How do electric lights work?

The old incandescent lights work by running the electricity through a very thin piece of wire so it gets hot and glows. The glass bulb protects the wire from physical damage and also contains a vacuum or inert gases so the wire doesn't simply burn up. They are however very fragile and inefficient and don't have a very long lifetime. Most of the electricity is converted to heat instead of visible light.

Fluorescent lights work by having the right conditions inside a glass tube to create and maintain a giant spark. A coating of chemicals inside the tube absorbs the (mostly UV) light from the spark and converts it to visible wavelengths. They are much more efficient and long lasting than incandescents, but still very fragile and physically large.

Light-Emitting Diodes are a semiconductor light source. They are based on the same kind of technologies as computer chips, where a very pure crystal of a substance is 'doped' with tiny amounts of other substances that change the characteristics. (This is quite a complex area that you can research if it interests you.) They are the opposite of a solar panel, where light is absorbed by a semiconductor and converted into electricity. LEDs are known as solid-state lighting because they are a solid substance rather than thin wires or tubes. As a result they can be very physically robust and long lasting.

Because LEDs are so much more efficient they produce much less heat than other technologies and they are also physically very small, meaning they can be used in many situations that were previously impossible. The little bit of heat they produce is very concentrated in the small chip area though, so if it's not drawn away it will overheat and fail, making heat management very important for LEDs.

The EnviroShop supplies a range of efficient lighting and we have the knowledge to help you choose the right product for your application.

Call or drop in to discuss the options.

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Energy • Sustainability • Efficiency

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EFFICIENT LIGHTING

Lighting has come a long way in the last decade or two, with efficiency gains eclipsing any other technology.

Lighting used to be a significant energy user in the home, but now with affordable LED lighting using up to 90% less energy than the old incandescent light bulbs it's very simple to make it a tiny portion of your bill. There's still quite a few aspects worth knowing about to make sure you get the right results and don't go compromising other areas of your energy efficiency.

What is wrong with downlights?

Downlights have been the default domestic lighting in Australia in the last 3 or 4 decades. However, there are many issues with them. Until recently they've used halogen lamps. Most used 12 Volt transformers, which confused many people into thinking they were lower power than 240 Volt lighting, but they actually used 50 Watts per lamp just to light up a couple of square metres of floor. With 4 – 6 in a typical room this meant 200 – 300W to achieve lighting that could usually be bettered with a single 100W light bulb in a pendant fitting.

There's also a serious fire danger from halogen lamps running hot enough to set fire to insulation and timbers in your roof cavity. This means large insulation clearances are required around halogen downlights, and the heat rising off the lamps would actively draw air through gaps in the light fitting, amplifying the heat losses.

The most common solution in the past was to simply replace the halogen bulb with an LED bulb of similar size, shape and light output. The benefits are lower upfront cost and easy DIY changeover. The downsides are that there are engineering limitations on the LED when you're cramming it into a halogen sized package, there are often compatibility issues with the halogen transformer, they often have large ventilation holes making them draughtier than a halogen lamp, and regulations say that if it is possible to revert to a halogen lamp in the fitting then it must be treated as such, with the large safety gaps in insulation etc.

A better way is to replace the entire fitting with a dedicated LED fitting. You get a better LED with no transformer issues and you can insulate right up to or even over the fitting, depending on it's rating. The downside is you're paying a little more and you need an electrician to swap the fittings over.

The best solution is to remove all of the downlights, patch the holes and repaint then redo your lighting design from scratch. You can achieve a much better overall result for lighting and insulation. If you're interested in this path give us a call or an email to talk about the possibilities. If you're capable and willing to do the patching and painting yourself the costs are often similar to replacing with LED downlights, due to less fittings being required overall.

Lighting Design

There are three main layers of lighting design:

1. Ambient Lighting

- To enable you to move around the space safely
- To make the room feel comfortable

Ambient lighting should generally be diffused and directed mostly at the ceiling and walls, where it is efficiently reflected back into the room. If the ceiling is well lit it feels psychologically comfortable at low light levels.

2. Task Lighting

- To light areas where tasks are being performed

Higher light levels are required for task areas such as kitchens, bathrooms, studies etc. You need to be careful of glare and shadowing affecting the work area.

3. Highlighting

- To highlight features such as artwork or architecture

Light and the contrast of shadows can really bring out features in your home, or distract from less interesting areas.

- A particular light fitting may actually fall into all three categories, but you`must ensure that all layers of lighting have been addressed when designing lighting layouts.

Dimmers

Dimmers have a minimum load, below which they tend to flicker. You *must* use dimmable LEDs if you have a dimmer. They are specially designed to 'trick the dimmer into thinking it has a higher load. Older dimmers have a fairly high maximum load, newer dimmers have been designed for modern high-efficiency lighting and behave much better.

TYPICAL LIGHT OUTPUTS

WATTS	LUMENS	
TUNGSTEN INCANDESCENT (OLD LIGHT BULBS)		
25	250	(180 - 375)
40	400	(280 - 600)
60	600	(420 - 900)
75	750	(525 - 1100)
100	1000	(700 - 1500)
MR16 HALOGEN (OLD SPOTS AND DOWNLIGHTS)		
20	130 - 250	
35	350 - 550	
50	550 - 900	
FLUORESCENT TUBES		
18W T8	1500	
36W T8	3500	
14W T5	1350	
28W T5	2900	

EFFICIENCY

(LUMENS/WATT)

LIGHT SOURCE	L/W
CANDLE	< 1
TUNGSTEN LAMP	7 - 15
HALOGEN LAMP	15 - 24
MERCURY VAPOUR	35 - 65
COMPACT FLUORO	45 - 75
FLUORO TUBE	60 - 120
METAL HALIDE	60 - 120
LOW PRESSURE SODIUM	100 - 200
LED	50 - 150+

Lumens

We've traditionaly measured light bulb brightness in watts. However, this is actually a measure of the electricity being used by it, not the light output. Because the efficiency has been largely unchanged for nearly 100 years this has been fine, but with increasing efficiency it's no longer a valid way to compare light output. Lumens is actually the measure of light output, and how you should compare light bulbs of differing technologies. See the table for some typical lumen values.

CRI

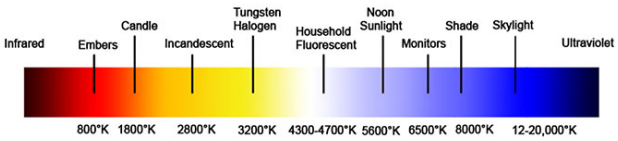
CRI, or Colour Rendering Index, is a standardised system for measuring the colour accuracy of light sources. It ranges up to 100 ('perfect', within the limited range of colours being measured by the system).

Sunlight is 100, the yellow sodium road lamps have a *negative* CRI (but are very efficient!). Old fluoro tubes were around 50, with modern ones capable of very high CRI.

LEDs range from terrible (when efficiency is more important than accuracy) through to excellent, with some having a CRI of 95+. Most of the LEDs commonly available are 80 - 85 CRI, which is good. If you are a professional photographer, artist or otherwise colour-fussy person you will need higher CRI lamps though.

Colour Temperature

Colour temperature is a measure of the 'colour' of white light. It is measured in K, (degrees Kelvin) and indicates the temperature a theoretical perfect object would be at to emit that colour of light. Imagine a piece of metal in a fire glowing red, then orange, then white hot.



- Lower colour temperatures are 'warmer' with an orange tinge, with typical home lighting being 3000K or less.
- Neutral white is typically 4000K, with cool white being around 5000K.
- Daylight has a definite blue tinge, and is typically 6000K+