The Challenges of Setting up an International Power Grid

The International Energy Agency published a report entitled 'Southeast Asia Energy Outlook 2022' last month. It said that the rapid economic growth in most Southeast Asian countries since 2000 is now threatening their energy security, as they struggle to keep pace with their growing energy needs.

The scene is not very different for other regions of the world.

To meet growing energy demand without also damaging the environment, we need to tap more green energy (although this energy source can also be deleterious). One such energy source is the Sun, and a part of whose energy output we harness using solar panels.

As part of efforts to reduce the global surface temperature by reducing emissions of various gases and pollutants – in keeping with the Paris and other agreements – governments around the world are installing solar plants aplenty.

However, solar radiation varies between time zones, so an interconnected global transmission system is required to effectively harness the energy generated in the different regions and be put to optimal use.

In recognition of this, India and the UK launched the "Green Grids Initiative – One Sun One World One Grid" (GGI-OSOWOG) at the COP26 climate talks in Glasgow in November last year, to move solar power worldwide. The initiative was designed to help electrify locations around the world. Member nations of the GGI-OSOWOG steering committee have universally agreed to the vision of an international power grid for the need-based transfer of solar power.

The North Sea Link – a high-voltage-direct-current submarine power cable, which connects Norway and the UK across some 700 km – is an example of an international grid connection. It is expected to help transfer wind power generated in the UK to Norway and hydropower generated in Norway to the UK, when the need arises.

Recently, India signed a Memorandum of Understanding with the Maldives to exchange power in similar fashion, through the GGI-OSOWOG.

However, building and operating global power grids come with their own challenges.

What makes it difficult?

For a country like India, which is surrounded by water on three sides and has many of the world's highest mountains on the fourth, the main challenge is to develop the grid infrastructure. Here, the sophisticated technology used to lay submarine cables can help – for sea links.

But installing a submarine cable is not a cakewalk either. Extreme weather events like tsunamis and cyclones can damage the cables and interrupt the exchange of power. So special care needs to be taken to decide on the cable's route and to protect it against disasters.

In fact, although the cables are placed beneath the seabed, they can also get damaged by fishing nets and anchoring activities. To deal with this, regular maintenance needs to be undertaken.

But the biggest challenge in setting up an international power grid anywhere relates to deciding the mode of power transmission: high-voltage alternating current (HVAC) or high voltage direct current (HVDC).

Different countries operate their power grids with different AC-current frequencies. Some have grids with 60 Hz frequency whereas some others have grids at 50 Hz. This is why HVDC current is preferred to connect grids of different frequencies. It also requires lower capital expenditure for transferring the power over longer distances.

Despite these challenges, an international solar grid remains desirable for the clear benefits it offers in terms of fulfilling global energy needs in a manner that is optimal and green.

What can be done?

Measures that help deal with the existing issues as well as prevent news ones from cropping up can be taken to enhance grid efficiency. For instance, robust transmission corridors should be planned and built to maintain system stability during unforeseen outages in the transmission network.

The power grid should be built in such a way that the outage of transmission equipment at one location does not lead to an outage in another location. For this, the network contingency criteria should be satisfied while planning the transmission infrastructure.

But natural calamities and technical issues can disrupt even the most efficient grids. The outage of any of the grid interconnectors creates a load-generation imbalance which can interrupt the power supply to the consumers. This can be overcome by setting up a distributed power generation mechanism at a national/regional level, based on the demand required to supply power for a minimum period.

This will help in reducing power interruptions during any grid outages by supplying the required energy locally. Similarly, the use of emerging technologies like battery energy storage systems and pumped-hydro energy systems can help in restoring power supply in less than the stipulated time.

Next, a core committee to analyse the technical implications and to devise policies for the global grid should be set up. Countries which are part of this global grid should abide by these policies and regulations. A proper generation and load balance analysis should also be carried out to understand the amount and direction of power exchange across the countries.

Careful planning, effective policies, and a mechanism to counter challenges and offset risks can enable the creation of a sturdy international grid through which solar energy concentrated in different pockets of the world can be shared and utilised optimally. This, in turn, would lead to a vibrant electricity market that facilitates power-trading across different countries.

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