Cover Story

Africa's quiet solar revolution

The continent skipped land lines for mobile phones. Now a new generation of start-ups is trying to bring sun power to rural Africa – and leapfrog the fossil fuel era.

By Lorena Galliot, Contributor JANUARY 25, 2015

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ARUSHA, TANZANIA — By Tanzanian standards, Nosim Noah is not poor. A tall, handsome woman with the angular features of her fellow Masai tribe members, Ms. Noah makes a good living selling women's and children's clothes in the markets of this northern Tanzanian city. The four-bedroom brick house she shares with her parents and three children outside town has many modern comforts: mosquito screens on the windows and doors, a gas cookstove, and, most important, a faucet with running water in the back of the yard, next to a stall with a working toilet.

But despite their relative prosperity, up until late 2013, the family had no electricity.

“We waited 10 years for them to turn the power on – 10 years and nothing,” says Noah.

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Then, one afternoon, the Noahs had an unexpected knock on the door. An agent for a new electrical company called M-POWER said that, for a sign-up fee of only 10,000 shillings ($6), he could install a fully functioning solar home system in their house – enough to power several LED lights and a radio. The payoff was immediate. While Noah used to spend $18 a month on kerosene, she now pays a monthly average of $11 for her solar lighting, and she no longer has to go into town to charge her cellphone. The person most affected, though, may be her 2-year-old daughter, Emilia, who is afraid of the dark.

“She would cry every night – every single night,” says Noah. “It was a struggle to put her to sleep.” Now, with a new light above her bed, “it makes a huge difference,” she says.

The changes taking place under the Noahs’ roof are emblematic of a quiet revolution sweeping across much of rural Africa and the developing world.

Until recently, the lack of electricity in many poor areas was seen as something of an inevitable fact of life. Building power grids across long distances to reach remote communities is slow and costly, and when the people in those

communities are subsistence farmers living on less than $2 a day, the returns often fail to justify the massive investment.

Now, however, a new solar energy movement is bringing kilowatts to previously unlit areas of Africa – and changing the lives of hundreds of thousands of people. The idea behind the latest effort isn't to tap the power of the sun to electrify every appliance in a household. Instead, it is to install a small solar panel not much bigger than an iPad to power a few lights, a cellphone charger, and other basic necessities that can still significantly alter people's lives.

Going smaller better fits the budgets of the rural poor. People use the money they normally would spend on kerosene to finance their solar systems, allowing them to pay in small, affordable installments and not rely on government help. The concept is called pay-as-you-go solar.

Many see it as helping to overcome the problems that have plagued previous solar "revolutions" in Africa. Richard Hosier, a senior analyst at the World Bank, likes to tell the story of his first encounter with solar panels in Africa.

"It was in a village in Kenya, in 1981, during the Carter administration," he recalls. "There were solar panels all right – cut into little bits to make necklaces for the women."

African villages, Mr. Hosier says, are littered with failed solar projects donated by well-meaning government agencies or nongovernmental organizations that installed the technology but couldn't afford to follow up with maintenance or battery replacements.

While some remain skeptical of the new approach, many believe the scale of the current movement, coupled with the involvement of local entrepreneurs and the changing economics of solar power, will make it different this time around. Some observers are even asking, Will rural Africa leapfrog the carbon energy age altogether and go directly to a solar-powered future?

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No one doubts the need to bring kilowatts to remote areas of the developing world. According to the International Energy Agency, more than 1.3 billion people – one-sixth of the world's population – lack access to modern energy services. In Tanzania, 81 percent of the population live without electricity.

Instead, many of these people rely on candles, battery lamps, and CO_2 -emitting kerosene lanterns and diesel generators to light their homes. This can be expensive. Kerosene and diesel, the two main fuels available to the poorest of the poor, are among the costliest for consumers. The United Nations Environment Program estimates that Africans spend between $12 billion and $17 billion a year on fuel-based lighting. In Asia, people spend $9 billion to $13 billion.

These fuels are also dirty. Burning kerosene in African homes and small businesses causes an estimated 30 million to 50 million tons of CO_2emissions annually, according to a 2010 study commissioned by the World Bank. Globally, kerosene use releases 190 million tons of CO_2 into the atmosphere each year – an amount greater than the emissions of Australia and Britain combined. Replacing all of the world's kerosene lamps with clean energy sources would have the same environmental impact as taking 30 million cars off the road, the study noted.

Underlying this welter of statistics is the main reason that advocates think the moment is propitious for a small solar revolution in Africa – improving economics. The Global Off-Grid Lighting Association, a nonprofit group based in the Netherlands, estimates that an African household living on $2 a day can save as much as 86 percent of its expenses for kerosene and mobile-phone charging by switching to solar.

Many residents of Tanzania who have installed solar panels have already felt some of these effects on their wallets, as well as in other ways. In one village, a resident describes how he'd stopped feeling the throbbing pain behind his eyes that came from working evenings in dim light.

In another case, a woman says that her 3-year-old son's chronic cough improved dramatically once he stopped breathing in kerosene fumes daily. Salome Simon, a young single mother in the northern Tanzanian village of Oldadai, mentions a more unusual benefit: Thieves stopped stealing the chickens in the coop outside her house after she hung a bright solar-powered LED light above her doorstep.

Yet solar is spreading for other reasons as well. As technology has improved, the cost of photovoltaic panels has dropped by more than 99 percent since 1977. LED lights and batteries are also becoming increasingly affordable.

Perhaps even more important, a new technology has come along in recent years that has had a deeply transformative impact on developing economies: cellphones. Cellular networks in Africa have spread at a pace that no one anticipated a decade ago, now covering more than 85 percent of the continent.

“Say you’re one of our customers, a Tanzanian farmer living on less than $5 a day,” says Xavier Helgesen, cofounder and chief executive officer of Off-Grid Electric, M-POWER’s parent company.

“You won’t have electricity, and you certainly won’t have a bank account, but you’ll have a cellphone.”

Their ubiquity, along with the development of mobile payment technologies that are commonly used by Africans, has helped change the calculus for entrepreneurs such as Mr. Helgesen. Before, transactions in rural Africa were cash-only – an open window for corruption, and a huge obstacle to business. Now, M-POWER’S solar home systems have meters digitally linked to the customers’ cellphone numbers. No matter how poor they are, or how remote their village is, customers can pay for the electricity consumption recorded by the meter simply by sending a text message.

All these factors have emboldened a generation of entrepreneurs to venture into the Wild West that is the last mile of electrification. Companies with business models rivaling M-POWER’s are flourishing all across East Africa, South Asia, and to a lesser degree in South America (where existing electrification rates are higher). According to the Consultative Group to Assist the Poor (CGAP), a World Bank-backed umbrella group of 34 organizations, at least 25 companies are promoting pay-as-you-go solar products and services across the developing world, with an estimated 250,000 such products sold as of late 2014. The organization projects that at least 3 million pay-as-you-go solar systems will be sold around the world in the next five years.

The numbers are even more impressive in countries where solar has benefited from government backing. In Bangladesh, more than 2.9 million pay-as-you-go solar home systems have been financed by Infrastructure Development Company Limited, a government-backed solar bank launched in 2003. The country is now installing systems at a rate of 80,000 a month, with a target of 6 million sold overall by 2017.

CGAP sees such technology as allowing developing countries to carve out an energy future that is smarter, cheaper, and cleaner than the one the West pursued decades ago. As energy consultant Julian Popov put it in a recent opinion piece he wrote for Al Jazeera, most African countries never did string phone lines to every home and business – and in the end, they didn't have to. Just as African mobile-phone networks skipped the land-line phase, he believes that African solar companies could bypass the fossil fuel era.

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On a hot, dusty afternoon, more than 80 villagers wait patiently for their turn to climb on the corrugated tin roof of the tallest house in Oldadai. Surrounding them is a team of recruiters holding clipboards and wearing T-shirts emblazoned with M-POWER's lightning-bolt logo.

"If you join us, you'll be climbing on roofs all the time to install solar panels," says Raphael Robert, the lean, athletic Tanzanian who is head of expansion at the company. "If you can't climb on the roof, then I'm sorry but you're out."

The unorthodox recruiting session is part of the young company's aggressive blueprint. In every village it does business, M-POWER hires local "agents" – villagers who are trained to sell, install, and repair the start-up's low-cost solar home systems. Typically, Mr. Robert and his team meet with a dozen or so candidates. But word of mouth on the company is spreading, and when they show up at Oldadai, a large crowd is waiting.

"There were old people, young people, village councilmen, schoolteachers, the pastor ... everyone wanted to try out," says Robert. With too little time to interview them all, Robert does what his job at M-POWER often calls for: He improvises.

The ability to hire and train local staff is one of the key factors of these companies' success – and one of the biggest challenges they face in electrifying rural Africa.

At the production center of a Tanzania-based solar micro-grid company called Devergy, a sign on the door of the outgoing inventory room reads, in bold red letters: "TUO." It's supposed to be "OUT," but a local painter read the model that was handed to him backward, and obligingly reproduced it.

"We kept that sign as a reminder of the challenges we'll inevitably face, which are never what you'd expect," says Fabio De Pascale, the chief executive of Devergy.

Distribution is another complication faced by companies looking to sell their product in the developing world. How do you reach customers in areas where there are no roads, no infrastructure, and no delivery service?

“We basically had to build, from scratch, the equivalent of FedEx for rural Africa,” says Erica Mackey, M-POWER’s chief operating officer, a young Texan with long, flowing blond hair and cowboy boots.

The key, she and her partners realized, was to build on the existing local economy. Instead of opening new shops when they expand into an area, they team up with the little roadside “dukas” (general stores) in every village. To get their products to the stores, they partner with area minibus and mototaxi drivers who deliver the systems along their route. The final link is the local M-POWER agents themselves, who pick up the systems at the duka, then deliver and install them at customers’ homes.

Investors as far off as Silicon Valley are starting to take notice of the technology. More than $45 million flowed into the off-grid solar sector in the first four months of 2014. M-POWER’S parent company, Off-Grid Electric, completed a $7 million round of funding in March, with Microsoft cofounder Paul Allen, the US solar firm SolarCity, and Omidyar Network as lead investors. In February, M-KOPA Solar, a Kenyan pay-as-you-go company, announced that it had raised $20 million to fund the expansion of its customer base – a record amount for the sector.

As with any emerging industry, however, there are inherent risks with start-ups – especially ones that operate in the bush. Investors are naturally wary.

“I’d want to know the statistics: How many of the systems break? How many of them get stolen? How can they stop users from hacking into their meters and getting power for free?” says Anders Hauch, the investment director of Frontier

Investment Management, a Danish firm that specializes in renewable energy projects.

These are some of the problems that doomed previous attempts at establishing solar energy in Africa in the 1970s and ’80s. But Helgesen says they are all woes that Off-Grid Electric has anticipated and successfully tackled. Before the company deployed its first pilot system, it bought “every solar product ever made” to test it in the field. Most broke down within a month, but one – from its current supplier – endured remarkably well in the rough rural conditions, with breakage rates in the single digits.

The company also created its own software, which links each M-POWER system sold to the address, cellphone number, and electricity use of each customer. Any lack of payment (or unusual payment pattern) is detected immediately, limiting the possibility of hacking or fraud. Ms. Mackey, Helgesen, and Mr. De Pascale are aware that companies like theirs, seemingly populated by idealistic 20- and 30-somethings who want to change the world, are the outsiders and underdogs of the energy field. Nevertheless, they hope that, ultimately, the success of their business model will speak for itself.

“We’re not just doing this out of the goodness of our hearts,” says De Pascale. “We’re in it for the money.”

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The idea that off-grid solar power makes both shillings and sense would certainly have found a few skeptics at the “Powering Africa”

conference, held in Tanzania's largest city, Dar es Salaam, early last year. The three-day affair, which Helgesen and Mackey attended, brought together all of the country's energy titans in a luxury oceanfront hotel. Of the 126 participants in attendance, many were white, middle-aged men. ("Will the bankers and lawyers please stand up?" a panel speaker quipped.)

"The reality is that no big investor is going to seriously consider funding off-grid rural electrification projects," said Chris Ford, the head of asset management for the British power company Globeleq, in an interview at the conference. "It's just too difficult to make money in that space."

Nico Tyabji, an associate at Bloomberg New Energy Finance, views the emerging small-scale solar industry with more optimism – but is still cautious.

"It's an exciting area, with high growth potential," he says in a phone interview. "That being said, it's been heavily incubated by development financing up until now. None of these companies has yet proven it can scale [up] with significant commercial investment, but they're trying out different technologies and business models. We're seeing a lot of innovation."

Others worry that the power offered by off-grid solar is too limited to answer Africa's growing electricity needs: Most systems currently on the market only power a few lights and cellphone chargers, not energy-intensive appliances.

"Africa must not be cornered to focus just on green energy," says Mwangi Kimenyi, a senior fellow with the Africa Growth Initiative at the Brookings Institution in Washington. In an e-mail, Mr. Kimenyi stresses the need to invest

in all power sources to boost electricity supply across Africa – including the continent's recently discovered coal, oil, and natural gas reserves. "These will be cheaper sources and, given that Africa's contribution to greenhouse gases is very low, it must utilize these sources."

But others believe that pushing the development of fossil fuel-produced electricity over off-grid solutions is a colossal mistake. They argue that, for many poor people, replacing a candle with an LED light is already transformative. Even if they were connected to the grid, most rural Africans couldn't afford larger appliances such as refrigerators or air conditioners.

Moreover, the International Energy Agency has said that if the world is to meet the UN goal of achieving universal energy access by 2030, more than half of all power-sector investments should be going to off-grid, clean energy services.

"The time frame for deploying solar is now; the time frame for extending centralized grids is hypothetically decades from now," says Justin Guay of the Sierra Club in San Francisco. "Should millions remain in the dark while big corporations are busy digging up dirty coal?"

Back in Dar es Salaam, participants of the Power Africa conference gathered to unwind on the hotel's private dock after a grueling day of talks. Sipping a cold drink, Helgesen surveyed the mingling crowd.

"Even if every single project announced in this conference gets going on schedule – and that's a big if – then, sure, Dar es Salaam will get power, and the mines will

get power," he mused. "But the 80 percent of rural Tanzanians without electricity? Forget them."

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He wouldn't get an argument from Noah and her family. When she and her late husband moved into their house in 2004, they paid about a $200 connection fee to TANESCO, the Tanzanian national utility, to extend a power line to their home. After a six-month wait, workers finally erected a utility pole outside their home, unspooled some wires, and attached a meter to the wall. The family put in a few sockets, light bulbs, and switches.

But the power never came. "I have no idea why it didn't work," Noah says. "All I know is that the lights never came on."

They have power now, though, with the help of the sun. And no one is happier on those inky dark nights than 2-year-old Emilia.

Lorena Galliot reported this story while on a Pulitzer Fellowship awarded by Columbia University's Graduate School of Journalism.

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