THE VALUE PROPOSITION

By Nadarajah Narendran

COLLABORATION CAN SHOW LIGHTING'S BENEFITS

Commoditization of LEDs must be avoided at all costs

A walk through any lighting show, or even home improvement store aisle for that matter, is proof positive that the lighting industry has fully embraced the LED. LEDs have become the first choice for many lighting applications because of their energy and maintenance cost savings. But despite the declarations that the lighting industry is on the cusp of transformation, the LED is in danger of losing its luster. How? By becoming a commodity product, like its predecessors. Lighting commoditization happens when we focus solely on lumens per watt or lumens per dollar. As previous authors of this column have avowed, if lighting is to have a bright future, the industry needs to focus on increasing value by providing greater benefits, not just by reducing energy use.

In lighting, we should recognize that *value* is determined by two factors, costs and benefits. Reducing the total cost of ownership increases the value of lighting. Cost is an important aspect in the decision-making process, but again this is where we fall into the commoditization trap. LED replacement light bulbs can be purchased for as little as $3, which is good from a global energy savings standpoint, but the ever-decreasing cost of lighting compromises innovation and therefore its future and importance to society. Value can also increase by providing greater benefits. For example, a $3 light bulb may bring value by reducing trips and falls on a stairway. However, a lighting system that uniformly illuminates the stairway without glare can provide users with greater benefits and therefore can provide greater value, even if it costs more.

The only way to measure the value of lighting is through metrics, and the industry needs better metrics than those we have used traditionally. And, in fact, the development of new metrics is where industry, government and academic collaborations have helped change the value proposition for lighting. The Alliance for Solid-State Illumination Systems and Technologies (ASSIST) program, established in 2002, is one collaborative group that has helped develop new metrics and inform industry standards[1]. ASSIST's collaborations have been instrumental in showcasing the value of solid-state lighting, using new metrics for both costs and benefits. The following examples illustrate how industry collaboration has helped LEDs prove their value beyond the traditional viewpoint of lumens per watt.

Freezer Display Cases. Freezer display case lighting was one of the first applications where industry collaboration helped transform the market from fluorescent lighting to LEDs. In 2002, the first study of supermarket freezer lighting showed that LEDs provided better value for displaying frozen foods than linear fluorescent lamps by reducing cost[2]. Several studies supported by the New York State Energy Research and Development Authority (NYSERDA) and ASSIST led to a freezer case lighting system performance measurement method[3]. In this application, LED lighting provided measurably more uniform illuminance across the face of the displayed merchandise, reduced the number of perished goods due to significantly less radiant heat and prevented expensive cleaning when fluorescent lamps break inside freezer cases. Subsequently, LEDs have become the primary light source for freezer display cases today.

Color Rendering Metric. Industry collaboration also plays a key role in the development of innovative metrics that show lighting can provide greater benefits. With the increasing use of LEDs, the lighting industry was looking for a better color rendering metric. In 2008, Rea and Freyssinier argued that no single metric could be used to predict color rendering[4]. An *ASSIST recommends* published in 2010 described a two-metric system, CRI plus gamut area index (GAI), that could be used to predict color preferences in retail lighting [5]. This proposal was subsequently supported through *a priori* hypothesis testing experiments[6]. In addition, Rea and Freyssinier showed that white illumination (minimum color tint) is mapped in color space along a different locus than the traditionally accepted blackbody locus[7]. These new metrics provide the foundation for innovative, value-added lighting products for retailers and others who care about color quality.

Outdoor Lighting. Outdoor lighting is another application where value can be increased by reducing costs and increasing benefits. Even though power demand and maintenance costs play important roles in determining the best system for this application, lighting that provides the benefits of good visibility and a sense of safety and security can be just as, or more, important. In the retrofit market, manufacturers have been designing LED luminaires to match the beam distributions of HID luminaires to maintain similar light levels and to meet the requirements of existing recommended practices, which have been based on the achievable illuminance and uniformity of traditional light sources.

However, LED outdoor luminaires can be designed to meet any lighting distribution due to the LED's small source size, making it possible to direct light efficiently toward the target surface, minimize wasted light and achieve a more uniform illuminance on a parking lot surface. A recent study funded by NYSERDA demonstrated that more uniformly lighted parking lots, compared to those with less uniformity as allowed by present industry recommendations, have very high levels of acceptance related to visibility, safety and goodness[8]. This study further determined the energy reduction potential of improved uniformity with lower average light levels by means of the "luminaire system application efficacy" (LSAE) metric, a concept proposed by ASSIST several years earlier[9].

The LSAE metric provides a tool for evaluating performance, where a parking lot luminaire is rated for its ability to direct light efficiently to the task while meeting industry requirements for illuminance and uniformity. By using uniformity as a metric, we can achieve both cost savings and the benefits of visibility, safety and good quality.

NEW TECH DEMANDS CHANGE

A final important takeaway from these collaborative research examples is that fitting new lighting innovations into existing standards limits their value to society. To increase benefits and decrease costs, new metrics need to support new technologies.

Organic light-emitting diode (OLED) lighting is one example of an emerging technology that is following the path of LED lighting. OLEDs have the promise of energy savings and the benefits of unique designs and compact, flexible packaging, but there is still a long road ahead to realizing this potential. Recently, NYSERDA provided support to the Lighting Research Center to establish a research, education and industry collaboration program for the OLED lighting market. The OLED Lighting Education and Application Program (OLED-LEAP) is now in the process of forming an initial group that is setting priorities for the type of research needed at this early stage of the OLED's evolution—research that will demonstrate lighting's value not captured by the old metrics.

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