Wuppertal Institute
for Climate, Environment
and Energy

ECOINNOVATION

Topics Online „Eco-Innovation" presents cutting-edge and fascinating best practices for increased resource productivity. In the tradition of „Factor Four" they show what is possible, present obstacles and how green lead markets can emerge.

Best Practice

››› Light-Emitting Diodes for General Lighting

A Bright Idea

Illumination accounts for around 14% of total electricity consumption in the European Union. New lighting technologies can save resources and emissions.

Light-emitting diodes (LEDs) consist of several layers of semi-conducting material. LEDs immediately transform voltage into light in a process reversing that of solar cells. The colour depends on the material used.

The development of white LEDs opens up new possibilities: Areas of use in the meantime comprise LEDs in signal lamps and for vehicle illumination, in traffic signals and for architectural illumination.

In the future, LEDs are expected to outperform energy-saving lamps in many areas. Current research focuses on organic LEDs (OLEDs), whose emissive electroluminescent layer is composed of a film of organic compounds. OLEDs are very energy-efficient and do not contain heavy metals. They are particularly interesting for thin displays and large-area applications.

LEDs and OLEDs can be integrated into nearly every lamp, object, surface or application and open the door to various possibilities of creative, innovative and resource-efficient illumination.

Sustainability-effects

ECOLOGY

LEDs consume little electricity despite their high light intensity. Coloured LEDs need only one tenth of the energy an incandescent bulb uses while emitting the same brightness. Increased energy efficiency leads to reduced emissions of the greenhouse gas CO_2. Implementing energy-efficient lights in municipalities, industry and private households throughout Germany would save up to 13 million t of CO_2 per year.

LEDs work up to 50 times longer than incandescent bulbs and ten times longer than energy-saving lamps without losing much of their lighting power.

Furthermore, LEDs save resources. Due to their small size and possible integration e.g. directly into furniture material can be saved.

- ✓ Energy consumption
- ✓ Emissions
- ✓ Product life
- ✓ Resource use

ECONOMY

LEDs need less maintenance than conventional lighting appliances. One year is enough to offset savings in electricity and maintenance against higher initial investment costs e.g. in traffic signal systems.

LEDs generate little heat and emit no infrared or ultraviolet rays. Exposure to LED light does not harm fabrics, wallpaper and foodstuffs.

Due to the wide range of possible applications, there is a big market volume. Leaders in LED-based product development can expect a growing export market.

- ✓ Costs
- ✓ Competitiveness
- ✓ Market volume
- ✓ Export options

SOCIAL

The non-flickering light of LEDs does not strain the eyes. LEDs operate with safe low-voltage direct current. They respond approx. 0.25 seconds faster than incandescent lamps, which increases safety e.g. in vehicle tail lamps. Another factor contributing to road safety is that LEDs in traffic signals do not reflect sunlight.

Consumers seeking an innovative image will be happy to adopt these inventive and attractive lighting solutions with energy efficient technology.

- ✓ Health
- ✓ Safety
- ✓ Positive image

Obstacles and drawbacks

LEDs contain toxic compounds of arsenic, gallium and phosphorus. Because of their toxicity and worldwide limited resources these elements should be recycled when old LEDs have to be disposed. At the moment, this still poses problems in private households, as their lights are not included in the waste of electrics and electronics law. As collection and disposal of the LEDs would cause additional costs, consumers could prefer the incandescent bulbs, which do not underlie the disposal directive and thus are cheaper.

Currently the up-front price is still too high for LEDs to be realalised as cost-efficient. The electronics of the LEDs is sensitive to humidity, and they lose some of their lighting power over the years.

LEDs as road lighting is still in its experimental stage. More research is needed until LEDs can fully replace other lamps in general lighting.

Potential

White LEDs have now reached an efficiency that enables them, combined with their long lifespan, to compete with energy-saving lamps. Currently the lighting power of white LEDs is around 20 to 70 lm/W (70 lm/W correspond to an efficiency of around 10%). In the medium-term, white LEDs can reach lighting powers of up to 200 lm/W, exceeding today's power of high-efficient discharge lamps of 150 lm/W.

By now there are also white LEDs with warmer colour temperature on the market. The lamp industry constantly enlarges its product line; in 2009 there will be at least one alternative to the 40-watt-incandescent bulb. The market for LEDs is growing rapidly. Suppliers expect that the world market volume will triplicate until 2015 (base 2005) to just under 15 billion Euro. There is strong international competition on the LED-market.

On 26 May 2009, the German Federal Ministry of Education an Research started the initiative „Kommunen im neuen Licht" that aims at implementing LED-technology for general lighting in public pilot projects. Diffusion barriers should be identified and overcome in order to rapidly create a high added value in Germany.

Policy recommendations

This new technology calls for linking knowledge located at numerous research institutes and manufacturers to launch the product as soon as possible. A network to further this purpose, Kompetenz-Netzwerk LED, was established in North Rhine-Westphalia in the framework of a state-supported initiative for innovative energies known as Landesinitiative Zukunftsenergien. Both the federal and Germany's regional governments can and should promote pilot projects in targeted competitions. Public procurement in administrations should focus on LED products serving as role models. Intracting can help administrations to switch to LEDs.

Energy standards for road and office lighting and gradual phase-out programmes for out of date technologies foster the conversion to LED technology.

Training and further training for technical engineers, electricians, lighting architects and architects, energy consultants etc. must take the new technology into account.

Links and contacts

Further information:

Industrieverband ZVEI
Licht.de
OLED 100 EU
EnergieAgentur.NRW

Manufacturers and suppliers (examples):

Odelo LED GmbH	www.odelo.de
Osram GmbH	www.osram.com www.ledlightforyou.com
Philips GmbH	www.philips.de
Siteco GmbH	www.siteco.com
Hess AG	www.hess.eu
Schréder GmbH	www.schreder.com
Aixtron AG	www.aixtron.com

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