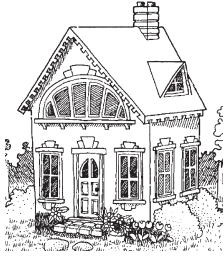


Home Energy Brief



#1 LIGHTING

Lighting uses about a fourth of all electricity used in the United States, consuming the energy produced by 120 large powerplants (about 4/5 directly and 1/5 in extra air conditioning energy to remove unwanted heat). By using the most efficient sources of electric light in the most effective ways, and by capturing more of the daylight reaching our homes and businesses, we can profitably save up to 90% of this electricity.

Lighting Efficiency

The visible light output of a source is measured in lumens. The power consumed by that source is measured in watts. The more lumens produced per watt consumed, the more efficient the light source. The standard incandescent light bulb, used in over 90% of residential lighting, is very inefficient, producing only 10–20 lumens per watt. The incandescent light bulb is so inefficient, in fact, that about 90% of the energy it consumes is given off as heat, while only 10% is converted into light. The incandescent light bulb is really an electric space heater that happens to give off a little light. Fluorescent lighting, on the other hand, produces 30–110 lumens per watt, typically yielding three to four times the amount of light for each watt it consumes.

Compact Fluorescents

The most significant development in lighting technology for homes in the past decade has been the compact fluorescent lamp (CFL). CFLs screw into ordinary sockets, provide incandescent-like color quality, last up to thirteen times as long as standard incandescents, and use one-quarter of the electricity to operate.

Don't be turned off because CFLs are fluorescent. The drawbacks some people associate with fluores-

cent tubes and older CFLs are primarily related to the type of ballast used to operate them and the quality of the phosphors that produce their light. New and improved phosphors provide much better color rendition than the old type, and can give the same warm, yellow light as incandescents if you wish.

A ballast is the device that starts and regulates fluorescent lights. Electromagnetic (core-coil) ballasts often take a couple of seconds to start CFLs, and may produce some noticeable lamp flicker and audible hum. (Ballasts typically last at least four times as long as lamps; electromagnetically ballasted CFLs are available in modular units that allow the lamp to be replaced; they also tend to be a bit less expensive than electronic ones.) More advanced and user-friendly CFLs are now available with electronic ballasts that solve all of the problems associated with electromagnetic ballasts, and are also more efficient. There are now over 500 kinds of CFLs on the U.S. market suitable for most applications except dimmers (and special models are needed for outdoors and very low temperatures). Many have globes, reflectors, or decorative diffusers.

Each incandescent bulb we replace with a CFL prevents the emission of 1,000–2,000 pounds of carbon dioxide from powerplants that leads to global warming, and 8 to 16 pounds of sulfur dioxide that causes acid rain. One CFL also eliminates the need to produce and dispose of up to a dozen incandescent bulbs. To sweeten the deal further, each CFL you install saves you roughly \$25–50 over the lifetime of the bulb. As Amory Lovins puts it, "This isn't a free lunch, it's a lunch you're paid to eat!"

Life-Cycle Cost

One of the first things most people notice about CFLs is their whopping price tag — "What? \$25 for

COMPACT FLUORESCENTS: CHEAPER IN THE LONG RUN

	Incandescent	Compact Fluorescent
Watts consumed	100W	27W
Rated lamp life (hours)	750 h	10,000 h
# lamps used over 10,000 hours	13	1
KWh used over 10,000 hours	1,000 kWh	270kWh
Cost of each kWh (average)	\$0.083	\$0.083
Operating cost per 10,000 hours	\$83.00	\$22.16
Cost per bulb (if labor is free)	\$0.75	\$25*
Bulb cost per 10,000 hours	\$9.75	\$25
Total life-cycle costs	\$92.75	\$47.41

Total savings from this one compact fluorescent = \$45.34

**The price of CFLs has come down dramatically, due to utility rebates improved manufacturing technology, and increased demand. It is now common to be able to buy CFLs for \$4-12 each with rebates. Check with your utility to see what rebates are available.*

a light bulb?" This brings us to the subject of life-cycle cost. Though some CFLs are available for much less, the above figure shows how purchasing a \$25 bulb can actually save you money. To get the best return on your investment, install CFLs in fixtures used at least two or three hours per day.

Tube Fluorescents

Standard fluorescent tube lighting has come a long way from the ghostly-toned, flickering, humming light often associated with it. Now, electronic ballasts eliminate flicker while reducing power consumption 25-40% compared to electromagnetic ballasts (high-performance electronic ballasts also eliminate hum.) Special tri-chromatic, rare-earth phosphors (also used in high-quality CFLs) solve the color rendering problem by producing a high quality light which shows colors accurately. Tubes are available in various warmer or cooler tones. Skinny "T-8" lamps, one inch in diameter, are the most efficient tubes, and are combined with special electronic ballasts and better reflectors and lenses to create state-of-the-art systems.

Halogens

Halogen lamps are "turbo-charged" incandescents which screw into standard sockets and are about 10% more efficient than standard incandescents. Often called "punchy," they emit a whiter light than stan-

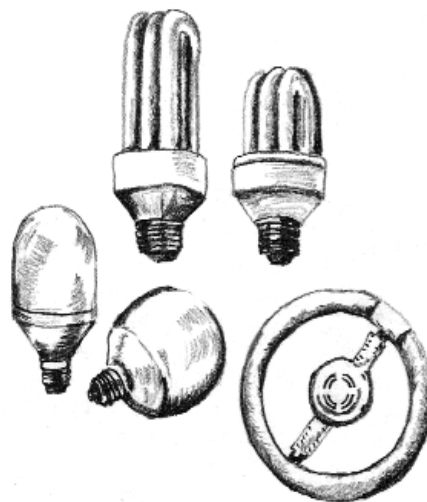
dard incandescents, making them a good choice for illuminating work requiring high visual acuity or where color rendition is important, such as lighting works of art. They are available in reflector flood, spotlight, and standard styles, and are dimmable. Halogens lose less than 10% of their brightness over their lifetimes, compared to 25% for standard incandescents.

Halogen-IR bulbs are even more efficient, using about half the electricity of standard incandescents, cost \$5-\$6 each, and last longer than normal incandescents.

Improved Incandescents

While compact fluorescents offer the greatest energy savings and longer life, you may prefer the lower initial cost of incandescent light bulbs for use in rooms where occupancy time is limited and frequent on-off cycles are typical. For bathrooms, closets, garages, and utility rooms there are some incandescents that can provide moderate energy savings.

Energy Choice, Watt Miser, Supersaver and Econo-Watt bulbs are incandescent lights being marketed by the major manufacturers that are simply lower-wattage bulbs. Such bulbs consume about 10% less electricity than standard incandescent bulbs. Of course, these bulbs are slightly dimmer but this may be comfortable and appropriate for many household lighting uses. Don't substitute two lower-wattage bulbs for one higher watt bulb, however, as this is less efficient. In a fixture that holds several bulbs, it is



Compact fluorescents come in a variety of styles. Clockwise from top: compact quads, a Circline unit, and globes.

more energy efficient to use a single higher-wattage bulb than two or more smaller wattage bulbs (but check the fixture for safe maximum wattage).

Philips Lighting has an innovative product, an “auto off” incandescent light bulb. This bulb has a built-in timer that automatically turns off the light after 30 minutes. The light bulb blinks a minute before it shuts off as a warning indicator and the off-command can be overridden by quickly switching the light off and on. Retail price of the Philips Auto Off bulb is in the \$5 range.

Long-life (2,000 to 5,000 hour) incandescents are less efficient than standard incandescent bulbs because their longer-lasting filaments use more electricity and put out less light. A lower cost incandescent is the 130-volt bulb. Putting one on a normal 120-volt circuit dims the bulb a little but extends service life to 2,000 hours compared to 750 hours for ordinary incandescents. There are also long-life 130-volt bulbs available, but if you want to get both long life and high efficiency, CFLs are still your best option.

Daylighting

Economics, health, and aesthetics all favor the maximum practical use of daylighting in our homes. Sunlight is free and uses no electricity. Until recent developments made windows much more energy-efficient, there was reason to minimize window area to reduce heating and cooling bills. But with current spectrally selective window technology, daylighting need not be at odds with space heating and cooling. In fact, using new superwindows, even a north-facing window in a cold climate can still be a net heat gainer, and contribute daylighting at the same time. (For more information on advanced windows, see “Windows” in this Home Energy Briefs series.)

In addition to using traditional windows for daylighting, clerestories, skylights, lightshelves, lightpipes, and atria represent other creative ways of bringing daylight into a building. Much of the art of practical daylighting lies in the use of simple architectural details such as wide window sills, louvers, walls, and other methods of bouncing light deep into a building. Use daylighting wherever practical before resorting to electric lighting.

Task Lighting

The standard practice of lighting a whole room to the highest level required to perform the most demanding visual tasks is almost as silly as refrigerating a whole house down to the temperature required to preserve perishable food, instead of just the box where it is kept. One of the simplest and most effective ways to save energy while enhancing lighting quality is to provide higher lighting levels only where they are needed, while lowering light levels in the rest of the room. Task lights, such as swing-arm lamps, allow users to direct light on the subject that requires it. They can spill light evenly across the papers on your desk, but stop just short of your computer screen to avoid glare. Many task lights are now available with built-in CFLs.

DIM AND SAVE

<i>Incandescent Lighting</i>	<i>Electricity Saved</i>	<i>Extends Lamp Life</i>
10% dimmed	5%	2 times
25% dimmed	15%	4 times
50% dimmed	30%	20 times
75% dimmed	50%	Over 20 times

Lighting Controls

Once you have maximized the use of daylight, focused lighting on the specific tasks for which it is required, replaced your most often-used incandescent lights with CFLs or halogens, and upgraded old style tube fluorescents with the much-improved new ones, its time to look at lighting controls such as dimmers, timers, and sensors. Controls ensure that lights are turned on only when and to what degree they are required.

Dimmers: Dimmers save energy and extend the life of incandescent bulbs as indicated below.

Unfortunately, ordinary compact fluorescents are not yet dimmable (though manufacturers are working on it). If you have any dimmer switches installed but use them only to turn lights on and off, you could save a lot more energy by replacing them with standard light switches and using CFLs of appropriate brightness.

Timers: Timers save energy simply by turning lights on and off at pre-designated times so they operate only when desired.

Sensors: Sensors also turn lights on only when they are needed but are more precise than timers

since they respond to actual conditions. Ultrasonic motion sensors turn lights on and off in response to movement; infrared sensors, in response to body heat; photosensors, when ambient light levels fall below and rise above preset levels.

More Efficiency Pointers

- **Finishes:** Paint and carpet rooms in lighter colors to reflect more light, enhance daylight distribution, and reduce the need for electric lighting.
- **Maintenance:** Periodically wash or wipe light fixture reflectors, diffusers, and/or lenses using the methods recommended by the manufacturer. Replace any components that have yellowed or lost their reflectivity.
- **Fixture selection:** If you use lamp shades, globes, or other diffusers, choose types that let the most light through while minimizing glare. The fixtures themselves, too, vary enormously in optical efficiency – some emit 92% of the light, other less than 30%. If possible, replace recessed ceiling fixtures with airtight “cans” to reduce moisture and air leakage.
- **Bulb selection:** If you have can-type downlights or track fixtures, be sure to use reflector type lamps in them. When standard bulbs are used in conventional can fixtures, more than 50% of the light can be trapped inside the fixture.

RESOURCES

Residential Lighting

CFLs and other efficient lighting products can sometimes be found at local retail outlets such as hardware

stores, discount stores, and lighting or electrical suppliers. Also, some utilities now offer CFLs for sale or lease to their customers at less-than-retail prices, so check with your local utility. If you can't obtain them locally, there are several mail order catalogs that offer a good selection:

Real Goods, 966 Mazzoni Street, Ukiah, CA 95482. (800/762-7325).

Ecological Innovations, 14 Tech Circle, Natick, MA 01760-1086. (800/876-0660).

Seventh Generation, 49 Hercules Drive, Colchester, VT 05446. (800/456-1177).

Commercial and Industrial Lighting

The potential for saving energy through efficient lighting retrofits in the commercial and industrial sectors is tremendous because lights are typically operated for so many hours each year. The energy dollars saved commonly pay for the cost of the retrofit very quickly; energy service companies and utilities will often finance such retrofits. Businesses can add to their bottom line while improving aesthetics and lighting quality. If you would like to learn more about efficient lighting retrofits, contact:

Green Lights, U.S. Environmental Protection Agency, 401 M Street SW (6202J), Washington, DC 20460. (202/775-6650).

National Association of Energy Service Companies, 1440 New York Avenue NW, Washington, DC 20005. (202/371-7980).

Rising Sun Enterprises, Inc., PO Box 1728, 40 Sunset Dr., #1, Basalt, CO 81621. (970/927-8051).

For more on window technologies, insulating solutions, and related home-energy measures, see Rocky Mountain Institute's forthcoming *Homemade Money: How to Save Energy and Dollars in Your Home*. Other titles in this series of Home Energy Briefs include *Windows*; *Water Heating*; *Refrigerators and Freezers*; *Cooking Appliances and Dishwashers*; *Washers, Dryers, and Miscellaneous Appliances*; and *Computers and Peripherals*. Written by Sue Hassol. © Rocky Mountain Institute 1994.

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