LED Technology — What's New, What's Next?

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Ever since blue LEDs appeared in the 1990's, a cascade of development and system evolution has advanced solid state lighting to become a viable and prosperous technology foundation. Today, LED technology is used for general lighting in small and large venues, in the automotive market, and in video displays, roadside signs, and digital signage.

According to Kevin Dowling, Vice President of Innovation for Philips Color Kinetics, the hospitality and retail markets are primary drivers for white light sources, and the broadcast market favors the technology for quality and long-lasting light sources. "Cove and under shelf lighting is driving LED usage because it's a natural fit for that application," he adds.

LEDs have come a long way in a short time. Dowling notes that the development of blue LEDs, and the subsequent creation of broadband white light by adding a phosphor coating, occurred in less than 20 years. "The first white LEDs were gray and dismal and there were technology hurdles in how they were driven and controlled," he says. "In 2000-2004, there was development in improving phosphors and the efficacy of blue LEDs, as well as packages for high power light output. Since 2004, LEDs continue to improve at pace that the industry is astonished by. Efficacy, light output and quality are improving faster than we projected."

Touted for its energy efficiency and increasing efficacy, "LED technology presents a huge opportunity because energy is becoming a rare commodity," says Chris Link, Business Development Manager for Energy Technologies at semiconductor supplier Texas Instruments (TI). Link's group studies and develops energy technology and the ways in which we can use energy more smartly. "LEDs are low watt and high lumens, but have specific requirements as to how current and voltage are delivered. TI specializes in the electronics for fixtures that improve the performance of LEDs."

Applications and Uses

TI's Link says that an environment like a refrigerated warehouse provides the perfect backdrop to show the advantages of LEDs. "LEDs shine when it's cold and perform better at lower temperatures than traditional lighting. They are also directional in the way they give light. You can design your layout so the light is where you need it," he says.

For Chris Flynn, Lighting Designer at Advanced Lighting & Production Services (ALPS), LEDs have added to the possibilities but not replaced traditional fixtures like par cans. "When we brought in LEDs, it opened up the possibilities in core and accent lighting, as well as up lighting," says Flynn, whose firm has also invested in a Hippotizer media server for advanced displays. "The media server software runs off the lighting board so it is forcing me to learn video terminology."

Flynn's colleague Paul DeRocher, Installation Project Manager for ALPS, agrees. "LED has augmented regular lighting but hasn't replaced anything yet because the cost is so much more. Fiber optics has been replaced with LED lighting for things like task lighting under a bar. In this application, you can't use a regular light bulb because, if it breaks into the ice below, you can't see the shards."

DeRocher notes that LED integration with video technology is becoming more prevalent. "The lines are becoming blurry between lighting and video people," he says. "My first LED install was 2003 and consisted of color-changing LED fixtures in a wall. Currently, I am working on a video wall for a storefront."

Perhaps where LED has had the greatest jaw-dropping effect is in large format, high definition LED displays such as outdoor signage or in large venues like a stadium. Limitations to LED technology are amplified when the diodes are installed in a mass density such as a panel, but it is this area where technology innovations and quality control are used to overcome those limitations.

The team at Barco has worked with LED technology since 1996, when the introduction of RGB LEDs meant true color could be achieved in a video display. Since its first LED video display product hit the market in 1999, the company has continued to push for perfect white/color uniformity and wider viewing angles. The company has developed quality control to address issues like color consistency, which remains an issue because LEDs are a dye-based technology.

"When we choose LED components, we make sure it is from the same batch or bin to ensure even color over the display. We have a strict selection process and each component must meet a high quality standard," says Miura Mamoru, Product Manager for LEDs for Barco Media & Entertainment.

Barco also deploys their calibration and measurement technology in their Belgian factory. "If there are LEDs from different bins on the same display, we can adjust the levels and produce uniform color," says Mamoru. "It is a very involved process to make sure the uniformity of the display continues for the life of the product."

Interestingly, LEDs do not burn out; they fade. "As they start to dim with age, you may need to increase the brightness level to get it where it was in the first few years," says Johanna Ocampo, Barco's Press & PR Specialist for North America. "If you need to change out a module, we have the technology that will measure its brightness and match it to the least level of brightness on the display for continuity."

Barco LED video displays continue to drive creative applications, such as "The Comcast Experience" at Philadelphia's Comcast Center. The LED wall is comprised of 6,771 LED modules and offer viewers over 10 million pixels on an 83.3 foot wide by 25.4 foot high viewing surface. The Comcast Experience is currently the world's largest installation of 4mm pixel pitch LED displays.

Legislation and Standards

In less than two decades, LED technology has become a technology foundation that can do something as simple as cove lighting to as complex as a large format video display. However, the absence of LED specification standards is an issue plaguing this quickly-evolving technology. Link and his colleagues at TI concur that U.S. government legislation will drive the adoption of LED technology, pointing to Europe where incandescent lighting will be phased out by 2012

Dowling at Philips Color Kinetics agrees that standards are sorely needed. "2008 was the year when three major standards for measuring color, lumens, and a testing method for lumen maintenance were established," he says. "Those standards were also used by the Department of Energy's EnergyStar program in their guidelines issued last fall. The standards are meant to level the playing field."

That leveling effect is needed since, by Link's count, the fragmented lighting industry has more than 100 fixture manufacturers in the USA

alone. Link has seen an accelerated effort to create energy efficiency standards such as California's Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24, Part 6, of the California Code of Regulations).

“It regulates how you look at the efficiency of LED light. You measure from plug to surface since components do incur losses,” he says. “It is best to know under what conditions it was it measured: was it in a lab or a fixture you can visit? What was the ambient temperature? How long was it on? Does the measurement account for the power supply? It is a challenge since that information is not readily available from all manufacturers.”

Looking ahead

As LED technology continues to innovate at a dramatic pace, issues like cost, light output, efficacy, and efficiency will improve. Applications will transition from indirect to direct lighting as performance progresses. “On the AV side, adding control systems and networking capabilities will further the value proposition of LEDs even more by adding automatic dimming and other advanced features,” says Dowling.

Barco’s Ocampo sees applications like modular designs and creative displays that are not married to one form or function, such as LED ribbons in a stadium or video displays wrapped in architecture. Meanwhile, Link thinks that LED backlights will be integral in PCs, TV screens, mobile phones and handheld devices, resulting in slimmer enclosures and more energy efficient devices.