

The Cost Factor

BY JAMES BRODRICK

When it comes to the tantalizing question of when we'll see a "tipping point" for solid-state lighting, where large numbers of consumers begin to choose it over other options, the U.S. Department of Energy (DOE) has a unique perspective, thanks in large part to its CALiPER and Gateway programs.

CALiPER conducts unbiased performance testing of off-the-shelf LED products, while Gateway showcases their use in real-life settings. Together, these programs give DOE access to a wide range of solid-state lighting products and data that provide a clear and overarching view of the technology as a whole, as well as a pretty good indication of where it's headed.

One thing that's become evident is that for certain applications, the tipping point for solid-state lighting may already be upon us. How can that be, when—as with any emerging technology—the cost still remains relatively high? It's because other factors, such as maintenance considerations, can tip the scale toward LED solutions when potential maintenance savings are considered along with the unique advantages of LEDs.

Take outdoor area lighting, for instance. There, maintenance not only is costly, but also can be difficult. That's why solid-state lighting is starting to pique the interest of retailers, facilities managers, municipalities and other stakeholders who

look at the total cost over time rather than just the initial outlay.

For example, a recent Gateway demonstration at a California supermarket found the payback for bi-level LED parking lot lights to be less than five years, with energy savings close to 70 percent. The incumbent metal halide lights drew an average of 346 watts. In contrast, the LED lights (which reduced their output when no motion was detected around them) drew an average of 149 watts on high power and 52 watts on low power. Compared with metal halide, the LED lights cost

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\$278 less per year to operate, when maintenance and replacement costs were also taken into consideration.

The potential for significant maintenance savings also played a key role in the decision to use LED lighting for the recently rebuilt I-35W Bridge in Minneapolis, MN (*LD+A*, December 2008). The constant vibration caused by bridge traffic and wind is known to significantly reduce the lifetime of the incumbent

high intensity discharge (HID) lamps, making the use of LEDs—with their vibration resistance and longer lifetime—an appealing solution. This Gateway demonstration—a collaboration between the Minnesota Department of Transportation, U.S. Federal Highway Administration, BetaLED and DOE—will measure not only energy savings but also lumen depreciation and deferred maintenance over the course of three years. Initial results show energy savings of 12-18 percent, and the significant difference in expected lifetime means the anticipated maintenance cost savings is substantial.

SEVERAL STAGES

It is very likely that we will not see one big tipping point that marks the

beginning of a massive consumer migration toward solid-state lighting. Instead, we'll probably see a series of incremental tipping-point stages. The first stage, which is already in progress, involves lighting applications where maintenance is costly or difficult, and where the long life and low maintenance of LEDs can significantly lower the bottom line.

The next stage is just beginning. In some applications, such as LED

downlights, directionality, dimmability and other advantages give the new technology a distinct leg up that compensates for prices that are still comparatively high.

Other stages will follow, as solid-state lighting technology improves and costs come down to the point where energy savings alone can make up for any remaining price premium. Bear in mind that, as a still-emerging technology, solid-state lighting is a moving target that's continually getting better, as well as cheaper. Haitz's Law, which is based on observations over the past 40 years, holds that over the course of each decade, the light output of red LEDs increases 20-fold while the price decreases by a factor of 10. That corresponds to a cost decrease of about 20 percent per year.

This line of thinking is consistent with what we're seeing through the DOE CALiPER program. Based on LED purchases associated with CALiPER testing, performance trends over the last five years show a steady increase in lamp efficacy from 20 to 100 lumens per watt, and a steady decrease in retail price in some typical good indoor lighting products from about \$500 per kilolumen a few years ago to around \$200 per kilolumen in 2008. The rate of decline in dollars per kilolumen is around 25 percent per year, somewhat better than Haitz's original estimate for red LEDs.

Another Gateway example adds further evidence: product reengineering between Phase II and Phase III of a streetlight demonstration in Oakland, CA, increased energy savings by 25 percent and reduced product costs by 34 percent. For

more details on these Gateway projects, visit www.ssl.energy.gov/gatewaydemos_results.html.

WIDESPREAD USE

Continuing improvement in performance coupled with steadily falling prices will drive the phased acceptance of solid-state lighting by consumers, to the point where eventually the cost will be low enough and the energy savings high enough that LEDs will be competitive based solely on those two considerations. The final stage in consumer acceptance of solid-state lighting will come when the initial cost drops to a level that's comparable with competing technologies, which many expect to happen between 2020 and 2025.

Meanwhile, there's quite a ways to go—not only in terms of the technology, but with regard to consumer education and awareness. We're still at a point where misinformation and confusion about solid-state lighting are rife, on both ends of the spectrum—from those who think that LED products cost \$1,000 per kilolumen, to those who enthuse that solid-state lighting will solve all of our energy problems within the next year.

The truth lies somewhere in between. Right now, there are some applications where LEDs are already competitive with the incumbent technology—for example, LED downlights, which have shown steady improvement in CALiPER testing and now can outperform incandescent, halogen and, in some cases, even CFL fixtures. But even there, we find a wide range in terms of quality, with some LED products

being quite good and others likely to disappoint the unwary consumer.

To keep up with the latest information on solid-state lighting, go to DOE's CALiPER and Gateway Web sites, www.ssl.energy.gov/caliper.html and www.ssl.energy.gov/gatewaydemos.html, where you can find helpful background material as well as current results and reports. From DOE's vantage point, the bottom line is that solid-state lighting is moving in a positive direction at a fast pace. The technology is steadily improving, while the cost continues to drop. It won't be long before the combination of energy savings and initial cost begins to tip the scale in a big way. It's just a matter of time—probably less time than you think.



James Brodrick is the lighting program manager for the U.S. Department of Energy, Building Technologies Program. The Department's national strategy to guide high-efficiency, high-performance solid-state lighting products from laboratory to market draws on key partnerships with the lighting industry, research community, standards organizations, energy-efficiency programs, utilities and many other voices for efficiency.

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