

LED Lighting: Concepts & Comparisons



LED lamps are replacing incandescent lamps – CFLs are a less-than-ideal temporary solution to the challenge of increasing the energy-efficiency of our area lighting. CFL light tends to be harsh, difficult on the eyes and does not render colors accurately. Disposal is expensive if one follows the rules, and businesses that don't follow hazardous waste regulations do so at their peril. Most CFLs are not dimmable; those that claim this feature render inconsistent practical results. For these reasons CFLs are rarely used in retail environments or galleries/museums as the light is not up to the needed quality standards. The reasons LEDs have not grown market share more quickly are twofold: early generation LED lamps had a narrow and focused light beam, and the cost of the LED bulbs was too high.

Recent developments in LED technology, however, have been addressing these issues. LEDs have been 'clustered' to provide more light, and mounted within diffuser lenses that spread the light across a wider area. Advancements in manufacturing technology have driven the prices down to a level where LED bulbs are more cost-effective than CFLs or incandescent bulbs. And, quality LED lamps are RoHS compliant, meaning they do not bring a hazardous waste disposal cost along with each purchase. This trend is continuing, with LED bulbs being designed for more applications.

The 'sticker shock' of the new LEDs remains a deterrent to their widespread acceptance by consumers. However their remarkable energy efficiency (80 to 90% less electrical energy consumption for the same, if not better, quality of light) frequently produce ROIs of less than one year. The following comparison charts illustrate the value of the latest LED lamps when compared with CFLs and incandescents for overall efficiency as well as cost-effectiveness.

Cost Comparison between LEDs, CFLs and Incandescent Lamps

	LED	CFL	Incandescent/Halogen
Light bulb projected lifespan	50,000 hours	8,000 hours	2,500 hours
Watts per bulb (equiv. 75 watts)	7	18	75
Cost per bulb	\$30	\$10	\$7
KWh of electricity used over 50k hrs	350	900	3750
Cost of electricity (@ 0.15 per KWh)	\$52.50	\$135	\$562.50
Bulbs needed for 50k hours of use	1	6.25	20
Equivalent 50k hours bulb expense	\$30.00	\$62.50	\$140.00
Total cost for 50k hours	\$82.50	\$197.50	\$702.50

Incandescent and CFLs generate a great deal of heat (as noted in the chart below, incandescent/halogen bulbs are particularly offensive). This additional heat puts a significant load on air conditioning systems and the AC system uses a great deal more electricity simply to offset the heat from these lamps. This additional energy consumption can be calculated scientifically with standard HVAC industry mathematical equations. Frequently, the cost savings from reduced air conditioning costs can be upwards of 50% of the electricity cost saved from illumination.

Comparing the features of LEDs, CFLs and Incandescents

	LEDs	CFLs	Incandescent/halogen
Frequent On/Off Cycling	no effect	dramatically shortens lifespan	some effect
Turns on instantly	yes	slight delay	yes
Durability	durable	fragile	fragile
Heat Emitted	low (3 btu's/hr)	medium (30 btu's/hr)	high (85 btu's/hr)
Sensitivity to temperature	no	yes	some
Sensitivity to humidity	no	yes	some
Hazardous Materials	none	5 mg mercury/bulb	none
Replacement frequency (over 50k hours)	1	6+	20

Notes:

- Cost of electricity will vary by region. The figures used above are for comparison only.
- The cost per bulb for may vary. We used costs for quality fluorescent and halogen lamps that are consistent with national averages among lighting retailers. No costs are included for procurement, logistics, inventory shrinkage, or disposal of fluorescent and incandescent/halogen bulbs (these costs add up and can be significant).
- Lifespan (life rating) is based on testing and scientific data related to the technology. Many practical application factors can greatly reduce the life expectancy of CFLs while LEDs and for the most part halogen's are immune to those factors. Average life means the time at which 50% of lights will need replacement. Some of those factors are highlighted in the chart above.
- Bulb breakage and bulb replacement costs have not been factored into this comparison chart. Incandescent bulbs and CFL bulbs are more easily broken than LEDs, which increases their cost of use.
- Our LED bulbs come with a 3 year warranty. Warranty claims for CFLs and Incandescents are seldom made because of the inconsistency of actual life and the difficulty of tracking their installation date

Terms:

Lumens This is the unit of measurement of the flow of light, or 'luminous flux'. In this context, it provides an estimate of the apparent amount of light the lamp produce.

Coloring Rendering Index (CRI) CRI represents the quality of light and its ability to render colors correctly. ETR bulbs, for example, feature a CRI of 80+, making them among the highest in the industry.