Roundtable: How should we improve LEDs?

Q: While LEDs continue to gain widespread adoption, what challenges must the industry address to maintain or improve progress?

Adrian Rawlinson, Marl International, http://www.leds.co.uk/ [1]
LED technology truly ticks all the boxes when it comes to energy efficient lighting and within five years, I believe that 90 percent of RGB lighting will have converted to LEDs. Despite its many advantages, it will take this long because there are barriers that are currently inhibiting wider take-up including initial costs, lack of standardisation of measurement and industry fragmentation. If you look at the true cost of ownership, and factor in the exceptionally long life as well as low energy use, LED lighting is very economic, but the initial purchase price is much higher, and this is tending to put buyers off. I believe the price needs to come down before the technology will take off, and there is every reason to suppose that this will happen as volumes rise. There is still no standardised method of measuring light output power. Buyers relate light output to the wattage of the incandescent bulb needed to produce 'equivalent' light output, an increasingly pointless exercise as this type of lighting is being widely abolished. The increasing use of integrating spheres to measure the total radiant power or luminous flux of light sources is a step in the right direction. One of the reasons for the lack of standards is that the LED lighting industry currently consists of a huge number of relatively small companies. This picture is changing however, and consolidation is starting to take place. 2011 saw a rash of acquisitions and over the next five years, this process will I think accelerate giving buyers the consistency of quality and supply they need before they adopt LED as their mainstream lighting technology.

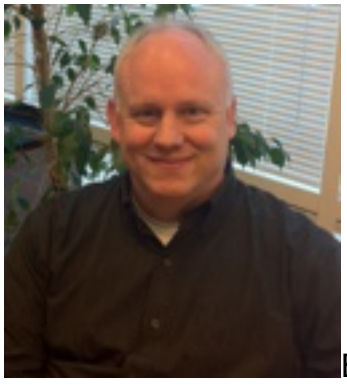
Chad Hall, Ioxus, Inc, www.ioxus.com [2]

LED adoption is on the rise, but makers of flashlights, street signs, and medical devices continue to look for new ways to extend their products' lifespan without increasing costs. Previously, the only energy storage options for LEDs were rechargeable batteries with short lifespans, which don't function properly when too warm or too cold. Even though LEDs in garden lighting last roughly ten years, the batteries cannot be replaced, and consumers are forced to buy new lights frequently.Hybrid capacitors, an ultracapacitor with a lithium-ion battery, help address these challenges. Hybrid capacitors provide greater energy storage capabilities in LEDs because they have an energy density 115 percent greater than that of a standard electric double-layer capacitor. This results in a longer usable time per charge. Compared to a nickel cadmium or lithium-ion battery, hybrid capacitors provide more than 20 times the cycle life and 60 times faster recharge rates.Device manufacturers can address challenges of battery lifespan by designing hybrid capacitors permanently into devices, since capacitor cycle life typically matches or exceeds device life. A typical hybrid capacitor has a cycle life of 20,000 cycles – or if charged once a day equals 54 years. This technology would not require a significant price increase, but insteadcuts maintenance costs since the extended life of the hybrid capacitor means LED lights don't need replacing until the LED itself burns out. Hybrid capacitors' long-lasting power will help LEDs gain momentum in the mainstream as a maintenance-free, energy-efficient light source.

Michael Kretzmer, ERG Lighting www.erglighting.com [3]
There are still a few hurdles that must be overcome before LEDs replace incumbent technologies.If we overlook price and anticipate that recent downward trends in cost will continue, two of the major obstacles remain: lack of standardization and the speed at which the technology is evolving. Many stakeholders throughout the value chain are lobbying for the standardization of components such as LED drivers, light engines, heat sinks, and optics. As MTBFs for some components far exceed their field time and test data, OEMs are looking for assurance that their expensive luminaire will not be rendered useless should one component fail. It's very important they consider the reputation of the component manufacturers before making decisions based solely on the lowest price and select products whose quality and longevity have been proven. For example, ERG has been designing and manufacturing long-life electronic components for over 30 years and has never obsoleted a power supply or LED driver. The rate technological evolution is slowing the adoption rate. LEDs are improving so rapidly products may be out-of-date by the time all the safety approvals and/or Energy Star ratings are met. Many consumers question whether the higher initial cost for an LED-based product is worth it when a better model will most likely be available in a few short months. As

advances in LED output start to slow, the market will be more willing to adopt it as the leading technology.

 Andrew Smith, Power Integrations, www.powerint.com [4]
Widespread adoption sounds nice, but for LEDs to become dominant, our industry must achieve universal acceptance. The consumer must be delighted by price and performance, the commercial space must see the value in re-equipping its facilities, and the industrial markets must have long lifetimes to justify costly infrastructure changes. In the consumer market, achieving the lowest possible cost is critical. While LED lamps have come down in price, their cost is still 2 to 3 times higher than compact fluorescent lamps and many times more than incandescent bulbs. The driver circuitry will need to continue to become more efficient to reduce package/heatsink expense. Increasing the level of integration to optimize manufacturing cost is also important. In many industrial applications, LED solutions benefit from government subsidies to reduce the cost of installation. Exterior LED lighting must also recover from the poor reliability of the first LED street lights deployed and impress the industry with lifetimes approaching several tens of thousands of hours. The commercial sector is ahead of the other market segments in adopting LED. Tube replacement and display lighting are already transitioning to solid-state lighting (SSL) for good business reasons. SSL needs to improve light quality to match that of incandescent to ensure that there are no residual barriers for the workplace or in retail spaces. Finally, robustly enforced and harmonized standards to enforce good practice for SSL must emerge to ensure that customer confidence is not affected by sub-standard products.

 Brian Johnson, Fairchild Semiconductors, www.fairchildsemi.com [5]
LED lighting technologies have already contributed to energy efficiency in the United States, primarily on a commercial level, although residential choices are becoming more available. The US Department of Energy has estimated by 2030 the adoption of solid-state LED lighting will reduce lighting electricity consumed by the nation by one-fourth, equaling approximately 190 terawatt-hours, 15 billion dollars (adjusted for today’s inflation), while reducing carbon gas emissions equivalent to

21 million cars. Reducing the cost of LED luminaries is critical to convincing consumers they benefit from LED-based bulbs. The technical challenges of higher efficacy, long lifetimes, dimming, intelligent control, and chromaticity are not to be ignored, but users must be willing to pay for the benefits gained from LED lighting products for industry success. Migrating to LED bulbs on a commercial and residential scale can be costly, but the efficiency of LED lighting is far greater than incandescent bulbs. The industry needs to make the case that LED bulbs will save money, making the return on the initial investment a beneficial and worthwhile one.The advent of silicon technology has allowed Fairchild to eliminate component count of an LED driver topology. This reduced component count saves manufacturing costs and reduces the need for extra components (including placement, test, and inventory.) An added benefit is the LED design fits on a smaller printed circuit board.

 Will Draper, Cirrus Logic, www.cirrus.com [6]
LEDs are on a clear path to become the next preferred lighting solution to incandescent lamps. But LEDs must address several technical challenges before going mainstream. The most immediate obstacles to mass-market acceptance are the three Cs: cost, color quality, and compatibility. Cost: As LED bulbs enter the high-volume consumer market, natural economies of scale combined with continued focus on lower system bill of material costs are expected to bring their retail price down to the $10 to$15 range in the immediate future and to the $5 to $7 range by 2015. Color quality: Given that consumers are largely dissatisfied with the performance of existing CFLs, LED lamps will soon emerge on the market that more closely replicate the user experience of incandescent lighting by simultaneously delivering warm CCT with high-CRI. Compatibility: To enter the mainstream, LED lamps need to be 100 percent compatible with the installed base of wall-mounted dimmers found within many of today’s residential and commercial lighting systems. Dimmer compatibility is virtually nonexistent with today’s CFLs, so the opportunity for differential LED products is significant. Although all aspects of the three Cs challenge are essential to the success of SSL in mainstream markets, compatibility is critical (Cirrus Logic’s first LED drivers combat this problem). LED products cost 5 to 10 times more than existing solutions, so customers have high expectations of the product’s performance. Compatibility less than 100 percent is frustrating, leading to many retail returns, and a negative experience.

 Roland Chapa, TT electronics Optoelectronics, www.TTelectronics.com [7]
TT electronics is working with several sub-segments of the lighting market to produce LED-based lighting solutions. We are seeing significant uptake in the medical, industrial, and military segments. In working with our customers, we have identified several challenges to be addressed as the market continues to expand.First, the lighting industry needs to come to agreement on designing retrofit products versus setting new standards. The latter would be better from a quality and safety standpoint. There are significant challenges in thermal management to be addressed when retrofitting LED-based bulbs to fit a socket designed for an incandescent bulb. The higher temperatures of these fixtures may damage the LED or surrounding circuits, compromising performance, or causing permanent failure. The cost of implementation is a major challenge. Whether you are designing a backlight for a theater display, surgical suite lighting, or a consumer lamp, migrating to LEDs is expensive. One way to reduce cost would be for the industry to work together to optimize manufacturing, testing and design to meet specific standards. For widespread consumer adoption, an industry-wide effort needs to be made to educate the public. Consumers are becoming more sensitive to efficient and green products, and the incandescent bulb is phasing out. That said, while technical advances have made it possible to develop a true incandescent replacement, with similar lumens, color temperature and CRI, the consumer simply doesn't understand the equivalence.

 Alex Mednik, Supertex, Inc., www.supertex.com [8]
The diversity of LED lighting applications calls for a large variety of LED driver solutions. While the challenges, such as cost reduction, improvement in LED utilization and life time, are common, the approach to addressing these challenges could be drastically different depending on an application. For example, one of the largest segments in the solid-state lighting market, incandescent bulb retrofits, must additionally address such aspects as packaging, heat management, safety, high PF, low line-frequency modulation of LED current, line transient immunity, and interfacing with legacy dimmer switches. Regardless of the approach, the simultaneous requirement of a high power factor and low 120Hz flicker calls for

large energy storage capacitors. Electrolytic capacitors used for this purpose put a severe limit on the product life time in many cases.Switching converters commonly used as LED drivers can provide good LED utilization by controlling DC current in the LED load accurately. However, they suffer high cost, poor packaging and thermal management, high electromagnetic emissions. Sequential linear regulators, so-called AC LEDs, provide excellent packaging and heat management and are very inexpensive. On the other hand, they suffer poor regulation of LED current, poor LED utilization, and line-frequency flicker prohibitive for use in many interior lighting applications.Dimmability is another culprit in making an efficient and inexpensive LED light bulb. Moreover, as the LED efficacies improve, it becomes increasingly difficult to load a phase-cut dimmer adequately to work reliably with the large assortment of legacy dimmer switches. Recently, National Electronic Manufacturer Associationpublished SSL 4 and SSL 6 documents, the minimum requirements to incandescent replacements. The attempt was made to consolidate a variety of requirements to a retrofit LED bulb. Yet, the solid-state lighting designs still largely remain technology-driven rather than being controlled by industry standards.

 Franz Rettenmeier, Vishay, www.vishay.com [9]

At Vishay we divide our high brightness LED lighting market into three segments: backlighting, automotive and general lighting. The Automotive segment is forecasted to grow significantly mainly driven by headlights and interior lighting. Vishay has tailored our white, red and yellow LED luminous flux and luminous intensities to meet market specifications. There is no impediment to adoption of solid state lighting in the automotive market. Automotive customers understand the benefits of longer life and rugged, vibration resistant packages. In General Lighting, the past five years can be described as a transitional period where retrofits of E40, E27 and E14 light bulbs have driven the market. At the same time, cities and municipalities have been running limited trials for street lighting applications. One of the limiting factors for both these markets has been a lack of standardization. With the upcoming standardization driven by ZHAGA adoption of lighting modules will accelerate. Price will continue to drop, further accelerating adoption. By 2020 approximatelly 70 percent of the replacement market will be LED based. We are focusing our efforts on color stability, higher color rendering index, and tighter binning. At the same time, we are partnering with FARALED and ECOMAL to deliver complete street, industrial, and residential lighting solutions.

 Daniel Slupik, Texas Instruments, www.ti.com [10]
Solid-state lighting fixtures and lamps continue to gain widespread adoption. One potential pitfall is the overall slowdown in the global economy. The new home sales statistics reported by the US Commerce Department continue to be soft, including an 8.4 percent drop in June. The seasonally adjusted annual rate of new home sales is 350,000—half the rate many economists equate with a healthy housing market. This is an indicator of potential softness in the residential market for new installations of solid-state lighting lamps and fixtures where the value proposition is the most compelling. Consumers aren't rushing out to buy $20 light bulbs when a six-pack of incandescent lamps will cost them $8.The lighting industry can mitigate this risk by dedicated focus on end pricing to consumers. While utility subsidies are becoming more prevalent, they are often inconsistent in availability. Suppliers must continue creating innovative solutions to drive initial costs down while improving dimmer compatibility, turn on time, and light quality. In the commercial and industrial sector, suppliers have focused on reducing initial hardware costs and increasing efficiency. There are an increasing number of intelligent solid-state lighting lamps and fixtures utilizing sensors to dim when light isn't needed, but often these are difficult to install and commission. This can improve energy usage costs at the expense of additional startup costs. By keeping key challenges in focus the industry will race closer to the inflection point on the price elasticity of demand curve, resulting in mass adoption of solid-state lighting products.

Links:
[1] http://www.leds.co.uk/
[2] http://www.ioxus.com
[3] http://www.erglighting.com
[4] http://www.powerint.com%20
[5] http://www.fairchildsemi.com
[6] http://www.cirrus.com
[7] http://www.TTelectronics.com
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