



The lighting industry got its fingers burnt trying to persuade householders to replace incandescent bulbs. Can the transition to LED lighting be smoother? By **Kris Sangani**



# Light work for domestic LEDs

DAILY MAIL READERS were 'incandescent' when the EU banned their favoured white-hot lightbulbs. The energy-efficient replacements, compact fluorescent lamps (CFLs), were unpopular because many took a while to light up from cold, had unflattering light tones and cost more.

The fact that they tended to last longer was little compensation to a public used to the gratifying effects of incandescent lightbulbs, though they were cheap enough for hoarders to buy in bulk ahead of the ban, which was announced by the UK government and implemented EU-wide from 2009.

Light-emitting diode (LED) lightbulbs are becoming increasingly popular, but claims made by some manufacturers on longevity have been disputed. The EU brought in directives to increase the quality of LED construction as the lamps are more complex

to manufacture and there are varying levels of quality. But there are anecdotal stories about poor quality construction.

There are two distinct markets: the retail market, which is still relatively small because of the high price of LED bulbs; and the new build market, specifically builders who are incentivised to make new build homes as energy efficient as possible. The new build market is the larger of the two, although the retail market is expected to catch up.

LED lamps have greater energy-efficient advantages over CFLs but without the problem of unflattering tones and uncomfortable flicker. However, unlike CFLs and incandescent products, the weakest component of LEDs is not the lamp, which can often last a great deal longer than some of the other intricate components.

One point of contention is with the claims made on the packaging for some LED products. A manufacturer may claim, for example, that their LED light would be expected to last for 50,000 hours. In practice, this would mean that the product would last for more than 17 years on the assumption that the light was on for approximately eight hours a day.

The reality is far more nuanced. Firstly, LED lights do not burn out suddenly like incandescent bulbs. Their efficiency decreases over time. The confusion is at what point should the efficiency drop before the product is deemed to have failed?

"The performance characteristics of an LED chip will change once it is incorporated into a lamp or luminaire, potentially impacting lifetime. Therefore, it is important to understand which lifetime is being quoted



– the chip or the system,” says Steve Wrapson, product marketing manager for Philips. “Our lifetime statements are based on a moment that LEDs reaches 70 per cent of their light output.”

To resolve many of these matters, the EU brought in a new directive that came into force in September of last year. The EcoDesign DIM2 Regulation, created to improve the accuracy of information on the packaging of LED lamps, will help consumers make better-informed choices.

There are now tougher performance requirements and the new regulation states that directional lamps, such as spots and reflectors, need to meet a certain lumen level to claim a certain wattage replacement.

“Historically, lightbulb purchases have been based on wattage, which actually refers to the energy consumed rather than

the bulb’s brightness. Now consumers need to understand lumen output to help them make the adjustment,” says Wrapson, who points out that Philips’ packaging gives Lumen equivalent to existing wattage measurements.

Additionally, 90 per cent of the lamps must survive and still have at least 80 per cent of their initial lumen output after 6,000 burning hours; and 95 per cent of the lamps must survive for at least 1,000 hours.

#### **Making the switch to LED**

Will this level of transparency be enough to persuade more consumers to switch to LED luminaires? Visit your local DIY superstore and you will still see rows and rows of CFL-based lighting and perhaps just a small space devoted to LED lighting.

Retailers appear to be unconvinced about

stocking too vast a range of LED alternatives, possibly driven by market confusion and uncertainty. In the meantime, consumers are left with what many consider a poorer alternative in CFL lights.

One way the government is managing to increase the uptake of LED lighting for businesses is by offering tax incentives and warranties. The Enhanced Capital Allowance (ECA) energy scheme provides tax allowances for a variety of energy-saving products. It offers a 100 per cent First Year Allowance (FYA) for investments in certain energy-saving plant and machinery including energy-efficient LED lighting systems, of which 100 per cent of the cost could be written off against that year’s taxable profits. This has enabled many businesses to save money, as well as reduce energy use, carbon footprint and climate >

< change levy payments. But no similar scheme exists for consumers, in the UK at least.

In the US, however, State Public Utility Commissions (PUCs) have been set energy-saving goals by state and federal government to provide an alternative to the capital expense of expanding power plant capacity. Utilities in almost every state offer rebates for LED lighting. The majority of these are a predetermined monetary amount for each fixture replaced, most of which is reliant on the products being bought with a US Energy Star rating scheme.

### New-build incentives for consumers

Although no similar rebate scheme yet exists for UK consumers, purchasers of new-build properties can still benefit through incentives offered to house builders.

In each newly built home, builders are supposed to ensure that at least two rooms are fitted with energy-efficient lightbulbs. However, because the onus is on the builder, whose interests may be more short-term than the owner, the choice of bulb might not be chosen on the basis of optimal energy efficiency or longevity. This unleashes potential for creating a market for cheap imports from unknown brands.

One such home builder, Gaillard Homes, discovered that because of its commitment to providing quality LED lighting from well-known brands, the bulbs were routinely going missing, so now the policy is to install as late as possible in the build.

Denis Sharp, an IET member and engineer, recently moved into a new-build home that was kitted out with poorly designed LED lamps that kept failing. Sharp attempted to replace the lamps himself with more reputable branded products: "I tried fitting a mains LED lamp from an alternative manufacturer and found I couldn't. The lamp holders appear to be GU10, but on closer inspection they are GU10 L1. This means that there is a small spike about 2mm high in the centre of the lamp holder. No one else seems to manufacture this type of lamp," explains Sharp.

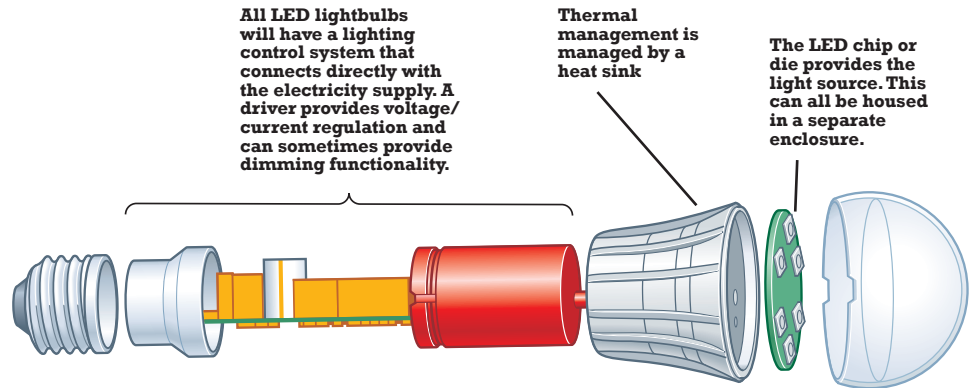
Concerns raised by consumer groups, manufacturers and installers are the main reason that prompted the IET to produce The Code of Practice for the Application of LED Lighting Systems, which was published in March.

### LED Code of Practice

According to the report's authors, poor quality installation of LED lighting systems could cancel out any advantage of LED technology and result in inadequate lighting, failure to meet lifetime performance expectations or even interference with other equipment from poor systems integration.

"A Code of Practice will benefit the industry and also build confidence in this technology for contractors and customers," says Ben Papé, chair of the IET Technical Committee on LED Lighting Systems.

The new Code of Practice covers performance, safety and lifetime, as well as



### DOS AND DON'TS LED INSTALLATION

#### DO

- \* Review the tasks to be undertaken in the space and ensure adequate illuminance.
- \* Ensure adequate light reaches wall and ceiling surfaces so the space does not look gloomy.
- \* Ensure that LED sources within public view are properly controlled by means of specification, location, orientation, glare shields or optical systems.
- \* Remember that the colour of the light that the lamp produces is important. Light colour is measured in Kelvins using an index called Correlated Colour Temperature. The lower the Kelvins the warmer the light (halogen lamps are ~2700 Kelvin – very warm white). LEDs are available in a wide range of colour temperatures from very warm to very cool, and even coloured.
- \* Check that the LEDs will give the required colour-rendering index in the space.
- \* Plan what will happen if an LED fails early.
- \* Take note that the output of LED lighting systems, such as other light sources, is measured in lumens and efficacy, not watts (a 3W LED is not necessarily brighter than a 1W LED).
- \* Check the lumens, lumens/watt and beam distribution.
- \* Remember that different LED replacement lamps from different suppliers can produce a different quality of light. LED sources from the same supplier can also produce a different quality of light if the colour consistency/binning is not properly controlled.
- \* Choose a lamp/luminaire that has been tested by an approved body and is being sold by a company that offers a refund as well as product warranty.
- \* Consider the physical size of LED replacement lamps when replacing an existing lamp that is recessed in a luminaire (such as a downlight). LEDs can be significantly longer than some halogen lamps because of their heat

sink and so they may project from the luminaire.

- \* Make provision to ensure that access is possible for LED lighting system installation, aiming/re-focusing, and future maintenance.
- \* Review operating temperature information and how this data relates to luminaire efficacy and lumen depreciation in the proposed installation location.
- \* Check ingress protection ratings of all LED system components (including any remote drivers located nearby), and choose an appropriate rating for the intended application.
- \* Check mechanical impact protection ratings of all LED system components where required, and select an appropriate rating for the intended application.
- \* Remember to ensure compatibility with dimming equipment if appropriate.
- \* Ensure regular cleaning of the luminaire and periodic inspection, testing and maintenance.

#### DON'T

- \* Forget that LEDs will reduce in output with time, so make sure illuminances will still be adequate at the end of life.
- \* Have LED sources directly within the line of sight. LEDs are often small and very bright point sources and as such can cause visual discomfort through glare if the source is in view.
- \* Rely on claims that an LED is equivalent to a particular halogen/GIS source.
- \* Install LED lighting systems in a situation where they will be operating beyond the temperature tolerances specified by the manufacturer.
- \* Forget that not all LED lights can be dimmed, and those that can may not always work with your existing dimmer or dimming equipment.

(From The IET Code of Practice for the application of LED Lighting Systems)



The long lifetime of LED lightbulbs makes them ideal for fitted lighting structures such as this staircase

detailing key compatibility considerations as part of a systems approach to the installation and maintenance of this important technology.

The retrofit market also has issues. Many current UK homes are predominantly fitted with bayonet cap fittings, which are mainly only found in the UK, Australia and New Zealand. As such, many well-known brands have concentrated on the more common type fittings such as the Edison Screw, GU10 and GU20 fittings. However, the good news is that bayonet cap fittings are slowly becoming more available, which should help increase uptake in the near future.

“We didn’t have [bayonet cap fittings] in our current range, but it makes common sense for us to include it in the near future,” explains Darren Watts, head of UK sales for Toshiba LED lighting.

### Low-energy, high-cost lighting

Cost is still the main issue for many home owners. With prices of up to £25 per bulb, the received wisdom is that LED lighting is too expensive. Rising electricity prices and falling LED costs mean that, for homes with a large number of halogen bulbs at least, the new generation of low-energy lighting finally makes financial sense.

Concerns over the weak or cold quality of LED lightbulbs have abated. Despite usually costing more than six times as much as CFLs, the payback for LEDs now comes in 15 months or less – and for homeowners changing dozens of halogen bulbs, the savings can be in the hundreds of pounds every year thereafter.

A typical 35W halogen replacement LED could use as little as 4W, which is considerably less than the 10W or so a CFL would use to produce the same level of light.

Dimmable versions cost slightly more, and while 35W halogen replacements are available for just less than £12 each for the newest perfect fit bulbs that price jumps dramatically for higher wattage replacements – this will delay the payback by a year or so.

Manufacturers are looking at other methods to reduce the cost of production and

to pass on those savings to consumers. One such company is Plessey Semiconductor, which has a manufacturing plant for LEDs in Plymouth.

“Our aim is to get the bill of materials down for the high-end companies such as Philips or Osram,” says Neil Harper, product group director for Plessey.

Harper explains that many LEDs are manufactured using expensive substrates such as sapphire on wafers, which are only 2in in diameter. Plessey’s answer is to look into manufacturing on cheaper substrates – such as silicon, without compromising on quality, and increasing yields by increasing the diameter of the wafer to 6in.

“We’ve just commissioned a test production line,” says Harper, although he remains tight-lipped on when these new LEDs will be available.

There are other ways prices could drop.

New competition is likely as big manufacturers from the Asia-Pacific market enter the UK and European market. Companies such as Toshiba in Japan and LG from South Korea have an excellent reputation in their native countries but are relatively unknown in Europe. Toshiba, for example, has a history in the lighting industry going back more than 120 years.

Additionally, there are cost savings available in the other components that make up a modern LED lightbulb. The driver houses a microcontroller to provide the correct output current and voltage for powering the LED chips to emit light at the required level of brightness. This is a significant cost on the overall bill of materials, but the semiconductor industry is relatively dynamic compared to the lighting industry overall and therefore the cost of microcontrollers are like to drop massively over the next few years.

Other components, such as housings, connectors and the heat sink, are also expected to drop as manufacturing efficiency improves – but at a smaller rate to the silicon.

The business has set high expectations with LED lighting and hopes it has done enough to avoid the controversies of the recent past. \*

## MYTHS

### THE TRUTH ABOUT LEDS

**1 LED lamps and luminaires have an expected minimum lifetime of 50,000 hours.** LED products do not always last for 50,000 hours. Lifetime will vary according to the quality of product design and manufacture, particular conditions and quality of installation.

**2 Our LEDs have a 20-year warranty.** Warranties may be conditional, specifying installation in particular conditions, for instance, and so it is worth checking the small print against the characteristics of the intended installation. LED luminaires require no maintenance – they are fit-and-forget. All luminaires and lamp types require maintenance, though the frequency of maintenance activity may vary and can be significantly less with LED products.

**3 More power means more light.** The light output of LED products is not necessarily decided by their power rating because LED lighting performance specifications are more complicated. It is worth checking the facts.

**4 Our 3W LED is equivalent to a 50W tungsten halogen reflector lamp.** The performance of LED products can offer advantages but it is advisable to first look beyond marketing materials to check that products meet user requirements.

**5 Our LEDs give 200 lumens per watt.** The headline performance of LED products in a perfect laboratory environment may not replicate the real performance in the field. Always seek professional advice on design parameters.

**6 LEDs don’t generate heat.** In simple terms all lamp types generate heat as a by-product – LED products just generate heat in a slightly different way, which needs to be appropriately managed.

**7 LEDs destroy artwork.** Lighting of artwork is specialist area. This scenario is not specific to LED products only, and advice should always be sought when lighting is deployed in sensitive areas containing important artwork.

**8 LEDs produce unpleasant coloured light.** LED technology and controls have improved significantly in recent years. Proprietary products from reputable manufacturers have greatly improved the colour temperature of newer LED products.

**9 LED lamps just plug into existing luminaires.** Not all LED products are plug-and-play in existing luminaires, and so it is worth checking the manufacturer’s literature for confirmation. For instance, control gear on fluorescent luminaires may need replacing.

(From The IET Code of Practice for the application of LED Lighting Systems)

# Wisdom of crowds

By **Kris Sangani**



The limited choices of finance often mean that technology startups have to pan-handle the men in pinstripes. Could crowdfunding be an alternative source of funding?

FORTY YEARS AGO, the only place to obtain financing for a new startup idea for the vast majority of businesses, including technology ventures, was the bank.

If you charmed the bank manager, he (as would invariably be the case) may grant you an overdraft facility but this could be taken away at the whim of head office bank-lending policy. Clearly, this was far from ideal.

Then came the 1980s and financial deregulation, which encouraged a great deal of interest in alternative investments. Thus there was a growth in venture capitalists and angel investors searching for a possible flutter in technology businesses.

Investing in risky technology projects became popular and grew massively until the dot-com bubble burst at the turn of the millennium.

In the current austere times, tech entrepreneurs have had a tougher run of raising finances than the previous decade – when even absurd propositions attracted millions of dollars and pounds. Now, however, startups have the option of asking complete strangers for cash – a strategy known as crowdfunding.

Crowdfunding was originally conceived as a way to fund mostly unprofitable creative projects such as films, music and books. US websites have used this

method to raise millions of dollars to fund a variety of creative ventures.

In the UK, money for new businesses is tight – Bank of England figures point to lending that has shrunk steadily since the beginning of the banking crisis in 2008.

Today there are hundreds of crowdfunding platforms around the world, with fundraising reaching billions of dollars annually. In 2012, crowdfunding platforms raised \$2.7bn and successfully funded more than a million campaigns.

Crowdfunding research organisation Massolution claims that the technique raised \$5.1bn last year alone. “In the past it would have been impossible



**Tile was funded through a crowdfunding platform on its developers' own website**

for ordinary investors to get in on the ground floor investing in companies such as Google, Facebook or Twitter," says Kevin Berg Kartaszewicz-Grell, research director for Massolution.

US sites Kickstarter and Indiegogo are the largest in the crowdfunding genre. On these crowdfunding platforms, donations are sought in return for special rewards such as a free product or even a chance to be involved in designing the product or service.

The most well-known example of this is Pebble Technology, which launched a Kickstarter campaign in April 2012 with an initial fundraising target of \$100,000. Backers pledging \$115 were promised a Pebble smartwatch when they became available – in effect, they were preordering a product that did not yet exist for a discount.

Within six days, the project had met its \$100,000 goal and within the first month it had become the most funded project in the history of Kickstarter, raising over \$4.7m. By mid-May, funding closed with \$10m pledged by almost 70,000 investors.

### Do-it-yourself crowdfunding

It is also possible to set up a crowdfunding platform on your own website using open-source crowdfunding platform software such as Selfstarter.

This is what software and hardware engineers Mike Farley and Nick Evans did when they started a new campaign. They used the software on their own website for their product Tile – a matchbook-sized, Bluetooth, low-energy device that aims to use peer-to-peer networking linked to social media to recover lost items to which it is connected. The Tile pre-order campaign ran from summer 2013 and reached its target of \$20,000 before the end of that year.

"We decided to use our own crowdfunding platform so that we could make the decision to go ahead and not rely on third-party rules," says Evans, chief executive of the company.

For the Pebble and Tile examples, none of the investors were promised equity, as financial regulation is very strict on selling shares in your company outside the remit of the Securities and Exchange Commission (SEC). However, this may soon be a possibility.

Two years ago, the US passed the Jumpstart Our Business Startups Act (Jobs) with the aim of allowing the general public to receive company equity in exchange for funding. But, even for Americans, equity crowdfunding comes with limits and caveats. The new law only permits investments of up to 5 per cent for individuals with an annual income of less than \$100,000, and up to 10 per cent for those who make over \$100,000.

Although the law was passed almost two years ago, the Securities and Exchange Commission has still to set up the regulatory framework for equities crowdfunding. But at least they will have a framework in place in the near future. The UK, on the other hand, has not enacted any similar legislation.

The regulatory future is uncertain in the UK, which focuses on protecting investors

from 'unsuitable' investments. The general rule is that for funds to be offered to the public the funds themselves have to be authorised, as do those who manage them. Unregulated funds can be offered, but only to specific classes of investor – which would exclude your average consumer backer.

The inherent vagueness of UK regulation is leading some within the industry to lobby for a similar law to that in the US for crowdfunding platforms to be applied.

### Regulating your campaign

With the current model of crowdfunding for technology companies, there are a number of pitfalls to circumvent. The obvious is the stigma attached if your crowdfunding campaign fails.

The main crowdfunding platforms have strict rules and time limits on campaigns. For example, on Kickstarter you would have to raise your target by a given date and if you fail to do so, no funds would be released.

You could end up losing money if you do not do sufficient research and development, however. Producing a prototype consumer

**'In the past it was impossible for ordinary investors to get in on the ground floor investing in companies such as Google, Facebook or Twitter'**

product, for example, is the first step. You need to consider the economics of mass-producing the product at the price that you state – it could end up costing a lot more once you have retooled the product and taken manufacturing into account.

Additionally, consumer law needs to be taken into account. Developed economies tend to have well-tested legislation to protect consumers from entering into unfair consumer contracts.

### WEBLINK

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"I have seen people who haven't been able to manufacture at the price they thought they would be able to and they have dropped off the face of the earth," says Salvador Briggman, a blogger and expert on crowdfunding whose site [www.crowdcru.com](http://www.crowdcru.com) reports on the global crowdfunding industry. "It's really crucial to concentrate on the preparation phase – particularly if you are a first time engineer who doesn't have experience in manufacturing."

There is a strong argument to be made that angel investors and even the high-street bank managers can offer more than just money; they could also provide entrepreneurs with advice. Tech enterprises could miss out on such mentorship by ignoring traditional investors and turning to crowdfunding.

Starting up a company is a very risky and challenging journey. Besides finding sufficient funding, there are always additional expenses that are impossible to forecast as well as challenges in market validation and people who want a piece of your venture in return for helping to get it off the ground.

However, having said that, crowdfunding provides a welcome strategy when the main banks are unwilling to invest. A successful crowdfunding campaign creates a base of customers who have a vested interest in the success of your business. It also allows an entrepreneur to gain market validation and avoid giving up equity before going all out and taking a product concept to market.

Crowdfunding can be good for publicity. Many platforms incorporate social media mechanisms, making it painless to get referral traffic and greater sales. This cannot have been lost on the founders of Pebble.

The past year has seen tremendous growth of interest and funds available from the different types of crowdfunding platforms. It's the adorable baby of the finance world. What will it grow up to be? \*

### SOURCES

## WHERE TO GET CROWDFUNDING

You might think that the idea of crowdfunding is a recent phenomenon from the US, but UK companies have pioneered this model.

\* UK peer-to-peer lending site Zopa pioneered the peer-to-peer crowdfunding lending model a decade ago. To date it has lent more than £467m to individuals with more than a quarter loaned in the past year, boasting an average return to investors of 5 per cent.

\* Ratesetter launched in 2010 and has already managed to persuade investors and savers to part with more than more than £100m worth of loans to borrowers. The

company also operates a provision fund that kicks in if a borrower defaults, and the company claims that every lender has received every penny of capital and interest expected.

\* Funding Circle was set up specifically to offer loans to the UK's small- and medium-sized enterprises that were being starved of cash injections. To date, it has funded £215m worth of business loans – and has recently started operating in the US.

\* Crowdcube was the first platform in the world to target investors who wanted to take equity stakes. To date it has invested in 95 businesses

and has raised funding of more than £18m for these companies since its launch in 2010. It currently has 59,000 investors. The business is already fully regulated by the Financial Conduct Authority.

\* Seedrs joined Crowdcube in the equity-based crowdfunding space in 2012 and, to date, has raised £5.5m for companies using the site. Unlike Crowdcube, however, it focuses exclusively on start-up companies and therefore has helped a higher proportion of companies that tend to be technology focused. It has recently expanded into continental Europe.