

Feasibility of Offshore Wind Farms in India

India's energy demand is expected to grow at about 3% per annum till 2040, which necessitates the development of more clean power sources to fulfil this demand. India aims to meet 50% of the nation's energy requirement through green energy sources by installing 500 GW of non-fossil fuel-based energy sources. In this context, the Indian power sector has introduced various policies to encourage investors and developers to establish more renewable energy plants. In FY 2021–22 alone, 13.54 GW of renewable energy capacity has been installed in India, with 12.43 GW of solar and 1.11 GW of wind. In terms of onshore wind power installed capacity, India ranks fourth (41.9 GW) in the world as of February 2023, as reported by the Ministry of New and Renewable Energy. At the national level, Tamil Nadu ranks first with 9.96 GW of onshore wind capacity, followed by Gujarat with 9.91 GW and Karnataka with 5.26 GW.

However, wind installations on land, although clean, have their own limitations. Only 6% of India's wind potential is being utilised at present by onshore windfarms because of difficulties in transporting wind turbines and Right of Way (RoW) issues. In general, RoW refers to the legal right of passage through a piece of land, typically granted or reserved over a property for transportation purposes, electrical transmission lines, and gas pipelines. Along with the Indian economy relying heavily on agriculture, 55% of India's total workforce depends on agriculture and its allied sectors. With onshore wind stations occupying more land area, installation of more wind turbines on land may lead to RoW issues affecting these sectors. In addition, because of obstructions due to nearby mountains or landscaping, the wind speed over land may be less than that over oceans. Thus, offshore wind farms provide a substantial advantage over onshore ones.

At present, China leads the offshore wind market with an installed capacity of 24.9 GW, followed by the United Kingdom (13.6 GW), Germany (7.7 GW), and the Netherlands (3 GW). India is currently estimated to have a wind turbine manufacturing base with a capacity of 10 GW per annum. The capacity utilisation factor (CUF), which is the ratio of power generated by a power plant to its maximum possible output for a year, of onshore wind plants is nearly 25% in India. As per India's Wind Potential Atlas report published by the National Institute of Wind Energy (NIWE), the average CUF for offshore wind farms is estimated to be 30%–40%, and it can even reach up to 50% at some specific locations on the Thoothukudi coast of Tamil Nadu. Further, the NIWE estimates the offshore wind potential of Gujarat and Tamil Nadu to be 36 and 35 GW, respectively. Owing to these factors, the wind sector is increasing its investments in offshore wind technologies.

Globally, offshore wind energy prices are reducing because of technological improvements and evolution of new electricity markets. As per an analysis conducted by a strategic consulting for renewable energy, the average levelised cost of energy (average total cost of a project per unit of total electricity generated) generated by European offshore wind farms has reduced from 110 €/MWh in 2019 to 60 €/MWh in 2021. Moreover, based on a report published by the International Renewable Energy Agency (IRENA), the global weighted average levelised cost of electricity of offshore wind has been reduced by 60% in 2021 compared with that in 2010. This is expected to further reduce with time and advancement in technology. In this context, on 9 June 2022, the Ministry of Power (MoP) decided to invite bids for the development of offshore wind farms with an installed capacity of around 4 GW/year for a period of 3 years starting from FY 2022–23. In addition, the MoP plans to add a minimum installed capacity of 5 GW/year for 5 years starting from FY 2025–26 to achieve 37 GW of the offshore wind target. To encourage more investments in the offshore wind sector, the MoP has introduced a policy stating that the power generated from all offshore wind farms will be evacuated from offshore wind pooling stations to the onshore transmission network free of cost until FY 2029–30. The Power Grid Corporation of India Limited (PGCIL) is

responsible for evacuating the power from offshore to onshore substations at a voltage level of 220 kV.

Nevertheless, like any other type of power generation, offshore wind generation has its own challenges and limitations. Unlike onshore wind generation, the development of offshore wind farms requires coordination among multiple agencies with expertise in oceanography, environment, civil, mechanical, and electrical, among others. This will require a higher capital investment and greater gestation period. Since these wind farms are located in the ocean, turbines are constantly prone to corrosion, resulting in damage. Thus, regular maintenance is required, which increases the operating cost of the farm. Furthermore, fishing and shipping routes may be impacted by offshore wind farms. Finally, the establishment of a wind farm and the noise produced by the turbines can have adverse effects on the marine life in the area. So, an offshore wind farm should be constructed considering all such effects to minimise any impact on marine life.

The coastal states of Gujarat and Tamil Nadu have a very good offshore wind potential with a high CUF. Onshore wind knowledge and marine oil extraction experience might help India overcome the challenges in offshore wind farm installation. Moreover, offshore wind farms can operate as one of the key renewable energy sources to meet India's 2030 renewable energy target. Although there are certain challenges during the installation and operation of these wind farms, these issues can be resolved over time with technological advancements and experience. Additionally, since transporting wind farms across the land is a significant problem, positioning wind farm manufacturers close to the ocean should be promoted. In addition to the technical and financial requirements for offshore wind turbines, there are other regulatory obstacles to entering the maritime industry, including the need for numerous agency permissions. The government should further explore these barriers and provide a nationwide window or clearance.

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