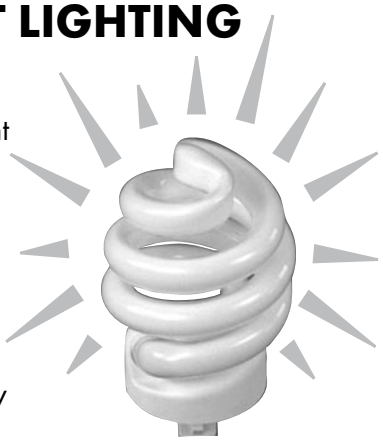
GREEN SEAL'S Green Chase REPORT

NOVEMBER–DECEMBER 1998

COMPACT FLUORESCENT LIGHTING



By switching from incandescent lighting to compact fluorescent lighting the average consumer can save 50 to 80% in energy costs without any loss in lighting quality.

The average compact fluorescent bulb lasts 8 to 10 times longer than any incandescent bulb.

Depending on the initial cost of the bulb, the Federal Trade Commission estimates that it costs $2.60 less per year to power a compact fluorescent bulb than an incandescent bulb. The full purchase price of the bulb will be paid back well within the 10 year life expectancy.

A BRIGHT IDEA!!

The world seems to find CFLs a wise investment. Global sales rose from 45 million in 1988 to 240 million units in 1995.

The current trend of global warming is mostly attributed to emissions of carbon dioxide from the burning of fossil fuels such as coal. To generate one Kilowatt-hour (kWh) of energy, approximately 2.5 pounds of carbon dioxide (CO_2) are emitted. One kWh is enough energy to run one 100 watt bulb for 10 hours.

Consider that the average home has approximately 34 sockets. If each socket is filled with a 100 watt bulb and is powered for 5 hours each day, 294 pounds of CO_2 are emitted into the atmosphere in one week!

Compact fluorescent bulbs are about 3 to 4 times more efficient than incandescent bulbs. Therefore if all 34 bulbs in our example were replaced with 30 watt compact fluorescent bulbs, only 95 pounds of CO_2 would be emitted into the atmosphere.

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The EPA estimates that nearly 25% of the energy needs in the US are dedicated to lighting. If more efficient lighting were to be installed in the majority of places, the US would cut down on particulate emissions of carbon dioxide, sulfur dioxide and nitrogen oxides by 240 million tons per year!

Compact Fluorescent Lamps (CFLs) have come a long way since their inception. CFLs of years past earned a bad name with inadequate technology. For this reason many people think of unnaturally bright lights and loud humming noises when they think of CFL lamps. Fortunately, CFL technology has greatly improved since those days. CFLs are becoming an increasingly wise choice, they yield quick savings on energy bills, emit less heat and allow lower cooling costs, and save on replacement labor costs. Consider that there are approximately 500 million incan-descent bulbs in US residential or business buildings using 75–150 Watts, this adds up to the energy produced in twenty 1000 MegaWatt power plants in a year! Imagine saving just 50% of that energy!

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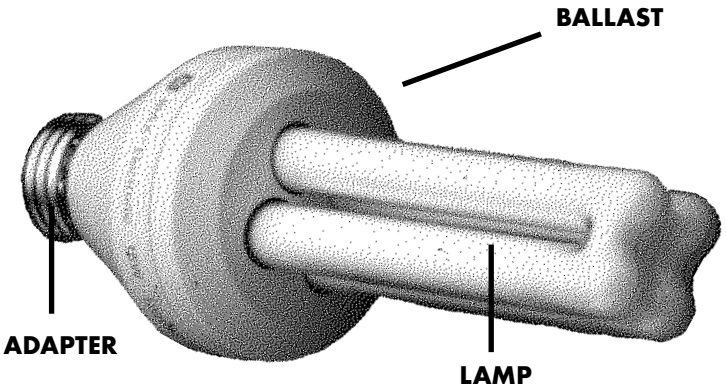
ANATOMY OF A CFL



QUAD LAMP. Quad-lamp, quad-tube, double biax, or in Philip Lighting's parlance, PL "clusters" or "PLC" lamps, pack four parallel tubes (or two U-shaped tubes with parallel legs) on the same base as twin tubes, and thus provide nearly the same light output as twin tubes of equivalent wattage in only half the length.
(Provided courtesy of E SOURCE)

System Design

A CFL can be found for just about every lighting need. They range in size from 4.5 to 22.5 inches, in power from 5 to 55 watts and in light output from 250 to 4,800 lumens. The average lifetime ranges from 8,000 to 20,000 hours based on three hour uses in each cycle.

A CFL can be found for just about every lighting need. They range in size, in power, and in light output.

Each CFL fixture has three key pieces, a lamp, a ballast and an adapter. To fully understand the different types of CFL systems available, each piece must first be defined.

■ ***Lamp***—the glass part of a light bulb that most people think of, but is specifically defined as a combination of electrodes, gasses and other electrical devices designed to provide artificial light through conversion from electricity.

■ ***Ballast***—a device used to convert electrical current into the voltage, amperage and waveform needed to operate the lamp.

■ ***Adapter***—the screw base of the light bulb, in the US it is the Edison base but can be found in other forms in different countries.

2-D. A relatively new addition in North America to the CFL family is the "2-D" or "double-D" lamp, first intro-duced in Europe in the mid-1980s and originally available only as an import. This lamp configuration is ideal for low-profile surface and recessed fixtures.
(Provided courtesy of E SOURCE)

Lighting Design

A new generation of electronic ballasts has hurdled CFL technology into the future. Previously, CFLs could only be used in magnetic ballasts which are bulky and often noisy on start up. But ballast manufacturers have developed electronic ballasts which lack the distinct humming noise of CFLs. These new ballasts can power more lamps, last longer, have a greater compatibility and some can also be dimmed. While these ballasts often cost more, they have a greater functionality and use less energy. For example, electronic ballast systems lose 20% less energy than those that are magnetically ballasted.

■ ***Integral units*** are probably the easiest type of replacement for incandescent fixtures because the three key pieces are combined together in one sealed unit. Unfortunately, when these burn out the whole unit must be discarded. Often maintenance crews replace the fixture with regular incandescent bulbs.

■ ***Modular units*** provide the ease of screw base bulbs without the need for disposal of the whole unit. These bulbs plug into a hardwired ballast/adapter unit. The only significant issue with this system is purchasing the proper bulb. The units have either two or four pin bases which cannot be interchanged.

■ ***Hardwired systems*** are a ballast and socket system permanently wired into a fixture. There is no screw base, eliminating the chance of interchange with incandescent bulbs. The bulbs are easily replaced when they burn out but as with Modular units, the consumer must choose the replace-ment bulb carefully.

A CFL FOR EVERY LIGHTING JOB

The graphics and descriptions of all the CFL lamps shown are provided courtesy of E SOURCE, an information services company providing organizations with unbiased, independent analysis of retail energy markets, services and technologies.

HELICAL. Perhaps the most unusual new twist in CFL lamp types is the helical shape being introduced by Duro-Lite under the name Spiral-Lite. This shape closely approaches the light distribution and physical dimensions of incandescent lamps by packing more luminous surface area into a tighter space.

TWIN-TUBE. First introduced to the U.S. market in 1981 under the Philips tradename of "PL," such designs consist of two straight, parallel, miniature fluorescent tubes (or one U-shaped tube with parallel legs) both ending side-by-side in a plug-in base that contains an integral starter. General Electric calls its family of such lamps Biax (short for "biaxial") and many people use this term generically. Sylvania called them "twin tubes." Osram Sylvania uses the original Osram trade name "Dulux." All of these terms describe the same two legged style of lamp.

OCT LAMP. The quadruple twin configuration, also known as "Performance Biax" or "Oct lamp" by General Electric, is available in 28-watt screw-in and 42-watt plug-in models. Though it increases light output per inch of lamp length, its design also traps a great deal of light inside, yielding diminishing efficiency returns.

TRIPLE-TWIN. To generate even more light from a shorter lamp, various manufacturers offer CFLs with three twin tubes. GE Lighting and Osram Sylvania cluster their triple tube lamps in a triangular or "delta" configuration. Other manufacturers, including Philips Lighting, offer triple tube lamps with three parallel arch-shaped curved tubes These products are often referred to as "triple biax" lamps.

The Lamp Choice

The proper choice of bulb type is important to ensure satisfaction with your choice of lighting. For this reason choosing the proper size, wattage and lumens is important but also sometimes tricky. In the past manufacturers stated that a CFL with 1/4 the wattage could replace an incandescent fixture and produce the same light output. However, a few initial disappointments with illumination forced the development of a more realistic rule of thumb, a 3:1 ratio. A CFL rated at 20 Watts can easily replace an incandescent of 60 Watts. Three specific issues must be reviewed to ensure proper lighting.

The ***Efficacy*** of a lamp is a measure of how much of the power going into the lamp is being converted into light. Efficacy is evaluated in lumens per watt.

A RULE OF THUMB— 3:1

A CFL with 1/3 the wattage can replace an incandescent fixture and produce the same light output.

Green Seal™ recommends the lamp efficacies in Table 1 for lamps without ballasts. For those self ballasted lamps or when lamps and ballasts are supplied together other recommendations are made (see Table 2).

TABLE 1

RECOMMENDED EFFICACIES FOR COMPACT FLUORESCENT LAMPS

Lamp Wattage (watt)	*Lamp Efficacy (lumens/watt)*
< 7 watt	40 lumens/watt
7 - 9 watt	50 lumens/watt
>9 - 13 watt	55 lumens/watt
>13 - 18 watt	60 lumens/watt
>18 watt	62 lumens/watt

TABLE 2

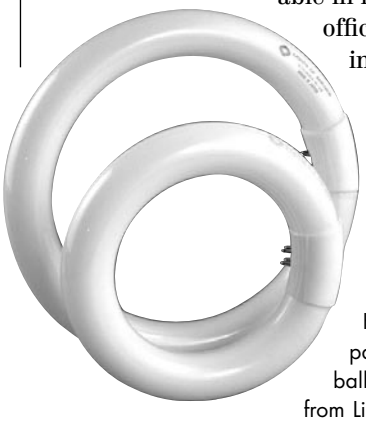
RECOMMENDED EFFICACIES FOR SELF BALLASTED LAMPS (or when lamps and ballasts are supplied together)

Lamp Wattage (watt)	*Lamp Efficacy (lumens/watt)*
< 10 watt	40 lumens/watt
10 - 15 watt	45 lumens/watt
> 15 watt	55 lumens/watt

The ***Color Temperature*** is another issue that was previously problematic for consumers. Four color temperatures are generally available, 2700 K, 3000 K, 3500 K and 4100 K. Depending on both the size and the manufacturer higher temperatures can be found. Lower temperatures provide a softer color that is more acceptable in lower lighting levels or an office maintaining soft lighting. The color associated with incandescent bulbs is approximated at 2700 K.

The ***Color Rendering Index*** (CRI) is a measure of a light source's ability to illuminate true colors. The CRI ranges from 1 to 100. A CRI of 80 or above indicates that the light source can reproduce colors accurately.

Utilities have been strongly promoting the switch to CFLs for years. However, various studies show that a market saturated with lower quality CFLs could cause a decrease in power quality. For this reason, Power Factor and Total Harmonic Distortion (THD) become decision factors, especially for businesses considering a total exchange of their



CIRCLINE. Circular (also known as "Circline") fluorescent lamps are not universally viewed as members of the CFL family. They came into use in the 1940s, and many of them utilize the same cool white phosphors as standard T12 lamps. However, at least one manufacturer—Lights of America—produces circular compact fluorescents with rare earth tristimulus phosphors and instant-on electronic ballasts in warm and cool color temperatures. The 20-, 22-, and 30-watt versions from Lights of America are among the few compact fluorescents that can replace 100- to 150-watt incandescents with comparable light output and still fit in residential reading lamps. Philips offers Circlines with rare earth phosphors but does not sell them with ballasts. (Provided courtesy of E SOURCE)

F-LAMP. The "F-Lamp" features two twin tubes aligned in a single plane, shoulder to shoulder. F-Lamps are well suited to task lights and low-profile surface and recessed fixtures. (Provided courtesy of E SOURCE)

incandescent fixtures for compact fluorescent systems. CFLs with a low power factor could cause a shift in the current, resulting in it going out of phase with the source voltage. A high THD can cause voltage distortion and ruin the power quality. Green Seal™ requires all Class A certified products to have a power factor greater than 0.9 and the THD to be less than 33%. This should prevent the degradation in power quality that can be associated with large amounts of end-use products, such as CFLs, on a specific power grid. It should be noted that consumers who place CFLs in their homes do not need to be greatly concerned with Power Factor or THD.

Dimming The Bulb

It has been difficult to find CFL fixtures which provided dimming capabilities in a cost effective and reliable manner. Now four pin CFLs with advanced electronic ballasts can be dimmed. Because the cost factor of implementing the technology in small wattage CFLs is the same as in large, manufac-turers have been hesitant to include the technology throughout their lines of products. Also, because special ballasts are needed for smooth dimming CFLs, only new or re-wired buildings are considered to be the applicable market. Since choosing dimming fixtures can cause the cost factor for the consumer to double, it may be easier to find alternative methods to lighting a room. However, market demand is slowly forcing manufacturers to produce some products that are both dimmable and cost efficient. Other manufacturers are producing three step dimming as an easier alternative since a re-wiring is not needed.

Mercury and Radioisotopes

Within each compact fluo-rescent lamp is a small amount of mercury needed to provide fluorescence. The Green Seal standard (GS-5) allows a maximum average of 10 milligrams per bulb. Of major concern is the possibility of leaking mercury into ground-water after break up in disposal. However, some studies suggest that the mercury is sputtered onto the glass throughout the lifetime of the bulb, binding it tightly with the surface. However, since less energy is needed for CFL use, less mercury containing coal is burned. This results in less total mercury being released for CFLs than for incandescent lamps. In fact, incandescent bulbs are responsible for releasing more than twice as much mercury into the environment than compact fluorescent bulbs.

Another concern is that some bulbs used in magnetic ballasts contain certain radioisotopes such as Krypton-85, Promethium-147 or Tritium. These compounds are used to provide initial ionization and aid starting. Green Seal prohibits the presence of any radioisotopes in certified CFLs.

Choosing the Right CFL

It may seem difficult to choose the right CFL without wasting money. But by examining your needs thoroughly and reviewing market availability, it should not be a trying experience. Look for testing and performance data from independent laboratories to insure truthful reporting.

When you know which CFL is right for you, contact your local utility company to inquire about rebate options, then request information or samples from some of the CFL manufacturers listed below. In all, remember that your investment will pay off both in economic and environmental value.

WHAT TO LOOK FOR IN A CFL

- ❑ A CFL lamp that uses 1/3 the wattage of your current incandescent bulb.
- ❑ A lamp that fits your shape, size and configuration requirements.
- ❑ An Efficacy meeting the minimum Green Seal guidelines
- ❑ A Color Temperature which replicates your current lighting.
- ❑ A system with a Power Factor equal to or greater than 90%.
- ❑ A system with a Total Harmonic Distortion Rating of 33% or less.
- ❑ A lamp with 10 mg or less of Mercury.
- ❑ A lamp without any radioisotopes.

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IN THIS ISSUE

WHAT'S THE REAL PRICE OF LIGHTING?

The real price of lighting is not simply its initial cost, but the cost of selecting, buying, installing, maintaining and operating the bulb system. This adds up to the life-cycle cost of using the lighting product. Converting your current incandescent lighting to compact fluorescent lighting can appear to be a costly matter at first glance. But determining and comparing the life-cycle costs can show that buying green lighting is actually cheaper in the end.

COMPARE THESE TWO LIGHTING OPTIONS OVER 10,000 HOURS OF USE

	Incandescent	Compact Fluorescent
Initial Costs (without labor)	$1.10 x 10 = $11.00	$15.00
Operating Costs	$8.00 x 10 = $80.00	$21.60
TOTAL LIFE-CYCLE COST:	**$91.00**	**$36.60**