

# Scaling up small, off-grid solar in Africa

**Small-scale PV** | The growing number of companies offering small solar solutions in off-grid areas of Africa is testament to the huge potential of this segment. The big prize is now getting the right policies and investment frameworks in place to fuel the next phase of growth. Tom Jackson reports

**A**frica has a power problem. The African Development Bank (AfDB) says almost 620 million people on the continent lack power, McKinsey that the region is “starved” of electricity.

Much of this shortage is attributable to the failure of grids. Southern Africa has installed grid-based capacity with 58GW. West Africa has only 20GW, East Africa 8.1GW and Central Africa 4GW. These grids primarily serve urban populations, with rural areas often in the dark.

“Since independence they have been saying that it is going to go everywhere, and it hasn’t happened. And it’s not going to happen. Even if they can extend the grid and distribute capacity, they don’t have enough generation capacity,” says Nate Heller, co-founder of PEG Ghana, which provides solar home systems on credit to households.

## The potential of small-scale, off-grid solar

The failure of grids means many regions are turning to off-grid solutions as a means of providing power, especially solar ones. Koen Peters, executive director of the Global Off-Grid Lighting Association (GOGLA), says the industry has grown from a “near standing start” less than a decade ago to more than 100 companies focusing on small-scale off-grid solar.

“By the middle of last year, these businesses had collectively sold 20 million products globally. Such products are very effective in enabling access to basic electricity services – for an estimated 89 million people across Africa and Asia,” he says. “They help



increase income levels, assist with business ventures and educational development, and they improve health and safety.”

There are cost benefits as well as social ones, with African consumers saving on average US\$3.15 for every dollar spent on pico-PV products, according to GOGLA.

## Set to boom

Further growth is expected, with the International Energy Agency (IEA) saying 220 million people in rural areas will gain access to electricity by 2040 through off-grid and mini-grid solutions. A recent report released by the World Bank Group and Bloomberg New Energy Finance (BNEF), in collaboration with GOGLA, said sales of off-grid solar products in emerging markets are expected to reach US\$3.1 billion by 2020, providing access to improved energy for 99 million households.

With these figures in mind, annual investments into the industry rose to US\$276 million in 2015, a 15-fold

**The concept of small-scale solar has been proved in Africa. The next step is to deploy it at scale.**

increase since 2012. Heller says investors are seeing huge return potential in the sector.

“Sub-Saharan solar is in a place now where mobile phones were in the 1990s. Solar panels are getting cheaper, LEDs and batteries are getting better and better. It keeps improving: the size and price of batteries and what they can power,” he says.

This had led to evident growth at a company level. Lars Krückeberg is co-founder and CTO of Berlin-based SOLARKIOSK. The company’s E-HUBB is an energy and business outlet for solar products, fast moving consumer goods and energy services, and has been rolled out in Ethiopia, Kenya, Rwanda, Tanzania, Botswana and Ghana.

“Our numbers are ever increasing,” he says. “And we know we just scratched the surface in most countries, as in many places the products never reached the people and they simply do not know about it and have to be educated, why it makes sense.”

## Scratching the surface

Yet if companies like Krückeberg’s are to do more than simply scratch the surface and actually deliver small off-grid solar solutions at the scale needed to make a meaningful difference, and please investors, there are a number of issues that need to be addressed.

Peters says scale is necessary in order to reach economies of scale, with solar providers hindered by costs around marketing and distribution.

“In very rural and dispersed communities, distribution costs are very high. The marketing and distribution cost per

product are lower if you have higher volumes. This then has impact on the end-user or customer, since the retail cost will be lower for them," he says.

Krückeberg agrees last-mile distribution, especially at the bottom of the pyramid, is the biggest bottleneck faced by firms in the sector.

"That is why there are almost no companies that are tackling this problem. Last-mile distribution and ongoing customer relationships will probably become even more important value drivers and determine who will be the few successful brands."

Yet for last-mile distribution to take place and for companies to scale sufficiently, finance is necessary. As seen above, investment is happening, with the likes of Kenya's M-KOPA Solar and Tanzania's Off Grid Electric raising large funding rounds last year. Heller says PEG Ghana is in the process of raising its third funding round. It currently has 8,000 customers and is targeting 40,000 by the end of the year.

### Business models

Giving investors what they want is key to attracting investment. PEG Ghana was originally working through microfinance banks, but found itself restricted by limited scope if the organisations it was working with had sprung from an NGO, or the restrictive KPIs imposed by larger institutions. The company switched to a pay-as-you-go model on the advice of its first investor.

Peters says this is happening across the board.

"Barriers to entry in the market are not too low. As a result investors are less keen on models where the business is selling direct to the customer, or simple distribution models, since these can easily be copied," he says.

"There's a move towards investment in PAYG models – where it's initially more complex to set up, and therefore more challenging for competing businesses, but it's easier to claim margins, and maintain more predictability. These are considered safer long-term investments."

The switch to pay-as-you-go has other benefits as well. One hindrance to the uptake of solar, in spite of the long-term savings it creates, is the

### Azuri Technologies – an eye on scale

Present in a number of African countries, UK-based Azuri combines solar and technology, and claims its business model enables users to save up to 50% each week and local entrepreneurs to build new revenue streams. Azuri solar home systems use pay-as-you-go technology, with a cloud-based distribution management system allowing customers to pay for their solar and access to training and systems information in real-time from a computer or phone.

The company's model is to work with an ecosystem of distributors, service agents, installers and local entrepreneurs. Azuri believes this end-to-end value chain incentivises all actors to ensure the systems work for the customers.

Azuri CEO Simon Bransfield-Garth says developments in off-grid power mean new distributed generation techniques have the ability to leapfrog conventional approaches. Whereas the cost of solar power systems previously limited adoption, the rapid growth of mobile money services and pay-as-you-go solar power are enabling even the lowest income households to access basic power.

"Over the past five years the costs of batteries, LED lights, and photovoltaic cells has dramatically decreased," he says.

"This means the technology is available, and can be manufactured at a realistic cost. The next step for growth is investment. The technology and business model have been developed to offer these off-grid solutions; it now requires large-scale financing to deliver them to market in high volume."

Deployment at scale remains a challenge, due to factors such as finance, logistics, distribution and customer education. Yet growth is happening regardless, and companies are putting in place the resources to address these challenges.

"The key to scaling is combining global finance and expertise with local knowledge, people and connections," Bransfield-Garth says.

"Azuri's business model is built around in-region partners with extensive in-country networks that facilitate rural reach, and provide a distribution network of local entrepreneurs. Through our partnerships, Azuri has reached isolated rural communities that would otherwise have been inaccessible."

Bransfield-Garth says an example of this was one of its sub-distributors In Kenya, which has grown from a single entrepreneur to a team of six full-time and 50 part-time sub-dealers, installers and top-up card sellers in the space of 18 months.

More finance is necessary, and Bransfield-Garth says the investors that are needed for the sector are those looking for a "compelling return" but also the opportunity to make a difference and accelerate the rate of development in Africa.

"However, in order to move from pilot projects to scale, investors want to see a proven product and business model, from development stages right through to delivering to market, and infrastructure to provide after sales support. The business as a whole has to be commercially viable, not just a particular aspect of it," he says.

He says enabling or supportive policies must be put in place to assist these businesses, such as a zero rate on solar home systems duty and VAT.

"In addition to this it is important that the sector is not constrained by energy sector regulations, enabling the market to grow and expand at its natural pace," Bransfield-Garth adds.



The growth in mobile money and pay-as-you-go solar services in Sub-Saharan Africa is helping low income households access power.

Phaesun – providing continuous power supply

Phaesun, headquartered in Memmingen, Germany, specialises in the sales, service and installation of off-grid PV energy systems worldwide. Given its global presence, the company has reached economies of scale that allow it to operate in seemingly less profitable places.

One example is Eritrea in East Africa, where the local Phaesun subsidiary partnered with German non-profit organisation Archemed to provide a maternity hospital with an Off-Grid Connect System based on Studer components.

The need for a solar solution was typical of the need across much of Africa. The part of the hospital that deals with children's paediatric cardiac surgery and neonatology was previously specifically sensitive to power failure, with the hospital often struggling with blackouts.

Phaesun installed one of its Off-Grid Connect Systems, a PV solution backed up by the grid and the extra diesel generator, and designed to provide 60kWh of daily production. The inverter charger was designed to provide the 42kW peak load. This way, the system can provide around seven hours of power during operation daily without grid or diesel generator, and four hours without sun.

According to Phaesun, the Off-Grid Connect System helps bridge power blackouts with a bank of OPzV lead acid batteries that offers 124kWh storage capacity. This is additionally solar fed with a 14.4kWp PV-generator consisting of 72 200W monocrystalline solar modules. For the power management, components from Swiss manufacturer Studer are used: three Studer VarioTrack 80 MPPT charge controllers, six inverter/chargers Studer XTH 8000 and a remote control guarantee a reliable energy management.



Credit: Phaesun

Phaesun's solar-plus-storage system helped bring reliable power supply to a hospital in Eritrea.

Phaesun said integrating the solar power system with the existing electrical installation of the hospital was the main technical challenge of the project. Specifically, its engineers had to separate the critical loads and make them independent when powered from solar, but still be part of the system during normal operation from the grid. But with these complications eventually resolved by the company's technicians, Phaesun says the system now offers the two hospital wards secure and uninterrupted power supply.

immediate up-front cost. Companies like M-KOPA Solar and PEG Ghana, therefore, allow users to pay over time, in much the same way as they would do with kerosene. It comes with the additional benefit that users are able to build a credit history, often for the first time.

Financing is not the only aspect that needs to be got right, however. Jackson Machuhi, managing director of Barefoot Power, which provides solar lighting and phone charging products, says all aspects of a company's value delivery system must be "optimally mixed" if a business model is to succeed.

He says Barefoot Power has pioneered the Light Up A Village (LUAV) delivery model, which integrates the right product with financing, community mobilisation, installation, user training, support and maintenance, and recycling strategy.

"The absence of one of these elements will hamstring scale at one point," he says, adding that traditional business and distribution models have not yet proven useful in scaling small-scale solar solutions.

"Every successful distribution has included an aspect of process innovation. For example, one distributor of

solar lanterns achieved short-term volume success through schools – a non-traditional channel. Pay-as-you-go is another."

Also key, he says, is transforming the consumer's needs for solar products to wants. "In this analysis a need is a gap, such as light, not compelling enough to make a customer to invest emotionally in a solution," Macuchi says. "A want – such as entertainment or lifestyle – is a much stronger cognitive driver for action."

Barefoot Power has seen a "sharp and sustained" increase in the demand for solar home kits, which bundle television and other lifestyle appliances to the base lighting solution, while M-KOPA Solar has started rolling out solar-powered televisions.

**The need for enabling policies**

Given the great societal problem being tackled by small off-grid solar solutions, all actors are agreed African governments must implement enabling policies to smooth the process. Peters says it is important off-grid is established in national energy access policies, and that import duties and taxes are removed or frozen to create a more level playing field.

"We'd like to see more VAT and import-duty holidays. In East Africa, namely Kenya and Tanzania, these have definitely helped to grow and support the market," he says.

Machuhi agrees these policies have been helpful in that they lower the end-user price and make uptake more likely, but he feels more needs to be done across the board.

"It has taken too long for governments to embrace distributed solar as mainstream in areas where it is uneconomical to transmit grid power," he says. "One cannot rule out confusion brought about by mini-grid solutions which compete for relevance with small solar solutions."

Some governments look set to go further than Kenya and Tanzania, with Rwanda motivating for a government-guaranteed rural off-grid solar lighting programme. In West Africa, meanwhile, Ghana has been one of the leaders in embracing the potential of small-scale solar in rural areas. The sector may still face some challenges in scaling up in Sub-Saharan Africa, but there can be little doubt that it is gathering a healthy head of steam. ■

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