

Review of Wind Energy Market

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ABSTRACT

In India, the wind power generation has gained a high level of attention and acceptability compared to other renewable energy technologies. New technological developments in wind power design have contributed for the significant advances in wind energy penetration and to get optimum power from available wind. This paper discusses potential of wind energy in India, status of wind power industry, wind energy programs including Indian wind energy policy and state-wise wind power of India.

Keywords: Wind Energy, India, Current Situation

I. INTRODUCTION

In the old economy, energy was produced by burning hydrocarbons-oil, coal, or natural gas-leading to the carbon emissions that have come to define our economy. The world today is facing a major environmental crisis. Global warming, erratic weather patterns, rising fossil fuel prices, oil insecurity and concerns about climate change have cast a shadow over the future of coal, oil and other conventional sources of energy. As a result, a new energy economy is emerging. This new economy harnesses the energy in wind, the energy coming from the sun, and heat from within the earth itself. Fossil fuel energies exhaust natural resources and are mostly responsible for adverse environmental impacts leading to climate change.

II. STATUS OF WIND ENERGY

Wind power has now established itself as a mainstream electricity generation source and plays a central role in an increasing number of countries. More than 54GW of clean renewable wind power was installed across the global market in 2016, which now comprises more than 90 countries, including 9 with more than 10,000MW installed, and 29 which have

now passed the 1,000MW mark. Cumulative capacity grew by 12.6% to reach a total of 486.8GW.

The wind capacity worldwide reached 486790 MW, after 432,680 MW in 2015, 369,862 MW in 2014, 318697 MW in 2013, 282,850 MW in 2012, and 238,110 MW in 2011 as shown in Fig.1 since 2001 to 2016[14]. The total installed wind energy capacity up to 486,790 MW. China (168,732 MW), U.S.A (82,184 MW), Germany (50,018 MW), and India (28,700 MW) which is at the fourth position. Table.1 shows the cumulative capacity of the top 10 countries. Since 2010 more than half of all new wind power was added outside of the traditional markets of Europe and North America, mainly driven by continuing boom in China and India. In 2015, China installed close to half of the world's added wind power capacity.

1.5xle wind turbine of General Electric Company is selected for the design and Analysis. GE's 1.5 MW wind turbine is the most widely used turbine in its class. This wind turbine was selected because Geometry Specification was readily available (Courtesy of GE Energy). 1.5xle was selected because higher capacity turbine would prove to be computationally expensive.

III. WIND ENERGY POTENTIAL IN INDIA

The Centre for Wind Energy Technology (C-WET) first estimated the onshore wind energy potential in India at around 45 GW and was recently increased to 49.10 GW at 50-m height and 102.8 GW at 80-m height [15]. The estimated wind potential in each state of India is shown in Table.2. The assessment shows that India’s total wind potential is 48,561 MW, with Karnataka, Gujarat, and Andhra Pradesh as the leading states up to 31st August 2011. At heights of 55–65 m, the Indian Wind Turbine Manufacturers Association (IWTMA) estimates that the potential for wind development in India is around 65–70 GW.

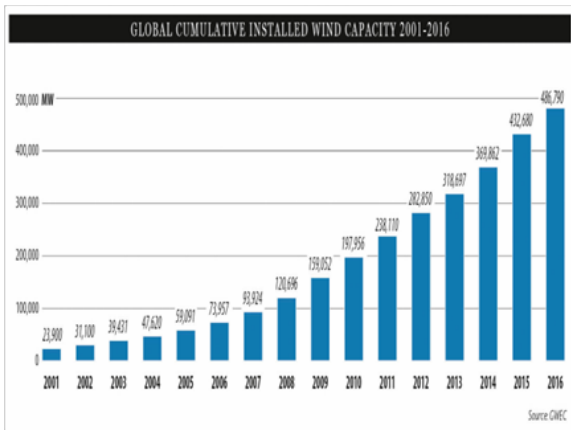


Figure 1. Global cumulative installed wind capacity 2001-2016

The National Institute of Wind Energy, formerly the Centre of Wind Energy Technology, recently announced that the total onshore wind energy potential in the country is 302 GW at hub height of 100m.

The fresh estimates are six times the wind energy potential determined at 50m hub height and three times determined at 80m hub height. The new assessment methodology also takes into account the actual land availability, with land features categorized into three ranks- wasteland, cultivable land and forest land. Of the total estimated 302 GW potential, 153GW is available in wasteland, 146 GW in cultivable land and 3 GW in forest land [17].

Table 1. Top 10 cumulative capacity Dec-2016

Country	MW	% Share
China	168,732	34.7
U.S.A	82,184	16.9
Germany	50,018	10.3
India	28,700	5.9
Spain	23,074	4.7
U.K	14,543	3.0
France	12,066	2.5
Canada	11,900	2.4
Brazil	10,740	2.2
Italy	9,257	1.9
Rest of the world	75,576	15.5
Total Top 10	411,214	84
World Total	486,790	100

TABLE 2. ESTIMATED WIND POTENTIAL (MW) IN INDIA [2]

State	At 50m	At 80m
Andaman & Nicobar	2	365
Andhra Pradesh	5,934	14,497
Arunachal Pradesh	201	236
Assam	53	112
Bihar	-	144
Chattisgarh	23	314
Diu Daman	-	4
Gujarat	10,609	35,071
Haryana	-	93
Himachal Pradesh	20	64
Jharkhand	-	91
Jammu Kashmir	5,311	5,685
Karnataka	5,981	13,593
Kerala	790	837
Lakshadweep	16	16
Madhya Pradesh	920	2,931
Maharashtra	5,439	5,961
Manipur	7	56
Meghalaya	44	82
Nagaland	3	16
Orissa	910	1,384
Pondicherry	-	120

Rajasthan	5,005	5,050
Sikkim	98	98
Tamil Nadu	5,374	14,152
Uttarakhand	161	534
Uttar Pradesh	137	1,260
West Bengal	22	22
Total	49,130	102,788

IV. WIND ENERGY PROGRAMME IN INDIA

Energy self-sufficiency was identified as the major driver for new and renewable energy in the country in the wake of the two oil shocks of the 1970s. The sudden increase in the prices of oil, uncertainties associated with its supply, and the adverse impact on the balances of payments position led to the establishment of the Commission for Additional Sources of Energy (CASE) in the Department of Science and Technology in March 1981. The Commission was responsible for the formulation of policies and their implementation, creation of programs for the development of new and renewable energy, and coordinating and intensifying R&D in the sector. In 1982, a new department, i.e., Department of Non-Conventional Energy Sources (DNES), which incorporated CASE, was created in the Ministry of Energy. A decade later, in 1992, DNES

became the Ministry of Non-Conventional Energy Sources. In October 2006, the Ministry was rechristened as the Ministry of New and Renewable Energy, (MNRE) which is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country and ensuring long-term energy security [18]. Over the next decade, India will have to invest in options that not only provide energy security, but also cost-effective tools for eradicating energy poverty across the board. India, as part of its obligations to the United Nations climate convention (UNFCCC), released National Action Plan on Climate Change (NAPCC) in June 2008 that laid out the government's

vision and mission with specific strategies for a sustainable and clean energy future. The NAPCC outlined its implementation strategy through the establishment of eight national missions, but this mission is not having any large agenda for the wind energy. The Indian government has finalized the National Solar Mission, outlining ambitious long-term plans to attain an installed solar power generation capacity of 20 GW by the year 2022, which would be increased to 100 GW by the year 2030 and further to 200 GW by the year 2050 [19]. Unlike other renewable sources like solar and biomass, there are no specific programs directed at wind. The primary reason behind the absence of wind-specific programs is that the wind does not target individual consumers. Despite that wind is the leading renewable source of power connected to grid with almost twice the size of all other renewable sources such as solar, small hydro, and biomass. Table.3 shows installed wind power capacity in India since 2007. [5]

TABLE 3. INSTALLED WIND POWER CAPACITY IN INDIA

Financial Year	Installed capacity(MW)
06-07	7,850
07-08	9,587
08-09	10,925
09-10	13,064
10-11	16,084
11-12	18,421
12-13	20,150
13-14	22,465
14-15	23,447
15-16	26,777
16-17	32,280

V. STATUS OF WIND POWER INDUSTRY IN INDIA

The development of wind power industry is driven by the initiative of the MNRE. Compared with other renewable energy technologies wind energy technology is receiving increasing emphasis since 1992, with the backup of private participation. There is a perceptible shift in government strategy in favor of renewable energy technology. Indian government subsidy programmers and private sector participation has achieved tremendous growth in wind power

industry with the use of attractive fiscal incentives (accelerated depreciation, low-cost credit, and reduction in customs and excise duties) and accommodating power wheeling and banking contracts from state electricity boards. Large scale development of commercial projects is currently taking place in Gujarat, Karnataka, Maharashtra and Tamil Nadu states. Public sector undertakings, public utilities and corporate houses are being encouraged to invest in commercial wind power projects to meet partly their power requirements and also to avail the financial and fiscal incentives [20]. India has become fourth largest wind power market in the world, its broad-based industrial resources represents an attractive manufacturing platform for wind turbine companies and most leading manufacturers in the world have invested for manufacturing facilities in India. Indian costs of wind energy equipment is largely determined by international prices due to the involvement of major international manufacturers in the Indian market, usually in partnership with Indian companies.

The top-five OEMs in terms of cumulative installed capacity in India are Suzlon (35.4%), Wind World (18%), Gamesa (10.1%), Vestas (7.6%), Regen (7.3%) and Inox (5.68%) [4]. Wind Power set up its second blade factory in Vadodra, Gujarat. Senvion, an established European player, started up its operations in India and acquired the Kenersys manufacturing facility. Gamesa set up new factory at Nellore in Andhra Pradesh; Acciona entered the market last year, and Envision and Sany Global are expected to enter the market soon. Vestas opened their blade manufacturing unit in Gujarat. The current manufacturing capacity in the country is around 10 GW.

VI. INDIAN WIND ENERGY POLICY

Wind policy framing in India happens at the central and state levels. The central government through the MNRE and its agencies develop federal level policies, and the states are allowed to develop their own operational level policies and tactics. The government does not want to focus its energies on actually setting up wind power projects. Instead it wants to concentrate. Only on R&D, developing small projects in remote areas and setting up demonstration projects. The government has formulated a strategy of providing incentives to private manufacturers in this sector. The various State Governments are providing support in the form of energy buy back, power wheeling and banking facilities, sales tax concession benefits, electricity tax exemption and capital subsidy. The government has also come up with a Generation Based Incentive (GBI) Scheme. The features of the scheme are as follows [21]:

1. The GBI Scheme is applicable only for those power producers who do not avail of the accelerated depreciation benefits under the Income Tax Act.
2. All grid integrated projects of capacity of more than 5 MW are eligible for this scheme. The project has to be synchronized with the grid and certified by the utility.
3. Wind site has to be validated by C-WET.
4. Electricity generated from the project should be sold to the grid.
5. The MNRE will provide the GBI of Rs. 0.50 per unit for a period of ten years to the eligible project promoters through IREDA. This scheme is currently valid for wind farms installed before 31 March 2012. This incentive shall be in addition to the tariff determined by the State Electricity Regulatory Commission (SERC).
6. The IREDA will disburse the generation based incentive to the generator on half yearly basis through e-payment.
7. Not applicable for those who have set up capacities for captive consumption, third party sale, merchant plants.

8. The component of the scheme will be reviewed when projects aggregating to 49 MW which are estimated to generate around 0.9 billion units of electricity will get registered by IREDA (Indian Renewable Energy Development Agency).

MNRE of India the conference which was held in 2016 based on Wind power policy in India stated Wind potential states are providing promotional tariff for wind power projects. Tariff of 4.84 per KWh for Andhra Pradesh, 4.19 per KWh for Gujarat, 4.50 per KWh for Karnataka, 4.78 per KWh for Madhya Pradesh, 3.82-5.56 per KWh for Maharashtra, 5.76 and 6.04 per KWh for Rajasthan and 4.16 per KWh for Tamil Nadu. States are also providing Concessional Wheeling, Banking, Electricity Duty and Cross Subsidy Surcharges. [22].

VII. WIND POWER BY STATES

There is a growing number of wind energy installations in states across India

TABLE 4. INSTALLED WIND CAPACITY BY STATE AS OF OCTOBER 2016 [7][8]

State	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

VIII. CONCLUSION

Wind energy technology is currently making a significant contribution to the electric power generation systems in India. Now India is one of the leading countries in the world for the development and utilization of wind energy. India has made considerable progress in the field of wind power capacity installation and generation. India's wind

power capacity is set to grow 30 percent or 4,300 MW in 2016-17, helped by capacity addition in Andhra Pradesh, Gujarat and Madhya Pradesh.

India needs more investments in wind power research and development, wind component manufacturing industry, wind project installation, distribution, and evacuation, grid integration, and more importantly skilled manpower development. Although there will be some ups and downs, following the cycles in the world economy, wind power has not only come to stay, but to grow. It may be concluded that India will have to improve in order to compete with China and become the leader in wind energy generation.

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