Everyday Environmental Stewardship

LED Lighting

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Key Issue: Appropriate Use

Stewardship Opportunity: Efficiency & Clean Air

Incandescent, fluorescent and halogen light bulbs are what we all grew up with. We refer to them by size (60 watt, 100 watt, PAR 38, T12 and so on) and by type (spot, flood, lamp, tube). These bulbs have several limitations, including short life, plus using of lots of electricity with corresponding environmental impact.

How do different light bulbs work?

Incandescent bulbs produce light when an electric current runs through a wire inside the bulb's glass globe. The current causes the wire to heat up and glow. *Fluorescent* bulbs (including CFLs) emit light when electricity excites a mix of gases inside the bulb, creating invisible ultraviolet light that is absorbed by the bulb's fluorescent coating and transformed into visible light. *LED* bulbs (Light-Emitting Diodes) generate light when electricity flows through an electronic component called a diode. Since LEDs do not scatter light and energy they are more light and energy efficient than either incandescent or fluorescent bulbs.

Which bulb to buy?

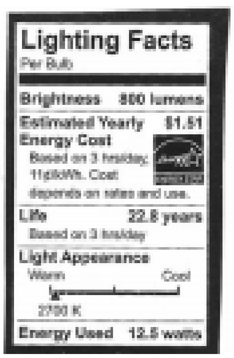
Knowing which bulb to buy is the key to using LED lighting. The investment can yield huge benefits because of significantly lower electricity use and very much longer bulb life. LEDs reduce electricity use as compared with incandescent and halogen bulbs by 80%±, and as compared with fluorescent and CFLs by 50%±. Lower electricity use means lower costs and lower environmental impact. LEDs also have long life, many in the 50,000 hours or more, compared with 1,000 to 2,5000 hours of many other bulb types. Longer life means fewer bulb changes, a particular consideration in Houses Of Worship (HOW) with spaces (such as sanctuaries) with very high ceilings, thus with hard-to-reach light fixtures. Another location with such complications are parking lots. Reducing time, cost and annoyance of such changes is no small thing in a HOW.

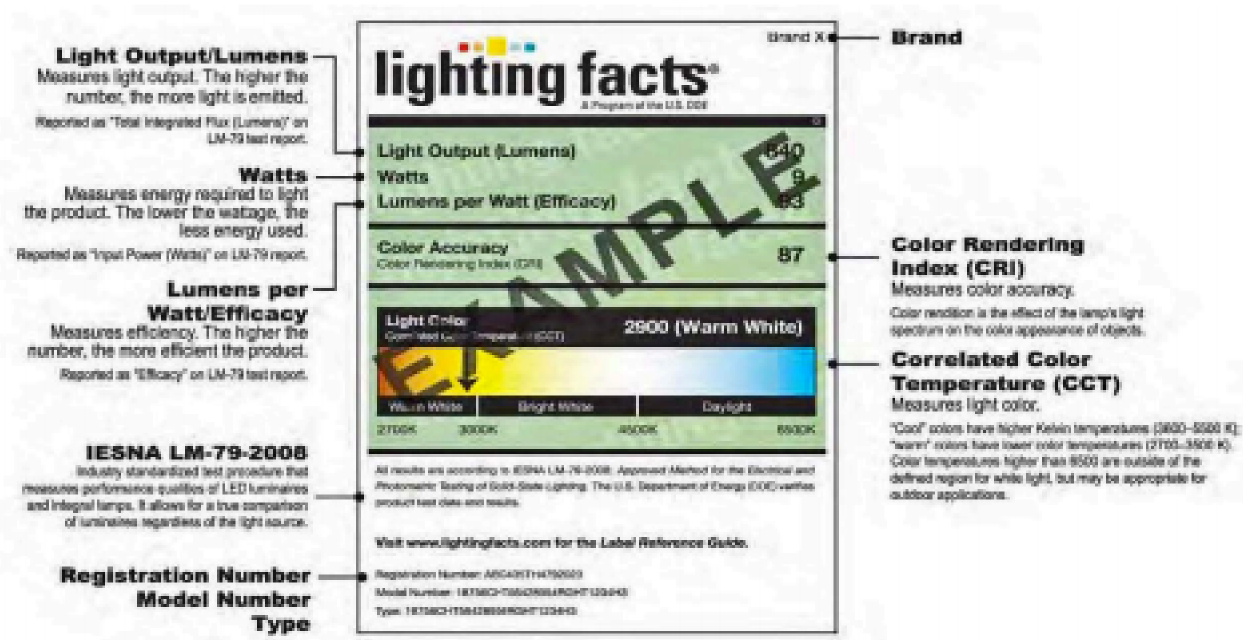
LEDs look like the bulbs we are used to buying and installing. The bulb at the top of this page is a *flood* or *spot* light. The bulb at the left is a *tube* in long (typically 4 feet) fixtures. The bulbs at the right are for lamps and candelabras. There are LED bulbs for virtually every light fixture.

The question is: Which bulb is best for which fixture? A Department of Energy web site provides useful guidance:

http://www.lightingfacts.com/products

There is a search tool at this site to find available products once a set of specifications is entered. It is important, then, to know about those specifications. The *Lighting Facts* program provides the information, with summary information on each bulb box, organized as below.





Facts on the package

LED bulb packages have this information in simple form. Typically, the packaging will also say on the front the size of an incandescent bulb with which the LED compares. For the *Lighting Facts* at left, the 12.5w LED bulb compares to a 60w incandescent. The "warmth" rating at 2700 K means its appearance when turned on will be virtually the same as the "warm/yellowish" color of the incandescent bulb. The brightness matches. The bulb has an estimated 25,000 hour life, so if used 3 hours a day it will not have to be replaced for nearly 23 years! For the 1,095 hours used, the bulb will have an electricity cost of $1.51/year, at 11¢/kWh. Another 60w replacement LED bulb with a "cooler" light appearance (5000 K) is only 9w, with an operating cost of only $1.08/year at the 11¢/kWh price. Most LEDs are dimmable, and can respond to motion sensors, both further benefits, especially compared to CFLs. LEDs do not change color output as they are dimmed and can dim down to 5-10% of full illumination. It is very sensible to install LED-conforming dimmers on light switches, given lower electricity demands of LEDs. This ensures that the dimming works well.

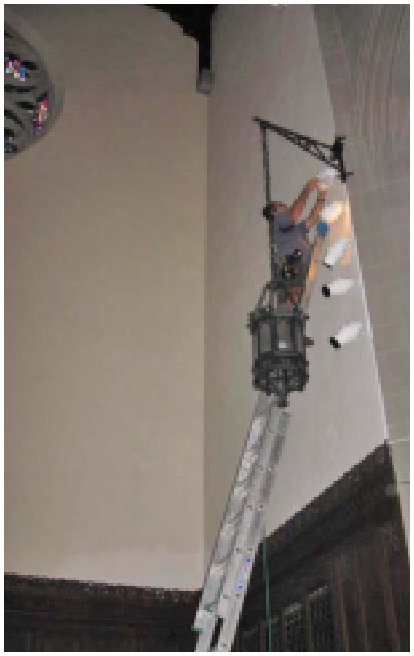
Beam Spread

LEDs for use in "spot" and "flood" light fixtures come in a wide variety of beam spreads, from 10° to more than 50°. It is important to figure out beam spread before buying bulbs. Basically, the farther away from the objects to be lit, the bulb needs a narrower beam spread and higher wattage. Illustrations of beam spreads through the use of LED calculators can be found at

https://lumicrest.com/beam-spread-calculator/

Light Bulb Cost Calculator

Massachusetts electric utilities offer **rebates** for installing high-efficiency equipment, including LED bulbs. The rebates can be in the 70 to 90% range. This information is important when calculating initial costs. MIP&L has a ***Light Bulb Cost Calculator***, that compares bulb price, cost of installation, cost of operation, and expected life. This worksheet is available at http://www.mipandl.org/ees.html. An example of use in comparing cost of the sort of bulb often found in a sanctuary — PAR38 Halogen — with a LED replacement is on the next page.



The example shows the cost to replace 10 existing PAR38 Halogen 75w bulbs with LEDs that will provide about the same lighting as measured in lumens. The LED purchase cost is only about 1.5x that of the halogen, before rebates.

A basic consideration is installation time. In the example, the bulbs require a ladder to install, which must be moved to each of the 10 locations. This task takes about 10 minutes for each bulb, which is 1 hour, 40 minutes total. Thus, the total installation cost by the HOW maintenance person at an annual salary of $30,000 (plus benefits) is more than $60.

Therefore, the combination of purchase and installation costs for the halogen bulbs is $145. The LED bulbs would cost about $186, with no rebates. Thus the initial cost of the LED bulbs is only about $41 higher (about 28%) than the halogens.

Really big savings come into play when the amount and cost of electricity annually are compared. Halogens will use about 1,100 kWh, compared to only 175 kWh for the LEDs. Annual cost at 20¢/kWh is $274 versus $44, translating to annual savings for the LEDs of $230. ***Thus in only 65 days, the higher initial cost of the LEDs is covered***.

A further cost factor comes into play. The halogens have a predicted life of only 2,500 hours, compared with the 50,000 hours for the LEDs. In the life span of the LEDs (over 34 years), the halogens would have to be replaced 19 more times. Thus the total installation cost of the halogens is nearly $2,900, compared with the LED cost of $186. Savings also come into play by eliminating 19 installation costs. ***Over the life of the LEDs the total savings (capital, installation, operating) is over $9,000.***

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LIGHT BULB COMPARISON

Cost in $s and Environmental Impact

Electricity Cost per kWh

Type

Size (watts)

Light Output (lumens) # of bulbs

Hours Used/day

Hours Use/Year

Life (hours)

Purchase Cost (each) Labor Cost (each)

75	1
1,060	1,1
10	1
5	5
1825	18
2,500	50,0
$8.33	$12
$6.16	$6.

Purchase Cost

Installation Cost

TOTAL INITIAL COST

$83.30	$12
$61.60	$61
$144.90	**$18**

Current LED

LED Higher Initial Cost $40.80

Annual kWh Use
Annual $s for electricity

ngs	
	16%
	65

$
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LED % of Cost of Current Bulb Electricity Use
Days to Cover Higher Intital Cost

# of times to replace current in LED life Total Lifetime Purchase & Installation Cost Years Between Replacement

20	1
$2,898.00	$185.70
1.4	27.4

	$2,712.30
	$6,300.00
	$9,012.30

Total Capital & Installation Cost Savings
Total Operating Cost Savings in LED Life
TOTAL COST SAVINGS OVER LED LIFE

ENVIRONMENTAL IMPACT

Annual Carbon Footprint (CO_2 lbs) # of New England Trees Needed to Offset

1,643	263

115	18

www.MIPandL.org