

OVERVIEW

The average American home has 37 incandescent bulbs and only several compact fluorescents lamps (CFLs). Each CFL bulb reduces the Colorado region's carbon dioxide emissions by approximately 180 pounds each year and 1,270 pounds over its lifetime, compared to the use of a 75-watt incandescent bulb (based on Energy Information Administration 1605(b) Voluntary Reporting of Greenhouse Gases, assuming operation hours, regional emissions factor and a lifetime of seven years). Energy-efficient lighting that is both attractive and cost effective has become widely available. It is time to adopt the best new lighting technology and integrate it into the new and existing homes.

Toward understanding the energy consequences of lighting, it is useful to examine the amount of light produced by various lighting sources per unit of power required to produce it. This is called **luminous efficacy**, measured in lumens per watt (lm/W). The luminous efficacy of CFLs is **over four times** that of incandescent bulbs, and they last **ten times** longer.

LIGHTING TERMS

In addition to luminous efficacy, several other terms of art in the lighting world are useful to understand.

- ☀ **Color rendering index (CRI)** is a figure of merit that ranges between 0 and 100 that expresses the degree to which a given light source renders “true” colors as seen by the human eye. Our sun is an almost perfect black body, which means that there are very few holes in its spectrum so its CRI is counted as 100. Incandescent bulbs, which include halogens, have relatively high CRIs that approach 100. Good-quality fluorescents have CRIs in the 80+ (some as high as 98) range and the best metal halide lamps have a CRI of 94.
- ☀ **Color temperature** expresses the characteristic color of a source of radiant energy we can see with our eyes. As a black body becomes hotter, it radiates more energy throughout the spectrum and increasing portions of its output are in the shorter wavelengths. Color temperatures are expressed in degrees Kelvin. A source with a color temperature of 2700K or below has a decided reddish feel to it, usually described as “warm.” A crystal blue northern sky on a clear day may have a color temperature of 10,000K or higher, the sun at noon in the summer 5400K, and at sunset, 2000K. Most people enjoy color temperatures of around 3000K to 3500K or so for most visual tasks, although warmer temperature light tends to be more comfortable in romantic restaurants, for example.

CFL ECONOMICS

In assessing the cost effectiveness of CFLs, it is best to ask the economic question, “how much energy and money will this CFL save over its lifetime?” To illustrate, take an ENERGY STAR-labeled 24 watt quadruple tube CFL suitable for a floor lamp. This bulb has an output of 1520 lumens, almost exactly that of a 100 watt incandescent, but a luminous efficacy of 63 lm/W, which is over four times that of the 100 watt incandescent at 15 lm/W. Over its lifetime, the CFL will consume 288 kWh, as compared to 1,200 kWh consumed by the incandescent, a savings of 912 kWh. At 10 cents per kWh, the energy savings is worth \$91.20 (ignoring the time value of money). Of course, over the lifetime of the CFL, one must replace the incandescent on the order of 12 times. Ignoring labor, runs to the hardware store, and

land filling 12 times as many burnt out bulbs, the first costs of the CFL and the incandescents over the lifetime of the CFL are effectively a wash.

What is the 912 kWh savings at the coal-powered power plant? At 10,000 Btu/kWh, a factor that accounts for the Carnot effect and line losses, it is over nine million Btus, which is the energy equivalent of nine person years of labor. It's also associated with the mining, transporting, and burning of 650 pounds of coal, the evaporation of over 450 gallons of water and the release of 0.89 tons of CO₂. Expressed in terms of gasoline, the energy savings are equivalent to 72 gallons of gas, enough to drive from New York to San Francisco in a Prius. This analysis applies to the savings associated with the lifetime of a single 24 watt CFL!

OTHER CONSIDERATIONS

CFL technology has come a long way and improvements are underway. CFLs can be chosen that fit in virtually any lamp of almost any size. It's now possible to purchase 3 watt CFLs useful for illuminating paintings as well as large 125 watt CFLs useful in industrial applications as well as in home shops. In all cases, choosing an ENERGY STAR accredited bulb is recommended. This ensures high-quality light and long life. Without the knowledge of his colleagues, a building scientist with a progressive builder in the Boulder area replaced 60 incandescents in a model home with CFLs. After a full day at the model home opening, in which managers and sales people showed the model to hundreds of potential customers, he revealed colleagues that every bulb in the home was a CFL. No one had noticed the changes.

DISPOSAL

A CFL bulb contains about 3-5 milligrams of mercury. While this is far less than coal power plants emit to provide energy for an equivalent amount of incandescent lighting, care should be taken in the disposal of CFLs. If a bulb breaks, do not vacuum; sweep up all the glass and fine particles and place them in a sealed plastic bag. Open windows and doors for ventilation. At the end of their useful life, CFLs should be disposed of at a household hazardous waste facility or recycled at a recycling station. If CFL bulb users have no other options for recycling, it is recommended they place the bulb in two plastic bags and seal them before putting them in the outside trash for normal collection.

CFL drop-off and recycling stations in Boulder County

- ☀ **Western Disposal Services Waste Transfer Station** (www.westerndisposal.com)
Address: 5880 Butte Mill Road, Boulder TEL: 303-444-2037
Hours: Wednesday, 8:00 a.m. to 3:30 p.m., Friday and Saturday, 8:00 a.m. to noon
- ☀ **Local ACE Hardware stores**
(http://www.xcelenergy.com/Residential/Programs_Resources/BulbRecycling/Pages/Recycling_Information.aspx)

LEARN MORE

ENERGY STAR Light Bulbs and Fixtures http://www.energystar.gov/index.cfm?c=lighting.pr_lighting

Xcel Energy's CFL Rebate Campaign <https://www.compactoffer.com/xcelenergyproducts.cfm>

Buy 7 CFLs from Xcel website and get one free.

Xcel is partnering with selected retailers (Albertsons's, Home Depot, Ace Hardware) in Colorado to offer discounted prices for ENERGY STAR qualified CFLs.