

## **Future Scope of Wind Energy in India**

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**Abstract:** *The paper first deals with the current scenario of the wind energy in India. Wind energy is available without any cost and it does not emit any greenhouse gases. This makes it a great source of energy production for any developing state. The field of wind energy has tremendous scope for innovation, translating to real world applications and tremendous economic opportunity. It is crucially important for India, as our economy continues to evolve, and we must ensure every Indian has access to opportunity, decent jobs and livelihood. For that we will need greater resources. Clean, sustainable, renewable - and equally important, domestic sources of energy are essential to fulfill the potential of India in the coming years and it is certain that wind energy will play a major part in shaping India's future. Wind power has emerged as the biggest source of renewable energy in the world.*

**Keywords:** *Wind Energy, Non Conventional Energy, Sources of Wind Energy, Renewable Resources*

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### **I. Introduction**

India is the home of 1.25 billion people i.e. 17.5% of the total world population, which makes it second most populous country in world. India has the second fastest growing economy of the world. India's substantial and sustained economic growth over the years is placing enormous demand on its energy resources. The electricity sector in India had an installed capacity of 253.389 GW as of August 2014 [1]. India became the world's third largest producer of electricity in the year 2013 with 4.8% global share in electricity generation surpassing Japan and Russia. Power development in India was first started in 1897 in Darjeeling, followed by commissioning of a hydropower station at Sivasamudram in Karnataka during 1902. Thermal power stations which generate electricity more than 1000 MW are referred as Super Thermal Power Stations. India's electricity generation capacity additions from 1950 to 1985 were very low when compared to developed nations. Since 1990, India has been one of the fastest growing markets for new electricity generation capacity [2]. India's electricity generation capacity has increased from 179 TW-h in 1985 to 1053 TW-h in 2012. Wind energy is indigenous and helps in reducing the dependency on fossil fuels. Wind occurrence is due to the differential heating of the earth's crust by the sun.

Approximately 10 million MW of wind energy is continuously available to India. India's Power Finance Corporation Limited projects that current and approved electricity capacity addition projects in India are expected to add about 100 GW of installed capacity between 2012 and 2017. This growth makes India one of the fastest growing markets for electricity infrastructure equipment. Of the 1.4 billion people of the world who have no access to electricity in the world, India accounts for over 300 million. The International Energy Agency estimates India will add between 600 GW to 1,200 GW of additional new power generation capacity before 2050 [3]. To fill the needs of the energy of this population, India have to look towards non conventional energy resource which can fill a huge demand of energy generated by the population of India. India is fulfilling its 85% of energy demand from the conventional recourses such as coal, nuclear energy, natural gas and petroleum which generate many greenhouse gases. Green houses gases- carbon dioxide (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O) etc. are produced in the energy generation process are not only harmful for people's health but it also deteriorates the environment vis-à-vis global warming and hole in the ozone layer. Thus it is the need of time that country should look towards the green & renewable methods for the generation of energy so that environment can be saved from those harmful effects. Wind energy, solar energy, biomass & other renewable methods can be used for the generation of energy to fulfill the energy demands of the country. Present paper has divided into three parts; Sources of the wind energy in India, future scope of the wind energy in India & Conclusion.

### **II. Sources of Wind Energy in India**

India has a vast coastal line which is a good resource of the fresh wind. Beside these there are other ways to generate the wind which need to get attention now. Highway wind turbine is the option for production of energy in India.

The development of wind power in India began in the 1990s, and has significantly increased in the last few years. Although a relative newcomer to the wind industry compared with Denmark or the US, domestic policy support for wind power has led India to become the country with the fifth largest installed wind power capacity in the world.

As of December 2013 the installed capacity of wind power in India was 20149.50 MW [4], mainly spread across Tamil Nadu, Maharashtra, Gujarat, Karnataka, Rajasthan, Madhya Pradesh, Andhra Pradesh, Kerala, West Bengal, other states [5]. Their share of distribution is shown with the help of this chart.

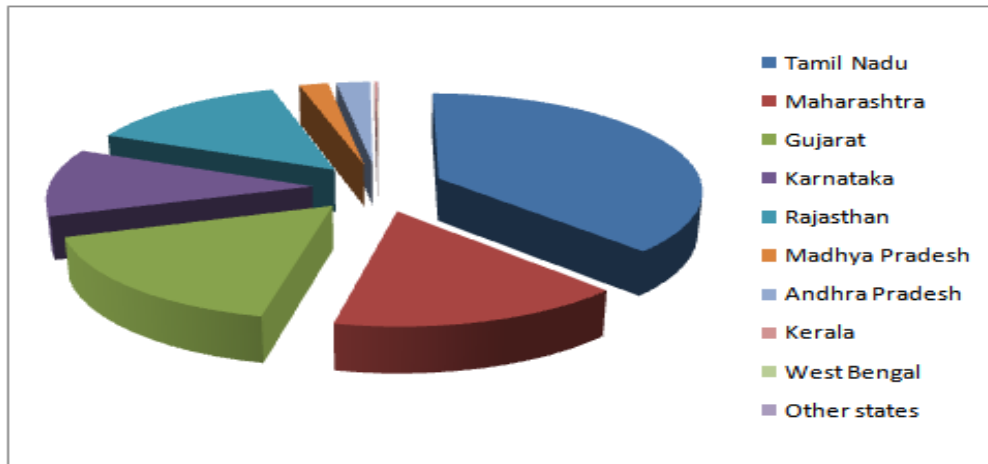


Fig.1. Distribution of wind energy production among states in MWs.

There are a number of wind farms in India. We have taken in account the largest producers of wind energy from them. Their contribution is shown with the help of following chart [6].

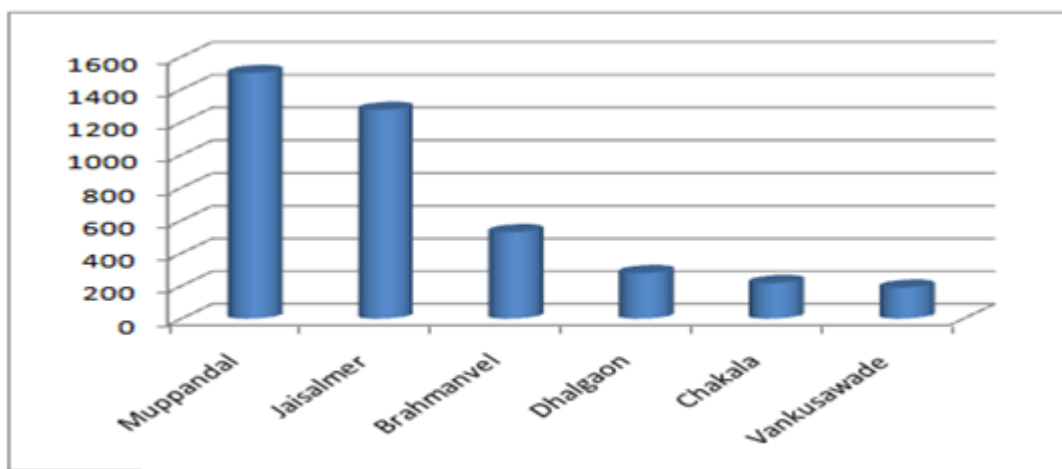


Fig.2. Energy distribution of largest wind farms of India.

#### A. By Offshore Wind Turbines

This is a very effective method of generation of wind energy. Offshore wind turbines are constructed near the water-bodies. Energy which is generated by offshore wind is more as compared to on land. Almost 1,662 turbines are situated at 55 offshore locations across 10 European countries for generating electricity and that energy is enough for almost 500000 households [7]. Generation of wind energy by offshore wind turbines are not much used in India because of the Indian economy. Indian economy is not very strong to setup an offshore wind turbines industry but, due to scope of this type of generation of energy some companies came forward to set up the offshore wind turbines. In India, Gujarat is the first place which is planning to set up the offshore wind power project which is initiated by Suzlon Energy limited, it is world's fifth largest wind turbine supplier.

The construction of wind turbine is followed by aerodynamic modeling; it concentrates the power of wind and harvest it using rotor blades. Kinetic energy is generated by rotor blades and this energy is transferred via rotor shaft to the generator. For maximum utilization of this energy wind blades can be rotated and adjusted to the wind direction and strength. Then the power is transferred through drive shaft and gearbox, and then the

kinetic energy is converted into electrical energy by generator. Now, the electricity is sent to the substation where that energy is converted and carried away for the grid. Speed of wind must be at least 10 feet per second for a typical large wind turbine power generator (2.3 MW). When the speed of wind is 34-47 knots (gale) then the maximum effect is achieved, at 48-63 knots (storm) the turbine is turned off to avoid damage to machine parts.

Wind turbines are usually collected in parks that vary in size. Wind farms in the US generate 41400 MW in electricity. Power is transferred from the turbines to a central transformer via cables that are buried in the road network in the wind farm. From there the flow goes on the regional power grid. The wind energy potential is about 3600 TW (equivalent of about two hundred times of the worldwide energy consumption). We have just begun tapping into this source. In India, there is a small land holding, farms are also small. Approximately there are 100 million small farmers in India. Some small industries consume less than 10KW power. So, small wind turbines can be place in every farm and small factory wherever there is ample resource of wind available. Hence, millions of people can use this wind energy for their own use. If small wind turbines are promoted in India, every farmer can supply excess power to the grid and thus power shortage can be avoided. It is not impossible that such excess power will go to the cities and big thermal power stations will be no more required [8].

### B. Highway Windmill

Vehicles moving in a highway suffer a lot to drive the vehicle during night time due to lighting problem. It is not possible task to lay electric cables underground and provide lighting throughout the length of the roads. In this paper, the drawback can be overcome by make use of VAWT (Vertical Axis Wind Turbine) [9]. The VAWT is coupled with disc type alternator placed on the highway road dividers. As the wind is forced by passing vehicles from both sides, the wind speed on the centre place of highway roads will be more than at the pedestrian walking lane. This wind is forced to the VAWT from two directions heavily but this VAWT makes use of both the wind directions and rotates in one direction only. If the speed of the turbine increases results in increasing the speed of the alternator and the corresponding increased power is obtained at the output terminal. This power can be stored in battery bank which is placed under the windmill and utilized at night time for lighting purpose on the highway.

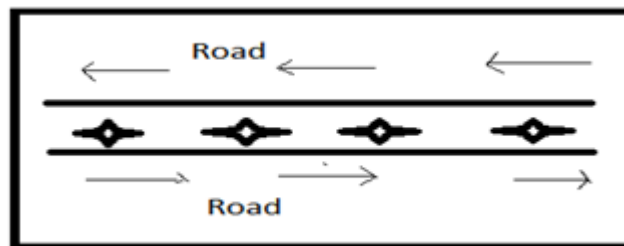


Fig.3. Model for highway windmill.

We suggest a model which could be used on highways which experience heavy traffic. Similarly, in the next diagram the wind turbines are situated between the middle of the railway tracks. This is a model we suggest which could be used especially in the case metro-railways as they have very high frequency of commute. The air which is emitted due to the high speed of trains which otherwise goes wasted could be used for this purpose.

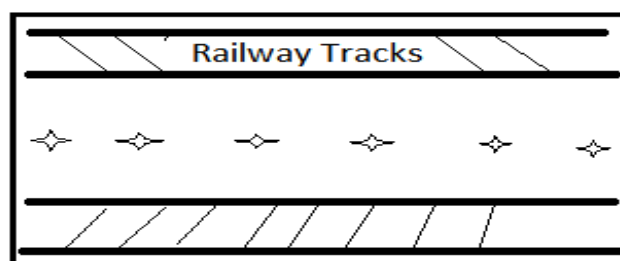


Fig.4. Model for railway windmill.

### III. Future of wind energy Sector in India

Presently, India has an installed power generation capacity of a little over 207.8 GW, of which renewable resources account for about 25 GW, and wind makes up a majority of this installed capacity. In 2011 the state-run Centre for Wind Energy Technology reassessed India's wind power potential as 102,778 MW at 80

meters height at 2% land availability, up from the earlier estimate of approximate 49,130 MW at 50 meters, also at 2% land availability. If the estimated potential of 102 GW were fully developed, wind would provide only about 8 percent of the projected electricity demand in 2022 and 5 percent in 2032 [10]. The MNRE (Ministry of New & Renewable Energy) had decided a target of 10500 MW between 2007 & 2012 [11]. According to 12th Plan period (2012-17) capacity over 88,000 MW of power generation is adding which is already set by The Planning Commission. Previous plan i.e. the 11th Plan aimed at 78,577 MW of capacity in addition, but it achieved only 52000 MW. Adding a grid interactive renewable capacity of about 30000 MW is also planned. It comprises 15000 MW from wind, 10000 MW from solar, 2100 from small hydro and the balance primarily from bio mass is planned [12].

Indian wind industry has however slowed in growth. Forty per cent dip in installation is recorded by the industries only its first half of the year. The growth of the industry is affected by the policies, it remains to be seen what steps are taken to restore balance. The India Wind Energy Outlook 2012 in its report estimated that the generation of wind energy could more than quadruple to 89 GW by 2020; it would also attract foreign investments of about US\$ 16.5 billion [13].

As per Section 80(J) of Income Tax Act 1961, industries were allowed 80% depreciation on capital invested. Since then till 2012 (when the benefit was removed), Wind Power development and growth has always relied primarily on Accelerated Depreciation (AD). Reinstatement of accelerated Depreciation benefits Wind Energy industry, from last few months, when Union Budget was presented; a point regarding the reinstatement of Accelerated Depreciation (AD) for wind energy generators was made. The new government has announced that it was reintroducing AD (80%) in 2014, much to the delight of Wind Power stakeholders. We believe that the investment momentum will shift again to wind due to more mature policies and attractive tariffs. Wind tariff in recent years have become very attractive and are close to solar tariff in many states. In Rajasthan, Maharashtra and MP, tariff in the range of Rs. 5, whereas solar tariffs are generally in the range of Rs. 6, leaving a very small gap. With this, there will certainly be a diversion in investments from Solar to Wind power in the times to come.

GBI (Generation Based Incentive) scheme has been extended by the government for wind power projects for the 12th five-year plan period. Main objective of this scheme is to broaden the investor base, inspire actual wind power generation, and to make more convenient entry of large independent power producers and attract the investors of foreign to the wind power industry. According to GBI Scheme, wind electricity is provided to the producers at the rate of 50 paise per unit on the basis of incentives. The Total expense in a year will not exceed one fourth of the maximum limit of incentives which is INR 25 Lakh per MW during its first four year. By this scheme, total target is 15000 MW [14].

If we want to increase the power & energy by wind then we need to replace the old turbines with new modern turbines. This replacement of wind turbines is called Repowering. In this small capacity wind turbines have to be replaced by high capacity wind turbines. Due to this installed capacity electricity output is increased. Repowering is also an economically viable solution. Also we can look for hybrid solutions- two renewable energy sources complementing each other. It must be considered for places rich in more than one kind of source [15].

Now, wind energy market is going through a new revolution, policies and capital has pushed investments in this sector in India. Investments are increasing towards Independent Power Producers (IPP) when compared with manufacturing projects. Wind energy potential of India is about 80000 MW and approximately 15000 MW of energy is already installed on the ground. Hence, there is no proof of single large IPP in the business. IPPs were favored as conventional energy sources were becoming expensive and when wind is at par with coal, there emerged enough opportunities to tap this potential [16].

Many challenges come in the way of wind power generation and a number of problems are faced. Due to these problems future of wind energy has only been deteriorating. If these challenges will be completely removed then India will set a new record of generating power & energy by wind, and the market of wind power generation will see an unprecedented growth. Wind power must strive to gain with conventional generation sources on a basis of cost. Depending upon the wind site that how energetic it is, wind farms may or may not be cost competitive. In the past 10 years the cost for setting wind power plant has decreased dramatically. Although the initial investment cost is higher, it requires more technology than fossils-fueled generators. Good wind sites are often in remote locations, far from cities where electricity is needed. Electricity is brought from the wind power plants to the city by transmission lines. So, its distribution should also be dealt with proper mechanisms to unleash its maximum potential.

Wind resource development may not be the most profitable use of the land. Land which is suitable for wind turbine installation must exceed with alternative use for the land, and that will be more highly valued than electricity generation. Although the turbines may cause noise and aesthetic pollution- when conventional power plants are compared with environment friendliness then there is a little adverse impact done by wind power plant. The concern over the noise produced by the rotor blades, aesthetic visual can be tolerated in comparison

to the ill effects of greenhouse gases. Another concern is that the turbines may be damaged by local wildlife. Sometimes birds are killed by rotors. Most of these problems have been resolved or greatly reduced through technological development or by properly establishing wind plants [17].

#### IV. Conclusion

India is a land of unlimited potential, but that potential is not getting used in an 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 the future tremendously. In India, metro 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 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.

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