LED - Simplified

Incandescent Light

CFL - Compact Fluorescent Light

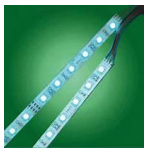
LED – (Light Emitting Diode) Light

The evolution of lighting from candlesticks to today's explosive technology in residential and commercial Light Emitting Diodes (LED) started in the late 19th Century with the heating of a wire to incandescent, low pressure mercury-vapor gas discharge lamps (Fluorescents) and the early 20th Century discovery of electroluminescence, an optical and chemical response to an electrical current.

I promise, I won't bore you with the science. My intent is to educate, so let's start with the incandescent. The internal tungsten filament is heated by an electrical charge to emit light. Oxidization of the filament is protected by a glass bulb filled with inert gas or through evacuation. It's big sister, the Halogen, works under the same principle - the exception is an added chemical process that redeposits metal vapor onto the filament, extending the life of the bulb. For decades, this was the standard for lighting throughout the world.

Then came the fluorescent lamp, typically from 4" up to 8'0", with a multitude of applications from household lighting to commercial signage and exterior featuring. With an applied electric current through low pressure mercury vapor, the reaction produces short-wave ultraviolet light that causes the phosphor coating inside of the lamp to glow. The electric current is regulated or controlled using electronic ballasts in the startup and continuous use process.

LED lighting is a chip, or semiconductor which emits light when voltage is applied. The chip is less than 1 mm square, with integrated optical components arranged to influence the light pattern.



According to the US Department of Energy, ENERGY STAR rated LED lighting products use at least 75% less energy, and last 25 times longer than incandescent lighting.

The table below compares annual energy cost of a 60 watt (W) traditional incandescent compared with energy efficient bulbs that provide similar light levels.

Comparisons between Traditional Incandescent, Halogen Incandescent, CFLs, and LEDs						
	60W Traditional Incandescent	43W Energy-Saving Incandescent	15W CFL		12W LED	
			60W Traditional	43W Halogen	60W Traditional	43W Halogen
Energy $ Saved (%)		25%	75%	65%	75%-80%	72%
Annual Energy Cost*	**$4.80**	**$3.50**	**$1.20**		**$.50**	
Bulb Life	Up to 1,000 hours	1,000 to 3,000 hours	Up to 10,000 hours		50,000 hours +	

*Based on 2 hours per day of usage, an electricity rate of $.11 cents per kilowatt-hour. Table provided by the U.S. Department of Energy 2016

But LED's are expensive, right? So let's do a comparison to weigh out the investment.

The table below compares cost of lighting products over 20 years based on average life.

	60W Traditional Incandescent	15W CFL	12W LED
Average cost each	$1.00	$3.50	$7.00
Quantity Purchased over 20 Years	$14.00	$7.00	$7.00
Bulb Life	Up to 1,000 hours	Up to 10,000 hours	25,000 hours +

*Based on 2 hours per day of usage, an electricity rate of $.11 cents per kilowatt-hour X 20 years (14,600 hours). Table provided by the U.S. Department of Energy 2016

The table below combines average product cost and energy cost extended over 20 years or 14,600 hours of operation.

Light Source	Total Required	Cost +	Energy Cost =	Total Cost
LED	1	$ 7.00	$ 5.00	$ 12.00
CFL	2	$ 7.00	$ 12.00	$ 19.00
Incandescent	14	$ 14.00	$ 96.00	$ 100.00

In the final analysis, LED wins out, with CFL coming in a close second. Incandescent is the equivalent to dial-up internet service, too expensive and inefficient. **Best practice** for the consumer is to choose the areas that require the most illumination on a continuing use basis, usually kitchen and bathroom areas, and replace incandescents, fluorescents, or CFL's with LED.

According to the U.S. Energy Information Administration, the estimated U.S. residential sector electricity consumption in 2014 was 11% for lighting, space cooling/heating was number one with 22% in comparison. If you average annual electricity cost is $2,000, you can conceivably save $200-250 per year using a combination of CFL and LED lighting products depending on low or high usage areas. The commercial sector, which includes commercial and institutional buildings, consumes about 19% of electricity consumption in 2015 – a significant opportunity to reduce costs including tax rebates for retrofitting to LED.

Choosing the Right Lights

There are 4 things you should consider before buying lights:

- Watts - The overall power consumption of the light.
- Lumens – The actual quantity of light given by a light source.
- Beam angle - The viewing angle at which the light is directed.
- Color and its relationship to light output.

What are you trying to achieve?

Watts

Watts is the measure of power usage. This is where the real cost savings comes with using LED light source – a 60W incandescent is replaced by a 12W LED, producing the same amount of lumens, or light out-put at 80% less energy!

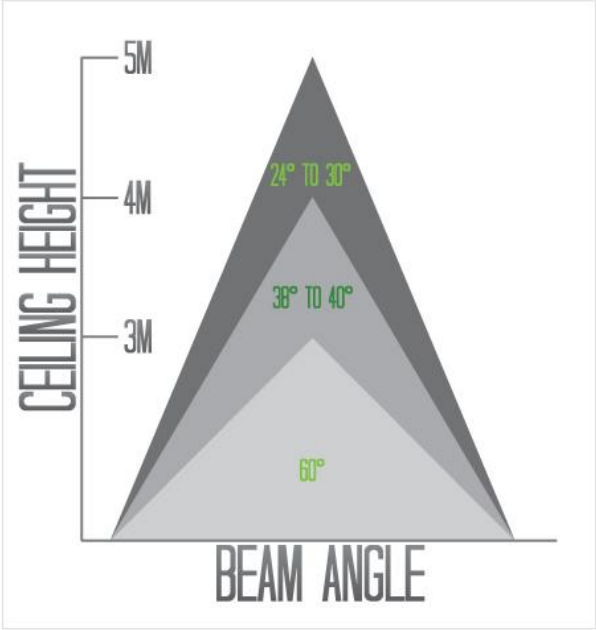
Lumens

Lumens are the measurement of the total amount of light emitted from a light source. You may hear the term 'lux' as well. Lux is simply the amount of lumens in a specified area.

1 lux = 1 lumen/m^2

Beam Angles

LED bulbs commonly use 120° beam angles. If you are purchasing LED spotlights and downlights, you'll want to consider which beam angle to use. Below is an easy guide on how to choose your beam angle when choosing lights:



1m = 3.28'

For general lighting, make sure you choose the correct wattage based on how many lumens you want.
If your ceiling is average height 2.5 to 3.5 meters high, use 60° beam angle
If your ceiling is 3.5 to 4.5 meters high, use 38° or 40° beam angle
Ceilings higher than 5 meters, use 24° to 30° beam angle.

Color

The most obvious and exciting advantage of LED lighting is the color variations available. The clarity of those colors is also an amazing benefit of LED lights. When we talk about color in relation to general lighting we are talking about 'color temperatures' within the 'White color spectrum' which is measured in Kelvin. 2700k to 7000k. In other words the colors ranging from warm white through to super daylight.

2700k – Interna – A very warm ambient color
3000k – Warm white – halogen bulbs are this color
4000k – Cool white – Compared to fluorescent lighting
5000k – Natural white – This is a good working color specified for Industrial, Healthcare, and Commercial spaces
6000k – Daylight – Also known as pure white or cool daylight
6500k – Super daylight

Furthermore, to assist consumers in their watts-to-lumens transition, the American Lighting Association has issued guidelines for consumers seeking efficient equivalent LED's to an incandescent:

- To replace a 40-watt incandescent bulb, choose an LED that will produce 450 lumens.
- To replace a 60-watt incandescent bulb, choose an LED that will produce 800 lumens.
- To replace a 75-watt incandescent bulb, choose an LED that will produce 1,100 lumens.
- To replace a 100-watt incandescent bulb, choose an LED that will produce 1,600 lumens.

Now, if you own a business, imagine the savings possibilities. Apply the same math to the efficiency of LED and CFL lighting source, and add to the bottom line!

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