

## Energy Efficient Homes: Fluorescent Lighting<sup>1</sup>

---

Hyun-Jeong Lee, Kathleen C. Ruppert, and Wendell A. Porter<sup>2</sup>

### Quick Facts

- Compact fluorescent lamps/bulbs, commonly referred to as CFLs, cost less than regular incandescent lighting in three ways.
  1. CFLs consume significantly less energy than incandescent bulbs. To produce the same brightness, an ENERGY STAR® qualified CFL uses only about 1/4 of the energy that an incandescent bulb uses.
  2. By using ENERGY STAR® qualified CFLs, you'll save on air conditioning costs because they generate 3/4 less heat than regular incandescent bulbs.
  3. A CFL lasts up to 10 times longer than an incandescent bulb. This means fewer bulbs to purchase and fewer trips to the store, saving you both the time *and* the travel costs you would normally spend on replacing burned-out incandescent bulbs.
- Replacing incandescent bulbs with CFLs in the rooms where you spend the most time, like your

family room, living room, and kitchen, will result in tangible dollar savings and comfort.

- Fluorescent lighting is no longer the industrial lighting of yesteryear—for example, it is now available in varieties to suit almost any need from ambient mood lighting to crisp task lighting.

### Terms to Help You Get Started

- **ballast:** The device that stabilizes the electric current for stable operation of a bulb. Depending on the bulb it can either be attached to the bulb (generally as in compact fluorescent bulbs) or be part of the fixture (as with pin-based and fluorescent tubes). Units with separate ballasts and bulbs are preferable because ballasts last much longer than bulbs.
- **bulb, lamp vs. fixture:** *Lamp* is the industry term for what we commonly refer to as light *bulb*, whereas a *fixture* is the housing unit that connects the bulb (lamp) to a power source.
- **CCT:** Color Correlated Temperature. A measurement of the appearance in tone of any given light source, i.e., how “warm” or

---

1. This document is FCS3270, one of an Energy Efficient Homes series of the Department of Family, Youth and Community Sciences, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. This material was prepared with the support of the Department of Environmental Protection, Florida Energy Office. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily express the views of the Florida Department of Environmental Protection. Original publication date June 2008. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.

2. Hyun-Jeong Lee, assistant professor, Department of Family, Youth and Community Sciences; Kathleen C. Ruppert, associate extension scientist, Program for Resource Efficient Communities; and, Wendell A. Porter, lecturer and P.E., Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL 32611.

“cool” it is, “warm” being closer to the yellow/orange end of the color spectrum, and “cool” being closer to the bluish end. Measured in Kelvin (K) temperatures.

- **CRI:** Color Rendering Index. A measurement of how accurately the emitted light renders the color of illuminated objects.
- **CFL (Compact Fluorescent Lamp):** A fluorescent tube of small diameter wound into a coil, spiral, or typical incandescent bulb shape so that it is comparable in size and shape to conventional incandescent light bulbs.
- **Efficacy:** See *Lumens per watt (LPW)*.
- **fluorescent:** Light source that, when electrical current is applied, glows because of a chain of events initiated by the current's arc.
- **hardwired (dedicated) systems:** These systems consist of a ballast and fluorescent bulb socket permanently wired into a fixture by the manufacturer, or as part of a retrofit kit.
- **incandescent:** Light source that glows because of its filament being heated to a high temperature.
- **integral light:** Bulbs that combine a bulb, ballast, and standard screw base in a single sealed assembly, which must be discarded when the bulb burns out. They can be installed in any standard screw-type light fixture where incandescent bulbs are normally used.
- **Kelvin (K):** A measurement for the characteristics of visible light in determining color temperature, often used for categorizing CCT.
- **kilowatt-hour (kWh):** Used on utility bills to define a unit of energy usage, e.g. a 100-watt light bulb (0.1 kW) used for 10 hours (0.1 kW x 10h) consumes 1 kilowatt-hour of energy during that time.
- **lumens:** Units of measurement for brightness issued by a light source, e.g. a candle generates about 13 lumens while a 100-watt incandescent bulb generates about 1,750 lumens.
- **lumens per watt (LPW):** An indicator of a bulb's efficiency determined by dividing the number of lumens generated (as indicated on the packaging by the bulb manufacturer) by its wattage; the higher the LPW, the greater the efficiency. Sometimes referred to as efficacy.
- **mercury:** A metallic element used in small amounts in CFLs and fluorescent tubes that, because of its behavior when exposed to air, requires special handling.
- **modular units:** This type of unit has a separate two- or four-pin base bulb that plugs into a separate adapter or ballast. When the bulb burns out, a relatively inexpensive replacement bulb can be installed in the original ballast and pin base.
- **reflector bulbs:** Perfect for providing directional light, as with recessed lights in kitchens or ceiling fans. There are outdoor reflector bulbs as well that are generally much larger than the reflectors designed for use inside. The outdoor types are sealed to withstand the weather and generally should not be used with timers, photocells, and motion sensors unless otherwise specified on the package.
- **watt:** A unit of electrical power/power consumption.

## How much would I save by switching to compact fluorescent bulbs?

Let's compare an incandescent bulb and a CFL with the same light output. A 60-watt bulb does not necessarily provide more illumination than a 15-watt bulb. Why? Because *watts measure energy use* while lumens measure light output. Lumen information appears on bulb packaging. For example, a 60-watt incandescent bulb produces about 800 lumens. You can replace this 60-watt incandescent bulb with a 15-watt CFL and get the same amount of lumens (light output), but the CFL will use 45 watts *less energy* (U.S. Department of Energy, n.d.). See Table 1 to compare estimated purchase price and residential energy costs of incandescent versus fluorescents, each with the same light output (lumens).

## Is it true that fluorescent lighting is harsher than incandescent?

This is not necessarily true. Two factors, the Color Rendering Index (CRI) and Color Correlated Temperature (CCT, sometimes called K), affect a light's harshness. Fluorescent lighting is generally more uniform than other light sources.

### ***What is the Color Rendering Index (CRI)?***

CRI measures the perceived color of objects under artificial light on a scale of 0 to 100. The higher the number, the more natural and vibrant an object will appear. Incandescent bulbs usually have CRI values of 100. Old-style fluorescents had values of 62, at best, which is why people used to complain that fluorescents gave false colors. A CFL with a CRI of 80 or more is suitable for everyday residential use.

### ***What is Color Correlated Temperature (CCT)?***

CCT is a measurement of the appearance of the light source itself, how "warm" or "cool" it seems. It is measured in Kelvin Temperature from 0 to 10,000+ and expressed as (K). Oddly, the lower the Kelvin number is, the warmer (more yellow) the light color. As the number goes up, the bluer the light source will be. For instance, a CCT of a standard incandescent bulb can range from 2800K to 3100K which provides warm, white lights. A fluorescent with a CCT of 3000K will provide the same warm, white light that an incandescent bulb produces. A 3500K fluorescent bulb gives about the same light as a halogen. Some bulb manufacturers promote 5000K to 6000K, which produce cooler (bluer), white light, as a daylight bulb.

## What should I look for when purchasing bulbs?

### ***Efficiency***

Compare brands for price, lumens per watt (LPW) and hours of life. To calculate lumens per watt, divide the lumens by the watts. For instance, an 800-lumen 60-watt incandescent bulb would have a LPW of approximately 13 (800 divided by 60); an 800-lumen 15-watt CFL would have a LPW of about

53 (800 divided by 15). Remember, the higher the LPW, the greater the efficiency and the more light you receive for the energy used.

### ***Color***

In addition, compare CRI and Kelvin Temperature if displayed on the product package—CRI will be a 2-digit number and Kelvin will be a 4-digit number with K, for example, 3500K. For an idea of how a room will look in varying shades of white light (warm–yellow or cool–blue), see the ENERGY STAR® *Choose a Light Guide* at <http://www.drmediaserver.com/CFLGuide/index.html>.

### ***Instructions for Appropriate Use***

When you purchase a bulb, check its packaging for any restrictions on use. For example, some bulbs should not be used in enclosed fixtures and some may specify that the base be up or down. Many are for specific fixtures, such as recessed cans, dimmer switches or outdoor fixtures. Bulbs used incorrectly can cause fire and/or electric shock. This pertains to incandescent bulbs as well, such as using a 100-watt bulb in a fixture that calls for 40 watts.

## Can I use dimmers or 3-way switches with fluorescent lights?

Yes, but you need to find the right bulbs. Manufacturers are beginning to produce CFLs that will work in standard incandescent fixtures with dimmers or 3-way switches, but using the wrong kind can be dangerous and costly if the bulb fails. Read package directions carefully to pick the right CFL for your purpose. Incorrectly installed bulbs can cause fires.

## What's different about an ENERGY STAR® qualified CFL?

The U.S. Department of Energy has defined the criteria a CFL must meet to earn the ENERGY STAR®. These criteria include very specific requirements for efficacy (LPW), CRI, CCT, product packaging, and warranty provisions (U.S. Department of Energy, 2008a). Recently, the U.S. Department of Energy added new criteria for the CFL

ENERGY STAR® (U.S. Department of Energy, 2008b) effective December 2, 2008. Some highlights of the recent updates are:

- First-time introduction of requirement for maximum mercury content (less than 5 milligrams)
- Addition of third-party testing requirement (effective November 2008)
- More stringent CRI requirements
- Addition of high-heat testing requirements for CFLs with reflectors
- Expansion of the criteria to CFLs with candelabra (a smaller size screw-in base)

### What's different about ENERGY STAR® qualified lighting fixtures?

Light fixtures that have earned the ENERGY STAR® label combine quality and attractive design with high levels of energy efficiency. Qualified fixtures (ENERGY STAR®, n.d.-a):

- Use one-fourth the energy of traditional lighting;
- Last at least 10,000 hours (about seven years of regular use);
- Distribute light more efficiently and evenly than standard fixtures;
- Come in hundreds of decorative styles including portable fixtures (like desk lamps, for example) and hard-wired options such as front porch, dining room, kitchen ceiling and under-cabinet lighting, wall sconces, bathroom vanity fixtures, and more;
- Deliver convenient features such as dimming capability on some indoor models (fixture must have a dimming ballast to be dimmable), and automatic daylight shut-off and motion sensors on some outdoor models;
- Are available at most home centers, lighting showrooms, and specialty stores; and

- Carry a two-year warranty, double the industry standard.

### Should I turn off the fluorescent lights when I leave the room to save more?

Contrary to popular belief, turning off fluorescent lights really does save energy. Frequent switching may shorten bulb life, but electric bill savings will more than compensate for the shorter lifespan, especially if you end up using more fluorescents than incandescents. ENERGY STAR® (n.d.-b) recommends using fluorescent bulbs in fixtures that you tend to use for at least 15 minutes at a time or several hours a day for the most savings.

### I've heard that CFLs (like other fluorescent tubes) contain mercury—how do I dispose of them? What if I accidentally break one?

As a general rule of thumb, CFLs require special handling, so don't throw them away with the regular household trash. While CFLs can be recycled, they should not be thrown into your recycle bin either. Check <http://www.epa.gov/bulbrecycling> or <http://www.earth911.org> (or call 1-800-CLEAN-UP) to find disposal options by zip code, or contact your local waste-management agency for guidelines in your community. For current information on what to do and what *not* to do when a CFL is broken, refer to the Web sites

[http://www.energystar.gov/ia/partners/promotions/change\\_light/downloads/Fact\\_Sheet\\_Mercury.pdf](http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf)

and

<http://www.epa.gov/mercury/spills/index.htm#fluorescent>.

By using CFLs, you can reduce power demand that will help reduce mercury emissions from power plants. Mercury emissions in the air come from both natural and manufactured sources. Coal-fired power plants are the largest contributors because the naturally occurring mercury in the coal is released into the air when coal is burned to make electricity.

In fact, coal-fired power generation is responsible for about 40% of the mercury emissions in the United States (ENERGY STAR®, April 2008). While fluorescent bulbs do contain very small amounts of mercury—about the amount that would cover the tip of a ballpoint pen—it is sealed within the glass tubing and is not released when the CFL is intact or in use. Moreover, with proper handling, mercury in the CFLs can be recaptured through recycling.

U.S. Department of Energy. (n.d.). *How compact fluorescents compare with incandescents*. Retrieved April 16, 2008, from [http://www.eere.energy.gov/consumer/your\\_home/lighting\\_daylighting/index.cfm/mytopic=12060](http://www.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=12060)

University of Florida *Energy Efficient Building Construction in Florida*, SP 267, Gainesville, FL.

## References and Resources

Consortium for Energy Efficiency. (2007). *Residential lighting*. Retrieved April, 18, 2008, from <http://www.cee1.org/resrc/facts/rs-lt-fx.pdf>

ENERGY STAR®. (2008, April) *Frequently asked questions: Information on compact fluorescent light bulbs (CFLs) and Mercury*, April 2008. Retrieved May 5, 2008, from [http://www.energystar.gov/ia/partners/promotions/change\\_light/downloads/Fact\\_Sheet\\_Mercury.pdf](http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf)

ENERGY STAR®. (n.d.a). *Compact fluorescent light bulbs*. Retrieved April 16, 2008, from [http://www.energystar.gov/index.cfm?c=cfls.pr\\_cfls](http://www.energystar.gov/index.cfm?c=cfls.pr_cfls)

ENERGY STAR®. (n.d.b). *Residential light fixtures*. Retrieved April 16, 2008, from [http://www.energystar.gov/index.cfm?c=fixtures.pr\\_light\\_fixtures](http://www.energystar.gov/index.cfm?c=fixtures.pr_light_fixtures)

Toolbase Services (c/o NAHB Research Center). *Compact Fluorescent Lighting*. Retrieved May 5, 2008, from <http://www.toolbase.org/Technology-Inventory/Electrical-Electronics/full-spectrum-fluorescent-lamps>

U.S. Department of Energy. (2008a). *ENERGY STAR® program requirements for CFLs*. Retrieved April 16, 2008, from [http://www.energystar.gov/ia/partners/prod\\_development/revisions/downloads/cfls/Criteria\\_CFLs\\_V4.pdf](http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/cfls/Criteria_CFLs_V4.pdf)

U.S. Department of Energy. (2008b, March 7). *DOE sets new Energy Star criteria for washing machines and CFLs*. Retrieved April 16, 2008, from [http://www.eere.energy.gov/news/news\\_detail.cfm/news\\_id=11628](http://www.eere.energy.gov/news/news_detail.cfm/news_id=11628)

**Table 1.** Estimated Cost to Household Comparison: Incandescent Bulbs and Fluorescent Bulbs

| Light Output<br>(Lumens) | Bulb Type<br>& Energy Use | Bulb Purchasing<br>Cost <sup>A</sup> | Rated Life<br>(hours) | Energy Cost<br>for 10,000 hours<br>(at \$0.10/kWh) | Total Cost<br>for 10,000 hours<br>(Bulb + Energy) |
|--------------------------|---------------------------|--------------------------------------|-----------------------|--|---|
| 800                      | Incandescent: 60 watts    | \$1                                  | 1,000                 | \$60   | \$70  |
|                          | Fluorescent: 15 watts     | \$4.50                               | 10,000                | \$15   | \$19.50   |
| 1,200                    | Incandescent: 75 watts    | \$1                                  | 1,000                 | \$75   | \$85  |
|                          | Fluorescent: 20 watts     | \$4.50                               | 10,000                | \$20   | \$24.50   |
| 1,750                    | Incandescent: 100 watts   | \$1                                  | 1,000                 | \$100  | \$110   |
|                          | Fluorescent: 25 watts     | \$4.50                               | 10,000                | \$25   | \$29.50   |

<sup>A</sup> Estimated purchasing costs do not include taxes, shipping, handling fees, recycling fees, or travel expenses associated with acquisition of bulbs at point of purchase, nor do they include additional taxes, fees, or charges required by your utility provider. Note: Actual light output, bulb cost, and rated life vary by product. Utility rates vary by provider.