Term Major Project On

STUDY ON BUSINESS OPPORTUNITIES FOR WIND POWER PROJECTS FOR NEW MARKET ENTRANTS IN INDIA

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DECLARATION

I, hereby, declare that the project work entitled **"Study on business opportunities for Wind power projects for new market entrants in India**", is an authentic record of my own work carried out as a part of requirement towards partial fulfillment for the award of degree of MBA Executive, Delhi School of Management, Delhi Technological University,ShahbadDaulatpur, Main BawanaRoad, Delhi,underthe guidance of**Prof. P. K. Suri (Professor – DSM).**

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ABBREVIATION

AD	Accelerated Depreciation
APPC	Average Pooled Purchase Cost
CDM	Clean Development Mechanism
CER	Carbon Emission Reduction
CERC	Central Electricity Regulatory Commission
CUF	Capacity Utilization Factor
C-WET	Centre for Wind Energy Technology
DISCOM	Distribution Company
DMRPS	Dynamic Minimum Renewable Purchase Standard
EPC	Engineering, Procurement and Construction
FDI	Foreign Direct Investment
GBI	Generation Based Incentive
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Geographic Information System
GW	Giga Watt
GWEO	Global Wind Energy Outlook
HT	High Tension
IEA	International Energy Agency
IEGC	Indian Electricity Grid Code
IISC	Indian Institute of Science, Bangalore
IPP	Independent Power Producer
IREDA	Indian Renewable Energy Development Agency
IRR	Internal Rate of Return
ISTS	Inter-State Transmission System
IWTMA	Indian Wind Turbine Manufacturers Association
KAMM	Karlsruhe Atmospheric Mesoscale Model
kWh	Kilo Watt hour
LBNL	Lawrence Berkley National Laboratory
LULC	Land Use Land Cover
MAT	Minimum Alternate Tax
MNRE	Ministry of New and Renewable Energy
MW	Mega Watt
MWh	Mega Watt hour
NAPCC	National Action Plan on Climate Change
NCEF	National Clean Energy Fund
NLDC	National Load Dispatch Center
NOWA	National Offshore Wind energy Authority
O&M	Operation & Maintenance
PGCIL	Power Grid Corporation of India Ltd

PPA	Power Purchase Agreement
R&D	Research & Development
R&M	Renovation & Modernization
REC	Renewable Energy Certificate
RPO	Renewable Purchase Obligation
RRF	Renewable Regulatory Fund
SERC	State Electricity Regulatory Commission
TERI	The Energy and Resources Institutes
TWh	Tera Watt hour
UI	Unscheduled Interchange

Executive Summary

Wind Power is one of the important alternatives in the energy sector to reduce dependency on fossil fuels. The development of wind power is the key to fight against climate change. Most importantly, wind power would save 1.5 billion tons of CO_2 emissions in 2020. “The Energy Roadmap -2050” is an industry blueprint that explains how wind power could supply 16.5% of the world’s electricity by 2020 and 34% by 2050”.

India has a vast potential in wind energy, India has now gained sufficient technical and operational experience in wind energy sector; Apart from offering as a viable option in the energy supply mix, and wind energy sector also offers an attractive investment option to the private sector. The recently announced policies and renewable purchase obligation are the key drivers towards encouragement of private sector developers to come up with wind power generation plans. The report starts with an overview of current wind power scenario in India and abroad. This section further covers basic technology behind electrical energy generation from wind power. After studying the current situation, the report further delves into the potential held by wind resources of the country. The report looks into the contrasting findings of different agencies in relation to the wind energy potential.

The report further discusses in detail the legislative and regulatory framework established in India for the development of renewable energy . This section of report also covers the views and commitments of Government and various other Government agencies, towards sustainable development of wind energy sector in India. Further, the report details the financial and supplier market aspects that are to be looked into by a new investor. It also describes broadly, the modes of financing a wind energy project.

The absence of reliability factor associated with renewable energy sources no longer bothers captive consumers, thanks to the banking mechanism introduced by many states. The study focuses on such opportunities for wind energy projects to utilize the energy generated economically. It also discusses the opportunity of selling power through the grid.India has great potential to accelerate the use of its renewable resources especially wind energy to power its growing economy with a secure and affordable energy supply. Strengths, weakness, opportunities and threats (SWOT) of wind energy sector are analyzed in this report.

The study also focuses on the prevalent practices in the sector, the policy initiatives, fiscal benefits being offered and other conducive steps taken by Government & other Government agencies towards promotion of wind energy. Estimates of annual profit resulting from setting up plant in different states are also attached with this report. The report concludes with recommendation of potential states for setting up of wind power plants depending on the attitude of the investor towards various related issues.

CHAPTER-1

1.1 Introduction

Energy is a critical infrastructure as the socio-economic development of the country depends on it. Every sector of economy viz. agriculture, industry, transport, commercial, and domestic requires energy. Since the time of independence for continuous economic development of India have necessarily required increasing amounts of energy. These outcomes in consistent ascent in utilization of vitality in all structures everywhere throughout the nation. To meet this necessity of vitality utilization the nation ending up progressively subject to non-renewable energy sources, for example, coal and oil and gas.

India's current energy generation is mostly coal based, limited domestic coal supply coupled with its poor quality, low level of technological advancements and high instance of environmental perils pose serious challenges for over dependence on coal. The limited domestic reserves and uncertain foreign supply of hydrocarbons in wake of their highly rising international price have seriously flawed the country's energy security.

According to the most recent report of MNRE, our nation imports around 80% of its oil. There is a risk of these expanding further, making difficult issues for India's future vitality Scenario. Rising costs of oil and gas and potential deficiencies in future prompt worries about the security of vitality supply expected to manage our monetary development. Expanded utilization of petroleum products additionally causes ecological issues at nearby and worldwide level.

In a study done by World Bank demonstrates that the India's demonstrated coal stores would last just an additional 45 years, it would mean more noteworthy dependence on imports. Be that as it may, expanding the offer of sustainable in the vitality would decrease reliance on coal and other petroleum derivatives. This would likewise protect condition normally and decrease inescapable import reliance. The investigation led by World Bank additionally demonstrates that there is a more noteworthy part for sustainable power source particularly twists in India's vitality division.

The major factors which created the ground for renewable energy to become a viable option in India are as follows:

- Focus on the rural sector, which needed matrix availability enabled the inexhaustible advancements to develop and furthermore the exploration endeavors embraced by driving foundations like IISC and TERI towards growing new sustainable power source advances and enhancing the current ones.
- The most imperative factor in regard of Indian Government about an Earth-wide temperature boost and subsequent natural aftermaths that the customary wellsprings of vitality have.Since the Consumption of energy cannot be practically reduced, so the only way is to reduce the dependence on the traditional sources of energy. This is where renewable energy scores more as a practical alternative.
- Another major contributing variable is the vitality security and enhancing of vitality portfolio, which the arrangement producers of India have been seeking after appropriate from the time of independence and as has been expressed in the Integrated Energy Policy 2006.

It has been seen that the demand for power is more than supply and this has been there for long time in the nation. The increase in gap between energy availability and demand prevail in India.

The power supply position prevailing in the country is portrayed by steady deficiencies and untrustworthiness and furthermore high costs for industrial consumer. The report "Integrated Energy policy" of India, states that energy demand scenario at 8% GDP growth rate till FY 2031-32 will be 800 GW.

In view of the above, the country urgently needs to develop a sustainable path of energy development. With promotion of energy conservation and use of renewable energy sources are the twin platform for a sustainable energy supply.

India by virtue is blessed with a plenty of renewable energy sources, the major ones being biomass, biogas, the sun, wind, and small hydro power. The domestic and industrial wastes can also be used a sources of energy.

The various policies issued for renewable energy has also worked for the production of unexplored energy from renewable sources. The Concept of Renewable Purchase Obligation (RPO) has been introduced under Electricity Act 2003, National Electricity Policy 2005, Tariff Policy 2006 & NAPCC (2008) & made mandatory for all SERCs to fix

a certain percentage for purchase of power from renewable energy sources in the area of a distribution licensee.

The strong economic development expected in near future requires significant addition to India's generating capacity. Being limited and non-renewable, fossil fuel resources therefore need to be used rationally.Use of non-renewable energy sources additionally prompts ecological issues, for example, a worldwide temperature alteration and environmental change. It is in this way basic to broaden the nation's vitality supply.
Looking into the present and future power situation of the country, and the various promotional policies adopted by Government of India there is no uncertainty about the absorption of the energy to be generated by renewable energy sources.With one of the most abundant renewable energy source available in the country, wind power can be initiator to meeting India's scorching energy demand.

1.2 Problem Statement

"Investors who intend to foray into wind energy sector need some direction. This report proposes the potential states for setting of wind power plants."

1.3 Objective of Project

- The study is conducted with the objective of reviewing the legislative, regulatory and policy frame work followed by various states in India along with the incentives provided for wind power producer. Key ingredients of wind power market are identified for exploring business opportunity in India. The analysis of preferential tariff prevalent across various states in India is also considered in this report:

1.4 Key Features of the Study

The Key features of the study are as following:

- The study analyzes the strength, weakness, opportunities & threat for wind power sector in India.
- The scenario of current wind energy sectors and the prospective target that could be achieved by the sector.

- The study takes a note of various alternatives available for the developer to utilize the energy generated.

- The study emphasis on the various policy incentives, fiscal benefits being offered, and the steps taken by the governments towards the implementation and set-up of an environment conducive to the prosperity of the Wind Energy markets.

1.5 Scope of Project

The scope of the project is limited to the following states of India viz. Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu.
The insistence on the renewable energy sources, especially wind, is of the highest degree for the above mentioned states. Based on this fact the states mentioned above has been selected for analysis.

1.6 Research methodology

This is basically a study project; therefore our main focus is on study of existing literature and extracting conclusion from them. Policy of the states and their actual implementation to reach conclusion have been examined.
Various publication such as relevant published articles, policy documents, consultancy report, Web sites etc. have been reviewed. The learning issues are synthesized.

Keeping in mind the end goal to have a technical analysis a lot of wind turbine technologies were considered and they were compared on premise of their performance, execution and worldwide patterns were broke down as for patterns in Indian breeze Industry.
CUF across various states were examined and compared with respect to each other.

CHAPTER-2

2.1 Review of literature

In order to analyze the wind power sector in India, various policy documents and fact sheets of wind sector in India has been reviewed. Data with respect to REC system were found from CERC regulations and website of power trading firms.

China's yearly installations totaled 6.3 GW in 2008, 13.6 GW in 2009, and 16.5 GW in 2010, inspired by enormous open speculation, low-intrigue credits, and government orders to utilities to increase purchases of non-hydro renewable. The Chinese wind industry has been developed from a gathering of little, locally engaged and government-bolstered organizations in 2005 to having three of the best seven makers universally and installing 46% of aggregate worldwide capacity in 2010. India, which in 2006 had more than twice as much combined wind capacity installed as China, was overshadowed in 2008. Notwithstanding being home to 17 wind turbine makers, India did not appreciate a similar level of government support amid the slowdown.

The techno-monetary potential rejects the potential on lands that are hard to use for wind control advancement, for example, low quality breeze zones (i.e. wind control thickness < 200 W/m2), regions with slants more noteworthy than 20 degrees, zones with height more prominent than 1,500m, timberlands, snow-secured territories, water bodies, urban zones, and ensured regions. These assessments are around 20 times the present authority gauge of wind vitality potential in India (evaluated at 80m center stature). The aggregate land impression of creating 543 GW of this breeze potential (with limit factor > 25% at 80m) is probably going to be roughly, 1,629 km2 or 0.05% of the aggregate land territory in India since, normally, just 3% of the land required for wind control advancement is its impression on the ground and whatever is left of the land can be utilized for different purposes.

To discover the clearing and dispatch issues different notice and petitions records by wind Power industry bodies has been assessed. The Scheduling Rules were taken from IEGC 2010 record distributed by CERC and its detail methodology by PGCIL and NLDC.

2.2 Current Scenario

2.2.1 Global Level

Growing concern for the environmental decline has led to the world's interest in renewable energy resources. Addition to it the fact that energy security and sustainable development are high in the global agenda due to the impact of volatile energy prices, high demand for energy security, and concerns over environmental sustainability and the global climate change. New and renewable energy technologies are considered to be one of the viable options to meet the challenge of achieving sustainable development while conserving natural resources that have been decreased due to the rapid growth in population, urbanization, and fossil fuel consumption.

Wind is considered economically and operationally the most viable renewable energy resource and emerging as one of the largest source in terms of the renewable energy sector.

Wind energy not only offers both a power source that completely avoids the emission of carbon dioxide, the main GHG, but also produces none of the other pollutants associated with either fossil fuel or nuclear generation.

Since many years, the wind industry has been driven by the big five country: China, USA, Germany, Spain, and India. These countries have shown the largest share of wind power during the last two decades. The world wide wind capacity grew by 5% inside a half year (after 5,8 % in a similar period in 2015 and 5,6 % in 2014) and by 16,1 % on a yearly premise .These country's standings at the end of 2016 were as follows:

Table: 2.1Analysis of Global Wind Markets

Position	Country/Region	Total capacity June 2016 [MW]	Added capacity H1 2016 [MW]	Total capacity end 2015 [MW]	Added capacity H1 2015 [MW]	Total capacity end 2014 [MW]	Added capacity H1 2014 [MW]	Total capacity end 2013 [MW]	Total capacity June 2013 [MW]
1	China	158'000	10'000	148'000	10'101	114'763	7'175	91'324	80'827
2	United States	74'696	830	73'867	1'994	65'754	835	61'108	59'884
3	Germany	47'420	2'389	45'192	1'991	40'468	1'830	34'660	32'458
4	India	27'151	2'392	24'759	1'297	22'465	1'112	20'150	19'564
5	Spain	22'987	-	22'987	-	22'987	-	22'959	22'918
6	United Kingdom	13'940	320	13'614	872	12'440	649	10'711	9'776
7	Canada	11'298	109	11'205	510	9'694	723	7'698	6'578
8	France	10'861	568	10'293	523	9'296	338	8'254	7'697
9	Brazil	9'810	1'095	8'715	838	5'962	1'301	3'466	2'788
10	Italy	9'101	143	8'958	124	8'663	30	8'551	8'417
11	Sweden	6'338	309	6'029	157	5'425	354	4'470	4'271
12	Poland***	5'300	200	5'100	283	3'834	337	3'390	2'798
13	Turkey	5'146	428	4'718	431	3'763	466	2'959	2'619
14	Denmark*	5'089	25	5'064	76	4'883	83	4'772	4'578
15	Portugal**	5'040	6	5'034	-	4'953	105	4'724	4'547
	Rest of the World***	44'309	2'900	41'409	2'600	35'968	2'275	29'718	26'861
	Total	**456'486**	**21'714**	**434'944**	**21'678**	**371'317**	**17'613**	**318'914**	**296'581**

(Source: WWEA Annual Report, 2016)

With the additional wind capacity of 44.6 GW, the 100 countries together can churn out 580 Tera-watt-hours per annum which amounts to 3% of the global energy demand.

2.2.2 Country Level

India, being a developing country, exudes huge potential for the renewable sources of energy. The major advantages of these energy sources are its inherent strength to support rural employment and growth of the rural economy of India. Further, unlike all other sources of power generation, the renewable sources consume nominal amount of water- which in itself will become a scarce commodity.

The wind power development in India was initiated in early 1990s followed by the introduction of 100% accelerated depreciation benefit for wind projects in 1994. At present the wind power installed capacity in our country is over 32.7 GW and wind energy establishes around 55% of the total renewable capacity.

According to the Global Wind 2016 Report, published by Global Wind Energy Council, India ranked fourth globally in terms of wind power installed capacity in 2016 was around 487 GW.

Regardless of the striking increment in wind control limit in the nation, just a small amount of the nation's breeze potential has been tapped till date. According to the current evaluation of National Institute of Wind Energy (NIWE), the potential for coastal breeze at 100 m over the ground level is more than 302 GW. The immense undiscovered breeze

control potential could be saddled to meet India's arrangement objectives, address vitality security challenges, and accomplish low carbon development, in a savvy way. In this undertaking, the Ministry of New and Renewable Energy (MNRE), Government of India, has embraced a multidimensional approach, going for expansive scale commercialization of practical age of network quality breeze control. The breeze control program incorporates far reaching wind asset appraisal program, R&D, execution of tasks exhibition to make mindfulness, advancement of infrastructural ability, ability to make alongside establishment, activity and support of wind turbines and valuable approach detailing.

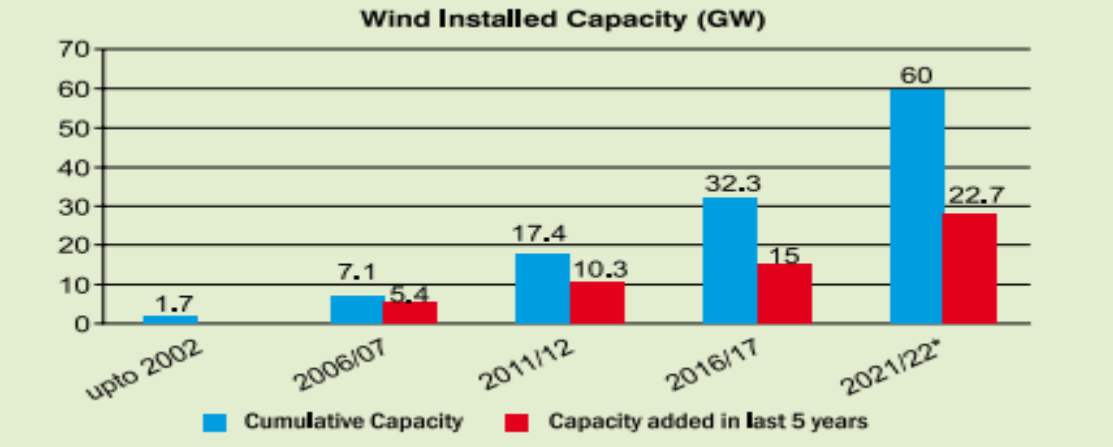


Fig: 2.1: Wind Installed Capacity (GW) (Source: MNRE)

2.3 SWOT Analysis of wind Power Sector:-

Strength	Weakness
• Proven technology. • Growth in manufacturing sector. • Dedicated wing i.e. MNRE at central level. • Separate state nodal agencies have been established at state level. • Financial assistance by funding agency IREDA. • Specialized institutes & organizations. • Comprehensive Resource Assessment for wind energy potential.	• Infrequent source of power supply • Low capacity utilization factor • CUF of the wind energy projects are generally low (18-24%) as compared to fossil fuel based power plants • Higher initial cost as compared to traditional source of power generation • Small wind farms are not techno-economically viable • Potential sites are inaccessible

• Environment friendly & Zero emission source of electricity. • Fuel for wind power projects is wind, which is freely available and hence no cost uncertainties from fuel supply price fluctuations.	• Inadequate Grid Infrastructure • Bird and Bat mortality • Noise pollution
Opportunities	**Threats**
• Competitive manufacturing base. • Huge untapped potential across India. • Continuing electricity demand- supply gap. • Decentralized Generation in rural India • Increase in cost of fuel • Interest and capital subsidies. • Remunerative Returns on Equity. • Renewable Energy Certificates mechanism. • Renewable Purchase Obligation. • CDM credits. • Hybrid models – Diesel, Natural Gas, and PV • The R&M of existing wind energy projects.	• Wind power subsidies & incentives may be rationalized or pegged down (GBI and AD). • Land cost may be shoot up. • Discounts provided by manufacturers may be removed • Technological up gradation process may be on hold • Delays in process of payments from variousDISCOMS

2.4 Existing Technology

There haven't been any radical changes in the wind turbine innovation over the most recent couple of decades. Directly wind turbines may fluctuate in their appearance particularly in regard of size when contrasted with more seasoned machines however the fundamental principals continue as before. When all is said in done, improvement patterns are towards bigger turbines that utilization higher towers to profit of the higher wind speeds advance starting from the earliest stage. They likewise utilize longer cutting edges to amplify the vitality catch from the wind.

Bigger turbines utilize proportionately less raw materials than smaller turbines and require a littler ground zone for every unit of energy yield than their smaller predecessors.

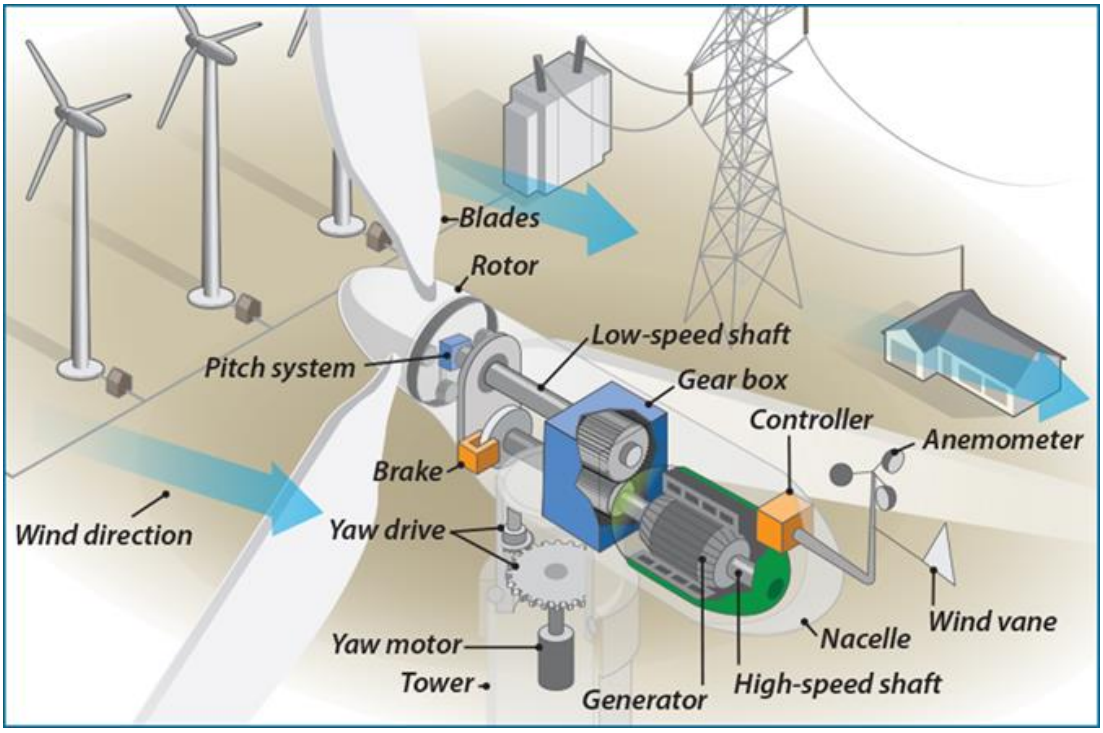


Fig. 2.2: Subsystems of a Wind Energy Generator (Source: IWTMA)

Wind turbines begin working at around 4 - 5 meter for each second (roughly 16-18 kmph) achieve a most extreme yield at 12 - 14 m/s and naturally close down for security at wind speeds more prominent than 25 m/s (roughly 80 kmph.).

The rotating motion is accelerated through the turbine transmission (which normally incorporates a gearbox, in spite of the fact that they are ending up less normal) into the generator that changes over the movement to power. The more the air goes through sharp edges, the more will be power produced.

Generally, the low voltage from the generator 'stepped up' through a transformer to match the grid voltage.

The most widely recognized business wind turbines introduced as of late are in the vicinity of 1.5 and 2 MW. For a 2 MW wind turbine the rotor measurement might be up to 70 or 80 meters with the nacelle regularly found 80 meters over the ground and a most extreme cutting edge tip stature of very nearly 120 meters. Changes in the plan and productivity imply that we can anticipate that breeze turbines will keep on increasing in estimate for quite a while yet. Where bigger turbines are utilized, less are required to deliver the proportionate power yield accomplished by a more noteworthy number of their littler

forerunners. In other words less breeze ranches are required and less land are expected to create a similar measure of vitality than is littler ones are utilized.

The manufacturing industry has been equipped furnished with demonstrated innovation from Europe with turbine measure running from 250 KW to 2.1 MW comprising of different innovation viz. stall, pitch, direct drive turbines with hub heights up to 100 meters and rotor size also up to 100 meters. The new turbines are intended to outfit even in low and medium breeze administrations. The producers have more than 40 models and with an assembling limit of around 9000 MW per annum.

The horizontal axis wind turbines (HAWT) having three distinct technology are as following:

2.4.1 Constant speed

The Turbines that keep running at one evaluated speed paying little heed to wind speeds. A consistent speed turbine will slow down when the breeze turns out to be excessively solid. The Constant speed turbines are strong plan and moderately shabby, yet are more inclined to mechanical pressure, streamlined effectiveness and commotion.

2.4.2 Variable Speed Double Feed Induction Generator

Since, the DFIG turbine keeps running at variable speeds in this manner it offers more noteworthy streamlined effectiveness than the consistent speed turbines and it has bring down clamor levels. The weight on the gearbox is brought down utilizing variable speed generators. Normally, the enhanced execution comes at an expanded beginning speculation cost.

2.4.3 Variable Speed Direct Drive

Direct drive generators kill the gearbox (and in this way, any resulting gearbox problems) totally. They offer enhanced execution through their selection of segments used however are the most costly beginning venture cost alternative along these lines.

2.5 Wind Power Potential in the Country

There are three different studies that establish that set up the wind control potential in the different area of our country. In any case, the examinations demonstrate that the possibility to be packed in similar territories however there exists a sea of contrast between the extents recommended.

The Wind Potential in India was first assessed by Center for Wind Energy Technology (C-WET) at 50m center point stature i.e. 49 GW however as indicated by the new study at 80m center point tallness, the potential develops as much as 102 GW. This was received by the legislature as the official gauge. In any case, LBNL has expressed the potential is around 300 to 400 GW.

2.5.1Wind Resource Assessment

CWET in relationship with Riso DTU, Denmark has built up a Numerical wind atlas of India. Numerical wind atlasmethodologies have been concocted to unravel the issue in deficient wind estimations. In this strategy, factual dynamical downscaling approach is utilized.

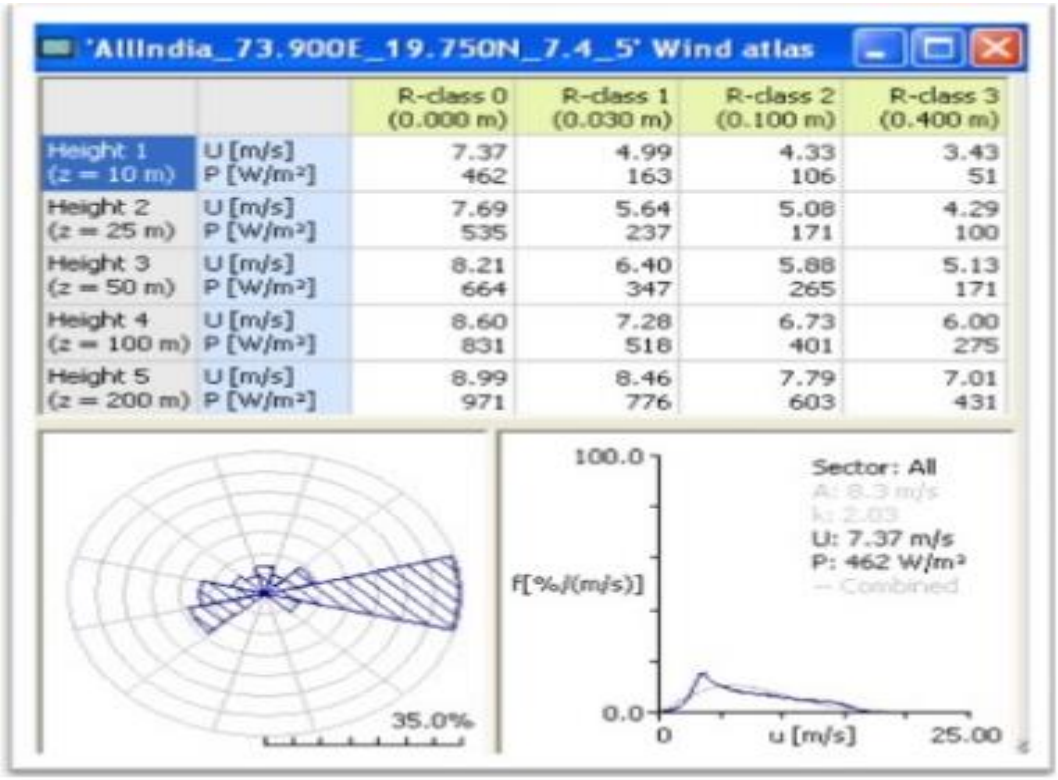


Fig. 2.3:- Numerical Wind Atlas of India (Source:: C-WET)

KAMM gauges the meso scale wind field utilizing as information a depiction of the brief scale climatology, and appropriate orography and unpleasantness maps. The climatology of the post-handled reproduced wind fields and the neighborhood orography and unpleasantness are in this manner utilized by WAsP (Wind Atlas Analysis and Application Program) for expectation of the nearby breeze atmosphere.

To assess the installable capability of the country, the KAMM produced mesoscale wind control thickness guide of 50 m level, which was incorporated with the breeze control

thickness delineate for genuine estimations and re-plotted the last breeze control thickness maps by utilizing the GIS instrument.

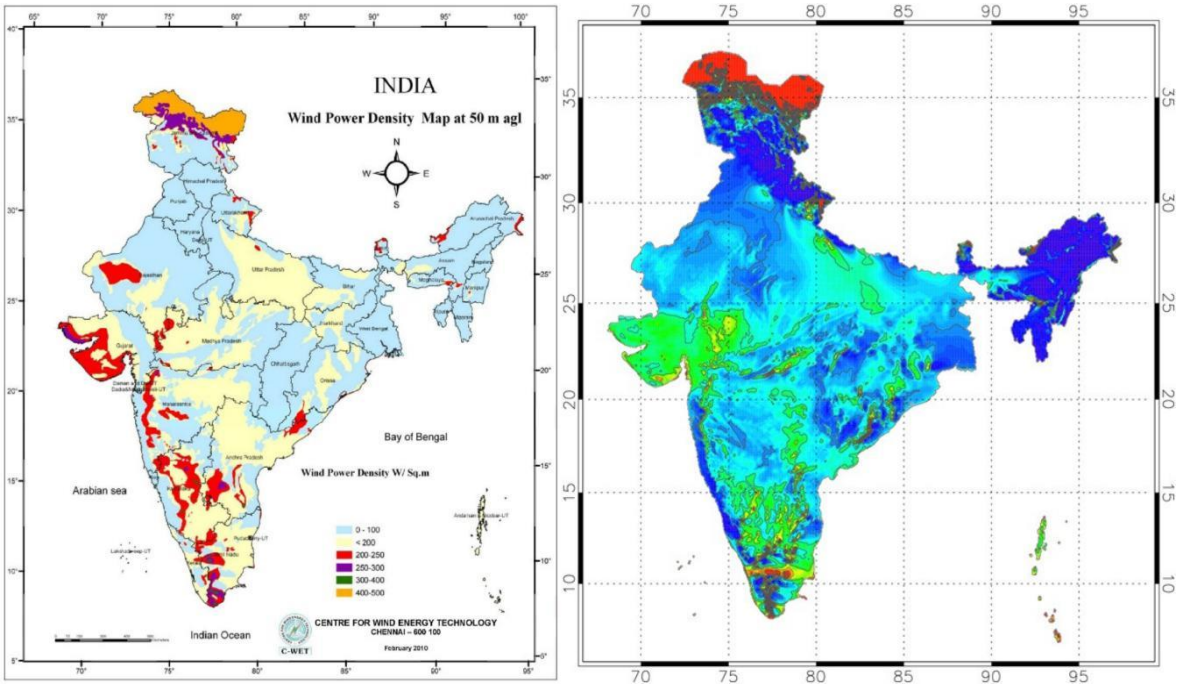


Fig. 2.4: Wind Power Density Map at 50m and 80m hub height (Source: C-WET)

The installable wind power potential (name plate power) was calculated for each wind power density range by assuming 9 MW could be installed per square kilometerarea. Finally the potential in the country at 50 m level with clearly stated assumptions is estimated as 49 GW.

Comparative exercise with no approval has been completed for 80 m level with the KAMM created mesoscale delineate the outcomes were ascertained. The assessed installable potential at 80 m level is observed to be 102788 MW.

The following table list out C-WET's estimate of state-wise wind power potential of India:

Table 2.2: C-WET's State-wise Estimate of Wind Power Potential

Sl. No.	State	Estimated potential at 50m hub height (MW)	Estimated potential at 80m hub height* (MW)
1	Andaman & Nicobar	2	365
2	Andhra Pradesh	5394	14497
3	Arunachal Pradesh*	201	236
4	Assam*	53	112
5	Bihar	-	144
6	Chhattisgarh*	23	314
7	Daman & Diu	-	4
8	Gujarat	10609	35071
9	Haryana	-	93
10	Himachal Pradesh*	20	64
11	Jharkhand	-	91
12	Jammu & Kashmir*	5311	5685
13	Karnataka	8591	13593
14	Kerala	790	837
15	Lakshadweep	16	16
16	Madhya Pradesh	920	2931
17	Maharashtra	5439	5961
18	Manipur*	7	56
19	Meghalaya*	44	82
20	Nagaland*	3	16
21	Orissa	910	1384
22	Pondicherry	-	120
23	Rajasthan	5005	5050
24	Sikkim*	98	98
25	Tamil Nadu	5374	14152
26	Uttrakhand*	161	534
27	Uttar Pradesh*	137	1260
28	West Bengal*	22	22
	Total	49130	102788

(Source: Centre for Wind Energy Technology)

Right Now710 Wind Monitoring Stations (WMS) in different states & UTs for the purpose to assessing the wind profile in specified areas has been already installed.

The checked wind information at an area on account of homogeneous landscape can be stretched out to a specific separation. In this manner it is conceivable to anticipate twist climatology around a station utilizing reference station information in conjunction with suitable models. These outcomes in the miniaturized scale overview of twist asset around a station. By leading a smaller scale study around a station the known windy areas around

the site can be reserved. Anyway this is constantly broad data and for finding and sitting wind turbines at any distinguished area is to be further miniaturized scale sited thinking about the geography, shape, unpleasantness etc.

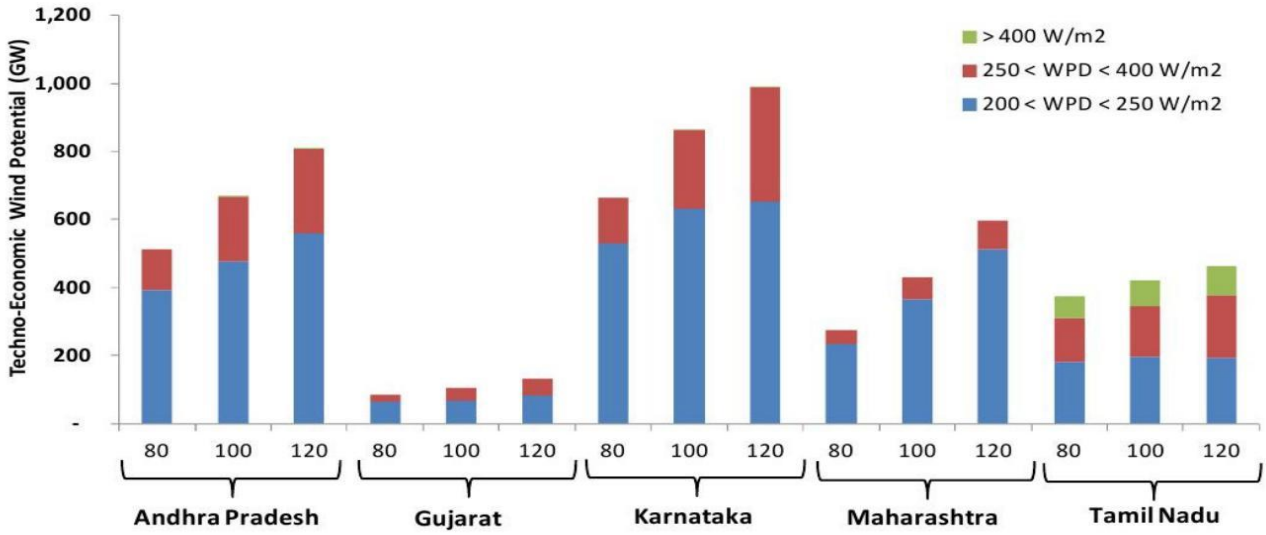
2.6 Wind Potential Estimates as per LBNL

The examination directed by Lawrence Berkeley National Laboratory was like C-WET's investigation in the suppositions and strategy took after. Wind vitality potential from yearly normal WPD and twist speed for turbines at 80m, 100m, and 120m center statures was assessed at different levels of limit usage factors. The information was acquired for every 5 km by 5 km cell in India from 3Tier. The information was assessed utilizing the system of musicale demonstrating and afterward down scaling it to small scale level.

According to accessible GIS information on geography and land utilize arrive cover (LULC) information was utilized to bar regions where advancement of wind offices would be in fact and financially unviable. The rejected locales included low quality breeze territories (WPD < 200 W/m), zones with inclines more noteworthy than 20 degrees, rise more prominent than 1,500m, backwoods, snow-secured zones, water bodies, urban regions and ensured zones. Limit thickness evaluate like C-WET's (9 MW/km2) was utilized for the investigation.

The GIS information accessible for cell size of 3.6 km by 3.6 km was mapped into the 5 km by 5 km cells and sub-isolated into 144 littler cells.The LULC information was used and the breeze capability of all qualified littler cells was signified deliver the total evaluations at state and national levels.

The result of the study states that the techno-economic wind potential at different hub-heights has been determined as follows:



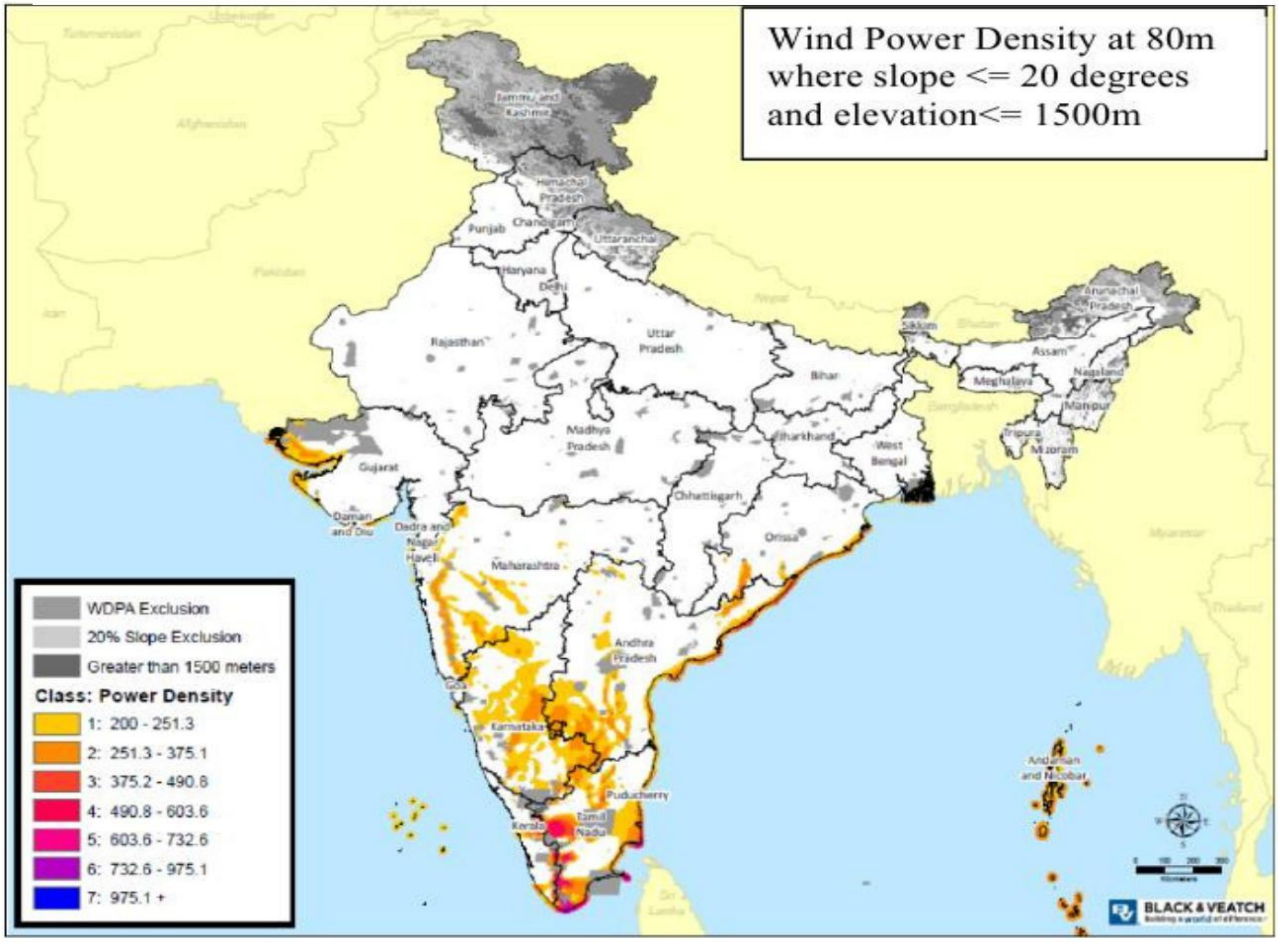


Fig.2.5: Density of wind power at 80m
(Source: RWPE for India: Economic and Policy Implications, March 2016)

The most likely reason for the large difference between the estimate in this analysis and the official Indian estimate is the difference in assumed land availability. Without stating any rationale, C-WET assumes that only two percent of the total windy land will be available for wind power development.

It is improbable that the greater part of the wind potential recognized will be produced. The land necessity for creating 543 GW (with WPD > 250 W/m and CUF > 25%) will be close around 60,362 km and it is around 2% of the aggregate land zone of India. Out of this land necessity, just a little rate (ordinarily around 3%) is aggravated for all time, fundamentally because of towers and streets, and whatever remains of the land can be utilized for different purposes. For instance, in view of the investigation of 93 wind ranches totaling 13,897 MW in the US, found that the forever affected land because of wind control improvement is around 0.3 Hectare/MW. Consequently, the genuine land impression of creating 543 GW of wind control is probably going to be around 1,629 km2, or 0.05% of the aggregate land zone of India.

95% of the techno-financial wind vitality potential is amassed in for the most part five states in southern and western India like Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, and Gujarat.:"The state with the general biggest asset is Karnataka (~655 GW at 80m) while the state with biggest best-quality asset (i.e. WPD > 400 W/m2; CUF > 32%) is Tamil Nadu (~65 GW at 80m i.e. in excess of three times the aggregate installed capacity of India).

In excess of 500 GW of this potential at 80m center point stature is accessible at a levelized tariff of Rs.5/kWh or less, in excess of 200 GW of wind potential is accessible at levelized tariff of Rs.4.5/kWh or less, and in excess of 100 GW of wind is even accessible at a levelized tariff of Rs. 4/kWh or less in some piece of India - particularly in Tamil Nadu.

2.7 Regulatory& policy framework

The Regulatory aspects are the main determinant of the extent to which the wind projects are successful The Regulations can single-handed make or break the wind energy business in the country. The current regulatory environment of the country, although not perfect, but tries to strike a balance between the interests of the business as well as the consumers. India has been very proactive in utilizing wind energy and initiated wind power programme as early as 1983

Ministry of New and Renewable Energy (MNRE) has been the main centre for all movement identifying with the sustainable power source industry. Being the highest expert helping with completing all the help exercises for the new and sustainable power source area. Indian Renewable Energy Development Agency (IREDA) has pulled up measures for giving financing to the engineers. Fundamentally it gives back to Wind Farm ventures having qualified machines of minimum limit of 225 kW or more, up to 75% of the qualified machine cost.

Centre for Wind Energy Technology (C-WET) helps the sector through its Research & Development unit that collaborates with other R&D institutions/industry. It also conducts Wind Resource Assessment and testing and certification of complete Wind Turbine Generator Systems (WTGS) according to international standards (IEC), Indian Certification Scheme and Type Approval Provisional Scheme (TAPS-2000).

The main regulationsdivision is the Central Electricity Regulatory Commission (CERC) and the State Electricity Regulation Commissions (SERCs) that continuously work with the detailed regulations to guide the growth of the power industry. CERC and SERCs' regulations provide the detailed and exact guidelines under which the power business should operate. The existence of SERCs looking over different regions of the country, the regulations change from one Commission to another.

2.7.1 The Electricity Act, 2003

There are numerous provisions in the Electricity act 2003 to accelerate for the development generation based on re-newable energy; some of them are as following:-

Section 3: This section basically mandated central government to draft National Electric Policy, National Electric Plan and National Tariff Policy for improvement of energy framework based on ideal usage of assets including renewable sources of energy.

Section 4: This segment mandated government to get ready National Policy on renewable sources of energy for rural area.

Section 61-h: Under Section 61, the proper commission might, indicate the terms and conditions for the assurance of tariff. According to Section 61 (h) the terms and conditions for the assurance of tariff are to be guided by advancement of age of power from sustainable power sources.

Section 86-1-e: Section 86-1 deal with the work and of the state commission. As per section 86-1-e to promote co-generation and generation of electricity from renewable sources the state commissions are required to fix a percentage of renewable energy out of total consumption of electricity in the area of distribution licensee.

2.7.2 National Electric Policy, 2005

Clause 5.2.20: Non – Conventional Energy Sources

This clause talks about harnessing fully feasible potential of non – conventional energy resources mainly small hydro, wind and bio-mass to create additional power generation. It also talks that suitable promotional measures will be taken to encourage private sector participation.

Clause 5.12: Cogeneration and Non-Conventional Energy Sources

This statement features the way that there is a pressing need to advance age of power in light of Non-regular wellsprings of vitality as they are condition cordial. For this reason, endeavors are to be made to diminish the capital cost of undertakings. Cost of vitality

can likewise be diminished by advancing rivalry inside such ventures. In the meantime, satisfactory limited time measures would likewise must be taken for advancement of advances and a managed development of these sources.

The clause restates what is mentioned In Electricity Act 2003 under section 86(1) (e) and basically talks about to promote co-generation and production of electricity from renewable sources the state commissions are required to fix a percentage of renewable energy out of total consumption of electricity in the area of distribution licensee.

Clause 5.6: Technology Development and R&D

This clause highlights the fact that special efforts are needed for research, development, and commercialization of non-conventional energy systems. Such systems would need to meet international standards, specifications and performance parameters.

2.7.3National Tariff Policy- 2006

Clause 6.4: This clause states the following:

a) In continuation to provisions of section 86(1) (e) of Electricity Act 2003, The clause states that the procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission as it will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity.

b) Procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Electricity Act within suppliers offering energy from same type of non-conventional sources.

c) The Central Commission should lay down guidelines for pricing non-firm power, especially from non–conventional sources, to be followed in cases where such procurement is not through competitive bidding.

d) In the Amendment in Tariff Policy the Ministry of Power has directed the State Electricity Regulators to fix a percentage of energy purchase from solar power under the RPOs. The solar power purchase obligation for States may start with 0.25% in Phase I (by 2013) and go up to 3% by 2022 This will be complemented by solar specific Renewable Energy Certificate (REC) mechanism to allow solar power generation companies to sell certificates to the utilities to meet their solar power purchase obligations.

2.7.4 Policy for Rural Electrification, 2006

This states that non-conventional energy sources for example, sun based, wind, biomass, ,small hydro, geo-thermal; tidal etc. along with traditional sources can be suitably and ideally used to make accessible dependable supply of power to every single family unit.

Clause 8: Policy Provisions for Rural areas:

This clause insists that State governments should make institutions for go down administrations and specialized help to frameworks in light of non-regular wellsprings of vitality. Such administrations would be given on cost premise in order to make the game plans feasible.

2.7.5 National Action Plan for Climate Change, 2008

Clause 4.1: National Solar Mission:

A National Solar Mission will be launched to significantly increase the share of solar energy in the total energy mix while recognizing the need to expand the scope of other renewable and non-fossil options such as nuclear energy, wind energy and biomass.

Clause 4.2.2: Grid Connected Systems:

This plan has advised the following towards improvement in the regulatory/tariffs regime to help mainstream renewable based sources in the national power system:

a) A dynamic minimum renewable purchase standard (DMRPS) may be set; with escalation each year till a pre-defined level is reached. NAPCC has set the target of

5% renewable energy purchase for FY 2009-10, with the target increasing by 1% for next 10 years. SERCs may set higher percentages than this minimum at each point in time.

b) Appropriate authorities may also issue certificates that procure renewable based power in excess of the national standard. Such certificates may be trade able, to enable utilities falling short to meet their renewable standard obligations.

2.7.6Indian Electricity Grid Code, 2010

The IEGC sets out the principles, rules and measures to be trailed by different people and members in the framework to design, create, keep up and work the power framework, in the most secure, dependable, financial and productive way, while encouraging solid rivalry in the age and supply of power.

The IEGC unites an arrangement of specialized and business rules, incorporating every one of the Utilities associated with/or utilizing the inter State transmission system (ISTS).The essential destinations of IEGC are to encourage the improvement of sustainable power sources by indicating the specialized and business matters for incorporation of these assets into the network.
In perspective of the Government's pushed on inexhaustible wellsprings of vitality and the impact of their variable nature of age on the between state framework, planning of wind and sun powered vitality sources has been fused in this Code. This has been done to advance extensive scale joining of such sources into the framework.

To help sustainable power sources while detailing point of view transmission design the transmission necessity for clearing power from sustainable power sources might likewise be dealt with.

The outage planning of run-of-the-river hydro plant, wind and solar power plant and its associated evacuation network shall be planned to extract maximum power from these renewable sources.

All renewable energy power plants, with the exception of biomass control plants and non-non-renewable energy source based cogeneration plants whose tax is controlled by the CERC.

This code gives the procedure to rescheduling of wind and sun powered vitality on three hourly basis and the approach of remunerating the breeze and sun powered vitality rich State for managing the variable age through a Renewable Regulatory charge.

The wind generators might be in charge of determining their age up to precision of 70%. In this way, if the real generation is beyond +/ - 30% of the scheduled, wind generator would need to shoulder the UI charges. For actual generation within +/ - 30% of the schedule, no UI would be payable/receivable by Generator, The host state, should bear the UI charges for this variety, i.e. within +/ - 30%.

2.7.7Foreign Direct Investment

The advancement of clean imperativeness part in India is monstrous. India gifts FDI up to 100 % in the part under the customized course in Renewable Energy Generation and Distribution wanders subject to the game plans of the Electricity Act, 2003. The modified course of FDI derives that the wander require no prior support of both of the Government or the Reserve Bank of India or some other authoritative masters.

2.7.8 Accelerated Depreciation

Under the wage survey law, maintainable power source associations were outfitted with revived degrading at 80 percent. Regardless, starting late, the organization has restricted the stimulated crumbling of 80 percent to windmills presented at the extremely most recent 31 March 2012. Windmills presented after 31 March 2012 will be fit the bill for depreciation of 15 percent instead of 80 percent on recorded regard procedure. A long ways past this 15% some SERCs are giving an additional disintegration of 20%. A couple of states give detach impose to generators benefitting Accelerated Depreciation benefits.

2.7.9 Generation Based Incentive

It was presented in the year 2008. The GBI conspire for wind control gave a motivation part of Rs. 0.50 for each unit of power, well beyond what State utilities pay as duty, nourished into the lattice for a period at the very least 4 years and a most extreme time of 10 years. The fundamental reason for existing was to draw in huge speculations. The impetus was made accessible to free power makers, excepting generators set up for hostage utilization, outsider deal, shipper plants and so on. By and large, generators with an introduced limit of in excess of 5 MW were made qualified for the motivating force.

In any case, an association can ensure either stimulated crumbling or GBI anyway not both. Along these lines GBI transformed into a liven for remote players who don't have a financial record in India and in this manner couldn't get benefits by the revived weakening contrive. The organization had wiped out the assignment in April 2012, causing urgent results for the breeze fragment.

2.7.10National Clean Energy Fund

The organization proposed the making of the National Clean Energy Fund (NCEF) in the Union Budget 2010-2011 by driving a Clean Energy Tax (cess) of INR 50 (~ $0.75) per ton on all coal conveyed and what's more on coal imports in India. The Ministry of Finance, through the Clean Energy Cess rules 2010, set tenets for the amassing and assessment of this cost by the Revenue Department. From that point on a between peaceful social affair was set up in the Ministry to support exercises and capability necessities for getting to stores from the NCEF. In any case since its start in July 2010, little information on the operationalization of the NCEF has been released in the overall public territory other than the standards and application shape for suggestions.

An examination drove by WISE measures that at the present obligation rate and the typical coal usage rates, a total of Rs. 670 billion (~ $10 billion) could aggregate to the store by 2022. This store could support system and other establishment headway to mull over more conspicuous flight of vitality made from feasible power sources. The store could in like manner be used for research, progression and association of flawless and economical power source propels.

The suggestions conveyed by supporting national Ministries were found to generally require quality and inventiveness, which fail to move the communicated focus of the NCEF. Additionally, most of the NCEF back remains unutilized. There is a need to rethink NCEF standards to take out unclearness incorporating the use of its advantages, and to limit its use for meeting general budgetary mishaps of Ministries. Sponsoring to help diverse Ministries' standard activities should be met from the fitting sources available inside the present financing structure of the general Budget.

2.7.11Tax & Fiscal Incentives

Tax cost shapes a considerable piece of the general EPC Project cost which ranges from 10 percent to 20% of the aggregate sustainable power source venture cost. Thinking about the unique spotlight on sustainable power source, the Central Government has given different motivations on setting up the sustainable power source control venture which incorporates exception from traditions and extracts obligations on particular products required for setting up the sustainable power source ventures. Wind based power extends likewise appreciate a tax-exempt salary from offer of energy for a long time under area 80 I A of the Income Tax Act. In spite of the fact that, it is to be noticed that amid this period the generator is subject to pay a Minimum Alternate Tax (MAT) as indicated by the government.

Indirect taxes levied by Government of India apply special rates for parts of wind operated electricity generators. Special bearings, gearboxes, yaw components and wind turbine controllers carry a rate of 5% whereas sensors, brake hydraulics, flexible coupling and brake calipers carry a rate of 25%. Beyond this, all mechanisms that harness wind energy are exempt from excise duty and also enjoy a reduction in Central Sales Tax and General Sales Tax.

In spite of the fact that, these exceptions are liable to satisfaction of endorsed conditions and compliances to be attempted by the EPC contractual worker or IPP. Moreover, a portion of the state governments have given the motivators as impose of VAT at diminished rate (i.e. 5%) though alternate states demands VAT at 12.5%. Given the immense assortment of expense and financial motivators accessible, one needs to

evaluate the duty cost and investigate the organizing choices, before putting into the segment.

2.7.12 RRF

The usage of Renewable Regulatory Fund (RRF) system was executed in 15 July 2013. RRF directions require wind and sun oriented undertakings that meet certain criteria to gauge and calendar their energy on a day-ahead premise. This has noteworthy operational and monetary ramifications for the tasks.

Projects should guarantee about forecast and schedule of Power, and furthermore have a Coordinating Agency designated to deal with the calculated prerequisites for planning, detailing and settlement. In the meantime, the planning, compromise and budgetary settlement prerequisites likewise requires on-ground coordination and liaising. The planning and anticipating is done on a pooling substation premise, which will frequently have turbines with different proprietors.

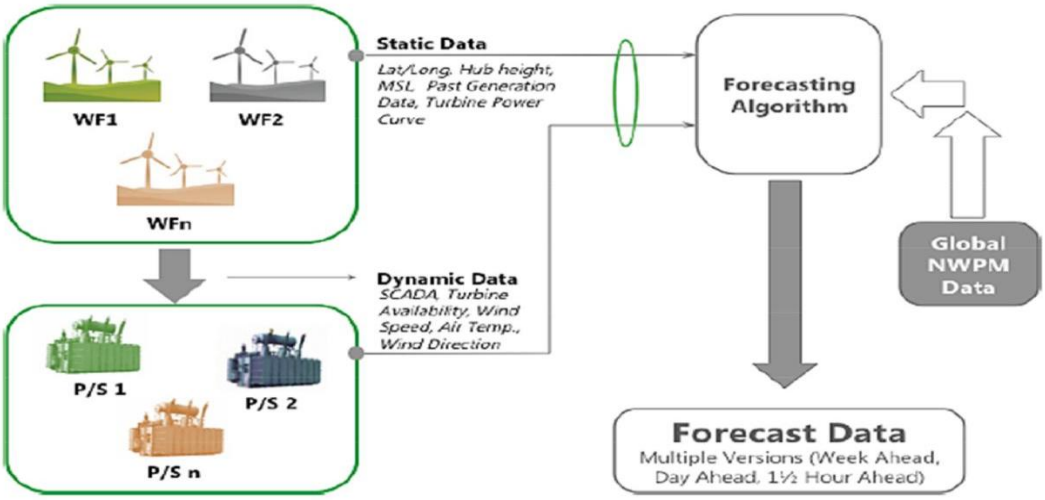


Fig.2.6: Process of Forecasting Wind Energy Output (Source: www.reconnectenergy.com)

The inexhaustible administrative reserve would bear charges forced on states facilitating wind extends that neglect to consent to their vitality supply responsibilities regarding the power matrix. CERC permits 30% deviation in the vitality supply responsibilities past which punishments are demanded or impetuses advertised. Ramifications of deviation

past 30% are proposed to be shared among all state conveyance organizations in proportion of their pinnacle request met in the earlier month.

2.7.13 Draft National Offshore Wind Energy Policy

The wind asset information for the coastline of Rameshwaram and Kanyakumari in Tamil Nadu and Gujarat Coast have demonstrated sensible potential. A preparatory evaluation recommends potential to build up around 1 GW limit wind cultivate each along the coastline of Rameshwaram and Kanyakumari in Tamil Nadu.

The noteworthy difficulties that exist in seaward breeze control sending identifies with asset portrayal, lattice interconnection and task, and advancement of transmission framework. Including huge limits of seaward breeze age to the power framework would likewise require dependable joining to the national network.

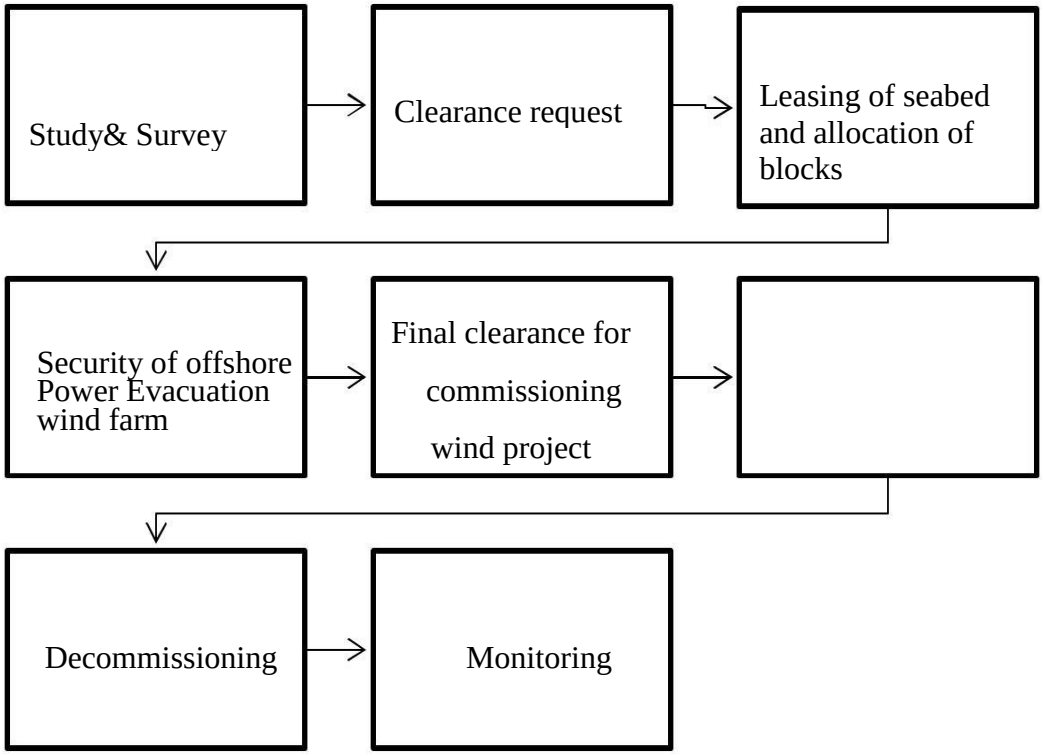


Fig. 2.7: Offshore Wind Energy Development Process (Source: MNRE website)

NOWA will be the single window agency and will coordinate with concerned Ministries/Departments for necessary clearances. However, NOWA will only act as a Facilitator for getting clearance and application for clearance will be dealt in entirety by the concerned Ministry/Department. The role of State Electricity Board or a similar agency designated by the State Government would undertake onshore evacuation and grid connectivity.

The draft National Offshore Wind Energy Policy provides for certain fiscal incentives such as tax holiday for first ten years of offshore wind power generation, concession in customs duty and exemption in excise duty for procurement of technology and equipment. Services such as resource assessment, environmental impact assessment and oceanographic study by third party and use of survey vessels and installation vessels may also be eligible for exemption from service tax.

2.8 Investment scenario

2.8.1 Financial Aspects of Regulations

Financial details assume an imperative part in wind vitality division for any state. SERCs, while attempting to stay reasonable towards the two buyers and generators, announce statutory arrangements that could be utilized by the generator as a benchmark. The directions permit costs up to a sensible point of confinement to be sent to the buyer as the tax for the breeze vitality produced. Directions indicate the arrangements for different monetary parameters viz. capital cost, Debt-Equity proportion, installment of enthusiasm on credit and its term, a sensible sum as profit for value against the venture, costs for tasks and support of the breeze vitality generator alongside the recompenses for deterioration and enthusiasm against working capital. These arrangements are met by the per unit levy paid by the purchaser.

The capital cost takes care of the expense of the hardware with all the sunk cost that joins it. It is the underlying expense that is required for setting up of the windpower project. This capital cost is financed from two sources: obligation and value which are in the proportion indicated by control. The tax additionally adjusts for the intrigue and key reimbursement on the obligation segment. The key reimbursement is encouraged through the piece of the duty reserved for devaluation. The administrative commission

recognizes the requirement for standard activity and upkeep and in this manner accommodates this cost. It additionally considers O&M cost heightening year-over-year at a sensible acceleration rate.

As the costs fluctuate from year-to-year, the per unit cost of generation excessively shifts. In any case, the administrative commission permits a settled duty for a WEG. Considering the perfect situation where the generator causes costs precisely as gave by the administrative commission, the benefit/misfortune in a year can be accounted to the distinction between the assigned levy and the cost of age for that year, in addition to the sum qualified for the generator as an arrival on value.

2.8.2Financing the Wind Power Project

Financing the wind power Project includes a piece of assets sourced as obligation from banks and other money related establishments. Ordinarily, all the breeze control ventures take after the ostensible obligation value proportion of 70:30 as commanded by the directions set by separate SERCs. The 70% venture cost sourced as obligation can comprehensively be financed through two courses i.e. Full plan of action financing or Limited/Non-response financing.

The fundamental distinction between a response and non-plan of action advance needs to do with which resources a bank can follow if a borrower neglects to reimburse an advance. In the two kinds of advances, the moneylender is permitted to grab any advantages that were utilized as guarantee to secure the credit. Much of the time, the insurance is the benefit that was bought by the advance. While potential borrowers may think that it’s alluring to wait for non-plan of action advances, recollect that they accompany higher loan fees and are held for people and organizations with the best credit. Furthermore, inability to pay off a non-response obligation may leave different resources unharmed, however the borrower's FICO assessment will be influenced similarly as an inability to reimburse plan of action obligation.

The following are the feature for financing shown in the table:-

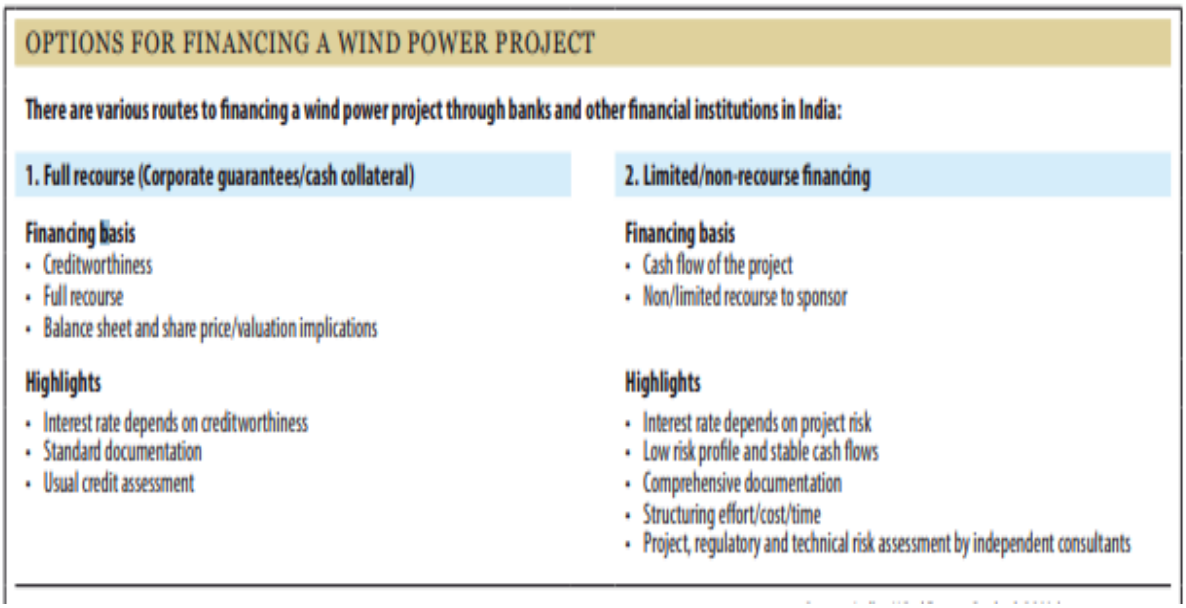


Fig 2.8: Alternative with respect to Funding a Wind Power Project (Source: IWEO-2017)

2.8.3Wind Power Financing – Predictions for the future

In the midst of rough winds in the worldwide wind vitality area and a progress stage after government motivating forces saw critical decreases post March 2012. With the decrease in Accelerated Depreciation rates, the asset report financing rates are stifled. With critical diminishment in AD benefits it is troublesome for the business to make up for the loss of this branch of financial specialists for the time being. The IPPs too are as of now dedicated with their assets for the rest of the monetary year. This has prompted a market with constrained liquidity, bringing about the local market developing by considerably less than its 3 GW extend a year ago.

Three are committed local institutional back organizations like IREDA, Power Finance Corporation and Rural Electrification Corporation which has helped sustainable access financing. Notwithstanding the nearness of an institutional financing component, under IREDA, there are impressive obstructions to securing nearby financing. As opposed to monetary record financing, the customary obligation financing instrument isn't designed for financing sustainable power source ventures, which are normally observed as high-chance, low return ventures.

For most wind vitality projects value cooperation from private value players.
The approach of IPPs in the wind power area has set up venture financing as the new typical. Today different household banks are thinking about sustainable power source extends on a non-plan of action premise. This move in the state of mind of agents is reflected in broadened developments and tenor of credits and lower getting costs.

Then again the counter-party credit dangers of state utilities have expanded fundamentally. For instance in Tamil Nadu, IPPs were antagonistically influenced by the critical decay in the monetary circumstance of the state utility, which caused long postponements in installments to wind control makers. Funding and private value firms are likewise seeing sustainable as a rising opportunity. Arrangements worth $437.3 million (~ Rs. 2348.30 crores) were struck amid the second from last quarter of 2016 and included undertaking money, obligation financing and investment stores.

Changing business sector discernment is additionally supported by the investment of sustainable power source age organizations in the value showcase through the IPO course. For instance, Infrastructure Leasing and Financial Services declared its intends to list its breeze control business through an around $325-$406 million business put stock in IPO in Singapore.

2.9 Analysis of Supplier Market

2.9.1Wind Turbine Manufacturers

India is developing as a noteworthy wind turbine-manufacturing center today. Expanded household request and extension of the in-house fabricating limit of the Indian wind sector has brought about drawing in numerous new producers into the shred. Starting at 2018, we have a combined yearly generation limit of more than 32,960 MW.

Indian producers are taking part in the worldwide market by exploiting lower fabricating costs in India. Indian organizations presently send out locally fabricated wind turbines and sharp edges to Australia, Brazil, Europe, USA and a couple of different nations. A portion of the universal organizations with auxiliaries in India are sourcing more than 80% of their parts from Indian segment producers.

Most parts of India with the exception of in pockets in the State of Tamil Nadu have low windregimes.Low wind regimsrequire extensive changes in the outline of

turbine segments as well as in generator design. The turbine plan and improvement objective is to decrease the cost of vitality (COE). Market powers in the low-wind-administration advertise as of now support this approach.

In the case of our country, most of the new manufacturers offer Class III machines which are more suitable for low wind regimes. Manufacturers now offer Class II and Class III machines with newer technologies and higher power capture capabilities.

MNRE has issued rules to streamline the advancement and encourage sound and precise development of the wind project area in India. The rules incorporate measure for the establishment of properly tried and confirmed quality gear which will enhance the generation of vitality from wind powerprojects. C-WET appropriately plays out the obligation of testing and guaranteeing the hardware and has as needs be turned out with a rundown of producers with models of twist turbines of unit limit 225 kW or more that have gotten type endorsement or accreditation according to the data got from the makers.

The followings are the some big market Players in the wind sector:

Table2.3: List of Tested and Certified Models & Manufacturers

S.No.	Manufacturer	Collaboration/JV	Model	Capacity
1	Chiranjjeevi Wind Energy Ltd.	None	CWEL C30/250 kW	250 KW
2	Enercon (India) Ltd	Enercon, Germany	E-48	800 kW
			E-53	800 kW
3	Gamesa Wind Turbines Pvt. Ltd.	GamesaInnovationand Technology, Spain	MADE AE59	800 kW
			G52	850 kW
			G58	850 kW
			G90	2000 kW
			G80	2000 kW
			G87	2000 kW
			G97	2000 kW
			G97 GF	2000 kW

4	GE India Industrial Pvt. Ltd.	GE Infrastructure Technology International, USA	GE 1.5sle	1500 kW
			GE 1.6-82.5	1600 kW
5	Global Wind Power Ltd.	Fuhrlander, Germany	W2E-W100	2500 kW
		NORWIN, Denmark	Norwin 750 kW	750 kW
6	Inox Wind Ltd.	AMSC-WINDTEC, Austria	WT2000DF	2000 kW
7	Kenersys India Pvt. Ltd.	KENERSYS, Germany	K82	2000 kW
			K100	2500 kW
8	LeitwindShriramManufacturing Ltd.	WindFin B V, The Netherlands	LTW77	1350 kW
			LTW77	1500 kW
			LTW80	1500 kW
			LTW80	1800 kW
9	NuPower Technologies Ltd	W2E Wind to Energy, Germany	W93	2050 kW
10	Pioneer Wincon Private Ltd.	None	250/29	250 kW
			750/49	750 kW
11	Regen Powertech Private Ltd.	VENSYS Energy, Germany	VENSYS 77	1500 kW
			VENSYS 82	1500 kW
			VENSYS 87	1500 kW

12	RRB Energy Ltd.	Vestas Wind Systems, Denmark	V39	500 kW
			Pawan Shakthi	600 kW
13	Shriram EPC Ltd.	TTG Industries Ltd.	SEPC 250T	250 kW
14	Sinovel DB India Private Ltd.	Sinovel Wind Group Co., China	SL 1500	1500 kW
15	Siva Windturbine India Private Ltd.	Wind Technik Nord, Germany	SIVA 250/50	250 kW
16	Southern Wind Farms Ltd.	None	GWL 225	225 kW
17	Suzlon Energy Ltd.	Suzlon Energy, Germany	S52	600 kW
			S64	1250 kW
			S66	1250 kW
			S82V3	1500 kW
			S88 V3A	2100 kW
			S95 DFIG	2100 kW
			S97 DFIG	2100 kW
			S88 DFIG	2100 kW
18	Vestas WindTechnology India Private Ltd.	Vestas Wind Systems, Denmark	V82	1650 kW
			V100	1800 kW
			V100	2000 kW
19	Wind World India Ltd. Ltd.	Enercon, Germany	E-48	800 kW
			WW-53	800 kW
20	Winwind Power Energy Private Ltd.	Winwind Oy, Finland	WinWinD	1000 kW

(Source: Centre for Wind Energy Technology)

2.9.2Other Component Manufacturers

One noteworthy segment is the blade for the wind turbine. LM Wind Power is the main supplier of parts and services. The organization providesproducts and services under

three flags: LM Wind Power Blades, LM Wind Power Service and Logistics and Svedberg brakes. It has worldwide assembling impression with wind turbine sharp blade production lines in China, USA, India, Canada, Denmark, Spain and Poland. The brakes division Svedberg Brakes has creation offices in Denmark and China.

ABB India Ltd. is the pioneer in the wind turbine auxiliaries market. ABB Ltd. provides an extensive variety of administrations and serves wind control clients at each phase of the procedure. It has a worldwide assembling impression and intensive comprehension of both wind turbine applications and power frameworks.

2.9.3Power Sale Opportunities

The partners in the Indian power industry understand the way that it is prevalent to wander into alternative source of energy like windenergy. However, such such source of energyemerge of the ordinary methods for the business, measures are being taken to draw in speculation to the field. Encouraging players to create isn't the main target; adequate push ought to be given to consolidate these vitality sources into the Country portfolio. Giving roads to offer the power produced from these sources conveys the business viewpoint to the business.

2.9.4Sale at Preferential Tariff

SERCs, subsequent to thinking about standardizing suspicions on the project cost, CUF, decide a tariff that would be pertinent to all the wind turbines for the states. The tariff along these lines chose is the particular rate at which the state utilities would purchase the power amid the control time frame characterized by the Commission. It is a single part tariff as it is figured that wind power generation brings about no variable cost. The tax is pertinent on the wind turbine for a settled period known as the tariff period.

The tariff varies from state to state. It ranges from as low as Rs. 3.51 per kWh in Tamil Nadu to Rs. 5.92 per kWh in Madhya Pradesh. . In case of adoption of such tariffs, wind energy projects can also avail the benefits of accelerated depreciation.

While choosing the preferential tariff, the statesconsult the tariff orders of different states and in addition the non specifictariff set by the CERC as a rule. The states to seek after the idea of nonexclusive tariff as the activity of deciding undertaking particular tariff would be excessively monotonous. States likewise enable the advantages of quickened deterioration to be passed onto the purchaser bringing about a plunge in the tariff rate determined by the Commission.

2.9.5 Nature of tariff

Regulatory commissions across the country adopt an approach for determination of preferential tariff on cost-plus basisfor procurement of wind power by DistributionLicensees and other entity .

In regard to the structure and design of the tariff, two methodologies are workable for the tariff decided on cost-in addition basis,which are as following.

"Single-Part Tariff or Two-Part Tariff":-

Two-part tariff is adopted when the variable segment is noteworthy. On account of wind generation, wind being the thought process drive which rotates the turbine and produces energy, there is no fuel prerequisite and consequently the variable generating cost is for the most part is nil. Along these lines, the SERCs have received single-parttariff for wind energy generation.

Project Specific Tariff or Generic Tariff:-

A generic tariff mechanism would provide incentives to the investors for use of most efficient equipment to maximize returns and for selecting the most efficient site, while a project-specific tariff would provide each investor, irrespective of the machine type and the site selected, the stipulated return on equity and it would shield the investor from the uncertainties involved in capacity utilization due to machine choice and site location. Considering the small capacities and diverse ownership of the wind power projects, the SERCs decide to determine the generic wind power tariff, rather than go for a project specific tariff on case-to-case basis .

Front loaded or back loaded or levelized tariff:-

In case tariff is front loaded the developer may lose interest in the project after enjoying the benefits of front loading .In a back stacked tax, the engineer will most likely be unable to meet his credit overhauling risk because of insufficiency of income. Most SERCs, in this way, choose to embrace a levelized approach for tax assurance in order to adjust the interests and prerequisite of different partners. States like Karnataka and Tamil Nadu agree to normal duty . Average tariff also mitigates the risk of front loading and back loading but unable to provide for the time value of money .

2.9.6Captive Usage or Third Party Sale

The Act provides that any person may construct, maintain or operate a captive generating plant and dedicated transmission lines. Under the provisions of this Act, every person, who has constructed a captive generating plant and maintains and operates such plant, shall have the right to open access for the purposes of carrying electricity from his captive generating plant to the destination of his use subject to the availability of transmission capacity

Generally (over 90%) of wind captive tie up is with HT association in particular classification at 33KV level. This classification is never sponsored and the yearly addition in the tax is relatively sure. By tying up twist control for hostage reason the power cost of the plant, creation is fixed for a long time." Wind venture ends up essential piece of the creation procedure and protections plant shape the yearly addition in the tariff to the tune of aggregate generation.The generator has the alternative of pitching the ability to appropriation licensees if the generation is in overabundance to the captive demand, though at a rate lower than the preferential tariff.

There is also the fact that captive wind generators cannot be used as a steady source of power because of its seasonal nature. Because of this, wind energy is for the most part used to supplement vitality drawn from the lattice.

2.9.7Banking- Mechanism

Banking of electricity is a facility to help generating stations based on non-conventional energy sources to produce power by maximizing utilization of available energy source without demand restrictions. The purchaser consumes the entire power generated by the plant and to the extent it is in excess of the demand of the consumer. The excess is then deposited or banked with the licensee which can be later released or returned to the generator as and when the generator may require .

This mechanism is a breakthrough for industries willing to set up wind turbines for captive use . When the generation is short of the demand, the consumer can withdraw energy from the distribution licensee's network . It is a financially neutral transaction with levy of banking charges, a percentage of the banked energy, being governed by the SERC's policy .

The energy banked with the distribution licensees is available for withdrawal for a specified banking period which varies among states. Gujarat offers banking for a period of one month whereas other states have a period ranging up to 12 months. Beyond the banking period the energy is deemed to be forfeited by the generator to the distribution utility for which the generator may be compensated at a rate lower than the existing wind energy tariff.

The mechanism is a boon for the captive users as the energy generated by the turbine can be used at their convenience. On the flip side, banking also faces heavy resistance at the hands of the distribution utility.

2.9.8REC Mechanism

National Action Plan for renewable power source in the aggregate generation capacity of India. The Plan set the base renewable power purchase obligation (RPO) focus at 5% of the aggregate energy procurement in 2009-10, with a 1% year-on-year increment for the next 10 years, i.e. 10% by 2015-16 and 15% by 2019-20.

The CERC issued REC regulations in January 2010 with key target to advance the improvement of sustainable power source and encourage its interstate flow. This empowers the committed substances (conveyance utilities and open access clients)

crosswise over states to meet their RPO targets. Under this system, expresses that can't meet their sustainable power source off-take targets can plug the shortage by acquiring Renewable Energy Certificates (RECs) from sustainable power source generators in different states. There are two classifications of RECs, specifically, sun oriented authentications issued to qualified elements for sun based power generation and non-sun based generation. One REC is proportional to the generation of 1000 units from a renewable power source.

As a result, REC component is a market based instrument to advance sustainable power source and encourage RPO. Cost of power age from sustainable power sources is named cost of power age proportional to regular vitality sources and the price for ecological properties. Renewable Energy generators shall have two options:

i. To sell the renewable energy at predetermined tariff, or

ii. to offer power generation and ecological characteristics related with RE generations independently. The natural characteristics being traded as RECs.

Fig. 2.9: Options for Sale of energy by Wind Energy Generators (Source: REC Mechanism in India)

The RECs remain honest to goodness for a period of 01 year from the date of issuance. Generous RECs could be exchanged inside the restraint cost and floor esteem, the cost being picked by the market powers winning at the period of trade. This discretion and floor cost would be managed by CERC in guide with Central association and FOR (Forum of Regulators) once in a while. At show the patience and floor costs remain at Rs. 2400 for each MWh and Rs. 1000 for each MWh.

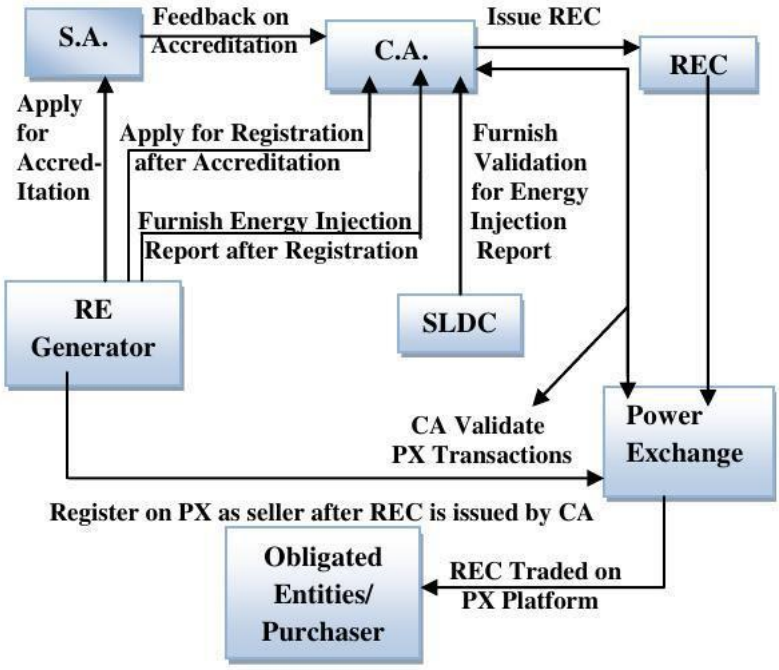


Fig. 2.10: Implementation of REC system (Source: Suzlon website)

2.9.9 Clean Development Mechanism

Clean Development Mechanism (CDM) is a procedure to support use of outpouring diminish exercises to acquire guaranteed release diminishment (CER) traits, each similar to one ton of CO2. These CERs can be traded and sold, and used by industrialized countries to a meet a bit of their release diminishing concentrations under the Kyoto Protocol. The part enables sensible change and transmission diminishes, while giving industrialized countries some flexibility by they way they meet their release diminishment restriction targets.

National Clean Development Mechanism Authority is the nodal association which evaluates and supports proposed expand and spreads information related to CDM. The

association has been instrumental in giving effective institutional structure and issues have country underwriting inside 40 days of the assignment convenience.

Controls the nation over are genuinely comparative as far as division of the CDM benefits. All the states permit 100% of CDM advantages to be held amid the main year of task. Amid the progressive years, the breeze venture engineer should impart the advantages to its customer. Every year the shopper gets an extra 10% offer of the CDM benefits until there is a 50:50 sharing among the generator and the customer.

Under the IEA New Policies circumstance, India's breeze control market would withdraw astonishingly to yearly increments of only 1,900 MW consistently by 2020. The result would be a total presented utmost of 32 GW by 2020 and 66 GW by 2030. Wind power would then convey almost 81 TWh reliably by 2020 and 174 TWh by 2030, and save 48 million tons of CO2 in 2020 and 105 million tons in 2030. Interests in turn control in India would in like manner drop from the present levels of €3.7 billion consistently to simply €2.4 billion by 2020.

2.9.10 Critical Issues Dogging Wind Energy

Wind energy speaks to around 70% of India's practical power source age, excepting huge hydroelectric power wanders. An organization focal point of duplicating manageable power source respect 55 GW in the four years depends seriously on improvement in the wind area.The administration is focusing on expanded sustainable limit to some extent to maintain a strategic distance from rehashes of energy blackouts that dove substantial swaths of the country into dimness because of creaky framework foundation, exacerbated by coal deficiencies. Meanwhile, it appears to be needing to on a very basic level lessen its yearly fuel import charge came to $143 billion in year completed March 31.

The administration pulled back a sustainable power tax connected appropriation and cut a duty motivating force program. In spite of the fact that it reported in February that levy sponsorship bolster for the breeze division would be reintroduced, it still can't seem to execute the choice. It is hazy whether the expense motivating force program will be restored. India have around 32 GW of introduced wind-power capacity as for 20 GW of sun based capacity.

The difficulties confronting wind control are unique. The strangeness of wind age causing issues for structures, which need to keep up smallest base weights to stay stable and the way that solid breeze control is valuable in just several regions of the nation. Around 85% of India's breeze control is conveyed in only five of India's 29 states viz.Tamil Nadu, Maharashtra, Gujarat, Karnataka and Rajasthan. Affiliations are looking present objectives in these states and investigating decisions in Andhra Pradesh, Kerala and Madhya Pradesh.

The nonappearance of rousing powers for wind-develop overseers to develop wanders is hurting demand books at turbine creators. Administration associations started approving various conditions on cross section arrange, for example, influencing own sub-to station by Wind Farm Developers/Wind Turbine Manufacturers, prohibitive feeder for interfacing wind turbines, et cetera. Also, they are in like manner focusing their discoursed towards age based inspirations rather than prisoner usage. The establishment change charges (IDC) has in like manner gone up tremendously due to the extended cost of capital equipment, spares and consumables, besides extended working and bolster cost.

2.9.11Expectations in future

The market created to be third greatest on the planet riding on the accomplishment of strong approach and authoritative structure. In 2011, India beat 3,000 MW in yearly foundations. This indicated a 138% improvement over a two year horizon; a brilliant achievement amidst overall budgetary pity.

The Indian breeze industry has at any rate ruined. In 2012, the industry recorded close to a 40% dunk in foundations in the essential bit of the year. Late approach changes have affected the improvement of the business and it remains to be seen what steps are taken to restore congruity. In any case, the whole deal viewpoint for the portion remains strong.

India's moves to address the monetary strength of its utilities and handle matrix coordination issues drive a more hopeful conjecture. By 2022, India is relied upon to dramatically increase its current inexhaustible power limit. Out of the blue, this development over the gauge time frame is higher contrasted and the European Union.

Under the IEA New Policies circumstance, India's breeze control market would contract fundamentally from the present yearly additions of around 3,000 MW to only 1,900 MW consistently by 2020. The result would be a total presented cutoff of 32 GW by 2020 and 66 GW by 2030. Wind power would then convey close to 81 TWh reliably by 2020 and 174 TWh by 2030, and save 48 million tons of CO2 in 2020 and 105 million tons in 2030. Interests in curve control in India would in like manner drop from the present levels of €3.7 billion consistently to simply €2.4 billion by 2020.

The Moderate situation is more probable in a world which carries on pretty much the way it has been, with wind control proceeding to make strides yet at the same time battling against vigorously sponsored officeholder vitality sources, and with the interwoven of carbon discharge decrease measures that exists at show, with a low cost on carbon outflows, where one exists by any stretch of the imagination.

The Advanced circumstance exhibits the capacity of curve vitality to convey no less than 20% of overall power supply in this present reality where there is strong political duty and worldwide joint effort to meeting viably agreed natural change goals, enhancing essentialness security, radically lessening new water use and making a considerable number of new occupations around the world.

The GWEO Moderate circumstance takes after the lines of without a moment's hesitation publicize projections out through 2019 with yearly market assess topping 70 GW by 2020 for a total aggregate presented point of confinement of 760 GW by that date. Under this circumstance, advancement would continue all through the 2020s, with yearly market assess pushing toward 100 GW consistently and a total presented point of confinement of around 1,600 GW by 2030.

The GWEO Advanced situation keeps up eager development rates consistently, accepting that present market troubles are overcome sooner rather than later. With yearly market measure topping 130 GW before the decade's over, it expect that assembling limit keeps on expanding while advertise request increments to fill it. Add up to introduced limit achieves 1,149 GW by 2020 and in excess of 2,500 GW by 2030, mirroring a full sense of duty regarding decarburizing the worldwide power supply which we have to do within the near future.

Under the GWEO circumstances, the total presented point of confinement would achieve practically 48 GW by 2019, and this would proceed to create to 75 GW by 2022 and 124 GW by 2030. By 2019 the breeze business will see endeavors of €6.8 billion consistently, €7.5 billion consistently by 2022 and €8.3 billion consistently by 2030. Work in the part would create from the at exhibit assessed 65000 occupations to more than 102,000 by 2022 and in excess of 126,000 jobs ten years sometime later.

Everything considered the GWEO Advanced circumstance exhibits that the breeze change in India could go essentially further: by 2022 India could have pretty much 98 GW of turn control in action, giving 219 TWh of energy consistently, while using in excess of 179,000 people in the territory and saving practically 131 million tons of CO2 outpourings consistently. Hypothesis would by then have accomplished a level of €13 billion consistently.

With the extraordinary necessity for shock and higher essentialness creation in the country, wind imperativeness will give an evidently basic offer of the renewables based point of confinement. By 2030 wind power would create practically 504 TWh consistently and be avoiding the outpouring of 304 million tons of CO2 consistently.The possibility to enhance the use of wind vitality is being tried crosswise over different scenario; for instance, cleaning water utilized for fuel investigation procedures, for example, fracking, and giving devoted energy to water system frameworks. Examinations are additionally in progress to utilize power created from twist to produce hydrogen; utilizing clean power to produce a perfect fuel for cutting edge vehicles. The field of wind vitality has inconceivable degree for advancement, meaning genuine applications and colossal monetary terms.

This is basically basic in India. As our economy continues creating, and we push to ensure every Indian methodologies opportunity, ordinary occupations and employment, we will require always noticeable advantages for make this possible. The key will be essentialness. Impeccable, possible, feasible and also basic, private wellsprings of imperativeness are essential to fulfill the ability of India in the coming years, and it is certain wind essentialness will have a critical effect in framing the India of tomorrow.

CHAPTER – 3

3.1 Conclusion and Recommendations

3.1.1 Conclusion

India's burning essentialness ask for and depleting oil based good resources joined with ecological change and imperativeness security stresses of Indian Government, made room for supportable power source change in India. Sustainable power sources are never again considered as "interchange vitality" source, yet have turned into a key part in the arrangement of country's vitality require. Establishment of Electricity Act 2003 quickened the improvement of sustainable power source based age. Different strategies both at focal and state level are empowering sustainable power source age particularly through breeze by giving aberrant monetary and special impetuses, for example, delicate credits, creative financing bundles, decreased obligations, and charges.

The key driver for practical power source based age is the surety of vitality off-take through renewable purchase obligation (RPO) set by various SERCs. RPO is summoned under EA 2003 and NAPCC. Wind is financially and operationally the most appropriate manageable power source resource in India and with 70% of nation's maintainable power source age starting from wind imperativeness, it is ascending as one of the greatest source the extent that the reasonable power source division.

Time is moreover positive for advantages in the breeze essentialness territory. Wind essentialness is getting the chance to be standard and the restriction in the supplier and EPC markets is tight which plays in the help of the architect.

In spite of the fact that this open door may not keep going long due to 2 factors: arrangements and accessibility of wind destinations. With the advancement getting the chance to be standard, there would come a point in time while overseeing bodies would find the driving forces unnecessary and the same would be pulled back. Decision of a better than average site may have a huge impact for another budgetary pro in the business and the openness of windy goals is on a lessening as a greater amount of theory is filling the division. It is best to grab a touch of the pie before it is no more.This, close by managerial exercises and lucrative methodologies propelling change of wind power

generation through private planners in India, it is endorsed that budgetary pros should assault into wind control age to utilize the rising wind power promote.

3.2 Findings

Examination of wind imperativeness procedures of states adjacent the non particular system described by CERC gave not all that terrible comprehension into the business condition for wind control architects in the individual states. Each one of the states are having the plan for whole deal PPA with DISCOMs, Third Party Sale of energy made, concessional wheeling charges, CDM benefits and Tax and Duty prohibitions. Most of the states have not allowed banking facility, at any rate some have allowed with portion of charges.

The CERC's wind tariff impose is seen to be a change one and the courses of action of the states were appeared differently in relation to the CERC's regulation for a measure. The commitments by different states for wind powerdevelopers are inspected freely. The fall in obligation and non-extension of Generation Based Incentive (GBI) for wind endeavors will inimically impact within rate of return for the new exercises, says India Ratings and Research. Creators may dodge low breeze resource regions which may some way or another have been reasonable with GBI or higher tariff.

3.2.1Andhra Pradesh

This state having a tariff of Rs. 4.84 per unit which is nominal considering about that a Capacity Utilization Factor of 23% is to be accommodated. In fact, AP has not indicated a tax mechanism for Wind Energy Generators profiting advantages of Accelerated Depreciation.

3.2.2Gujarat

This state having a tariff of Rs. 4.52 per Kwh for Wind Energy Generators yet in the event that the engineer profits Accelerated Depreciation benefits, the Wind Energy Generator sare entitled for a duty of Rs. 4.15 per Kwh. Gujarat takes into consideration a Capacity Utilization Factor of 24.5% which is profiting for a utility lavishly blessed with wind power assets.

3.2.3 Karnataka

It provides a tariff of Rs. 4.69 for each unit with no arrangement for Accelerated Depreciation and this has been the situation for as far back as four years. This state hasn't amended its wind power strategy since year2009. Karnataka accommodates a Capacity Utilization Factor of 26.5%.

3.2.4 Kerala

This state having a tariff of Rs. 4.77 per Kwh with a Capacity Utilization Factor of 25%.This state does not take into consideration an alternate tax for engineers profiting advantages of AD.

3.2.5 Madhya Pradesh

This state having wind energy tariff of Rs. 4.78 per Kwh with CUF of 23%. MP wind portfolio permits just for a Capacity Utilization Factor of 23%. Madhya Pradesh likewise doesn't give an alternate duty to benefits collected because of AD.

3.2.6Maharashtra

In accordance with the CERC's direction, issues tax contingent upon the breeze control thickness of the site. The tariff ranges from Rs. 3.88 per Kwh for high WPD sites to Rs. 5.81 per Kwh for sites with lower Wind Project developers.This state likewise accommodates an alternate tax in the event that the designer settles on AD benefits. Maharashtra has an introduced twist limit of 2976 MW which shapes very nearly half of the accessible wind power potential in the state.

3.2.7Rajasthan

This state wind power policy provides a tariff of Rs. 5.45 per Kwh for wind sites in districts of Jaisalmer, Barmer and Jodhpur whereas other districts get a tariff of Rs. 5.72 per unit. This difference is due to the difference in wind profile of the regions. Rajasthan additionally recognizes the advantages accumulated from Accelerated Depreciation system.

3.2.8Tamil Nadu

This state is the pioneer as far as introduced twist limit among the states in India. In any case, Tamil Nadu having the tariff of Rs. 4.16 which might be added up to the high Capacity Utilization Factor accepted during the time spent tariff count. Tamil Nadu accepts a Capacity Utilization Factor of 27.15% over the state. The state doesn't give an alternate tariff to engineers profiting Accelerated Depreciation benefits.

Out of these states, Andhra Pradesh, Karnataka, Rajasthan and Tamil Nadu were the main ones that have proclaimed their APPC for the year under thought.

3.3Recommendations

Gujarat, Maharashtra, Karnataka, Rajasthan and Tamil Nadu are the states would provides the base hazard in light of the fact that their breeze profile being the choicest.

For financial specialists leaning toward high IRR, Maharashtra is the best alternative. Karnataka has additionally a higher IRR however it isn't prescribed on the grounds that its arrangement for capital expenditure being low.

From the perspective of theorists hunting down unfamiliar wind resources, it is recommended to look for after Andhra Pradesh or Kerala as objectives. Another lucrative option is of repowering more prepared wind turbines. These old generators are of small breaking point and masterminded in the best available wind goals, thusly power to a lesser degree a danger for the money related expert.

Budgetary pros concentrating on bend imperativeness for prisoner use, the states with best methodologies as to open access and sparing cash are recommended. The states of choice are Maharashtra, Gujarat and Tamil Nadu.

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