

# LIGHTING UPGRADES WITH LED BULBS

## WHY UPGRADE TO LED

Light emitting diode (LED) technology has evolved to the most efficient light source and costs can be competitive with incandescent, halogen and CFL bulbs. Upgrading from incandescent or halogen can:

- Produce energy savings up to of 75%.
- Have simple payback in 1 to 3 years for many applications.
- Reduce frequency of bulb burnout by a factor of 10 for incandescent and halogen bulbs.

The range of efficiency of CFLs and LED overlap and a detailed comparison is needed to identify the preferred type.

This fact sheet covers LED bulbs available in Standard "A", flood, spot, globe, and candelabra configurations. (Linear lamps are covered in a separate fact sheet.)

### How much light is enough?

Illuminating Engineering Society of North America sets officially recognized standards measured in foot candles (or lux).

Illumination Level for Space /	Foot candles, fc
Corridors, Stairs	5 min.
Parking Garage	10
Lobbies , Reception, Hospitality Guest Rooms	10 to 30
Offices , Meeting Rooms, Kitchen, Industrial	30 to 50
Retail, Inspection, Detail Work	50 to 100

<http://www.ies.org/>

## EIGHT STEPS TO EVALUATE LED BULB OPPORTUNITIES

**1. Get the right quantity of light.** The goal is to provide sufficient illumination for people to do their activities comfortably and in a pleasing environment (see sidebar). Use a light meter or get a lighting survey to determine if any areas are over or under lit. Determine the lumen output of the current lighting and proportionally adjust the target lumen level of the new bulbs to bring the illumination in line with standards.

Uniformity of illumination is as important as amount of light. *The darkest areas should have at least 1/3 the illumination as brightest.*

**2. Get the right quantity of light.** Determine the color temperature and Color Rendering Index (CRI). Color temperature is typically specified as 3000 K or less for hospitality, 3000 to 4000 K for indoor and 4000 K or more for outdoor.

We have grown accustomed to incandescent lighting which has been defined as a color rendering index of 100. Other light sources differ in their distribution of light through the spectrum and this affects the perceived color of objects. Specify a CRI of at least 80. This information is available on most LED packaging.



*Evaluate color temperature and CRI of sample bulbs before committing to a large scale replacement.*

**3. Use Energy Star or Design Lights Consortium Qualified Bulbs.** Both these rating systems establish minimums for a wide range of performance parameters simplifying procurement specifications.

ENERGY STAR® Certified Light bulbs – Product finder <http://www.energystar.gov/productfinder/product/>

DesignLights Consortium <http://www.designlights.org/>

**4. Rank efficiency in lumens per watt.** For incandescent bulbs with equal wattage, the light output in lumens was virtually to same. For LED and CFL products with similar light output, the wattage varies significantly. Therefore it is important to compare products on their efficiency measured in lumens per watt. Bulbs should be readily available with efficiency better than Energy Star minimums as illustrated in the accompanying table.

**Recommended Efficiency to Specify**

Bulb Type	Energy Star Efficiency Minimum		Specify Efficiency
	Current Lumens/W	Proposed Lumens/W	Lumens/W
General Purpose	50 to 55	65	> 75
Candelabra	> 7 W	65	> 65
	< 7 W	55	> 60
Flood & Spot	40	65	> 65
MR16	40 to 45	65	> 60

To maximize the benefits of an upgrade, it is imperative to obtain the highest lumens per Watt in relation to cost. Suggestions for specifying the efficiency are listed in the table. Seek guidance from your lighting supplier.

**5. Special Requirements Checklist**

**Check bulb compatibility with existing fixture.**

LED bulbs typically have a larger base than the corresponding incandescent or may have a different height. Track lighting in particular should be checked to physical interference.

**Check angular distribution of light.** LED bulbs are good for directional uses such as flood and spot bulbs. For standard, globe and candelabra bulb replacements, test the LED bulb in the fixture.

**Check compatibility with existing dimmers and transformers.** Existing dimmers were designed for the high wattage of incandescent bulbs and may not be able to dim LED bulbs over the full range. LED compatible dimmers are now readily available. For low voltage lighting such as MR16 bulbs, there is a potential incompatibility of the external transformer circuit and the internal electronics of the LED bulb.

**Check for adequate cooling.** Heat buildup shortens LED life, so make sure that the cooling fins on the bulb have access to free air flow.

**Light output of the downlight is what counts.** Downlights that use white or reflective surfaces to direct the light need a replacement bulb that radiates from the same location in the fixture and with the same spatial distribution. An Integrated LED/luminaire (or modification kit) is likely to perform better than bulb replacement. For downlights it is important to evaluate all the options.

**6. Determine annual energy costs.** Start with an estimate of the hours a bulb is operated per year and the electric rate.

$$[\text{Annual operating cost}] = [\text{Wattage}] \times [\text{Hours per year}] \times [\text{Cost per kWh}] \times [.001 \text{ kW per Watt}]$$

**Light Output Efficiency Varies Significantly**

Application		Output, Lumens per Watt		Best Increase Over Avg.
LED Type	Lumen Range	Average	Best	
General Purpose	700 to 1600	69	94	36%
Directional	600 to 1300	57	89	56%
MR16	400 to 600	55	77	40%
Decorative	400-700	58	77	33%



**8. Financing Options**

DSIRE is a comprehensive database of information on federal, state, local, and utility incentives and policies that support renewable energy and energy efficiency. <http://www.dsireusa.org/>

Duke Energy SmartSaver® Prescriptive incentives include \$10 per Energy Star LED and larger rebates for LED fixtures. <http://www.duke-energy.com/pdfs/SS-Comprehensive-Prescriptive-NC.pdf>

Duke Energy Progress Incentive Program [https://www.progress-energy.com/assets/www/docs/business/Progress\\_Lighting\\_Application\\_123113-FINAL.pdf](https://www.progress-energy.com/assets/www/docs/business/Progress_Lighting_Application_123113-FINAL.pdf)

Lime Energy is Duke Energy's authorized contractor for the Small Business Energy Saver Program. Duke Energy will pay up to 80 percent of select energy-efficiency improvements. The program pays the rebate upfront, so reducing investment cost without waiting for a rebate. The upgrade is completed by a local contractor who takes care of all necessary material and labor. <https://www.progress-energy.com/carolinas/business/save-energy-money/sbes/index.page?>

**Additional Resources.**

More detailed information about specific types of bulbs can be found in the following:

LED General Service Lamps [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led\\_general-service-lamps.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led_general-service-lamps.pdf)

LED Directional Lamps [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led\\_directional\\_lamps.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led_directional_lamps.pdf)

LED MR16 Lamps  
[http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led\\_mr16-lamps.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led_mr16-lamps.pdf)

Recessed LED Downlights [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/recessed\\_downlight.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/recessed_downlight.pdf)

DOE Adoption of Light-Emitting Diodes in Common Lighting Applications [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led-adoption-report\\_2013.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led-adoption-report_2013.pdf)

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