Energy Access: Role of Mini-grids in the Changing Landscape of Rural Electrification

PANEL DISCUSSION II

India and Its Rural Electrification Story

The year 2022 will mark the 75th anniversary of Indian independence and has been earmarked for achieving '24x7 Power for All'. Over the years, the Government of India has witnessed significant progress in rural electrification through supportive policies, programmes and their implementation plans (Figure 1).

Figure 1: India's Electricity Access Story

Notably, grid extension into un-electrified villages, and providing new connections to rural consumers have been the principal focus of the government initiatives. The energy access received a boost when the Electricity Act was enacted by the Government of India in 2003, providing a roadmap for expanding electricity access in the country, both via grid extension as well as through standalone systems. Post the introduction of this landmark legislation on electricity, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) was launched by the Government of India in April 2005, with the objective of extending electricity to all un-electrified villages in the country (numbering more than one lakh at the time), and the intensification of electricity infrastructure in the electrified villages. The key features of the programme included the provision of Village Electrification Infrastructure (VEI) with distribution transformers of appropriate capacity in all villages and free connections to all 'below poverty line' (BPL) households in the villages. Under the scheme, a 90% grant was

provided by the Government of India and the remaining 10% as loan by the Rural Electrification Corporation (REC) to the state governments.

In 2015, the Government of India launched the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) which subsumed the RGGVY and brought in an additional component of agricultural feeder separation. The extremely remote 18,500 villages that remained un-electrified under the RGGVY were taken up for electrification under this scheme and on 28th April 2018, the milestone of complete village electrification in India was achieved. DDUGJY has also been crucial in providing support for strengthening sub-transmission and distribution networks in rural areas particularly focusing on the metering of distribution transformers, feeders, and consumers in rural areas. Even though with the achievements of RGGVY and DDUGJY, village electricity expansion was achieved, the rate of household electrification continued to be slow.

The Government of India launched the Saubhagya Scheme in September 2017 aimed at ensuring electricity connection to the yet-to-be-electrified 40 million households in the country, with a primary focus on rural areas, by December 2018. This scheme complements the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), the flagship national rural electrification programme, which focuses on creating and strengthening rural electricity infrastructure in the country. Even as the Government of India pursues these ambitious targets, the sustainable development goal of achieving universal electricity access remains a colossal challenge.

Till date, decentralized generation systems (diesel, kerosene, etc.) were being used to electrify households and distant villages, where grid electrification was a far-fetched dream. With the clean energy revolution in India, stand-alone renewable energy (RE)- based systems such as solar home lighting systems, street lighting systems, etc. started playing a significant role in meeting the basic lighting needs of the rural population. With increasing demand, DRE-based micro/mini-grid systems evolved and became an enabler in meeting consumptive and productive demands (1). These micro/mini-grids provided quality and reliable power and received support from various State-level policies and regulations. During all these years, DRE systems and DRE- based mini-grids had reached villages and hamlets which were still devoid of any electricity supply or had a very limited

1 Detailed in Box 1

Box 1: The Micro/Mini-Grid Experience

Certain states in India witnessed the thriving of mini and microgrids in rural areas. It was clearly observed as a smarter and reliable way to electrify the long-time un-electrified households and small commercial units. It provided an aspirational boost to the rural population as it improved cooking options, made clean water available and enhanced the rural health and education facilities. Besides meeting the essential needs of households, these systems enabled increment in job and income through cottage enterprise-based opportunities and supportive small-scale productive and commercial loads. With advancements in clean energy, hybrid-based micro/mini-grid systems i.e. a combination of RE (mostly solar) and battery back-up emerged to help meet increased electric load requirement. Today, a range of reliable RE technologies to generate, distribute, and manage power for a wide variety of applications, are making the installation of micro/mini-grids popular.

During the last few years, the prices of PV and energy storage have descended rapidly, presenting micro and mini-grids as cost-effective options for a variety of power applications. Mini and microgrids using highly efficient/smart grid inverters are an effective way to maintain the supply of energy as well as help cut the operational costs for any facility. These grids showcase operability in isolation with the electricity networks as well as present an opportunity to interact with the Discom grid to exchange power. Hence, these mini and microgrids help in achieving grid reliability and resilience even in the face of climate or natural disasters. Also, it allows a combination of both alternative current (AC) and direct current (DC).

On the policy and regulatory front, a draft policy on setting up RE-based mini and microgrids in the country was issued by MNRE. Similarly, States like Bihar and Uttar Pradesh announced policy and regulations supporting the development of RE-based mini and microgrids.

New Development and Growth Opportunities

Considering the current scenario, economics, and consumer preference are driving the micro and mini-grid businesses. Also, it is supporting the integration of higher concentrations of a non-dispatchable renewable energy of varying capacity in their systems. There are several factors that are driving these specialized solutions and leading to the commercial-scale expansion of these grids such as remote industrial operations, increasing fuel prices and access to electricity via unreliable Discom grid. Hence, leveraging the positives from both Discom and mini/microgrids can present a good opportunity for smarter and more effective rural electrification in India.

access to electricity. This mini-grid model is a decentralized approach to provide electricity to villages that are un-electrified and/or under-served in terms of electricity supply. A mini-grid generates electricity primarily via solar/biomass sources and distributes it via poles and wiring infrastructure that serves households, businesses, and institutes within a geography/segment. A variety of stakeholders including governments, multinational companies, start-ups, non-governmental organizations, large philanthropies, corporate social responsibility arms of multiple corporations and social enterprises continue to engage with these initiatives.

Modalities of the Saubhagya Scheme

The scheme aims to provide last-mile connectivity and electricity to all un-electrified households in rural areas; and also to areas, where the grid connectivity is not feasible or cost-effective, by providing Solar-PV based standalone systems in remote and inaccessible areas, limiting the load of each household to 200-300Wp (with battery bank) and providing maximum 5 LED lights, 1 DC fan, 1 DC power plug etc. The scheme is also in alignment with the DDUGY which aims at strengthening and augmenting sub-

transmission & distribution (ST&D) infrastructure in rural areas, including metering at distribution transformers, feeders and consumer end, which includes micro-grid and off-grid distribution network.

Both the schemes mentioned above are heavily subsidized by the Government of India, where a grant of 60% is available from the central government and an additional grant of 15% can be made available if the DISCOMs meet the prescribed milestones, which limits the state's contribution to 25% only.

There are 39,073 inhabited villages in Bihar as per the census-2011. All villages are electrified in the state as reported by the State Government (2).

There are around 11.7 million households in rural Bihar while more than 2.2 million households in urban Bihar. As per the Saubhagya Scheme, 73% households in rural Bihar and over 90% households in urban Bihar are electrified till 10th October 2017. The electrification of an additional 13% rural households and 0.5% urban households is under progress till 30th June 2018. However, 14% in rural and 9% in urban areas (together little over 1.8 million households in Bihar) are still waiting to get electricity in their homes (3).

The government of Bihar is pushing aggressively to achieve the milestone of providing electricity to all by FY 2018, which we believe can be achieved if implemented with right strategies and combined with a pragmatic approach. There is a serious challenge to assure continuous quality supply along with addressing the risk of load-shedding, proper voltage and power outages, which are quite prevalent in many parts of the state. The distribution sector component will play the most critical role as a link between power generation and end users, as it is a complex challenge to deal with the intermittent supply of power as well as reducing AT&C losses.

A few challenges that Discoms continue to grapple with or anticipate in the near future while implementing projects under the SAUBHAGYA scheme include:

a. Need for an upgraded/augmented and maintained distribution infrastructure to service all the households.
b. Limited number of manufacturing units catering to electricity infrastructure equipment.
c. Cost of extending lines to each and every household.
d. Metering of all new connections, and in parallel, of existing unmetered connections.

2 http://www.ddugjy.gov.in/portal/state_wise_summary1.jsp?stateCode=10
3 http://www.ddugjy.gov.in/portal/state_wise_summary1.jsp?stateCode=10

e. Limited human resource capacity of Discoms to undertake such an extensive scheme.
f. Maintaining revenue sustainability, managing theft, keeping the network stable and bringing AT&C losses within the acceptable range.

An Integrated Approach Towards Delivering Quality Electricity Supply

The challenges faced by the Discoms can be addressed through an integrated approach of utilizing both mini-grids as well as the connections provided under the Saubhagya Scheme. This signifies that mini/microgrid is not an option but a necessity to provide power to all, and its existence and support can better be utilized as a complementary solution towards electrification. RE based micro and mini-grids with their enormous potential are a promising solution to the access to energy challenges in the country. They offer the benefits of boosting the local economy by meeting energy needs of both residential and commercial activities; thereby supporting enterprise development, generating employment opportunities, and raising individual/ household incomes etc.

Stating so, it should also be noted that with the onset of the above-mentioned schemes of the government, the mini-grids could provide a significant boost to the programme. The central and state governments must utilize this opportunity to help in reducing the cost of supply by improving the AT&C losses and better revenue collection efficiency to the Discoms. The T&D losses in rural areas stand above 20-25%, whereas in mini-grids, the losses will be contained within 5%, which means that the consumers will get a better quality of power at a better voltage level with more up-time for a longer duration of supply. Existing mini-grids or new mini/microgrid can cater to all the needs of its consumer without limiting the use of the consumer and with an option to increase its supply as per the demand.

Micro/mini-grids are way to provide a reliable and quality supply of power round the clock, with the additional benefit of reducing demands upon the conventional distribution network. Users connected to a micro/mini-grid can be insulated from the power outages on the conventional network; while micro/mini-grids connected to the main distribution network have the potential to support the main grid by exporting surplus power. Typically, micro/mini-grids use power from a combination of sources. They can help reduce greenhouse gas (GHG) by facilitating the use of low-carbon energy

3 https://mnre.gov.in/file-manager/UserFiles/financing-of-Solar-Rooftop.pdf

sources, such as solar and wind. Rendering their services, the state government can also reduce their burden of RPO to a certain extent. Mini-grids can also be a source of backup power in the absence of the grid supply, owing to the fact that now the government is eyeing to provide 24*7 continuous power supply. Mini-grids have the potential to change its supply as per the needs of the consumers, which will in turn help in the establishment of small shops, factories, rice mills, etc., whose additional demand can easily be met through mini/microgrids.

The main objective of this integrated approach could help ensure sustained use of electricity not just for rural households, but also for the entire rural economy including farms, schools, hospitals, and small businesses. It must lead to the enhancement of consumer satisfaction as electricity truly becomes an enabler of prosperity in rural India. Such an approach will be able to leverage advantages of a reduce AT&C losses and improved customer services. In addition, it could help achieve broader outcomes such as efficient demand-side interventions for consumptive use, strengthened focus on productive loads and efforts toward developing alternative tariff mechanisms including service-based charges and reliability charges (Table 1).

CUSTOMERS	DISCOM	STATE GOVT
• Enhanced reliability and service levels. • Increased electricity availability (as local generation is captive; the rural areas are guaranteed supply). • Accelerating community development. (While not sufficiently by itself, the availability of guaranteed, long-term, reliable electricity from a local source can spur economic growth through energy intensive value-added service industries).	• Contribute to the RPO of the Discom if the local plant uses a RE resource. • Avoid transmission charges and losses associated with centralized power sources by using local generation utilities. • Meet its service obligations. • Discom can focus its existing manpower to strengthen their service offering in urban areas.	• Meet the goals of improving availability, reliability, and quality to rural areas. • Increased generation capacity by encouraging private professional service providers to invest in distributed generation.

Table 1: Advantages of an Integrated Approach

3 https://mnre.gov.in/file-manager/UserFiles/financing-of-Solar-Rooftop.pdf

Accelerating the Sector through Enhanced Stakeholders' Participation

In order to de-risk the developers and enhance investor and stakeholders' participation, it is required to:

a. Standardise mini/microgrids using IT-enabled systems.
b. Provide payment-based incentives for consumers.
c. Provide generation-based incentives for developers.
d. Provide additional services such as mobile connections and internet along with electricity.
e. Bring in parity in the price of electricity charged by the consumer.
f. A policy safeguarding the interest of the developers (existing and new), Discoms and consumers.

Finding a solution to these challenges will not only help bring a major chunk of India out of the dark ages but also power India's future through her smart initiatives.

For further information:

1) Anand Prabhu Pathanjali, Manager-Clean Energy; anand.pathanjali@ceedindia.org; +91 9884453527
2) Ashwani Ashok, Business Analyst; ashwani@ceedindia.org; +91 7856896950
3) Abhishek Kumar Pratap, Director-Programs; abhishek@ceedindia.org; +91 9931446964

3 https://mnre.gov.in/file-manager/UserFiles/financing-of-Solar-Rooftop.pdf