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Review Paper

A Review of Wind Energy Scenario 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. Wind energy is indeed a form of solar energy produced by differential heating on the earth surface. Wind's kinetic energy can be captured and converted in to electricity via wind turbines. 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.

Keywords: Wind energy, status, renewable energy, policies, 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 country like India where most of the population (i.e. over 40 percent) has no access to modern energy services. On an average, electricity demand is expected to rise 7.4 percent annually for next 25 years[1]. According to International Energy Agency, more than 28 percent 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 India[2]. 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 program[3]. By moving towards renewable energy production, which must be indigenous in nature and must have low generation cost, we 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[1]. 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. Wind power has been using since ancient eras for various purposes. Before the development of the steam engine, conventionally wind power was primarily used for various applications such as sailing ships etc[4].

Indian Wind Energy Status

Wind energy program was commenced in India by the end of the 6th five yearly plan during 1983-84 and in the last few years it has increased considerably. The main objective of the program was the commercialization of wind energy production, support research and development, provide help to wind projects and to create awareness among people. Under this program Ministry of Non Renewable Energy (MNRE) has done various modification regarding incentives, schemes and policies for wind energy. India is relatively newcomer to the wind energy sector as compared to Denmark or USA. But Indian policy support for wind energy has led India and it ranked fifth with largest installed wind power capacity[5]. The total installed power capacity was 19,565 MW on June 30, 2013[6] and now India is just behind USA, China, Spain and Germany. Global installed wind power capacity shows India's better performance in wind energy sector (table-1). The five main wind power countries are China, USA, Germany, Spain and India and they together represent a share of 73 percent of the global wind capacity. As per MNRE (figure- 1), wind power accounts for the largest share of renewable power installed capacity i.e.70 percent (2012), as compared to the other renewable sources. The total installed wind power capacity in India had reached 17.9

GW in August 2012. The total capacity added during financial year 2012-2013 was around 1,700 MW[7]. India's cumulative installed capacity up to year 2011 is shown in figure -2. A rapid growth in wind power installation has been measured in southern and western states in India. A need for about 350- 360 GW of total energy generation capacity was reported by the Central Electricity Authority in its National Electricity Plan (2012), by the year 2022[8]. Only onshore wind potential has been utilised so far by India. In spite of the fact that India has long coast line over 7500 km, we have not yet tapped our offshore wind resource for energy generation. The Capacity Utilization Factor (CUF) of offshore wind turbines is much higher as compared to the onshore turbines because of the high offshore wind speed[7]. Offshore Wind Steering Committee was established by MNRE in August 2012, which released a draft of the National Offshore Wind Energy Policy in May 2013.

Wind Energy Potential Sites

Wind atlas is helpful to determine the promising sites for large scale production of energy through wind turbine. Indian wind atlas at 50 m height is shown in figure-3. As per C-WET data the total installable potential at 50 m level is 49130 MW.

Table-1
Total Global Installed Capacity (Up to June 2013)

Global Wind Power Scenario	
Country	**Installed Capacity (MW)**
China	80,824
USA	60,009
Germany	32,422
Spain	22,907
India	**19,565**
UK	9,610
Italy	8,415
France	7,821
Canada	6,578
Denmark	4,578
Portugal	4,564
Sweden	4,066
Australia	3,059
Brazil	2,788
Japan	2,655
Rest of the World	26,204
Total	**296,065**

Source: WWEA, 2013

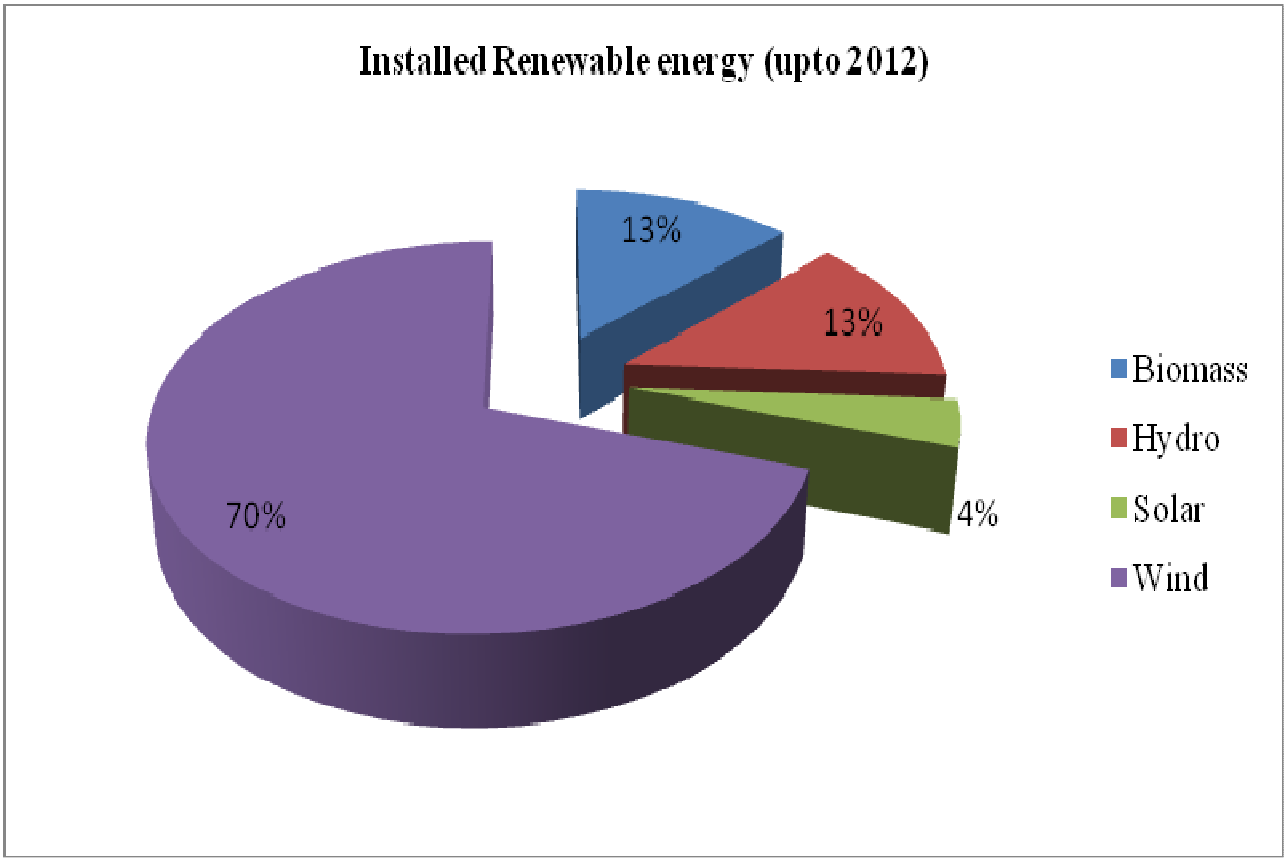

Figure-1
Renewable Power Sector in India (Source: MNRE)

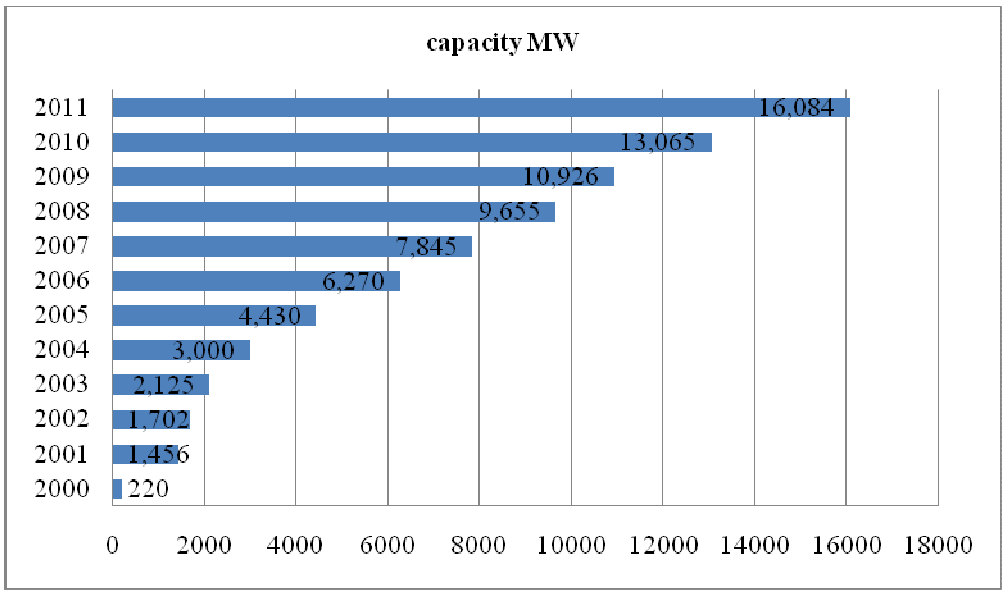

Figure-2
India's Cumulative Wind Installation (MW) (Source: GWEC, 2012)

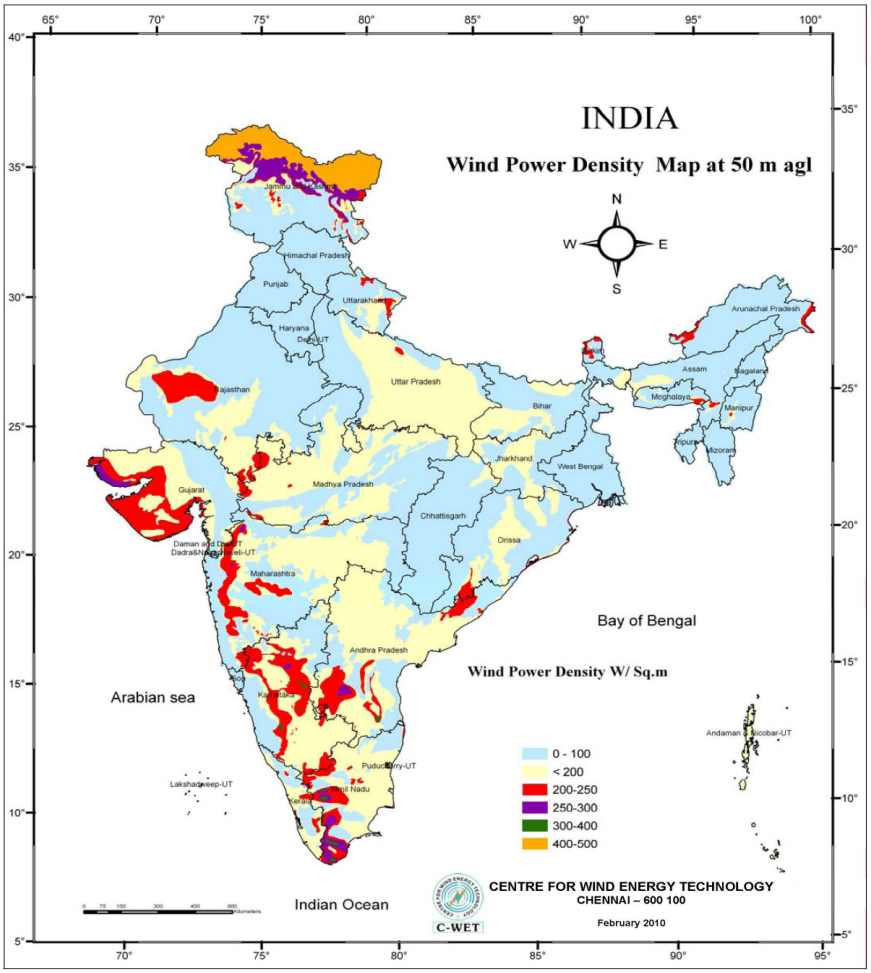

Figure-3
Wind Power Density Map (Source: C-WET, 2010)

State wise Wind Energy Scenario

More than 95 percent of total nation's wind energy generates from just five states located in southern and western India i.e. Gujarat, Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh. These five states are also accounted for approximately 85 percent of total installed capacity before the end of 11th five yearly plan. It clearly indicates that these five states have been leaders in wind energy generation while other states like Madhya Pradesh, Rajasthan and Kerala are also quickly increasing their capacity. Table-2 provides state wise installed wind power capacity and growth rate of wind energy in India (Up to June 20th 2013) as well as semi annual growth rate. The highest wind energy installed state Tamil Nadu, which has total installed capacity of 7,196 MW till June 2013, had added 8 percent wind capacity between years 2011 to 2012[9]. Table-3 provides state wise comparison of Wind Power Development (2012) among eight most promising states.

National Policies on Wind Energy

Renewable Purchase Obligations (RPOs) has been introduced by Government of India through National Action Plan for Climate Change (NAPCC). The obligated entities are narrated to meet their respective RPOs by setting up their independent renewable energy power plant OR can directly purchase power from renewable energy plants by signing a Power Purchase Agreement (PPA) with energy plants. States such as Maharashtra, Andhra Pradesh, Madhya Pradesh, Kerala, Rajasthan and Gujarat have updated their energy policies for wind as of March 2013[9]. Various State Electricity Regulatory Boards (SERCs) specified their new wind specific RPO's requirements i.e. i. Wind energy purchase obligations for Rajasthan, Gujarat and Karnataka have an RPO requirement of 7-9 percent by 2015. ii. Andhra Pradesh, Tamil Nadu and Gujarat also have issued modified tariff during the year. iii. "Open Access" mechanism has been allowed consumers for direct power purchase from any generator in the country with due applicable charges like wheeling, transmission, point-of-connection charges, State Load Dispatch Charges (SLDC) and Regional Load Dispatch Charges (RLDC).

Table-2
State Wise Installed Wind Power Capacity and Growth Rate of Wind Energy in India (Up to June 20th 2013)

State	Installed capacity as of December 31st 2012 (MW)	Installed capacity as of June 30th 2013 (MW)	Growth (%)
Tamil Nadu	7,153	7,196	1%
Gujarat	3,093	3,250	5%
Maharashtra	2,976	3,294	10%
Karnataka	2,113	2,170	3%
Rajasthan	2,355	2,717	15%
Madhya Pradesh	386	386	0%
Andhra Pradesh	435	514	18%
Kerala	35	35.1	0%
Others	4	4.3	8%
Total	**18,550**	**19,565**	**5%**

Source: MNRE

Table-3
State Wise Comparison of Wind Power Development (2012)

Details	States							
	Andhra Pradesh	Gujarat	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Rajasthan	Tamil Nadu
Total number of identified sites	34	40	26	17	7	33	8	47
Identified number of potential districts	7	9	11	3	5	12	5	11
Annual mean wind speed (m/sec) @ 50m mast height	4.86–6.61	4.33–6.97	5.19–8.37	4.41–8.12	5.0–6.25	4.31–6.58	4.02–5.73	4.47–7.32
Number of wind monitoring stations established till July 2012	78	69	59	29	37	128	36	70
Number of wind monitoring stations operating (as of August 2012)	16	6	12	2	-	20	1	2
Installable wind potential (MW) @ 80m height	14,497	35,071	13,593	837	2,931	5,961	5,050	14152
Presently installed capacity (MW) as on 31st March 2012	245.5	2,966.30	1,933.50	35.1	376.4	2,733.30	20,70.7	6987.6
Untapped installable potential (MW) as of April 2012	14,251.50	32,104.70	11,659.50	801.9	2,554.60	3,227.70	2,979.30	7164.4

Source: WISE, 2012

The Indian Renewable Energy Development Agency (IREDA) under MNRE provides various incentives for the wind energy generation in India such as loans to wind project developers with a benefit of ten years tax exemption on income accumulated through wind energy power projects[10]. Indian companies engaged in manufacturing of wind turbine equipments are also exempted from excise duty liabilities. An import duty concession on the import of electric generators has also been implemented.

Accelerated Depreciation (AD) has been the major motivating factor for wind market in past, which allowed a depreciation of 80 percent of the installation cost in the first year and therefore reduces the taxable income of plant owner by an amount equivalent to 80 percent of the plant's cost. Although this scheme has been discontinued from April 2012. The Generation Based Incentive (GBI) scheme was also discontinued from March 2012, but it has reintroduced from August 2013. The scheme has been designed in such a manner to continue to fulfill 15,000 MW target during the 2012 to 2017period. 100 percent Foreign Direct Investment (FDI) is allowed in wind sector, which has increased due to GBI scheme.

In August 2013, a national consultation on draft offshore policy was held which was based on the near shore wind data provided by C-WET, studied at different 54 locations along the coast line[11]. This draft identifies the arrangement of a National Offshore Wind Energy Authority (NOWA) which is supported by MNRE. NOWA is supposed to act as the nodal agency which will go through into contracts with project developers and will also synchronize with other agencies for clearances. As per draft, a ten year tax exemption will be applicable on wind power generation along with other benefits like customs duty concession, excise duty exemption for offshore wind turbines manufacturers, service taxes exemptions along with accessibility of survey vessels and installation vessels. It also offers exemption on land lease fee on seaboard area for a specified period with applied conditions such as ownership transferred to the government[11].

Challenges in Wind Energy and Major Issues

Technical: As per statics, the cumulative wind power farms capacity in India were observed approximately 1,380 MW before 2002. At present wind power accounts for 8.7 percent of the installed power capacity in India but it only contributes 1.6 percent of the power generated[12]. Indian wind power already has a lower Plant Load Factor (PLF) in comparison to fossil fuel, nuclear and hydropower plants and it is also low if we compare it with international standards. The core reason of this issue is because most of wind power farms in India have been reached up to its commissioned period and requires repowering.

Repowering will not only helps them to remain productive but also could create a possibility of power generation capacity enhancement to their best performing sites. As per studies, repowering of old wind farms could increase the wind energy PLF percentage significantly from 15 percent to 30 percent. It has been observed that in the absence of proper government policies framework and subsidies, many wind power companies are not willing to repower their plants which is essential to overcome this obstacle. MNRE must need to motivate such old wind farms for repowering their capacity by supporting with good and log terms policies.

Infrastructural: Fluctuations in grid frequency and voltage create difficulties in wind farm operations and reduce the chances for successful wind energy grid penetration, which is clearly indicated in reports[13]. Due to the limitation of grid infrastructure, it has been found that the amount of energy produced from wind farms could not be effectively transmitted throughout to consumers cause wastage of energy. MNRE has noticed this issue and accumulated in its report on "Green Energy Corridors", which identifies the infrastructure requirement for evacuation and transmission of renewable energy, including wind[14] and also sought Germany's cooperation to bring advanced grid integration technology to India.

Economic: High borrowing costs in India creates obstacle for wind energy sector growth. The project financing methodology applied for majority of wind power projects are conceived with 70: 30 debt equity ratio, that also with high interest rates which creates an expensive debt under difficult macroeconomics conditions of India.

Other Issues in Wind Power Development in India: i. Forest land clearance, e.g. in Karnataka, ii. Creation of infrastructure for power evacuation and transmission facilities, iii. Availability of land for wind farms, iv. Potential land mostly acquired by manufacturers/ developers, v. Implementation of revised tariff as per CERC guidelines, vi. Development of scheduling and forecasting system (industry and LDCs not yet fully prepared), vii. Withdrawal of Accelerated Depreciation.

Conclusion

It's been observed that wind energy has achieved and repeatedly surpassed the targets set under five yearly plans. The target set during 10th five yearly plan (year 2002 to 2007) was 1,500 MW whereas the actual installations been observed were 5,427 MW. Similarly, the target set during 11th five yearly plan (year 2007 to 2012) was 9,000 MW whereas the actual installations were 10,260 MW.

The proposed target for 12th five yearly plan (year 2012 to 2017) is 15,000 MW. Here in India, it is necessary to introduce long-term comprehensive stable policies to support and boost the necessary investments in renewable energy. To avoid the distraction of renewable energy policies effectiveness, the policies must be carefully structured considering a harmony with existing state level mechanisms. Considering the

effectiveness of wind energy share in renewable energy set targets, it should be allowed to grow without hurdles and policy withdrawals.

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