LIGHTING TECHNOLOGIES: A GUIDE TO ENERGY-EFFICIENT ILLUMINATION

Lighting accounts for nearly 20 percent of the average home's electricity use. It pays to know which types of lighting are most energy efficient and some of the pros and cons of each. Though this guide is not exhaustive, it may serve as a reference point when choosing between the more common home lighting technologies.

LIGHTING TECHNOLOGIES

Compact Fluorescent Lamps (CFLs) have been available for residential use for about 30 years, with recent advances increasing their quality and popularity. They are the most energy-efficient choice readily available on the market for homes today. CFLs use gases and phosphor inside the lamp to create light. CFLs come in screw-in or pin-based configurations, in many sizes and shapes. Screw-in lamps fit into almost any fixture that accepts standard bulbs. Pin-based CFLs plug directly into a dedicated energy-efficient fixture. All indoor and most outdoor ENERGY STAR® qualified light fixtures are designed to accept only pin-based CFLs. CFLs last longer and use fewer watts than incandescent and halogen lamps to provide the same amount of light. They operate at a low temperature and come in 'warm' and 'cool' colors. Most CFLs do not operate well on remote or dimmer switches, though specialty dimmer-compatible and 3-way switch CFLs are beginning to appear on store shelves. Because CFLs contain a small amount of mercury, they should always be disposed of responsibly, ideally recycled.

Initial Cost:	Medium – Low	Color Rendering Ability:	Medium-High
Energy Consumption:	Low	Operating Temperature:	Low
Lifetime:	High		

Incandescent Lamps are "standard" electric light bulbs that were introduced for residential use more than 125 years ago by Thomas Edison. They have the lowest initial cost and good color rendering. They typically have short life spans and use significantly more watts than CFLs and halogen lamps do to produce the same lumens, or light output. Incandescent technology produces light by heating up a metal filament enclosed within the lamp's glass. More than ninety percent of the energy used by an incandescent light bulb escapes as heat, with less than 10% producing light. Incandescents are the most commonly found bulbs in American homes.

Initial Cost:	Low	Color Rendering Ability:	High
Energy Consumption:	High	Operating Temperature:	High
Lifetime:	Low		

Halogen Lamps are somewhat more efficient than incandescent lamps, but operate at an even higher lamp temperature. These high operating temperatures can present a safety concern in some fixtures, such as torchiere fixtures which consume as much as 500 watts. Halogens are often used for recessed, accent, and flood lighting.

Initial Cost:	Medium	Color Rendering Ability:	High
Energy Consumption:	High	Operating Temperature:	High
Lifetime:	Medium		

Linear Fluorescent Lamps are most often used in residential garages and basements for general lighting. They are highly efficient and long-lasting. More stylish fixtures that use this technology can be found for use indoors, such as for kitchen ceiling lights.

Initial Cost:	Low-Medium	Color Rendering Ability:	Medium-High
Energy Consumption:	Low	Operating Temperature:	Low

Lifetime:	High		

Light Emitting Diodes (LEDs) have recently become commercially available as a lighting source. They have extremely long life spans, are energy efficient, and come in a variety of colors. As research continues, LEDs continue to improve and be used in new applications. An increasingly popular residential use is decorative light strings, or holiday lights. Colored LEDs are now commonly used commercially in exit signs and traffic signals, which can significantly reduce maintenance costs. While LED technology is being explored for common residential use, technical and cost barriers remain. However, the ENERGY STAR program is adding decorative light strings to the list of product types that can earn the label and is exploring bulbs and fixtures for the future.

Initial Cost:	Medium - High	Color Rendering Ability:	Low - Medium
Energy Consumption:	Low - Medium	Operating Temperature:	Low
Lifetime:	High		

WHAT IS A BALLAST?

A ballast is a device that serves to control the flow of power to a fluorescent lamp. Advanced electronic ballasts have replaced many magnetic ballasts of the past in new CFL bulbs and fixtures. Electronic ballasts improve fluorescent energy efficiency even further, eliminate the "hum" and visible flickering found in older fluorescent technology, and some are compatible with dimming and daylight controls.

COMPARING DIFFERENT LIGHTING TECHNOLOGIES

The table below summarizes some key criteria for evaluating different lighting technologies.

Technology	CRI	Efficacy (lumen/W)	Lifetime (hrs)	Color Temperature (K)
Compact Fluorescent	80-90	60-70	6,000-10,000	2700-6500
Incandescent	100	12-18	750-1,500	2400-2900
Linear Fluorescent	70 - 90	80-100+	20,000	2700-6500
Halogen	100	16-29	2,000-4,000	2850-3200
White LED	65-90	20-50	Up to 100,000	2700-6500

+ **Color Rendering Index (CRI)** is a comparison of a light source's ability to accurately render the color of an object to that of a standard reference light source. The CRI scale is from 0 to 100, with a value of 100 indicating excellent color rendering. Sunlight and most incandescent lamps have CRI values of 100. Only compare the CRI values of light sources of roughly the same color temperature.
+ **Color Temperature** is a way to compare the color of light from different types of lamps. It is often referenced as cool (slightly blue) or warm light (slightly orange). Incandescent lamps and candles give off warm color temperatures, while sunlight and some fluorescent lamps emit cool color temperatures.
+ **Efficacy** is a measure of light output (lumens) per watt of electrical power needed by the lamp. Lumens measure how much light is emitted. Watts indicate how much electrical power is consumed.

Sources:
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