

Present Wind Energy Market Scenario in India



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Abstract Presently, India has the 5th worldwide position for the total installed renewable power capacity. India has planned the retinue of new renewable sources of energy (NRSE) schemes under the ministry of non-conventional energy by the ninth plan. Wind power has seen consistent development in India for around three decades. Wind power is a pollution-free renewable energy source. Wind energy is available at no cost, and with new technology, it can be captured efficiently. Therefore, this paper shows the overall present scenario and progress of wind energy in India. Present government policies and goal-oriented objectives are also explained in this paper.

Keywords Environmental challenges · Non-conventional sources · Wind energy · Government policies

1 Introduction

The source that does not exhaust or can be refilled within a human lifetime is termed renewable energy. Productivity is rapidly increasing in industrial and farming areas [1–3]. It is supreme to give a cost-effective, well-managed alternative to electric power production to society. Renewable energy could be the only solution to the energy crisis in this new prosperity. It can enhance the economy of the nation. In our daily life, the role of electrical energy is increasing epidemically and can be safely managed at an individual level by society. There is no logic as to why 100% of

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our power needs could not be met by renewable energy sources. India, being a rising nation, has observed an acute growing power demand due to speedy industrialization growth and an increasing demographic framework.

The wind power age limit in India has fundamentally expanded lately. Starting on February 29, 2020, the all-out introduced wind power limit was 37.669 GW, the fourth biggest introduced wind power limit in the world [4–8]. The wind power limit is for the most part, spread over the Southern, Western, and Northern locales. Wind power alone can deal with the entire power prerequisite of India is not so distant hundreds of years. With the help of this technology advancement and offshore potential, there could be increased power generation in all areas [9–14].

Wind power has seen consistent development in India for around twenty years. As of now, wind power is one of the key sustainable power hotspots for the power age in India. Presently, wind energy has spread over the South, West, and North areas of India. The Indian government reported an aspiring objective of introducing 175 GW of environmentally friendly power (RE) by December 2022 [15]. The measure of total energy consumption is increasing, as shown in Figs. 1 and 2 [16, 19–22]. Figure 1 shows that currently, renewable energy has the second position for power generation [17, 18, 23]. So, day by day, the utilization of this technology is increasing. Figure 2 shows the quarterly development in power generation capacity with the help of different energy sources.

Therefore, this paper completely presents a short survey of the arrangements, improvement projects, and the current status of the wind market in the nation. This paper is organized as follows: Sect. 2 provides the details of various sources of renewable energy; Sect. 3 describes the Indian wind energy potential; Sect. 4 explains the challenges of wind energy; Sect. 4.3 presents the existing and future scenario. The paper concludes in Sect. 5.

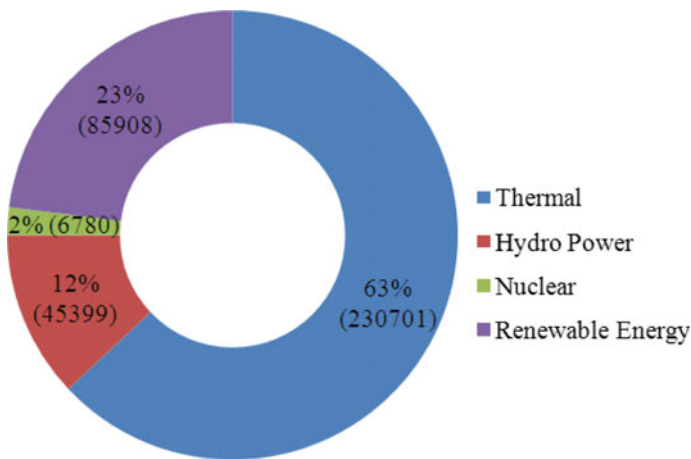


Fig. 1 Various sources-based installed power generation capacity (MW) as on 31.12.2019

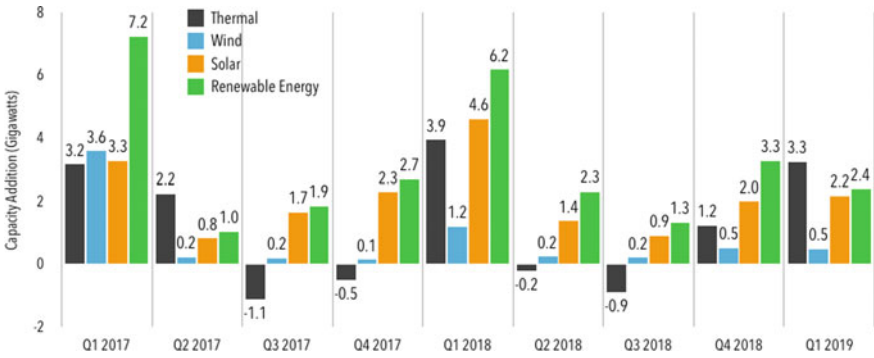
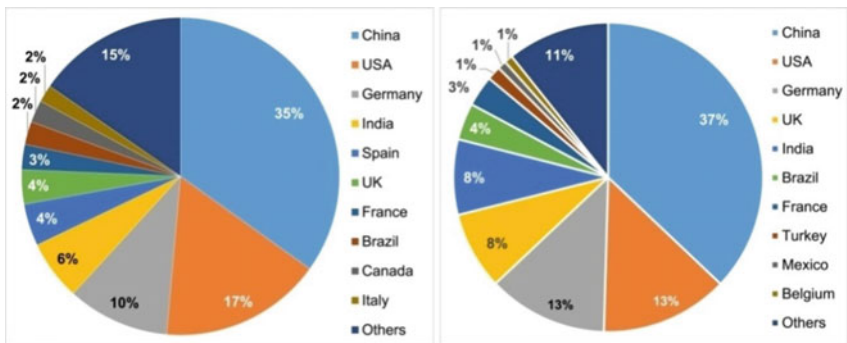


Fig. 2 Indian power installation capacity development through different sources

2 Indian Wind Energy Potential

India has expected offshore wind vitality potential to produce around 70,000 megawatts (MW) of power, the majority of that recognized in seaside Gujarat and Tamil Nadu, as indicated by the administration of new and practical force source (MNRE). “Initial examinations exhibit toward the ocean wind imperative-ness capacity of around 70 gigawatts (GW) inside the recognized zones in the banks of Gujarat and Tamil Nadu, in a manner of speaking,” India recognizes offshore wind vitality capability of 70,000 MW along with Gujarat, TN coasts [24, 25].

Wind power has seen consistent development in India for around three decades (1985–2015). The nation, as of now, positions fourth on the planet in wind power, with 37.5 gigawatts (GW) of limit introduced [26, 27]. The greater part of which was driven by motivators, for example, quickened deterioration and age-based instalments and alluring feed-in duties (FiT) as shown in Fig. 3.



(a) Wind energy capacity at till December 2017 (b) New installation in 2017

Fig. 3 Power production situation through the wind in world (As on December 2017) [28]

In 2015, India declared a goal-oriented objective of introducing 175 GW of sustainable power source (RE) by December 2022. Be that as it may, it concurred to some degree with the humble objective of 60 GW to twist as the center moved into sunlight-based force. By then, the residential breeze industry had just developed, with an introduced limit of 25 GW.

The breeze area has overwhelmed the RE limit expansion for very nearly three decades. However, its offer has been declining as of late. Wind limit expansion was created in 2016–17, with about 5.5 GW of establishments as shown in Fig. 3. Utilizing this development, an objective of accomplishing 60 GW wind establishments by 2022 required 5 GW expansions for the following seven years, which was unambitious for the development the business was seeing [29, 30].

3 Challenges in Wind Energy

Nowadays, wind energy is one of the popular growing renewable energy sources which reduces the dependency on fossil fuels and helps to combat global warming. But, several challenges are linked with harnessing this electrical power for grid application, mostly due to its unpredictable nature. The major challenges are as follows:

3.1 Location Challenge

As construction of wind power plants requires large areas, these areas should be free from building obstructions and topology obstacles (because the wind speed is influenced by these obstacles). Therefore, these plants are usually located in rural or remote areas at a sufficient height where there is adequate availability of land. In addition to this, the process of land acquisition and necessary paperwork is sometimes very lengthy, which causes delays in projects.

3.2 Power Grid Connection Challenge

The two main problems which are encountered in wind energy generation for the power grid are as follows: Firstly, the limitations of grid infrastructure in many rural areas [29, 31, 32] and secondly, the presence of weak power grid in these areas, which lead to technical issues such as voltage fluctuations, voltage sags, voltage unbalances, faults, etc., due to the variable nature of wind [33, 34]. Due to the limited grid infrastructure, the amount of electrical energy produced by windmills cannot be efficiently transmitted to the consumers, which leads to the wastage of energy.

3.3 Environmental Challenges

Although wind energy is a clean source of energy and has less effect on the environment as compared to conventional power plants, sound and visual impacts are the two main health challenges associated with wind energy. Sound or noise pollution is the most critical environmental challenge to harnessing wind energy. Because when the wind turbines operate, they produce noise that can be quite distracting to nearby people [35, 36]. Due to the noise, property values in that area also go low.

Wind energy has visual or aesthetic impacts on the landscape. It depends upon the size, shape, and layout of the wind turbine. These impacts are specific to a particular site.

3.4 Cost Challenge

The initial investment cost (approx. 80% of the total project) of wind power is significantly higher as compared to conventional energy sources because of the wind turbine construction costs, transportation costs of wind turbines to remote areas, packing and storage of all associated components are very high. Wind power plants have high production costs. Wind energy is intermittent, which leads to a lower plant capacity factor. A lower plant capacity factor means less output power, which increases the overall production cost.

3.5 Turbine Design Challenge

Proper design of the wind turbine is also an important challenge in harnessing wind energy [36, 37]. The wind turbines must be properly designed for blade loading and aerodynamic stability.

3.6 Variable Output Power

The wind is variable (intermittently) due to weather patterns and cycles of day and night. Therefore, wind power generated through wind also varies accordingly. Therefore, wind power plants cannot be used as base-load power plants.

3.7 Major Technical Issues

The integration of energy generated by windmills produces several technical issues due to the variable nature of the wind. This affects the power quality and power reliability [33]. The major parameters that affect power quality are as follows:

- (i) Voltage fluctuations
- (ii) Low power factor
- (iii) Electromagnetic interference
- (iv) Synchronizations
- (v) Power system transients and harmonics
- (vi) Reactive power etc.

4 Wind Energy Present and Future

4.1 Wind Policies

The largest state in the country, Rajasthan, has come up with a draft of a solar-wind hybrid policy that aims to achieve 2000 MW of wind power capacity. The target is set for the fulfillment of the Renewable Purchase Obligation (RPO) of State DISCOMs in respect of wind energy as determined by the RERC up to 2023–24. The National Institute of Wind Energy (NIWE) has assessed a wind power potential of 18,770 MW in Rajasthan. Figure 4 shows the wind energy-based capacity in different states [16, 17]. In this figure, Tamil Nadu has the maximum installed capability in the nation with around 9.3 GW, and its state regulations are very favorable for wind power generation. Wind power yearly generation is shown in Fig. 5. From this figure, we can say that the growth of wind power generation is continuously increasing yearly.

The state will allow the setting up of projects that were already approved before 31.03.2016 (31st March 2016) by the State Level Empowered Committee under the Wind Policy, 2012. For the sale of power to DISCOMs of Rajasthan at the weighted average tariff determined through competitive bidding from the first lot of wind power projects for the fulfillment of the Renewable Purchase Obligation (RPO) target. Rajasthan state wants to promote wind power projects with storage devices to decrease the variability of wind power outcomes on the grid and to ensure the accessibility of firm power. Therefore, 5% of the RPO targets in MW include solar/wind-solar hybrid with storage and will be in addition to the RPO target.

Quarterly wind power installations are shown in Fig. 6 [38]. For the already functioning wind energy projects, the state will promote the repair of existing wind turbines of capacity below 1 MW which have remained in operation for at least 10 years. For the wind power projects with storage systems, additional land will be allotted as per the rules of the Revenue Department, Govt. of Rajasthan. In the case of land allotment, submission of a cash security deposit of Rs. 3 lakh/MW will be required. The state will also look into private lands for setting up wind projects.

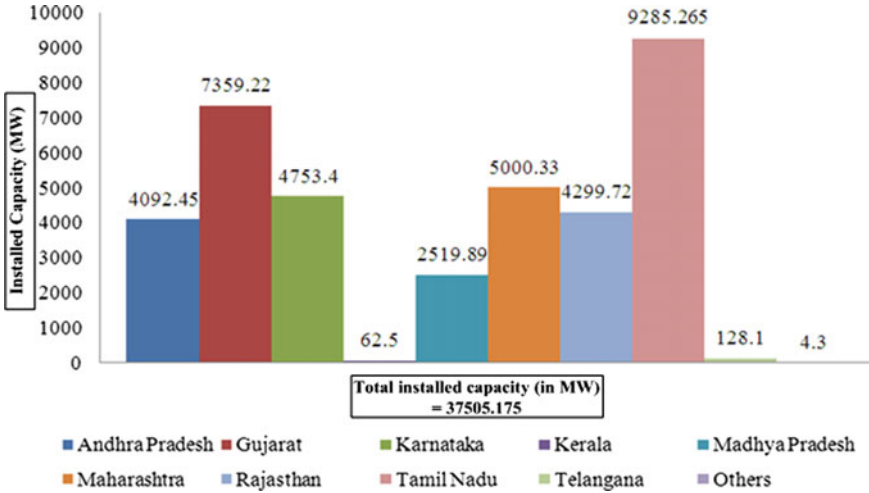


Fig. 4 Wind power-based installation capacity as of December 2019 in the different states

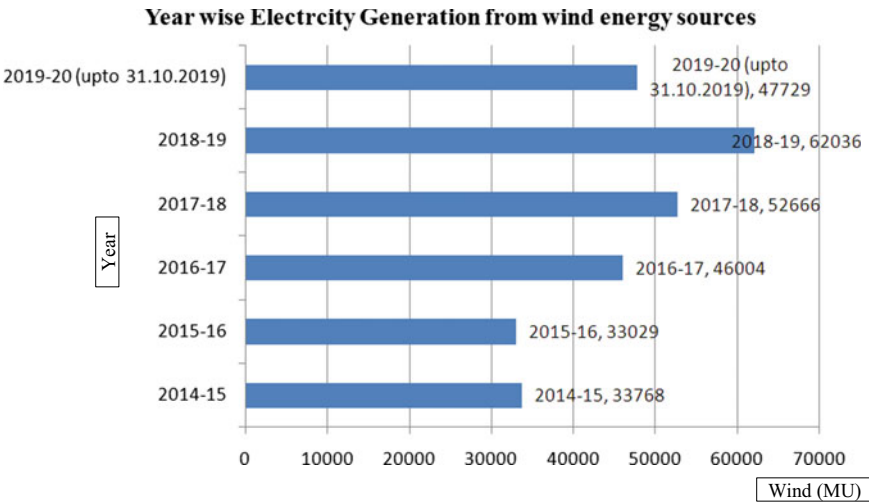


Fig. 5 Electricity generation yearly from wind power

4.2 Wind Power Vision of Government

- To promote wind power projects and required storage systems.
- Promotion of “Repowering” of wind power projects.
- Promotion of Wind Resource Assessment Program.
- To promote industries in the manufacturing of wind energy equipment.

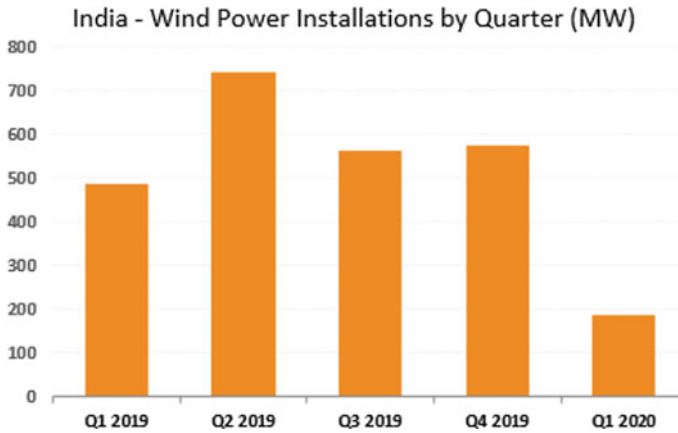


Fig. 6 Wind power installations in the previous year with quarterly

- Hybridization of wind and solar technologies to meet the challenge of grid security and stability along with optimum utilization of land resources and transmission systems [39, 40].
- The state aims to accomplish the 2 GW of wind power capability to perform a Renewable Purchase Obligation (RPO) of state DISCOMs as determined by the RERC up to 2024–25 with the land distribution for wind energy as per the provisions of Rajasthan Land Revenue Rules, 2007 [41].

4.3 Future Scope

In India, wind energy has scope for innovation, translating into real-world application, and better economic opportunity. For the economy's purposes, it is the most important source of energy. If India takes a major step to improve the generation of energy through wind energy sources, the economy will boost and create decent jobs for people and play a major role in a fast-growing economy. In 1950–1985, the electricity generation in India was very slow, but since 1990, the electricity generation in India has been very fast. The biggest advantage in the field of wind energy generation in India is that it has a large coastline which is approximately 7600 km. That is very useful for the wind generation system to get a major amount of fresh air. India is the third-largest energy consumer in the world and is the backbone of the economy. The IEA predicts that India's consumption rate of energy in 2040 will be more than double the total present consumption of energy. It is more important for India as our economy continues to evolve, and we must ensure every Indian has access to opportunity, a decent job, and a livelihood. India plans to add 60 gigawatts (GW) of wind power installed capacity by the year 2022.

The recent survey indicates that a gross wind power potential based on 302 GW at 100 m above ground level is mostly used in only seven states of the country. These are Gujarat, Rajasthan, Maharashtra, Tamil Nadu, Madhya Pradesh, Karnataka, and Andhra Pradesh. The government is promoting the wind power projects in the entire country through private sector investment by providing financial support like subsidies and many types of benefits like concessional custom duties exemption on certain components of wind electric generators.

The government through NIWE has installed over 800 wind monitoring stations all over the country. The main future scope for India is to provide a clean energy generation and energy security field of electricity or energy generation. Promote the benefits of wind energy and the big role it can play to provide a sustainable path for economic and social development in the country.

Make sure that the industry develops sustainably by protecting the interest of all stakeholders. To make, the wind energy is the primary source of energy for the people of India. In the future, the main focus of energy generation will be on renewable energy sources in India because India has some favorable geological conditions, and they play a major role in the economy of India to grow up faster with better results.

5 Conclusion

A wind turbine converts the wind's kinetic energy into mechanical energy, which is then turned into electrical energy by an induction generator in a wind power plant. Wind energy reduces carbon emissions and offers a large potential for meeting energy demands. It may also be a lucrative source of employment. However, wind energy initiatives come with a number of difficulties. As a result, in order to utilize wind energy effectively, these problems must be addressed by research and development, innovations & technological breakthroughs in wind turbines, grid infrastructure strengthening, storage method improvements, and so on. If India makes significant steps to enhance energy generation using wind energy sources, the economy would be stimulated, creating good employment for people and playing a significant part in a fast-growing economy. Renewable energy sources will be the major focus of energy generation in India in the future. Because India has some advantageous, such as geological characteristics, which have a significant influence on the Indian economy's rapid growth and improved results.

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