JANUARY/FEBRUARY 2010

LEDs MAGAZINE®

LEDsmagazine.com

TECHNOLOGY AND APPLICATIONS OF LIGHT EMITTING DIODES

+ Manufacturing

LED makers install more capacity P.23

Backlights

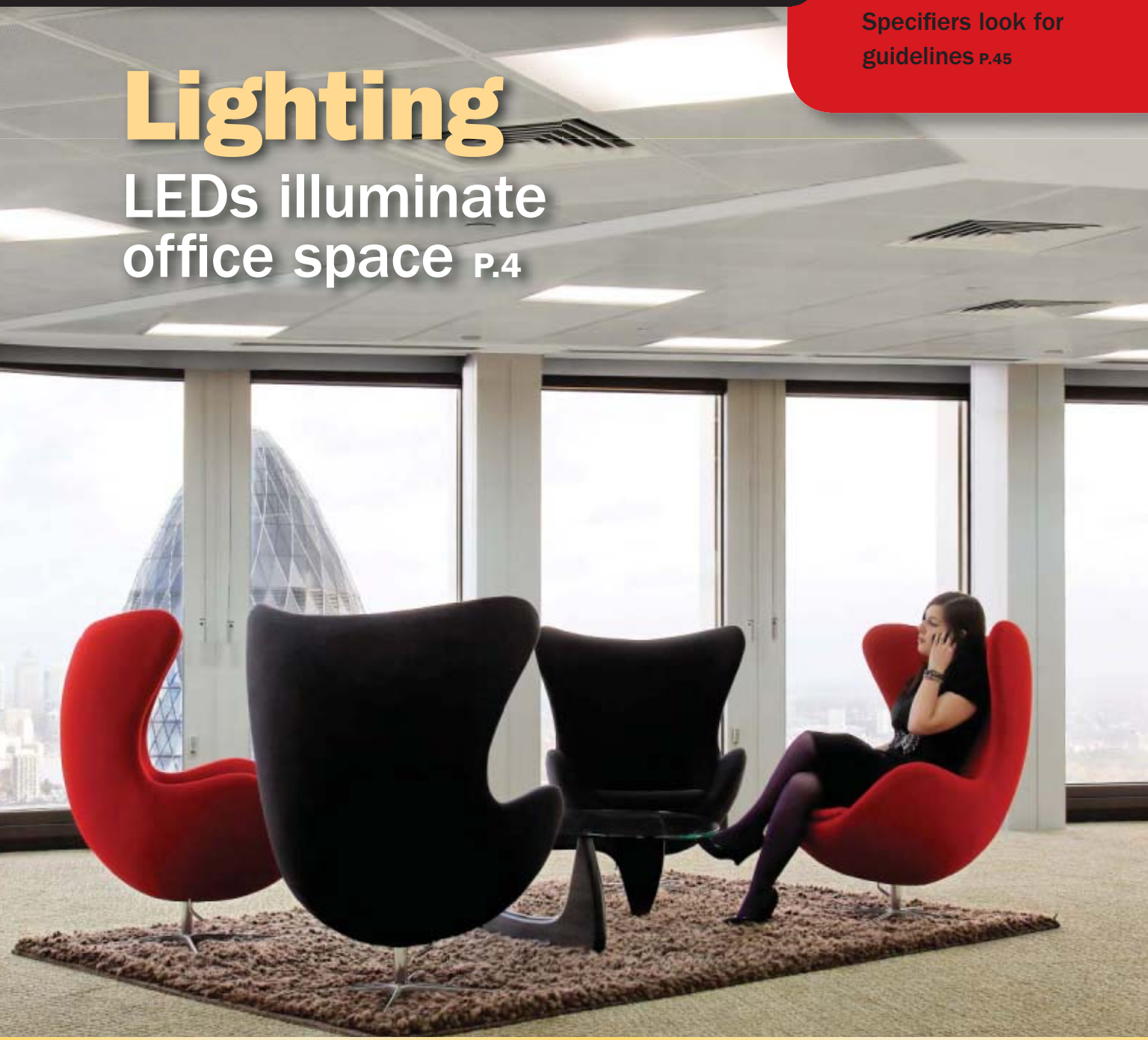
TV sales drive LED demand P.37

Lighting

Specifiers look for guidelines P.45

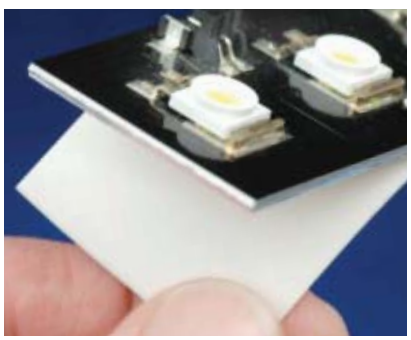
Lighting

LEDs illuminate office space P.4



NEW T-CLAD® PA STICKS IT TO HEAT.

Peel and place thermal solution withstands the heat of solder reflow.



Thermally conductive insulated metal substrate boards specifically configured for LED applications.

Easier assembly, cooler LEDs.

Bergquist's T-Clad with pre-applied Bond-Ply®450 allows you to adhere your mounted LEDs to a variety of heatsinks and surfaces while thermally optimizing your application. This version of peel and place T-Clad can withstand the high temperatures of solder reflow during LED assembly and then be positioned in the lighting application using its strong thermally conductive adhesive. Call or visit to qualify for your FREE sample.

FREE T-Clad® PA Sample Board

Call **1.800.347.4572** or visit **www.bergquistcompany.com/preapplied**

THE BERGQUIST COMPANY

18930 West 78th Street • Chanhassen, MN 55317 • A ISO9001:2000 registered facility
(800) 347-4572 • Phone (952) 835-2322 • Fax (952) 835-0430 • www.bergquistcompany.com

Thermal Materials • **Thermal Substrates** • **Fans and Blowers**

Transforming Light

LUXEON LEDs are changing the way we light the spaces we live, shop and play in. With unparalleled efficiency, quality, and reliability, LUXEON LEDs are a simple way to transform lighting and improve the well being of our environment.

Whether you're lighting a restaurant, roadway or architectural masterpiece, you can count on LUXEON to deliver long life, high-quality white light while reducing energy consumption.

To learn how LUXEON can help you transform lighting, call our partner, Future Lighting Solutions, at +1-888-589-3662, or visit www.philipslumileds.com/transform.

LUXEON®

PHILIPS
LUMILEDS
sense and simplicity

LEDs MAGAZINE®

ISSUE 31

january/february 2010

Cover Story

Tower 42, a London office building, has fitted LED lighting and controls throughout an entire floor, which has around 9000 sq.ft. of office space (p.4). Photo: Philips Lighting.

features

columns/departments

commentary

TV is the thing to watch...for now

Here's a statement that won't surprise anyone tracking developments in the LED industry: an unexpected surge in demand for LCD televisions with LED backlights has put pressure on the LED supply chain, which is now responding by rapidly adding capacity. Our article on backlighting (p.37) quotes the head of the LCD TV Association as saying that "LED-backlit TVs are going to take over the industry," and this view was supported by announcements at the recent Consumer Electronics Show. In response, many leading LED makers are building new fabs, expanding their existing facilities or combining their resources with other companies (see p.23). Having raised million of dollars in financing recently, Seoul Semiconductor (p.10) and Bridgelux (p.14) have still to announce how they plan to spend their cash.

While TV backlighting is in the ascendancy, lighting applications are still in their infancy. Lighting specifiers often struggle to understand the capabilities of LED technology, and the risk remains that over-selling will ruin the reputation of solid-state lighting. Some of these issues were discussed at a recent seminar in London (see p.45). The good news is that industry organizations are developing guidelines for specifiers and end-users, while the development of new standards is continuing at a rapid pace, not just in North America but also in Europe (see p.32) and elsewhere. Meanwhile, technological improvements continue to be made, not just in terms of efficacy but also in areas such as color quality, enabled by new approaches such as separated-phosphor modules (see p.49).

In the USA, the DOE has been heavily involved in establishing Energy Star criteria for LED lighting, but control of this program has now passed to the EPA (see p.19). After the final criteria for replacement LED lamps were unveiled (www.ledsmagazine.com/news/6/12/4), these were challenged by manufacturers including Lynk Labs Inc. because of a requirement that the LED operating frequency should be at least 150 Hz (www.ledsmagazine.com/news/7/1/9).

Meanwhile, impressive LED lighting projects continue to be unveiled. The LightSavers program, run by The Climate Group, will look at outdoor LED lighting demos in numerous cities around the world (p.64). As an example of what is already being achieved indoors, a London office building, Tower 42, has refurbished a 9,000-sq.ft. office space with LED lighting and controls from Philips (see cover image and www.ledsmagazine.com/casestudies/20777). Believed to be the first UK office space to use solid-state lighting throughout, the energy saving is around 40% compared to conventional T5 fluorescents. The 600x600-mm Savio fittings, originally developed for use with fluorescent light sources, were adapted and optimized for use with 3 x 18W Fortimo LED light sources (which also use remote-phosphor technology). All the lighting, including LuxSpace mini LED downlights, is controlled through a Philips lighting management system using DALI so that all luminaires are individually addressable. Multi-sensors are used to provide both occupancy detection and dimming in relation to daylight levels. Occupants will also have the ability to control their own lighting using infra-red remote control units. Such installations give a strong indication that TV backlighting will not be the only market to create a strong demand for LEDs in the years to come.

Tim Whitaker, EDITOR
twhitaker@pennwell.com

LEDs MAGAZINE®

GROUP PUBLISHER Christine Shaw
cshaw@pennwell.com
EDITOR Tim Whitaker
twhitaker@pennwell.com
Tel. +44(0)117 946 7262
SENIOR TECHNICAL EDITOR Maury Wright
maurywright@gmail.com
CONTRIBUTING EDITOR Brian Owen
MARKETING MANAGER Luba Hrynyk
PRESENTATION MANAGER Cindy Chamberlin
PRODUCTION DIRECTOR Mari Rodriguez
SENIOR ILLUSTRATOR Christopher Hipp
AUDIENCE DEVELOPMENT Debbie Bouley

PennWell®

EDITORIAL OFFICES PennWell Corporation, LEDs Magazine
Corporate Offices
98 Spit Brook Road, LL-1
Nashua, NH 03062-5737
Tel: +1 603 891-0123
Fax: +1 603 891-0574
www.ledsmagazine.com

SALES OFFICES
SALES MANAGER (USA) Mary Donnelly
maryd@pennwell.com
Tel. +1 603 891 9398
SALES MANAGER (EUROPE) Joanna Hook
joannah@pennwell.com
Tel. +44(0)117 946 7262
SALES MANAGER (JAPAN) Manami Konishi
manami@ics-inc.co.jp
Tel: +81 3 3219 3641
SALES MANAGER (CHINA & HONG KONG) Mark Mak
markm@actintl.com.hk
Tel: +852 2838 6298
SALES MANAGER (TAIWAN) Alice Chen
alice@arco.com.tw
Tel: +886 2 2396 5128 ext.206

CORPORATE OFFICERS
CHAIRMAN Frank T. Lauinger
PRESIDENT AND CEO Robert F. Biolchini
CHIEF FINANCIAL OFFICER Mark C. Wilmoth

TECHNOLOGY GROUP
SENIOR VICE PRESIDENT Christine A. Shaw
SENOIR VP OF AUDIENCE DEVELOPMENT Gloria S. Adams

SUBSCRIPTIONS: For subscription inquiries:
Tel: +1 847 559-7330;
Fax: +1 847 291-4816;
e-mail: led@omeda.com;
ledsmagazine.com/subscribe

LEDs MAGAZINE® online

Web Exclusive Articles

A tentative courtship: an impression of the PLDC Conference, Berlin, from an LED manufacturer's perspective

The Professional Lighting Design Conference demonstrated practical and informed engagement by lighting designers with the potential to use LEDs in mainstream lighting applications, writes ERIC SENDERS of Philips Lumileds.
www.ledsmagazine.com/features/6/12/1

Strategically Speaking: For Replacement Lamps, LEDs are Different

Although CFLs have benefited from aggressive promotion, adoption in the consumer lighting market has slowed. Meanwhile, LED lighting has begun to gain attention, not least in energy-efficiency circles, writes VRINDA BHANDARKAR.
www.ledsmagazine.com/features/6/12/3

Featured Companies

The following have recently been added to the LEDs Magazine site as Featured Companies (see www.ledsmagazine.com/buyers/featured):

Stanley Electric • Instrument Systems • Opto Diode • UPEC Electronics • Everlight Electronics • Kingbright Electronic Europe • Edison Opto • Thomas Research Products • FoxSemicon Integrated Technology

ADVERTISERS *index*

FEATURED *event*

Strategies in Light 2010

Strategies in Light®

The Leading Events for the Global LED and Lighting Industry

February 10-12, 2010
Santa Clara, California, USA
An expanded Lighting Track and a new solid-state lighting Investor Forum will be among the highlights of SIL 2010 — see www.ledsmagazine.com/news/6/10/28 for full program details.
MORE: www.strategiesinlight.com

LED China 2010
March 2-5, 2010
Guangzhou, China

LED Next Stage 2010
March 9-12, 2010
Tokyo Big Sight, Japan

CIE Lighting Quality & Energy Efficiency
March 14-17, 2010
Vienna, Austria

Light+Building 2010
April 11-16, 2010
Frankfurt am Main, Germany

Lighting Japan
April 14-16, 2010
Tokyo Big Sight, Japan

Lightfair 2010
May 12-14, 2010
Las Vegas Convention Center, United States

Lighting Africa Conference
May 18-20, 2010
Nairobi, Kenya

SID Display Week 2010
May 23-28, 2010
Seattle, WA, United States

LED Lighting Taiwan
June 09-11, 2010
Taipei, Taiwan

LED Expo and OLED Expo 2010
June 22-25, 2010
KINTEX, South Korea

Strategies in Light Europe
September 28-29, 2010
Frankfurt, Germany

LED Japan - Strategies in Light
September 28-October 01, 2010
Yokohama, Japan

MORE: www.ledsmagazine.com/events

Sharp LED solutions for bright sparks

LED's work together!

[IC] [OPTO] [LED] [LCD] [RF]

Go for the broad range of Sharp LED solutions to present your applications in the best possible light: LED multi-chip modules, white light LEDs, RGB LEDs and flashlight LEDs. Whether single spotlight or wide-area ambient lighting, indoor or outdoor, stationary or mobile usage, Sharp LEDs combine maximum efficiency and lifetime with minimal heat generation. You can define white in the most beautiful tones – anything from warm to cold white and high CRI optimised for almost natural colour reproducibility. The Sharp portfolio offers a wide variety of different packages: from PLCC2 to PLCC6, standard or extra thin, sideshoot and ultra-small – and features LEDs for work and reading lamps, indoor and outdoor lighting, signalling equipment and advertising panels, flash-lights and displays as well as architectural and medical applications. Call or mail us to benefit from nearly 40 years of experience in LED technology.

Our Service Team will be glad to supply you with any engineering samples and advice you need.

E-Mail: info.sme@sharp.eu; phone: +49 (0)180 507 35 07

light+building

Visit us at the Light+Building 2010
from 11-16 April in Frankfurt am Main: Hall 4.2, Booth J71.

SHARP | Microelectronics

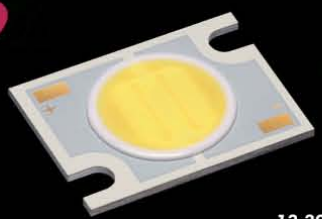
CITILED™
The Light Engine

CITILED delivers more light output with less power!

●Over 100 lm/W ●High efficiency type ●High color rendering type

CITILED highest lumen output
1335 lm, 100 lm/W

NEW



13.39W

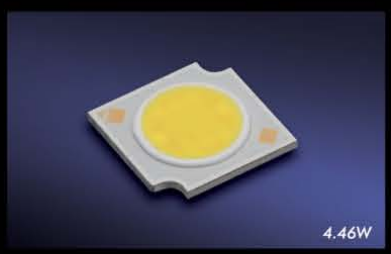
CL-L233-C13 Series

IF:720mA
3000K(Ra85) : 900 lm· 67 lm/W
5000K(Ra65) : 1335 lm· 100 lm/W

3.26W

CL-L102-C3 Series

IF:350mA
5000K(Ra85) : 255 lm· 78 lm/W
3000K(Ra85) : 220 lm· 68 lm/W
5000K(Ra65) : 340 lm·104 lm/W



4.46W

CL-L251-C4 Series

IF:480mA
5000K(Ra83) : 340 lm·76 lm/W
3000K(Ra85) : 290 lm·65 lm/W
5000K(Ra65) : 425 lm·95 lm/W

▶ Please contact us for samples!

CITIZEN ELECTRONICS CO., LTD.

CITIZEN Micro HumanTech

Distributors

Italy : Velco S.p.a. velco S.p.a.
Contact person : Paola Tonel Tel : +39-0444-922-922 E-mail : info@velco-electronic.com

Germany / Austria / Swizerland : Endrich Bauelemente Vertriebs GmbH endrich components of life
Contact person : Albrecht Lohrer Tel : +49-7452-600756 E-mail : a.lohrer@endrich.com

England : Marl International Ltd. (Optosource) MARL
Contact person : Clare Millard Tel : +44-1229-582430 E-mail : clare.millard@optosource.com

France : Eurocomposant Eurocomposant
Contact person : Patrick Fichot Tel : +33-1-30-64-2602 E-mail : pfichot@eurocomposant.fr

Spain / Portugal : Antonio Lopez Garrido, S.A.
Contact person : Jose Luis Garrote Tel : +34-96-192-06-34
E-mail : ventas@algsa.es (for sales) / laboratorio@algsa.es (for technical assistance)

Scandinavia / Baltic states : Arrant-Light Oy www.light.fi
Contact person : Janne Makinen Tel : +358-2-2462-300 E-mail : janne.makinen@light.fi

Belgium / Netherlands / Luxembourg : Elincom Electronics B. V. elincom electronics
Contact person : Michiel Wubs Tel : +31-10-264-0270 E-mail : m.wubs@elincom.nl

Please contact us for distributors in other countries.

Contact

Europe	Tel : +49-69-2992-4810
North America	Tel : +1-847-619-6700
Japan	Tel : +81-3-3493-2716
Asia	Tel : +852-2793-0613
Other area	inquiry@ce.citizen.co.jp

● Request / Inquiry
E-mail : inquiry@ce.citizen.co.jp

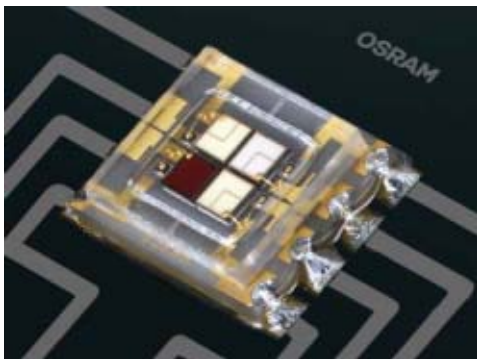
Website : http://ce.citizen.co.jp/e

news views

CHIP PERFORMANCE

3M claims record efficacy for green LED

3M has unveiled a color-conversion technology that doubles the efficiency of green LEDs, compared with currently-available green emitters. The St. Paul, MN-based company says that the technology could lead to accelerated adoption of LEDs in demanding applications such as LCD display backlights and pico-projectors



Micro projectors from 3M, which can be connected to mobile phones and cameras, are enabled by Ostar LEDs from Osram Opto, which contain 1 red, 1 blue and 2 green chips (see www.ledsmagazine.com/news/6/11/13).

Mainstream blue and green LED chips are manufactured using gallium nitride (GaN)-based materials, but the efficiency varies by color (wavelength). The performance of green LEDs lags behind other colors, so much so that it is often necessary to use 2 green LEDs in combination with one red and one blue to create a balanced RGB pixel. High-performance green LEDs should reduce the total number of LEDs required in a device, while improving color » page 10

RETAIL LIGHTING

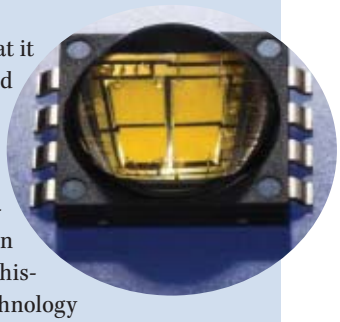
Starbucks converts US stores to LED lighting

Starbucks Coffee Company has begun implementing its LED lighting conversion program in all company-owned stores in the US and Canada, and has already completed installation in more than 1000 US locations. It will expand the program to international markets in March 2010, aiming to complete installation in more than 8,000 company-owned stores around the world by the end of 2010.

In 2008, Starbucks explored the substitution of incandescent and halogen lighting with LED lighting to conserve energy, but found no commercially available LED product that met the company's aesthetic and functional requirements. As a result, the coffee giant reached out to GE Lighting, which devel- » page 10

POWER LEDS

Cree reports 186 lm/W LED, unveils EasyWhite bins



LED maker Cree has reported what it describes as "industry-best reported R&D results for a white power LED" of 186 lm/W. It's important to emphasize that this is a laboratory result; this level of performance is not yet available in Cree's production LEDs. However, history shows that the advanced technology behind such R&D results usually transitions into production LEDs after a certain period.

The Cree LED had a light output of 197 lm with 186 lm/W efficacy at a correlated color temperature of 4577K. The tests were conducted under standard LED test conditions at a drive current of 350mA, at room temperature. Cree also told *LEDs Magazine* that the CRI was not measured, and that the device contained an XLamp XP-G size chip mea- » page 12

3M from page 9

performance, energy efficiency, heat dissipation and reliability.

Rather than use a green GaN-based chip, the 3M approach is to bond a color-converting material to a high-efficiency GaN-based blue LED chip. The 3M material absorbs the blue light and re-emits it as green light. Using blue LEDs (ThinGaN high current UX:3) supplied by Osram Opto Semiconductors, 3M achieved record green emission of 216 lumens with 181 lm/W efficiency at a drive current of 350 mA/mm^2.

"We developed a process, covered by strong intellectual property protection, that will produce any color LED with a high degree of precision, durability and color saturation," said Steven Webster, VP of research and technology commercialization for 3M's Display and Graphics Business. "We believe this breakthrough shows a path to solving several traditional LED performance limitations."

Webster told *LEDs Magazine* that 3M has a long-standing expertise in this area, and that the company has developed a range of enhancement films for displays that make the backlight more efficient, meaning fewer LEDs need to be used. The company has also used LED light sources in pico-projector products (see photos). The converter material was developed after 3M identified a specific requirement in LED technology.

The converter material is a cadmium zinc selenide (CdZnSe) quantum-well structure, grown by MBE, which can be engineered to enable conversion to almost any wavelength. Webster said that color-converted amber showed very good results as well, but green represented the biggest improvement compared with current technology. However, Webster did not comment on the suitability of this technology for creating a white light source.

The color-converter material can be bonded at the chip- or wafer-level. Typically less than 1% of the blue light leaks through the material.

Webster expects that LED products using the converter material are "about one year away." He said that 3M is already speaking with LED makers, and has no plans to make LEDs itself. ◄

MORE: www.ledsmagazine.com/news/6/11/24

Starbucks from page 9

oped an energy-efficient LED lamp that complements Starbucks store design approach and fits existing fixtures.

"Our team jumped at the chance to create a GE-quality LED solution that could meet Starbucks stringent efficiency and color-quality requirements," said Michael Petras, president and CEO of GE Consumer & Industrial's lighting and electrical business. "Starbucks' aggressive moves on the conservation front will have far-reaching environmental and financial impacts. Other GE customers will benefit from these achievements." Following global implementation, Starbucks projects a 7 percent per-store reduction in energy use. This improvement will contribute toward the company's goal of achieving a 25 percent reduction in energy use by the end of 2010. ◄

MORE: www.ledsmagazine.com/news/6/11/21

BUSINESS

Seoul Semiconductor raises $248 million in capital

Seoul Semiconductor Co., Ltd., the Korea-based LED maker, and its affiliate company Seoul Optodevice Co., Ltd. have raised $248 million in capital. Seoul Semiconductor issued 6.9 million shares at $33.565 per share for a total of $232 million, and Seoul Optodevice issued 2.7 million shares at $5.870 per share for a total of $16 million.

The funds will be used to address increased product demand, due in part to the efficiency improvements and market acceptance of Acriche, the company's AC-driven LED light source. Another factor, says the company, is the patent cross-license agreement with Nichia signed in early 2009 (see www.ledsmagazine.com/news/6/2/1). This infusion of capital, by Singapore's sovereign wealth fund, was based on the business potential and growth opportunities for Seoul Semiconductor and Seoul Optodevice in the lighting market-place, say the company's press release, which added, "The ability to easily and quickly address expansion requirements with capital equipment and infrastructure will strengthen Seoul Semiconductor and Seoul Optodevice as world-leading LED manufacturers." ◄

MORE: www.ledsmagazine.com/news/6/11/31

Hot!

EdiStar Module Series

High/Low Bay Module Series

Products	50W Low Bay			100W High Bay		
CCT	3000K	4300K	6600K	3000K	4300K	6600K
Lumen(Typ.)	2,200lm	2,300lm	*2,700lm*	3,600lm	4,100lm	*5,000lm*
Field Angle	90°					

www.edison-opto.com.tw service@edison-opto.com.tw

T+ 886 2 82276996 F+ 886 2 82276993 4F, No.800, Chung-Cheng Rd., Chung-Ho City, Taipei 23586 Taiwan

news+views

Cree from page 9

suring 1.4 x 1.4 mm (2 mm^2). The chip size is important when trying to compare results, since a larger chip at the same current has lower current density, which should lead to enhanced performance.

MORE: www.ledsmagazine.com/news/6/12/2

Cree EasyWhite bins simplify fixture design, improve color consistency

Cree has introduced EasyWhite bins for its multichip XLamp MC-E LEDs, and says the new binning approach both simplifies LED system design and improves LED-to-LED color consistency. The bins are offered at color temperatures of 3500K, 3000K and 2700K, and are 75 percent smaller than the ANSI C78.377 standard color regions. Cree says it is responding to customers' requests for tighter color points, and that they can now buy LEDs just like traditional light bulbs, by specifying CCT and light output.

Currently, it is very difficult to produce white LEDs economically at a specific CCT with high levels of consistency. This situation, experienced by all LED makers, is due to the manufacturing issues associated with controlling both the wavelength of the blue LED chips and also the distribution of the phosphor. The resulting performance distribution requires white LEDs to be binned.

Ideally, LED manufacturers would like to use their entire distribution output of white LEDs, across all bins. However, many lighting customers need to be able to purchase LEDs that have a specific CCT and that provide visual consistency from fixture to fixture. Ideally, this means small bins centered on the blackbody curve at the required CCT.

It is possible for customers to mix LEDs from multiple bins, to achieve consistent color points. However, this can only be done with a lighting application where the output of multiple LEDs can be mixed. It also increases the manufacturing complexity, with more inventory required, more parts to place, and complicated mixing recipes.

Cree has taken the approach of carrying out the color-mixing internally within its four-chip MC-E package. Four white LED "chips" (i.e. chips with phosphor coating) are chosen by Cree, having previously been sorted, so that the resulting mixed white-light output hits the desired color point. The outcome is a series of bins that are much smaller than the ANSI-standard bins. The new bins are based on a 4-step MacAdam ellipse, rather than 7-step for the ANSI standard. Narrower 2- or 1-step bins may be introduced in the future. ◄

MORE: www.ledsmagazine.com/news/6/12/10

AUTOMOTIVE

LED headlights for Audi A8

Audi has made LED headlights available as an optional extra on the new A8. The low beams comprise 10 individual lens modules extending through the headlight in a

distinctive arc known as the "wing" owing to its shape. Just below this is another arc of 22 white and 22 yellow LEDs for the daytime running lights (DRLs) and the turn signals. These appear to the viewer as homogenous, continuous strips of light. Located above the "wing" are the high beams, whose light is generated by two powerful four-chip LEDs and a free-surface reflector system. Additional high-output LEDs generate the highway light and the cornering light. A

news+views

separate fan and heat sink regulate the temperature of each headlight unit and prevent condensation. ◄

MORE: www.ledsmagazine.com/news/7/1/2

BUSINESS

Bridgelux appoints CEO, raises $50 million

LED maker Bridgelux, Inc. has appointed Bill Watkins as CEO, replacing Mark Swoboda, who will become president. Watkins is the former CEO of Seagate Technology, the world's largest hard disc drive and storage solutions company.

Bridgelux has also raised an additional $50 million Series D financing, led by VantagePoint Venture Partners. DCM and all other existing investors also participated, along with new investors. The company intends to use the capital to "aggressively develop its manufacturing technologies and expand its global manufacturing infrastructure" to meet increasing market demand while continuing to drive its technology R&D activities.

"Bridgelux experienced substantial growth over the past two years," said Bill Watkins. "We intend to seize this opportunity and dramatically grow the company. I look forward to working with the team to build upon the strong foundation they have established. In the coming weeks we will be announcing several initiatives that will further underpin our growth strategy as we pursue this huge market opportunity." ◄

MORE: www.ledsmagazine.com/news/7/1/11

OUTDOOR LIGHTING

LightSavers program, Boston and a 98 lm/W streetlight

LightSavers, an international program to evaluate the use of LED lighting and smart controls in outdoor spaces, has been launched by The Climate Group at the UN climate talks in Copenhagen, Denmark in December 2009. LightSavers has launched a global trial to test the efficacy and cost savings of outdoor LEDs in a series of cities, beginning with Adelaide, Guiyang, Hong Kong, Kolkata, London, Mumbai, New York, Tianjin and Toronto. More details on this project can be found in our Last Word column on page 64.

The use of LED lighting for public spaces, sidewalks and roadways is being explored in Boston, Massachusetts, through the installation of a demonstration project on Boston Common. Six different styles of "acorn" fixtures were provided by Lumec Lighting, Hadco Lighting, Sternberg Lighting, Osram Sylvania, King Luminaire and Spring City Electrical. The City is in the process of identifying sites for temporary installation of "cobra head" style streetlights (see www.ledsmagazine.com/news/6/11/29).

A China-based lighting manufacturer, Ningbo Liaoyuan Lighting Co., has demonstrated a 150W street lamp with a system efficacy of 98.3 lm/W. The fixture was enabled by Cree XLamp XP-G LEDs, which have a component efficiency of up to 132 lm/W. Liaoyuan Lighting is planning volume production of these 150W street lamps to address the lighting needs of Chinese cities. The company also demonstrated a 300W street lamp, using Cree XLamp XP-E LEDs, which have been installed on Southern Guangzhou Avenue, a key 10-lane thoroughfare in downtown Guangzhou. The city is reporting energy savings of more than 40 percent over the old high-pressure sodium lights, as well as better light quality and uniformity (see www.ledsmagazine.com/news/6/12/2). ◄

CHIP MANUFACTURING

Azzurro transfers GaN-on-Si technology to Osram

Azzurro Semiconductors, which specializes in the growth of gallium nitride (GaN) on silicon (Si) substrates, has licensed and transferred its process technology for GaN-on-Si growth to Osram Opto Semiconductors. The agreement was signed in late 2008, and the transfer of the GaN-on-Si process technology is exclusive to Osram Opto until November 7, 2010. Outside the Osram agreement, Azzurro is able to license its technology to other

news+views

parties, and continues to supply GaN-on-Si epiwafers to other customers.

The proprietary GaN-on-Si technology was developed by Magdeburg, Germany-based Azzurro Semiconductors over the last six years. It enables the growth of thick and crack-free GaN-layers on Si substrates with an excellent crystal quality and minimum bow, says Azzurro.

Most LED epiwafers are grown by depositing GaN-based multilayer LED structures onto sapphire or silicon carbide (SiC) substrate wafers. Wafer sizes range from 2 to 4 inches, although some companies are also looking at 150 mm (approx 6-inch) sapphire. The use of large, lower-cost Si substrates could lead to significant device-cost reductions, provided that high-quality device layers can be grown successfully.

Erwin Wolf, CEO of Azzurro Semiconductors said "This license and transfer agreement is a big step for the commercialization of LEDs produced on silicon substrates. Our technology will enable manufacturers to use silicon fabs to produce LEDs on 150 mm, and in future also on 200 mm, silicon substrates." Azzurro says that its unique capability to grow very thick (8 micron) high-quality GaN on Si substrates (currently 150 mm) is expected to enable cost breakthroughs for high-brightness LEDs and GaN-based high-voltage devices. ◄

MORE: www.ledsmagazine.com/news/6/11/16

DECORATIVE LIGHTING

Siemens lights up revolving LED Christmas star

LEDs mounted onto the blades of a giant windmill near Munich, Germany, created a giant revolving multimedia installation in the run-up to Christmas 2009. Siemens and its lighting subsidiaries Osram and Traxon, together with multimedia artist Michael Pendry, created the Superstar, which had a span of nearly 70m and was visible from a distant of up to 30 km.

Around 1000 Traxon Dot XL-9 lighting fixtures (see photo below), each containing 9 Osram LEDs, were mounted on the rotor blades, requiring nearly 400 meters of power cables. The LEDs were fastened to the wind turbine blades (see photo right) with superglue used in space programs, since under windy conditions the LEDs are subject to forces up to 20G.

Controllable by DMX as well as DVI input signals, the Dot XL fixtures were capable of showing full-color lighting effects as well as medium-resolution video content. The lighting installation added 100 kg to each rotor blade, but tests showed that the LEDs had only a minimal effect on the wind turbine's performance. ◄

MORE: www.ledsmagazine.com/news/6/12/11

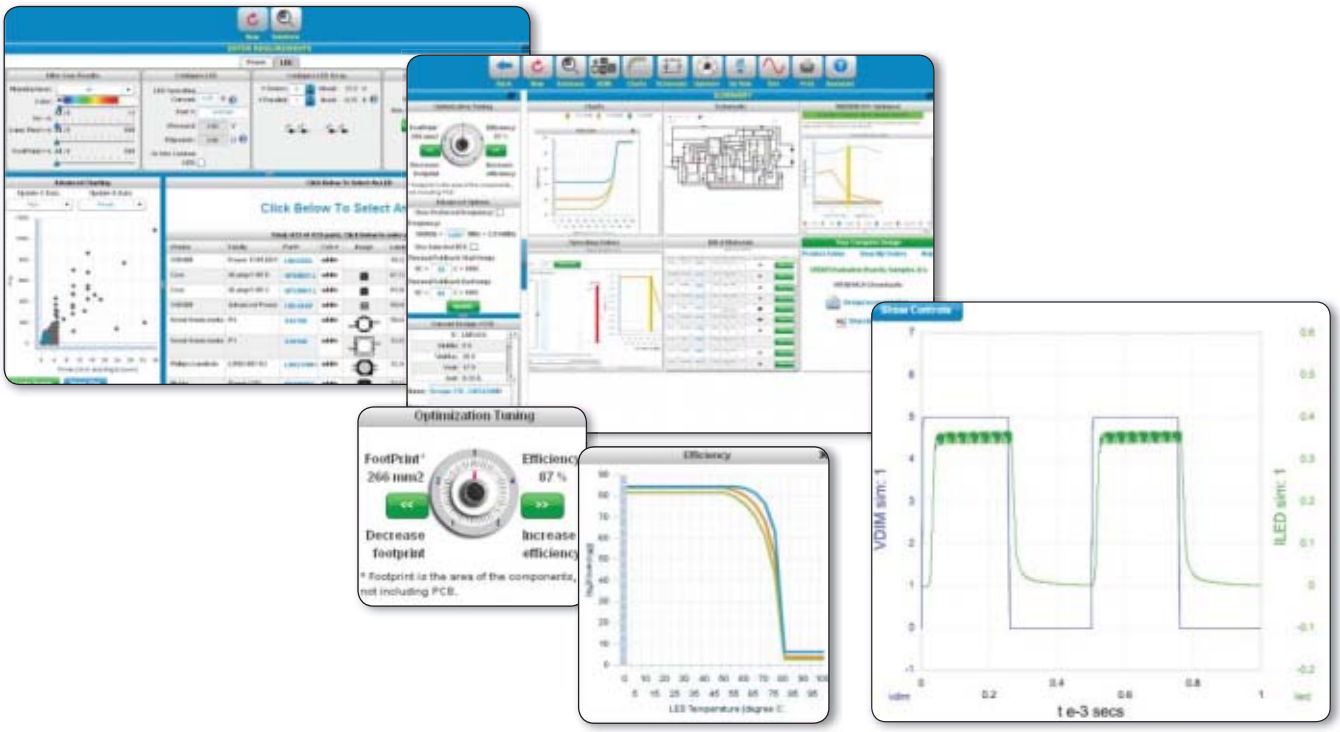
PowerWise®

High Performance. Easy Design.

Create LED Designs In Minutes

National Semiconductor's intuitive and easy-to-use WEBENCH® LED Designer online tool allows you to choose the optimal LED for your specifications and complete an LED driver design in just minutes. Now you have the world's most powerful online design environment right at your fingertips. Design, optimize, generate your prototype, and download your test vectors – all online. And do it all for free, anywhere, anytime.

- ✔ 200+ LED options
- ✔ PowerWise® LED drivers
- ✔ Reference designs and application notes



Design

Enter your application specifications and LED requirements such as color, luminous flux, drive current, and footprint for a list of more than 200 industry-leading LEDs. Then select the optimal energy-efficient PowerWise® LED driver for your application by analyzing tradeoffs such as efficiency or footprint.

Optimize

Analyze electrical properties such as power dissipation, efficiency, or LED current over various parameters. The WEBENCH circuit calculator generates a bill of materials including all of the external components required for your design.

Verify

The electrical simulator verifies circuit stability and operation, and allows you to visualize circuit behavior under dynamic conditions such as pulse-width modulation (PWM) dimming. Once your design is finished, print out a custom summary report or order a customized prototype kit.

national.com/led

National Semiconductor

60~150W
CLG Series
- PFC function
- IP65~67
- Potted with thermal-conducted glue for a better heat reduction
- Metal case
- Suitable for outdoor and street lighting

18~60W
CEN Series
- IP66
- UL8750
- Metal case
- Suitable for outdoor and street lighting

20~96W
PLN Series
- PFC function
- IP64
- UL1310 Class 2, UL879
- Plastic case
- Suitable for all kinds of LED lighting

30~60W
ELN Series
- IP64
- UL1310 Class 2
- Plastic case
- Dimming function
- Suitable for LED indoor lighting

Going Green? Go LED Power!

Dry, Damp, Wet locations

Class 2 / UL 879 SAM / UL 8750 (LED Power Source)

Mean Well's 2600 Power Supply models have been serving worldwide customers since 1982. If you are thinking green, Mean Well's LED power supplies have 9 series with dozens of models that will provide the best power solutions for your needs.

NEW

96~240W
HLG Series
- IP65~67
- UL8750
- Metal case
- Suitable for LED lighting and street lighting applications

18~60W
LP Series
- IP67
- UL1310 Class 2
- Plastic case
- Suitable for LED-based decorative, architectural lighting, and LED electronic displays

30~96W
PLC Series
- PFC function
- UL1310 Class 2
- Plastic case
- Terminal block type
- Suitable for indoor LED lighting and moving sign applications

20~60W
PLP Series
- PFC function
- PCB type
- Suitable for LED-based decorative, architectural lighting, and LED electronic displays

150W
ULP Series
- PFC function
- U bracket type
- Suitable for LED street lighting (built-in lighting fixture)

ledpower@meanwellusa.com

Call us for OEM Evaluate samples!

MW MEAN WELL

MEAN WELL USA, INC.

Tel: 510-683-8886 Fax: 510-683-8899

website: www.meanwellusa.com

funding + programs

Energy Star proposes changes to lighting program

The US Department of Energy (DOE) and Environmental Protection Agency (EPA) have unveiled a proposal to integrate the separate performance specifications for Energy Star-qualified lighting. The proposal is the result of the partnership between the DOE and the EPA, signed on September 30, 2009, which passed operational control of the Energy Star program to the EPA. The agencies are also seeking to "remove any overlap or contradiction among specifications so as to eliminate confusion." Integration will include "a specification revision process that is open and transparent, incorporating the input of partners and stakeholders and allowing adequate transition time."

There are currently four separate Energy Star performance specifications that address lighting:

- **Residential Light Fixture specification (RLF v4.2, v4.3 draft):** Developed by EPA, covers a variety of technologies including SSL. The EPA introduced SSL into its RLF v4.2 in June 2008 (marking the start of the so-called "Energy Star Wars" controversy).
- **Solid State Lighting specification (SSL v1.1, v1.2 draft):** Developed by DOE. Limited to luminaires employing SSL technology and addresses residential, commercial and industrial fixture applications. As part of the transition, DOE will complete SSL v1.2, which includes additional outdoor light fixture categories.
- **Compact Fluorescent Lamp specification (CFL v4.0)**
- **Integral LED Lamps:** Focuses on LED replacements for general service lamps, reflector lamps, and decorative lamps. The final version of the criteria was released on December 3, 2009 (see www.ledsmagazine.com/news/6/12/4) and will go into effect on August 31, 2010.

The new proposal addresses lighting in three areas: residential light fixtures, residential (replacement) lamps, and commercial/industrial light fixtures. In the short term, EPA and DOE are proposing to leave the RLF and SSL specifications in place. However, eligibility to qualify LED-based light fixtures under RLF v4.2 will be limited to decorative fixtures, as defined in a document (LSD 51-2009) co-authored by the National Electrical Manufacturers Association (NEMA) and the American Lighting Association (ALA) – see www.ledsmagazine.com/news/6/9/7. This change clarifies EPA's existing RLF V4.2 specification, and makes the number of fixtures that could qualify much smaller and more specific than formerly proposed.

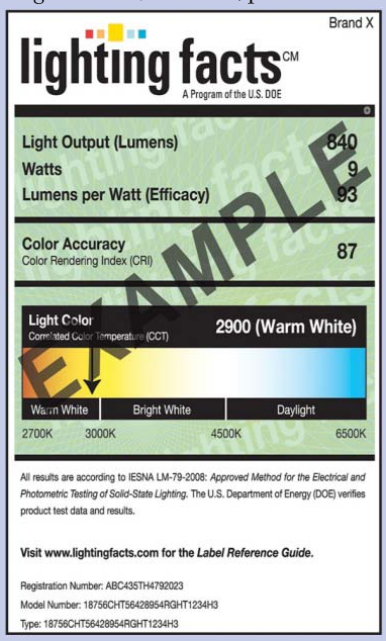
For fixtures that are currently covered by DOE's existing SSL specification, the proposal says that "no immediate changes to the performance levels, fixture categories, or test procedures are warranted. The existing test procedure for fixtures, LM-79, provides a strong and well recognized technical basis for evaluating the existing SSL fixture categories and will remain in place." For the longer term, EPA will initiate a formal specification revision effort, which among other things will reference a national standard for LED light-engine testing (currently at the draft stage).

EPA plans to release a draft specification by mid February 2010, which will be followed by a stakeholder input process involving multiple draft proposals, comment periods and stakeholder meetings before revisions are finalized and effective dates are established. ◄

MORE: www.ledsmagazine.com/news/6/12/3

Lighting Facts label receives overhaul

The DOE Quality Advocates program has updated the Lighting Facts label that is used by SSL product manufacturers to demonstrate their commitment to accurate and consistent reporting of product performance claims. The changes will make it more difficult to copy or recreate the label, following some examples where companies did just that – see "Rogue lamp labels hit the shelves," *LEDs Magazine* Nov/Dec 2009, p.17.



The label carries the same performance measurements as the original version, but now has a green background with a watermark, and includes the Lighting Facts logo. It also carries a registration number, model number and product type that are unique to each product that is registered.

A "Buyer Beware" section on the website now cautions against label misuse, stating "Only products that are registered and listed on the Lighting Facts Products list may use the label in accordance with the SSL Quality Advocates program requirements…Please report any questionable uses of the Lighting Facts label immediately to the Lighting Facts team." Manufacturer's printed labels can be checked against the official product list at www.lightingfacts.com/products. ◄

funding + programs

UL 8750 safety standard for LED lighting is published

Underwriters Laboratories (UL), an independent product safety certification organization based in Northbrook, Illinois, has published ANSI/UL 8750 "Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products." The first-edition standard creates a global platform of safety requirements for LED lighting equipment as well as the entire supply chain of components used in lighting products employing LED technology.

"UL 8750 provides manufacturers a single, much-needed safety standard for testing their LED products and related components sold in the United States," said Alberto Uggetti, general manager, UL Lighting Business.

In North America, several Nationally Recognized Testing Laboratories (NRTLs), including UL itself, are authorized to conduct product safety testing and certification of LED products according to standards that now include UL 8750 (see www.ledsmagazine.com/features/6/11/4 for more details).

The evolution of LED lighting technology created the need to address potential safety concerns, including the risk of overheating, electric shock and fire. In response, UL hosted a lighting stakeholder summit with more than 100 representatives of industry, government and testing organizations to discuss the proliferation of LED technology and its future use in lighting design and manufacturing. Using the insight gained from the summit, UL published the first of three Outlines of Investigations, or safety requirements, in January 2007 (www.ledsmagazine.com/features/4/1/3), which eventually became UL 8750. ◄

MORE: www.ledsmagazine.com/news/6/11/34

CEE unveils SSL Position Paper for manufacturers

The Consortium for Energy Efficiency (CEE) has released a position paper (see www.cee1.org) that identifies the information needed to evaluate SSL products. CEE members administer energy-efficiency programs in the United States and Canada. The paper will guide their evaluation of SSL products that they will consider promoting to commercial and residential markets. The paper also outlines the technical information needed from manufacturers for evaluation. CEE says that the paper will help manufacturers ensure that their SSL products are introduced to the market in the best light possible. Administrators have been cautious about promoting SSL products because some have failed to live up to manufacturers' claims and failed to outperform traditional lighting.

MORE: www.ledsmagazine.com/news/6/12/1

funding + programs

FTC proposes new light bulb labels

The US Federal Trade Commission (FTC) is proposing significant changes to its light bulb labeling requirements, which could see an end to statements such as "equivalent to a 60-watt light bulb." The proposed amendments apply to common household (medium screw-base) light bulbs, including general service incandescent bulbs and CFLs, and would also apply to medium screw-base LED lamps. A comment period closed at the end of December 2009.

Current FTC regulations require that most incandescent and CFL packages display information about the product's light output (in lumens), energy use (in watts), and lamp life (in hours). The proposed amendments create a two-panel labeling format. The front panel will show brightness in units of lumens (although lumens are actually the units for luminous flux) and estimated energy cost in dollars per year. The side or rear will carry a Lighting Facts label, similar to the labels introduced by the DOE's Quality Advocates program, carrying additional information including lifetime, color appearance and power usage.

The two data points on the front of the package are those shown by focus groups to be most important to buyers when trying to compare products. The choice to emphasize lumens, not watts, as the measure of lamp brightness is significant. Research showed that "respondents mistakenly understood the measure of brightness to be wattage, and this was how they selected bulbs." . ◄

MORE: www.ledsmagazine.com/news/6/11/26

SMASH looks at nano-structured LEDs

A group of 14 partners from across Europe are participating in a program to establish disruptive materials technologies and processes based on nano-structured LEDs. SMASH is an EU-funded project with a budget of EUR 11.5 million and is coordinated by Osram Opto Semiconductors GmbH. The other participants are Universita di Roma "Tor Vergata" (Italy), University of Kassel, Technical University Braunschweig and Paul Drude Institute Berlin (Germany), CEA-LETI Minatec, CRHEA-CNRS and L-up SAS (France), University of Bath, Oxford Instruments Plasma Technology Ltd and MacDermid Autotype Ltd (UK), Universidad Politecnica de Madrid (Spain), Obducat Technologies AB (Sweden) and International Laser Centre (Slovakia).

The project is addressing high power efficiency and low cost, two key success factors for the broad penetration of LEDs into the general lighting market. It will look at two different approaches:

- Novel low-defect, strain-free nanostructured templates that enable epitaxial growth of LED structures on large-area substrates with high efficiency
- Arrays of nanorod emitters to realise LEDs with high efficiencies and unique properties.

Both approaches will have a large impact on costs because they allow epitaxial growth on large area, low cost substrates such as silicon.

MORE: www.smash-fp7.eu

CREE RGB AND BRIGHT-WHITE, HIGH-BRIGHTNESS LEDs FOR VIDEO, DISPLAY AND SIGNAGE

LIGHTING THE LED REVOLUTION™

GAME CHANGING PERFORMANCE.

CREE HIGH-BRIGHTNESS LEDs.

Cree LEDs are revolutionizing lighting. Our full line of RGB and white high-brightness LEDs deliver high-performance at an economical price. Cree can help you bring energy-efficient LED light to video screens, display and informational signage, channel lighting, light strips and architectural lighting worldwide.

LEAD-FREE
RoHS-COMPLIANT

4-mm Oval LED

Screen Master Series for matched Radiation pattern

Luminous Intensity (mcd)
- C4SMF
  Red (1100 - 4180)
  Green (2130 - 8200)
  Blue (550 - 2130)

PLCC4 3 in 1 SMD LED

Luminous Intensity (mcd)
- Red (355 - 900)
- Green (560 - 1400)
- Blue (180 - 450)

Viewing Angle: 120 degree

PLCC6 3 in 1 SMD LED

Water-Resistant (IPX5*)

Moisture Sensitivity Level: 3

Luminous Intensity (mcd)
- Red (560 - 1120)
- Green (1120 - 2240)
- Blue (280 - 560)

PLCC4 1 in 1 SMD LED

Color Temperatures (K)
- Cool White: Min. (4600) / Typical (5500)
- Warm White: Min. (2500) / Typical (3200)

Typical CRI: Cool White 72, Warm White 80

Luminous Intensity (mcd)
- Cool White (1800 - 4500)
- Warm White (1400 - 3550)

Contact an authorized distributor at www.cree.com/hb or call 800-533-2583.

CREE®

* This part is tested under the condition of assembling it on a PCB with isolating the electrical path by silicone.

focus on

Fabs & Growth

Reflecting the growing level of demand in the LED industry, particularly for backlighting applications, a number of companies are investing in capacity expansions. In some cases, this involves building or acquiring new fabrication facilities, or forming joint ventures and partnerships with other companies.

Osram begins production at Penang LED chip plant

Osram Opto Semiconductors has announced that its second LED chip-production facility, located in Penang, Malaysia, is now in full operation. Two years after the ground-breaking ceremony in July 2007 (see www.ledsmagazine.com/news/4/7/21), the last installation work has been completed and the test phase successfully concluded in what Osram describes as "the world's most modern LED chip production plant." The new plant complements the company's main production facility in Regensburg, Germany, which was expanded in 2008 (see www.ledsmagazine.com/news/5/4/9).

The production facility in Penang makes the German company the first LED manufacturer with high-volume chip production facilities in Europe and Asia. Osram says the new facility will enable it "to respond flexibly to the demand for top-quality LEDs at competitive prices in the LED market, which has begun to pick up steeply again."

Osram Opto Semiconductor's new chip-production facility in Penang.

Development of the 35,000-m^2 facility area has involved the investment of tens of millions of euros, and has created over 220 new jobs in Penang. Osram Opto Semiconductors employs around 2,600 of its total worldwide workforce of 4,400 at its Malaysian facility, which also hosts major packaging facilities.

Routine production is now under way of indium gallium nitride (InGaN)-based LED chips, fabricated on 4-inch wafers. Ruediger Mueller, CEO of Osram Opto Semiconductors said: "There is no question that the rise of the LED, which has only just begun, is set to sky-rocket in the coming years. This is why we are pursuing our investment and expansion course consistently and uncompromisingly, even in this difficult economic environment. With our production facilities in Germany and Malaysia, we are now in an ideal starting position in terms of quantity and quality."

MORE: www.ledsmagazine.com/news/6/12/8

Cree to produce LED chips outside USA

LED maker Cree Inc. has agreed to purchase a 592,000-sq. ft. facility in Huizhou, Guangdong Province, China, which will be the company's first chip-production facility outside North America. The new facility will be used to make high-brightness and lighting-class LED chips, although epitaxial wafer growth will not be carried out at the new plant. Chip production is likely to commence in mid-to-late 2010. The new facility will also enable future expansion of components manufacturing.

A Cree spokesperson explained that the company's existing facility in Huizhou is used primarily for LED packaging, and was acquired when Cree bought Cotco, a Hong Kong-base LED maker (see www.ledsmagazine.com/news/4/3/12). More than half of Cree's employees work in China, mostly at the current Huizhou factory.

"This investment enables us to expand our presence in China and demonstrates our commitment to serving the growing demands of both our local and global LED customers," said Chuck Swoboda, Cree chairman and CEO. "We are building on a solid foundation in Huizhou with a strong local management team and a history of manufacturing excellence."

Cree also announced that Huizhou is the first city in southern China to join the LED City® program, an international initiative to promote the deployment of energy-efficient LED lighting. Huizhou has completed several LED streetlight trials and is in the process of deploying LED streetlights in the ZhongKai Hightech Industrial Zone.

MORE: www.ledsmagazine.com/news/6/11/11

Interview:

M.J. Jou, President of Epistar Corporation

What current applications are creating most demand for LED chips?
Firstly, LED backlights for LCD TVs, notebook PCs, monitors and mobile devices, and secondly, functional lighting.

Is there enough supply capacity in the industry to meet demand?
Currently, demand is more than supply, particularly for TV and monitor applications.

What is Epistar doing to address this situation?
We are expanding our capacity by the following: (1) expand our own capacity in Taiwan (2) invest or cooperate with chip makers such as Teckore and Nan Ya Photonics (3) set up fab operation in China.

Is it correct that Epistar is planning to build another LED chip factory in China?
Yes, we are going to set up an LED fab in Chang Zhou, Jiangsu province. The facilities are expected to be completed by October 2010 and we plan to begin mass production by either 1st or 2nd quarter of 2011.

Where are Epistar's other LED chip production facilities?
We have five fabs in Hsinchu Science-Based Industrial Park and two fabs in Tainan Science-Based Industrial Park, all in Taiwan. In addition, we have two chip production facilities in China other than Chang Zhou, one in Xiamen and the other in Dalian.

For how long will LED demand exceed supply capacity?
It is difficult to tell, depending on the penetration rate of LED into TV/monitor and lighting applications. We believe it will last for about one to two years before supply is able to catch up with demand.

Is Epistar a major LED supplier to the LCD-backlight market?
Yes, our chips are widely used for TV and notebook applications. Last year, our market share is around 50% and our major customers are located in Japan and Korea. This year we have customers from Taiwan and China as well.

Why has Epistar made investments in other companies such as Tekcore?
We believe that the LED industry shall try to fully utilize the current capacity and not expand over-aggressively. By investing in Tekcore, we can leverage the capacity as well as raw material cost. We have also invested in Nan Yan Photonics for the same reason.

When do you expect to see a major surge in demand for LEDs for general lighting applications?
It really depends on how fast the LED industry can achieve the lumen per dollar target. Generally speaking, we believe 2014 to 2015 will probably see a major surge in demand for general light.

SemiLEDs to open production fab in China

LED maker SemiLEDs Corp. has established a new state-of-the art fabrication facility in Foshan, Guangdong Province, China. The facility will produce LED wafers and high-power LED chips using SemiLEDs' patented vertical-LED-on-metal technology. The new facility will be developed in three stages. The first stage will involve an investment of $96 million, and full-scale production is expected to commence by October 2010. The initial monthly production capacity will be 20 million 1×1-mm LED chips per month, which will made on 4-inch wafers. Both investment and production are expected to grow by a factor of three times within a period of three years.

Headquartered in Boise, Idaho, SemiLEDs also has production facilities in Taiwan. In July 2009, SemiLEDs announced the opening of a third production facility in Hsinchu Science Park, Taiwan (see www.ledsmagazine.com/news/6/7/8), which the company said would bring its capacity for 1×1-mm high-power LED chips to 15 million per month (before the new facility in China comes online).

SemiLEDs says that the new facility in China will provide the company with the opportunity to provide further service and support to a growing number of companies involved in solid-state lighting throughout China, while further increasing production to meet rapidly growing global demand. The LED maker supplies chips to many packaging companies in China that focus on solid-state lighting applications such as street lights, and commercial and residential lighting.

SemiLEDs Chairman and CEO Trung Doan said "Developing a fabrication facility in the NanHai Economic Development Zone will allow SemiLEDs to be in the center of the LED industry in China. This is especially true since NanHai has invested RMB 2 billion (around $290 million) to support the industry's development. The government provides great support and, combined with the local industry, it makes a perfect match. The presence of SemiLEDs in China at such a large scale is a further proof of trust from customers for SemiLEDs products and technology."

MORE: www.ledsmagazine.com/news/6/11/17

Superb LED Lighting by XLEDs, Korea

CE c UL us ENERGY STAR PARTNER

LED MR 16 LAMP 8W

GA1607S
8W
12V
280Lm
440Lux

LED MR 16 LAMP 4W

1605TL
4W
12V
190Lm
320Lux

LED Desk Lamp 10W

3 Color Mode
Q-200
10W
12V
1400Lux

3-Color Change Mode

XLEDs

Light Temptation

DAEJIN DMP Digital Micro Products
DoHyeon B/D 4F #128-6 Nonhyeon-dong, Kangnam-Gu, Seoul Korea, www.exleds.com
Tel : 82-2-3443-5360 ext 309 Fax : 82-2-3443-5351 E-mail : info@daejindmp.co.kr

Taiwan LED industry continues growth, invests in China

Taiwan-based companies are continuing to expand their capacity and to develop relationships with one another. Unconfirmed reports indicate that Taiwan-based LED chip and epiwafer makers Formosa Epitaxy and Arima Optoelectronics, as well as lighting manufacturer Neo-Neon, are all planning to invest in new LED fabrication facilities in mainland China. More developments among Taiwan-based companies are described elsewhere on pages 26 and 27.

One of the most active companies is also the country's largest LED chip maker, Epistar. In December 2009, the company announced plans to invest $120 million in a mainland Chinese company, tentatively named Changzhou Company, which will manufacture and sell LED epiwafers and chips. The new fab in Chang Zhou, Jiangsu province, will be Epistar's third in China, as confirmed by Epistar's president M.J. Jou (see Interview, page 24).

Epistar is also investing $8 million in United LED Corp., another LED chip and epiwafer manufacturer that will be located in Shan Dong province. UMC, a silicon semiconductor foundry company, has invested the same amount in the same company (see below).

Earlier in 2009, Epistar raised US$351 million in financing (see www.ledsmagazine.com/news/6/9/23) and also celebrated its 150th production MOCVD tool purchased from Aixtron GmbH (www.ledsmagazine.com/press/19011).

In October 2009, Epistar announced that it would invest NTD722.4 million ($22.7 million) to acquire a 19.9% stake in Tekcore, a smaller LED chip and epiwafer supplier. Epistar's filing said that the move was for reasons of "sharing resources with our strategic partner, reducing the potential risk of substantial expansion, enhancing profitability, and increasing shareholders' equity."

For similar reasons, Epistar announced a collaboration agreement with Nan Ya Photonics Inc. in December 2009. Epistar will invest approximately NT$1 billion ($31.5 million) in the LED epiwafer and chip maker.

Silicon foundries TSMC and UMC look at LEDs

Both Taiwan Semiconductor Manufacturing Co., Ltd. (TSMC) and United Microelectronics Corporation (UMC), two of the world's largest wafer foundry companies, are investing in LEDs. As silicon semiconductor device makers, these companies are experts at high-volume, low-cost manufacturing and clearly feel they can extend this expertise to the non-silicon world of LEDs. Success will be more likely if processes can be developed to grow LEDs on large-diameter (150 mm and above) silicon wafers. This will also enable TSMC and UMC to employ any under-utilized 150-mm fabrication lines.

Both companies are investing in LEDs. Among the resolutions passed at the TSMC board meeting on November 10 last year was approval for capital appropriations of US$46 million to set up a production line and product development lab for solid-state lighting. Unconfirmed rumors last year suggested that TSMC was looking to acquire an LED maker (www.ledsmagazine.com/news/6/9/19), with Philips Lumileds and Toyoda Gosei suggested as candidates.

Meanwhile, in December, UMC revealed in a stock-exchange announcement that it was to invest US$8 million in United LED Corp. Based in Shan Dong province, the company will be involved in LED

chip design, manufacture and sales. In a separate announcement, LED chip maker Epistar also announced an investment of $8 million in United LED Corp. UMC has also invested $1 million in U-Lighting Opto-Electronic (Shan Dong) Inc., which will conduct LED lighting manufacture and sales.

AU Optronics LED subsidiaries to merge

Lextar Electronics Corp., a Taiwan-based maker of LED epitaxial wafers and chips, is to merge with SMD LED maker LightHouse Technology through a 1:1 stock swap. Both companies are affiliates of LCD panel maker AU Optronics (AUO).

The AUO Group has a 35% stake in LightHouse, and is the biggest shareholder of Lextar. Vertical integration will enable Lextar to speed up product development and provide more cost-effective lighting solutions and services to clients. Lextar currently has about 20 MOCVD machines, while LightHouse has a monthly capacity for packaging 500 million LED chips, according to various reports. Orders from AUO, mainly for LED backlights for notebooks, account for 30%-40% of LightHouse's total revenues. Lextar apparently intends to invest hundreds of millions of dollars to build LED chip manufacturing facilities in Taiwan.

HUGA boosts BLU LED capacity

LED chipmaker Huga Optotech recently ordered six more Aixtron MOCVD tools for its production facility in the Taichung Science Park, Taiwan. The six AIX 2800G4 HT MOCVD reactors, in the 42×2-inch configuration, add to the 13 similar systems already in operation for the high-volume manufacture of LED epiwafers. Sybil Yang, Huga's CEO, said the company would place more orders for MOCVD systems in 2010 to increase its capacity. "The next phase of expansion in our business involves the strongly growing high-brightness backlighting LED product market and it is necessary to add further manufacturing capacity." The company plans to enter more diversified application markets for lighting and automotive in the near future.

MORE: www.ledsmagazine.com/press/20640

Tyntek acquires Ubilux

Tyntek Corp, a Taiwan-based LED chip maker, has acquired Ubilux Optoelectronics Corp., the LED chip manufacturing arm of Powerchip Semiconductor Corp, Taiwan's second-largest computer memory chipmaker. Powerchip is now the biggest shareholder in Tyntek. The company has aggressive expansion plans and will increase the number of MOCVD tools used to make LED chips, from six units at present to 30 units by the end of next year.

MORE: www.ledsmagazine.com/news/6/10/24

麗光科技股份有限公司

Beautiful Light Technology Corporation

Green Technology of Lightings

bltc
www.bltc.com.tw ®

Headquarter / 本社:
TEL: +886-5-2392881 / FAX: +886-5-2392007
Address / 住所: No. 16-2, Dingshanmen, Neighbor 12, Jinlan Village, Jhongpu Township, Chia-yi, Taiwan.
Zip code: 60665 / Sales / 営業窓口: sales@bltc.com.tw / Technical / 技術サポート: service@bltc.com.tw

Factory / 工場:
TEL: +86-769-8312-2838 / FAX: +86-769-8312-2128
Address / 住所: Golden Rooster Hills (JinJiLing), Shabu Village, Dalang Town, Dongguan City, Guangdong Province, China
Zip code: 523755

When considering an LED retrofit or incentive policy, do your research

Evaluation of 250 LED bulbs and fixtures from 23 leading vendors indicates that LEDs offer compelling payback periods when compared to conventional incandescent and halogen lighting solutions. However, as **DAVID RAEZER** and **ROMAHLO WILSON** describe, LEDs are not yet competitive as replacements for compact fluorescent, metal halide, and linear fluorescent lights.

LED payback period by end-market, application, and conventional benchmarks

	Incandescent	Halogen	CFL	LF	MH
RESIDENTIAL: LOW INTENSITY DIRECTIONAL LIGHTING (WARM WHITE, UNDER 500 LUMENS)					
	2.0	107	5.3	–	–
RESIDENTIAL: HIGH INTENSITY DIRECTIONAL LIGHTING (WARM WHITE, OVER 500 LUMENS)					
	2.9	2.7	12.9	–	8.1
RESIDENTIAL: OMNIDIRECTIONAL LIGHTING (WARM WHITE)					
	1.7	–	6.2	–	–
COMMERCIAL OFFICE: LOW INTENSITY DIRECTIONAL LIGHTING (COOL WHITE, UNDER 500 LUMENS)					
	1.8	1.7	4.5	–	–
COMMERCIAL OFFICE: HIGH INTENSITY DIRECTIONAL LIGHTING (COOL WHITE, OVER 500 LUMENS)					
	3.3	3.4	12.5	8.1	7.8
COMMERCIAL OFFICE: OMNIDIRECTIONAL LIGHTING (COOL WHITE)					
	1.8	–	5.9	21.5	–
RETAIL: LOW INTENSITY DIRECTIONAL LIGHTING (UNDER 500 LUMENS)					
	2.3	2.2	5.0	–	–
RETAIL: HIGH INTENSITY DIRECTIONAL LIGHTING (OVER 500 LUMENS)					
	3.4	3.5	6.9	–	7.8

Applications where average SSL payback periods are quick and extremely attractive are highlighted in green, modestly attractive in yellow, and least attractive in red (LF = linear fluorescent, MH = metal halide).

While LEDs can save substantial energy and maintenance costs over the course of their lifetime, the investment case associated with their adoption is often difficult to discern among the maze of general lighting reports, marketing materials, and strong competition from conventional lighting solutions. The information and independence that municipalities, institutions, and real estate stakeholders need is often so illusive that a large municipality asked Cleantech Approach (CTA) to determine the scenarios—spanning a range of vendors, products, applications, and end-markets—under which it made financial sense to move ahead with LED implementation.

As lighting accounts for approximately 16% of the municipality's energy consumption, it is a central part of its energy efficiency and sustainability efforts. This information was critical as the municipality considered retrofitting their own facilities and sizable infrastructure, as well as creating effective legislation and financial incentives for property owners and citizens to retrofit their own properties.

Benchmarking

Effectively charged with determining where LEDs offer the most compelling return on investment (ROI), we benchmarked them against the most prevalent conventional lighting solutions (incandescent, halogen, CFL, linear fluorescent, and metal halide) across three end-markets (residential, commercial office, and retail).

Given the specificity of products, CTA further subdivided each end-market by application: directional, low-intensity (under 500 lumens, the equivalent of a 50W incandescent); directional, high-intensity (over 500 lumens); and omnidirectional.

With the end-markets and applications established, we used purchase price, performance (total power, light output, and efficacy), and lifetime cost of operation (including electricity, bulb replacement, and maintenance costs) to calculate the payback periods for a representative group of LED products: 250 LED bulbs and fixtures from 23 leading vendors.

Besides the general availability of capital and the relative ROIs of competing initiatives, payback period is often the most critical metric when evaluating upgrades to costlier lighting solutions. To calculate

DAVID RAEZER *and* ROMAHLO WILSON *are Partners at Cleantech Approach (cleantechapproach.com), an independent research and advisory firm focused on helping municipalities, global development organizations, and private businesses devise sustainable, technology-enabled strategies.*

the payback period (in years) for any given LED fixture or replacement bulb, Cleantech Approach determined the time required to recapture the initial price premium (excluding user-specific installation costs) through associated operational cost savings. These operational cost savings included lower electricity costs from higher LED efficacies, as well as the absence of bulb replacement and lower maintenance costs from longer LED lifetimes. It should be noted that CTA's maintenance costs assumed a standard "screw in" replacement. Systems with more time consuming and costlier replacement requirements (e.g., the removal of paneling) would make the payback period even longer.

With this payback-oriented analysis, we isolated the end-markets, applications, and conventional solutions for which LEDs currently offer a compelling ROI, and equally important, where they do not (see table).

Payback analysis

CTA's detailed report yielded the following four critical conclusions.

Incandescent lighting

Compared with incandescent lighting solutions, LEDs offer a compelling payback period of 1.7 to 3.4 years.

On average, annual electricity costs for incandescent lighting solutions are four to six times greater and their bulb lifetimes are 4% to 5% of their LED counterparts. This yields an overall cost of operation that is 8 to 14 times greater and a payback of the initial LED price premium (7 to 62 times their incandescent counterparts) over 1.7 to 3.4 years. CTA's analysis suggests that paybacks are fastest (1.8 to 2.0 years) for directional, low-intensity applications; attractive (2.9 to 3.4 years) for directional, mid- and high-intensity applications; and surprisingly quick (1.7 to 1.8 years) for omni-directional applications.

Halogen lighting

Compared with halogen lighting solutions, LEDs offer a compelling payback period of 1.7 to 3.5 years.

On average, annual electricity costs for halogen lighting solutions are four times greater and their bulb lifetimes are 4% to 6% of their LED counterparts. This yields an overall cost of operation that is 7 to 15 times greater and a payback of the initial LED price premium (3 to 10 times their halogen counterparts) over 1.7 to 3.5 years. CTA's analysis suggests that paybacks are fastest (1.7 years) for directional, low-intensity applications, and attractive (2.7 to 3.5 years) for directional, mid- and high-intensity applications.

Compact fluorescent lamps

Compared with CFL solutions, LEDs are bordering on competitive payback periods (4.5 to 6.2 years) in directional, low-intensity applications, but are uncompetitive in directional, high-intensity applications.

On average, annual electricity costs for CFL lighting solutions are 1.1 to 1.4 times (10% to 40%) greater and their bulb lifetimes are 11% to 17% of their LED counterparts. This yields an overall cost of operation that is 3 to 7 times greater and a payback of the initial LED price premium (4 to 8 times their CFL counterparts) over 4.5 to 12.9 years. CTA's analysis suggests that paybacks are fastest (4.5 to 5.3 years) for directional, low-intensity applications; uncompetitive (12.9 years in residential and 12.5 years in commercial office) for directional, high-intensity applications; and modestly attractive (5.9 to 6.2 years) for omni-directional applications.

Metal halide or linear fluorescent

Compared with metal halide or linear fluorescent lighting solutions, LEDs offer an uncompetitive payback period of approximately eight years.

On average, annual electricity costs for metal halide and linear fluorescent solutions are roughly equivalent and their bulb lifetimes are 13% to 25% of their LED counterparts. This yields an overall cost of operation that is one to three times greater and a payback of the initial LED price premium over 7.8 to 21.5 years.

Overall, Cleantech Approach's report indicates that large energy savings can be realized by replacing inefficient lighting with more efficient LED solutions. These efforts will concentrate on replacements of standard incandescents and halogens (incandescent technology still represents over 60% of US lamp shipments). Moreover, the report indicates that the upfront cost premiums of these solutions can be recouped relatively quickly (less than two years) through their associated electricity, replacement, and maintenance cost savings.

Accordingly, depending on the sentiment of their constituencies and the availability of capital, municipalities can make a strong case in favor of hastening the adoption of LED technologies through the creation of "green building" legislation and financial incentives for citizens.

Though the lack of available capital, lower occupancy rates, and the inability to recoup investment costs from tenants has slowed the pace of adoption in the current economy, the rapid pace of LED development will continue to lower costs and payback periods.

For those who are concerned about investing in the technology too early, Cleantech Approach recommends a phased approach of replacing fast-payback bulbs and fixtures to capture upfront cost savings now; other conventional bulbs and fixtures can wait until their associated payback periods fall into a more reasonable range. This approach can be implemented across the board from single residential owners to large commercial and retail facilities.

A complimentary copy of CTA's "Solid State Lighting: Benchmarking Report," containing detailed product analysis by application, is available to *LEDs Magazine* readers and can be downloaded from www.cleantechapproach.com/LEDsMagazine. Cleantech Approach will continue to cover developments in the lighting market through regular updates of its report.

Lyon illuminates European

European directives, LED standards, color quality and technological innovation were among the main subjects discussed at December's ForumLED in Lyon, France, writes **TIM WHITAKER**.

A comprehensive perspective on the solid-state lighting market, mainly from European speakers and exhibitors but with some international participants, was provided at ForumLED, held in Lyon, France in December 2009. Lyon is home to Le Cluster Lumière (www.cluster-lumiere.com), with 85 member organizations from throughout the lighting industry value-chain. Many French companies and organizations are actively involved in solid-state lighting, with energy efficiency high on the agenda.

In France, lighting is becoming the main energy consumer in office buildings, typically using 30-50 kWh/m^2/yr, according to Christophe Martinsons of CSTB Grenoble. However, the next building code (RT 2012) will require total energy consumption (i.e. for everything, not just lighting) of 50 kWh/m^2/yr for non-residential buildings from 2011, and for residential buildings starting in 2013. LEDs are "excellent candidates," said Martinsons, to reduce energy consumption, particularly in combination with occupancy sensors. However, energy is not the only consideration. "Building occupants demand good products, well installed, and safe products that are safely installed," he said, adding that standards will help LED lighting to meet these requirements. "However, Europe has not produced all the standards needed for LED lighting…yet."

Martinsons heads the CITADEL program (www.ledsmagazine.com/features/6/4/10), which will gather real data on performance, reliability, safety and user acceptance, to assist the integration of LED lighting in buildings. Among the program's expected deliverables are building a set of LED-lighting standard devices for traceability of photometric measurements, establishing protocols for measurement and accelerated ageing, and identifying breakdown mechanisms.

European perspective

Many European policy directives and European Commission (EC) activities are being driven by the EU's key climate and energy objectives for 2020. These are to reduce greenhouse gas emission by 20%, to reduce energy consumption by 20%, and to reach a level of energy generation from renewable sources of 20%. Improving end-use efficiency is recognized as the fastest and cheapest way to reduce CO_2 emissions by 2020, said Paolo Bertoldi of the EC Joint Research Centre (JRC) Institute for Energy. In 2007, lighting accounted for 10% of the final electricity consumption in the 27 countries currently in the EU (EU-27). This comprised 84 TWh/yr for residential lighting, 164.5 TWh/yr for tertiary lighting (e.g. offices, schools, industry etc) and 36 TWh/yr for street lighting. Bertoldi explained that a JRC study indicated that total replacement of incandescent lamps in the residential sector with CFLs could save the EU-27 about 44 TWh.

In March 2009 the EC adopted an Eco-Design Regulation to improve the energy efficiency of household lamps, which stipulates the progressive phasing out of incandescent bulbs. The phase-out started in 2009 and will finish at the end of 2012, and applies to non-directional lamps. Directional (reflector) lamps, such as spots, will be covered by a dedicated measure in 2010. A less well-known directive has also been implemented that relates to tertiary lighting, and which will eliminate inefficient fluorescent and HID lamps, as well as magnetic ballasts.

Bertoldi also described the European GreenLight program (www.eu-greenlight.org), which is an ongoing voluntary program in which private and public organizations commit to the EC to reduce their lighting energy use. Launched in early 2000, GreenLight has 575 partners. The EC provides free publicity and support to the partners in the

LED Roadway Lighting from Nova Scotia, Canada, manufactures street lights using Nichia LEDs. The full optical pattern is provided by groups of 12 LEDs.

view on LED lighting

(above) Capelec Electronics' booth. (left)LED modules operating under water from Light Engines, a company headquartered in Geneva, Switzerland.

form of information resources and public recognition. Partners don't receive funding, because the projects are expected to be cost-effective and to pay for themselves through energy savings. Obviously, the partners also have better lighting conditions, which is good for their employees and their clients. They also get technical assistance, and the potential to receive financing from energy suppliers in the form of up-front capital loans.

Color quality

The CIE 1931 standard colorimetric system is widely used, but also heavily flawed, explained Prof Janos Schanda of the University of Pannonia in Hungary. The TC1-36 technical committee of the CIE (International Commission on Illumination) is working on a new colorimetric system based on cone fundamentals i.e. color matching functions derived from cone spectral sensitivities. The new system is significantly different from the existing one in the blue spectral region. Another CIE group (CIE1-69) is working on a replacement for color rendering index (CRI), which is also known to be flawed. The new approach combines aspects of color fidelity, which is similar to color rendering (i.e. the best resemblance under reference illumination) and color preference, which is a more complex concept. Different labs around the world are conducting experiments in these areas. Other CIE technical committees are shown in the Table (p.34).

Françoise Viénot of France's Museum of Natural History, had a message for the LED community: "Yes, improve the technology, increase the efficacy, but, for everyday life, give priority to a complete light spectrum in order to provide color rendering fidelity and visual comfort," she said. Her talk began by stating what is expected from illumination: white light with high efficacy, low energy consumption, limited energy in the UV and NIR regions, and the ability to adjust intensity. Visual quality is also required, and this means color fidelity, fine color discrimination, natural appearance and appropriate visual performance, as well as newer criteria such as brightness, pleasantness, comfort, and appearance of detail. In fact, she said, there is a visual paradox concerning color vision and color rendering, which requires a design choice to be made between maintaining fidelity, discrimination and naturalness, or offering colorfulness, enhancement and beautification. Another issue is that the subjective visual sensation does not correlate with measured performance.

Chip development

LEDs are still in the technology phase of the market, but are in transition to high-volume solid-state lighting applications, said Berthold Hahn of Osram Opto Semiconductors. There continue to be rapid developments, he said,

Selected CIE Technical Committee (TC) activities (www.cie.co.at)

TC	Coverage
TC1-36	Fundamental chromaticity diagram with physiologically significant axes (replacement for CIE 1931 system)
TC1-58	Visual performance in the mesopic range
TC1-69	Colour rendering of white light sources (working on a new metric to replace CRI)
TC2-46	CIE/ISO standards on LED intensity measurements (based on CIE 127:2007 Measurement of LEDs, 2nd ed.)
TC2-50	Measurement of the optical properties of LED clusters and arrays
TC2-58	Measurement of LED radiance and luminance
TC2-63	Optical measurement of high-power LEDs
TC2-64	High-speed testing methods for LEDs
TC2-65	Photometric measurements in the mesopic range
TC 2-66	Terminology of LEDs and LED assemblies
TC 4-47	Application of LEDs in transport signaling and lighting
TC 6-55	Photo-biological safety of LEDs

with efficiencies in the 75-100 lm/W range available today, and the economics are "starting to work." Numerous applications can achieve break-even in total cost of ownership. OLED lighting is even earlier in the development cycle, and challenges remain before OLED lighting comes to market.

The potential for energy savings using LEDs is very large, said Hahn. Today, replacing existing installations with the best available alternatives would save 30% of the energy used by lighting. However, in the future, the combination of LEDs, sensors and embedded software in intelligent lighting networks has the potential to save an additional 40%.

Focusing on chip technology, Hahn explained that Osram Opto has achieved a 4-fold increase in brightness within 4 years for blue 1W LED chips, reaching 643 mW with an advanced R&D device. Improvements include the introduction of multi-quantum well (MQW) structures to improve the performance at high drive currents, and enhanced light extraction through optimized surface roughening.

Also, in the standard ThinGaN structure, metal n-contacts are placed on the top surface of the emitter, and these absorb some of the light before it leaves the chip. However, in the company's latest UX:3 structure, the n-contacts are buried within the chip. The results include a 5% brightness increase for blue and green emission (at 350mA), as well as 10-20% brightness increase for white LEDs due to improved chip-phosphor interaction. The chips also exhibit less droop, with just 15% deviation from linear behavior in the 350-1000 mA range, as well as a reduced forward voltage of 200mV at 1A.

The UX:3 chip technology has resulted in significant improvements, with R&D results (using 1mm^2 chips at 350 mA) of 155 lm and 134 lm/W for cold white (5000K) and 124lm and 104 lm/W at 3000K and 82 CRI. Hahn said that the efficiency limit for cold white is about 180 lm at 350 mA. He also the use of white and red LEDs together to achieve warm-white light with high CRI.

Nichia's new LEDs

On the exhibition floor, Nichia showed its 3.5W Helios LED (designated NS9W153M), which contains 9 chips in a package measuring 4.0 x 4.0 x 0.85 mm. At 350 mA the forward voltage is 10.5V, and the device produces 350 lm with "standard" CRI at a color temperature of 5000K. This is equivalent to 95 lm/W. The warm-white version has an output of 250 lm with "moderate" CRI at 3500K. For point-source applications, Nichia's NCSW119 containing a flip-chip and a domed lens, has an output of 130 lm at 350 mA with a forward voltage of 3.3V at 5000K and standard CRI. The efficacy is in excess of 110 lm/W. The warm-white version (3500K) produces 92 lm.

Replacement lamps

Solid-state lighting will take over completely in the not-so-distant future, even in the consumer market, said Peter Deixler of Philips Lighting, describing the advantages of LED retrofit lamps. "Professional markets are opening up based on energy and cost savings," he said, with the important factors being performance, payback and carbon footprint. In the consumer market, the key selling points are look and feel, value for money and "green" concerns.

For mass adoption by consumers, Deixler said that SSL retrofits must approach CFL-like price points, which he described as a "huge cost-stretch for SSL right now." However, Philips believes this is "absolutely possible" thanks to very significant, volume-driven, LED component price erosion coupled with radical technological and scientific innovation. Examples of innovation were GaN-on-silicon epitaxial growth, which should lead to chip fabrication on larger, cheaper wafers. Because dimming is a key requirement, the "true retrofit SSL lamp" requires that the dimmer-lamp interface must be re-engineered and radically cost-optimized.

Philips' LED lamp was the first accepted entry for the L Prize competition.

Thirdly, Deixler called for the development of mains-compatible LED systems with a total Vf matched to mains voltage. These would be driven by very simple, low-cost "conditioning" electronics instead of the classical switch-mode-power-supply drivers. The final area is to develop new, optimized SSL lamp holders, as well as standardized, replaceable SSL modules. Deixler rounded off his presentation with a demo of the Philips LED lamp submitted for the L Prize (see www.ledsmagazine.com/news/6/9/24).

Professional Manufacturer of LED Products

Energy Saving Light - Lighten Future

Why select Jiuzhou

- The top 100 electronic enterprises in China.
- 50,000 sq.m plant area with variety of production lines.
- With a complete set of top-brand Japanese imported automatic equipments.
- In 2008, we caught two hundred million as the sales volume.
- In 2010, six hundred million will be ploughed into the new LED industrial park.
- 6 years experiences in manufacturing LED products mainly including: high power LED lamps, SMD, LED displays, LED spotlights, PAR light series, tubes and various others.

Sourcing
Regional Distributor

Booth #11K25 Integrated Systems Europe

www.jiuzhou.com.cn www.jz-led.com

JIUZHOU SINCE 1958

JIUZHOU OPTOELECTRONICS
E-mail:tango.liu@scjz-led.com Tel:+86-755-26947007 Fax:+86-755-26715369

markets | TV BACKLIGHTS

LED TV backlights to drive escalation in LED production

Analysts forecast a ramp in LED-backlit LCD TV sales, but will LED makers be able to deliver the required capacity? **MAURY WRIGHT** reports.

VIZIO

There's a very good chance that LED-backlit LCD TVs in all sizes will significantly boost LED production requirements immediately and over the next few years. Most indications—including analyst projections and product introductions at the recent Consumer Electronics Show—point to a faster uptake of LED backlighting than previously predicted. But can the LED suppliers handle the increased demand, and will consumers actually pay the premium for LED-backlit TVs? We can't definitively answer these questions, but we can see an unmistakable trend toward LED backlighting.

Bruce Berkoff, chairman of the LCD TV Association, states "LED-backlit TVs are going to take over the industry." Berkoff won't predict when LED-backlit sets will take a predominant share of market, but he can tell you why. According to Berkoff, consumers care about three things in buying large-screen TVs—"image quality, WAF (wife acceptance factor), and green." Berkoff states, "LED-backlit sets win in all three areas."

LED-backlit TVs offer image quality improvements in two ways. First, the LEDs allow the TV to selectively dim and brighten individual regions of the screen—effectively boosting contrast ratio. Some of the latest models just introduced have in the range of 500 screen regions that can be dynamically dimmed or brightened in concert with bright or dim areas of the video image. The TV makers are claiming "dynamic contrast" ratio figures as high as 10,000,000:1 (see, www.ledsmagazine.com/news/7/1/5). LED-backlit TVs can also reduce the motion blur that's commonly seen on LCD sets by strobing the backlights in synchronization with screen refresh.

As for Berkoff's WAF criteria, he is really talking about styling or industrial design. He points out that the new ultra-thin sets and those with minimal bezels around the screen look good in the living room. LEDs are largely responsible for that styling although some of the thinnest sets use an edge-lit design and those generally don't match the image quality of sets with a full array of LEDs in a direct-backlight configuration. The edge-lit designs use light guides to offer dimming in rectangular segments, but have far fewer controllable zones relative to the backlit designs.

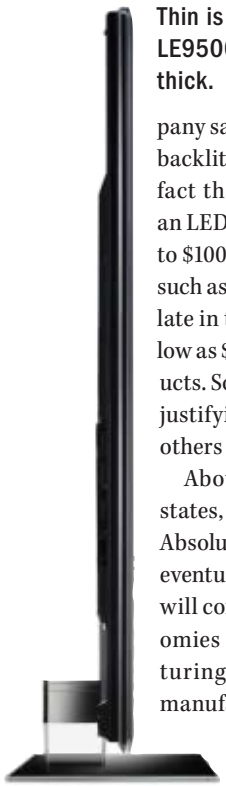
Finally consider the green angle. Berkoff points out that LED-based sets use less power than those based on CCFL backlights. Moreover the CCFLs carry a small amount of mercury, a potentially harmful material that isn't in LEDs.

So perhaps it's not surprising that consumers bought more LED-based HDTVs than most analysts expected in 2009. DisplayBank just issued a new report estimating that 3.6 million LED-based sets were sold in 2009 while iSuppli has a similar new report that pegs the number at 2.9 million; however, the iSuppli number is specifically for 40-inch and larger sets.

Both companies have the market escalating much more quickly than previously expected. DisplayBank projects 32 million total LED units in 2010, and 156 million by 2013 taking almost 70% of the LCD TV market. iSuppli projects (for the 40-in and up market) that LED-based units will make up 83.2% of the total by 2013.

The actual growth rate will depend on two factors—price of the TVs and availability of LEDs, and of course the two factors are intertwined. Market leader Samsung has done amazingly well in 2009—the com-

MAURY WRIGHT *is the Senior Technical Editor of LEDs Magazine.*



Thin is in: LG's LED-backlit LE9500 TV is only 8.5mm thick.

pany said it sold 2.6 million LED-backlit TVs in 2009—despite the fact that the price premium for an LED-based set was in the $700 to $1000 range. Other companies such as Vizio that came on strong late in the year had premiums as low as $300 for LED-backlit products. Some consumers are clearly justifying the premium now, but others will wait for lower prices.

About the premium, Berkoff states, "Will it go to zero in 2010? Absolutely not. Will it go to zero eventually? Absolutely." The drop will come courtesy both of economies of scale in TV manufacturing and in lower-cost LED manufacturing.

It's also tough to discern the exact effect that LEDs have on prices. Since the LED models tend to be at the top of the product line-up for most manufacturers, those sets also come with other extra features such as faster screen refresh rates that also add to the cost. Most even have some level of Internet connectivity that's lacking in lower-end CCFL-based units.

The analysts are also not segmenting the market in any projections at this point. The edge-lit models use far fewer LEDs than do the direct-backlit models. The latter can use more than 1000 LEDs. But that doesn't necessarily mean the edge-lit models will be cheaper. Berkoff points out that the slim edge-lit models may use fewer LEDs, but may have to use higher-power LEDs to achieve suitable brightness. He states, "Cost can be a wash."

Such fragmentation, however will directly impact the demand for LEDs. Moreover, some manufacturers will surely make LED-backlit models with no dimming or other image-enhancement features hoping just to take advantage of the green features and perhaps achieve an Energy Star rating that's not achievable with CCFLs. Those sets will use even fewer LEDs.

So will LED manufacturers meet the demand surge caused by LED-based LCD TVs, or will we have a near-term shortage of LEDs? Bob Steele, Director of Optoelectronics for Strategies Unlimited, says that his team is working on new projections right now, adding "The 2009 LED-based TV sales were certainly greater than we expected." Steele will present an updated LED forecast at the Strategies in Light conference (www.strategiesinlight.com).

Steele states, "We could have a shortage in LED capacity or substrates or both in 2010." Indeed it appears that LED manufacturers are trying to add capacity via new capital equipment purchases. Apparently the MOCVD (metalorganic chemical vapour deposition) reactor used in the manufacturing process could be the roadblock to a boost in capacity. Steel states, "It depends on how fast they can crank out reactors."

CHANGE your LIGHT, SAVE more ENERGY

All NEW LumiDas-CL 5W

FAWOO provides sustainable lighting solutions.
Suitable for both general and decorative uses.
Excellent alternative to the incandescent bulb.

GOOD DESIGN

LumiDas-CL 5W creates a warm atmosphere.

- Size(mm): Ø52XH135, E26/E27
- Replaces 40W incandescent lamp
- Dimmable/Non dimmable
  AC100–120V/AC200–240V
- GOOD DESIGN Award
  and AIDA(Australian Idea Design Award) in 2009
- A wide variety of applications
  for office, household, hotel, shop as direct or indirect lighting
- Very safe from electric shock as LENS of LumiDas-CL
  is made of insulated plastic
- Unique internal heat sink system guarantees long lifetime
  and durability

LumiDas-B 6W

Replaces 60W incandescent lamp

- Size(mm): Ø63XH109.5, E26/E27/GU10
- Dimmable/Non dimmable
  AC100–120V/AC200–240V
- Radiates the light in all directions
  like conventional incandescent bulbs.

LumiDas-D 6W

Replaces halogen PAR20

- Size(mm): Ø63XH84.5, E26/E27/GU10
- Dimmable/Non dimmable
  AC100–120V/AC200–240V

SOON to be launched in February 2010

light+building
Hall 4.2 Booth G90

FAWOO TECHNOLOGY

739-8,Ojeong-dong, Ojeong-gu, Bucheon, Gyeonggi-do, Republic of Korea (zip) 421-170
TEL : +82-32-670-3231 FAX : +82-32-670-3101 fawoo@fawoo.com www.fawoo.com

focus on OLEDs

Photo: Philips

Early-stage OLED lighting technology impresses

While OLED (Organic LED) lighting is still in the earliest phases of actual product deployment, the technology has already yielded impressive-looking fixtures and the sleek Mirrorwall that Philips has demonstrated using its Lumiblade technology. OLEDs and LEDs are both semiconductor-based, but are made in a far different manner. Of greater importance to the lighting application, the two technologies yield vastly different lighting characteristics. LEDs deliver narrow beams that require reflection and diffusion schemes to serve in general lighting roles. OLEDs, conversely are flat panels that emit light over the surface of the device – inherently a diffused light source. Like LEDs, OLEDs have the potential to offer lower-power, longer-life, solid-state alternatives to today's incandescent and CFL lighting.

Photo: Osram Opto Semiconductors

To date, Philips and Osram Opto Semiconductors are the only two vendors shipping OLED lighting. Just this past November, Osram launched the Orbeos lighting panel (see www.ledsmagazine.com/news/6/11/30). The circular light-emitting area has an 80 mm diameter and is just 2.1 mm thick. The panel delivers 25 lm/W, which Osram claims is better than existing halogen lamps.

Philips, meanwhile, has Lumiblade OLED panels in a variety of shapes and sizes including triangles and hexagons that designers can craft into custom fixtures. The company even sells an evaluation kit called the Lumiblade Experience Kit that can jumpstart a lighting project (see www.ledsmagazine.com/news/5/9/25).

Philips has also demonstrated its technology in a Mirrorwall in several venues—most recently at the International Design Museum Munich. The wall includes 900 OLED modules that appear to be mirrors but that selectively switch on, mimicking the person standing before the wall. The company also produced a compelling video of the wall in action entitled "You fade to light" (see www.ledsmagazine.com/news/6/4/17).

Expect to see a number of other companies launch OLED lighting panels in 2010. Likely candidates include GE, Lumiotec, Konica Minolta, and Visionox.

Funding targets all aspects of OLED lighting R&D

Newly announced R&D initiatives across Europe and in North America promise to address most all of the challenges of getting affordable OLED lighting to the mass market. The NEMO (New materials for OLEDs from solutions) project targets soluble materials for use in large-area OLED components. DuPont will also research solution-processing manufacturing techniques with a grant from the US government. Meanwhile the German government has funded the LIli (Light InLine) project to investigate large-area manufacturing processes. And finally the So-Light project in Germany will focus on OLED lighting applications.

The German BMBF (Federal Ministry of Education and Research) is funding the EUR14.7 -million So-Light project that will run until June 2012. The scope includes all parts of the OLED value chain, included characterizing aspects

Photo: Merck KGaA

of OLEDs central to lighting applications (see www.ledsmagazine.com/news/6/12/15).

Merck KGaA, Applied Materials, and Braunschweig University of Technology are heading up the LILi project, which is squarely targeted at lower OLED manufacturing costs. The EUR7.49-million effort is jointly funded by a BMBF grant and the industry partners (see www.ledsmagazine.com/news/6/11/22).

Merck KGaA and BMBF are also central to the NEMO project. Merck will lead a consortium of 11 partners—four from industry and seven from academia—through July 2012. The budget totals EUR31.8 million and will focus on the multilayer structure of solution-based OLEDs on indium-tin-oxide-coated glass (see www.ledsmagazine.com/news/6/11/6).

The US government awarded a $2.25 million grant to DuPont that the company will use to extend its OLED solution-processing technology that's proven in small display applications to lighting (see www.ledsmagazine.com/press/20517).

Lighting to drive OLED materials market

A new report by analyst firm NanoMarkets projects a rapidly growing market for OLED materials. According to the report, the materials market will grow from $420 million in 2010 to $2.9 billion in 2015. While the growth will be driven by all segments of the OLED market including displays for mobile phones and MP3 players, which dominate OLED deployment today, lighting will dominate by 2015. Indeed the report predicts that lighting will account for 70% of that 2015 projection (see www.ledsmagazine.com/products/20839).

More OLED capacity on deck while IP changes hands

Manufacturers of OLEDs certainly see the technology as a growth segment, although some IP owners will sell or license the technology and focus on core competencies. Konica Minolta is an example of the former trend with a new manufacturing line. Kodak, conversely, is selling its OLED display business to focus on consumer products.

Konica Minolta will invest ¥3.5 billion to build a roll-to-roll coating line destined to produce OLED lighting products. Construction has already begun, and production will begin this year. Konica Minolta has a strategic partnership with GE to accelerate the development of OLED lighting, and GE has also indicated that it hopes to have OLED lighting products in 2010 (see www.ledsmagazine.com/news/6/11/23).

Kodak, meanwhile is selling the assets of its OLED business to a group of LG companies. The company has been a leader in OLED development for small displays. The deal will allow Kodak continued access to the OLED technology for use in its own products (see www.ledsmagazine.com/press/20643).

OLEDs stay small in consumer electronics products

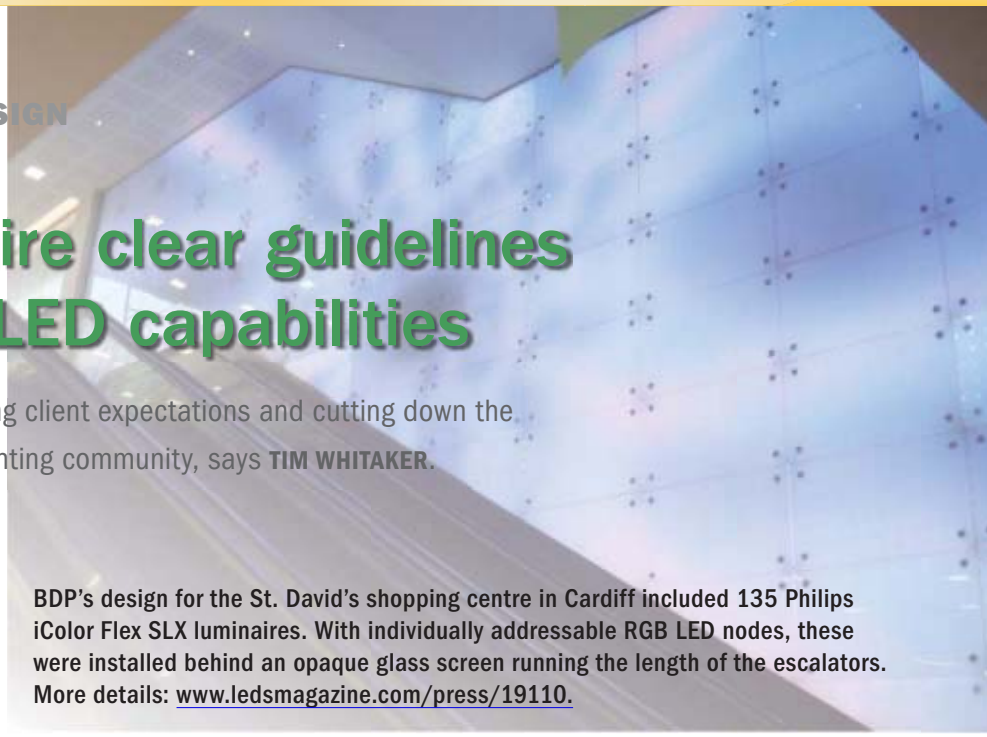
OLED technology had a low-key presence at the recent CES (Consumer Electronics Show) held Jan. 7-10 in Las Vegas, NV. In fairness, the technology continued its momentum in portable products. But no new OLED-based TV or lighting products appeared beyond the prototype stage.

There certainly were impressive prototype OLED TVs at CES. Sony demonstrated a 24.5-inch 3D-capable model. LG demonstrated a 15-inch model that presumably will ship this year. It also appears that OLEDs are headed to the notebook PC market. Samsung demonstrated a notebook with a 14-inch OLED screen, which is transparent when not in operation.

Samsung had perhaps the broadest array of portable products with OLED displays at the show including mobile phones, an MP3 player, digital cameras and camcorders, and even a digital photo frame. The IceTouch MP3 player (see photo) integrates a 2-inch full-color transparent AMOLED (Active Matrix OLED) display that is also touch sensitive. Samsung claims the OLED screen provides DVD quality video (see www.ledsmagazine.com/products/20840).

Specifiers require clear guidelines to understand LED capabilities

Providing useful information, managing client expectations and cutting down the hype remain key tasks for the LED lighting community, says **TIM WHITAKER**.



BDP's design for the St. David's shopping centre in Cardiff included 135 Philips iColor Flex SLX luminaires. With individually addressable RGB LED nodes, these were installed behind an opaque glass screen running the length of the escalators. More details: www.ledsmagazine.com/press/19110.

LEDs already exert a major influence within the lighting industry, and represent an exciting opportunity, but there is a risk that their reputation will be undermined if they do not perform to client expectations in the early years of market penetration. Lighting specifiers are still struggling to understand the capabilities of LED lighting, and it is important to manage the expectations of LEDs versus other lighting technologies. These were some of the key messages that came across from a recent one-day seminar entitled "LED Lighting Solutions and Applications Today," organized by the UK's Lighting Industry Federation (LIF). Eddie Taylor, LIF's Chief Executive, explained that the aim of the seminar was to provide an update on the current practicality of LEDs, looking at realistic product and lighting performance, as well current applications.

Designer's view

In presenting a "Designer's view on lighting with LEDs", Martin Lupton talked about what lighting designers want, and also what they don't want. Lupton is the lighting director of BDP, the largest interdisciplinary practice of architects, designers, engineers and "urbanists" in Europe, and is also the current president of the Professional Lighting Designers' Association (PLDA). "This is what I want; a dimmable lamp, producing lots of light, with a long lifetime," said Lupton, holding up an MR-16 lamp. What he doesn't want, he said, is the "massive amount of hype" which is often associated with LEDs. Citing the "ultra-efficient catch phrases" used by manufacturers, he said that if over-selling continues, the industry will start to enjoy the same reputation as used car salesmen.

BDP has been involved in many projects that use LEDs (see photo), but sometimes clients decide they want to use LED lighting from the outset, despite knowing very little about the technology. Lupton gave an example where the requirements, such as dimming down to extinction, and a very wide range of lux levels, would have made an LED solution prohibitively expensive, especially because the customer was an owner/operator who was concerned with return-on-investment. "Lighting should be built around a concept, and the starting point is the lit effect," he said. "We need to make it look like it should, with the most appropriate and sustainable products. LEDs are not the only light source in the world."

Speaking more generally, Lupton described lighting as "both a science and an art. "You have technical specifications, but you also have interpretation and preference," he said. One of BDP's principles is to focus on lighting places for people. "This is a social medium, which is people-oriented. Architectural lighting is dying in terms of simply lighting the structure," Lupton explained. "We also want sustainability. The most sustainable light source is daylight. Ideally, lights should only be on when people are there."

Coming back to LEDs, Lupton highlighted examples of trying to shoehorn LEDs into existing form-factors. Instead, he said, with LEDs as a new lighting technology, the focus should be on developing new lighting concepts. He likened LED fluorescent replacements to some kind of "Frankenstein's monster" of the lighting industry.

Other issues that should be addressed are inconsistency in LED performance; the strong demand for dimming, particularly in applications such as museums; and the need to be able to upgrade products through their lifetime, via the use of appropriate modules. Lupton also called for a universal cost-of-ownership model that everyone can use, for all applications.

As an independent lighting designer, Lupton explained that he sells knowledge and does not receive a commission on product sales. He talks to architects in the very early stages of a project, and says that the industry needs to develop tools that lighting designers can use to "defend their professional solutions," in other words to explain to clients why particular choices have been made.

He listed a few questions that designers could ask if they want to be sure they are getting a quality LED product. For example, how long has the company been producing LED fixtures? (If less than five years, he said, then the company does not have the history to justify long-life claims.) How long is the warranty? Why does the supplier offer a one-year warranty for a product they say will last 50,000 hours? Does the product literature address lumen depreciation? Whose LEDs are inside?

"We need to be able to differentiate between good and rubbish, and manage the expectations of our clients. We need to be able to make apples-to-apples comparisons, with a standard type of information that specifiers can use," concluded Lupton.

Product type	Safety standard	Performance standard
LED lamps	IEC 62560. Publication expected 2010.	IEC/PAS 62612 (pre-standard document). Published 2009.
LED drivers	IEC 61347-2-13. Published 2006.	IEC 62384. Published 2006.
LED modules	IEC 62031. Published 2008.	Draft under preparation.
LED luminaires	IEC 60598-1. Published 2008.	No standard.
Definitions	IEC/TS 62504. Publication expected 2010.	

International standards and specifications for LED products. Search for documents on the IEC website at www.iec.ch. Table courtesy of Mike Simpson, Philips Lighting.

Specification guide

Fortunately for Martin Lupton, work is already underway to develop a standardized template for reporting information. LIF has an LED Application Panel (LEDAP), chaired by Allan Horn of Philips Lumileds, which has a mission to speed up and increase the adoption of quality LED and solid-state lighting products and luminaires. It does this by driving standards in favor of quality solutions, and by engaging with, harmonizing and "speaking with one voice" with the many different UK-based LED & SSL interest groups and other non-LED interest groups. The panel has generated a Technical Statement (LIF TS44) entitled "Key Standards for Production, Testing & Measurement of LED-Based Luminaires," which lists many of the standards in place or under development (see Table). LIF has also produced a "Guide for OEMs & Producers of LED-based Luminaires," which summarizes some of the relevant aspects that need to be taken into consideration, such as thermal issues and color quality. The documents are available on LIF's website at www.lif.co.uk.

Taking this further, Mike Simpson of Philips Lighting explained that several organizations have jointly developed a specification guide. The "Guidelines for Specification of LED Lighting Products" is approved for use by LIF and PLDA, as well as the International Association of Lighting Designers (IALD), the Institute of Lighting Engineers (ILE), the Society of Light and Lighting (SLL), and Highway Electrical Manufacturers and Suppliers Association (HEMSA). It can be downloaded at: www.greenpages.pld-a.org/led-specification.

The document identifies criteria that ensure the performance claims for LED luminaires can be matched against traceable data. The performance data should relate to the luminaire during operation, not just to the performance of the LED. The document allows the choice of using absolute photometry, conducted according to IES LM-79-08, or relative photometry, con-

ducted according to EN13032-1 (2004). "Both methods produce the same result," says the document. "The manufacturer should state the format in which the photometric data is supplied." Crucial LED data includes the manufacturer of the LED package, and the depreciation curves for the LED package at an ambient temperature of 25°C. Luminaire data should be measured when the luminaire is operating at an ambient temperature of 25°C, or 15°C for exterior luminaires. Luminaire power, lumen output and efficacy are required, as well as the CCT and CRI and the shift in these two values over life.

Technology

As mentioned above, a key requirement is realistic LED performance specifications. Roger Sexton of Xicato quoted several fundamental performance indicators: flux and efficacy, life, color point target, color rendering and uniformity. He spoke about the effects of temperature, explaining that heat-sink design requires thermal analysis of the luminaire in realistic application conditions (orientation, ambient temperature, air flow). He pointed out that common drivers are 70-90% efficient, and the wasted energy becomes heat, which also needs to be taken into account when designing the thermal system. Drivers are usually most efficient when operating at their maximum specified voltage. Luminaires should use a well-designed reflector and high-quality materials to minimize loss. Color-point targets should be on—or close to—the black-body locus (BBL) to appear as a natural white, otherwise the color will appear greenish (above the BBL) or reddish (below). The distance from the BBL needs to be specified in addition to the CCT.

Lumileds' Allan Horn talked about LED reliability, which he described as a complex but crucial area. "It's not just about the product reliability," he said. "It's also about the reliability of data, and data-sheet values, and the reliability of the supplier."

Drivers for LEDs are not simple low-voltage transformers, said Graham White of Coopers Lighting and Safety, but are a dedicated control device. They are also, potentially, the weakest link in an LED system, since they contain a large number of electronic components. "It is therefore important to specify the correct driver for the type and number of LEDs," he said, adding that a higher driver temperature causes a decrease in lifetime, but should not affect performance.

Gordon Routledge of Ideas With Energy Ltd said that good optical design can reduce system costs, improve system efficiency, ease design for manufacture and deliver the promise of LED technology. He claimed there can be a tendency to assume that there is something special about the light produced by LEDs—"the attitude is that 'these are not just lumens, these are LED lumens'," he said—but of course this is not the case. However, LEDs are very good at delivering light efficiently in a target application.

lighting | ACCENT LIGHTING

LED modules for accent lighting surpass the performance of halogen lamps

Modules built using separated phosphor technology demonstrate that the benefits of LEDs can be harnessed in the realm of accent lighting with no compromises in light quality, even taking halogen as a benchmark, as **ROGER SEXTON** describes.

In the 1970s, the advent of dichroic halogen lamps allowed high-quality accent lighting in retail, hospitality, museums and other applications. From the 1990s until now, compact metal halide lamps have also been used in these applications offering more "punch" (for example, highlighting of merchandise even against the higher background illumination levels of department stores) alongside improvements in longevity and energy consumption.

At the beginning of this decade, high-brightness LEDs showed the promise that more improvements could still be made in terms of longevity. However, until now, light output and efficacy, luminaire size and light quality compromises have been barriers to adoption.

LED efficacies have been a key issue holding back LED acceptance. Because a large number of LEDs have been needed to meet high luminaire outputs, luminaire size (especially considering heat sinking requirements) has been a problem for many applications. Discrete track-mounted LED luminaires, for example, have until now only been available with limited intensities. Light quality issues have included correlated color temperatures (CCTs) that are too high, resulting in a bluish-white color and often poor color-rendering indexes (CRI).

In an attempt to improve efficacies, many LED products have targeted a color point above the black body locus (BBL). However, this has the unfortunate effect of creating unnatural light. On top of this the lighting industry has had to accept a broad tolerance on color point to accommodate the large variations in LED wavelengths. These are exacerbated by the consistency and performance of the commonly-used red and yellow phosphor mix that varies from product to product and over temperature and time (the efficacy fall-off of the red phosphor with increasing temperatures exceeds that of the yellow). Finally, non-uniformity of spectral distribution due to multiple sources can produce uneven beams and shadowing effects unless a diffuser (inducing a loss in efficacy) is used.

FIG. 1. The Xicato Spot Module (XSM) has a fixed form-factor with 48 mm diameter. Fixed outputs are 400, 700 or 1000 lm at 700 mA, at 9, 15 and 22W respectively. The outputs are similar to 20, 35 and 50W halogen lamps respectively. As LED efficacies improve, fewer LEDs will be needed and the module efficacy will improve, but the form factor and optical interface will stay the same. All technical data is taken at a recommended operating test point (Tc) temperature of 70°C.

Improvements

Efficacy improvements in LEDs—to the extent that 100 lm/W is now possible at a chip level — have led to greater luminaire efficacies, and a better balance of output versus luminaire size. Also, separating phosphors away from the chip increases light quality in terms of both uniformity and color consistency. Most white LEDs have phosphor coated directly on the blue LED chips.

This article discusses the Xicato Spot Module (XSM; see Fig. 1), which used as its design starting point the above concerns and improvements. As shown in Fig. 2, the concept of a separated phosphor is taken to a new level with Xicato's "Corrected Cold Phosphor Technology." An array of blue LEDs is separated via an optical chamber from a phosphor plate, which converts the blue light to white light. Differing yellow and red phosphor mixes produce different CCTs (2700K, 3000K and 4000K). The thermal design around the phosphor plate and

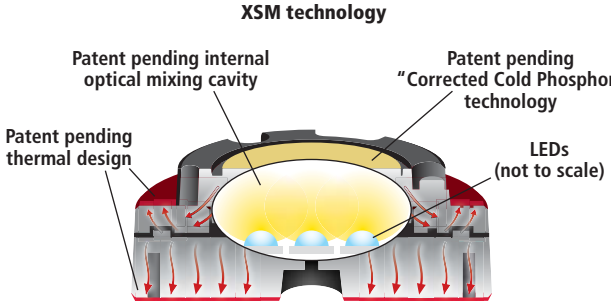


FIG. 2. Corrected Cold Phosphor technology, in which an array of blue LEDs are separated via an optical chamber from a phosphor plate.

ROGER SEXTON *is VP of Marketing and R&D at Xicato (www.xicato.com).*

FIG. 3. Rivona shopping mall in Vingis, Lithuania, featuring Dotto luminaires from Lunoo.

the LED array is such that both the LEDs and the phosphor are kept cold (~60°C cooler than phosphor that is coated on a LED chip). This maximizes the efficacy and life of both the LEDs and the phosphor, and also results in an improved ratio between module efficacy and miniaturization.

Keeping the phosphor cold also means that the color point is kept stable, because the aforementioned difference in red and yellow phosphor performance with increasing temperature is minimized. The position of each color point in the XSM range is on the BBL, not above it, which as mentioned above, would result in a less natural looking light. Also, via phosphor correction, variations in the aggregate wavelengths of the LED arrays are compensated for such that there is very tight tolerance on these color point targets. While industry-standard LED binning structures allow for color points in a seven-step McAdam Ellipse, XSM modules perform to less than a two-step McAdam ellipse.

Color-rendering performance is at the industry norm of 80+ for the standard range of XSM. However, a unique "Artist Series" has, via attention to both LED and phosphor specification, a CRI of over 95 for all three CCTs. Unlike with most light source specifications, this figure is calculated with all 15 standard test colors including the saturated ones and not just the first eight pastel colors. The often problematic R9 (deep red) performance is over 95 at 2700K CCT, over 90 at 3000K CCT, and over 85 at 4000K CCT—outperforming not just other LED solutions but traditional lamp types like compact fluorescent and compact metal halide.

Extensive accelerated life testing proves that Xicato's "Corrected Cold Phosphor Technology" has the ability to retain product flux levels and color point over longer periods than is possible with traditional white LEDs under the same operating conditions. Even under the extreme conditions of ongoing Wet High Temperature Operating Lifetime tests (85°C, 85%RH, 1hour on/off), extrapolated lumen maintenance curves indicate well under 30% degradation at 50khr with color maintenance within the initial Xicato color specification. XSM construction allows for an IP 66 rating for all module types.

The XSM enables discretely-sized, long-life, energy-efficient accent

FIG. 4. Decorative scalloping on a white wall in a UK department store, using AlphaLED luminaires from Projection Lighting.

luminaires, offering halogen-like light quality without compromise, and has already been used in a variety of accent lighting applications.

Applications

Lower energy costs compared with halogen lamps, added to the maintenance savings afforded by their longevity, result in short payback times (often two to three years depending upon hours of usage and whether lamp replacement is in-house or subcontracted). This permits realistic usage in, for example, department stores where halogen dichroic life and efficacy makes their usage unsustainable in large quantities, even if the effect is greatly appreciated. A good example of where the sheer number of halogen dichroic lamps used led to unsustainable costs was in the public areas of the Rivona shopping mall in Vingis, Lithuania (where electricity prices have doubled in less than three years). The halogen luminaires were completely replaced by Dotto luminaires from Lunoo in April 2009 (see Fig. 3).

Reliability and long-life performance is important where lamp outages would result in the tarnishing of critical corporate imagery. The tight tolerance on the color point makes XSM particularly suitable for accent lighting on a white wall, e.g. decorative scalloping (see Fig. 4). The DOE's Solid-State Lighting Assist scheme recommends a two-step MacAdam ellipse "for applications where the white LEDs (or white LED fixtures) are used to illuminate an achromatic (white scene)."

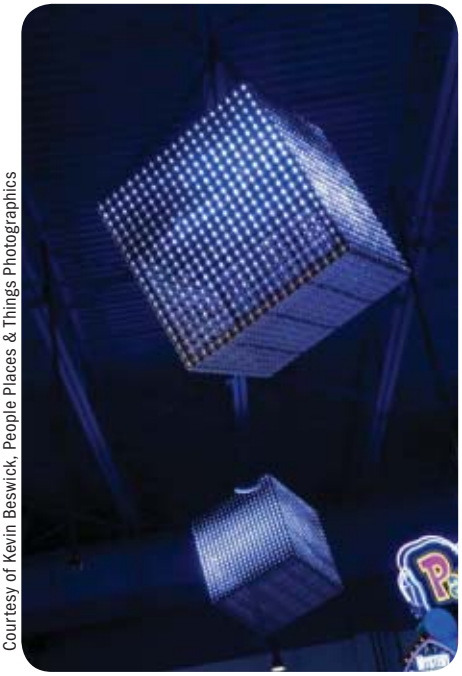
The high color rendering of the Artist Series makes them highly appropriate for domestic applications, and also for museums and art galleries, where the absence of IR and UV is a further benefit (see Fig. 5). The XSM's IP 66 rating increases confidence in outdoor lighting luminaires, and the light quality aspects mentioned above combine to make the solution ideal for ambient lighting in hospitality segments or decorative city-centre lighting, especially in tourist areas. An example is shown in Fig. 6.

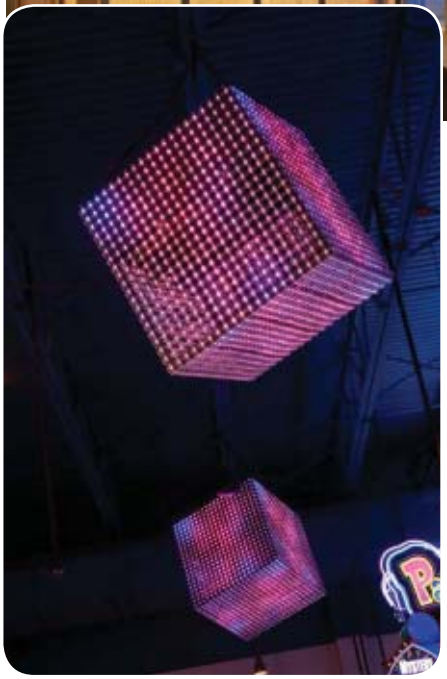
FIG. 6. The Area Docks restaurant in Brescia, Italy, using Belvedere luminaires from Flos.

FIG. 5. The Biddick Art Centre, Washington, using Bromo luminaires from High Technology Lighting .

Partnerships point the way ahead in the solid-state lighting industry

The acquisition of a lighting control company and a joint venture partnership with Osram is helping Traxon Technologies to bring optimism to the specification community, writes **VALERIE COFFEY**.





Courtesy of Kevin Beswick, People Places & Things Photographics

FIGURE 1. Traxon's Mesh RGB was used to create two dramatic 5-foot cubes at Firekeepers Casino in Battle Creek, Michigan (left). The 70% transparency of the Mesh RGB enables media to be viewed from both sides. In the case of the cubes, the designers are able to play with lighting content on five sides simultaneously. The interior front vestibule of Firekeepers Casino also uses Traxon's Mesh RGB (above). Like the cubes, the vestibule lighting features a continually evolving LED display of lights and color. All the dynamic lighting displays in the casino are controlled by e:cue Butlers and a video control server utilizing Emotion software.

Adding links on both ends of the supply chain, LED lighting manufacturer Traxon Technologies recently developed its relationships with e:cue and Osram. Tony Carrella, president of Traxon Technologies and e:cue lighting control, took some time to discuss what this partnership means to the solid-state lighting community.

In October 2008, after several years of collaboration, Traxon, a manufacturer of LED-based lighting systems headquartered in Hong Kong, acquired e:cue, an independent lighting control company headquartered in Paderborn, Germany. At the end of 2008, Traxon further extended its global reach through a joint venture partnership with lighting giant Osram (www.ledsmagazine.com/news/5/12/15). Traxon, now officially known as "Traxon Technologies – An Osram Company" became a 51% Osram-owned subsidiary while retaining its independence, including its own board of directors.

While Traxon has completed installations in such famous architectural sites as London's Tower Bridge, the Guggenheim Museum in New York, the International Commercial Center, Hong Kong, and Antwerp Stadsfeetzaal, the Osram partnership is particularly significant. For Traxon, this joint venture validates the company as a leading player in the lighting industry and signifies its presence in the marketplace.

VALERIE COFFEY *is a freelance science and technology writer and editor at Stellar Editorial Services (www.stellaredit.com), and contributing editor to Laser Focus World.*

Courtesy of Traxon Technologies

FIGURE 2. The David H. Koch Theater at Lincoln Center in Manhattan features an LED installation using the Traxon 1PXL Board Warm White, which illuminates cut Corian material from behind. The dual-view cut Corian with Traxon's Boards creates static grayscale images of a ballet dancer from one angle and opera singers from another angle.

Working together

How do the three companies fit and work together? Traxon focuses on fixture-level LED lighting systems, particularly RGB and white-light solutions for the architectural, hospitality, and retail industries, while e:cue's focus is on control systems. "About six years ago, Traxon recognized we needed a more complex and comprehensive control offering, while e:cue wanted to broaden their approach, so Traxon began a strategic relationship with e:cue," says Carrella.

With the acquisition, e:cue complements Traxon with lighting system capabilities while continuing to pursue independent control projects. The joint venture with Osram (Osram Sylvania in the USA) brings to the table a component- and OEM-level focus at the so-called "lightbulb level." Now, with Osram, Traxon, and e:cue combined, the focus stretches from lightbulbs to fixtures to control systems. With the additional ability to offer customized solutions, software, and project management, Traxon can now cover an entire project from design inception to on-site programming and support.

Traxon also benefits from the size and global strength of Osram. "The strength and leverage that Osram Sylvania has from an R&D standpoint helps us with their heavier presence in the marketplace," explains Carrella. "Using certain aspects of their services helps us give our clients more. We retain our flexibility, which has always been our strength, to turn out solutions project by project. Because it's a joint venture rather than an acquisition, we retain our independence, our brand identity, our intimate customer service, and our commitment to flexibility, simplicity, and innovation."

In turn, the joint venture benefits Osram Sylvania by enabling them to expand the link between their bulb/fixture offerings and the design-and-control aspect. Rick Leaman, president and CEO of Osram Sylvania, said that "the joint venture with Traxon expands our portfolio of LED products and services to provide an even broader array of choices for lighting designers and specifiers."

The nature of the partnership is non-exclusive. "In specifying components for an entire project, the lighting designers must pick which manufacturers they want to work with," says Carrella. "A project may require a variety of manufacturers. For example, a project may call for fluorescent lamps, LEDs, cove lights, and down lights. A one-stop solution makes our client's job easier, but we select whatever solution is right for the project."

Cue the controls

e:cue's contribution is to supply control systems that comprise a network of servers, software, terminals and drivers all connected via cables or wireless links to control everything—the color shifting, patterns and brightness of the lighting system, and its interconnection to other systems, such as syncopated music. About 80% to 90% of Traxon's clients choose the e:cue control system. "We find that the clients enjoy the seamless solution for their lighting projects," says Carrella "It's faster to pull them together, and from the support level, to execute them. However, e:cue still sells into the market independently. And we do the same. Both companies plan to maintain their own identity; Traxon as a complete LED solution provider from fixture to control, and e:cue as a control-solutions provider." In this way, the Osram/Traxon/e:cue unit works together to hit different parts of the lighting market, and bring in the other partners as needed.

While the Osram Sylvania partnership has been in place for over a year, large-scale installations take many years to come to fruition. Examples include the Yas Hotel in Abu Dhabi (which uses an e:cue control system; see www.ledsmagazine.com/press/20496), the Fontainebleau Spa in Miami, and Firekeepers Casino in Battle Creek, MI (see Fig. 1). Examples of completed projects through the Traxon/Osram partnership are still forthcoming. However, Traxon/e:cue has recently completed several smaller projects, including white-LED lighting of the ticket booth at Lincoln Center (see Fig. 2), and the lighting of the top of the Worldwide Plaza, a commercial and residential complex in Manhattan.

As the partnership matures, the big collaborative projects are beginning. When an architect or lighting designer approaches Traxon to come up with solutions, Traxon and e:cue work together with the client to help with the specifications for the project. "As the project evolves, a lot of engineering happens, and Traxon provides drawings and mock-ups of solutions," says Carrella. "Osram Sylvania in the US gets involved in a couple ways. We help bring Osram Sylvania into the specification part of the project. And we use the leverage of Osram Sylvania's sales force of several hundred people to bring in Traxon as they come across opportunities, especially for architectural projects that need LED lighting. The partnership gives us exposure we wouldn't otherwise have had."

In a recent installation at Mystic Lake Casino in Prior Lake, MN, lighting designers used Traxon fixtures in a casino expansion

Courtesy of SMSC Gaming Enterprise/Brian Droege

FIGURE 3. Traxon provided 1500 XB-high-output luminaires and 5000 linear feet of cove lights for an expansion of the Mystic Lake Casino in Prior Lake, MN. The Mystic "River of Fire" ceiling installation features Traxon's 1PXL Cove Light XR RGB and Wash XB-36 RGB. The control system for the "River," as well as the dynamic lighting shows, music, and syncopated lights are provided by e:cue lighting control.

(see Fig. 3). The design called for 1500 XB-high-output luminaires and 5000 linear feet of cove lights. "After working carefully with the designer," says Carrella, "we found that on the control side, the manufacturer they originally specified could not realize the complicated dynamic lighting shows involving music and syncopated lights. So we presented e:cue as an option." Traxon/e:cue helped the casino design a mock-up and install the control solution, and the casino ended up using the e:cue control system for the entire casino.

As the industry grows, such partnerships and mergers may be the rule rather than the exception. "While the lighting design community has been enthusiastic about the idea of partnering with component and control designers," says Carrella, "nobody has wanted to be the guinea pig. There are many small companies out there trying to come up with solutions. The promise of this partnership has given a high level of comfort to the specification community." A successful merger may encourage other smaller players in the solid-state lighting industry to find partners of their own.

In the near future, Carrella says he sees the LED market expanding into applications such as the office, healthcare, and schools, whereas in the past the focus was primarily on entertainment. "In 2010, we expect to see more creative use of white-light applications and more integration of control systems in everyday applications, such as occupancy, energy savings, and smart building management," he concludes.

Shop & Retail Innovation Japan

Join the Best!

Japan's No.1 LED Lighting Exhibition

LED Next Stage 2010

～LED, Expand with No Limit～

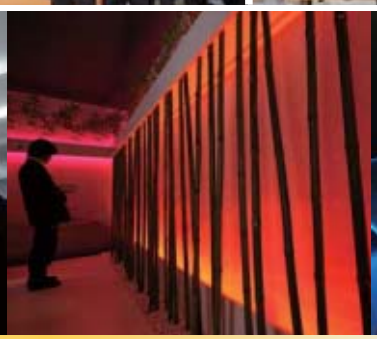
March 9－12, 2010
TOKYO BIG SIGHT, Japan

www.lednext.jp/en

Online Pre-registration starts from Jan. 2010
on the website.

Organizer: Nikkei Inc.
Special Cooperation: Japan LED Association (JLEDS)

Overseas Contact Office
Space Media Japan
E-mail: tradefairs@smj.co.jp
Phone: +81-3-3512-5670



design forum | **CIRCUIT PROTECTION**

Coordinated schemes provide circuit protection for LED lighting

Utilizing a coordinated circuit protection scheme based on several device types can help designers reduce component count, provide a safe and reliable product, comply with regulatory agency requirements, and reduce warranty and repair costs, writes **FARAZ HASAN**.

LED technology has advanced rapidly, with improved chip designs and materials facilitating the development of brighter, more energy efficient, and longer-lasting light sources that can be used in a wide spectrum of applications. In spite of the technology's growing popularity, LED light manufacturers continue to wrestle with the fact that LED luminaires are extremely heat-sensitive. Without adequate thermal management, heat can degrade the LED's lifespan and affect color output. Also, because LED drivers are silicon devices, they can fail short. This means fail-safe back-up overcurrent protection may be required.

Resettable polymeric positive temperature coefficient (PPTC) devices have demonstrated their effectiveness in a variety of LED lighting applications. Like traditional fuses, they limit current after specified limits are exceeded. However, unlike fuses, PPTC devices have the ability to reset after the fault is cleared and the power is cycled. A variety of overvoltage protection devices—including metal oxide varistors (MOVs), electrostatic-discharge (ESD) surge protection devices, and polymer-enhanced Zener diodes—can be used in a coordinated scheme with PPTC devices to help improve LED performance and reliability.

Junction temperature effect

The optical behavior of an LED varies significantly with temperature. The amount of light emitted by the LED decreases as the junction temperature rises and, for some technologies, the emitted wavelength changes with temperature. If drive current and junction temperature are not properly managed, the LED's efficiency can drop quickly, resulting in reduced brightness and shortened life.

Another LED characteristic, related to junction temperature, is the forward voltage (V_f) of the LED. If only a simple bias resistor is used to control the drive current, V_f drops as temperature rises and the drive current increases. This can lead to thermal runaway, especially for high-power LEDs, and cause the component to fail. It is common practice to control junction temperature by mounting the LEDs on metal-core PCBs to provide rapid heat transfer.

Power-line-coupled transients and surges can also reduce LED lifespan and many LED drivers are susceptible to damage resulting from improper DC voltage levels and polarity. LED driver outputs can also be damaged or destroyed by short circuits. Most LED drivers include built-in safety features, including thermal shutdown, as well as open and short LED detection. However, additional overcurrent protection devices may be needed to help protect integrated circuits (ICs) and other sensitive electronic components.

Input and output protection

LEDs are driven with a constant current, with the forward voltage varying from less than 2V to 4.5V, depending on the color and current. Older designs relied on simple resistors to limit LED drive current, but designing an LED circuit based on the typical V_f drop as specified by a manufacturer can lead to overheating of the LED driver.

Overheating can occur when the V_f drop across the LED decreases to a value significantly less than the typical stated value. During such an event, the increased voltage across the LED driver can result in higher total power dissipation from the driver package.

Today, most LED applications utilize power conversion and control devices to interface with various power sources, such as the AC

FARAZ HASAN is Global Marketing & Business Development Manager–Appliance/Industrial/Lighting for Tyco Electronics Circuit Protection Products.

line, a solar panel, or battery power, to control power dissipation from the LED driver. Protecting these interfaces from overcurrent and overtemperature damage is frequently accomplished with resettable PPTC devices.

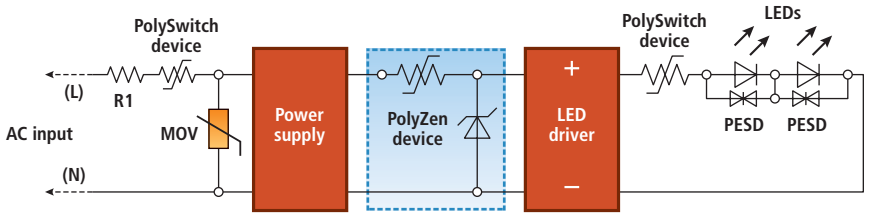


FIGURE 1. A coordinated protection scheme uses PolySwitch PPTC devices and MOV devices for SMPSs (left), and PolyZen, PolySwitch, and ESD protection (PESD) devices for LED driver inputs and outputs (right).

Protecting against overcurrent damage

The PPTC device has a low-resistance value under normal operating currents. In the event of an overcurrent condition, the device "trips" into a high-resistance state. This increased resistance helps protect the equipment in the circuit by reducing the amount of current that can flow under the fault condition to a low, steady-state level. The device remains in its latched position until the fault is cleared. Once power to the circuit is cycled, the PPTC device resets and allows current flow to resume, restoring the circuit to normal operation.

While PPTC devices cannot prevent a fault from occurring, they respond quickly, limiting current to a safe level to help prevent collateral damage to downstream components. Additionally, the small form factor of PPTC devices makes them easy to use in space-constrained applications.

A coordinated protection scheme for switch-mode power supplies (SMPSs) and LED driver inputs and outputs is illustrated in Fig. 1. As shown on the left-hand side of the figure, a PPTC device, such as a PolySwitch™ device, can be installed in series with the power input to help protect against damage resulting from electrical shorts, overloaded circuits or customer misuse. Additionally, an MOV placed across the input helps provide overvoltage protection in the LED module.

The PPTC device can also be placed after the MOV. Many equipment manufacturers prefer protection circuits combining resettable PPTC devices with upstream fail-safe protection. In Fig. 1, for example, R1 is a ballast resistor used in combination with the protection circuit.

LED drivers can be susceptible to damage resulting from improper DC voltage levels and polarity. Outputs can also be damaged or destroyed by an inadvertent short circuit. Powered ports are also susceptible to damaging overvoltage transients, including ESD pulses.

The right side of Fig. 1 shows a coordinated circuit protection design for an LED driver and bulb array. A PolyZen™ device placed on the driver input offers designers the simplicity of a traditional clamping diode while obviating the need for significant heat sinking. Developed by Tyco Electronics, this device's unique polymer-protected precision Zener design helps provide transient suppression, reverse-bias protection, and overcurrent protection in a single, compact package.

As shown in Fig. 1, a PolySwitch PPTC device on the driver output can help protect against damage caused by inadvertent short circuits or other load anomalies. To fully leverage the PolySwitch device, it can be thermally bonded to the metal-core circuit board or LED heat sink. To help prevent damage caused by an electrostatic discharge (ESD) event, ESD protection (PESD) devices—such as low-capacitance (typically 0.25 pF), small-form-factor PESD devices—can be placed in parallel with the LEDs.

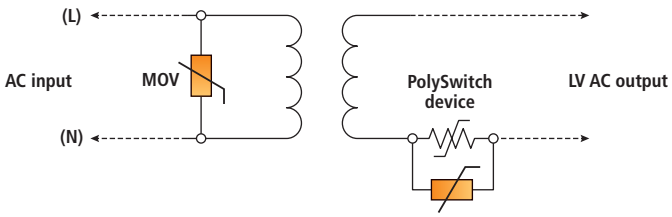


FIGURE 2. A coordinated protection scheme is used for Class 2 power sources.

Class 2 safety standards

Utilizing a Class 2 power source in a lighting system can be an important factor in reducing cost and improving flexibility. Inherently limited power sources—a transformer, power supply, or battery—can include protective devices, as long as these are not relied upon to restrict the output to within Class 2 limits.

Noninherently limited power sources, by definition, have a discrete protective device that automatically interrupts the output when the current and energy output reaches a prescribed limit.

A variety of circuit protection devices can help provide operation of Class 2 power sources for LED lighting applications. Fig. 2 illustrates how a coordinated circuit protection strategy, employing an MOV on the AC input and a PolySwitch device on an output circuit branch, can help manufacturers meet the requirements of UL1310 paragraph 35.1 overload test for switches and controls.

Summary

Resettable PPTC devices help protect against damage caused by both overcurrent and overtemperature faults in LED lighting applications. MOV overvoltage protection devices help manufacturers meet a number of safety-agency requirements and provide high current-handling and energy-absorption capability, as well as fast response to overvoltage transients. ESD protection devices help protect against ESD events and provide low capacitance, while Tyco Electronics' PolyZen devices help provide protection against damage caused by the use of improper power supplies, as well as transient suppression, reverse-bias protection, and protection from damage caused by overcurrent events.

How to pick the perfect inductor for your LED driver application

IC reference designs are a good start. But what if you want to optimize the driver inductor for size, efficiency or price?

Or evaluate newer, high performance parts that weren't available when the reference design was created?

Then you'll want to check out the new LED Design Center on the Coilcraft web site. It's filled with interactive tools that let you compare hundreds of inductors for all LED driver topologies, including SEPIC.

Our new LED Design Center lets you:

- ✔ Search by IC to find all matching inductors
- ✔ Compare DCR, current rating, size and price
- ✔ Analyze all core and winding losses
- ✔ Request free evaluation samples

www.coilcraft.com/LED

To start your search for the perfect LED driver inductor, mouse over to **www.coilcraft.com/LED**

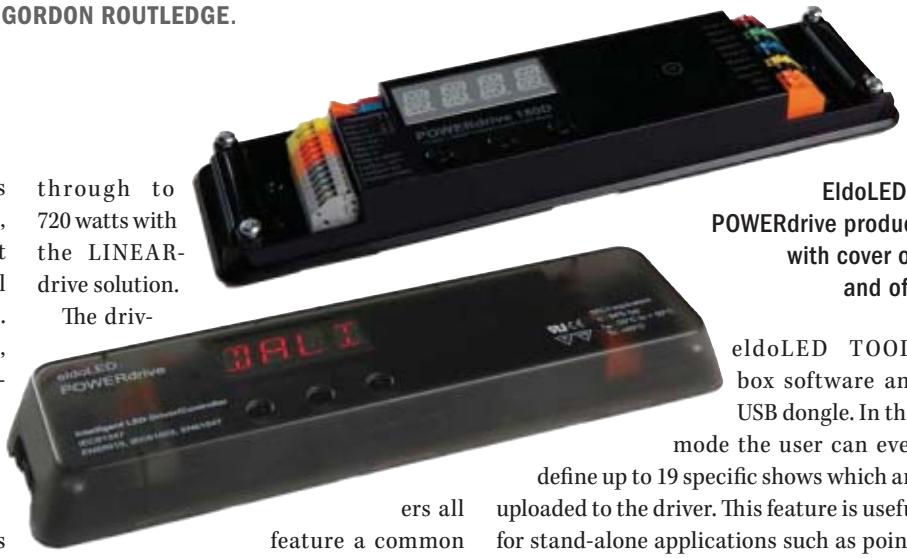
ORDER DIRECT
BUY.COILCRAFT.COM
800-322-2645
OVERNIGHT DELIVERY ORDER BY 5
RoHS COMPLIANT

Coilcraft®

www.coilcraft.com 800/322-2645

Flexible drivers enable dynamic color-changing lighting projects

The use of intelligent and flexible drivers allows OEMs to respond quickly to special project requirements, says **GORDON ROUTLEDGE**.



EldoLED's POWERdrive product with cover on and off.

Color-changing lighting using LEDs has been around for over 10 years, and is now, probably, the dominant technology choice in dynamic architectural and entertainment lighting applications. LED technology has continued to evolve, often with the addition of a 4th control channel—white or amber—to expand the color gamut. Moreover, multi-chip LEDs have improved the color-mixing capabilities of lighting fixtures.

Over the same period, the range of options to drive the LEDs has also expanded dramatically. However, many of these sophisticated solutions are chip-based and require extensive electronics expertise and investment to arrive at a final drive solution. This may be fine for entertainment companies with in-house electronics capabilities, but, in the architectural and general lighting segments, dynamic color-change projects are often project-specific and have to be supplied on short delivery times.

Over the last 5 years, eldoLED has developed a wide range of intelligent drive solutions, which are simple to integrate within products and easy to configure to suit the requirements of a particular project or fixture. The latest incarnations of the eldoLED technology are the ECOdrive, POWERdrive and LINEARdrive products. These boxed products (see photos), which are easy to mount and connect for OEMs, require just basic wiring skills similar to any other electronic ballast. The range can cope with LED-array powers from 15 to 180 watts in the ECOdrive and POWERdrive products, through to 720 watts with the LINEARdrive solution.

The drivers all feature a common user interface which is accessed via 3 push buttons, with parameters displayed on a 4 digit HEX LED display. Users can easily change parameters such as a DMX start address, access one of the predefined color shows, select DALI or 1-10 volt control inputs, and even set the LED drive current. The user interface can also be used to set more complex parameters such as the temperature at which the LED array's thermal feedback sensor should operate. The thermal feedback protection is an excellent feature to protect against lighting fixtures being used in high ambient temperatures for which they were not originally intended.

Once the OEM has configured the driver to match the requirements of the fixture to which it is connected, the end user can be prevented from changing the more complex parameters. However, access is allowed to those parameters which require changing in the final installation, such as show or color.

As well as being able to set parameters via the user interface on the front panel, the drivers can be connected to a PC using the eldoLED TOOLbox software and USB dongle. In this mode the user can even define up to 19 specific shows which are uploaded to the driver. This feature is useful for stand-alone applications such as point-of-sale or variable-white task lighting, as it removes the need for a separate DMX control system which can be costly.

This degree of flexibility and options may sound great for an R&D environment, but having the option to set so many parameters is complex in a volume production environment. This is where the final twist in the eldoLED technology comes in. A dedicated website (www.ledcode.com) can be used to define how the driver is going to be used e.g. number of channels, and LED drive current. The website then produces a recommended wiring diagram and a series of 3-digit codes which can be directly entered into the driver to set the required parameters. This makes set-up of multiple drivers in a production environment a breeze.

The eldoLED approach to the complex and ever-evolving requirements of LED technology is unique. The degree of flexibility and creativity it provides for OEMs is tremendous—the major advantage is that all this flexibility can be achieved with a common set of drivers, reducing the stock-holding requirements and enabling OEMs to react quickly to a specific special project requirement.

GORDON ROUTLEDGE *is in charge of UK Business Development for eldoLED (www.eldoled.com), a privately-owned company with headquarters in Eindhoven, The Netherlands.*

The Largest and Fastest-Growing HB LED and Lighting Events Worldwide

Meet face-to-face with thousands of the world's most influential and motivated manufacturers, equipment suppliers, and end-users who come to evaluate products and services and get the information they need to conduct business within the global LED and lighting industry.

NEW Event for 2010!

Strategies in Light Europe
The Leading Events for the Global LED and Lighting Industry

Sept. 28 – 29, 2010
Sheraton Frankfurt Hotel & Towers
Frankfurt, Germany
www.sil-ledeurope.com

Nearly doubled attendance set in previous inaugural year 2008 – 5,300 total attendees in 2009!

LED JAPAN *Conference & Expo*
Strategies in Light
The Leading Events for the Global LED and Lighting Industry

Sept. 29 – Oct. 1, 2010
Pacifico Yokohama
Yokohama, Japan
www.sil-ledjapan.com

Record-breaking attendance 4 years running– 2009 the largest in its 11-year history!!

Strategies in Light
The Leading Events for the Global LED and Lighting Industry

February 23 – 25, 2011
Santa Clara Convention Center
Santa Clara, CA USA
www.strategiesinlight.com

Attendee Profile

- LED & lighting specialists working with:
  - Mobile Appliances
  - Signs and Displays
  - Automotive Lighting
  - Signals
  - Electronic Equipment
  - Illumination
- LED lighting manufacturers
- LED product designers
- LED makers & distributors
- Lighting designers, specifiers & architects
- Energy-efficiency organizations
- Corporate R&D staff
- Government regulators & policy-makers
- Financial analysts, investment bankers, & venture capitalists

Applications Include:

- General lighting/ illumination
- Architectural & decorative lighting
- Mobile devices
- Outdoor lighting
- Signs & displays
- Automotive lighting
- Signals
- Backlighting

Who Will Exhibit

- LED manufacturers
- Component distributors
- Driver & controller manufacturers
- Test & measurement providers
- LED lighting manufacturers
- Design software suppliers
- Equipment & materials suppliers
- Thermal management & optics suppliers
- Module & light-engine vendors

Whether you are a supplier, an LED manufacturer trying to reach new customers, a designer looking for new product information, or a buyer exploring the latest technologies, Strategies in Light can help achieve your objectives.

For more information on exhibiting or sponsoring at ANY SIL event , please contact:

US (West Coast), Europe, & Asia (Outside Japan):
Tim Carli, *Sales*
+1 650 941 3438, x23
tcarli@strategies-u.com

US (East Coast):
Mary Donnelly, *Sales*
+1 603 891 9398
maryd@pennwell.com

For more information on exhibiting or sponsoring at the LED JAPAN event, please contact:

Japan Office:
Manami Konishi, *Sales*
+81 3321 93 641
konishi-manami@ics-inc.co.jp

For more information on the SIL Europe event, please contact:

ROW: **Virginia Willis,** *Sales*
+44 0 1992 656 663
virginiaw@pennwell.com

Germany/Austria Office:
Holger Gerisch, Sales
+49 8801 302430
holgerg@pennwell.com

Owned and Produced by: LED & LIGHTING Media Group | PennWell (EST. 1910, 100th ANNIVERSARY)

Presented by: strategies unlimited

Flagship Media Sponsor: LEDs MAGAZINE

PRODUCT *focus*

TO PROMOTE YOUR PRODUCT HERE, PLEASE CONTACT **JOANNA HOOK** AT *joannah@pennwell.com* OR **MARY DONNELLY** (U.S. SALES) AT *maryd@pennwell.com*

Bergquist Introduces

Thermal Clad® HPL

Dielectric For High Power LED Lighting Applications

This dielectric withstands high temperatures with a glass transition of 185°C and delivers phenomenal thermal performance. Benefits include low thermal impedance of 0.02°Cin2/W (0.13°Ccm2/W) and high thermal conductivity of 3.0 W/m-K. **FREE HPL Sample Packet** at **www.bergquistcompany.com/hpl** or call **1.800.347.4572**

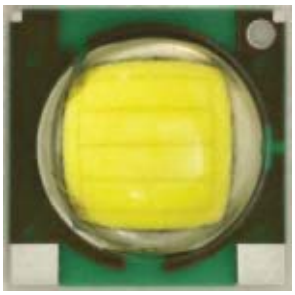
THE BERGQUIST COMPANY

18930 West 78th Street • Chanhassen, MN 55317 • A ISO9001:2000 registered facility
(800) 347-4572 • Phone (952) 835-2322 • www.bergquistcompany.com

CREE

Cree XLamp® XP-G: Up to 367 lumens

Cree's XLamp family sets the new standard for LED performance with the cool white XP-G, the industry's brightest and most efficient lighting-class LED. The XP-G LED can produce up to 367 lumens at 1A, and deliver a typical efficacy of 111 lumens per watt in a compact package.



CREE

Tel: 919-313-5300
Fax: 919-313-5558
Web: www.cree.com

ELDOLED

POWERdrive: constant current LED driver

POWERdrive is a 4-channel, DMX/DALI/0-10V compatible constant current LED driver/controller that is easily configured over its 3-button user interface. It has a high power output (up to 180W), robust thermal management and its LED current can be set in 50mA steps from 200mA up to 1.4A. Offers smooth dimming, fine colour and warm white/cool white mixing, and user-definable show sequences.

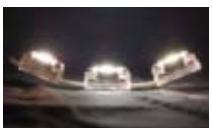
Email: sales@eldoled.com
Web: www.eldoled.com/powerdrive

LYNK LABS INC.

GeoLite™ AC LED Festoon

Breakthrough – Simple – 12VAC Direct LED Retrofit

- EFFICIENT
- SIMPLE
- NO DRIVERS



LYNK LABS Green Lighting Technologies

Bulb n' Ballast LED Solutions

Contact: Lynk Labs Inc.
Tel: 847.783.0123
Fax: 847.783.0130
Email: ACLED@lynklabs.com

AC LED Bulbs accelerate and simplify LED retrofit integration.

MACROBLOCK, INC.

Macroblock Launches LED Drivers for LED Architectural Lighting

Macroblock now has provided 3-and 12-channel constant current LED drivers MBI6020, MBI6024 and MBI6030 for LED architectural lighting applications. With phase-inversed output clock, auto-addressing and auto latch schemes, these LED drivers series are able to enhance the long-distance transmission performance of LED architectural lighting systems without suffering the signal distortion or degradation.

Tel: +886-3-579-0068
Fax: +886-3-579-7534
Email: marketing@mblock.com.tw
Web: www.mblock.com.tw

UPEC ELECTRONICS CORP.

UPEC releases innovative Intelligent Lighting Management System

The innovative Intelligent Lighting Management System equiped with electronic dimming gear and area RF/PLC control, each device can be individually controlled, and monitored. By using the system, we could achieve energy-saving, labor costs reducing, and accuracy reporting.

- Best utilization for energy usage
- Fewer staff with remote control
- Improved lamp lifespan to reduce cost
- Provide accurate system status

UPEC

Email: ledsmg@u-pec.com
Web: www.u-pec.com

last word

Cities are transforming the outdoor lighting market, but barriers remain

A global trial is strengthening the case for LED acceptance by municipal lighting asset managers, says **PHILIP JESSUP** of **THE CLIMATE GROUP**.

In 1893, visitors to Chicago's Columbian Exposition were awestruck by the blaze of artificial light that bathed the fairground's neo-Renaissance streets and plazas. Aglow at night with 93,000 electric lamps, the fairgrounds were dubbed the White City. Searchlights alone consumed more electricity than the entire city of Chicago, reports John Jakle in his definitive City Lights. The Exposition's 16 million dazzled visitors spread the word. To emulate the White City, municipal governments began converting their archaic oil and gas street lamps to electric lights. Cities would never be the same.

Thus, municipal governments historically became important players in the transformation of lighting markets. During the late 1800s, they set up their own companies to raise capital to install gas street lighting on commercial streets. When electricity brought brighter light, they made large financial contracts with fledgling private utilities to convert the old to the new.

Municipal leadership continues apace today in the LED market. In North America, small cities like Ann Arbor, Anchorage, Raleigh, and Welland braved the first LED demonstrations. Well publicized via *LEDs Magazine*, positive results from these trials traveled fast. Larger cities like Los Angeles, New York, San Francisco, and Toronto followed. The US DOE's Gateway demonstration projects, Cree's LED City program, and the Clinton Climate Initiative also spread the word. Meanwhile in China, favorable political circumstances and local entrepreneurs thrust Tianjin into world LED technology prominence. The PRC government's new 21-city LED initiative will soon see the installation of 210,000 streetlights across the country.

Globally, lighting accounts for 19% of the world's annual electricity use and about $19 billion in annual operating costs. The percentage of CO_2 emissions from lighting (9%) exceeds emissions from all commercial buildings (6%) and approaches that of road vehicles (10%) worldwide. Early trials are showing energy reductions of 40% to 70% when paired with smart controls. These trials are also confirming substantial quality-of-life benefits. Obviously, a rapid shift to LEDs would make a considerable dent in planetary carbon emissions.

Recognizing this potential, The Climate Group (TCG), an international membership organization of corporate and government climate leaders with offices in Australia, China, Europe, India, and North America, is undertaking an initiative to accelerate this transformation. LightSavers is a consortium of municipal market players started by the City of Toronto's Atmospheric Fund in 2006. TCG is scaling up Toronto's initiative globally (see www.ledsmagazine.com/news/6/12/14).

Can cities repeat their successes of 100 years ago in transforming the lighting market? Yes. There are an estimated 90 million streetlights worldwide. Cities control most of them. LEDs make sense in this niche, because their directional qualities have a comparative advantage—most of the light ends up on street surfaces. However, there are considerable barriers. The key concerns on lighting asset managers' minds are performance, durability and longevity, energy savings, environmental benefits, and costs.

In LightSavers' first phase, TCG is mounting a global trial of LED luminaires to address such concerns. These trials involve large cities as partners and are designed to produce credible, comparable data that helps remove the remaining barriers to acceptance of the technology. Results are coming in from Hong Kong, New York, Toronto, and Guiyang and Tianjin, China. More trials begin in the first quarter, 2010, in Adelaide, Australia; London, U.K.; and Kolkata, India. Two of Asia's largest cities, Mumbai and Shanghai will follow.

Initial reporting is positive. Lighting managers report that most local roadways and parking lot lighting standards are being met. Energy savings up to 80% with controls are being recorded. The directional benefits of LED systems are being quantified and indicate a two-fold (or more) efficacy advantage over the incumbent HID technology.

One unknown is lumen depreciation. This will impact cost and the business case that municipal lighting managers make to their councils. The second phase of LightSavers will address these financial questions, the final barriers to significant scale-up worldwide. If cities in partnership with financial institutions can reinvent the capitalization innovations they pioneered 100 years ago, the outdoor LED market will move quickly toward its proverbial tipping point. Global collaboration will help pave the way.

MORE: www.theclimategroup.org/lightsavers

Taiwan International Lighting Show

台灣國際照明科技展

March 12-15, 2010

Taipei World Trade Center Exhibition Hall

www.TILS.com.tw

Sponsor: Bureau of Foreign Trade, MOEA

Organizers: TAITRA www.taipeitradeshows.com.tw

TLFEA www.lighting.org.tw

Reliable Lutron® dimming down to 1%

NEW

Experience the full range of LED light levels with the Hi-lume® LED driver from Lutron

Superior performance
Smooth and continuous dimming to 1% of total light output enhances your space and saves energy.

Proven compatibility
The Lutron fixture qualification program ensures your fixture and our driver work together seamlessly.

Scalable intelligence
Works with Lutron EcoSystem® digital bus and 3-wire controls for a single room or an entire building.

Models available: 700mA, 1.05Amp, 1.4Amp, and 2.1Amp

For details and a list of qualified fixtures, please visit **www.lutron.com/HilumeLED**

Find the answers to all your LED control questions by calling the Lutron LED Control Center of Excellence at **1.877.DIM.LED8**

LUTRON®

save energy with Lutron™