

## **Report on the Lighting Trade-Show LIGHTFAIR International 2011 (Philadelphia, May 15-19)**

*By Alession Corraza, SAES Getters*

This year the renowned LIGHTFAIR® International (LFI), the world's largest architectural and commercial lighting trade-show and Conference, was held in Philadelphia.

Nearly 500 manufacturers presented products in the field of light sources, lighting systems, daylighting products, decorative lighting, ballasts, fixtures, lamp-holders, luminaires, lighting control components, control devices and mounting devices.

Many courses in the field of lighting technologies, architectural and commercial lighting were organized for the LIGHTFAIR® International Conference.

A high number of manufacturers, engineers, lighting designers, architects, distributors, electrical engineers, energy managers, consultants, utility specialists and urban planners attended the Lighting Trade show.

In addition to the main exhibition on light sources, four pavilions were arranged at LFI:

- the Building Integration Pavilion
- the Daylighting Pavilion
- the Design Pavilion
- the Global Light + Design Pavilion.





The LFI Innovation Awards program provided an overview of the latest lighting-related products and designs proposed by the manufacturers over the last 12 months. The awards program encompassed over 200 products for 14 different categories. Each product was judged by an independent panel of renowned lighting professionals. The winners were awarded for product entries that demonstrate the best in innovative design and thinking.

The most important prizes were assigned as follows:

- *winner of the* **AWARD FOR THE MOST INNOVATIVE PRODUCT OF THE YEAR** - the highest award, recognizing the most innovative new product → **Revel™ by Acuity Brands**



A 5-panel modular OLED ceiling mounted system of 6.5 watt, 4" square panels at 60 lumen per watt and CRI = 85.

- *Winner of the* **TECHNICAL INNOVATION AWARD** - award recognizing the best advancement in lighting technology- and **SPECIALTY LAMPS AWARD** → **LUXEON A by Philips Lumileds:**



A hot-tested LED with tight binning at 85 lumen per watt providing 170 lumen at 2700 and 3000 kelvin with CRI = 80. Philips Lumileds has committed to provide LEDs

produced with advanced manufacturing controls so as to target specific correlated color temperatures; each LUXEON A LED falls within one 3 step MacAdam ellipse space at actual operating conditions.

- *Winner of the DESIGN EXCELLENCE AWARD* – award recognizing outstanding achievement in design → **Low-Voltage LED Wall Wash/Flood by Tech Lighting-Generation Brands**



A 10 or 20 watt single or double 12 volt wall wash track head producing 600 or 1200 lumen dimmable to 10% in flood or asymmetric optics.

- *Winner of the JUDGES' CITATION AWARD* - special recognition of an innovative product at the judges' discretion → **IES Lighting Handbook 10<sup>th</sup> Edition by the Illuminating Engineering Society (IES)**.



The 37 chapter, reference Handbook, new in format, scope, and depth.

- *Winner of the AWARD FOR CONVENTIONAL LAMP* → **ED 28 145W Energy Advantage CDM with AllStart by Philips Lighting**



A 145 watt CDM direct retrofit for 175W QMH lamps on either a probe or pulse start magnetic ballast.

- *Winner of the AWARD FOR FLUORESCENT BASED TROFFERS SUSPENDED SURFACE LUMINAIRES* → **Unity Over-bed by Visa Lighting**



A sealed housing over-bed LED fixture for patient rooms offering multi-light outputs with blue-light therapy and RGB color changing.

- *Winner of the AWARD FOR EXTERIOR LIGHTING – ROADWAY OUTDOOR LIGHTING* → **Mc-Graw-Edison Marquis LED Sign Light by Cooper Lighting**



A 132 or 288 watt LED sign light exceeding the IES RP-19 for sign lighting uniformity in 4000 kelvin.

- *Winner of the AWARD FOR CONTROLS DAYLIGHT INTEGRATION AND SYSTEMS* → **Remote-mount dimming module with Ecosystem by LUTRON Electronics Co. Inc**



A remote-mount dimming retrofit module for personal control, occupancy and daylight strategies and wireless compatibility.

- *Winner of the AWARD FOR BALLASTS AND TRANSFORMERS* → Quicktronic® QTO by OSRAM SYLVANIA



A UL Type II wet location, high efficiency HID 50% step-dimming ballasts for standard 100 to 200 watt MH and HPS lamps.

Other interesting new products presented in the field of conventional lamps were:  
for Metal Halide lamps:

- **Cera Arc® Tubular Mogul Base 150W** by EYE LIGHTING International: a 24,000 hour, energy-efficient Ceramic MH lamp with up to 117 LPW with horizontal mean lumen higher than a 250 watt pulse start lamp;



For Linear and Compact Fluorescent lamps

- **High Output T5 lamps** → **PENTRON® HO XL ECOLOGIC® T5** by **OSRAM Sylvania**: 54 watt T5HO lamp claiming 60,000 hour life, 5000 lumen (93 lm/W) and dimming to 1% on their 0-10 volt DC control ballast.



- **High wattage compact fluorescent lamps** → **High Power CFLs** by Maxlite 40 – 200W CFLs  
or **High Watt CFLs** by Litetronics  
65-150 watt CFLs with a remote ballast as an alternative



to HID

lamps for high bay applications.



- **Tru Start CFL** by TCP Inc.: CFL with a 15-20 second run up time and 20,000 hour life.

New products in the field of Solid State Lighting and related applications:

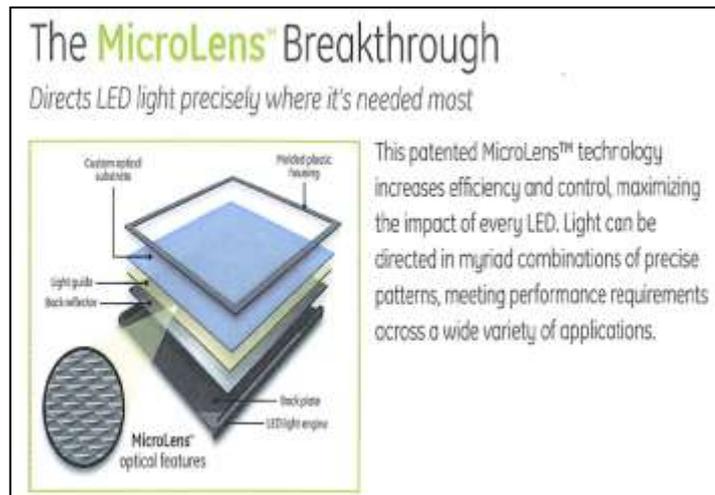
- **GE Lighting** presented recessed and suspended fixtures that will make solid-state lighting a solution for widespread use in commercial and residential applications. The new design fixtures will feature an ultra-thin “light guide” with built-in LED technology that will maximize the full potential of LEDs. The new LED fixtures will be available as ceiling troffers and suspended fixtures that will appear to float in thin air through a framed light source. Each fixture will have transparent or opaque light panels coupled with a MicroLens technology. Through the use of GE proprietary optical modeling software and design techniques, the MicroLens “ray-angle control pattern” can be used to efficiently spread light across the entire lighting surface or focus the light in specific locations. According to GE indications, each fixture will deliver uniform, bright light in a thin design with the following features:

- CRI of 80 or higher.
- Long Life: Each fixture type will carry a min. rate of 35,000 hours.
- Instant Start and dimming Capabilities.

GE’s family of LED edge lighting ceiling troffer fixtures

will become available late 2011, while GE’s suspended LED edge lighting fixtures are expected to arrive on the scene the first half of 2012.

The LED Circular Suspended Luminaire is an example of the new technology: a dimmable 54 watt 2' circular suspended luminaire offering 3200 lumen at 3500K for 50,000 hours. It exploits microlens optics for uniformity.



The innovative LED EdgeLighting Linear Luminaires will be available by Spring 2012: expected lumen output of 1700 lumens per each fixture and efficacy 75 lm/W.



- Also **CREE Inc.** presented LED Troffers with high efficiency: CR Series luminaires consisting of 2x2, 2x4 and 1x4 foot LED troffers at 90 lpw in 2 color temperatures and CRI = 90.



- **Philips** unveiled EnduraLED A21 17-watt light bulb designed to replace a 75-watt incandescent bulb: it can reduce energy consumption by 80% and lasts 25 times longer. The EnduraLED A21 17-watt is the latest addition to the already released 25W, 40W and 60W equivalents LED bulbs. The new lamp fulfills specifications for delivering 1100 lumens with just 17-watts of electricity, a color temperature of 2700k, a color rendering index (CRI) of 80, and a rated life of 25,000 hours. The new bulb will be submitted to ENERGY STAR in the coming months for qualification testing.



It will be available during the fourth quarter of 2011 in the US; the price is expected to be in the range of \$40 - \$45.

- **Switch Lighting** announced the first ever 100 watt-equivalent LED bulb. Switch is using an innovative technology: the bulb creates a self-cooling environment inside, allowing maximum brightness with fewer LEDs. Few time ago the company presented 75W and 60W equivalent bulbs. All of the bulbs offer incandescent quality light, are dimmable, and can be used in any direction.

The 100 watt equivalent A19 lamp will produce 1700 lumens in neutral white and a warm white version of the 100W equivalent bulb will be offered in mid- to late-2012. Switch introduced its unique cooling technology on April 2011 with the company launch announcement.

- **Lighting Science Group (LSG)** presented a new 60W-equivalent bulb: 13W lamp delivering 850 lm. According to the company information the passive cooling heat sink is replaced with an active scheme based on micro-electro-mechanical systems (MEMS)

technology. Micro-scale structures can create air movement and improve cooling: in the near future MEMS-based cooling will enable the release of a 880 lumen lamp that consumes just 11W. LSG is developing a new-generation LED lamp that will use MEMS- based cooling and also quantum dots to generate light in place of traditional phosphors. Such a design should produce 1000 lm at 10W.

- **Osram Sylvania** announced the plan to release a 75W-equivalent LED bulb, 13W 1100-lm lamp (85 lm/W), by fall 2012. Sylvania is going to deliver 40W- and 60W-equivalent light sources, consuming 8W and 13.5W respectively, this summer. The lamps will generate light with a 2700K color temperature and a CRI = 85.



- **Future Lighting Solutions** announced the introduction of its Intelligent Lighting Platform, featuring Synapse Wireless Technology: it provides a broad range of easy-to-use, scalable, robust, flexible, and interoperable lighting systems, sub-systems, and solutions to maximize the energy savings in solid-state lighting. The technology integrates wireless, power-line communication (PLC), sensor, and LED driver products in creating comprehensive system solutions that are powered by a single network operating system and software user interface.

Features of the Intelligent Lighting Platform include:

- A broad range of communication technologies, including 2.4 GHz wireless, sub GHz wireless, and PLC for indoor and outdoor lighting applications.
- Simple certified wireless/PLC system controllers that output 0-10V, DALI, PWM, DMX signals to control any available off-the-shelf dimmable LED drivers.
- Certified LED drivers that incorporate the various communication technologies in order to enable highly integrated and compact systems
- Energy measurement systems that quantify and monitor energy savings
- Ambient light and motion/occupancy sensing systems programmed to automatically turn on/off or dim luminaires.
- Remote controlled hardware products, such as wall mount dimmers and touch screen LCDs that can control luminaires locally.
- Web-based software that monitors and controls lighting hardware.

During the LFI 2011 Conference many education opportunities on LEDs and Light Sources were offered. One of the most interesting courses was the course “How do LEDs compare with High performance Fluorescent, Halogen, HID, Induction and Plasma lamps”: the speaker, Stan Walerczyk, founder of Lighting Wizards, compared performances of LEDs with those of discharge lamps, remarking advantages and differences. He pointed out that

good LEDs are ready for specific applications such as task lights, recessed can kits, downlights, spotlights and exterior fixtures, but they should not be used in other applications, especially LED T8s (as shown in the following comparative example: LED vs T8 for troffers).

2x4 lensed troffer with 4 F34T12CWs															
\$0.15	blended rate	3500	annual hours	1.1	reduced AC savings x	\$0.05	/KWH saved incentive	15	cumulative years in long term benefit						
existing				proposed											
type	watts	annual elect. cost	lamp life @ 12 hour cycles	end of life lamp lumens	retrofit and relamping options	end of life lamp lumens	lamp life @ 12 hour cycles	watts	watt reduction	annual elect. savings	incentive	appr. installed cost	pay-back (yrs)	comprehensive long term benefit	notes
4 F34T12 CW lamps, 2 2-lamp energy saving magnetic ballasts, angled sides with good white paint & clear prismatic lens	144	\$75.60	25,000	6500	4 1600 lumen 17W LED T8s	4480	50,000	68	76	\$43.89	\$13.30	\$220.00	4.7	\$714.99	may not be sufficient light long term
					2 3100 lumen long life 32W fluorescent F32T8s in outboard lamp holders & 2-lamp .89 BF high performance parallel wired program start ballast	5077	40,000	58	86	\$49.67	\$15.05	\$55.00	0.8	\$1,077.51	probably sufficient light with better thermals & fixture efficiency
					2 2950 lumen extra long life 32W fluorescent F32T8s in outboard lamp holders & 2-lamp 1.00 BF high performance parallel wired program start ballast	5428	55,000	65	79	\$45.62	\$13.83	\$57.00	0.9	\$1,051.77	probably sufficient light with better thermals & fixture efficiency
					2 3100 lumen long life 32W fluorescent F32T8s, 2-lamp .89 BF high performance parallel wired program start ballast & white reflector	5077	40,000	58	86	\$49.67	\$15.05	\$65.00	1.0	\$1,067.51	reflector may increase light levels
					2 2950 lumen long life 32W fluorescent F32T8s, 2-lamp 1.00 BF high performance parallel wired program start ballast & white reflector	5428	55,000	65	79	\$45.62	\$13.83	\$67.00	1.2	\$1,041.77	reflector may increase light levels

footnotes: Numbers in colored boxes can be changed, which automatically alters computations.  
Copyright of Stan Walerczyk, LC, principal of Lighting Wizards. January 1, 2011 version.

He explained that following factors are really critical in order LEDs become mainstream

- Pricing to continue to come down
  - according to projections, costs for LED devices (not fixtures)
    - \$10,00/klm in 2010
    - \$ 5,00/klm in 2012
    - \$ 2,00/klm in 2015 (to be compared with current costs of 0,28 \$/klm for low-end CFLs and 2,04 \$/klm for High Performance T8 lamps)
- Replaceable and interchangeable LED and driver modules from several manufacturers
  - Some manufacturers have already started this
  - international Zhaga Consortium is working ( [www.zhagastandard.org](http://www.zhagastandard.org) )
- Maintenance of constant lumens during life (acceptable just a small decay as occurring in most of the discharge lamps)
  - 30% lumen drop from initial to end of life (L70) results in: either “too much light initially so enough light at end of life” or “good amount of light initially, which would be too little light at end of rated life”. Several manufacturers are already thinking to this issue.

As illustrated in the following graph, lumen depreciation during 55Khours LED life is really important with respect to that observed in case of T8 lamps (use of two T8 lamps rated with 42 Khours instead of one LED with 55Khours life)



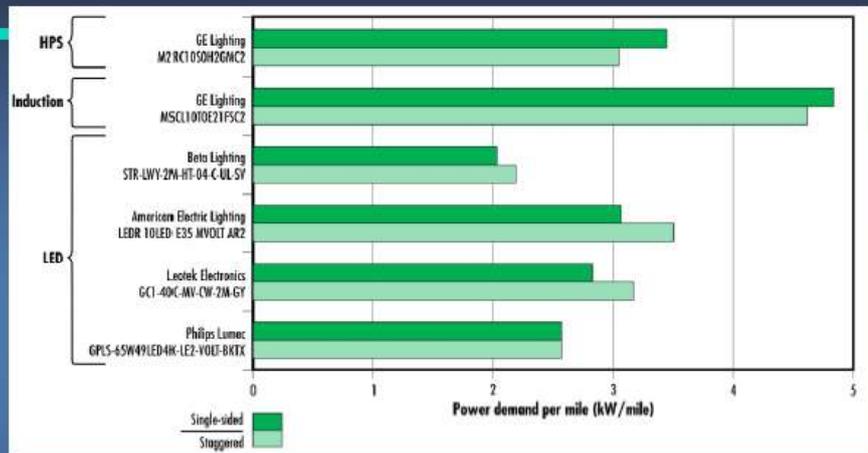
In a seminar with title “LEDs: Facts vs Fiction”, Leora Radetsky, researcher at the Lighting Research Center, presented some studies carried out at LRC on Street Lighting. Some of the results are also described in recent National Lighting Product Information Program (NLPIP) Reports published at the following link:

<http://www.lrc.rpi.edu/programs/nlPIP/publicationResults.asp?type=1>

She explained that LED systems can be useful to obtain energy savings in Streetlights for Collector Roads and Streetlights for Local Roads. The adoption of LED systems is suggested especially for new installations because they need a reduced pole spacing (more devices) with respect to High Pressure Sodium lamps and to Metal Halide lamps in order to meet RP-8 illuminance criteria; even if they require a higher initial investment, in many cases they allow to achieve significant energy savings.

In the following example of Streetlights for Local Roads it is shown that the use of LEDs assures, on average, a power saving of 24% with respect to HPS lamps (and even more with respect to induction lamps).

## Power Demand: Streetlights for Local Roads



LED: On average, 24% or less power per mile than HPS  
 Induction: On average, 46% more power per mile than HPS

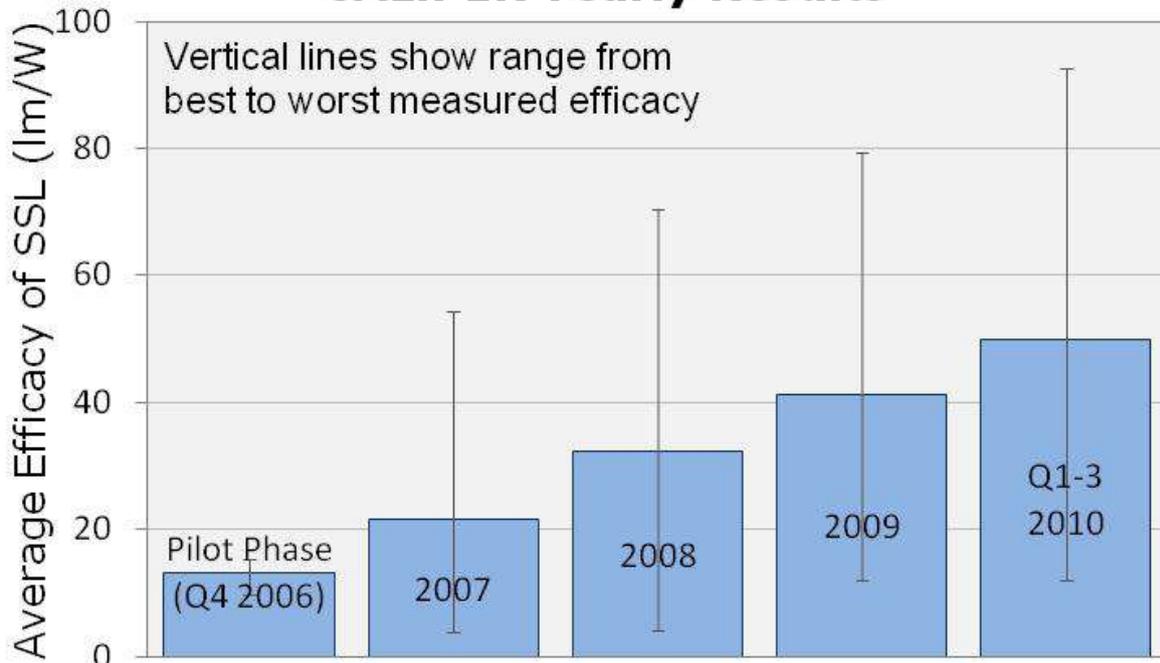
In other seminars (Curran, Baum, Walerczyk), recent results of measurements related to the DOE CALIPER Program (Commercially Available LED Product Evaluation and Reporting program) were discussed.

During the last round of testing (Round 11 completed in September 2010) mainly outdoor luminaires, high-bay luminaires, linear replacement lamps and small replacement lamps (MR16, PAR lamps, A-Lamps) were considered.

The CALIPER summary report can be found at <http://www.ssl.energy.gov/caliper.html>

The average overall efficacy of SSL products tested in Round 11 (from Q1 to Q3 2010) was 57 lm/W, ranging from a minimum of 17 to a maximum of 93 lm/W, while it was 46 lm/W in 2009. The reported graph shows the steady increase in performance of market-available SSL products since CALIPER testing started in 2006. The average efficacy of the SSL products is continuously improving, however many products continue to carry misleading equivalency claims and inaccurate manufacturer published performance metrics.

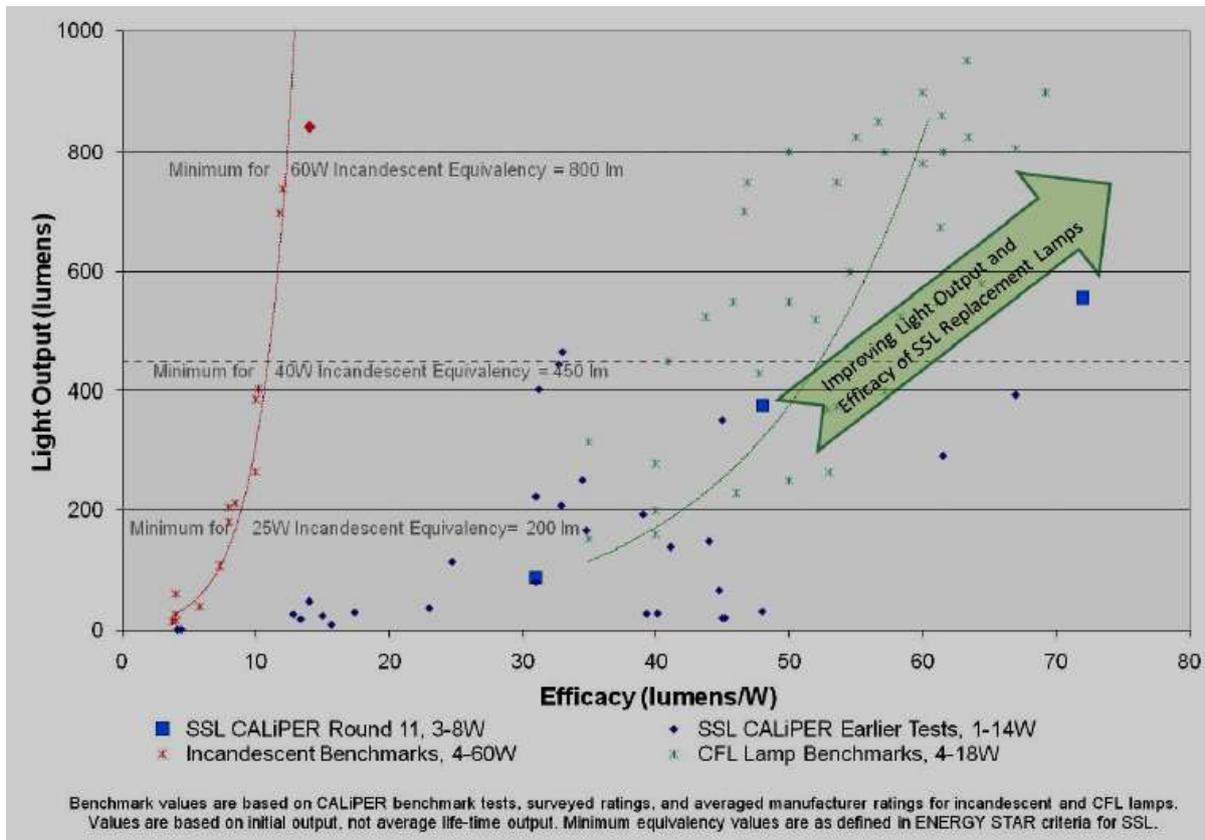
## CALiPER Yearly Results



- Outdoor luminaires exhibit, on average, significant improvements over earlier CALiPER results: half of the tested luminaires achieved overall light output and efficacy values matching or exceeding levels of benchmark outdoor luminaires.
- Also linear replacement lamps show progress, however the light levels and distribution of fluorescent lamps are not yet achieved. Also color qualities of the majority of SSL linear lamps are not within standard tolerances for white light at their respective nominal CCTs.
- Small replacement lamps, including MR16 lamps, PAR lamps, AR111 and omni-directional lamps, show progress for each lamp type; nevertheless a high number of products are not compliant with the claimed lamp equivalencies; some of the products are not meeting standard lamp geometries for the type of lamp they claim to replace and some of the products are not meeting average light output levels or beam characteristics of the lamps with which they claim to be equivalent.

Concerning measurements on Omni-direction lamps and small replacement lamps, SSL products marketed as A19 replacement lamps and decorative SSL candelabra lamps were included in Round 11, along with a standard 60W frosted A19 incandescent lamp for benchmarking. The following graph plots the light output and efficacy of these lamps as compared to earlier CALiPER testing and benchmark incandescent and CFL.

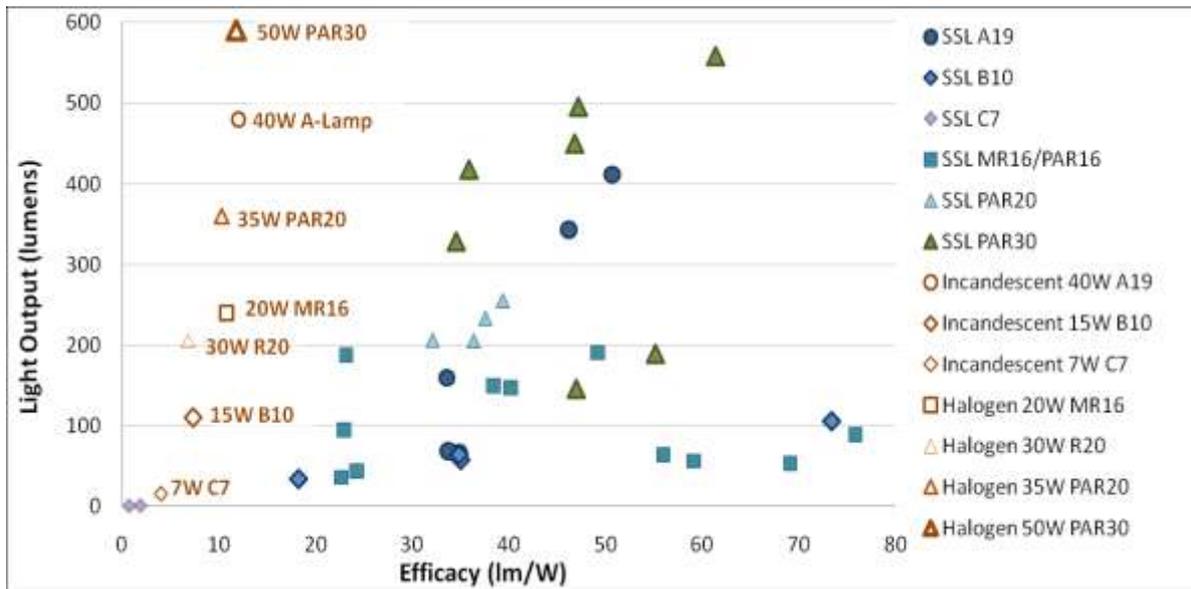
For similar light output levels, the SSL omni-directional replacement lamps achieve efficacy levels similar to, or exceeding, CFL lamps. One of the A-lamps comes close to achieving the minimum light output for a 40W incandescent equivalency rating, while using 20% of the power. An other A-lamp, which is a “neutral-white” color (3951K), surpasses the minimum light output for 40W incandescent, but does not meet the overall minimum light output for 60W incandescent.



In April 2011 a special CALiPER summary report on Retail Replacement Lamp Testing was released. Samples of different SSL products, including A19, B10 (candelabra), C7 (night light), MR16/PAR16, PAR20 and PAR30, were purchased anonymously from retail stores between June - August of 2010 and were tested.

As illustrated in the following graph, all the analyzed products (except some C7-shaped lamps) offered better efficacy than incandescent and halogen products. However, several products achieved high efficacy while Correlated Color Temperature (CCT) was much higher than the products they have to replace. This aspect may be difficult to be accepted by the consumers.

- Average efficacy was 40 lumens per watt (lm/W), which on average is about 4 times the efficacy of incandescent and halogen benchmarks.
  - 1/3 of the products had efficacy of 45 lm/W or better. (These efficacy levels exceed those of CFLs for small and directional lamp formats such as candelabras and R20-format CFL, but they do not meet CFLs levels for larger spiral A-lamps and R30 lamps.)
  - More than 50% of the products had efficacies in the range of 20 – 45 lm/W.
  - 10% of the products had efficacies in the range of 1 – 19 lm/W.



Most of the SSL products were marketed explicitly or implicitly as replacements for incandescent products that typically have CCTs in the 2700 to 3000K range, but many of them had CCTs: as already mentioned this might not be acceptable to a buyer because they generate a white colder (above 3000K) than that typical for small replacement lamps.

During all the LFI sessions, it was often remarked that a big challenge for the producers is related to the need of improving light quality and colour characteristics of SSL lamps.

In a Panel Discussion organized during LFI Conference, Jim Brodrick, DOE SSL Program manager, presented possible perspectives for OLEDs in the field of lighting. He explained that OLEDs are now in a critical stage: they are used for display applications, but are present just in limited numbers in general lighting (especially due to their performances limits and to the high prices). Some of the currently marketed products are shown in the following slide.

## A Critical Stage for OLEDs

- OLEDs currently used for display applications
- General illumination applications not commercially viable
- Handful of niche products exist with high price, limited quantities, significant performance limitations



Flexible, thin OLED light panel from GE



WAC Lighting's SOL OLED Chandelier, featuring ORBEOS lighting from Osram (2010)



Philips' Lumiblade OLED module (2009)



Acuity Brands' OLED luminaire (2010)\*



Osram PirOLED (2010)

\*©John Sutton Photography 2010

Dr. Brodrick described main challenges that are now facing for OLEDs to enter general illumination in big volumes:

- 1) Technical issues
  - Some lab devices can compete with conventional technologies in terms of performances, but products are still quite far
  - Work needed to develop long-lasting blu emitter
  - Work needed to improve lifetime, especially on high current density
- 2) Manufacturing issues
  - Infrastructure investment needed to develop commercial OLED products
  - Reduction of the costs needed
- 3) Testing and Standards
  - Need for reliable test methods standards to establish consistency and to have comparison with other systems

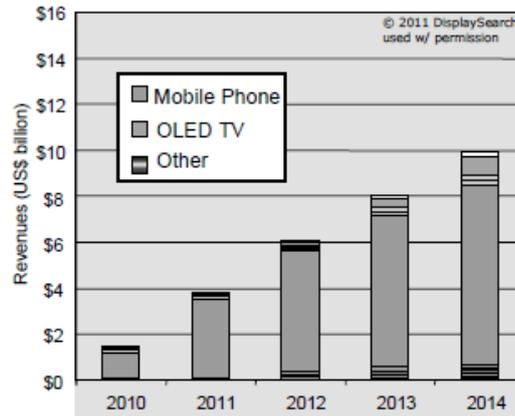
Dr. Brodrick illustrated also the expected evolution of OLED market in the next years:

- Main volumes are now related to OLED TV and Mobile phone, but starting from 2012/2013 some revenues are expected also in general lighting.
- A trend of the market is reported in the next graph.

Concerning improvement of the performances, according to DOE roadmap, the efficacy of the devices should achieve values of 100 lm/W or higher in 2015; actual efficacies are now in the range of 50-60 lm/W.

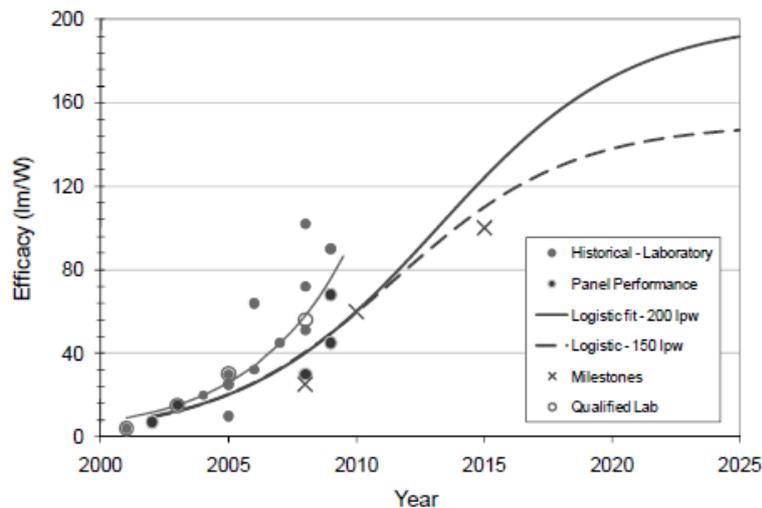
## OLED Market

- Shipments: ~73 million units in 2009<sup>1</sup>
- Total product revenue: ~\$826 million<sup>2</sup>
- Currently limited market penetration
  - OLED lighting panel prototypes commercially available from Philips, Osram, and Lumiotec
  - Expected to increase as performance improves and prices drop



<sup>1</sup> DisplaySearch, 2010; <sup>2</sup> Ibid.

## DOE OLED Efficacy Targets



SSL Multi-Year Program Plan, March 2010, [www.ssl.energy.gov/techroadmaps.html](http://www.ssl.energy.gov/techroadmaps.html)