



Energy efficient LED lighting ready for the big time.

Peter Vogel* explains why recent advances in solid-state lighting are spawning a new industry of almost unlimited potential.

Reducing energy wastage in lighting

In 2007 the Australian Government announced that Australia's 87 million incandescent lightbulbs will be progressively banned. By 2015 this will cut the CO₂ emissions by 4 million tonnes per annum and could reduce household lighting costs by up to 66 per centⁱ. Other governments including Britain and the US have announced similar measures.

Globally, the cost of lighting energy is about \$250 billion per year, of which at least half could already be saved with existing technologies. The electricity savings are equivalent to the output of 300 power plantsⁱⁱ.

Fluorescent is obsolete

To date, the preferred "eco bulbs" have been fluorescent lights, either in tube form or as compact fluorescent (CF) replacements for bayonet or screw-in bulbs.

However fluorescent lamps have many serious problems. First, they are a health hazard. They contain hazardous materials such as mercury and they emit significant doses of ultra-violet rays which can cause cancer and eye damage. The British Migraine Action Association recently claimed eco-bulbs worsen the symptoms of migraines, epilepsy and the auto-immune disease lupusⁱⁱⁱ.

While they are much more energy-efficient and longer lasting than incandescent lamps, their light output diminishes fairly rapidly and constantly over their lifetime, typically 10,000 hours. Safe disposal of fluorescent tubes or eco-bulbs presents its own environmental problems.

LED space lighting

In recent years light-emitting diode (LED) technology, also known as solid state lighting, has advanced rapidly. White LEDs are now being used in general lighting applications. The best LED lighting is now similar to fluorescent in terms of efficacy (light output per watt input) but they have numerous advantages:

- Lifetime 5 times longer than fluorescents
- Do not break when dropped
- Very little UV emission
- No hazardous chemicals
- Direction of emission can be accurately controlled to minimise wasted energy
- Output is more constant over lifetime
- Spectrum provides better visibility for same energy consumption
- Light output does not degrade at low temperatures

LEDs are still far more expensive than fluorescent lighting based on initial cost, however the longer life means significant long-term savings when replacement cost is factored in. Typical payback period is now 2-3 years, falling rapidly as energy prices increase and LED costs decrease.



Parking station fluorescent lights (left) replaced by LEDs — increased visibility, decreased energy and maintenance costs^{iv}.

The industry

The major lighting companies such as Philips and Osram have invested heavily in LED technology and a range of LED lighting products are already commercially available.

The manufacturing industry comprises two main segments:

- LEDs — the semiconductor components which generate the light
- Luminaires — complete fittings containing one or more LEDs, power supplies to convert mains electricity to the voltage required by the LEDs, and a suitable housing.

Luminaires are now available for the whole range of applications ranging from desk lamps through to street lights. Given the present high capital cost of LED lighting, the most profitable application to date has been in industrial or public lighting infrastructure where reduced maintenance cost combined with massive energy savings result in payback periods of as little as 1-2 years, after which dramatic savings accrue.

Economics of solid state lighting

LED lights are already available for the whole range of applications, from desk lamps through to street lights. Given the present high initial cost of LED lights, the most profitable application to date has been in industrial or public lighting. In these situations reduced maintenance costs combined with massive energy savings result in payback periods of as little as 1-2 years, after which dramatic cost savings kick in.

Street lighting is already being upgraded to LED in some cities. In China, the main motivation is electricity shortages which lead to regular blackouts. In the USA, the cost of running street lights is a major burden on the public purse. Cities which have switched to LED streetlights have already reported reduced costs. An important side effect is that the light from the LEDs is similar to daylight which improves visibility and that means better personal safety and reduced car accidents.

Market growth

The solid state lighting device market is projected to grow at a CAGR of 33% for the next few years^v. Government programs are likely to drive this market. For example, U.S. legislation enacted at the end of 2007 requires 25 percent greater efficiency for light bulbs starting in 2012, progressing to 70 percent greater efficiency in 2020.

LED devices for street lighting alone is estimated to grow from \$108m in 2008 to \$1bn by 2011^{vi}.

The dollar value of the solid state lighting luminaire market is much bigger due to the unit cost of complete fixtures. The worldwide market for lighting fixtures is expected to top \$94 billion by 2010^{vii}.

The vast market combined with the small number of manufacturers at present means there is scope for massive growth in coming years. The replacement market alone is massive. There are 4 billion incandescent light bulbs to be replaced just in the U.S.^{viii}. Given the vast number of lights to be replaced world-wide, demand will outstrip supply for the foreseeable future.

In addition, LED lights make it possible to install lights where conventional lighting was not previously feasible. For example, solar powered public lighting can be installed where there is no electricity at all. They are also perfect for expanding lighting in situations where the available electricity is already stretched to the limit.



EverGen solar-powered area light – no wires, just plant it in the ground and forget about it for many years.

Asia is the biggest producer and consumer of LED lighting. China has named energy efficient lighting as a top priority towards emission reduction, and has already made significant inroads through the China Green Lights project. As the suppliers of 80% of the world's lighting products, China will be driving global changes in lighting technology.

Some major Asian device manufacturers including Everlight, Epistar, Bright, Toyoda Gosei, Semco, and Seoul Semiconductor are strongly challenging the dominance of lighting market leaders such as Philips and Osram.

The LED industry has rightly caught the eye of the investment community. Shares in US market leader Cree Inc are trading at a P/E of more than 50 (July 2008).

Given the scramble for carbon reduction strategies, the growth of this industry will certainly be spectacular.

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About Lincoln Crowne & Company

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ⁱ Plan to give old light bulbs the flick, Sydney Morning Herald February 20, 2007

ⁱⁱ Global Lighting Energy Savings Potential Light & Engineering. 2002. Vol 10, No 4

ⁱⁱⁱ Green globes trigger migraines Syndey Morning Herald January 6, 2008

^{iv} Photos Courtesy BetaLed

^v Strategies Unlimited, January 2008

^{vi} Streetlights take on a new glow, Macquarie Research, March 2008

^{vii} Lighting fixtures market to exceed \$94 billion by 2010 LEDs Magazine, August 2007

^{viii} LED global market should keep getting brighter and brighter Business Journal, Friday, January 11, 2008