How Cheap LEDs Could Efficiently Power Africa and Beyond

(Photograph by Evan Mills)

By Paul Tolme
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Smoky kerosene lamps cast a dull glow across the fruit and vegetable stands of a bustling night market in a slum outside Nairobi, Kenya. Evan Mills watches as customers squint to examine produce in the dim light and merchants hold grubby money close to their eyes.

The researcher with California's Lawrence Berkeley National Laboratory has come to witness the effects of inadequate lighting in Africa—where only 25 percent of inhabitants have electricity and most rely on crude kerosene lamps made of welded-together soup cans.

Mills is a key player in Lighting Africa, a $13 million World Bank initiative that has steered the global race to develop a better light bulb in an even more challenging direction: Make bulbs efficient, affordable and rugged enough for use in developing countries. Light-emitting diodes (LEDs) appear to be the technology that will take researchers over the finish line.

"Traditional lighting is maxed out on the efficiency side," Mills says. "LEDs are the only domain where rapid efficiencies are possible." Incandescent bulbs contain a filament that emits heat, only some of which is visible. Compact fluorescent bulbs (CFLs) use 75 percent less energy, emitting light when charged mercury vapor excites the bulb's phosphorus coating. In LEDs, electrons are converted directly to light-emitting photons—a cleaner process.

While the energy efficiency of LEDs is comparable to that of CFLs (without posing any of the disposal problems associated with mercury), engineers are squeezing out twice as many lumens per watt as they were just a few years ago. "LEDs are where it's at," says Erik Page, director of engineering at the California Lighting Technology Center at the University of California, Davis. "There are labs with rooms full of Ph.D.s working on driving this innovation forward."

But building lights for Africa requires more than just efficiency. LEDs must be integrated with the best optics (to provide uniform light), rechargeable batteries and charging systems. They then need to be bundled together in a housing that can withstand years of daily use and abuse.

"In Africa, you've got to make them survivable," says David Floyd, CEO of Freeplay, a Lighting Africa participant that has developed a reading lantern and a hand-crank flashlight for the developing world. Cranks that are strong enough for American consumers would get torn off in African villages.

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(Photograph by Kellie Brown)

Affordability is another major hurdle. Americans can spend $50 to $100 for a quality flashlight or lantern, but in Africa, where families often make less than $1 per day, the lights must sell for $10. To stimulate innovation and bring down the cost of developing these products, Lighting Africa will award 20 grants of up to $200,000 to companies and institutions.

Although Lighting Africa aims to help 250 million Africans, there are 1.7 billion impoverished people worldwide who burn kerosene for light. Fuel for this purpose costs $40 billion and emits 200 million tons of greenhouse gases per year—equivalent to the emissions from 30 million cars. While Americans spend a fraction of their income on light, people in the developing world devote 10 to 15 percent of theirs to it—for little return. Fuel lamps account for 17 percent of global lighting costs but provide less than one-tenth of one percent of global light output.

"The poorest people in the world are paying the most for the worst quality light," says Russell Sturm, director of the Lighting Africa project. "LEDs are a breakthrough technology that can make a huge difference."

Developing clean and affordable light is more than an energy and environmental issue, it's about social justice, says Evan Mills, who helped write the proposal that led to Lighting Africa. "The number of people without adequate light is greater than the entire world population when Edison invented the light bulb." And in the end, innovations that make LEDs globally appropriate will benefit American consumers as well.

Back in the Nairobi night market, Mills approaches a woman hawking produce and flicks on an LED pen light to witness the transformational power of this simple device. "I can see the money," says the woman, suddenly able to identify the currency in her hands.

“She didn’t mean she could see the profit. She literally meant she could see her money and make change,” Mills says. “The difference was like night and day.”

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