As. J. Energy Env. **2007**, 08(02), 540-546

Asian Journal on Energy and Environment

ISSN 1513-4121

Available online at www.asian-energy-journal.info

Wind Energy Developments in India

Jagadeesh Anumakonda*

Centre for Energy and Sustainable Resources, R.M.K Engineering College, Kavaraipettai, 601 206,Tamil Nadu, India

*Author to whom correspondence should be addressed, email: a_jagadeesh2@yahoo.com

Abstract: There is a constant gap between demand and supply in the energy scenario in India. The installed capacity of power in the country is about 1, 30,000 MW. According to reliable sources, there is a deficit of 9,000 MW every year. A lot of interest is being shown in harnessing renewable energy sources in the country not to replace the conventional energy sources but to supplement them. Among the renewable energy sources, wind is the most matured and clean energy source. The incentives provided by the Government and India and different state governments helped India to rise to the 4th position globally next only to Germany, Spain and USA. The country's wind installations stood at 5300 MW at the end of March 2006 and Tamil Nadu state has the lion's share with 3300 MW. Identifying more windy sites through GIS, creating 'Wind Fund' to provide finances to set up wind farms, wind farm co-operatives stressed in the paper. Linking incentives to production for optimum efficiency of wind turbines suggested in the paper. The current status and past progress of wind energy in India compared to other countries around the globe.

Keywords: Wind Fund, Wind Farm Cooperatives, Off-shore Wind Farms, Depreciation, Incentives

Introduction

In India wind energy was first tapped in the 1950s for its potential to pump water for domestic use and for irrigation as an alternative to electric/diesel pump sets. Wind pumps were imported on a modest scale and installed on an experimental basis at a number of sites. A National Water Pumping Windmill Demonstration Programme was subsequently introduced by the Government of India during the 6th(1980-85) and 7th(1986-91) plan periods and about 2,800 units of the 12-PU-500 wind pumps for shallow well water pumping were installed around the country. In addition, over 200 indigenously developed gear type pumping units have also been installed in 9 states under an Operational Research Programme (ORP). Unfortunately, due to various technical and nontechnical reasons, the 12-PU-500 could not succeed except in some regions.

A Wind Resource Assessment Programme was taken up in 1985, comprising wind monitoring, wind mapping and complex terrain projects. The programme covered 25 states with over 600 stations (1-6).The original impetus to develop wind energy in India came in the early 1980s from the then Department of Non-Conventional Energy Sources, now known as the Ministry of Non-Conventional Energy Sources(MNES). Its purpose is to encourage a diversification of fuel sources away from the growing demand for coal, oil and gas required to feed the country's rapid economic growth. MNES undertook an extensive study of the wind regime, establishing a countrywide network of wind speed measurement stations. These have made it possible to assess the national wind potential and identify suitable areas for harnessing wind power for commercial use. The total potential for wind power in India was first estimated in 1990 as 45,000 MW The growth of Wind energy since 1980 along with other countries is presented in Table 1.

Incentives

The fiscal incentives extended by the Indian Government to the wind energy sector:
• Direct taxes – 80% depreciation in the first year of installation of a project.
• Tax holiday for 10 years
• No income tax to be paid on power sales to utilities.
• FDI investments are cleared very fast.

Table 1 Wind electricity – General capacity by country and world total, 1980-2005

Megawatts

Year	Germany	Spain	U.S.	India	Denmark	Other Countries	World
1980	0	0	8	0	5	0	10
1981	0	0	18	0	7	0	25
1982	0	0	84	0	12	0	90
1983	0	0	254	0	20	0	210
1984	0	0	653	0	27	0	600
1985	0	0	945	0	50	25	1,020
1986	0	0	1,265	0	82	0	1,270
1987	5	0	1,333	0	115	0	1,450
1988	15	0	1,231	0	197	137	1,580
1989	27	0	1,332	0	262	109	1,730
1990	62	0	1,484	0	343	41	1,930
1991	112	5	1,709	39	413	0	2,170
1992	180	50	1,680	39	458	103	2,510
1993	335	60	1,635	79	487	394	2,990
1994	643	70	1,663	185	539	388	3,488
1995	1,130	140	1,612	576	637	683	4,778
1996	1,548	230	1,614	820	835	1,023	6,070
1997	2,080	512	1,611	940	1,120	1,373	7,636
1998	2,872	822	1,770	1,015	1,433	2,238	10,150
1999	4,445	1,522	2,500	1,077	1,748	2,638	13,930
2000	6,113	2,502	2,566	1,167	2,300	3,802	18,450
2001	8,754,	3,337	4,275	1,407	2,417	4,740	24,930
2002	12,001	4,830	4,685	1,702	2,880	5,939	32,037
2003	14,609	6,202	6,374	2,110	3,110	7,026	39,431
2004	16,629	8,263	6,740	3,000	3,117	9,971	47,720
2005	18,428	10,027	9,149	4,430	3,122	13,928	59,084

Source : Compiled by Earth Policy Institute from World watch Institute, **Signposts 2001**, CD-Rom (Washington, DC : 2001) ;Worldwatch Institute, **Signposts 2004**, CD-Rom (Washington, DC : 2004) ; Global Wind Energy Council (GWEC), **"Record year for Wind Energy : Global Wind Power Market Increased by 40.5% in 2005",** press release (Brussels :

17 February 2006) ; GWEC, **"Global Wind Power Continues Expansion",** press release (Brussels : 4 March 2005) ; American Wind Energy Association, **Global Wind Energy Market Report** (Washington, DC : 2000-2004).

MNES has also issued guidelines to all state governments to create an attractive environment for the export,purchase,wheeling and banking of electricity generated by wind power projects. Renewable Purchase Obligation or RPO as it is commonly known is a mechanism that makes purchase of electricity generated by renewable energy sources obligatory for all electricity utilities. The mechanism is an important provision that comes in the wake of Section 86(1)(e) and Section 61(S) of the Electricity Act, (EA) 2003, which stipulates that State Electricity Regulatory Commissions(SERCs) shall promote co-generation and generation of electricity from renewable energy sources by providing suitable measures for connectivity with the grid; sale of electricity to any person; specify percentage of the total consumption of electricity in the area of a distribution licensee; specify terms and conditions for determination of tariff, etc. The National Electricity Policy notified by the Ministry of Power,GoI,vide notification dated 12 February 2005, also stresses the need to increase the share of electricity from renewable sources, as prescribed by SERCs.Status of RPO in different Indian States is presented in Table 2.

Table 2 Status of RPO in Indian states

Sl. No.	State	Status of RPO	Eligible Renewable Energy Sources	Operationlisation Mechanism	Validity
1.	Maharashtra	Order issued on 06.09.04	RE generation from grid connected RE projects (wind energy, bagasse, solar energy, etc.) excluding RE projects meant for captive use and third party sale. SHP projects set up by ID for self consumption purposes are also excluded	Percentage RPO for a financial year shall be the ratio of 'total RE generation in the state to the sum of gross input energy units' for all licensees for that financial year excluding any inter-se sale / consumption of electricity among the licensees. Target percent-tage RPO for each licensee shall be same as the percentage RPO for the state as a whole.	Till further revision or revoked
2.	Karnataka	Final Regulation 27.09.04	Wind energy, solar energy, biomass, municipal waste, mini hydel and all other RE sources approved by MNES	Each distribution licensee shall purchase a minimum quantum of 5% and a maximum quantum of 10% of electricity from renewable sources expressed as a percentage of its total consumption during a year	Revision once in 3 years
3.	Andhra Pradesh	Order issued on 27.09.05	Co-generation (from renewable sources of energy like bagasse), mini-hydel, wind, municipal waste, industrial waste, and biomass	Each licensee shall purchase 5% of its consumption of electricity from RE sources during 2005-06 to 2007-08. This is subject to 0.5% of 1% of total consumption to be always reserved for wind based energy	Up to 2007-08

4.	Gujarat	Final Regulation 29.10.05	Mini-hydel, wind, solar, biomass (including sugar mill co-generation), urban / municipal waste, or other such sources as approved by the Ministry of Non-Conventional Energy Sources, GoI, or Govern-ment of Gujarat	Each distribution licensee shall purchase a minimum quantum of 1% of its total consumption of electricity during 2006-07, followed by 1% and 2% during 2007-08 and 2008-09	Revision once in every 3 years.
5.	Uttar Pradesh	Order issued on 12.01.06	All non-conventional energy sources approved by MNES, GoI	Each distribution licensee shall purchase 7.5% of its total power consumption from renewable sources located within the state.	Not specified
6.	Madhya Pradesh	Order issued on 11.06.04	Presently for wind energy only	0.5% of total annual consumption (including third party sale) for wind power every year.	Valid for 3 years
7.	Orissa	Order issued on 23.04.05	Wind energy and small hydro	Distribution licensee shall purchase 200MU of power from renewable energy sources in FY 2006-07	Valid up to FY 2006-07
8.	Tamil Nadu	Discussion paper on tariff related issues	Presently for wind energy	Distribution licensee shall purchase a minimum 10% of its total power consumption from renewable energy sources.	--
9.	Kerala	Consulta-tive paper	Proposed for wind energy and small hydro	Distribution licensee shall purchase between 1% to 5%	--

Sl. No.	State	Status of RPO	Eligible Renewable Energy Sources	Operationlisation Mechanism	Validity
		18.01.06		renewable energy as percentage of consumption in area of supply.	
10.	Rajasthan	Consulta-tion paper November 2005	Proposed for wind, biomass, small hydro	The quantum of wind power purchase (in MW) as percentage (between 7% to 9%) of power availability to the distribution licensee at interconnection with state grid (in MW) of the distribution licensee for executing PPAs and wind energy purchases (in MU) at interconnection point as a percentage (between 2.3% to 3%) of drawl of the distribution licensee from the state grid.	--
11.	Himachal Pradesh	Draft Regulation 30.11.05	Small Hydro Power	It is proposed that the distribution licensee shall indicate the quantum of purchase from renewable energy along with sufficient proof	--

Source: Green Energy, World Institution of Sustainable Energy Vol.2 No.1 Jan-Feb 2006 17-18.

Incentives for Wind Energy promotion offered by different state governments are presented in Table 3.

Table 3 Incentives offered by different state governments

Items	Wheeling	Banking	Buy-back	Third party-sales	Capital subsidy	Other incentives
Andhra Pradesh	2% of energy	12 months	Rs.2.25/kwh (5% escalation 95-96) presently Rs.3.37	NOT allowed	NOT available NEDCAP	Van drawal 0.10p/unit. To give 10 lakhs/MW to AP Transcol lakh / to NEDCAP
Tamilnadu	5% of energy	5% for 12 Months	Rs.2.70/kwh (no escalation)	NOT allowed	NIL	No generation tax for 5 years van drawal 0.40p/unit
Karnataka	30% of energy	2% every month for 12 months	Rs.3.40/kwh	Allowed to HT consumers	Same as for other industries	-
Kerala	2% of energy	6 months	To be agreed mutually	--	15% (max RS.5 lakhs)	-
Uttar Pradesh	2% of energy	12 months	Rs.2.25/kwh(5% of escalation)	Allowed	Same as for other industries	-
West Bengal	2% of energy	6 months	To be decided on case to case to case basis	NOT allowed	-	-
Gujarat	4% of energy	6 months	Rs.3.32/kwh	NOT allowed	-	-
Madhya Pradesh	2% of energy	2% for 12 months	Present Rs.3.90/kwh	Allowed	Same as for other industries	-
Maharashtra	2% of energy<200kms	2% for 12 months	Rs.3.50h/kw	Allowed	30% (max Rs. 20 lakhs per project)	Sales tax (Exemption for 6 years subject to a minimum PLF of 20%)
Rajasthan	2% of energy	2% for 12 months	Present Rs.3.32/kwh	Allowed	-	-

IUS$ = Rs 45

Wind turbine manufacturers in India

Over the past years, both the government and the wind power industry have succeeded in injecting greater stability into the Indian market. This has encouraged larger private and public sector enterprises to invest. It has also stimulated a stronger domestic manufacturing sector; some companies now source more than 80% of the components for their turbines in India. This has resulted both in more cost effective production and in creating additional local employment. Most recently, some Indian manufacturers have started to export their products.

The major players in wind turbine manufacture are Suzlon, Enercon, NEG Micon, Vestas RRB, Pioneer Asia, GE etc., The geographical spread of Indian wind power has so far been concentrated in few regions especially in the southern state of Tamil Nadu which accounts for 33300 MW out of the country's wind installations of 5300 MW. Karnataka, Rajasthan, Maharashtra are starting to catch up. The Indian government envisaged a capacity addition of around 5,000 MW by 2012.

Some suggested measures to promote large scale wind farms

Wind farm co-operatives

In India, most of the wind farms are set up by big industries mainly as a tax shelter plan. Unless wind projects are mass based, it is hardly possible to get the political support besides resources to support wind projects. Comparatively, wind energy development in Denmark is worth emulating in India. About 75% of the wind turbines in Denmark are owned by local associations and private individuals (7). More than 100,000 families are involved as shareholders. Over the past decade, the popularity of wind turbines had grown to such an extent that today they cater for a substantial percent of the country's total electricity consumption. This, in turn, provided an excellent basis for renewed community spirit and the growth of interest in energy and environment issues. In India Wind farm co-operatives can be promoted on the lines of those in Denmark.

Wind fund

There is the need to create more financial support avenues to promote large scale wind farms. A 'wind fund' in line with the one in UK can be created in India to support wind projects. Such a fund will provide equity finance for small-scale wind energy projects and will offer investment

Geographic information systems for wind sitting

Latest methods like Geographical Information Systems (GIS) have to be utilized for large area screening of prospective sites for wind power development. Wind speeds at the height of a wind turbine depend strongly on terrain elevation, exposure, slope, and orientation to prevailing winds, which can be calculated from a GIS-based Digital Elevation Model (DEM). In addition, with the appropriate database, a GIS can account for other factors that affect wind site suitability, such as the distance to transmission lines, proximity to protected areas, and type of vegetation cover.

Off-shore wind farms

In Europe Off-shore wind farms have contributed to the success of wind energy exploitation. Off-shore wind farms produce on an average produce 30% more energy compared to On-shore. Moreover with Megawatt size wind turbines available, it is sensible to install them off-shore on large scale. In India a beginning can be made to identify windy sites off-shore to erect large wind turbines

Conclusions and Prognosis

The potential of wind energy in India is large. Apart from on-shore wind turbines, possibilities of off-shore should be exploited. In Europe off-shore wind farms are quite successful. Costs have to come down further, requiring development of advanced flexible concepts and dedicated off-shore wind energy systems. Although wind-generated electricity is an intermittent resource, it can be transformed to base load power supply if combined with energy storage. For compressed air storage the additional costs may be limited to about $0.01 a kilowatt-hour, opening the possibility of exploiting good wind resources remote from markets. With improved design for wind turbines, financial package, political will to support large-scale wind projects through public sector undertakings, and a remunerative price for wind generated electricity, it is hoped that wind energy will play a supplementary role to meet the growing power demands in the country in general, and Tamil Nadu in Particular.

References

[1] Wind Energy Resource Survey in India-I, 1990, New Delhi: Allied Publishers Ltd.

[2] Wind Energy Resource Survey in India-II, 1992, New Delhi: Allied Publishers Ltd.

[3] Wind Energy Resource Survey in India-III, 1994, New Delhi: Allied Publishers Ltd.

[4] Wind Energy Resource Survey in India-IV, 1996, New Delhi: Allied Publishers Ltd.

[5] Wind Energy Resource Survey in India-V, 1998, New Delhi: Allied Publishers Ltd.

[6] Ministry of Non-Conventional Energy Sources, Government of India, Annual Report, 2004-2005.

[7] Meyer, N.I, 1995,"Danish Wind Power Development", *Energy for Sustainable Development*, 2, No.1, 18-25.