years

Code

Restrictions None

SECTION 26 50 00 (SECTION 16500) – LIGHTING³

- A. General Description:** The complete shall be capable of starting and operating the light engine within the limits specified by the LED manufacturer. The luminaire shall contain completely prewired integral drivers and an optical assembly that shall provide a distribution type, specified according to photometric selection table. Labeling shall be in accordance with ANSI standards. All units shall be UL/cUL Certified.
- B. Product**
- 1. Photometric Performance of installed units:**
Examine luminaire photometric files in standard IES file format from qualified independent or qualified manufacturer-based laboratories. The photometric test reports should be based on the IESNA LM-79-08 test procedure. The photometry should be based on an actual working product, not a prototype or computer model.
Lumen output and efficacy (lm/W) should not be used to generalize the performance of all luminaires. Downward fixture efficiency should be considered to analyze illuminance levels provided to the target areas, both horizontal and vertical, using lighting design software and actual site measurements.
 - 2. Durability:** Look for an Ingress Protection (IP) rating appropriate to the intended application condition.
 - 3. Color:** Check correlated color temperature (CCT) for the intended application. Color rendering index (CRI) of 50 or higher are adequate for most street and area lighting applications.
 - 4. Operating temperature:** Check operating temperature information of the product and how it affects the luminaire efficacy and lumen depreciation.
 - 5. Glare Control:** Assess glare at intended mounting height and under typical nighttime viewing conditions.
 - 6. Product Warranty:** The manufacture should replace the product if it fails before 5 years.

³ LED Application Series: Outdoor Area Lighting.

http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/outdoor_area_lighting.pdf