

Refocus design challenges to move LED lighting forward

BRAD KOERNER, director of experience design at Philips Lighting, asks if R&D into sustainable materials and fabrication technologies could lead to radical cost reductions in the LED-based lighting industry.

At the recent 2013 Solid-State Lighting (SSL) Manufacturing R&D Workshop organized by the US Department of Energy (DOE), I called upon the DOE to sponsor R&D competitions with the intent of discovering new sustainable materials and fabrication methods. Innovations in sustainable design may lead the lighting industry to achieve radical cost reductions not possible with our current technology paradigms.

I proposed two possible R+D challenges similar in spirit to the L Prize program. The first challenge is to design a complete luminaire — from electrons to photons — to meet a stringent life-cycle analysis such as the Cradle-to-Cradle Certification program. Such an “L Prize LifeCycle” award would stimulate entrants to reduce toxicity, design for end-of-life repurposing, and to reduce supply chain complexity. The second challenge is to generate the most lumen output from the least mass, normalized against output, efficacy, and other performance requirements. Such an “L Prize FeatherWeight” award would dare entrants to reduce material consumption, fixture size and complexity, and secondary transport and handling costs.

Notice that all the benefits listed above from these sustainable R&D challenges lead to cost savings. The notion that sustainable design can lead to significant cost reductions is counterintuitive for many, because most manufacturers tasked with greening their products usually start with their existing product lines, which are rooted in decades of decidedly non-sustainable

design, materials, and assembly methods. This situation has only become worse with the transition to digital lighting products. LED lighting has been piggy-backing on the technical paradigms of the consumer electronics industry, such as FR4 printed circuit boards and surface-mount technology (SMT) assembly. This synergy leads to a scale and style of manufacturing better suited for producing cheap audio players than for supplying the robust and messy needs of building construction sites.

Moreover, this reliance on the consumer electronics industry has unfortunately sent large percentages of SSL manufacturing straight to Asia. Stimulating local manufacturing, especially in support of the construction industry, should be straightforward. Anybody who's been on a construction site knows that fragile electronics with 16-week global lead times are exactly the opposite of what construction managers need from their suppliers.

While the lighting industry has spent the last decade coming to grips with the disruptions caused by LED lighting, the architecture and construction industries have experienced their own disruptions. Building information modeling, parametric design, digital fabrication, and aggressive environmental certification programs have shifted building construction to a heavily mass-customized approach with the use

of more bio-friendly materials. The current paradigm of PCB-based LED electronics seems a poor long-term fit with these macro industry trends, which leads to the question: Is the lighting industry developing the technologies needed to support these advances in the construction fields?

Competitions like the proposed “LifeCycle” or “FeatherWeight” challenges will

broaden the perspectives of the modern lighting industry and perhaps introduce radical new methods of fabricating lighting systems — methods that may not fit neatly on current technology development roadmaps. Such R&D challenges may also open innovation in the lighting industry to secondary partners — such as raw-goods manufacturers, equip-

ment suppliers, university research programs — partners who are not directly capable of meeting a narrowly-defined end goal such as manufacturing a more efficient A-lamp.

With its long-term vision and patience, the DOE should continue to drive the lighting industry — even acknowledging all the amazing advances we're currently enjoying — by challenging the status quo with smartly abstracted goals of sustainability to stimulate manufacturers and research organizations to explore dramatically different technical paradigms. The results may lead to unexpected but critically important advances in how we conceive of lamps, luminaires, and systems. ◉

