



# LED lighting



## what is it?

LEDs (light-emitting diodes) are semi-conductors that emit light via electroluminescence. An electric current is passed through the semi-conductor, whose electrons are agitated and emit light in the form of photons. This doesn't involve very much heat (and the heat that is generated is dissipated), so LEDs are cool to the touch, even when illuminated. They differ from other light sources in the following ways:

- Traditional incandescent light bulbs give off light in the form of electromagnetic radiation from a filament, simply because it's hot.
- Halogen lamps work on the same principle as ordinary incandescent bulbs, but with a tungsten filament and filled with a halogen gas which stops the tungsten deteriorating; they are smaller, hotter, brighter and last longer than incandescent bulbs.
- In fluorescent lighting, electricity excites mercury vapour in a tube, which emits short-wave radiation that makes a phosphor coating on the inside of the tube glow.
- Compact fluorescent lamps (CFLs) were the first wave of energy-saving bulbs, that work on the same principle as fluorescent lighting; their tubes are smaller and bent so that the lamps fit into standard incandescent light fittings.

LED lighting takes energy saving a step further.

## History

Light emission from semi-conductors had been known about since the turn of the 20th century, but it wasn't until the 1960s that the first visible red LED was developed. Other coloured LED lights were developed over the following years but the level of illumination that they provided was fairly low. In the 1970s, brighter LEDs were developed and used in fibre optics. LEDs began to be used in displays but you needed thousands gathered together to make a difference to the surrounding light. This continued to be an issue until the 21st century, when ways to produce more light from a single bulb were found.

LEDs for homes and businesses are now available everywhere, and represent the foreseeable future of lighting, until something more energy- and cost-effective is invented (or we learn to see in the dark).

LED lighting is now increasingly being used outside. Councils are turning to LED street lighting to reduce costs, and sports clubs are changing their floodlights to lower their carbon emissions and improve lighting conditions. They are used more and more for vehicle lights too.

## what are the benefits?

**Environmental:** LED lights use less electricity - up to 90% less if replacing filament bulbs and up to 30% if replacing CFL or fluorescent ones. They last much longer too - they'll outlast a CFL bulb by about five times (and an incandescent bulb by at least 20 times). You can expect good-quality bulbs to last for more than 20 years.

They don't require mercury, like CFLs, but although they contain arsenic and lead (less so the whiter the light), they're less of a toxicity hazard than fluorescent lights.

**Cost:** you can expect to pay about £10 for a single bulb on average, but prices are falling and, if you take into account their longevity and low energy usage, they're more efficient and more cost-effective than other bulbs, despite the initial outlay. If a £10 LED bulb lasts 5 times as long as a CFL bulb which costs £2 you are already on a par. Add in the electricity cost savings and you can see the overall benefit. According to GMI Energy, replacing 40 58W fluorescent strip lights with 40 20W LED lights can save in excess of £1,300 a year on utility bills for a business.

Very roughly, replacing filament bulbs with LEDs is likely to save you at least £10 per year per bulb, if used for around 4 hours per day.

**Effectiveness:** LEDs give out their light immediately - you don't get that period when they are warming up before you get full illumination.

LEDs come in a wider range of colours than other lights. For offices or shops, they can give very bright, white light, but in the home, you might want to ask for a 'warm' white or yellowish hue (around 2700 kelvin). Friends may be reticent because of memories of trying earlier LED bulbs that produced a weak, pasty, puddle of light. Show them that LEDs have changed.



*Light-emitting diode.*



## what can I do?

**Fittings:** you don't have to change your fittings - LEDs come in screw fitting and bayonet as standard, for ceiling, wall or desk lights. If you're replacing halogen bulbs with two little pins, you can find LEDs to replace them too. They might be low-voltage bulbs though (for off-grid / battery systems) - so talk with the retailer if you're unsure. Changing fluorescent strips can be more of an issue. Some LED strip lights fit into fluorescent tube fittings, but others will need an electrician to do a bit of work first - again, talk to your retailer.

**Brightness:** check lumens for brightness, not wattage, which tells you how much energy the bulb is using, not its brightness. A typical 60-watt incandescent bulb will give 800 lumens, but an LED light will give the same brightness for around 10 watts. A 100-watt incandescent bulb and a 25-watt LED will both give around 1600 lumens.

**Buying LEDs:** LED lighting is now widely available. You can buy online but it's essential to buy quality. Read reviews and choose a reputable supplier or brand before you settle on a particular product. In the end, it's worth paying a bit extra for a bulb that actually does the job you want it to do. You can change to LEDs in each room as and when you can afford it. Replace bulbs that are used most first - you'll save more that way. It may be worthwhile replacing existing bulbs with LEDs rather than waiting for them to die, because you will almost definitely save more energy than the



LED bulbs come in a huge range of styles, shapes and sizes.

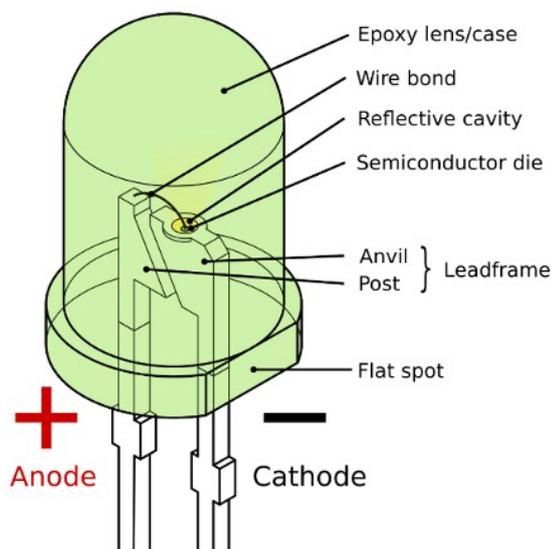
embodied energy already in the existing bulbs. You can also buy low-voltage LED bulbs for off-grid / battery systems.

**Installing and using LEDs:** LEDs do produce some heat, but it's dissipated so the bulb stays cool. This means that LEDs might not be ideal for enclosed spaces, where they might not be able to dissipate the heat.

LED bulbs are now being developed that will work with dimmer switches - ask when you buy. If your LED isn't compatible with a dimmer, it will cause problems such as buzzing and flickering. Currently, non-intensive livestock farmers can benefit from government grants to install LED lighting in buildings used to house livestock.

## resources

- see [lowimpact.org/led-lighting](http://lowimpact.org/led-lighting) for more info, products, links & books, including:
- Simon Marlow, *LED lighting for your home & business*
- Sal Cangeloso, *LED lighting*
- R N Soar, *50 simple LED circuits*
- [ledjournal.com](http://ledjournal.com), enewsletter on the LED industry
- [jillgoulder.plus.com/green/LEDlighting.pdf](http://jillgoulder.plus.com/green/LEDlighting.pdf) - beginner's guide
- [cnet.com/uk/how-to/five-things-to-consider-before-buying-led-bulbs](http://cnet.com/uk/how-to/five-things-to-consider-before-buying-led-bulbs) - things to consider
- [cnet.com/uk/news/appliance-science-how-led-lights-work](http://cnet.com/uk/news/appliance-science-how-led-lights-work) - the physics behind LED lighting



LED basic design.

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