



energy transition: opportunities and challenges for the Indian power sector

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At the 26th Conference of Parties (COP) held in Glasgow, India pledged that it will cut its emissions to net zero by 2070. Currently, India is the world's fourth-largest greenhouse gas (GHG) emitter after China, the United States, and the European Union. Sourcing 50% of the country's installed capacity from non-fossil fuel sources by 2030 will translate to integrating almost 500 GW of capacity from renewables.

The country has already made significant progress with installed renewable energy (RE) capacity reaching 114 GW as of 30 June 2022. This includes 41 GW of wind energy and 58 GW of solar energy. However, to get to 500 GW, India still has a long way to go. It needs to install more than 300 GW of RE capacity in the next 8 years. For this, a concerted effort from power sub-sectors (generation, transmission, and distribution) and a detailed analysis of the opportunities and challenges of each of them is required.

In this article, we touch upon transmission and distribution.

Transmission

The transmission network, which integrates and transfers power from the generating stations to the load centres, forms the backbone of the power sector. Given India's ambitious RE target, we need to examine the opportunities and challenges associated with the transmission infrastructure:

- India needs robust transmission corridors to transfer power from states in the southern and western regions, which have a significant RE potential, to states with less renewable potential.
- The intermittent nature of power from renewable sources is one of the main challenges for grid operators. Currently, they are utilising the existing conventional generators to fill the net load (total demand minus renewable generation) to supply consumers with uninterrupted electricity. But the increased intake of renewables and the decommissioning of thermal generators will make maintaining grid stability a difficult task.
- We also need to tap into offshore wind to meet RE targets. This calls for a study of the technological implications of such a move.

along with an examination of the transmission technology required to evacuate ocean energy.

- India will also need more storage space to accommodate RE. Despite the presence of a few pumped-hydro energy storage (PHES) plants, India's battery energy storage system (BESS) is still in its infancy, requiring more research and development.

- Since renewable power plants don't have rotating parts and inertia components to support the variation in grid frequency, the grid is likely to be sensitive to disturbances, increasing the chances of grid failure.
- Electric vehicles (EVs) can introduce undesirable power quality sources to the grid, affecting the transmission network as well. To manage this, the transmission network should be upgraded.
- The adoption of renewable power, improvement of the transmission infrastructure, and upgrade of the storage capacity demands a significant investment. This may increase the financial burden on power sector companies.

One Sun, One World, One Grid

At COP26, India also introduced the concept of "Green Grids Initiative - One Sun, One World, One Grid" (GGI-OSOWOG), a worldwide network of interconnected solar power grids. Some of the major opportunities and challenges associated with the project are:

- Power generated by solar power plants can be transferred globally through international networks, allowing for the most efficient use of solar energy.
- The hours of sunlight and the pattern of demand will vary globally due to time zone differences. By capitalising on this characteristic, surplus solar energy from countries with high solar radiation can be transferred to regions that have high demand.
- Exchanging surplus RE rather than curtailing will reduce the need for storage.
- By identifying the countries with strong hydro potential, the global grid will also aid in harnessing hydropower. This will help to maintain grid balance.
- The synchronisation of grids running at various frequencies, their functioning, and the

interconnection of grids across the ocean are a few of the primary issues related to OSOWOG. Maintaining grid stability is also important, as the loss of one network shouldn't have an impact on the supply on the other side.

Distribution

The power sector is at the cusp of a major transformation with the rapid evolution of disruptive technologies such as electric vehicles, storage, solar rooftop photovoltaic, smart grids, and high integration of variable RE.

However, the existing utilities are not acting as catalysts for this transformation but only focusing on day-to-day crisis management. For a smooth transition to a future-ready mechanism, we need utilities that are decarbonised, decentralised, and digitalised.

However, such a transformation poses opportunities and challenges for the distribution sector discussed in the following sections:

Decarbonised

- **EV uptake:** The Indian transport sector contributes 10% to the total national GHG emissions, with road transportation accounting for 87% of the sector's total emissions. Although EVs can help decarbonise the transport sector, the present charging infrastructure to support this decarbonisation is lagging. Innovative business models (public-private partnerships) and feeder-level studies to accommodate the additional demand from the EVs could help in mitigating this challenge.

- **RTPV penetration:** Though India had a national target of 40 GW of rooftop photovoltaic by 2022, we are way behind with just 7.1 GW installed as of 31 July 2022. To boost RTPV, the Government should consider incentives coupled with storage (behind the meter) for round-the-clock support.

- **Sustainable agriculture through RE:** Most Indian states subsidise or provide free power to the agricultural sector. With an increase in the number of consumers, the quality of power supply has also suffered. Solarisation is important for the long-term sustainability of the agricultural sector. The government of India had launched PM-KUSUM scheme for solarisation of

the agricultural feeders and stand-alone irrigation pump (IP) sets. However, its uptake is low. The distribution companies (DISCOMs) should conduct awareness campaigns for farmers, discussing the benefits of IP set Solarisation and energy-efficient IP sets.

Decentralised

- **Commercial accountability at the feeder level:** Currently, the distribution sector is struggling with high aggregate technical and commercial (AT&C) losses and a high revenue gap. Recently, the Government of India (GoI) launched the revamped distribution sector scheme (RDSS) to make the sector operationally and financially sustainable. However, until the field-level functionaries are sensitised about the impact of such schemes on the overall health of the DISCOMs, the reforms may not be able to yield the desired results. It is, therefore, necessary that operational-level officials are made accountable for the revenue that they need to earn w.r.t to the energy received by them at each feeder. The targets set should be matched every month with actuals with any deviations to be explained by the feeder manager. This would help in decentralisation of accountability from the corporate office to the field level.

- **Peer-to-peer (P2P) trading:** Peer-to-Peer trading is another way of decentralising electricity. This would help both prosumers and consumers to trade electricity at a price both agree on. This would also result in higher renewable energy deployment and grid flexibility. With the advancement in rooftop and electric vehicle technologies, it is important that the consumers are able to pay and use the electricity the way they want so that there is less dependency on the centralised grid. However, before the large-scale roll-out of such trading mechanisms, a conducive regulatory framework should be prepared.

Digitalised

- **Smart metering:** Smart metering has been touted as the best measure for reduction of losses in the distribution system and a step towards grid digitalisation. The GoI under RDSS has laid emphasis on pre-paid smart meters. A smart meter can provide reliable electricity consumption data, which can be used for plugging operational inefficiencies in the system.

However, the uptake of smart meters despite various initiatives has been rather low. High cost of implementation, lack of skilled manpower and data integration, and inter-operability issues are some of the reasons for the tepid response. Although many pilots have been initiated, a consolidated reporting of the pre- and post-impact assessment of these pilots is missing. Generating such a report will allow DISCOMs to understand specific challenges to loss reduction in an area.

- **GIS-based energy auditing:** It is often said, "You can't manage what you can't measure." One of the main causes for the inability in arresting AT&C losses is the lack of actual measure of these losses. None of the DISCOMs (barring a few private) have been able to report authentic AT&C losses. A digital system is needed for conducting energy audit with GIS-based technology. This will arrest all issues related to consumer indexing. Further, with area segregation, DISCOMs would be able to identify theft-prone areas or where billing and collection is lower. Additionally, it will help in segregating the technical and commercial losses. The uptake has been low for this measure as well. It will be good to have energy audit champions at each section office to ensure that the auditing and reporting is not hampered with. Rewards and recognitions for best performing sections can further motivate employees.

Way forward

To harness the RE potential, efficient transmission corridors must be built across the country. To balance the grid with more RE, advanced technologies should also be explored to deal with the instability caused by non-synchronous generation from RE. OSOWOG is a viable alternative for utilising solar energy globally, but has unique challenges.

The distribution sector can be the critical link for integrating RE into the grid. However, the challenges related to implementation of various reforms and increasing accountability and responsibility at the localised level of the sector should be handled carefully.

While RE integration is an opportunity at the global level, we have to come out with more customised solutions suited to the local context and environment.



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