

Wind Energy Potential in India and its Harnessing Plan

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ABSTRACT

India is blessed with solar and wind as renewable energy resources. The potential of wind energy resources are also immense. While assessing the potential of wind energy resources, India has remarkable study and development of wind turbine and its installations in continual process. The capacity of wind power plants installed up to 2018 was about 34,605MW and it is increasing day by day as per advancement in design aspects and today India stands on fourth position in the world in the wind energy production. The study discusses the current status and development of wind energy in India and its challenges and opportunities while producing the wind energy. The different aspects as how to increase and expand the utilization of wind resources is also presented.

Keywords: wind energy, wind energy resources, wind power plants, renewable energy.

1. INTRODUCTION

India has tremendous energy needs and an increasing difficulty in meeting those needs through traditional means of power generation. On 30th and 31st July 2012 the world's largest blackout, the Great Indian Outage, stretching from New Delhi to Kolkata occurred. This blackout, due to failure of the northern power grid, caused nearly 700 million people – twice the population of the United States – to be without electricity.

A grid failure of such magnitude has thrown light onto India's massive demand for electricity, together with its struggle to generate as much power as it needs. India is aiming to expand its power-generation capacity by 44 percent over the next five years but recent problems indicate the scale of the challenge. Even before the blackout, in June of 2012, the country's power generation fell short by 5.8 percent when confronted with a peak-hour demand of 128 GW, according to Government data.

Electricity consumption in India has been increasing at one of the fastest rates in the world due to population growth and economic development. India's economy faces increasing challenges because energy supply is struggling to keep pace with demand, and there are energy shortages (as much as 15 percent daily) almost everywhere in the country. Such chronic lack of energy and unreliable supplies threaten India's economic growth.

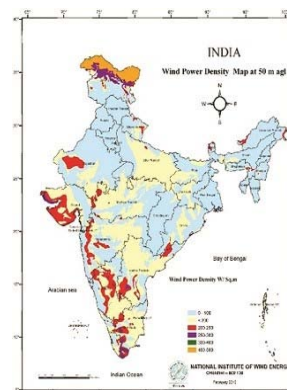
For economic as well as environmental reasons India needs to shift to non-polluting renewable sources of energy to meet future demand for electricity. Renewable energy is the most attractive investment because it will provide long-term economic growth for India. Renewable energy also has the advantage of allowing decentralized distribution of energy – particularly for meeting rural energy needs, and thereby empowering people at the grass roots level. Solar electricity could also shift about 90 percent of daily trip mileage from petroleum to electricity by encouraging increased use of plug-in hybrid cars. For drivers in India this means that the cost per mile could be reduced by a quarter in today's prices.

Wind power generation capacity in India has significantly increased in recent years. As of 31 December 2019, the total installed wind power capacity was 35.53 GW, the fourth largest installed wind power capacity in the world [2-3]. Wind power capacity is mainly spread across the Southern, Western and Northern regions [4]

Wind power costs in India are decreasing rapidly [5]. The levelized tariff of wind power reached a record low of 2.43 (3.4¢ US) per kWh (without any direct or indirect subsidies) during auctions for wind projects in December 2017 [6-8]. In December 2017, union government announced the applicable guidelines for tariff-based wind power auctions to bring more clarity and minimise the risk to the developers [9].

2. RENEWABLE ENERGY IN INDIA

India was the first country in the world to set up a ministry of non-conventional energy resources, in early 1980s. Renewable energy in India comes under the purview of the Ministry of New and Renewable Energy (MNRE). Newer renewable electricity sources are targeted to grow massively by 2022, including a more than doubling of India's large wind power capacity and an almost 15 fold increase in solar power from April 2016 levels. Such ambitious targets would place India amongst the world leaders in renewable energy use and place India at the center of its International Solar Alliance project promoting the growth and development of solar power internationally to over 120 countries. As of 30th April 2016 India's cumulative grid interactive or grid tied renewable energy capacity (excluding large hydro) reached about 42.85 GW, surpassing the installed capacity of large scale hydroelectric power in India for the first time in Indian history. 63% of the renewable power came from wind, while solar contributed nearly 16%. Large hydro installed capacity was 42.78 GW as of 30 April 2016 and is administered separately by the Ministry of Power and not included in MNRE targets.



From 2015 onwards, the MNRE began laying down actionable plans for the renewable energy sector under its ambit to make a quantum jump, building on strong foundations already established in the country. MNRE renewable electricity targets have been upscaled to grow from just under 43 GW in April 2016 to 175 GW by the year 2022, including 100 GW from solar power, 60 GW from wind power, 10 GW from bio power and 5 GW from small hydro power. The ambitious targets would see India quickly becoming one of the leading green energy producers in the world and surpassing numerous developed countries. The government intends to achieve 40% cumulative electric power capacity from non-fossil fuel sources (i.e. renewable energy) by 2030. The country's total installed power capacity stood at about 371 GW as of December 31, 2019. Meanwhile, cumulative hydropower installations moved up to about 50.1 GW and accounted for 13.5% of India's total installed power capacity.

Table- 1: Installed Grid Interactive Renewable Power capacity in India as of 31st Dec 2019, Source: (RES MNRE)

S.No.	Source	Total Installed Capacity (in MW)	Target 2022 (in MW)
1.	Wind Power	37,505	60,000.00
2.	Solar Power	33,731	100,000.00
3.	Bio-Mass Power	10,001	10,000.00
4.	Small Hydro	4,672	5,000.00
	Total	85,908	175,000.00

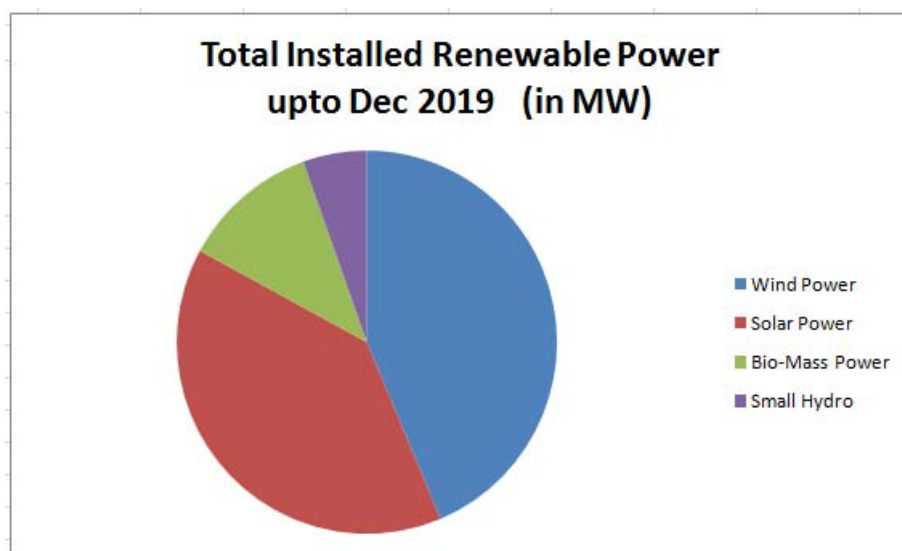


Figure 2: Installed Grid Interactive Renewable Power Capacity in India as of December 31, 2019 (RES MNRE)

Renewable Energy Overview and Targets

- Wind Power: 37,505.15 MW (21.4%)
- Solar Power: 33,731.00 MW (19.2%)
- Biomass Power: 10,001.83 MW (0.6%)
- Small Hydro Power: 4,672.27 MW (2.6%)
- Waste-to-Power: 115.08 MW (0.1%)

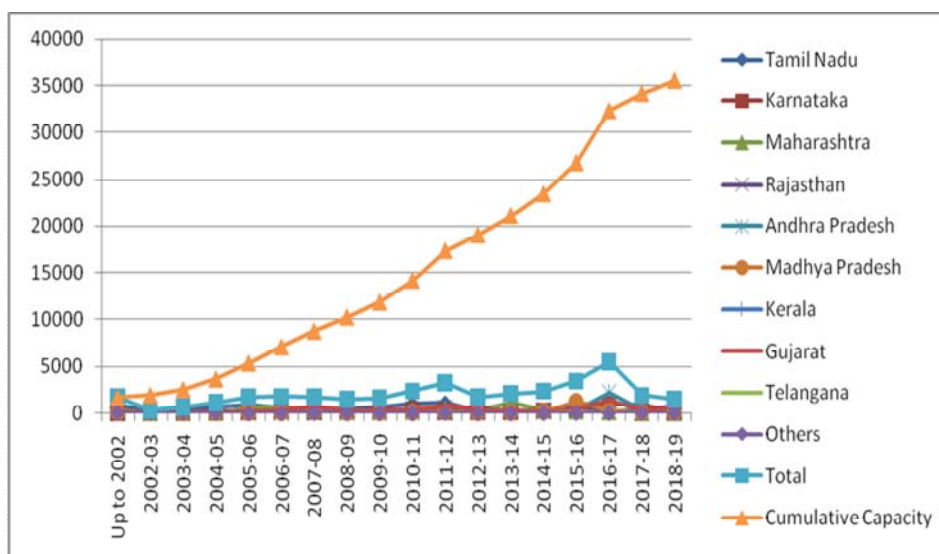
India's present generation capacity is about 200,000 MW. The country could potentially increase grid-connected solar power generation capacity to over 200,000 MW and wind energy to over 100,000 MW by 2030, if the right resources (and more importantly, energy policies) were developed.

3. WIND ENERGY

Wind power is one of the most efficient alternative energy sources. There has been good deal of development in wind turbine technology over the last decade with many new companies joining the fray. Wind turbines have become larger, efficiencies and availabilities have improved and wind farm concept has become popular. It could be combined with solar, especially for a total self-sustainability project.

The economics of wind energy is already strong, despite the relative immaturity of the industry. The downward trend in wind energy costs is predicted to continue. As the world market in wind turbines continues to boom, wind turbine

prices will continue to fall. India now ranks as a ‘wind superpower’ having a net potential of about 45,000 MW only from 13 identified states.



Status of Statewise Wind Power Generation in India upto Dec 2019

Statewise Wind Power Generation upto 2018-19

State	Up to 2002	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Tamil Nadu	877	133.6	371.2	675.5	857.6	577.9	380.7	431.1	602.2	997.4	1083.5	174.6	107.38	124.45	158.8	247.57	335.64	723.82
Karnataka	69.3	55.6	84.9	201.5	143.8	266	190.3	316	145.4	254.1	206.7	201.7	183	230.5	230.9	882.3	857	86.5
Maharashtra	400.3	2	6.2	48.8	545.1	485.3	268.2	183	138.9	239.1	416.5	288.6	1074.5	273.45	207.85	117.55	12.6	10.2
Rajasthan	16.1	44.6	117.8	106.3	73.3	111.8	69	199.6	350	436.7	545.7	615.4	98.8	267.7	685.5	287.7	16	2
Andhra Pradesh	93.2	0	6.2	21.8	0.5	0.8	0	0	13.6	55.4	54.1	202.2	298.5	166.3	400.1	2187.45	348.1	123.5
Madhya Pradesh	23.2	0	0	6.3	11.4	16.4	130.4	25.1	16.6	46.5	100.5	9.6	37.4	143.9	1261.4	356.7	22.1	0
Kerala	2	0	0	0	0	0	8.5	16.5	0.8	7.4	0	0	0	0	8.4	8	1	0
Gujarat	181.4	6.2	28.9	51.5	84.6	284	616.4	313.6	297.1	312.8	789.9	208.3	279.8	126.9	392.4	1392	272.8	459.65
Telangana	--	--	--	--	--	--	--	--	--	--	--	--	--	--	77.7	23.1	0	27.3
Others	4.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1666.8	242	615.2	1111.7	1716.2	1742.1	1663.3	1484.9	1564.6	2349.2	3196.7	1700.4	2079.4	2333.2	3423.05	5502.37	1865.24	1480.97
Cumulative Capacity	1666.8	1908.8	2524	3635.7	5351.9	7094	8757.3	10242.2	11806.8	14156	17352.7	19053.1	21132.5	23465.7	26777.4	32279.8	34145	35527.4

4. OFFSHORE WIND ENERGY POTENTIAL IN INDIA

India has an offshore wind energy potential of around 70 GW in parts along the coast of Gujarat and Tamil Nadu. India started planning in 2010 to enter into offshore wind power [10] and a 100 MW demonstration plant located off the Gujarat coast began planning in 2014 [11]. In 2013, a consortium instead of group of organizations, led by Global Wind Energy Council (GWEC) started project FOWIND (Facilitating Offshore Wind in India) to identify potential zones for development of off-shore wind power in India and to stimulate R & D activities in this area [12]. The other consortium partners include the Centre for Study of Science, Technology and Policy (CSTEP), DNV GL, the Gujarat Power Corporation Limited (GPCL) and the World Institute of Sustainable Energy (WISE). The consortium was awarded the grant of ₹.0 million by the delegation of the European Union to India in 2013 besides co-funding support from GPCL. The project action will be implemented from December 2013 to March 2018.

The project focuses on the States of Gujarat and Tamil Nadu for identification of potential zones for development through techno-commercial analysis and preliminary resource assessment. It will also establish a platform for structural collaboration and knowledge sharing between stakeholders from European Union and India, on offshore wind technology, policy, regulation, industry and human resource development. FOWIND activities will also help facilitate a platform to stimulate offshore wind related R&D activities in the country. The consortium published initial pre-

feasibility assessment reports for offshore wind farm development in Gujarat and Tamil Nadu on 16 June 2015 [13-14]. In September 2015, the India's cabinet has approved the National Offshore Wind Energy Policy. With this, the Ministry of New & Renewable Energy (MNRE) has been authorized as the Nodal Ministry for use of offshore areas within the Exclusive Economic Zone (EEZ) [15].

India seems pacing up rapidly towards offshore wind energy development as the Nodal Ministry (MNRE) & Nodal Agency (NIWE) calls with the Expression of Interest (EoI) [16] inviting the bidders for development of first 1000MW commercial scale offshore windfarm in India, near the coast of Gujarat. The EoI published on 16 Apr 2018, specifies the proposed area identified under the FOWIND & FOWPI study funded by European Union. The proposed location of the offshore windfarm could be 23–40 km off the coast from the Pipavav port, Gulf of Khambhat. The proposed area covers about 400sq km. The wind measurements & other data collection are under progress under the supervision of NIWE.

5. CONCLUSION

There is an urgent need for transition from petroleum-based energy systems to one based on renewable resources to decrease reliance on depleting reserves of fossil fuels and to mitigate climate change. In addition, renewable energy has the potential to create many employment opportunities at all levels, especially in rural areas. An emphasis on presenting the real picture of massive renewable energy potential, it would be possible to attract foreign investments to herald a Green Energy Revolution in India. Thus following conclusions can be drawn from the above study:

- India's current generation capacity is about 200,000 MW and wind energy to over 100,000 MW by 2030.
- The solar energy may further enhanced to 800GW after 2030. The country could potentially increase grid-connected solar & offshore power generation capacity, if the right resources (and more importantly, energy policies) were developed.
- The possibility of international grid-connected solar power and wind generation is also to be explored to supply power to neighboring countries.

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