MARK HERRING LIGHTING

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Energy efficient lighting - what's the future?

The Australian government's decision to ban incandescent lamps in favour of compact fluorescent lamps (CFLs) is seen as a globally iconic step for the environment. But some suggest it's not enough, or that we should look for better lighting technology to save our environment. Could we be taking the wrong path without considering all the options?

We've been lighting and powering our homes and businesses for over a hundred years, with little thought to how much energy we consume, to the point where our century of thoughtlessness has led us to crisis, with our blue planet turning into a 'green house', now forcing governments, industries and communities to make radical changes to our energy consumption.

Statistics suggest lighting is a big contributor to greenhouse gas emissions (GHGEs), consuming 20-25% of all electricity generated in Australia, so improving lighting efficiency will significantly reduce emissions. Putting it into perspective, the Climate Group reports Victoria alone currently generates 1.85 million tonnes of GHGEs a week.

Australia's initiative, announced as a world-first by Environment and Water Resources minister, Malcolm Turnbull, aims to reduce Australia's GHGEs by 4 million tonnes by 2012. As good as that sounds, it's only half the job - just domestic lighting. What about commercial lighting where fluoros have been used for decades? Does that suggest we can't reduce energy consumed by commercial lighting any further? And will GHGE reductions be negated by increases in toxic chemicals from used CFLs dumped in landfills? These issues may question the validity of the directions we're taking with lighting.

The 2006 Building Code of Australia forced the electrical industry to deploy energy-saving commercial lighting strategies like high-efficiency lamps, fittings and control systems, which will significantly reduce GHGEs. The CFL initiative adds to it, but what other issues emerge?

CFLs - the pros and cons

Lighting Council Australia chairman Russell Loane states the incandescent phase-out is welcomed but adds: "While there are compelling reasons to embrace CFLs, there are technical issues which need to be resolved in the phase-in period before incandescent lamps are banned, including dimming CFLs, adapting CFLs to some light fixtures and determining appropriate exemptions for special needs such as medical and appliance lighting".

According to Philips research, over 40 million incandescent bulbs are used annually in Australia. Since CFLs consume 80% less power than incandescents, we'll see a dramatic reduction in GHGEs when they become the norm. They also last five times longer, so far fewer units will be replaced each year, perhaps just 8 million units instead of 40 million, producing added environmental benefits of less fuel consumed and pollution produced in making and shipping them and less waste build-up in landfills.

But this initiative has a dark side. Anne Prince, CEO of Australian Council of Recyclers (ACR), says moving to CFLs without corresponding legislation governing their disposal is an ecological disaster in the making: "We need to be smart enough to avoid creating a mercury-pollution problem in order to fix a carbon-pollution problem. With the phasing out of incandescent lighting, it's now definitely time for Australia to join the rest of the industrialised world in banning the dumping of fluorescent lights in landfill and introducing a collection system to ensure proper recycling".

Professor John Buckeridge, head of civil, environmental and chemical engineering at RMIT University agrees, adding: "If we continue to allow dumping of fluorescent tubes into landfill the consequences will be disastrous. We can expect increases in neural degeneration and a surge in nervous diseases and deaths associated with mercury poisoning".

ACR says energy-efficient lamps, like CFLs and HIDs, contain mercury. While they're totally safe to handle and use, the mercury released from broken lamps can be an extremely dangerous neurotoxin. Advanced Recycling Australasia CEO, Doug Rowe, adds that industry and households are largely unaware of dangers associated with fluoros in landfill: "Governments need to take leadership and act on recycling legislation now. Phasing out incandescent lighting without bringing in proper recycling laws for fluorescents is simply swapping one environmental problem for another".

But there's a twist to the recycling argument: fluoros will be used throughout Australia, but recycling plants are located in only a few places. How much fuel will be consumed and how much pollution produced to ship truckloads of fluoros around the country? It's not as simple as the government just making us recycle fluoros. We have to think about the total impact on the environment rather than just mandating CFLs.

Another CFL hurdle is that fluoros have ballasts that lower a site's power factor, consuming more electricity and producing more GHGEs. Commercial sites counter this with power factor correction (PFC), but it's not provided in domestic installations. So while one house filled with CFLs has little impact, all houses in Australia will collectively have the potential to counteract some of the GHGEs reductions brought about by CFLs. Will this result in the need for domestic premises to have PFC provided for them? If so, how will this be sold to consumers on top of the added cost of CFLs?

Are all LED's Created Equally

Buyers beware - not all LED systems are created equal! Not only are there different quality LED chips, but system design, componentry and assembly also directly affect reliability and longevity. There's no point quoting a 50,000-hour LED life if the system driving it fails after

three months. The biggest challenge for LED buyers is identifying differences between good and bad LED products and realistic quoted lifetimes. Understanding that 'you get what you pay for' is a good start. Then think about the total project cost. Using high-quality reputable brand LEDs instead of unknown brands might mean a 20% difference in LED cost, but that translates into say a 2% difference in the overall project. That extra money is a small investment in minimising the likelihood of having to go back to site to repair or replace failed components after a month's operation, not to mention saving your reputation. Of course, the best way to ensure reliable LED systems is to specify performance parameters that qualify the system is fit for purpose, such as light output under specific conditions, longevity of components, service intervals and warranty periods.

LEDs use up to 80% less power than neon (colour dependent) and generate much less carbon emissions. As LEDs produce very little heat, lower heat loads are imposed on air conditioning in internal applications. This is why GE white LED systems are now replacing fluoros in supermarket refrigerated cabinets, reducing lighting load by 37% and heat load on compressors by 8%. LEDs can also be switched off after hours, saving another 33%, which can't be done with fluoros as they may not restart the next day because of sub-zero temperatures."

Future lighting technology

A new LED technology - organic LEDs (OLEDs) promises to revolutionise lighting and video displays like plasmas and LCDs. The technology uses special plastics that, when energised, emit light. Several companies and research institutes are collaborating to develop OLED lighting technologies, their goal to commercially produce paper-thin light sources that generate 50 lm/W, consume much less energy than fluoros and have 10,000-hour lifetimes. Researchers predict OLEDs could realistically compete with fluoros in 10-15 years time, simply being attached flat to ceilings to light rooms. One fascinating innovation is a combination window/light source that uses transparent OLEDs working as windows by day and light sources by night.

OLED technology has been adopted from nature. Researchers found some organic materials are similar to semiconductors in transporting electric charges, where electricity flowing through the material is directly converted into light.

GE is currently developing OLED light sheets where it has so far achieved better efficiency than incandescents, aiming to better fluoro performance soon. GE also discovered that OLEDs have a reverse process, where light energy can be converted into electricity, the end application being a low-cost plastic photovoltaic sheet used as a roofing material to act as a solar energy source.

In July 2006, Konica Minolta announced it had developed a 64 lm/W OLED lamp producing 1,000 cd/m2 luminance intended for general lighting, causing its share price to jump 6%, emphasising its potential to replace fluoros in the future.