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India's Participation in the Wind Energy Race: Potential and Challenges

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Abstract

In this paper we have discussed the role of wind energy as renewable energy source for sustainable development in India. What we have found that wind energy is gaining strong foothold in India for its various advantages. India's wind energy sector is led by indigenous wind power industry and has shown consistent progress. The country currently has the fourth highest installed wind energy capacity in the world with total installed capacity of 39.25 GW. Whether in the manufacturing and installation of wind turbines or in the operation and maintenance of wind farms, there are abundant employment opportunities. One of the primary hurdles confronting the wind energy sector in India revolves around land acquisition, a crucial requirement for establishing wind farms. The intermittent nature of wind energy in India, attributable to its geographical location, poses challenges for seamless integration into the power grid. Inadequate transmission infrastructure and grid connectivity issues may lead to the curtailment of wind energy, thereby impacting the economic viability of wind energy projects. India has a history of frequent policy changes and bureaucratic complexities. Despite notable improvements in recent decades, the wind energy sector in India continues to grapple with policy uncertainties. Such unpredictability acts as a deterrent for investors and developers, hindering investments in wind energy projects. Nevertheless, there is optimism that new innovations and government support can surmount these challenges, paving the way for a significant contribution from wind energy to the renewable energy sector.

Keywords: Renewable energy, wind energy, clean energy

Introduction

Wind turbines made their debut over a century ago. After the invention of the electric generator in the 1830s, engineers embarked on endeavours to utilize wind energy for electricity production. The initial instances of wind power generation occurred in the United Kingdom and the United States in 1887 and 1888¹. However, the origins of modern wind power are often attributed to Denmark, where horizontal-axis wind turbines were constructed in 1891, and a 22.8-meter wind turbine commenced operation in 1897. The contemporary wind power sector gained prominence in the 1980s.

In recent years, wind energy is the fastest growing energy sector among all available renewable energy sources. As of March 2022, the global installed wind power capacity stands at 786 GW², preventing over 1.1 billion tonnes of CO₂ emissions worldwide-equivalent to the annual carbon output of South America. China leads the world in wind energy with an installed capacity of 310 GW, followed by the United States at 138 GW. Together, China and the US contribute more than half of the total global installed wind energy

capacity. Denmark leads in wind energy consumption³, with wind power contributing nearly 43% to its total energy consumption-the highest globally. The Jiuquan Wind Power Base in China, also known as Gansu Wind Farm, holds the title of the world's largest onshore wind farm, boasting a capacity of 7,965 megawatts (MW)-five times larger than its closest competitor. General Electric has recently introduced the Haliade-X, the most powerful offshore wind turbine globally⁴. With a rotor size of 220 meters and a height of 248 meters, it is the most efficient ocean-based wind platform, achieving an impressive capacity factor of 60-64%. This formidable wind turbine has the capability to power a typical household for two full days with just one rotation of its powerful blades.

As of March 2023, India boasts an installed wind energy capacity of 42,868 MW⁵, contributing to the country's renewable energy sources (excluding large hydro) constituting 30.08% of the total installed power capacity, which stands at 125,160 MW out of 416,059 MW as of March 31, 2023. Among renewable sources, wind energy maintains a dominant

position, holding 34.06% of the total renewable energy capacity and persisting as a primary provider of clean energy.

Key Advantages of India for Wind Energy Generation

India is blessed with a coastline of about 7600 km surrounded by water on three sides and has good prospects of harnessing offshore wind energy. India has a huge potential of over 300GW onshore and 195GW offshore wind energy and also has a stated national target of achieving over 140GW by 2030. India's wind energy sector is led by indigenous wind power industry and has shown consistent progress. The country currently has the fourth highest installed wind energy capacity in the world with total installed capacity of 39.25 GW⁵ (as on 31st March 2021). This underscores the substantial untapped capacity for wind energy within the country.

The 1,600MW Jaisalmer wind park is India's biggest wind farm. Developed by Suzlon Energy, the project features a group of wind farms located in the Jaisalmer district of Rajasthan, India.

The advancement of wind energy projects in India holds the potential to generate a substantial number of jobs. Whether in the manufacturing and installation of wind turbines or in the operation and maintenance of wind farms, there are abundant employment opportunities. Communities involved in wind energy development can allocate the additional revenue to support school budgets, alleviate the tax burden on homeowners, and fund local infrastructure projects.

Challenges for Wind Energy Generation in India

One of the primary hurdles confronting the wind energy sector in India revolves around land acquisition, a crucial requirement for establishing wind farms. The process of acquiring large tracts of land is intricate and time-consuming in India, resulting in project delays and cost overruns within the realm of wind energy. The intermittent nature of wind energy in India, attributable to its geographical location, poses challenges for seamless integration into the power grid. Inadequate transmission infrastructure and grid connectivity issues may lead to the curtailment of wind energy, thereby impacting the economic viability of wind energy projects. India has a history of frequent policy changes and bureaucratic complexities. Despite notable improvements in recent decades, the wind energy sector in India continues to grapple with policy uncertainties. Such unpredictability acts as a deterrent for investors and developers, hindering investments in wind energy projects. The progress of wind energy projects in India is also hindered by technological challenges. These encompass the unavailability of suitable wind turbines and components, the necessity for specialized skills and expertise, and challenges in securing financing for the adoption of new and innovative technologies.

Conclusions

Despite the obstacles confronting the Indian wind energy sector, substantial opportunities abound. India has the potential to significantly contribute to the worldwide wind industry. To bolster its competitiveness in the global wind supply chain, India needs to prioritize key aspects such as aligning technology, achieving cost convergence, and establishing a favourable tax regime. By implementing sound policies, regulations, and incentives, India can position wind energy as a significant contributor to its renewable energy landscape, fostering energy security and aligning with sustainable development goals.

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