

# Wind Power Generation in India- A Review

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**Abstract:** India is rapidly gaining importance globally due to its growing economy and availability of natural resources. India is focusing on power generation using renewable energy resources to mitigate the problems of global warming and environmental pollution. This paper reviews the power generation using wind in the Indian context. It is estimated that India has a capacity to generate up to 100,000 MW of wind energy and presently stands fourth globally in wind power installation. The paper also gives statewide installed capacity and wind power generation in India.

**Keywords:** Renewable energy sources, Wind energy development, cumulative capacity.

## I. INTRODUCTION

Energy is a vital input in all sectors of any country's economy. It is crucial for human development index as human development is positively co-related to energy consumption. Till late 1980s, energy has been generated largely by burning coal, hydrocarbon oil and natural gas leading to huge carbon emissions. Hence, environmental crisis has become a critical concern for the world today. Emission of greenhouse gases, limited coal availability, environment distortion, rising prices of fossil fuels and pressure on foreign exchange reserves have created hindrance in the prolongation of these resources. Due to this, new energy economy is developing. This new energy economy generates energy from wind, sun and through heat within earth itself. Energy generated by burning fossil fuels damages the environment and causes climate change. However, energy based on renewable sources in general and wind energy specifically, does not affect the environment that adversely, which conventional energy sources do. Due to the geographic conditions of India, plenty of renewable energy sources such as solar, wind, biomass, hydro and tidal are available to it. India has strongly maintained fourth place in the world in installing wind energy, after China, U.S., and Germany. India is one of the fastest growing, developing nation in the world and is considered as a favorable investment destination. India has come a long way from having mere 1350 MW generation capacity at the time of independence in 1947 to 249,488 MW in 2014. Indian government had embarked on giving attention to renewable energy in 1970s. Today, various plans are operating in India for promotion of renewable energy. Numerous renewable energy equipments are commercially available in the country. An Indian wind energy program which was initiated in the second half of the 1980s has increased the installation of wind energy substantially in the last few years. Wind energy policies

issued by the Indian government are very investor friendly and offer attractive tariff and regulation that provides healthy growth to this sector. Government of India has set up a separate ministry for renewable energy called Ministry of New and Renewable Energy (MNRE) which is responsible for planning and carrying out of the policy framework for renewable energy. Recently, MNRE has introduced generation based incentive scheme to provide financial incentive for every unit of generation up to ten years. This policy of providing incentive linked to generation will attract huge investment from domestic independent power producer and foreign investor as this has created a level playing field between domestic investor and foreign investor.

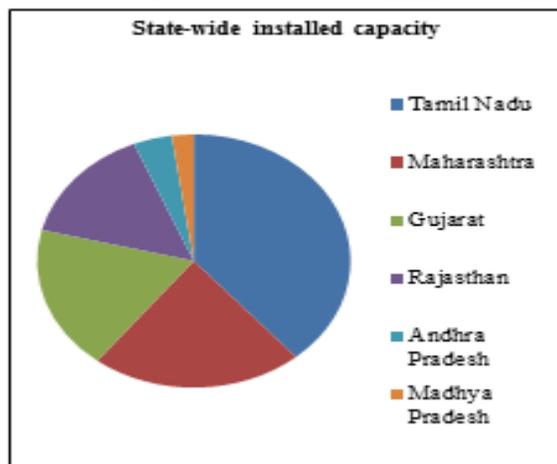


*Fig 1: Wind mill installed at Sanjeevan socio medical foundation*

## II. WIND ENERGY IN INDIA

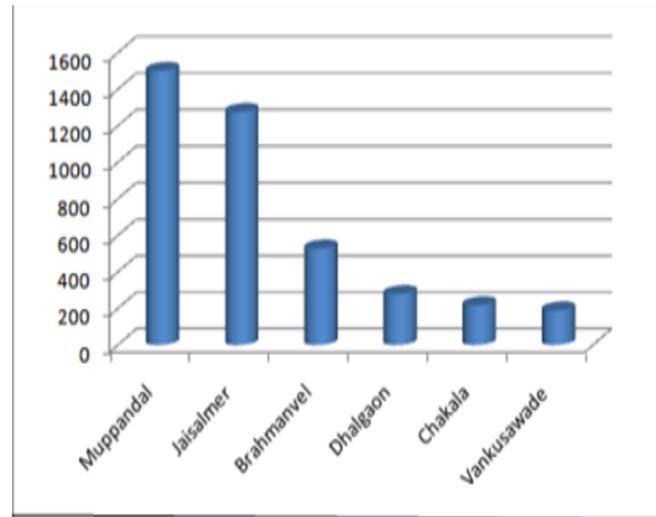
In 2012, despite a slowing global economy, India's electricity demand continued to rise. Electricity shortages are common, and over 40% of the population has no access to modern energy services. India's electricity demand is projected to more than triple between 2005 and 2030. In the National Electricity Plan (2012), the Central Electricity

Authority projected the need for 350-360 GW of total generation capacity by 2022. Historically, wind energy has met and often exceeded the targets set for it under both the 10th Plan (2002-2007) and 11th Plan (2007-2012) periods. During the 10th Plan period the target set was of 1,500 M W whereas the actual installations were 5,427 MW. Similarly during the 11th Plan period the revised target was for 9,000 MW and the actual installations were much higher at 10,260 MW. Wind power contributes a sizeable share of 3 to 4% to country electricity generation mix. The total installed capacity of wind power in India as on 31 January 2018 was 32,848.46 MW which is 9.8% of total installed capacity in India. However, for India to reach its potential and to boost the necessary investment in renewable energy it will be essential to introduce comprehensive, stable and long-term support policies, carefully designed to ensure that they operate in harmony with existing state level mechanisms so as to avoid reducing their effectiveness. As of 28 February 2017, the installed capacity of wind power in India was 29151.29 MW, mainly spread across Tamil Nadu (7,269.50 MW), Maharashtra (4,100.40 MW), Gujarat (3,454.30 MW), Rajasthan (2,784.90 MW), Karnataka (2,318.20 MW), Andhra Pradesh (746.20 MW), and Madhya Pradesh (423.40 MW).



**Fig 2: Distribution of wind energy production among states in MWs.**

There are a number of wind farms in India. We have taken in account the largest producer of wind energy from them. Their contribution is shown with help of following chart.



**Fig 3: Energy distribution of largest wind farms of India.**

### III. INDIAN CONTRIBUTION AT GLOBAL LEVEL

India is emerging as a major wind turbine-manufacturing hub today due to favourable policy framework, low manpower cost, raw material availability and vast market potential. Currently 18 existing manufacturers have a consolidated annual production capacity of over 10,000 MW. Some of the international companies with subsidiaries in India are sourcing over 80% of their components from Indian component manufacturers. Besides manufactures like Enercon, RRB, Suzlon and Leitmer Shriram, Win Wind has also set up a blade manufacturing facility in India. The Indian manufacturers have ramped up their production capacity over a period of time. Besides meeting the domestic demand, some manufacturers have also started exporting turbines. The wind turbine manufactured in India has been exported to countries like Thailand, Turkey, Estonia, Netherlands, the UK and Srilanka.

#### 3.1 Winds of change in India

- India has fourth largest wind power capacity in the world.
- Highest ever wind capacity addition of 5.5 GW in 2016-17.
- 52% increase in installed wind power capacity 21 GW in march 2014to more than 32 GW in march 2017.
- Record wind tariff of Rs. 3.46 per unit.
- 17% reduction in wind power cost by moving from fixed tariff regime to competitive bidding framework.
- National wind solar hybrid policy drafted for:
  - 1.Promotion of large grid connected wind solar pv system.
  - 2.Better grid stability.
  - 3.Optimal utilization of transmission infrastructure.

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#### IV. ADVANTAGES

The advantages of wind energy are more apparent than the disadvantages. The main advantages include an unlimited, free, renewable resource (the wind itself), economic value, maintenance cost, and placement of wind harvesting facilities. First and foremost, wind is an unlimited, free, renewable resource. Wind is a natural occurrence and harvesting the kinetic energy of wind doesn't affect currents or wind cycles in any way. Next, harvesting wind power is a clean, non-polluting way to generate electricity. Unlike other types of power plants, it emits no air pollutants or greenhouse gases. The wind turbines harmlessly generate electricity from wind passing by. Wind energy is far more ecofriendly than the burning of fossil fuels for electricity. Once turbines and energy centers have been installed, the cost of maintaining turbines and generating wind power is next to nothing. Another advantage of wind power is the ability to place turbines wherever necessary. Since wind turbines are mostly installed in rural areas, the nearby towns get electricity, and economic activities spring up including small and large businesses. Wind energy development projects bring about new short term and long term green jobs like meteorologists, structural engineers, bankers and assembly workers.

#### V. DISADVANTAGES

The two major disadvantages of wind power include initial cost and technology immaturity. Firstly, constructing turbines and wind facilities is extremely expensive. The second disadvantage is technology immaturity. High cost of energy can, in part, be addressed directly with technology innovations that increase reliability and energy output and lower system capital expenses. Offshore wind energy produces more energy than onshore wind energy, but costs much more to establish. The primary costs of wind turbines include construction and maintenance. New technology is needed to lower costs, increase reliability and energy production, solve regional deployment issues, expand the resource area, develop infrastructure and manufacturing facilities, and mitigate known environmental impacts.

**Table 1. Growth in wind power capacity in India**

Installed Wind Power Capacity	
Fiscal year	Cumulative Capacity (in MW)

2009	13,064
2010	16,084
2011	18,421
2012	20,149
2013	21,264
2014	23,354
2015	26,769
2016	32,280
2020	56,297
2030	163,473
2040	294,184

**Fig 4. Year wise growth in wind power capacity in India**

#### VI. FUTURE SCOPE:

India is a land of unlimited potential, but that potential is not getting used in effective manner. Wind energy is a great source to fulfill India's energy needs as well as develop its economy. Future and development of India depends upon many factors: one of them is being self-dependent for its energy demands. It will free India from its dependency on other countries for nuclear energy generation. Although Government's plans look ambitious now but it certainly aims to be self-reliant. Of all the major renewable sources they are primarily focusing on wind (generation and distribution). But, there are some limitations with implementation of this technology that must be considered. Wind turbines cannot be set up in many of the unused areas because it requires a huge amount of capital investment. Therefore, cost of wind turbines should be less so that they can be easily planted in more areas. Many research and development centers should be opened for the further enhancement and progress of wind power. Subject regarding to wind power technology and other renewable energy technologies must be introduced in colleges and schools which may increase its scope in future tremendously. In India, metros network can be a great source of wind power generation as it will need lighter equipment than conventional wind turbines to harness the wind generated by commute of metro trains. In some cities metro rails are already running and in several other cities

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government is planning to run it. So, lighter wind turbines can be installed at sites of the metro tracks so without much extra investment wind energy can be generated. Right now India's is headed on an increasing graph with a slower slope than before. It will have to keep the slope of this growth rate steeper if it wishes to achieve its targets in energy sector.

### VII. CONCLUSION

India's global position in wind energy can be bettered since nature has provided it with abundant resource of wind energy. Indian government has led the foundation of comprehensive renewable energy program which can meet this growing energy demand by increasing energy capacity of country. Over the period, Indian government has taken many steps to promote renewable energy in the country.

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