# How to Implement LED lighting

Light emitting diodes (LEDs) are an exciting new technology; this guide considers their use when replacing existing lighting schemes.

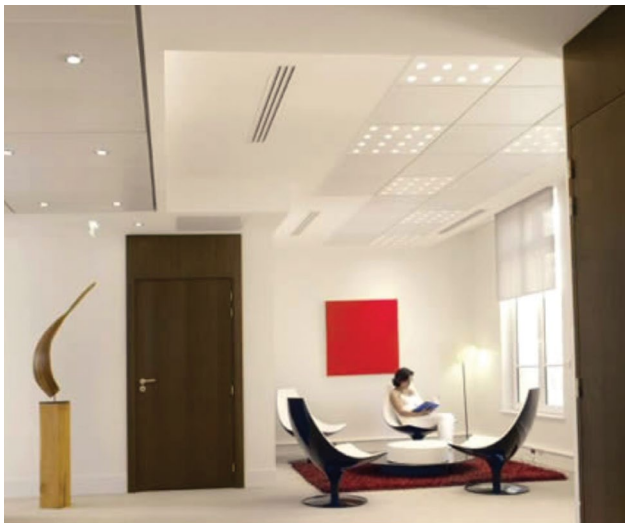


Image courtesy of Philips Lighting

## Introduction

The quality of artificial lighting is one of the most important influences on performance in the work place.

Some 80% of our sensory input at work comes through our eyes. Compromising our vision is, therefore, not an option when considering energy efficiency measures.

## What are LEDs?

Light emitting diodes (LEDs) are a relatively new light source that can offer improved energy efficiency in a number of applications. They are a solid state device that can be easily included in an electronic circuit.

Their recent emergence as a practical light source has brought a number of new companies into the lighting market. As a consequence not all of these businesses have experience in the main stream lighting market and widely differing claims about performance and suitability are common.

LEDs have also gained a reputation for being the most energy efficient form of lighting, which is currently not true. Both fluorescent and some high intensity discharge lamps can still better the performance of LEDs and probably at a lower cost.

Therefore working with a supplier that understands the principles of good lighting will ensure that you get solutions that are energy effective and meet your organisational requirements.

Our Lighting Technology Overview (CTV049) is a great place to start if you want to understand what lighting technologies are available, when they should be used and how effective they are.

## What are the benefits?

LEDs do have a number of benefits when compared to some other light sources.

LEDs are very compact, almost point sources, of light. As a result they are good for directional or spotlighting applications. Currently LEDs use at least 80% less electricity than an equivalent tungsten halogen source. However, they still struggle to match the overall performance of a good ceramic metal halide (CDM) lamp.

LEDs perform very well in a cold environment and are well suited to use in refrigerated display cabinets. In these applications they have successfully supplanted fluorescent lighting technology and delivered savings in the order of 75% when the reduced cooling load is taken into consideration.

A properly engineered LED light has a comparatively long life, typically in the order of 50,000 hours. This can reduce maintenance costs significantly depending on the light source they are replacing.

However LEDs can be used in other ways that are closer to the needs of general lighting. LEDs can be produced in a form called a 'light engine' which broadens their appeal by making them less of a point source.

Whatever the application, though, the use of LEDs should not compromise good lighting design principles and criteria.

**LED lighting being used at Sainsbury's**

Image courtesy of Philips Lighting

White LEDs are available in a wide range of colour temperatures and generally the cooler versions are more efficient. A white LED may also have a very good CRI (colour rendering index). They are, therefore, well suited to replace some fluorescent lighting schemes so long as the CRI is >80.

## Coloured lighting

Traditionally coloured lighting has been produced by using gels or filters applied to white light sources. These filters are generally very inefficient and can reduce light output by as much as 80%.

LEDs are available in a range of saturated colours – red, blue and green being the most commonly used. As a result large improvements in efficacy can be achieved where coloured lighting is required.

Some fixtures contain red, green and blue LEDs in order to allow colour changing. Such a fixture can also produce white light when all three colours are used.

**LEDs can be switched on and off frequently without reducing their life. They will also come on instantly.**

## What technology is available?

There are two main streams of solid state lighting; Lighting Emitting Diodes (LEDs) and Organic LEDs (OLEDs). This document only considers LEDs. OLEDs are still in their infancy and currently unsuited to general lighting applications.

LEDs have been developed for lighting in a number of ways. Manufacturers have sought to produce both replacements for existing lamp forms and to develop completely new luminaires.

Images courtesy of Osram Lighting

LED products have been designed to replace a wide range of display and directional lamps, especially tungsten halogen lamps. These retrofit solutions use the existing lamp holder and fixture. Often they may be fitted by anyone able to replace a 'bulb'.

These replacement lamps are, in effect, almost complete light fixtures because they combine a light source, power supply, optics and heat management components. As a result they are generally more expensive but they can last up to 35,000 hours; or at least 10x as long as the incandescent lamp they have replaced.

Life will be influenced by the quality of the thermal management; in smaller lamps life may be reduced to 25,000 hours to achieve a practical solution. If the LED lamp does not dissipate heat well then life will be short.

The LED replacement lamp market extends beyond directional and display halogen lamp fixtures. There are also LED versions of traditional GLS bulbs and candle lamps. Some LED lamps are not easily dimmed; check compatibility or test them. Such a test will also prove that the LED lamp really is equivalent to the halogen one it is replacing.

There are also LED lamps designed to replace fluorescent tubes but these are the subject of separate advice: see How to implement T5 lighting retrofits (CTL165).

### Luminaires

The fact that LEDs require good thermal design to preserve their long life and performance means that they are more suited to inclusion in purpose designed luminaires and light engines.

A fixture designed specifically for LED technology will offer the best performance and life expectation – usually no less than 50,000 hours. Some of these designs use modular light engines to provide a more sustainable approach so that only this component needs to be replaced at end of life. This preserves much of the mechanical fixture (housing, optics etc.) so that waste is minimised.

Some LED downlights are now more energy efficient than those based on compact fluorescent lamps.

Image courtesy of Philips Lighting

## What are the options?

### Retrofit

LEDs can readily replace most display and directional lighting. However, some consideration needs to be given to the existing fixture. If the current lamp operates at 12V dc it will be supplied by a transformer. Some LED replacements claim compatibility with existing control gear but a trial should always be carried out.

Suppliers may offer their lamps with either new gear or may suggest changing the fixture from low voltage to mains operation based on the application. These approaches avoid compatibility issues.

**Try LEDs before you buy, and prove they are both suitable and compatible.**

It is important to check how the current lighting is controlled. Many display lighting schemes are operated by dimmers and the change in the load from the simple, resistive incandescent to electronic LEDs may be incompatible. The marked reduction in the load (Watts) can also upset some dimmers.

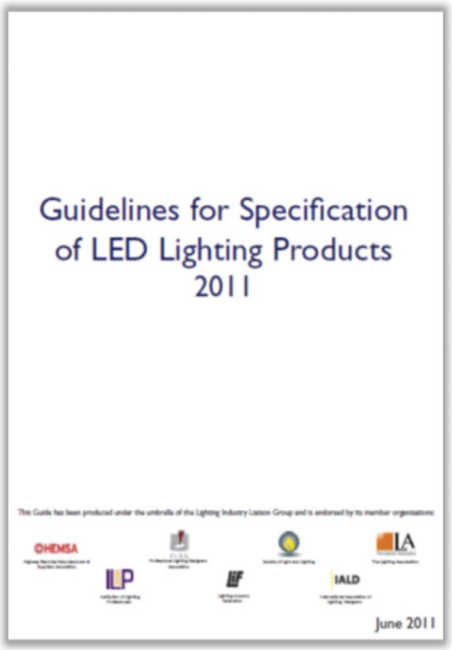
### Renew (Renovate)

Lighting refurbishments are well worth considering if your existing lighting is more than 10 years old. See How to implement lighting refurbishments (CTL163).

Although generally more expensive than conventional luminaires there may be good reasons to choose new LED luminaires in some applications, e.g. in hard to access areas.

Renewal of luminaires may be a direct one-to-one replacement or a complete re-design. In either case it is worth consulting a qualified, or experienced, person to check that the solution meets your needs. Renewal also offers an excellent opportunity to either introduce or to improve your lighting controls. See How to implement lighting controls (CTL161).

Whichever choice is made – retrofit or renewal – it is well worth obtaining a copy of the Guidelines for Specification of LED Lighting Products 2011 publication. It is free to download and is supported by all the UK's lighting bodies.



## How to get LEDs installed

Even though most LED replacement lamps appear to be suitable for anyone competent to change light bulbs it is recommended that you use a qualified electrician or engineer. Ask your supplier to create a proposal that details:

- The number of lights being replaced.
- Whether it is like for like or changes (e.g. more or fewer fittings, switching luminaires etc).
- Power use of existing and new lighting, with an estimate of the saving, and the cost and the payback vs current system.
- Expected performance in terms of light levels, colour etc vs existing lighting.
- Whether any new controls are desirable/required.
- Commisioning/operational details.

Involving any staff that might be affected by the new lighting, is likely to lead to better working conditions, and seeking their opinions, will avoid employee resistance later on.

**There may be an intangible return on investment, like improved productivity or increased sales.**

## The business case

Making the business case for low energy lighting is quite straightforward in terms of electricity saved v. investment required.

Calculating the potential savings is based on identifying:

- The current lighting load. (Watts or kiloWatts)
- The hours of use per annum.
- The new LED lighting load.
- The unit rate you pay for each kWh of electricity.

First multiply the existing lighting load by the hours of use. This will give the number of kWhs used each year; multiply this by the unit rate and divide by 100 to give the annual cost in £. Do the same calculation for the new lighting. Subtract the new lighting cost from the old and this gives the annual savings in £. This figure can then be compared to the investment and a payback calculated.

If the LEDs have a longer life than the previous lamps there may be further quantifiable savings in lamp costs over their lifetime, and maintenance.

## Check list

1. Consider reading the Lighting Technology Overview (CTV049).
2. Understand the lighting needs of your application.
3. For a major scheme, consider a qualified lighting advisor/consultant.
4. Keep any affected staff informed.
5. Present a well worked business case.
6. On approval obtain alternative quotations from a number of suppliers.
7. Place the contract with the bidder you trust the most; the lowest bid may not be the best.
8. Ensure the new lighting is properly commissioned.
9. Make sure the new installation is properly maintained.


Commissioning Code L available from www.cibse.org

## Common problems & finding suppliers

### Common problems

**The new LEDs lamps are flickering.**

Check the control gear is compatible. If necessary change to dedicated LED drivers. Can we change one or two bulbs before changing them all?

**The new lighting is not bright enough.**

The supplier's claims for 'equivalence' are wrong or the loss of spill light has changed the appearance. Always test lamps in situ to check performance.

**The lighting control system no longer dims smoothly, or at all.**

The LEDs are not compatible with the existing controls. A test before full installation should reveal this.

### Questions to ask

Are the LEDs fully CE marked and is there a genuine Certificate of Conformity available?

How long has the supplier been in business? How many LED installations have they done?

What lighting qualifications or experience has the supplier got? Can the supplier provide references, and / or previous case studies?

When are LEDs not appropriate? Can we change one or two lamps before changing them all?

### Finding a supplier

**Lighting designers**
There are directories of practices available through the Society of Light & Lighting and the Institution of Lighting Professionals.

**Manufacturers**
The Lighting Industry Federation has a comprehensive list of member organisations who supply lighting equipment.

**Electrical contractors**
The Electrical Contractors Association can put you in touch with electrical contractors who operate nationally or local to your area.

**Carbon Trust Implementation Services**
The Carbon Trust Implementation Services puts you in contact with accredited suppliers across all sections of lighting.