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INDIA'S WIND ENERGY IN 2013 - A REVIEW

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Abstract

Wind is the indirect form of solar energy and is always being replenished by the sun. Wind is caused by huge convection currents in the Earth's atmosphere, driven by heat energy from the Sun. The energy of moving air or wind is converted into electricity by wind turbines. It has been used by mankind for many centuries, since it is clean, reliable and does not produce any green house gases. India has witnessed a rapid achievement in installing wind mills in the past decades due to its availability. The long standing advantages in harvesting wind energy over other renewable energy also led to its flourishment. The boom in wind power sector entering India as the third largest global market paves way for the attention of investments in renewable energy. This paper reviews the current status of India's wind power and its development in 2013. The available and installed capacities of the wind high potential areas in Andhra Pradesh, Tamil Nadu and Gujarat are also identified. This paper also summarizes the contribution of wind energy in meeting India' growing population demand and government's various policies for increasing its development.

Keywords: Renewable energy, Wind power, High potential areas, Power generation, Installation capacity.

Introduction

Renewable Energy source forms a miniscule portion (25 GW~12%) of India's overall power generation today (202 GW). The share of wind energy (17 GW) is 67% of the total renewable energy basket (Swaminathan Mani and Tarun Dhingra, 2013). India is a developing economy which is investing hugely in power sector for country's growth. Its increasing demand can't be just fulfilled without its step into renewable energy. The sudden increase in crude oil price, depletion of fossil fuel has made the country to think of investing in renewable energy sector. The gross and technical wind energy potential in India is assessed as 45,195 and 12,875MW by CWET. The development of wind power in India began in the 1990s, and has significantly increased in the last few years. The short gestation periods for installing wind turbines, and the increasing reliability and performance of wind energy machines has made wind power a favored choice for capacity addition in India (Lalwani and Singh, 2001). The use of electricity has grown since it can be used in variety of applications as well as it can be easily transmitted, the uses of renewable energy like wind and solar is rising. Wind energy is a clean, eco-friendly, renewable resource and is nonpolluting. The gross wind power potential is estimated at around 48,561 MW in the country; a capacity of 14,989.89 MW up to 31st August 2011 has so far been added through wind, which places India in the fifth position globally (Atul Sharma *et al*.,2012). India now ranks 5th in the world after USA, Germany, China and Spain in grid connected wind power installations. A cumulative total of over 119 billions units of electricity have been fed to the State Electricity Grids up to January, 2011. The designed capacity to be installed to achieve the technical wind power potential of India and five potential Indian states, Tamilnadu, Maharastra, Karnataka, Gujarat and Andhra Pradesh are 51,500, 7000, 12,080, 4480, 7120 and 7000MW, respectively (Carolin Mabel and Fernandez, 2008).

Wind Installation Target

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 MW 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. The 11th Plan had aimed to create 78.7 GW of additional capacity for grid connected power but actual realization was around 50 GW. The 12th Plan envisions installing 100 GW of new capacity of which 30 GW is projected to come from Renewable Energy Sources, of which wind would account for 15 GW.

Historically the Indian wind energy sector has met and occasionally exceeded its allocated target 17. The report of the sub-group for wind power development appointed by the Ministry of New and Renewable Energy to develop the approach paper for the 12th Plan period (April 2012 to March 2017) fixed a reference target of 15,000 MSW in new capacity additions, and an aspirational target of 25,000 As per Section 86(1)e of the Electricity Act, 2003, different state electricity regulatory commissions have fixed a percentage of electricity which should be purchased from renewable energy

Name of location	State	Latitude		Longitude		Height from sea level (m)	Density of air at the location (kg/m^3)	Shape factor (k) for the location	Scale factor (c) for the location	Annual mean wind speed (m/s)
		deg	min	deg	min					
Ayikudy	Tamilnadu	9	01	77	20	182	1.145	2.3	6.81	5.95
Bhadka	Rajasthan	26	00	71	23	193	1.135	1.9	4.67	4.19
Bhimnupatnam	Andhra Pradesh	17	54	83	34	100	1.156	1.9	5.75	5.31
Chalkewadi	Maharashtra	17	31	73	46	1372	1.159	1.7	5.94	5.53
Dahod	Gujarat	22	51	74	11	167	1.118	2.2	5.03	4.58
Dandi	Gujarat	20	53	72	51	3	1.156	2.1	4.22	4.03
Harshad	Gujarat	21	51	69	20	12	1.161	2.4	6.00	5.56
Jaisalmer	Rajasthan	26	54	70	55	231	1.135	1.8	5.39	4.93
Kaipdar	Orissa	20	07	85	37	84	1.153	1.5	4.44	4.30
Kakulkonda	Andhra Pradesh	13	43	79	18	981	1.060	1.5	6.72	6.67
Kattadimlai	Tamilnadu	8	17	77	32	35	1.152	3.0	7.31	6.64
Lonavla	Maharashtra	18	45	73	25	660	1.159	2.0	4.92	4.31
Malwan	Maharashtra	16	01	73	19	35	1.159	2.0	3.89	3.72
Muppandal	Tamilnadu	8	15	77	33	42	1.152	2.2	7.75	7.08
Pachpadra	Rajasthan	25	55	72	12	112	1.135	1.5	3.75	3.35
Panchgani	Maharashtra	17	49	73	46	1372	1.159	2.2	5.50	5.06
Ramanaidukandrika	Andhra Pradesh	13	37	78	29	751	1.060	2.1	4.75	4.37
Tirumala	Andhra Pradesh	13	45	79	22	80	1.060	1.9	6.08	5.68
Tuticorin	Tamilnadu	8	50	78	08	3	1.155	2.3	5.50	4.89

Annual mean wind speed at 20m height from the ground level and other relevant characteristics at some selected locations in India (Meera Sudhakar *et al*.,2013).

State	2008-09	2009-2010	2010-11	2011-12	Cumulative
Andhra Pradesh	0.333	0.106	0.076	0.122	1.650
Gujarat	2.104	2.988	2.881	4.181	15.077
Karnataka	1.723	2.895	2.825	3.279	16.303
Kerala	0.000	0.065	0.065	0.070	0.246
Madhya Pradesh	0.003	0.082	0.090	0.130	0.775
Maharashtra	2.207	2.779	2.692	3.296	17.931
Rajasthan	0.758	1.127	1.387	2.420	7.826
Tamil Nadu	6.206	8.146	8.720	9.855	59.675
Total	13.334	18.188	18.736	23.353	119.483

Statewise and yearwise cumulative wind power generation data in billion units(BU).

State	2008-09	2009-10	2010-11	2011-12	Total
Andhra Pradesh	0.0	13.6	55.4	54.1	245.50
Gujarat	313.6	197. 1	312.8	789.9	2,966.30
Karnataka	316.0	145 .4	254.1	206.7	1,933.50
Kerala	16.5	0.8	7.4	0.0	35.1
Madhya Pradesh	25.1	16.6	46.5	100.5	376.40
Maharashtra	183.0	138.9	239.1	416.5	2,733.30
Rajasthan	199.6	350.0	436.7	545.7	2,070.70
Tamil Nadu	431.1	602.2	997.4	1083.5	6,987.60
Others	0.0	0.0	0.0	0.0	3.2
Total	1,484.9	1,464.6	2,349.6	3,196.9	17,351.60

Installed wind capacity upto 31-03-2012

1. Energy Potential In States

Current installed base of Renewable energy is 16,492.42 MW which is 10.12% of total installed base with the southern state of Tamil Nadu contributing nearly a third of it (5008.26 MW)

largely through wind power (Baksh, 2002). Interestingly more than 95 percent of the nation's wind energy development to date is concentrated in just five states in southern and western India -Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, and Gujarat (LBNL, 2012). These five states accounted for over 85% of the total installed capacity at the end of the last plan period. Rajasthan is another emerging State with rising wind turbine installations. India installed a record 3.1 GW of new wind power capacity. For this scale of growth to be maintained and escalated it is essential that the industry is supported by a stable policy and regulatory environment. India had installed almost 18 GW of wind power capacity by August of 2012 (MNRE).

Historically, the States of Tamil Nadu, Karnataka, Maharashtra and Gujarat have been the leaders in terms of total wind installations. The States of Rajasthan, Madhya Pradesh and Kerala are quickly catching up. By the end of the 11th Plan period in March of 2012, the total installed capacity had reached a total of 17,351.6 MW.

Andhra Pradesh

Andhra Pradesh shows a gradual and steady increase in harnessing its technical wind potential. The state may attain the inflection point in the year 2014 and tends to accomplish 99% of the state's total technical wind potential by the year 2025 (Carolin Mabel and Fernandez, 2008). Of the cumulative total of 665 stations established till 31.03.2012, 233 stations have been found to have Wind Power Density (WPD) in excess of 200 W/m2 at 50 m agl. Welspun Energy Ltd. (WEL) has inked an MoU with the Government of Andhra Pradesh for installing 500 MW of wind power projects. The current installed capacity of wind power and AP is 248 MW and the wind power potential in Andhra Pradesh is assessed to be at least 88,900 MW from wastelands, according to a study by the Centre for Study of Science, Technology and Policy (CSTEP). Furthermore, there is a potential of around 12,000 MW if 5% of the state's agricultural lands suitable for wind power were used (Meera Sudhakar *et al*., 2013).

Tamil Nadu

In Tamilnadu, wind power technology has already gained importance showing a good progress in the development .State Nodal Agency -TNEB Up to pooling S/S execution and investment by WFD with 11% E&S charges to TNEB with 68 monitoring stations. The study reveals the diffusion of wind energy technology may reach 99% of the technical potential of 3020 and 1120MW by the year 2020. The inflection point for Tamil Nadu is in the year 2008 and may reach 99% of its total technical potential by the year 2022 (Carolin Mabel and Fernandez, 2008). The largest installation of wind turbines in the country so far is in the Muppandal and Perungudi area near Kanyakumari in Tamil Nadu with an aggregate installed capacity of about 500 MW (Baksh, 2002). As of March 2012,the installed capacity in Tamil Nadu is 6987.90 MW(TEDA).

Gujarat

The State of Gujarat has the highest wind power potential in the country, 9675 MW and has the country's second largest wind power plant. In case of Gujarat, the growth rate is very slow and reaches the inflection point by the year 2021. When the state suffered from a major earth quake in 2001, it drastically affected its growth rate, After 2003, it is slowly picking up and according to the study it may achieve 86% of its technical potential only by the year 2030 (Carolin Mabel and Fernandez, 2008). The installed capacity showed a considerable increase between April 2011 and May 2012 which was 789.9 MW. Gujarat's estimated potential for 50m height is found to be 10609 MW and for 80m is 35071 MW (India's wind energy Outlook-2012). So far by 31st January 2011, 69 wind monitoring stations have been developed across the state and six more were added into operation by 2012 (India's wind energy Outlook-2012) wind power is purchased at Rs.3.56 per unit. The power so far harvested is nearly 2966.30 MW by March 2012 generating about 5045 million units of electricity annually, which is only 30% of the estimated value [GEDA].

MW Potential		
Hub height (m)	**Wasteland**	**Agricultural land (moderate scenario)**
80	88, 900	12, 000
100	1, 15, 200	18, 200
120	1, 63, 800	30, 800

	State					
	Year	TamilNadu	Maharashtra	Karnataka	Gujarat	AndraPradesh
Projected value of installed capacity(MW)	2015	6386.8	11,569	4280.3	1832.3	4469.6
	2020	6858.1	12,050	4466.5	3410.6	6471.5
	2025	6968.9	12,078	4479.1	5050.1	6918.5
	2030	6993.3	12,080	4479.9	6167.4	6988.1
Projected value of potential that can be Attained (MW)	2015	1597	2,892	1070	458	1117
	2020	1715	3,012	1117	853	1618
	2025	1742	3,019	1119	1263	1730
	2030	1748	3,020	1120	1542	1747

Projected potential that can be attained

Conclusion

India has seen a rapid growth in the field of wind energy in the past decades. As of March 2012, renewable energy accounted for 12.2 percent of total installed capacity, up from 2 percent in 1995. Wind power accounts for about 70 percent of this installed capacity. By the end of August 2012, wind power installations in India had reached 17.9 GW.

India's predicted Installation for the fore coming years says a maximum of 124 GW is set as a target for 2030. Arecent study from Lawrence Berkeley National Laboratory (LBNL) estimated wind power potential in India to be 2006 GW at 80 m and 3121 GW at 120 m hub-height (Amol Phadke and Jagmeet Khangura, 2012).

Year	Predicted Installation(GW)
2012	19
2015	31.4
2020	59
2030	124

References

Carolin Mabel, M. and Fernandez, E. 2008. Growth and future trends of wind energy in India. *Renewable and sustainable energy reviews*,12(6): 1745-1757.

India's wind energy Outlook-2012. http://www.gwec.net/publications/country-reports/india-wind-energy-outlook-2012/updated on12/06/15.

Baksh, R. 2002. Wind energy-the Indian scenario. Power Engineering Society Winter Meeting, IEEE, RRB Consultants & Eng., Ltd, New Delhi, India, 1(14)**:** 344 - 345.

Lalwani, M. and Singh, M. 2010. Conventional and renewable rnergy scenario of India: Present and Future. *Canadian Journal on Electrical and Electronics Engineering*, 1(6): 122-140.

TEDA website,updated on 2014

Swaminathan Mani and Tarun Dhingra, 2013. Offshore wind energy policy for India-Key factors to be considered in Energy Policy. Elsevier. 56: 672-683.

Atul Sharma, Jaya Srivastava,Sanjay Kumar Kar and Anil Kumar, 2012. Wind energy status in India: A short review. *Renewable and Sustainable Energy Reviews*, 16(2):1157-1164.

Meera Sudhakar, Deepthi Swamy, Mohd Saquib, Abhijith Sastry and Anshu Bharadwaj, 2013. Wind Power in Karnataka and Andhra Pradesh: Potential Assessment, Costs and Grid Implications'. Center for Study of Science, Technology and Policy (Report).

Amol Phadke, R.B. and Jagmeet Khangura, 2012. Reassessing wind potential estimates for India : economic and policy implications (https://ies.lbl.gov/sites/all/files/lbnl-5077e_1.pdf).