

Installing mini-grid cable, India – Credit: Smart Power for Rural Development ▶

Renewable mini-grids: UNLOCKING AFRICA'S RURAL POWERHOUSE

In 1930's America, 90% of those living in urban areas were benefiting from electricity, while 90% of the rural population lived without power, 60% below the poverty line. In the face of calls for greater energy access, investor-owned utilities often denied services to the rural poor, citing high development costs, low consumer demand and low profit margins. Eighty years later, sub-Saharan Africa faces similar challenges with 76% of its rural population living under the poverty line, 85% is un-electrified and low consumer demand and long distances make extending the grid to these areas prohibitively expensive.

Alluding to these parallels, African Development Bank President, Akinwumi Adesina announced the ambitious 'New Deal for Energy in Africa' – targeting 130 million grid-connections and 75 million off-grid connections – linking to Franklin Roosevelt's 'New Deal' in the USA. Adesina has updated Roosevelt's cry for 'Relief, Recovery and Reform' in a bid to jumpstart growth and jobs, to a 21st Century call for 'Power, Potential and



Partnership'. To reach the hundreds of millions of people living in un-electrified communities, 'power, potential and partnerships' through 21st century clean energy mini-grids will also be critical.

Unleashing the power of mini-grids

While there are many similarities with the energy challenges of 1930's USA, advancements in renewable, decentralised technologies have created game-changing differences. In 2011, the International Energy Agency found that mini-grids provide the most cost effective way to reach over 480 million rural people with electricity. Commonly defined as systems that provide 10kW to 10MW electricity generation, mini-grids provide power to a limited number of customers and are often run on renewable or hybrid (e.g. solar-diesel) energy. Microgrids are smaller, with 1-10kW generation capacity; nano-grids smaller still. More

nimble and flexible than traditional infrastructure, renewable mini-, micro- and nano-grids also provide a faster way to electrify rural regions, rapidly reducing customer's dependence on expensive, toxic alternatives.

Providing higher levels of energy than solar PV home systems, clean energy mini-grids can power machines, irrigation, refrigeration and more, playing a vital role in micro-enterprise and SME development – the backbone of African economic growth. Given the challenges of grid reliability and the high cost of backup generation, the potential to replace the 1,000GW of diesel generator sets currently operating presents a very real opportunity for immediate impact.

Yet despite a growing number of success stories – from the 2,200 micro-hydro plants powering Nepal to the 867 solar PV, wind and small hydro mini-grids that enabled China to meet its electrification goals – the sector still has to evolve further. When analysing the reasons for past challenges with mini-grid projects in Africa, the Alliance for Rural Electrification (ARE), the industry

Mini-grid, Mali – Credit: Studer Innotec ▼



body, found that in addition to the often lacking government commitment, several common themes exist:

- 👤 Scarce and inaccurate data, e.g. over- or underestimated electricity demand
- 👤 Non-inclusion of transaction, management, and risk mitigation costs into tariff calculation
- 👤 No flexibility in tariff structures
- 👤 Supply-chain failure to provide spare parts
- 👤 Mismanagement, including a lack of provision for operations and maintenance
- 👤 Donor-based projects with a four year cycle lacking longer-term plans
- 👤 Long registration, permitting and licensing processes
- 👤 Inadequate skills capacity
- 👤 Insufficient policy and regulatory framework

Without addressing the above challenges, it will be impossible to unlock the full potential of mini-grids. Fortunately, businesses, donors and policy-makers have been taking note.

Creating the enabling environment

At the international level, the Sustainable Energy for All initiative has determined clean energy mini-grids to be a 'high impact opportunity' for achieving energy access, while several African countries have begun integrating mini-grid regulation into their electrification plans and policies. In Senegal, for example, a framework caters for both large private mini-grids and smaller community projects. In Tanzania, the regulator has set out a suite of provisions to address issues such as the arrival of the grid, consumer tariffs and licensing. While in Kenya, home to the Green Mini-Grid and ReFit programmes, the solar mini-grid company Powerhive became the first private company in the country's history to receive a utility concession. Geospatial mapping – which measures availability of renewable resources, the extent of current grid infrastructure and population density amongst other aspects – is also helping policy-makers determine the cheapest, fastest energy

solutions for each of their regions. Very often mini-grids.

Support and scale

Yet even in regions where policy is supportive, the high upfront costs need to be addressed for the sector to reach rapid scale. A variety of low-cost financing mechanisms are a central tenet of many successful programmes, as they were when the US Rural Energy Agency (REA) was established in 1935. The REA was established as a "government-financing agency providing subsidised loans to private companies, public agencies, or cooperatives for the construction of electrical supply infrastructure in rural regions", the work of which is considered to have had an "immediate" and "profound" success on the US national economy. It also led to huge energy market disruption. By enabling municipalities, cooperatives and others to enter the sector, customers not only gained choice, but themselves became catalysts for change.

As in the case of business models for US rural electrification, there is no one-size-fits-all approach to clean energy mini-grid development. ARE has defined four common operating models: utility; private; community based and hybrid, each with different needs and objectives. Providing support that can catalyse all stages of market development and a variety of these different models will be key to unlocking rapid growth.

Experience and experimentation will drive growth

The opportunity for scale and impact is also being noticed by the financial sector. In recent months, corporate



▲ Irrigating with a solar pump, Kenya – Credit: Futurepump

players, such as Enel, Caterpillar and Total Energy have placed multi-million dollar stakes in the industry, and impact investors, such as Rockefeller Foundation and Vulcan Impact Investing, are using knowledge gained from early projects to finance ever more sophisticated programmes. Lessons are being taken from around the world and applied to new regions and new scenarios.

One such lesson is the use of a business as an 'anchor' customer, where the mini-grid operator contracts with an organisation that has a constant power demand and income flow providing them with a reliable offtaker. The anchor's revenue is then bolstered by that of



▲ Turbine installation, Nigeria – Credit: Smart Hydro Power



▲ *SteamaCo microgrid, Kenya – Credit: Vulcan Impact Investing*



SUNFLOWER solar pump demonstration day, Kenya – Credit: Futurepump ▼

homeowners and micro-business energy users. In India, OMC uses telecom towers as an anchor for their small solar power plants, while Smart Power for Rural Development proactively seeks to engage a variety of businesses in their project planning phase – an approach which is seeing them extend their mini-grid ambitions from 85 projects to 1,000. Meanwhile, Ausar, operating in Central and West Africa, engages with real estate companies to build solar mini-grids into new housing developments, aiming not just to provide solutions to those already located in rural regions, but to make rural areas themselves more attractive.

Community-based approaches also provide lessons on sustainability. Smart Hydro Power in Zambia, for example, has been part-funded by grants and low-interest loans, but its long-term project viability will require revenue for operations and maintenance. The programme is therefore catalysing enterprise by supporting irrigation systems and the creation of an IT hub, aiming to increase its own electricity customers alongside productivity and welfare. The involvement of community and business stakeholders in the early phase of project development is helping operators gain valuable insights into potential demand profiles and proactively support complementary activities that will increase both impact and revenues.

Experience is key; yet so too is innovation

In recent years, breakthroughs in data management systems are proving to be a game changer. Service providers like SteamaCo use the latest digital technology to view customer demand and supply in real time, providing unique insights into load management, system efficiency and cost recovery. These insights help to decrease risk, guide new project design and provide critical data for investors. Flexible, localised solutions, supported by the latest demand management technology, are creating strong credit and project histories and attracting new sources of capital.

Indeed the investment potential is already significant. Following a review of project developers, the United Nations Foundation Energy Access Practitioners' Network conservatively estimated that the micro- and mini-grid industry presents a US\$500 million investment opportunity today. A figure which could reach billions of dollars in the coming years, and this is just the tip of the iceberg. Complementary solutions, such as solar irrigation by companies like Future Pump, industrial solutions from CrossBoundary Energy, modular power systems from organisations like Devery, and the increasing energy demand resulting from the anticipated

US\$4.7 billion efficient appliance market, will add to and amplify this investment potential.

As will experimentation. More trials, new policy support and new business models will enable even greater social and economic impact: whether coupling community mini-grid schemes with skills training, providing additional support for offtaking enterprises or finding ever more innovative ways to integrate various forms of nano-, micro- and mini-grids into systems planning.

Mini-grids can unlock the potential of thousands of African and Asian rural communities, creating un-measurable opportunities. In 1930's USA, electrification paved the way for agricultural mechanisation, a boom in consumer appliance markets and the extension of telephone wires across the country. The rise of the clean energy mini-grid comes at a time when mobile phone technology is itself driving electrification, appliance manufacturers are creating efficient DC products and smallholders are beginning to benefit from cost effective solar irrigation and renewably powered agro-machinery.

We are in a new era. With new technologies, new business models and new innovations. Just as in 1930's America, the opportunity to electrify rural areas in Africa and Asia is vast. What remains to be seen is how fast we can scale the mini-grid opportunity of the 21st century, and who will make the most of it. [ESI](#)

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◀ *Installing solar panels, India – Credit: Smart Power for Rural Development*

