

Electrifying Rural and Remote Areas through Mini-grids

HIGHLIGHTS

- Mini-grids provide decentralized, reliable and efficient electricity, connecting remote communities that lack access to the existing electric grid.
- Mini-grids bridge the gap between small solar home systems and large grids, offering customers nearly the same service as a grid connection.
- Customer-friendly payment schemes, including mobile payment, prepaid scratch cards, and smart metering make the systems easy to use and provide back-end information about the use of electricity.



Development Challenge

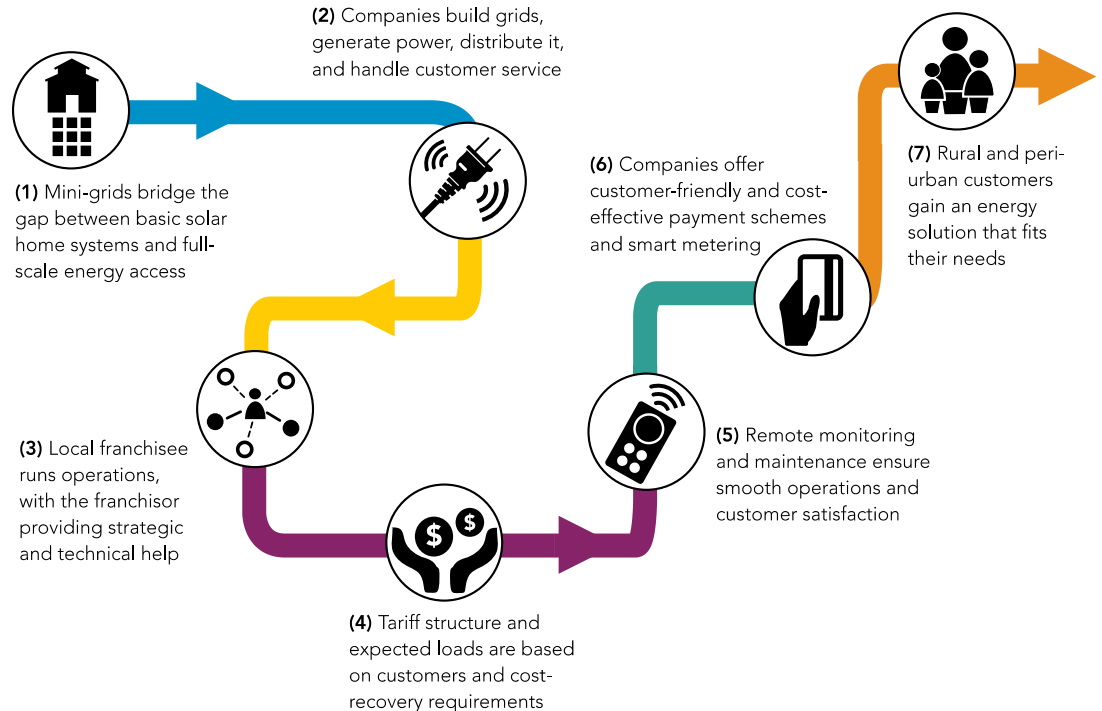
According to the International Energy Agency, more than 1.2 billion people lacked access to electricity in 2013. Most of them live in rural areas in Sub-Saharan Africa and South Asia. They rely on traditional biomass, kerosene, and batteries, which are expensive and pose environmental, safety, health, and other risks. Lack of regular access to power also hinders rural development, slows the formation of human capital, and reduces the quality of life for people at the ‘bottom of the pyramid. Utilities in many low- and middle-income countries either lack the capacity to expand their grids to isolated rural areas or choose not to do so because of the low return on investment. Off-grid solutions are therefore needed.

Business Model

A mini-grid (MG) is a set of electricity generators and storage devices connected to a distribution network that provides electricity to communities and customers that are not connected to the main grid. Most of them use low alternating current (AC) voltage (220V–380V) or direct current (DC) with a centralized production and storage system and have installed capacity of 5–500kW. Companies operating MGs usually build the grids, generate and distribute the power, and take care of all customer-related services, including marketing and bill payment.

MGs use a range of technologies. Diesel-powered MGs are expensive and unreliable. For this reason, many models combine diesel with hydro or other renewable energy resources, which reduces storage costs. MGs also bridge the gap between basic and full-scale energy access, enabling people to use electricity to light homes and power devices such as cook stoves, refrigerators, and mobile phones.

Stages of the Mini-Grids Business Model



Implementation: Delivering Value to the Poor

Awareness

All stakeholders—customers, local businesses, government and the banking sector—need access to information about all available energy solutions to find out which solution is affordable and best fits their needs. Tanzania's Scaling-Up Renewable Energy Programing Low Income Countries (SREP) program mapped out different energy solutions for different categories of households and provided a supportive political framework. Some organizations, such as Mera Gao Power in India, visit villages and collaborate with local NGOs.

Acceptance

Successful developers integrate local partners in the development of new sites; local knowledge is as vital as technical. The German enterprise Inensus funded the joint venture ENERSA S.A. with the Senegalese company Matforce CSI to set up MGs in Senegal to tap local knowledge. Remote monitoring in combination with a local service team helps improve the efficiency of operations and increases customer satisfaction and profitability.

Accessibility

MG operations are locally based; much of the day-to-day business cannot be performed at a distant headquarters. Many companies (including Husk Power Systems in India) therefore use a franchise model to facilitate investments, scaling, and transferring responsibility for local operations to the franchisee (while the franchisor provides strategic, technical, and practical expertise).

Affordability

Tariff structures and expected loads are developed to match the customer base and cost-recovery requirements. India's DESI Power projects future customer use of electricity to size the grid correctly and strike the right balance between affordability and future growth. Powerhive in Kenya offers customers the opportunity to pre-purchase electricity through mobile banking services.

Cost and tariff structures of MGs vary, depending on a number of factors. These include the size and energy source of MG, the socioeconomic status of users, the type of operator (private or public), ownership model, and the funding structure (for-profit, partly or fully subsidized). The size of the required investment and payback period vary as well. Also, village grids that can be connected to the national grid at a later stage usually cost more than isolated low-voltage DC micro-grids.

Many MGs are set up as part of the national electrification initiative and are at least partly financed by governments. Other companies are strictly private. For example, Husk Power Systems in India is profitable at the plant level, with a gross margin of 20 percent. It typically takes two to three months for a plant to reach operational profitability and two and a half to three years to recoup capital expenditures (with subsidies). Husk Power Systems has secured formal equity investment, but grants and some equity from the owners still finance its capital and operating costs.

Results and Effectiveness

The number of customers ranges from a few to a few hundred per one MG. Devergy started operations in Tanzania in 2012; it now serves almost 1,000 households in six villages and is connecting more than 100

households each month. Husk Power Systems, founded in 2007 in Bihar, India, serves 210,000 people in 250 villages, through 91 plants powered by rice husk. Desi Power provide services to 14 villages in India, reaching 2,000 people. Its biomass gasifiers provide electricity that is more reliable and about 25 percent less expensive than diesel-based generation.

MGs have a variety of positive effects. They extend villagers' activities beyond daylight hours, enhancing the quality of life and promoting economic development, by allowing local shops, restaurants, and small-scale manufacturing units to stay open longer. MGs further increase the time children can study, improving educational outcomes. They also reduce indoor air pollution and the risk of fires from kerosene, improving health and reducing accidents. MGs save consumers money and prevent damage to the environment from the improper disposal of zinc-carbon batteries (widely used for operating radios).

Finally, MGs can be a viable and cost-effective route to electrification. For example, rural residents in Tanzania who use a mini-grid spend approximately 20 percent less on lighting and 50 percent less on phone charging than rural residents without access to the mini-grid.