

# The potential of mini-grids

In large parts of sub-Saharan Africa and other remote areas, up to two-thirds of people have no access to electricity. How attractive is the mini-grid market?

For the 1.2b people around the world that lack access to power, it's a compelling vision. Just as emerging economies leap-frogged over fixed-line to mobile telephony, so power-starved rural communities could develop their own mini-grids – small-scale power networks, using renewables, batteries and, if required, diesel generators – rather than waiting for network operators to build out expensive centralized grid infrastructure.

On the face of it, this is a big market opportunity. “The cost of energy can be dramatically cut by eliminating the need for transmission infrastructure,” says Constantin Ginet, Head of Micro Grid at Siemens in Nuremberg, Germany. As an example he cites remote locations in Africa, facing electrification challenges: “Micro-grids can reduce operational costs for electricity by over 30% compared with a connected grid.”

Such systems can compete favorably with diesel, often the default alternative. In some remote rural areas in Africa consumers are paying as much as US\$6/kWh for power, while solar/battery mini-grids, depending on size and user numbers, can potentially deliver power at US\$1.30/kWh, says a 2017 study by the Rocky Mountain Institute (RMI) and the Carbon War Room. For solar-diesel hybrids, costs may be as low as US\$0.30/kWh.

This sector has attractions for investors. RMI estimates that the addressable off-grid market in just four African countries (Senegal, Kenya, Tanzania and Uganda, which have existing markets and regulatory environments that are friendly to mini-grids) would generate US\$740m in annual revenue – or US\$1.5b, if the costs of such systems could be reduced by 50%, which RMI believes is achievable.

Mini-grids come in all sizes. A village mini-grid with 10kW–200kW of capacity costs between US\$100,000 and US\$2m; mini-grids that could power a large town or small city might require up to US\$30m. But there is a circular challenge, notes Pepukaye Bardouille, Senior Operations Officer at the International Finance Corporation (IFC), the private sector arm of the World Bank Group: “The ‘typical’ mini-grid requires average revenue per user of roughly US\$15 to US\$30 a month. Assuming power costs at 10% of income, that assumes monthly income of between US\$150 and US\$300, which in turn assumes users have ‘productive use’ appliances – i.e., appliances that allow their owners to make a living.

“At that level of economic activity, central grid extension is likely to make sense, so mini-grid developers would likely find themselves competing with the grid.” The danger for investors is if the conventional grid is subsequently extended, and subsidized power is offered to the mini-grid users without a clear approach to compensation, their investment is at risk.

There are also other barriers, says Bardouille: “For example, no national utility mandated with serving the country wants to come across as unable to do so, which becomes apparent when other players – often smaller developers from overseas – come into the market. If viewed as competition rather than a perhaps more cost-efficient approach to complementing the central grid’s reach, the result is friction.

“Many mini-grid developers are approaching this space with limited demographic and socioeconomic information – where exactly are households located, how much do they earn, how much do they spend on electricity.

And getting this data can be costly. Moreover, there is a lack of clarity on central grid extension plans on the part of utilities or rural electrification agencies. As such, business planning becomes complex.”

“There is a data gap,” agrees Harrison Leaf, the CEO of SteamaCo, a UK-based automation company which, among other things, provides downstream consumer management systems that enable mini-grid systems. A better understanding of how usage patterns change once consumers start paying for power can inform new investments, he says.

Meanwhile, inadequate policy and regulatory frameworks in many frontier markets can make investment difficult. “For example, in several countries only the national utility can sell power,” says Fabrice Nicolas, Head of Sales Microgrid at Siemens in Nuremberg, Germany. In addition, renewable energy assets carry greater investment risk than conventional generation equipment, as the costs are all up front. “A diesel genset, by contrast, is a small capital expenditure but carries high operating costs,” he adds.

All this makes the investment proposition complex and returns uncertain. “The main challenges are not around technology but financing,” says Nicolas, noting that the due diligence and transaction costs are high relative to the sums needed.

“Mini-grids offer an exciting investment opportunity. But we need to be clear-eyed about how early the market is. It is really difficult to make energy access micro-grids work on a purely commercial basis,” says Alexia Kelly, CEO at Microgrid Investment Accelerator (MIA), launched by Facebook and Microsoft and incubated by the

merchant banking firm Allotrope Partners.

“The participation of grant funding and low-cost, very patient debt and equity is critically important in attracting private finance,” she adds. MIA is seeking to raise a US\$50m facility that blends concessionary finance with private-sector funding, which should enable it to offer returns in the high-single digits, rather than the mid-teen to low-20s that private sector investors would typically expect.

“A lot of what MIA will do is looking at aggregation and investment vehicle options where we help to pool, derisk and aggregate bundles of projects,” says Kelly, given that development finance institutions tend to have minimum thresholds of around US\$10m for these types of investments. “There’s a real need to look at innovative financing models and approaches to enable us to help scale up the market and crowd in private capital.”

Bardouille at the IFC would like to see a broader array of companies in the market. “The solution is partnerships,” she says. “I would like to see greater involvement of international utilities as well as domestic utilities, who know how to [have a] dialogue with regulators and who can influence policy.” Larger companies, experienced in infrastructure development, can offset some of the weaknesses in the start-ups and social enterprises that currently dominate mini-grid development in emerging markets.

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Such partnerships could bring down the costs. The RMI report states it is possible to halve average mini-grid costs by using best-in-class technologies and systems. Other tactics – buying components and software direct from specialists, increasing system modularity, using smart meters and demand-management techniques, clustering mini-grids – can help reduce costs by a further 50%. And this is all before factoring in continuing declines in the costs of crucial components such as solar panels.

These cost cuts make medium-term prospects for mini-grid roll-out and profitability very bright, says Kelly: “If we can make it work today at current equipment costs, and at the early stage that many developers are at, things will only get better.”

But with the mini-grid sector currently dependent on funding from development finance institutions and other donors, the withdrawal of the US from the Paris Agreement, and the expectation that it will reduce the volume of climate finance that it sends overseas, has cast a pall.

“The US withdrawal has limited the potential

pool of concessionary capital we’d be looking to engage with – the US Government has done a huge amount of work across climate change mitigation,” says Kelly. “Having those resources start to pull out from the Green Climate Fund and from all the bilateral programming has an impact. Although I note that a number of European governments – Germany in particular – have really stepped up.” In the six years to 2020, the EU has committed more than €1.06b (US\$1.25b) to West Africa for sustainable energy projects, including off-grid and mini-solutions.

Meanwhile, there are lessons that are being learned in emerging markets that can inform business models and technology deployment in industrialized countries, notes Nicolas at Siemens. “Fantastic solutions have been developed in terms of how mobile phones are used to buy electricity, and the centralized systems and databases that lie behind them,” he says. “We’re learning from these experiences every day.” ■



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## Creating an asset class



In Nairobi, Kenya, Powerhive is building a mini-grid business that aims to deliver electricity to rural communities, on a fully commercial basis – and that could end up deploying hundreds of millions of dollars in off-balance sheet project finance. “What we’re trying to do is make this an asset class that people can invest in, [via]

properly structured [transactions] done in the same way you’d do large infrastructure projects,” says Rik Wuts, who co-founded California-based Powerhive in 2011.

The initial plan was to develop the technology to remotely monitor and control mini-grids and their payment systems, but the lack of potential customers encouraged the company, after some pilots, to develop its own projects. It is building and operating mini-grids in Kenya and the Philippines, and is expanding into Uganda and Nigeria. “Our angle is using technology to build a scalable model for mini-grids,” he adds.

Government policy is a key determinant of success. Wuts says the company is a strong proponent of “cost-reflective tariffs,” on the grounds that few governments would have the resources to subsidize more than a fraction of the rural energy need. To help make its projects work, Powerhive is also

developing businesses that can leverage its presence on the ground – including one providing Internet services, and another helping its customers farm chickens, and other revenue-generating activities.

Powerhive funds projects on its balance sheet, raising US\$20m last year from a mix of financial and corporate venture capital funds, including Caterpillar Ventures and Total Energy Ventures. But the company is eyeing wider fund-raising.

“This model needs scale to really work. It’s hard to make a good business on a few mini-grids,” Wuts says. The objective has been to put the processes, methods and tools in place that will allow large-scale investment. “We’re trying to show everyone that this can be done properly, that it’s a viable business, and that investors can have an impact with their money rather than just investing it with oil companies.”

Powerhive’s 50kW Bara Nne site in Kenya’s southwestern Kisumu County