The progress of renewable energy with respect to wind energy in last 6 years in India

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Abstract

Energy is the most essential element of socio-economic development and nation's economic growth. Renewable energy sources can play an immense role to fulfill this need of energy. These sources will not only enhance independency of energy but also helps in many ways such as mitigation of climate change, swift development of rural areas, improved health status and will be the best way to move towards sustainable development. Renewable energy sources like wind energy are identified by International Energy Agency as key element to reduce fossil fuels dependency and helpful tool to combat global warming. In this paper, the status of wind energy is explored in Indian context. The state wise status, different challenges, issues, barriers, wind power development (on and offshore) and policies are discussed in detail. The research work contains secondary data that has been taken from government websites. Findings from the research have been that the wind energy sector has been growing year on year in India but side by side the FDI and FII's have not grown which has had its impact on the development of this sector.

Keywords: Wind energy, status, renewable energy, policies, and wind turbines.

Introduction

The exponential growth in the rate of energy consumption is the main cause of energy shortage, as well as energy resources depletion worldwide. Electricity shortage is very common in India where most of the population (over 40%) has no access to modern energy services. On an average, electricity demand is expected to rise 7.4 percent annually for next 25 years. According to International Energy Agency, more than 28% share of the world's total energy will be consumed in India and China by the year 2030. Therefore a significant amount of energy must come from renewable sources. National Action Plan on Climate Change (NAPCC) was formed in 2008 for climate change control, has also considered role of renewable energy in total energy production of India2. NAPCC has also set a target to increase the renewable energy share in total energy production up to 15 percent till year 2020, which clearly shows India's commitment towards a sustainable development. The huge gap between demand and supply requires more energy resources. The basic challenge is to fulfill the energy requirements in a sustainable way and one of the best available options in current scenario is renewable energy sources, so it is required to intensify renewable energy and energy efficiency program3. By moving towards renewable energy production, which must be indigenous in nature and must have low generation cost, one can enhance energy security condition, reduce our import dependency, solve problem of fuel price instability etc. Carbon di oxide emissions can be reduced on an average 3.3 million tons in a year by adding 1 GW energy of renewable origin so it will help to minimize the adverse effects of climate change in India. Wind energy can emerge as a solution of most of the problems because it is cost-effective in nature, clean energy resource, reduce fossil fuel demand and more over could be

a fighting tool against climate change. Before the development of the steam engine, conventionally wind power was used for various applications such as sailing ships etc.

Review of Literature

Mani and Dhingra in 2013 conducted a research on the 'Policies to accelerate the growth of offshore wind energy sector in India'. Their research objective was to find policy framework to encourage the development of offshore wind farms. They administered a questionnaire to 181 stakeholders of wind energy in India to seek their feedback on the absence of policy for the development of offshore wind farms. Their major finding was that government support, fiscal and quota based incentives and building an enabling R&D ecosystem have a much higher impact on the growth of offshore wind energy for India. From their work, we learned that there is a huge potential for renewable energy as it is hardly 12% of the total energy consumption in India. And there is no contribution by the offshore wind farms which have a huge potential, which needs to be tapped with the right policy framework.

Dublin - Research and Markets in their publication has published an article titled 'Wind Energy Market in India 2009-13, in which they have mentioned that Indian wind energy sector has been growing rapidly in past few years, mostly due to Government's incentives such as tax exemptions and subsidies. The installed capacity is growing rapidly due to the entry of various private players in manufacturing of wind turbines and production of electricity.

Objectives

1. To know the growth in wind energy sector in India
2. To analyze the growth in FDI and FII investments in wind energy sector in India
3. To suggest the policy change for the wind sector to achieve sustainability

Methodology

Wind sector has huge untapped potential which need to be explored hence the present topic was selected. The study was carried out using primarily secondary data. Previous studies were collected from various journals and publication and also from website of ministry of natural and renewable energy. Data has also been taken from websites of various government organizations.

Hypotheses:

Hypothesis1:

H_0: India wind sector is not growing.

H_1: India wind sector is growing.

Hypothesis 2:

H0- FDI and FII investments have not grown year on year

H1- FDI and FII investments have grown year on year

Analysis of Data: A consolidated table for data of general information has been prepared while separate tables for each specific analysis are presented with simultaneous interpretation using pie charts and bar graphs.

Results and Discussions

Table 1: Wind Industry Progress Analysis

S.No	Wind Power – Progress (in MW)
1	Potential (at 80 m)
2	Achievement so far
3	11th Plan Target
4	Achievement during 11th Plan
5	Achievement during 2011-12
6	Achievement during 2012-13
7	Target for 12th Plan
8	Target for 2013-14
9	Achievement during 2013-14(so far)

Source: Ministry of Natural Resources and Energy

Discussion: As per Ministry of Natural Resource and Energy India's wind potential at the 80 meter hub height is 102000 MW and so far in India the installed capacity is 20150 MW. India has huge untapped potential which lie at above 80 meter hub height. Manufacturers of wind turbines, since last few years, are trying to cash this potential by installing turbines of height more than 80 meters up to 125 meters. The 11th plan had targeted to install 9000 MW and by the end of 11th plan India had installed 10260 MW and this clearly shows that India has over achieved. In the 12th plan the target is of 15000 MW and so far only 5300 MW (1700+2500+1100) has been installed which is far behind the target.

Table 2: Capacity Addition Analysis

S.No	Target		Achievement in March		Achievement		Cumulative Achievements	
	2012-13	2013-14	2012-13	2013-14	2012-13(% of target)	2013-14(% of target)	As on 31/3/2013	As on 31/3/2014
1	2500	2500	416.6	729.1	1698.8(68%)	2083.3(83.34%)	19051.5	21136.3

Source: Ministry of Natural Resources and Energy

Discussion: According to Ministry of Natural Resources and Energy in the financial year 2012-13 the target achieved was 68 % of the proposed target and in the 2013-14 financial year the target achieved was 83.34 % of the proposed target. The reason for this high installation in the year 2013-14 is higher RPO (Renewable purchase obligation) of states, REC (Renewable energy certificate) demand, FDI inflow and entry of more number of domestic and foreign players in this sector.

Table 3: Installed capacity per state analysis

		STATES								
SNo	**Year**	**Tamil Nadu**	**Karnatka**	**Maharashtra**	**Rajasthan**	**Andhra Pradesh**	**Madhya Pradesh**	**Kerala**	**Gujarat**	**Other's**
1	Mar-09	4304.5	1327.4	1938.9	738.4	122.5	212.8	27	1566.5	1.1
2	Mar-10	4907	1473	2078	1088	236	229	28	1864	4
3	Mar-11	5904.4	1730	2310.8	1524.8	200.2	275.5	32.8	2175.5	0
4	Mar-12	6987.6	1933.5	2733.3	2070.7	245.5	376.4	35.1	2966.3	3.2
5	Mar-13	7162.18	2135.15	3021.85	2684.65	447.65	386	35.1	3174.58	4.3
6	Mar-14	7275.68	2323.85	4064.95	2783.45	783.35	423.4	35.1	3447.28	4.3

Source: Ministry of Natural Resources and Energy

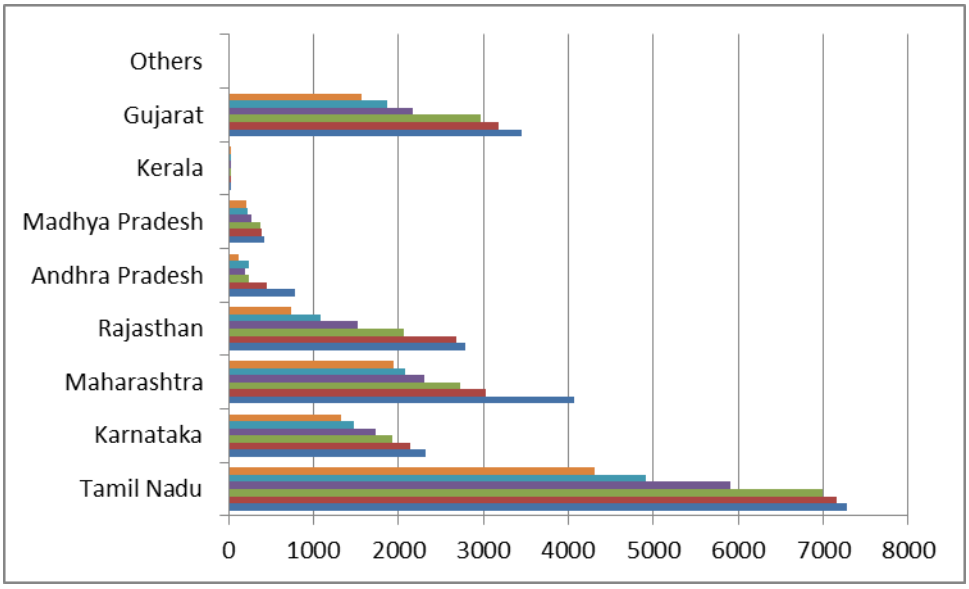

Figure 1: Installed capacity per state for different years

Discussion: This analysis gives the insight of the growth rate of the wind sector in various states and how much they have grown in past years. Each state is analyzed separately below:

Karnataka: The growth rate was almost 11 percent in March 2010 (from the previous year 2009) and till March 2011 it was growing but after March 2011 it started decreasing. The various reasons for this decline were market slowdown, less FDI inflow in this sector. Many companies were even struggling to maintain working capital. All the major players were in huge debt. For the year ending March 2014, the growth rate was 8.835 percent.

Tamil Nadu: In year 2010, 2011 and 2012 the growth rate was above 15 percent and in the year 2011 it was 20 percent. There after there is a continuous decline and for the year ending March 2014 it was as low as 1.6 percent. This was a huge setback for this sector and the state because there is huge untapped potential in state which needs to be harnessed.

Maharashtra: This is the only state in which the installation has been growing year on year and for the year ending March 2014 the growth rate was 34.511 percent. This happened due to government policies and huge investment by foreign investors like China Link Power and Goldman Sach.

Andhra Pradesh: The growth rate for this state is also very impressive, for the year ending March 2014 the growth rate was 74.99 percent. In the year 2011 the growth rate was negative otherwise the state is doing good and it has huge untapped potential which can be harnessed in the coming years.

Table 3: Analysis of Wind Power Development

S.No	Details	Andhra Pradesh	Gujarat	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Rajasthan	Tamil Nadu
1	No of identified sites	34	40	26	17	7	33	8	47
2	No of Potential Districts	7	9	11	3	5	12	5	11
3	Annual Mean wind speed(m/sec)@50m	4.8-6.6	4.3-6.9	5.1-8.3	4.4-8.1	5-6.25	4.3-6.5	4-5.7	4.4-7.3
4	No of wind monitoring stations	78	69	59	29	37	128	36	70
5	Installable wind potential (MW)@ 80m	14497	35071	13593	837	2931	5961	5050	14152
6	Present installed capacity	783.3	3447	2324	35.1	423.4	4065	2783	7276
7	Untapped	14252	32105	11660	801.9	2555	3228	2979	7164

Source: Ministry of Natural Resources and Energy

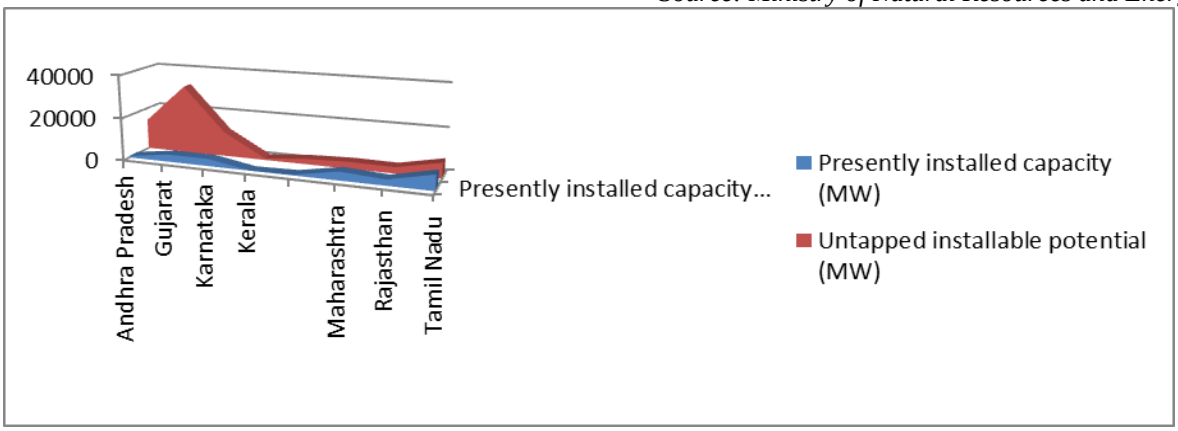

Figure 2: Analysis of Wind Power Development

Discussion: The state wise sites identified for wind power development are highest in Tamil Nadu and Gujarat which have 47 and 40 sites respectively while Rajasthan and Madhya Pradesh have the least sites - 8 and 7 respectively. Identified number of potential districts is highest in Tamil Nadu and Karnataka with each having 11 districts while Madhya Pradesh has the least number of districts which are 5. Maharashtra with 128 has the highest number of wind monitoring stations established till now while Kerala has the least with 29. Tamil Nadu, Andhra Pradesh, Gujarat have 70, 78 and 69 stations respectively. Out of the established wind monitoring stations the highest number of stations operating are in Maharashtra (20) followed by Andhra Pradesh which has 16. Rajasthan and Tamil Nadu have the least with 1 and 2 stations respectively. Installable wind potential is highest in Gujarat with 35071 MW followed by Tamil Nadu having 14152 MW while Kerala has the least with only 837 MW. Tamil Nadu presently has,, the highest maximum installed capacity of 7275.68 MW while Kerala has the least 35.1 MW. Untapped installable potential is the maximum in Gujarat, which has 11,659.50 MW untapped potential while Kerala, has minimum with 801.9 MW.

Table 4: FDI Detail in Renewable Energy Industry

FDI Detail In Renewable Energy Industry											
SNo	**States Covered**	**2009-10**		**2010-11**		**2011-12**		**2012-13**		**Total**	
		Apr-Mar		**Apr-Mar**		**Apr-Mar**		**Apr-Dec**			
		Rs	***US$***	***Rs***	***US$***	***Rs***	***US$***	***Rs***	***US$***	***Rs***	***US$***
1	Andhra Pradesh	0	0	138.51	30.07	630.37	132.04	48.38	8.9	**817.26**	**171.01**
2	Gujarat	172.81	37.6	567.31	124.98	0	0	0.45	0.08	**740.57**	**162.66**
3	Karnataka	138.87	29.55	123.15	26.77	45.34	9.03	275.28	52.96	**582.64**	**118.31**
4	Maharashtra, Dadra & Nagar Haveli, Daman & Diu	328.17	71.87	98.1	21.49	701.08	142.95	654.01	120.14	**1,781.35**	**356.45**
5	Rajasthan	0	0	0.01	0	0.51	0.1	0	0	**0.52**	**0.1**
6	Tamil Nadu, Pondicherry	14.09	3.03	20.47	4.48	104.43	20.57	1,106.32	202.87	**1,245.31**	**230.95**
7	Uttar Pradesh, Uttaranchal	1.03	0.21	0	0	0	0	0	0	**1.03**	**0.21**
8	West Bengal, Sikkim, Andaman& Nicobar Islands	0	0	0.63	0.14	0	0	22.5	4.13	**23.13**	**4.27**
9	Chandigarh, Punjab, Haryana, Himachal Pradesh	0	0	2.45	0.54	2.95	0.57	0	0	**5.4**	**1.12**

10	Delhi, Part of UP and Haryana	2,217.34	480.25	26.48	5.79	707.53	145.83	308.42	58.75	**3,259.77**	**690.62**
11	Goa	0	0	0	0	0	0	0.85	0.15	**0.85**	**0.15**
12	Region not Indicated	0.1	0.02	0.61	0.13	5.3	1.08	104.86	19.08	**110.86**	**20.31**
	Grand Total	**2,872.41**	**622.52**	**977.71**	**214.4**	**2,197.50**	**452.17**	**2,521.08**	**467.07**	**8,568.69**	**1,756.17**

Source: Ministry of Natural Resources and Energy

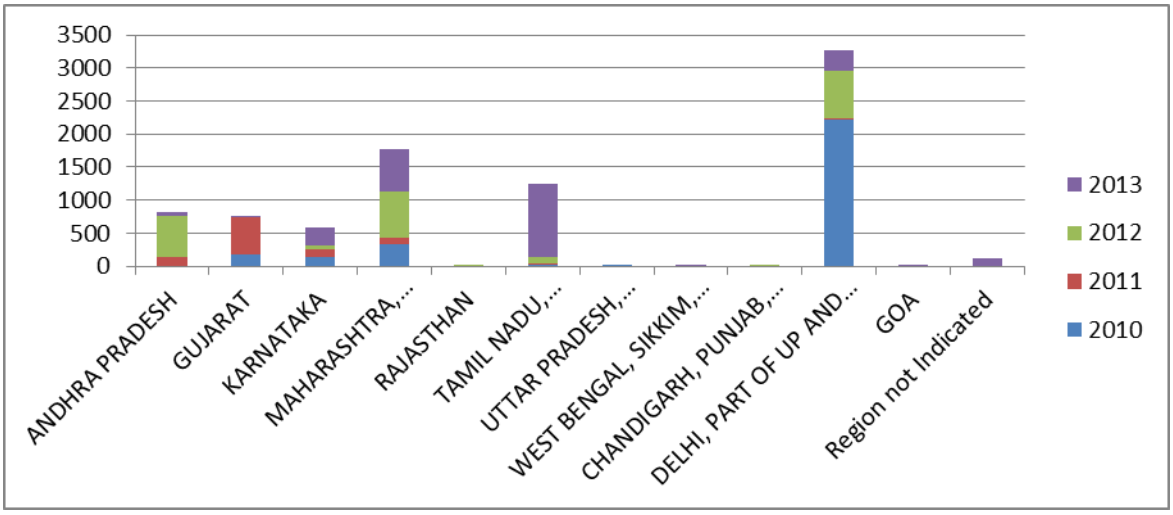

Figure 3: FDI Detail in Renewable Energy Industry

Discussion: There has been Foreign Direct Investment (FDI) inflow to the tune of Rs.8569 Crore (US$ 1756 million) in the renewable energy sector during the last four years. From the Data presented in the table in chapter 4 it is quite evident that FDI in this sector across Different state has seen many fluctuations. Some of these states are as follows –

- Andhra Pradesh – Initially in 2009-10 there is zero foreign investment in this state but 2010-11 has seen a very high increase of Rs.138.51 crore. There is a gradual decrease in FDI after 2010 FDI in 2012-13 was only Rs.48.38 crore.
- Gujarat – Foreign investment in this state has also seen a very high fluctuation. While it was 172.81 in 2009-10, it came down to only 0.45 crore
- Rajasthan – There is an overall a very low Investment in this state, though there is huge capacity in the state. It has a total of only 0.52 crore of foreign investment till 2012-13.
- Tamil Nadu & Pondicherry – over the last four years Tamil Nadu & Pondicherry has seen huge flow of FDI in renewable energy. The highest inflow was in 2012-13 of Rs.1245.31 crore

Overall FDI in renewable energy is increasing in all the states though in some states it is increasing at a very low rate. The Government also has a policy to encourage transfer of foreign technologies, including those in renewable energy sector. Foreign Direct Investment (FDI) up to 100% under the automatic route is permitted in Renewable Energy Generation and Distribution projects subject to provisions of Electricity Act, 2003

During the 12th Five Year Plan term (2012-13 to 2016-17), the **Ministry of Natural Resources and Energy** (Ministry of New & Renewable Energy) has been slated to add 29,800 MW power capacity from renewable energy sources (Wind – 15,000 MW).

Hypothesis Testing:

To test the first hypothesis, statistical tool of correlation was applied. The correlation coefficient r value = .9958. The critical value at DOF 4 and at probability 0.5 and 0.01 is 0.811 and 0.917 respectively. This result rejects the null hypothesis of hypothesis 1 which states that ": India wind sector is not growing", Hence the alternate hypothesis ": India wind sector is growing" can be accepted.

For testing the second hypothesis, correlation coefficient r value = .9958. The critical value at DOF 4 and at probability 0.5 and 0.01 is 0.950 and 0.990 respectively. This result accepts the null hypothesis of hypothesis 2 which states that ": FDI and FII investments have not grown year on year", Hence the alternate hypothesis ": FDI and FII investments have grown year on year is can be rejected.

Conclusion

The above results are in agreement with the results of Dublin – Research and Markets, who found that Indian wind energy sector has been growing rapidly in past few years, mostly due to Government's incentives such as tax exemptions and subsidies. The installed capacity is growing rapidly due to the entry of various private players in manufacturing of wind turbines and production of electricity. Also due to policy paralysis the sector was not given so much of attention earlier but in the recent years the growth in the sector has picked up with the rising oil prices and search for harnessing of clean energy fuel.

Recommendations

India has huge unutilized resources sitting idle like manpower, technology, potential wind site and capital. There is a need for micro zonation of all resources for better utilization. The wind turbines used by Indian wind farm developers are all directly or indirectly foreign designs. In India only one manufacturer uses synchronous generator for wind turbines which is original design of Enercon GMBH, a German giant. There is a need for indigenous design which suits the Indian wind scenario. Only a hand full of premium institute offer courses in wind technology in India. Due to huge potential and growth in this sector, more and more foreign and domestic players are investing in this sector. The only thing government need to do is develop policy and environment which caters to the need of industry and country efficiently. The competition in wind industry is now cut-throat, which is good for country and investors. India is lacking in hybrid technology like combining wind turbines with solar power, which will eventually lead to better utilization of land, capital and resources. India has already developed grid codes for wind industry for better functioning of electricity grid but its implementation is limited to few grid codes only. We need to force the implement of the grid codes so that future failure of grid can be avoided. India's investment on R&D is always debatable, Indian firm focus less on R&D and due to this quality is lacking in many areas for example many manufacturers still imports epoxy for FRP, yaw motors and many others for production. India's second largest wind turbine manufacturer still imports 40 to 49% of BOMs from outside India.

The table below shows where all changes can take place;

AREA	CURRENT STATUS	DESIRED CHANGE
Resource	Gross-potential	Micro zonation for accuracy
Private investments	Tax/incentive driven	CDM/generation/green Energy/Quality
Manufacturing	From foreign IPRs/DWG	Indigenous Design capability
Competition	Cut-throat	Open-Consortium
Health-monitoring	minimal	Learn from failures
R&D & innovation	In closed doors	A consortium and industry supported
Small Wind Turbines & Hybrid (Wind & Solar)	Small alone battery charger type	Net metering with Grid interactive/interfaced
Grid Code	Not mandatory	May be practiced to ensure power quality/stability of Grids

Recommendations in policy changes state wise:

Rajasthan: The Honorable Commission in its draft tariff Regulation, 2014 has proposed to reduce the period of banking i.e. on monthly basis which was earlier on six monthly basis ; and ROE @ 14.5% which is not reasonable return to investor and also not in line with CERC RE Regulation and is defiance of National Tariff Policy- 2006.

Gujarat: In preferential tariff calculation there is a computational error in RoE and AD which has reduced the RoE of the investors.

Karnataka: At present, third party sale with REC is not allowed in the state which limits the wind investment in the state

a) Tariff determined on average basis shall not consider time value of money
b) The banking should not be revised as per the draft wheeling and banking agreement format published recently.

Tamil Nadu:

a) Tariff determined on average basis shall not consider time value of money
b) No wind power policy in the state. Conducive policy required
c) Evacuation issue

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