# Can energy access improve health?

**Wole Soboyejo**

In 2007, I was invited by a colleague to teach a global technology course to Princeton students at the Mpala Research Centre in Kenya. This is a wildlife research centre located in the Laikipia district of Kenya, which has a population of about 250,000 people in a land area about twice the size of Israel. It seemed like a perfect opportunity to explore ways of using technology to address the development challenges associated with energy access and waterborne disease. I therefore accepted the offer, with the hope that I would have the opportunity to trial some of the technologies that had been developed or tested in my lab[1,2,3].

### *Defining a need*

On arrival in Mpala, I noticed that most of the Kenyan staff lived in two village communities with no access to electricity or potable water. In the absence of an electricity grid, most of the huts relied on kerosene lanterns, resulting in environmental pollution and about an 80 per cent incidence of pulmonary health problems, with most of the children in the village suffering from asthma. They also had waterborne diseases from drinking contaminated water from the local river, and there were serious concerns about the potential for bone deformities and the pitting of teeth that could occur due to the consumption of fluoride-contaminated water[4] from the local borehole.

Inspired by the challenges of life in Mpala village, I asked my Princeton students to talk to the villagers to learn more about the role that technology could play in addressing their basic needs. Somewhat surprisingly, the villagers identified electricity access as the most serious issue. Similarly, the Mpala clinic identified electricity access as their biggest hurdle in preserving much-needed vaccines and medicines necessary for the prevention of major diseases across the Laikipia district. We therefore decided to focus on ways of developing sustainable solutions to problems

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of energy and water, using Mpala village as a model of a rural village in a developing country. This essay presents the results of our efforts and their implications for rural communities across the world.

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In the case of access to electricity, our questionnaire studies revealed that the homes in the village had energy budgets of about US$ 4 per month, while the average income of individuals was between US$ 1 and US$ 2 per day. This meant that any alternative solutions had to cost about US$ 4 a month or less if they were to be competitive with the kerosene lanterns that had become part of the local culture.

### *Meeting the challenge*

After some out-of-the-box thinking, we realised that a conventional system involving a 100-watt solar cell and a 12–24-volt battery with a cheap charge controller and inverter could offer no solution[2] because of its relatively high initial cost – approximately US$ 500–1,000 – when compared to the average monthly income of about US$ 60. We needed a system that cost no more than US$ 4 a month over 12 months.

To meet the US$ 4-a-month target, the solution was a solar-powered lantern with a 2-watt solar panel and a 6-volt motorcycle battery. Although many of the villagers wanted us to give this system to them for free, we realised that the lanterns would not be properly cared for unless they had been paid for, so every home in the village was given the option of financing a solar lantern over a period of 12 months. This resulted in the introduction of solar lanterns into all 200 homes of the village. The income from the lanterns was used to introduce ceramic water filters[3] that further improved the health and well-being of the people.

After a year, the health impact of the solar lanterns was much greater than we had anticipated. First, we found that they essentially eliminated the use of kerosene lanterns, resulting in much lower levels of pulmonary health problems. We also developed ways of converting old kerosene lanterns to solar power, enabling the local people to convert their lamps at a cost of about US$ 25 per lamp.

Encouraged by the success of the solar lanterns, we worked with the people of Mpala, the College of Art and Design in Pasadena and the Nomadic Peoples Trust to develop a solar-

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**Introduction of a solar lantern to Mpala village.**

powered refrigeration system that was mounted onto a bamboo frame on a camel. The system enabled the Nomadic Peoples Trust to use community-medicine approaches to provide refrigerated vaccines and medicines to the Laikipia community of about 250,000 people, and it is now being used in their monthly trips across Laikipia district.

## *Conclusion*

The above examples show that villages such as Mpala can be provided with funds to develop demand-driven sustainable solutions to their energy needs, and they also show that the users value the solutions and are willing to take care of them when they are asked to pay for them.

There is, however, a need for funds to finance the initial acquisition of sustainable solutions when the initial costs of the products are greater than the available cash flow of the consumers. Such funds, which can be administered through local banks and/or cooperatives, can also be used to purchase water filters for removing the microbial pathogens that cause diseases such as dysentery, diarrhoea and typhoid, which kill up to 20 per cent of children in rural villages.

In addition, the combination of solar energy and refrigeration can be used to preserve vaccines in rural communities that cannot be reached by jeeps or landrovers. In such cases, rugged animals such as camels and donkeys can be used to transport the systems to the communities that need them. Further work is clearly needed to develop evidence-based strategies for scaling these approaches into policies that could improve the lives of the 1.3 billion people that live without access to electricity.

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## Author

*Professor Wole Soboyejo served as President of the African University of Science and Technology, Abuja, until 2014, and is now based in the Department of Mechanical and Aerospace Engineering at Princeton University.* soboyejo@princeton.edu