ISSN 2250-3153

Wind Power Scenario in India: A Review

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Abstract- As energy consumption rises with increase in population and living standards, the need to expand access to energy in new ways is growing as is the awareness of the environmental costs. This review paper provides a citizen's view of Wind Energy Generation(WEG) in India, in the backdrop of (a) the ever-rising national demand for primary energy (b) the national electricity policy (c) wind energy policies. Increased recognition of the contribution that renewable energy (RE) can make to energy independence, climate change mitigation, rural development, improved health and lower health costs (linked to air pollution), is shifting RE from the fringe to the mainstream of sustainable development . India has a vast supply of renewable energy resources and it has one of the largest programs in the world for deploying renewable energy products and systems. Indeed, it is the only country in the world to have an exclusive ministry for renewable energy development, the Ministry of Non-Conventional Energy Sources (MNES). Since its formation, the Ministry has launched one of the world's largest and most ambitious programs on renewable energy. Based on various promotional efforts put in place by MNES, significant progress is being made in power generation from renewable energy sources. The remarkable increase in installed capacity for WEG over the past years has not led to a proportionate increase in the kWh of wind power generated. The unbridled growth in this sector has pitted farmer activists against wind energy companies. Policies of doling out excessive incentives for MW-scale under-utilized wind farms that feed inefficient grids must be reconsidered. The people of India must receive direct tangible benefits from WEG for it to be a truly clean option of green energy for them.

Index Terms- policy, status, capacity, government, utilisation

I. INTRODUCTION

Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface and rotation of the earth. The earth's surface is made of different types of land and water. These surfaces absorb the sun's heat at different rates, giving rise to the differences in temperature and subsequently to winds. During the day, the air above the land heats up more quickly than the air over water. The warm air over the land expands and rises and the heavier, cooler air rushes in to take its place, creating winds. At night, the winds are reversed because the air cools more rapidly over land than over water. In the same way, the large atmospheric winds that circle the earth are created because the land near the earth's equator is heated more by the sun than the land near the North and South Poles. Humans use this wind flow for many purposes: sailing boats, pumping water, grinding mills and also generating electricity. Wind turbines convert the kinetic energy of the moving wind into electricity.

II. WIND ENERGY IN INDIA

In 2012, despite a slowing global economy, India's electricity demand continued to rise. Electricity shortages are common, and over 40% of the population has no access to modern energy services. India's electricity demand is projected to more than triple between 2005 and 2030. In the recently released National Electricity Plan (2012) the Central Electricity Authority projected the need for 350-360 GW of total generation capacity by 2022[1].A cumulative total of 119.5 billion units of Electricity have been fed into the state electricity grids up to 31st march, 2012 as shown in table1 [2].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 M W 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.Wind power contributes a sizeable share of 3 to 4% to country electricity generation mix at present. The total installed capacity of wind power in India as in 31 march was 17,351.60 MW which is 8.7% of total installed capacity in India[2] as shown in table2.A cumulative total of 119.5bu of electricity have been fed into the state electricity from wind energy. We have saved 89.72 millions of tonnes of coal and 118.29 million tonnes of co_2 emission. This indicates environmental and economic validity of wind power in India. However, for India to reach its potential and to boost the necessary investment in renewable energy it will be essential to introduce comprehensive, stable and long-term support policies, carefully designed to ensure that they operate in harmony with existing state level mechanisms so as to avoid reducing their effectiveness [2].

TABLE1 state-wise and year-wise cumulative wind power generation data in billions units(BU)

STATE	UPTO MAR2005	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	CUMULATIVE
Andhra Pradesh	.721	.079	.111	.101	.333	.106	.076	.122	1.650
Gujarat	1.332	.286	.455	.851	2.104	2.988	2.881	4.181	15.077
Karnataka	1.409	.935	1.397	1.840	1.723	2.895	2.825	3.279	16.303
Madhya Pradesh	.3000	.030	.070	.069	.003	.082	.090	.130	.775
Maharashtra	2.650	.790	1.714	1.804	2.207	2.779	2.692	3.296	17.931
Rajasthan	.494	.427	.532	.682	.758	1.127	1.387	2.420	7.826
Tamil nadu	11.970	3.444	5.268	6.066	6.206	8.146	8.720	9.855	59.675
Kerala	.047	.000	.000	.000	.000	.065	.065	.070	.246
Total	18.923	5.991	9.547	11.413	13.334	18.188	18.736	23.353	119.483

Source:MNRE

TABLE2 state-wise and year-wise cumulative wind power installed capacity in MW(upto march,2012)

STATE	UPTO MAR2002	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	Total
Andhra pradesh	93.2	0.0	6.2	21.8	.45	.80	0.0	0.0	13.6	55.4	54.1	245.50
Gujrat	181.4	6.2	28.9	51.5	84.640	283.95	616.36	313.6	197.1	312.8	789.9	2966.30
Karnataka	69.3	55.6	84.9	201.5	143.80	265.95	190.30	316.0	145.4	254.1	206.7	1933.50
Madhya Pradesh	23.2	0.0	0.0	6.3	11.40	16.40	130.39	25.1	16.6	46.5	100.5	376.40
Maharashtra	400.3	2.0	6.2	48.8	545.10	485.30	268.15	183.0	138.9	239.1	416.5	2733.30
Rajasthan	16.1	44.6	117.8	106.3	73.27	111.75	68.95	199.6	350.0	436.7	545.7	2070.70
Tamil nadu	877.0	133.6	371.2	675.5	857.55	577.90	380.67	431.1	602.2	997.4	1083.5	6987.60
Kerala	2.0	0.0	.000	0.0	.000	0.0	8.50	16.5	0.8	7.4	0.0	35.1
others	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2
Total	1,665.7	242.0	615.2	1,111.7	1716.17	1,742.05	1,663.32	1,484.9	1464.6	2,349.6	3,196.9	17,351.60

Source: MNRE

III. ASSESSMENT OF WIND POWER SOURCE

Presently, India has an installed power generation capacity of a little over 207.8 GW[3], of which renewables account for about 25 GW and wind makes up a majority of this installed capacity. The wind power generation capacity in India is 49,130 MW as per the official estimates in the Indian wind Atlas(2010) by the centre for wind energy technology(C-WET).The potential is calculated with respect to 2 percent land availability at windy locations and pertains to a 50m hub height level of wind turbine.[4]. 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 [5].If the potential of 49,130 MW at 50m `level is extrapolated at 80m standard height, the projected wind potential using the same land availability will be in the order of 1,02,788 MW(not officially declare).Table3 shows the estimated installation potential at hub height of 50m and 80m by C-WET

State/UTs	Estimated potential (MW)	
	@50m($)	@80m(*#$)
Andaman & Nicobar	2	365
Andhra Pradesh	5394	14497
Arunachal Pradesh*	201	236
Assam*	53	112
Bihar	-	144
Chhattisgarh*	23	314
Daman and Diu	-	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
Odisha	910	1384
Puducherry	-	120
Rajasthan	5005	5050
Sikkim*	98	98
Tamil Nadu	5374	14152
Uttrakhand*	161	534
Uttar Pradesh*	137	1260
West Bengal	22	22
Total	**49,130**	**1,02,788**

*Wind potential has yet to be validated with actual measurement

#Estimation is based on meso scale modelling

$As actual land assessment is not done on a conservative consideration 2 percent land availability for all states except Himalayan and north eastern States, Andaman and Nicobar Islands .In other states .5% land availability has been assumed.

IV. STATEWISE WIND POWER INTALLATION

During the period from 2002 to 2012, the growth momentum in Indian wind energy sector picked up. The pace of development was marked by formulation of right regulatory framework, incentive mechanism, flourishing component manufacturing industry, emergence of local players and coming of multinational companies as well as technology advancement. 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. 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 [2] as shown in table2.

V. REPOWERING WIND POTENTIAL

The average size of a wind turbine has increased from .77MW in 2004 to 1MW in 2009 and the MW-class turbine now comprise over half of the new wind power capacity installed in the country. One of the immediate benefits after repowering the old wind turbines is that more electricity can be generated from the same site.Inspite of lack of policy and incentive, there are many problems which are faced during repowering such as disposal of old machines, fragmented land ownership in existing wind farms, clarity on the feed-in tariff offered to newly repowered projects and constrained evacuation of the extra power generated. A study on repowering potential conducted by WISE for the Ministry of New and Renewable Energy estimated India's Current repowering potential at approximately 2,760 MW.

VI. INDIA: INTERNATIONAL MANUFACURING HUB

India is emerging as a major wind turbine-manufacturing hub today due to favourable policy framework, low manpower cost, raw material availability and vast market potential. Currently 18 existing manufacturers have a consolidated annual production capacity of over 10,000 MW. Some of the international companies with subsidiaries in India are sourcing over 80% of their components from Indian component manufacturers. Besides manufactures like Enercon, RRB, Suzlon and Leitmer Shriram, Win Wind has also set up a blade manufacturing facility in India [2].The Indian manufacturers have ramped up their production capacity over a period of time. Besides meeting the domestic demand, some manufacturers have also started exporting turbines. The wind turbine manufactured in India has been exported to countries like Thailand, Turkey, Estonia, Netherlands, the UK and srilanka. According to estimates by WISE the annual wind turbine manufacturing capacity is likely to cross 17,000 MW by the 2013 if all manufacturers go ahead with their plans.

VII. NATIONAL POLICY MEASURES SUPPORTING RENEWABLES

In 1993, when the MNES issued guidelines for purchase of power from renewable energy sources by state utilities, it marked the beginning of initial policy support for renewable energy-based power generation in India.The most important development after this was the enactment of the Electricity act, 2003 with specific provision for promotion of renewable energy. However, the EA 2003 changed the legal and regulatory framework for the renewable energy sector in India. The significant provision of this Act are---Section 61(h) which give power to state electricity regulatory commission for fixing prefential tariff for renewable energy projects so as to promote investment while Section 86(1) e enables state commissions to create market for RE and co-generation projects by prescribing a minimum percentage of electricity to be procured from non conventional energy sources. [2]

7.1 NATIONAL ELECTRICITY POLICY

This policy provides direction on determination of percentage for renewable power procurement. The policy also provides a roadmap for gradually increasing the share of renewable power generation.

7.2 TARIFF POLICY

It recommends 'prefential tariff' for purchase of power from renewable energy sources as well as lays out a long-term strategy for pricing of power from RE sources.

VIII. REGULATORY AND POLICY INCENTIVES FOR WIND POWER

India, as part of its obligations to the United Nations climate convention (UNFCCC), released a National Action Plan on Climate Change (NAPCC) in June 2008[8] that laid out the government's vision for a sustainable and clean energy future. The NAPCC stipulates that a dynamic minimum renewable purchase target of 5% (of total grid purchase) may be prescribed in 2009-2010 and this should increase by 1% each year for a period of 10 years. That would mean that by 2020, India should be procuring 15% of its power from renewable energy sources. Current policy and regulatory incentives for wind power development are listed as-

8.1 GENERATION BASED INCENTIVE

Initially implemented in June 2008 and then re-launched in December 2009 by the union government for grid connected wind power projects. A GBI of INR 0.50 per kWh (~ 1 US$ cent), with a cap of approximately $29,000 per M W per year, totalling $116,000 per MW over 10 years of a project's life was offered under this scheme[10].The GBI scheme includes captive wind power projects, but excludes third party sale. The scheme is applicable for the projects commissioned on/after 17.12.2009.Elligibilty criterion is that projects should not avail accelerated depreciation and should sell the electricity to grid at a tariff fixed by SERC/state govt.This scheme expired on 31st march and is likely to be announced with some modification by MNRE.

8.2 ACCELERATED DEPRECIATION.

There is a provision for accelerated depreciation of 80 percent. This provision has enabled large profit making companies, small investors and captive users to participate in this sector. While IPPs may not be interested in the AD benefit, there is a whole class of small and medium enterprises that would be willing to invest in wind power for captive power consumption provide the AD benefit is available. [2]

8.3 RENEWABLE ENERGY CERTIFICATES

The trading of RECs in the Indian market began in February 2011.The RECs were introduced to enable all states to buy a certain proportion of their total power purchase from renewable resources. An REC is a tradable certificate of proof that a renewable energy plant has generated one MWh of electricity. Under this framework, renewable energy generators can trade RECs through a power exchange platform that allows market based price discovery, within a price range determined by the Central Electricity Regulatory Commission. The respective price limits are called forbearance price and floor price and their values are calculated separately for solar and all no solar sources (i.e. wind, biomass, small hydro). The issued RECs are traded at qualified power exchanges within the boundary set by the floor price and forbearance price as determined by the CERC. For wind power generation as of April 2012, the revised range is between INR 1,400 (~ $26) to INR 3,480 (~ $65) per MWh. By mid-October in 2012 the national REC registry had issued 3,384,257 RECs of which 3,381,714 were non-solar RECs[6]. Some of the States have imposed penalties for non-compliance with RPO targets on the generators or utilities.

8.4 NATIONAL CLEAN ENERG Y FUND

The government proposed the creation of the National Clean Energy Fund (NCEF) in the Union Budget 2010-2011 by imposing a clean energy tax (cess) of INR 50 (~ $1) per tonne on all coal produced as well as on coal imports in India. The Ministry of Finance through the Clean Energy Cess rules 2010, set guidelines for the collection and assessment of this tax by the Revenue Department. Thereafter an interministerial group was set up in the Ministry to approve projects and eligibility requirements for accessing funds from the NCEF [9]. However since its inception in July 2010, little information on the operationalization of the NCEF has been released in the public domain other than the guidelines and application form for proposals.[1]

IX. OTHER INCENTIVE[2]

1)10 years income-Tax holiday for wind power projects.
2) Excise duty exemption.
3) Concessional import duty on certain components of wind electricity generator.
4) Power wheeling and banking facilities.
5) Sales tax concession/benefits.
6) Loan facility for setting up wind power projects by IREDA.

X. INDIA SMART GRID TASK FORCE

Especially after the introduction of the IEGC, grids across the country are required to take on electricity produced from nonconventional energy sources under various schemes (RPSs and RECs). Hence the need to revamp and modernize the national/regional and local grids must be one of the primary areas of investment and development. The Ministry of Power (MOP) took the first step towards grid reforms when it set up the 'India Smart Grid Task Force' (ISGTF) in June 2010[7]. The ISGTF is an inter- ministerial group that serves as the government focal point for plans related to Smart Grid development in India. MOP's vision of a smart grid was to bring together the fields of communications, IT and the power sector to establish a comprehensive power grid infrastructure. Further, on the demand side it envisioned giving a choice to the consumer to decide the timing and amount of electricity consumption based upon the real-time prices in the electricity market.

XI. IMPROVING WIND FORECASTING AND SCHEDULING [1]

In India the grid infrastructure is outdated and an under invested aspect of the national infrastructure. The existing electricity grid code allows inter-state sale of power by relaxing provisions for forecasting and scheduling for renewable based generation. According to the norms laid down in the 2010 Grid

Code (IEGC), wind power generators are responsible for forecasting their daily generation with accuracy up to 70%. In Europe this requirement is closer to 95%. Only in the event of generation being ±30% of the scheduled the wind generator will have to bear the unscheduled interchange (UI) charges. One way to overcome the lack of forecasting and scheduling is to improve the guidance to wind farm developers on scheduling requirements with suitable non-penal norms over the short to medium term. With continuously rising wind power penetration in the grid, wind power generators will have to work together with grid operators and electricity distribution companies to address issues related to grid stability and power quality in the immediate future. However, partly due to old and often limited infrastructure and in part due to a lack of penalization for non-compliance with forecasting and scheduling requirements, IEGC's implementation has been delayed. For the long-term growth prospects for wind power the industry and the load dispatch centres must proactively prepare for forecasting and scheduling, to ensure its full operationalization.

XII. CONCLUSIONS

Policies for and status of WEG in India are explored.Inspite of maximum contribution of wind energy in term of RE capacity as well as generation, the wind sector is still lacking in its policies. The recent withdrawal of AD has come as a shock to the investors and industry. Another weakness in the system is the manner of fixation of tariff and RPOs.Existing units face problems relating to under-evacuation and grid integration, and operate with poor capacity utilization factors. In order to change this situation for the better, governments must revise their relevant wind energy policies to remove loop-holes. Instead of promoting a headlong rush into WEG projects with further sops, govt. policies must reward generation and optimum utilization of the existing units. Instead of MW-scale grid-connected units, smaller-scale solar-assisted decentralized WEG units that can be installed at community levels must be promoted. WEG must be matched properly with demands of an appropriate kind; in order to maximize the benefits. The target of 15 percent of renewable power by 2020 can be achieved only if wind sector is allowed to grow without brakes and policy withdrawals.

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