

Compact fluorescent lamps (CFL)



A **compact fluorescent lamp (CFL)**, also known as a **compact fluorescent light** or **energy saving light**, is a type of fluorescent lamp. Most CFLs are designed to replace incandescent lamps and fit into most existing light fixtures.

Compared to general service incandescent lamps giving the same amount of visible light, CFLs use less power and have a longer rated life. Downside is they have a higher purchase price. Like all fluorescent lamps, CFLs contain mercury, which complicates their disposal.

CFLs radiate a different light spectrum compared to incandescent lamps. New phosphor compositions have improved the colour of the light emitted by CFLs in such a way that the best warm white CFLs are nearly similar in colour to standard incandescent lamps.

The power output mentioned on CFLs can be compared to incandescent lamps according to the following table:

Incandescent lamp	CFL
25 W	5 W
40 W	8 W
60 W	12 W
75 W	15 W
100 W	20 W

Parts

There are two main parts in a CFL: the gas-filled tube and the magnetic or electronic ballast. An electrical current from the ballast flows through the gas (mercury vapour), causing it to emit ultraviolet light. The ultraviolet light then excites a phosphor coating on the inside of the tube. This coating emits visible light.

Standard CFLs do not respond well in dimming applications and special lamps are needed when dimming is required.

Notes: CFLs that flicker when they start have magnetic ballasts
CFLs with electronic ballasts are more common

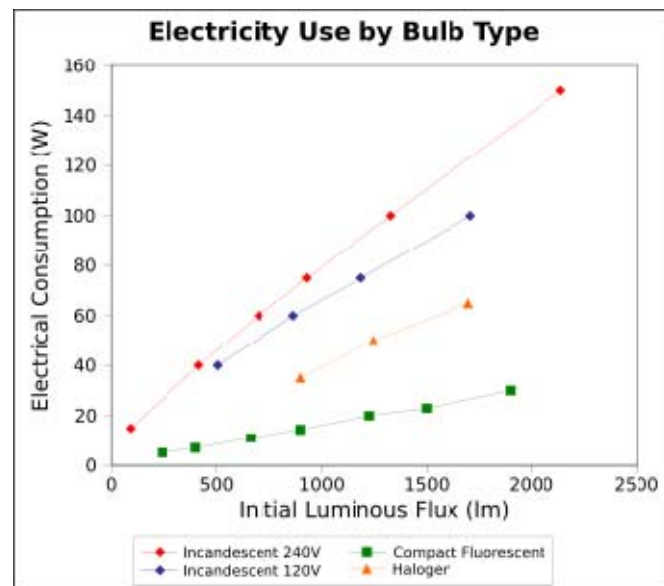
Comparison with incandescent lamps

Lifespan

The average rated life of a CFL is between 8 and 12 times that of incandescent lamps. CFLs typically have a rated lifespan of between 6.000 and 10.000 hours, whereas incandescent lamps usually have a lifespan of 750 hours or 1.000 hours.

CFLs produce less light with aging. The light output decay is exponential, with the fastest losses being soon after the lamp is first used. By the end of their lives, CFLs can be expected to produce about 70–80% of their original light output.

Energy efficiency



The chart shows the energy usage for different types of light bulbs operating at different light outputs. Points lower on the graph correspond to lower energy use.

For a given light output, CFLs use 20% to 33% of the power of an equivalent incandescent lamps.

Cost

While the purchase price of an integrated CFL is typically 3 to 10 times higher than that of an equivalent incandescent lamp, the extended lifetime and lower energy use will more than compensate for the higher initial cost.

Starting time

Incandescent lamps reach full brightness a fraction of a second after being switched on. As of 2009, CFLs turn on within a second, but may still take time to warm up to full brightness. Some CFLs are marketed as "instant on" and have no noticeable warming-up period, but others can take up to a minute to reach full brightness, or longer in very cold environments.

Spectrum of light

The light of CFLs is emitted by a mix of phosphors on the inside of the tube, each emitting a different colour. Modern phosphor designs are a compromise between the shade of the emitted light, energy efficiency and cost.

Colour temperature is mostly indicated in Kelvin

Color temperature	kelvin
'Warm white' or 'Soft white'	≤ 3000 K
'White' or 'Bright White'	3500 K
'Cool white'	4000 K
'Daylight'	≥ 5000 K

Colour temperature is a quantitative measure. The higher the number in Kelvin the 'cooler' (bluer) the shade will be.

CFLs are also produced in other colours:

- Red, green, orange, blue, and pink, primarily for novelty purposes
- Blue for phototherapy
- Yellow, for outdoor lighting, because it does not attract insects
- Black light (UV light) for special effects

Design and application issues



A spiral-type integrated compact fluorescent lamp, with combined tube and electronic ballast. This style has slightly reduced efficiency compared to tubular fluorescent lamps, due to the excessively thick layer of phosphor on the lower side of the twist. Despite this, it has become one of the most popular types among consumers since its introduction in the mid 1990's.

The primary objectives of CFL design are high electrical efficiency and durability. However, there are some other areas of CFL design and operation that are problematic:

Size

CFL light output is roughly proportional to phosphor surface area and high output CFLs are often larger than their incandescent equivalents. This means that the CFL may not fit well in existing light fixtures.

Dimming

Only some CFL lamps are labelled for dimming control. Using regular CFLs with a dimmer is ineffective at dimming, can shorten bulb life and will void the warranty of certain manufacturers. However, dimmable CFLs are available. The dimming range of CFLs is usually between 20% and 90%. Dimmable CFLs are not a 100% replacement for incandescent fixtures that are dimmed for "mood scenes" such as wall sconces in a dining area. Below the 20% limit, the lamp remains at the approximate 20% level, in other cases it may flicker or the starter circuitry may stop and restart. Above the 80% dim limit, the bulb will generally glow at 100% brightness. Dimmable CFLs have a higher purchase cost than standard CFLs due to the additional circuitry required for dimming. A further limitation is that multiple dimmable CFLs on the same dimmer switch may not appear to be at the same brightness level.

Perceived Coldness of Low Intensity CFL

When a CFL is dimmed the colour temperature (warmth) stays the same. This is different from most other light sources (such as the sun or incandescent lamps) where colour gets warmer as the light source gets dimmer. Emotional Response Testing suggests that people find dim, bluish light sources to be cold or even sinister. This may explain the persistent lack of popularity for CFLs in bedrooms and other settings where a subdued light source is preferred.

Time to achieve full brightness

Compact fluorescent lamps may provide as little as 50–80% of their rated light output at initial switch on and can take up to three minutes to warm up, and colour cast may be slightly different immediately after being turned on. This compares to around 0.1 seconds for incandescent lamps. In practice, this varies between brands/types. It is more of a problem with older lamps, 'warm (colour) tone' lamps and at low ambient temperatures.

Outdoor use

CFLs that are not designed for outdoor use will not start in cold weather. CFLs are available with cold-weather ballasts, which may be rated to as low as -23°C. Standard compact fluorescents will fail to operate at low temperatures. Light output drops at low temperatures.

Efforts to encourage adoption

Due to the potential to reduce electric consumption and pollution various organizations have encouraged the adoption of CFLs and other efficient lighting. Efforts range from publicity to encourage awareness, to direct handouts of CFLs to the public. Some electric utilities and local governments have subsidized CFLs or provided them free to customers as a means of reducing electricity demands (and so delaying additional investments in generation).

At the meeting of the Ecodesign Regulatory Committee in Brussels on December 8, 2008, the European Union Member States experts approved the European Commissions' proposals for a regulation progressively phasing out incandescent bulbs starting in 2009 and finishing at the end of 2012 as shown below. By switching to energy saving bulbs, EU citizens will apparently save almost 40 TWh (almost 11 million European households electricity consumption), which may lead to a reduction of about 15 million tons of CO₂ emission per year.

Starting September 2009		2009	2010	2011	2012	2013	2014	2015	2016	2017
Incandescent bulbs	Clear lamps	15 W	15 W	15 W	phase out of all clear lamps					
		25 W	25 W	25 W						
		40 W	40 W	40 W						
		60 W								
		75 W	75 W	75 W						
		100 W	100 W	100 W						
Incandescent bulbs		all frost lamps should be replaced by CFL's with enery class A								
Frost lamps										

