

Distribution and Future Prospects of Wind Energy in India

Abstract

Among the various non-conventional energy resources wind energy emerges as the most potent sources of energy for growth . The 21st century is the age of sustainable energy, a country with limited non-renewable natural resource would certainly like to develop its non conventional energy resource like wind energy. With a minimum operational cost wind power has fast emerging as the source of cheap, renewable and eco friendly way for producing electricity.

Keywords: Renewable Energy, Wind Power, Generator (WEG), Geo-Climates, (C-Wet)

Introduction

Renewable energy is indigenous and can help reducing dependency on our fossil fuels. Renewable energy augments National energy security at the time when fossil fuels threaten the long-term sustainability of the Indian economy. With abundance of wind energy resource in many parts of the country, especially along the long coastline electricity generation through wind energy provides a viable and environmental friendly option. Even among other application of renewable energy technology, power generation through wind has an edge because of its technological maturity, good infrastructure and relative cost competitiveness. The development of wind power in India began in the 1986 with first wind farm being setup in coastal areas of Ratnagiri-Maharashtra, Okha-Gujrat and Tuticorin-Tamilnadu. With 55 KW vestas wind turbine these demonstration projects were supported by the ministry of new and renewable energy (MNRE) the capacity has significantly increased in the last few years and as of 31 August 2016 the installed capacity of wind power in India was 27676.55 MW mainly spread across the South, West and North regions India by the end of the year 2015 has fourth largest installed wind capacity in the world after China, USA and Germany.

Objective of Study

The purpose of current studies is to find the ways through which we can maximize the production of wind energy in different states which is having high potential of developing wind energy due to its uneven relief features and plain surfaces and coastal location

Basic of Wind Energy

Energy available in airflow has been in use for centuries through sailing of boat, pumping of water, grinding of wheat etc. after the oil crisis during late seventies the technology to produce electricity from wind received serious attention throughout the world. In this system the wind strikes the blade, which in turn rotates an electrical generator through a transmission mechanism. The whole system is termed as Wind Electric Generator (WEG). Several geo-climate features like weather condition, plantation, topography for site etc which influence the wind speed and consequently power produced by wind is seasonal and constantly variable beside highly site specific. This variable source of wind power cannot be treated as a firm base power but can always be utilized as a spinning reserve to replace high cost energy through proper system integration and control. This variable energy cannot be stored in a battery due to prohibitive cost of battery and is therefore fed directly into the grid of the state Electricity Board which can absorb substantial fluctuation.

History of wind power in India

The first wind turbines in India had an installed capacity of only 55 KW. In the early 1990s after the announcement of wind power policy, wind turbines of capacity of 100 KW, 150 KW, and 200 KW were developed and brought to the market. Mid nineties saw the installation of large number of wind turbine of capacities in the range of 200 KW to 350 KW, with the bulk of the market share going to wind turbines of capacity 200 KW to 250 KW.



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Installed wind capacity by state as of 19 October 2016

With such	Total Capacity (MW)
Tamil Nadu	7,684.31
Maharashtra	4,664.08
Gujarat	4,227.31
Rajasthan	4,123.35
Karnataka	3,082.45
Madhya Pradesh	2,288.60
Andhra Pradesh	1,866.35
Telangana	98.70
Kerala	43.50
Others	4.30
Total	28,082.95

Source ; Wind Atlas of India 2015 -16

Higher capacity machines entered the market in late nineties. Today wind turbine of capacities of 255 KW to 2000 KW are readily available in the Indian Market. The wind power conversion route also has been upgraded from the fixed speed asynchronous induction generators to viable speed asynchronous machines which are more suited to Indian wind regimes and site condition. Currently, India has an installed capacity of 280028 MW on year 2016, making it one of the highest wind power

produces in the world along with Germany, USA, Denmark and Spain.

State wise Wind power Generation

With the above mention table we find that area wise big state like Uttar Pradesh, Bihar, Orissa and Jammu and Kashmir are having negligible contribution in the field of wind power production .As these states occupies a large portion of our country, suitable location for developing wind power and high energy demand the development of wind farms with high capacity is inevitable . In states of Jammu and Kashmir the regions like Ladakh and Aksai chin has the huge potential of generating Wind Energy due to its flat plain and elevated surface.

Wind energy deficient state and their potential in India

In India the development of wind energy is highly uneven and only three states,Tamilnadu, Maharashtra and Gujarat holds 60% of total wind energy production of India. Though states like Uttar Pradesh, Orissa ,Jammu and Kashmir and Bihar have huge wind power potential yet they all combine produce only 1% of total . As wind is caused due to un even heating of the atmosphere by the Sun, irregular surface area near major river basin , and long coast line. Almost all the states of India are having these attributes one or more. In Uttar Pradesh huge river basin of Ganga –Yamuna and Sharda- Yamuna in Uttar Pradesh out of which wind energy is just 1% as in table no 2.

Installed generation capacity by sector in March 2013 in MW Table 2

	Thermal		Total Thermal	Nuclear	Hydro	Renewable Energy	Grand Total
	Coal	Gas					
State	4923	0	4923	0	524	25	5472
Private	3090	0	3090	0	0	799	3889
Central	2749	550	3300	336	1297	0	4933
Total	10763	550	11313	336	1821	824	14294

Source – renewable energy report Govt of india 2015- 2016

The total renewable energy percentage is only 5% while in Jammu Kashmir uneven surface and flat surface in Orissa the relief features are the main factors which helps in wind energy production. In Uttar Pradesh several district like Sitapur, Bundelkhand, Pilibhit, Mirzapur, Sahajanpur, Sonbhadra, Lakhimpur have huge potential of wind power. According to an estimate Uttar Pradesh alone has the potential of 1400 Mw while Jammu and Kashmir, Orissa, Bihar, respectively have 11000Mw, 2100Mw and 144Mw

wind power potential. As mention in table no 3 . besides this other states like Tamil Nadu Karnataka, Andhra Pradesh and Gujarat are producing far less than their estimated potential by comparing table 1 and 3.

Estimation of installed Wind Power Potential at 50 meter and 80 Meter hub-height.
Table3

States / UTs	Estimated potential (MW)	
	@ 50 m (\$)	@ 80 m (* # \$)
Andaman & Nicobar	2	365
Andhra Pradesh	5394	14497
Arunachal Pradesh *	201	236
Assam*	53	112
Bihar	-	144
Chhattisgarh *	23	314
Dieu Damn	-	4
Gujarat	10609	35071
Haryana	-	93
Himachal Pradesh *	20	64
Jharkhand	-	91
Jammu & Kashmir *	5311	5685
Karnataka	8591	13593
Kerala	790	837
Lakshadweep	16	16
Madhya Pradesh	920	2931
Maharashtra	5439	5961
Manipur*	7	56
Meghalaya *	44	82
Nagaland *	3	16
Orissa	910	1384
Pondicherry	-	12
Rajasthan	5005	5050
Sikkim *	98	98
Tamil Nadu	5374	14152
Uttarakhand *	161	534
Uttar Pradesh *	137	1260
West Bengal*	22	22
Total	49,130	1,02,788

Source - Indian Wind Atlas 2016

Environmental Benefits

Wind power projects also result in substantial socio-economic and environmental benefits. The estimated environmental benefits of installing wind farms would be reduction of the following emission annually:

CO₂-2100 metric tons /MW

SO₂-2.5 metric tons /MW

NO₂X-1.7 ,metric tons/MW

Total Suspended particulate -0.5 metric tons /MW

Employment Generation

Moreover, introduction of grid connected wind power projects results in direct and indirect generation of employment. It has been estimated that for each MW of installed capacity of wind farms there is an employment potential of 3 skilled operators and 2 unskilled persons. The indirect employment opportunities are about 4 times of direct employment i.e. 20 manpower. During the construction phase lasting about 6 months additional employment is available to 50 local people for civil and electrical works.

Manufacturing Companies

So far as domestic industry is concerned there are 12 major companies that are manufacturing wind turbines and components. These companies are either joint venture or licensee of reputed international companies, a majority of them from the European Union. For testing and certification, Center for wind energy technology (C-Wet) has been established which is also the focal point for wind related research and development activities.

Government's Renewable Energy Policy

The government keep on increasing the share of renewable energy in country's installed power generation capacity by an additional to percent or 12000 MW by the major application areas are :

1. Minimum rural energy needs
2. Decentralized energy supply for agriculture, Industry, Commercial and house hold sector in rural and urban areas.
3. Grid quality power generation and supply

In formulating the goals and the strategies for these applications major objectives are to enhance the diversity and security of energy supplies through the optimum utilisation of indigenous resources promote private-sector participation and competitiveness enhance the substitution of fossil fuels and augmentation of energy supply support local and global environmental protection, facilitate enhanced local participation, specially of women and NGOs' particularly in rural areas.

Merits of Wind Power

1. Through variable in nature, wind is perennial source of sustainable energy
2. With zero fuel cost wind energy is cheap
3. Wind energy is not subjects to price variation due to increase in cost of input fuel.
4. Production of wind energy is totally pollution free.
5. Large scale production of wind energy conserves the limited stock of fossil fuel
6. Wind power arrests the ever increasing cost of electricity in long term perspective.

Wind Power potential

India's Wind power potential was initially assessed at round 20000 MW. assuming 3 percent of land availability for wind power generation in potential areas. the technical potential is estimated at about 13000 MW. assuming 20 percent grid penetration which will go up with the augmentation of grid capacity in the potential states. Identifying the huge potential of wind power in the country and its major role in meeting the power demands the ministry formulated a National Wind Power Policy with the following objectives:

1. Developing / including state of the art wind technologies in the country
2. Encouraging private entrepreneurs to develop commercial projects with the ultimate aim of complete commercialization of wind power in a phased manner.

Selling Wind Power

Wind energy produced at any identified windy site in the state and fed to the state electricity Board's grid can be either sold to electricity board or may be utilized against captive consumption and third party sale on payment of wheeling charges. With established of state electricity regulatory commission (SERC) the rates as well as terms and conditions of generation and sale of wind energy is determined by the commission and is no longer subject to frequent change at state Govt./ Electricity board level act 2003. Maharashtra Electricity Regulatory Commission (MERC) is the first to declare a long-term tariff policy with clear-cut terms and conditions for sale/utilization of wind energy. As per electricity Regulatory commission shall determined a minimum percentage of renewable energy which must be purchased by the state

Findings

In the current study we find that India has the great potential to develop wind energy due to its uneven topography and vast plain surface. We also observe that there is huge opportunity of developing wind power in state likes Madhya Pradesh, Orissa, Andhra Pradesh, Rajasthan, and Gujrat due to its varied relief features.

Conclusion

The wind energy sector has grown significantly in India despite ups and downs. Today after having surmounted many a problem, wind in India is known to be a very mature industry. Presently, the focus is on higher capacity machines and low wind regime turbines, Higher tower height and wider swept areas have resulted from the experienced gained by India in the last two decades. equally important has been the ability of wind power producers in dealing with grid problems in the country.

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