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Scenario of Offshore Wind Power Generation in India

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Abstract

An exponential increase has been seen in the human population in the last few years. To meet the electricity requirement production has to be increased. The dependence on fossil fuels for generation has to be minimized. The practices of fossil fuel have contributed to the environmental degradation and its resources depleted continuously, that's why the whole world is switching to an alternate or renewable energy options. The electricity sector has to develop more generation capacity to maintain this development. According to 2012 data, only a small fraction (26GW) of India's total installed electricity capacity (210GW) produced from renewable sources. Hence Indian Government wants to shift to renewable forms of energy source share 40-42% of the total energy production i.e., 166GW. The share of wind energy is 60% of the total renewable energy basket, but the contribution from the offshore wind farms is lacking, as the wind energy generated in India is mostly through onshore wind farms. Promotion of offshore wind energy will farm will lead to reduction in dependency on fossil fuels, deplete in greenhouse emission, increase in environmental conservation and increase employment in India. India is coping up with the industry. Offshore wind energy is an emergent renewable energy industry, and it will become as main source of the future energy for India. This paper deals with the present situation and drift of offshore wind industries in India.

Keywords

Wind power, offshore wind farms, Present scenario of wind industry

1. Introduction

India's power producing capacity must be increased to meet the country's rising electrical consumption. India needs to move to sustainable energy fuels because it has historically powered its generators with fossil fuels. Wind power generation can be increased by increasing the power generation of already running farms are increasing the efficiency of the windmills. These two criteria can't meet our energy demand because stable wind is available only in the offshore areas, so it is to be emphasized to develop new projects in the offshore areas [1, 2].

In order to help India's growth of offshore wind power, the government of India joined forces with an association led by the Global Wind Energy Council (GWEC) and funded by the European Union (EU) in 2013 to work on the Facilitating Offshore Wind Energy in India (FOWIND) project in India. The FOWIND project resulted in a number of comprehensive research articles, including the pre-feasibility studies, evaluations of the supply chains, port facilities and logistics and a grid infrastructure study. Off the coasts of Gujarat and Tamil Nadu, offshore wind energy development was the focus of the study. For the Government of India to take into account as it develops the framework for offshore wind projects to be bid and ultimately implemented between 2018 and 2032, the FOWIND project outlined five essential route items in 2017 [3].

India is world's 2nd most populated country with population of 140.76 crores as of 2021, i.e., 17.7% of the total world population. The energy sector has seen many changes over time due to the introduction of new technologies [4]. To meet the energy demands of such a large population, energy generation has to be extraordinarily increased. In 1897, Darjeeling was the 1st place where power development was started, and then a hydropower station was built at Sivasamudram in Karnataka around 1902. Wind energy is domestic and can be of great help in reducing the need to generate energy from fossil fuels, owing to the variable heating of the earth's surface by the sun, wind occurrence takes place.

The wind power installed capacity is presented in figure 1, the installed wind power capacity and generation in India since 2007 is presented in figure 2. The installed wind capacity by state up to 31 March 2021 is presented in figure 3. India has installed capacity in the year 2022 of 40358W of wind energy and the renewable energy sources currently accounted by 27.78% (109885MW) of overall installed power capacity of India (which is 395608MW in 2022). 60% of the overall renewable energy basket is made up of wind energy. Yet, as onshore wind farms produce the majority of India's wind energy, the contribution of offshore wind farms is minimal. No systematic study was done till 2012 to estimate the available offshore wind energy (OWE) potential off the coasts of India [5].

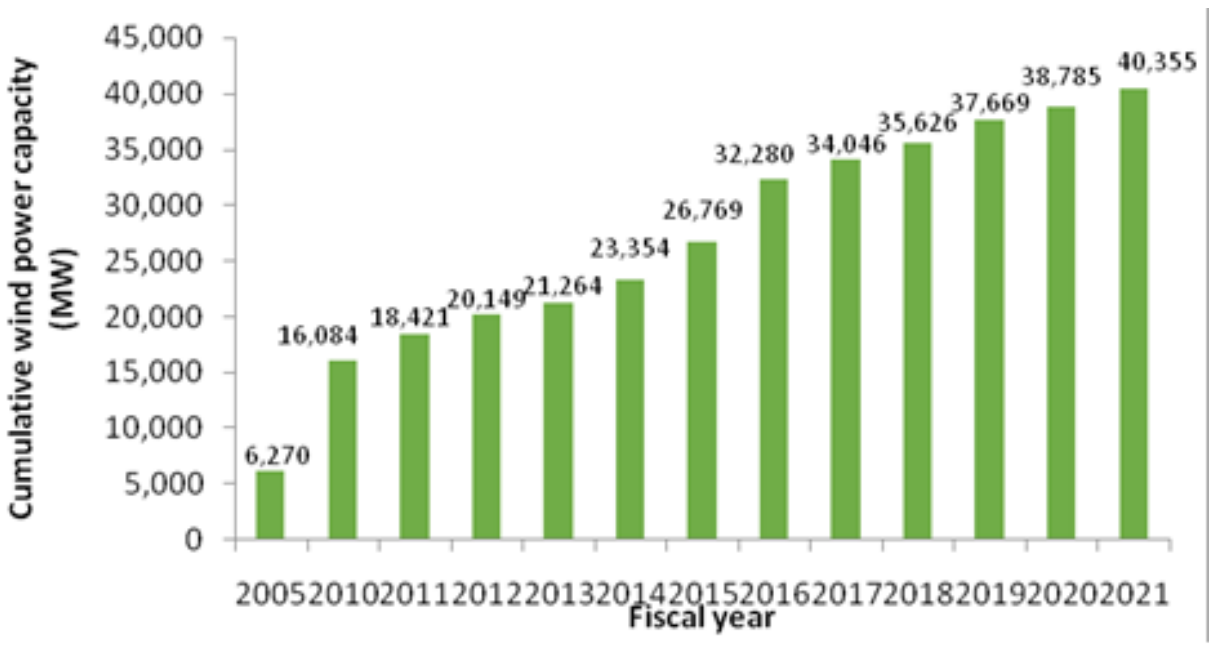


Figure 1. Installed Wind Power Capacity of India

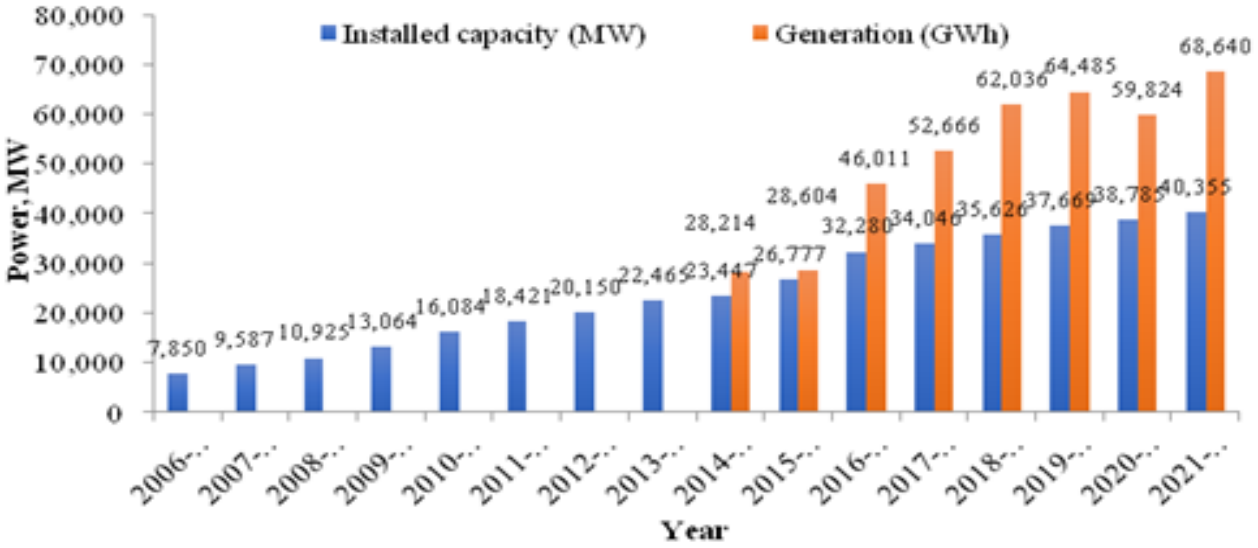


Figure 2. Installed wind power capacity and generation in India since 2007 [6]

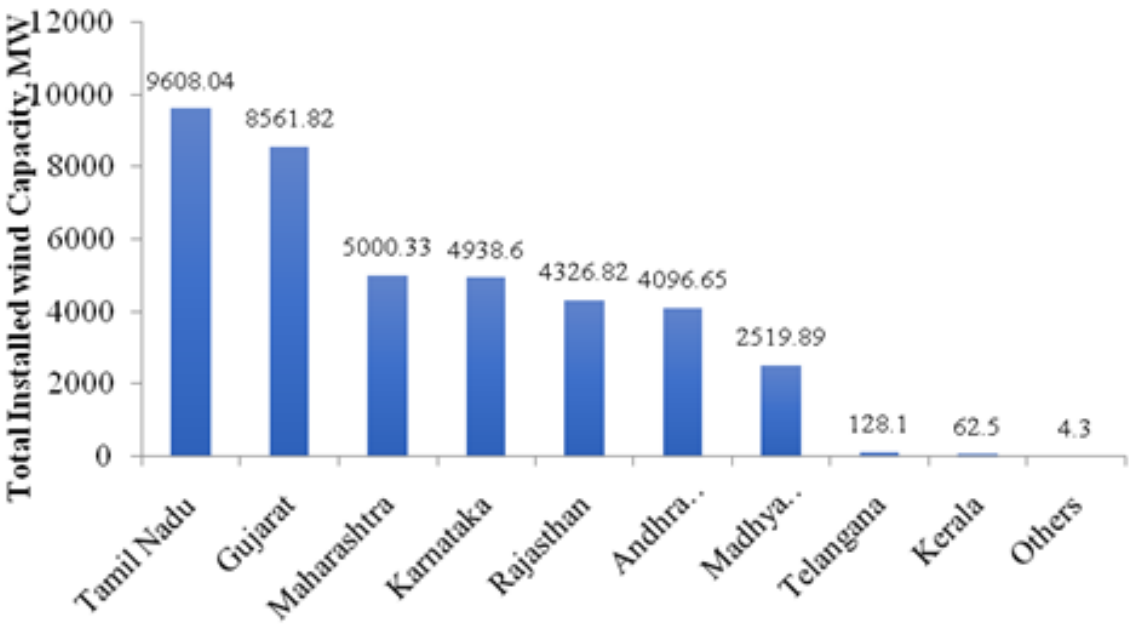


Figure 3. Installed wind capacity by state as of 31 March 2021 [7]

India has a large coastline of 75000km which have a great potential for the installation of offshore wind farms. As of 30 September 2022, the total installation wind capacity was 41.666GW, the fourth largest installed wind capacity in India power. The future Indian power economy in which renewable, wind and solar, could meet 80% of anticipated 2040[8]. The wind speed availability is more on the coastal areas of India as shown in figure 4. At any offshore wind development site, water depth is crucial for identifying an appropriate foundation technology [9].

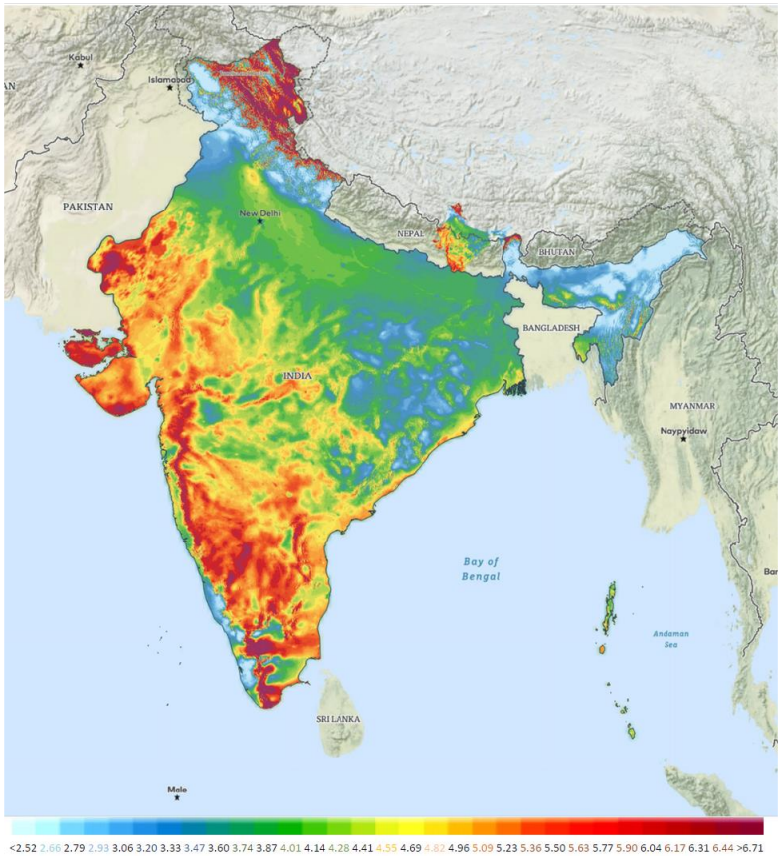


Figure 4. Wind speed (m/s) potential in India

The Indian Exclusive Economic Zone's offshore wind farm development is boosted by the Wind Energy Policy 2015 (EEZ) [9]. By 2030, India pledged to lower its intensity of greenhouse gas emissions by 35% from 2005 levels [11]. Exploration of offshore wind is becoming more practical, and several programs have been successful. The greatest installed wind power producing capacity is in Tamil Nadu, which contributes 23 percent of all installed wind capacity in India, or 37,505 MW [12], Gujrat has 142,560MW wind power potential at 120m above ground level [13], Gujrat is followed by Rajasthan with 127,155MW, Karnataka with 124,155MW, It was noted that from 2006 to 2012, Karnataka's energy consumption increased by 8% while the supply increased by just 6%, resulting in steadily growing energy deficits [14].

The ground level wind potential for Maharashtra is 98,213 MW, and for Andhra Pradesh it is 74,906 MW. Onshore wind farms have a more noticeable aesthetic influence on the landscape than some other power facilities, although they are more expensive than brand-new coal and gas plants. Offshore wind farms have a lower visual effect and produce more energy per installed capacity with fewer swings. Offshore wind power is growing even though there is now less of it and the expenses of production and maintenance are greater. The region between the southern and south-western coasts had the lowest annual average wind speed and WPD, whereas the area near the southernmost tip of India had the highest annual average wind speed and WPD [15].

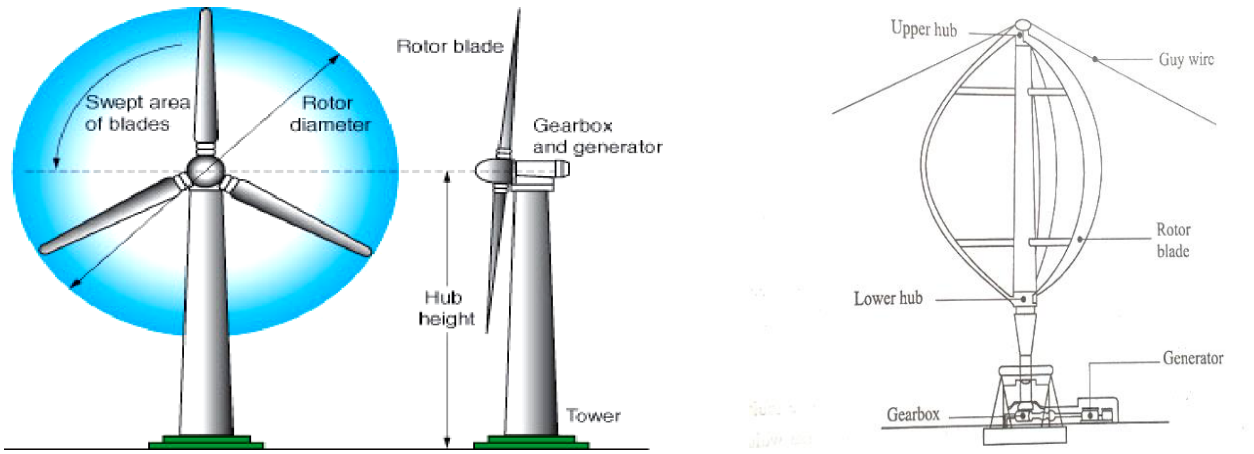
The first SAR operation in India Among other SAR missions, RISAT-1 fills the data void in coastal regions [16]. China and India are now relevant locations to investigate patterns of technology transfer that have supported the creation of multiple top wind power technology enterprises because they are the two largest emerging country wind power marketplaces in the world [17].

2. Material and Methods

2.1 Types of wind Turbines used in India

Wind turbines can be divided into two distinct types, based on the direction of the rotating axis.

- Horizontal axis wind turbines (HAWT) – It is a turbine with a rotor axis that is parallel to both the ground and the wind stream.
- Vertical axis wind turbines (VAWT) – It is a turbine in which the rotor is rotated along vertical axis.



(a) Horizontal axis wind turbines (HAWT) (b) Vertical axis wind turbines (VAWT)

Figure 5. Types of wind turbines used in India for offshore wind power generation

2.2 Benefits of offshore

The offshore wind measures higher speed as compared to onshore [18]. This is a very efficient way to produce wind energy. Near aquatic bodies, offshore wind farms are built. In comparison to on-land wind, offshore wind generates greater energy. A total of 55 offshore areas in 10 different European countries are home to over 1,662 wind turbines that produce enough electricity to power nearly 500 000 homes. Because of its economy, India does not deploy offshore wind turbines to generate much wind energy, offshore wind farms can be installed near to the major urban centers, which required shorter transmission lines to bring the wind power generated electrical energy to the high electrical energy price market [19]. Although the Indian economy is not strong enough to support the establishment of an offshore wind sector, some businesses have stepped forward to install offshore wind turbines because of the potential of this form of energy generation.

Offshore wind energy is a perpetually renewable and clean energy source that emits no damaging greenhouse gases during the process of converting wind to power. Offshore wind farms are distant from the coastline therefore cancelling the effect of noise produced due to the rotation of wind turbine blades. Due to its large coastline, there is large space for multiple installations. The government predicts that an increase in offshore wind capacity to 40 GW during the same time period will support up to 60,000 new employments. Because offshore wind generation is cost-effective, electricity costs will go down. It has no impact on the real estate value of land. Several factors, including stronger winds for effective electricity generation, make offshore wind farms appealing. In order to facilitate workflow, barriers to the effectiveness of India's wind energy policies and programs have been carefully examined [20].

2.3 Challenges in offshore installation

The installation is not easy as we reach practical installation. The primary obstacles to the effective use of offshore wind energy are its high present costs. [21]. Large wind turbines are challenging to erect on the open ocean. In comparison to onshore turbines, offshore wind turbines have significantly bigger dimensions and capacity. The plant load factor will be higher for offshore wind turbine as compared to the onshore turbines. The offshore wind farms may create disturbance in marine life [22] that's why the increase in electricity generation from offshore wind must be assess the effects on maritime birds and possible negative effects on bird populations in regions with wind farms [23]. Depending on the sea depth, an offshore wind generating project will cost 50–100% more per MW than an onshore installation. The presence of cyclones and sea breezes affects the wind resource of India's northwest. [24]. It creates No-go areas for commercial shipping. The Interaction Agency Model implies that when considering offshore wind growth generally, the sorts of policy tools, the direction of public values and norms, and the caliber of institutions are significant in both an independent and interacting manner. [25].

2.4 Present global and Indian offshore wind power scenario

Globally, the UK tops the list of offshore wind markets. The UK has the largest portfolio of offshore wind projects, with 1200 MW of offshore wind power generating electricity there, followed by Germany, Taiwan, China, which has a coastline of more than 4000 kilometers and USA [26-28]. The China has the largest existing offshore wind power capacity, but the UK has the biggest pipeline. In 2021, 7.4 MW was the average offshore wind turbine installed capacity, which was slightly less than 7.6MW in 2020 and it was also significantly higher 3.3 in 2011. In 2021, the global offshore wind energy market was valued at USD31.2 billion [30-31]. Capacity potential was firstly restricted geospatially using a GIS methodology to exclude EEZ areas, globally, that are infeasible for development [29]. In India by survey done by NIWE within the identified zones suggests 36GW of offshore wind energy potential exists off the coast of Gujrat and nearly 35GW of offshore wind energy potential exists off the Tamil Nadu coast. India's coastline of 76000km, the country has vast potential for OWE. The government of India has announced its intention of installation 5GW of offshore wind installation by 2022 and 30GW by 2030.

3. Conclusions

Offshore wing energy has started advancing in India. Policies have been set up to speed up the pace and due to the large coastline, the potential for its immense expansion. Targets are set so that the existence and potential of offshore wind energy can be tapped to the fullest. Ministry of new and renewable energy (MNRE), government of India have started the establishment procedure and installations of offshore wind farms in various states. It is also benefitted because the stable wind is available at the offshore sites. Indian coastland having large area that's why the possibility of offshore wind farms is more. Due to the installation of offshore windmills the wind power generation contribution will be 24% till 2030 in India.

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