An Introduction to Mini-grids in India

This article is the first in our 'Powering Ahead' series on what mini-grids are and why they can be key for achieving remote energy access in India.

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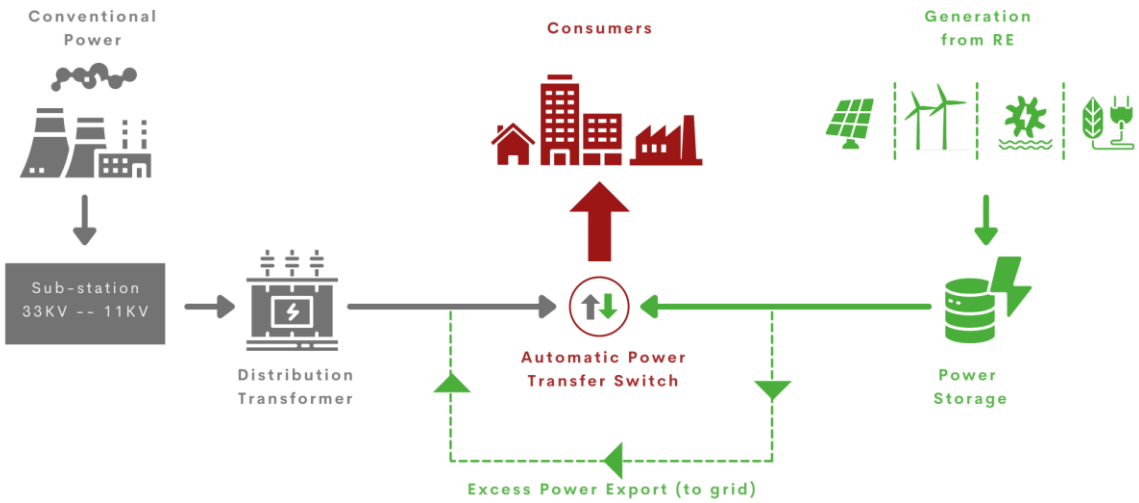
Mini-grids (MG) — the small power stations that are scaled-down versions of city power grids — are today recognised for their role in bringing reliability to power supply. They are also known for their inherent ability to utilise the abundant renewable energy (RE) present in India, and for providing a controllable and independent energy-service option to consumers. Mini-grids are crucial for creating a national-level distributed grid system too. Further, they offer location-specific, energy-centric, expandable solutions to meet the needs of people in rural and urban areas. For India, which has diverse social clusters and remote demographic settings, the solutions offered by mini-grids can especially be useful for last-mile initiatives.



Improved power reliability with mini-grid

History

The idea of a mini-grid has been mooted at several research hotspots, with its technology and terminology evolving in developing countries since the 1980s.

In India, the work on MGs commenced in 1996, with the installation of the solar mini-grid in Sagar Islands in the Sundarbans region (West Bengal), as also in Lamni Village in Bilaspur district of Chhattisgarh. However, the term 'mini-grid' was formalised in India only in September 2016, through a Draft Mini-Grid Policy of the Ministry of New and Renewable Energy.

The term 'microgrid' (micg) came into existence with the pioneering work at the University of Wisconsin, which was being led by Professor (Dr) Robert Lasseter, and was first presented in his paper in 2001–02 to define a 0 to 100 kilowatts (Kw) power system network. Later, several nations took up micg implementation, such as Tokyo Gas micg (2005), Laden micg of Spain (2005), Manheim micg of Germany (2006), etc.

In the early years of the last decade (i.e. in 2013–14), the concept of nanogrids also emerged. Nanogrids are the smallest-level power systems that serve a single house or building. They can be supplied with energy by diverse sources and can be integrated with any existing power network.

Classifications and Terminologies

All definitions of an MG system recognise an RE source of generation, be it a single source or a hybrid combination of sources (including solar PV, wind, biomass, etc.). MG systems utilise a public distribution network (PDN) — either existing or newly installed (as per national grid standards) — and serve a community/group of communities or hamlets (small villages). Most of the mini-grids in India (like those in Jharkhand, Bihar, and Orissa) have been installed for last-mile energy access, using popular RE technologies such as solar-PV- or biomass-based systems.

While an MG system may be classified in several ways, the main basis of classification is size. Based on the size, which may range from a few kilowatts to megawatts, the mini-grid may be classified as a 'microgrid' (micg) or a 'nanogrid' (NG).

a) **Microgrids (micg):** Often confused for a mini-grid, a microgrid is a similar system with a generation capacity that ranges from 1 to 10 Kw (as specified by the Ministry of New and Renewable Energy). Microgrids serve a single community or hamlet with basic lighting support, or to complement the existing grid operations for commercial and industrial loads (such as agro-processing, water purification, etc.). To enhance reliability, a group of microgrids can also be clustered to form a web-like topology. Though microgrids are modular and can be utilised with diverse sources and loads, they require a better energy management system.

b) **Nanogrids (NGs)**: These can be seen as an isolated power system that serve a single house, an enclave, or an independent commercial facility. The concept of nanogrids emerged with discussions on net-zero energy consumption, green building concepts, and energy independence. NGs are supported by solar-PV systems and basic energy storage systems. They work with a smaller capacity, which is in the range of 0 to 5 Kw. Though nanogrids are easy to deploy and need simpler energy management, their utility is limited by design and they cannot be clustered.

Mini-grids can also be classified on the basis of system-current configuration. These include direct current (DC) MGs (12, 24, 36, 48, 72, 96 volts systems), or alternating current (AC) MGs (220-volts single-phase system for home lighting or 440-volts system including commercial power requirements). In the presence of mixed components (both AC and DC converters in one design), they may be termed as hybrid MGs.

Further, an MG that has no interaction with the main grid can be termed as an 'off-grid' or 'standalone' MG, and the one with power transactions may be termed as a 'grid-tied' or 'grid-interactive' MG.

In Conclusion:

From being a localised, remote-area alternative power system, mini-grids have come a long way. Despite challenges, they are set to play a definitive role in strengthening the decentralised power grid framework of India, while adding resilience and reliability at various levels, throughout the power sector. Moreover, by providing the power for bringing clean energy and clean water together, they can help raise the agricultural and entrepreneurial aspirations of people in rural India, bringing transformative socioeconomic benefits.

In the next article of the series, we will talk more about the role of mini-grids in India, based on our experience of how the MG system delivered comprehensive gains to the residents of Kudagaon, an island village in Odisha.