

Can technology free developing countries from light poverty?

LED and solar technology is liberating remote communities from dependence on unhealthy fuel, explains US department of energy scientist **Evan Mills**

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A sixth of humanity spends upwards of \$40bn (£26bn) per year on lighting (20% of the total energy spend for lighting), yet enjoys only 0.1% as much illumination as does the electrified world. Looked at another way, the unelectrified poor spend 100- to 1,000-times as much per unit of light as do people on the grid. A myriad of fuels are used for this purpose, including kerosene, diesel, propane, candles, grass and wood, flashlights with disposable batteries, and even discarded tire rubber. The corresponding greenhouse-gas emissions equate to those of 30m American cars.

Fuel-based lighting is an example of how the hyper-inefficient use of energy plays a role in trapping people in poverty with a negative environmental impact affecting everyone. The spectre of fuel-based lighting extends far beyond its energy use, hampering health and safety, impeding better livelihoods and saddling governments with crippling energy subsidies.

Enter wireless lighting – a solution for the bottom of the pyramid

As recently as a decade ago there were few solutions to this problem. Traditional solar electrification (solar panels on roofs) had been pushed for years, with some success, but the price of these systems equated to a poorer family's entire annual income. Miniaturisation - in the form of small and powerful white LED light sources - has constructively disrupted this market. Thanks to ultra-low wattages, solar cells and associated commodity batteries can be radically downsized. The resulting lighting systems are ready to go out of the box; no professional installation required. Another critical improvement is portability.

Today, nearly 100 high quality solar-LED products are in the market. Light output and other features vary widely, reflected in end-user prices ranging from approximately \$10 to \$75. Some adopt a compact flashlight-like form, while others are also integrated but designed to sit on a table, and others still allow one or more lights to be strung and located remotely from the solar cell and battery. A few special-purpose lights have emerged, such as those for use in night fishing. Depending on local kerosene prices, these technologies typically pay for themselves in less than a year, while the energy embodied in their manufacture is recovered within a matter of weeks.

How can solar-LED lanterns be scaled-up?

Solar-LED lights were first introduced by non-profit organisations demonstrating their viability, and the ravenous consumer demand for it. It didn't take long before a flurry of commercial start-ups entered the space, with a wide range of product offerings. Phone charging was soon added and today most solar lights offer this extended functionality. The power of miniaturisation is now being applied to other end uses, including energy-efficient flatscreen televisions and small fans. Market realities such as distribution chains are an equally formidable challenge. Solar Aid has been a particularly successful entity in this regard, selling over 1m lights across five African countries.

Early on, low-quality componentry and assembly was identified as a potential market spoiler. The World Bank Group's International Finance Corporation took early research conducted by Lawrence Berkeley National Laboratory's Lumina project and scaled it into a testing procedure and quality assurance programme. In 2014, 91 of 135 products tested had passed, some failing initially but then improved in response to the feedback. And the market share of quality-assured lights rose from 3% in 2009 to 50% in 2014.

Financing has been a prime impediment to scale-up. Mobile money has fit very well in this context, and pay-as-you-go technologies are now enabling consumers to make micro-payments by phone, in some cases signaling a small chip embedded in the light to continue functioning as long as payments are current. Green remittances could represent another game-changing financing alternative. Investment capital is being mobilised at the corporate and public-sector levels as well, but significant scale-up is still needed in order to meet global energy access goals.

As an industry and market watcher for two decades, it became clear to me that communication among the rising number of stakeholders in the off-grid lightening community was quite fragmented. This was due to the disparate geographies in which people work on this issue and the highly budget-constrained development workers that rarely have the luxury of travelling to posh conferences and trade shows. In an effort to help bridge this divide, I founded the social network LuminaNET, with support from the US Department of Energy. Within two years it grew to over 700 members from 72 countries, a virtual manifestation of the widespread underlying global community driving this market.

All of this is making a difference. More than 40 companies now offer almost 100 quality-assured solar-LED lights in the marketplace. They have fielded an enormous array of business models, collectively selling millions of lights. The sales growth rate is a dizzying 30% each year and shows no sign of abating. In Africa alone, 35 million people in 7m households (across 25 countries) have obtained improved energy access thanks to non-polluting solar-LED lights. The industry is maturing, as evidenced by the creation of the Global Off-Grid Lighting Association, which is helping to foster market growth.

When the sun goes down each day, lighting stands among the most basic human needs. It is encouraging that the emergent affordable alternatives have made such great strides in a relatively brief time. Thanks to technology innovation and ingenious business models, lighting poverty is slowly but surely on the wane.

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