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## The Circuit - Returns: The Lumina Project

By [Kelly Davidson](#)

Jun/Jul 2010 (#137) pp. 22-23

Introductory Level

Empowering manufacturers with research and data to make smart off-grid lighting solutions for developing countries

In 1995, after attending a meeting in India of the International Commission on Illumination, Evan Mills decided to take a side trip to Varanasi, the oldest known city in the world. While walking along a narrow street one night, he saw a man crouched down, selling a spread of beads and bangles by the glow of a kerosene lantern.

Mills, then a staff scientist at Lawrence Berkeley National Laboratory researching energy efficiency, couldn't help wondering how many people were lighting by flame in their homes or workplaces. How much fuel did they use each year? And how did the low quality and high cost of this lighting impact their lives?

"That moment really clinched it," he says. "The human dimension of this problem became clear, as did the huge potential for improving people's lives—not to mention saving enormous amounts of energy—with better alternatives."

Working on his own, mostly at night and on weekends, Mills began studying off-grid lighting methods used in several countries—and exploring how white LED light sources could help reduce the dependency on flame-based lighting. This culminated in the first published estimate of global expenditures and energy use on fuel-based lighting: \$40 billion per year and greenhouse-gas emissions equaling those from 30 million cars.

Inspired by the fundamental linkages between light—or the lack thereof—and literacy, commerce, safety, health, and general development, Mills hatched a plan to develop low-cost, miniaturized LED lighting systems that could be powered with small PV modules and inexpensive rechargeable AA batteries.

Mills began measuring fuel-use rates and light output from kerosene lanterns, and comparing those results to off-the-shelf LED products such as headlamps. He was later invited to help teach a class at Stanford University, where undergraduate and graduate students in design, engineering, and business came together to craft LED prototypes and business plans for test markets in China, Mexico, and India. This process helped Mills develop an appreciation for user-centered design and the imperative for affordability. Students from UC Berkeley later sought his help in conducting more in-depth field research in India, Tibet, and Africa.

Arne Jacobson, professor and co-director of the Schatz Energy Research Center at Humboldt State University in Arcata, California, became a close collaborator, working with Mills to establish a testing lab and develop a performance and quality testing protocol for products that were coming to market. They found problems with virtually every component, from the LEDs themselves to the PV modules and the batteries.

The work gained momentum in 2006 when the project received seed funding from the Blum Center for Developing Economies. Taking an analytical approach to promoting clean energy alternatives, the nonprofit Lumina Project, as it became known, continues to conduct field projects and laboratory testing to compile information aimed at helping manufacturers improve the viability of LED-based lighting products for the developing world.

"The biggest barrier is the market-spoiling effect that happens when low-quality products are dumped into

Traditional kerosene-fueled hurricane lantern (left) and a prototype LED lantern (right) in Sauri, Kenya.



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these markets," Mills says. "They can dissuade a whole generation of people from trusting the underlying, good technology."

One of the Lumina Project's key goals, Mills says, is to help manufacturers develop quality products that are affordable for the masses and do not require subsidies or charity models to deploy.

The project has involved about 20 researchers and students to date, and is currently completing market tests in Kenya, where LED systems have been sold to small businesses, night guards, and homeowners through existing market channels at true market prices. The study is collecting data on affordable price points, total cost of ownership, user satisfaction, usage patterns, and durability. This data, says Mills, is relayed to manufacturers, investors, and policymakers, which helps them understand market expectations as well as the realities of what product characteristics are desired and what is affordable.

The real highlight of Lumina's work so far, says Mills, is how the World Bank and the International Finance Corporation leveraged the project to develop their Lighting Africa initiative, which conducts widespread market research, product testing, and market development across sub-Saharan Africa. At the Copenhagen Climate Summit last December, U.S. Secretary of Energy Steven Chu launched an even larger initiative—the Solar and LED Energy Access Program (SLED).

"When we talk to people in Africa who have bought the lights and they say, for example, that they can keep their shops open longer or do more business with the better light, we know we're on the right track," Mills says.

—Kelly Davidson

### Other Illuminating Projects

- Working with the United Nations to qualify clean-energy off-grid lighting projects for carbon credits
- Equipping LED systems in Kenya with instruments to measure how much of the available solar resource the users actually capture, and whether the PV modules are properly sized in existing products
- Helping avoid brownouts in renewable micro-grids by evaluating how LEDs might work with other "smartgrid" strategies to provide lighting that can deal with voltage spikes, while reducing overall demand
- Identifying and measuring indoor air pollutants emitted by kerosene lanterns

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