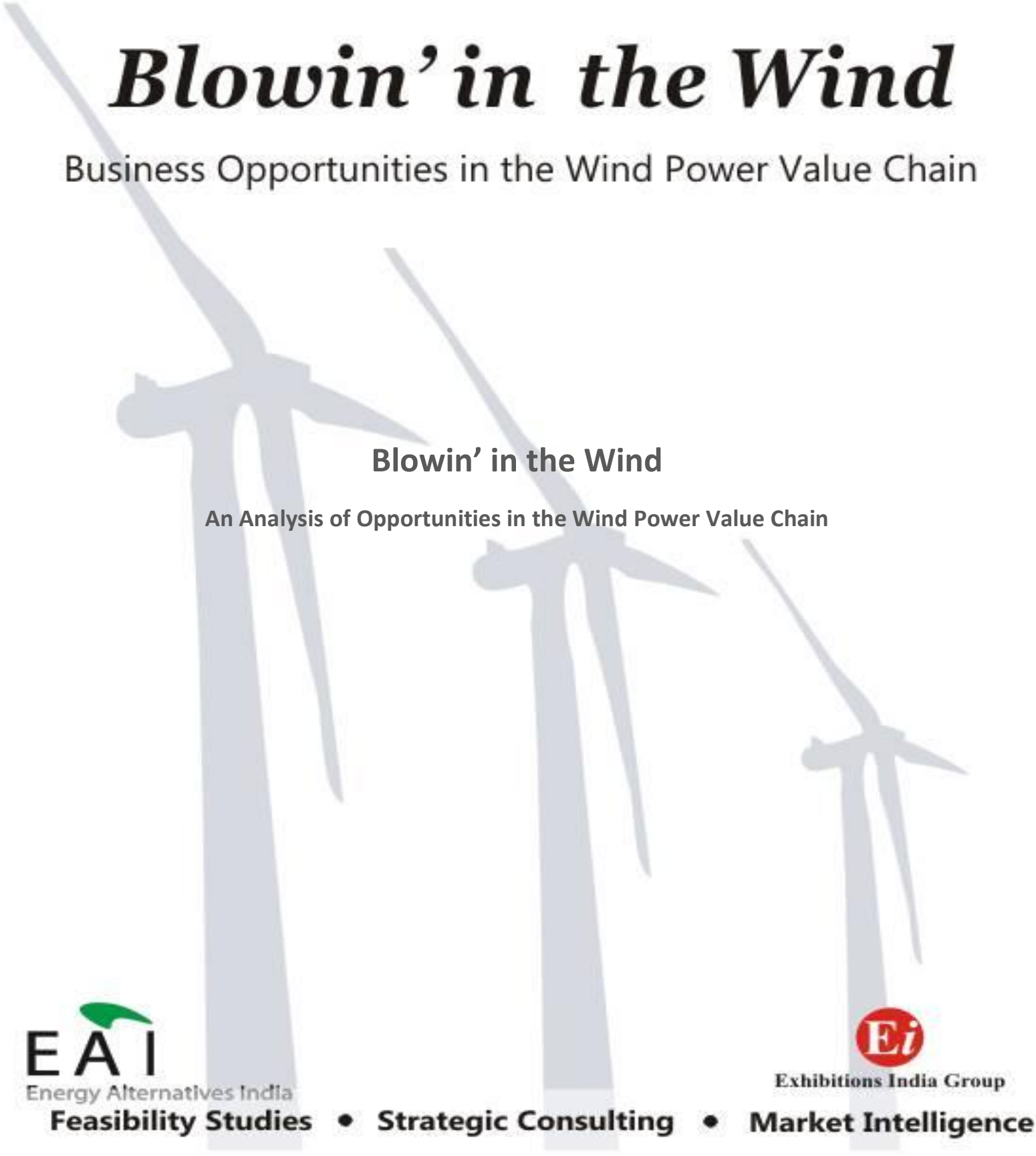
Blowin' in the Wind

Business Opportunities in the Wind Power Value Chain



Blowin' in the Wind

An Analysis of Opportunities in the Wind Power Value Chain

EAI
Energy Alternatives India

Ei
Exhibitions India Group

Feasibility Studies • Strategic Consulting • Market Intelligence

Preface

Greetings from Energy Alternatives India (EAI).

Hardly a day passes by without exciting updates on renewable energy in India. While solar is capturing the headlines every day in this context, wind has been the silent winner all along.

With a total installed capacity close to 15 GW (fifth largest worldwide), constituting over 75% of the total installed renewable energy capacity in the country, and with almost 3000 MW being added each year, the growth of wind power in India has been very encouraging.

What makes the wind sector in India even more promising is the fact that the manufacturing ecosystem for wind is growing strong and steady too. Except for a couple, every one of the top ten wind turbine manufacturers in the world already has a manufacturing base in India. In parallel, the procurement of components for wind turbine manufacturing from indigenous sources has been growing as well.

While the achievements of the wind sector have indeed been laudable, it is time for us to raise the bar. The easiest way to do this will be to benchmark ourselves against China, a country which has raced to the top both in terms of total wind power plant installations as well as manufacturing capacity. While these two countries are significantly different in polity and markets, some lessons could surely be transplanted from China to India. In addition to the China benchmark, we could also perhaps look at the inherent strengths India has as a manufacturing base (our proven positioning as a high quality, medium cost supplier) to explore specific opportunities within wind energy.

Being a premier research and consulting group with a dedicated focus on the Indian renewable energy sector, the above considerations made us at EAI work on this white paper. This paper evaluates the opportunities along the entire wind energy value chain, with a special focus on opportunities in manufacturing. **Done in conjunction with the Exhibitions India group for the 4th Renewable Energy Conference – Wind Energy Edition in Coimbatore to be held on 16th Nov 2011**, I hope this intelligence document enables entrepreneurs and investors take investment decisions for productive opportunities in wind energy.

I also take this occasion to wish the very best for the conference organizers and delegates.

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1. Introduction & Overview of the Wind Energy Industry in India

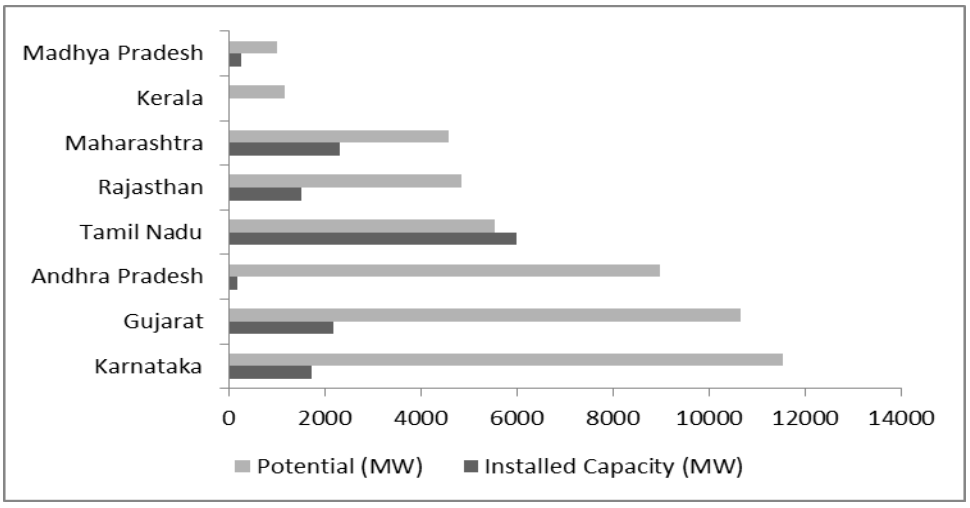
The development of wind power in India began in the 1990s, and has progressed steadily in the last few years. The short gestation periods for installing wind turbines, and the increasing reliability and performance of wind energy machines have made wind power a favored choice for capacity addition in India. Currently, India has the fifth largest installed wind power capacity in the world. Wind power accounts for about 8% of total installed power capacity and 70% of the total grid interactive renewable energy in India. It is estimated that 7,500 MW of additional wind power capacity will be installed in India between 2011 and 2015, taking the total installed capacity beyond 22GW[1].

In addition to the progress made in wind turbine installed capacities, the progress of the overall wind energy ecosystem has been encouraging as well. Pointers to this are the increasing number of component manufacturers and the rapid utilization of India's land for wind energy. While the growth of wind power in India was largely driven by tax incentives until recently, it is expected that more IPPs (independent power producers) will be interested in investing in this segment with the recent announcement of generation-based incentives.

1.1 Wind Industry - Status and Trends

The growth of wind energy in India has been spurred by only a handful of states so far, with Tamilnadu being by far the leader.

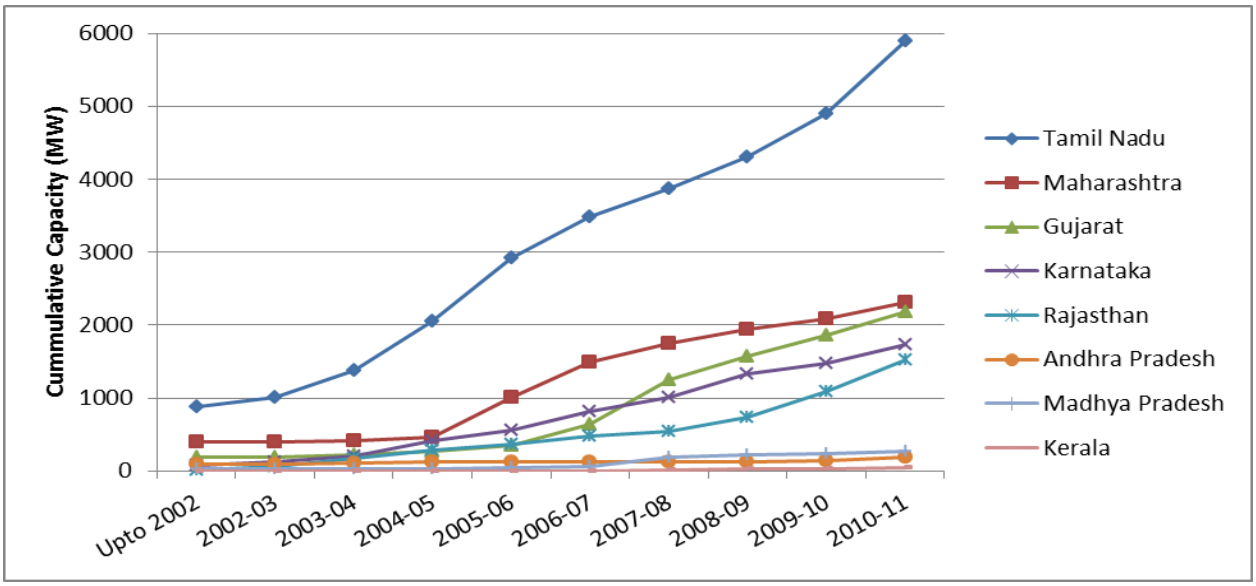
Potential vs. Installed Capacity



[1] HSBC Global Research

Source: MNRE, IWEA

Installed Capacity Trends in Different States



Source: MNRE, EAI

It can be observed from the two charts that while Tamilnadu garners the most limelight currently owing to its leading position in installed wind capacity, attention will quickly be shifting to states such as Maharashtra, Gujarat, Andhra Pradesh, Karnataka and Rajasthan where the gap between the available potential and installed capacities are much higher than those for Tamilnadu. ***The first chart also illustrates the inadequacies in the current potential estimates, which has resulted in the curious status where the installed capacity of Tamilnadu is higher than its estimated potential!*** MNRE has recognized this and in association with CWET is undertaking a project to re-evaluate the wind energy potential in the country.

> "Until recently, though the State had the potential, Karnataka was not so much in the reckoning because policies were better in Tamil Nadu. However, policies are in place now and companies are moving into Karnataka. Chennai-based Orient Green Power Ltd is one such with plans to put up a 50 MW project at an investment of Rs 330 crore." – Hindu Business Line

1.2 Potential

The total potential for wind power in India was first estimated by the Centre for Wind Energy Technology (C-WET) at 45 GW, and was recently increased to 48.5 GW. This figure was also adopted by the government as the official estimate.

At heights of 55-65 meters, the Indian Wind Turbine Manufacturers Association (IWTMA) estimates that the potential for wind development in India is around 65-70 GW. The World Institute for Sustainable Energy (WISE) estimates that with larger turbines, greater land availability and expanded resource exploration, the potential could be as high as 100 GW.

A 100 GW potential for wind energy significantly widens the attractiveness of the Indian wind energy segment, given that the total installed capacity for electricity is India is about 160 GW.

In addition to this, significant potential exists in the offshore wind energy sector. In view of this, MNRE has recently commissioned studies to estimate the potential of offshore wind in India which is to be completed over the course of the next two years.

In the future, a significant portion of the capacity addition is also expected to come from repowering of existing wind farms. This is due to the fact that most high wind energy density sites are already exploited and are occupied (in most cases) by inefficient/poorly designed wind farms. Upgrading these wind farms with better design as well as the use of more efficient turbines would result in the wind farms seeing higher PLF thereby aiding in the realization of higher revenue. For example, Gamesa recently completed replacing 11 old wind mills of 225 kW capacity each with three 850 kW turbines. As a result of this, the capacity of the plant remained almost the same, but the PLF was much higher due to the fact that the new turbines operated even at lower speeds, were more efficient and had little downtime.

Projected Benefits of Repowering Wind Farms

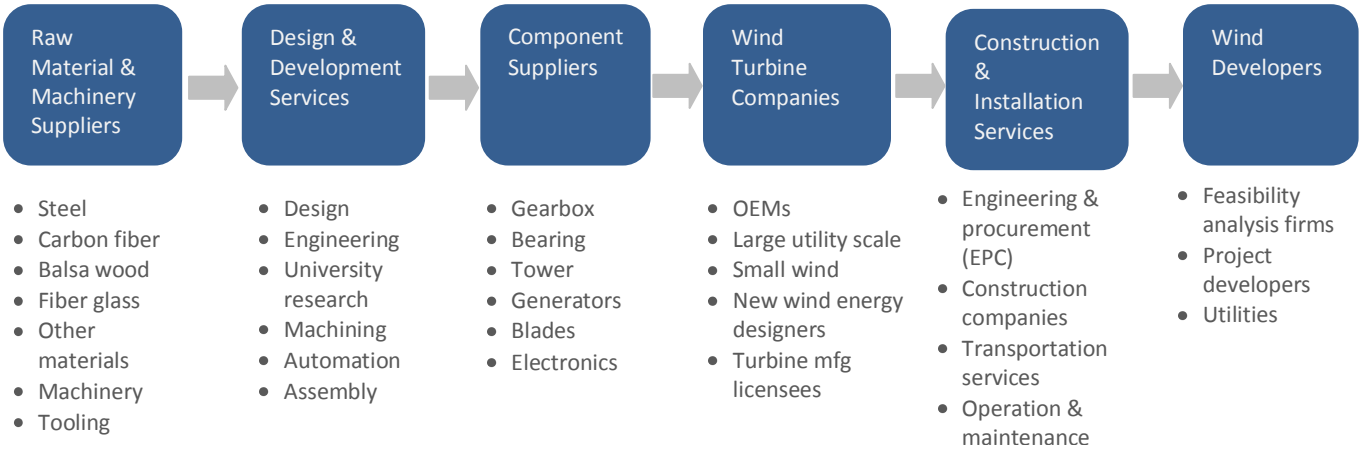
	Existing Wind Farm	After Repowering
Capacity	8.1 MW	8.5 MW
Estimated Annual Generation	104 lakh units	220 lakh units
Plant Load Factor	14.7%	29.5%

Source: Hindu Business Line, Gamesa, Indicative data only

It is estimated that about 1400 MW of wind power capacity was installed prior to 2002. These wind farms use outdated technology while occupying prime wind energy density properties, leading to sub optimal electricity output.

2. Wind Energy Industry Value Chain

The wind energy value chain consists of a number of specific and distinct steps - from the supply of raw materials to the transmission of electricity. These steps, along with the prominent supporting products and services for each, are given below. The illustration below also provides a bird's-eye view of the opportunities available along the entire wind energy value chain.



Source: www.nextenergy.org

A detailed analysis of the various stages presented above and the products and services applicable for each stage will also show how opportunities exist for a range of entrepreneurs at each stage. Except for the "wind turbine companies" stage, which is a relatively concentrated OEM market with the top ten players cornering a large share of the market (over 80% of capacity installed during 2010), the rest of the stages could present ample opportunities for small and medium players.

A trend in the wind energy industry that entrepreneurs should be aware of is the move by incumbents towards vertical integration along this value chain. And there is a reason for the vertical integration efforts.

Turbines have been doubling in size every four years, and technology has been developing at excellent speed, but the suppliers that had the right expertise, facilities and capacity to deliver on increasingly challenging orders have been thin on the ground.

With supply chain bottlenecks a constant threat, many of the large wind firms have responded by buying out suppliers of critical components such as blades, generators, and gearboxes. By bringing suppliers in house, they could ensure they would get the products they needed on time, and at an acceptable price.

Vertical integration of the supply chain has been a gradual process over the last decade. Today, most turbine manufacturers make their own blades, after a rush to bring them in-house four or five years ago.

OEMs including Vestas, GE, Gamesa, and Suzlon also have in-house supply of generators and controllers, although they also still source some of these components from other suppliers.

Vertical integration has not always been a smooth process, however. An example is Suzlon's acquisition of Hansen Transmissions (a gearbox manufacturer) in 2006 and its subsequent sale to Germany's ZF Friedrichshafen AG in September 2011.

2.1 Key Players in the Wind Power Development

Key players with a role to play in wind energy development include: wind turbine manufacturers; wind project developers; consultants and contractors; electric utilities, government agencies; and landowners.

Wind Turbine Manufacturers: Large wind turbines are either sold directly by the manufacturer or by the manufacturer's regional dealers and distributors.

Wind Developers: Wind developers buy or lease windy land, finance the installation of wind turbines and operate and maintain the turbines for an extended period. After a project is constructed, the wind developer's role varies. The developer may own and operate the wind farm, or merely operate the project for a different owner.

Private Consultants and Contractors: Private consultants and contractors provide specialized skills or knowledge. A consulting meteorologist can independently evaluate the wind resources at a site. Engineering consultants can offer technical comparisons among competing wind turbines or provide "due diligence" reports to banks considering loans for proposed wind projects. Contractors are often needed for the construction phase of wind projects for tasks such as pouring concrete and erecting the turbines.

Electric Utilities: The cooperation of electric utilities (mainly state electricity boards) is required to interconnect wind turbines with the power grid. Selling electricity to a utility involves negotiations between the power generator and the electric utility. These negotiations generally result in a contract binding both parties to an agreement for a fixed amount of time. In India, state electricity boards represent the main market for wind-generated electricity, whether they are interested in wind power for their own purposes or are under obligations to invest in wind energy as mandated under the Renewable Purchase Obligation wherein, a percentage of the total electricity generated/distributed should be from renewable sources (a detailed list of the obligation requirement in various states is available in annexure I). The RPO mechanism has encouraged big companies such as TATA power and Jindal Steel & Power to set up large wind farms with capacities exceeding 100 MW.

Landowners: As the suppliers of windy land, landowners – especially in rural areas - can have substantial influence over how wind energy develops. As the industry has grown, windy landowners and their communities are gaining an understanding of the tremendous value of their wind resource and are

finding ways to keep more of the benefits in the local community. These methods range from farmers negotiating better land leases with developers to local and community investments in wind projects. With the anticipated removal of accelerated depreciation benefit, a large chunk of the incentives available to the wind farm developer would be through the Generation Based Incentive (GBI) mechanism. GBI stipulates that the higher the amount of electricity generated, the more the incentive provided (i.e. incentive is provided per unit of electricity). This encourages wind farm developers to setup power stations in high potential sites. With most of the high wind energy potential sites already taken up, the price of land with high wind energy potential (usually farm land) is expected to shoot up.

2.2 Wind Energy Business Opportunities

Business opportunities in wind energy industry are available in manufacturing, services and trading. Among these sectors, the widest range of opportunities is present in the manufacturing sector, followed by services.

The analysis of business opportunities presented in this section is, to a large extent, not country specific, but we have provided some notes in the Indian context.

2.2.1 Manufacturing Opportunities in Wind Energy

Manufacturing opportunities in wind exist in:

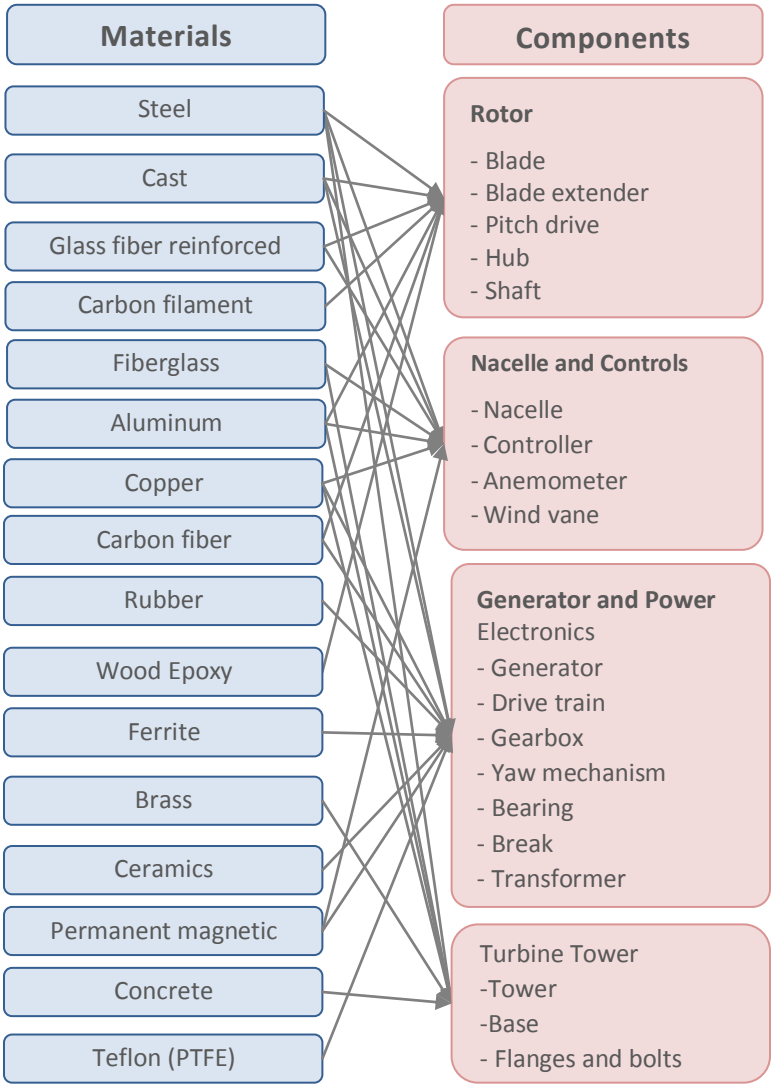
1. Raw materials production
2. Original equipment manufacturing
3. Component manufacturing

Raw Materials Production

A wide range of materials are used for wind turbine construction. Steel is one of the most important materials because of its strength and durability. Turbines are primarily made of steel, which accounts for 90% of the machine by weight. A single 1 MW utility scale wind turbine tower is constructed from an estimated 100 tons of steel, and larger turbines use a significantly greater amount of steel. The rotor is constructed from approximately 45% steel, with the hub being made of 100% steel, and the blades being made up of 2% steel and a combination of fiberglass (78%) and adhesive (15%). Steel accounts for between 87% and 92% of nacelle components (American Wind Energy Association, 2009).

While steel is perhaps the most important material in this context, a diverse list of raw materials are required to produce the vast number of components that comprise a wind farm. The following illustration provides a detailed review of the materials and components used in the production of wind turbines.

Raw Materials Required for Wind Turbine Components



Source: CGGC, based on industry sources and company websites.

There is a move in India to indigenize wind turbine component production; this could lead to significant opportunities for suppliers of raw materials that go into the production of these components. Indian producers of the above raw materials should hence explore how they can become suppliers to this sector.

Original Equipment Manufacturing

In the wind energy sector, turbine manufacturers represent the predominant OEM segment. The top 10 OEMs in the wind energy industry (by market share, 2010) are: Vestas, Sinovel, GE Wind Energy, Goldwind, Enercon, Suzlon Group, Dongfang Electric, Gamesa, Siemens Wind Power and United Power.

OEMs usually manufacture some of the critical components such as the nacelle in-house, and blades and towers are produced either by the OEM or fabricated to the OEM's specifications by a supplier. Typically, the wind project developer's contract with the OEMs for the delivery of the complete wind turbines include the nacelle, blades, and turbine tower, which are transported from the manufacturing facility directly to the wind farm construction site.

Supply chain of the top wind turbine manufacturers

Turbine Manufactuerer	Rotor Blades	Gearbox	Generators	Towers	Electrical Controllers (VSE)
Clipper	Tecsis	Clipper	Potencia	Emerson, Anston	Clipper
Enercon	Enercon	Direct drive	Enercon	KGW, SAM	Enercon
Gamesa	Gamesa, LM	Echesa (Gamesa), Winergy, Hansen	Indar (Gamesa), Cantarey	Gamesa	Ingelectric (Gamesa
GE	LM, Tecsis	Winergy, Bosch Rexroth, Eickhoff, GE	Loher, GE	DMI, Omnical, SIAG	GE
Nordex	Nordex	Winergy, Eickhoff, Maag	Loher	Nordex, Omnical	Nordex, Mita Tekni
RE Power	LM	Winergy, Renk, Eickhoff			Mita Teknik, ReGuard
Siemens	Siemens, LM	Winergy	ABB, Siemens	Roug, KGW	Siemens, KK Electronic
Suzlon	Suzlon	Hansen, Winergy	Suzlon, Siemens	Suzlon	Suzlon, Mita Teknik
Vestas	Vestas, LM	Bosch Rexroth, Hansen, Winergy, Moventas	Weier (Vestas), Elin, ABB, LeroySomer	Vestas, NEG,DM	Cotas (Vestas), NEG (Dancontrol

Source: GWEC

Competition among wind turbine OEMs has increased substantially as the wind power industry has expanded. In addition, as noted earlier, there has been a significant trend towards vertical integration in the wind energy industry and this could see OEMs producing more of the components themselves.

While opportunities do exist for new OEMs in India with the projected continuous growth in the wind industry, it should be noted that this is an area that faces intense competition from large global companies, and entering the OEM domain will require significant capital and marketing investments.

Acquisitions could be one of the ways for a medium or large business group to enter the OEM market. An example of this is the acquisition of controlling stake in WinWind Oy, a Finnish manufacturer of wind turbines, by Siva Group of India in 2006.

To encourage indigenous manufacturing of wind turbines and to facilitate transfer of new technology, MNRE is expected to introduce local content requirements for wind turbines.

> "Turbines made by companies that sell more than 15 megawatts of machines in India without establishing an "adequate manufacturing facility" may be uprooted at their owners' cost and will face "heavy" penalties" – MNRE draft guidelines as reported by Bloomberg Businessweek

Component Manufacturing

Component manufacturers manufacture a wide range of mechanical and electrical components, including generators, hydraulics, sensors, hardware, drives, power distribution, composites, cabling, big steel, castings, forgings, bearings, gearboxes.

The primary components in a wind energy generating system are:

- Rotors and Blades
- Nacelle and Controls
- Generator and Power Electronics
- Tower Components

Sub-components for each of these components are provided in the earlier illustration.

A modern wind turbine consists of about 8000 unique components. Such components and related services are supplied by an estimated 25 to 30 highly specialized companies in India in addition to a large number of international suppliers. Companies involved in component manufacturing for the wind power industry range from OEMs such as Vestas, Suzlon, and GE Energy to smaller firms.

Many of the components used in wind turbines are "generic" components – examples of such "generic" components include brakes, ladders, bearings, shafts etc. For Indian firms that are already producing components that could be supplied to the wind energy industry with minor customizations, component manufacturing could be a very attractive avenue, as these firms will able to use their existing skills and assets to quickly diversify to become suppliers for the wind sector. The interest shown towards higher indigenization for wind turbine components also makes the component manufacturing segment an attractive one for Indian businesses.

Some of the components which contribute significantly to the cost of the wind farm are specified in the table below. For a detailed list, refer Annexure II

Cost breakup of various components in a wind farm

Reference Year	**2010**	
Annual Installation (MW)	2003	
	Cost (Billion INR.)	%
Total Station Cost	**79.28**	**68.3%**
Blades	11.62	10.0%
Gearbox	11.70	10.1%
Tower	13.57	11.7%
Variable Speed Electronics	9.10	7.8%
Generator	7.49	6.5%
Others	25.8	22.2%
Total BoS Cost	**36.87**	**31.7%**
Electrical Interface/Connections	9.33	8.0%
Grid Connection	8.01	6.9%
Others	19.53	16.8%

Source: NREL

2.2.2 Services & Support Opportunities

While manufacturing opportunities are the most prominent in the wind energy industry, a range of service opportunities are available as well.

Broadly, the services opportunities could be categorized into:

- Feasibility studies and project development
- Geotechnical services
- Logistics support for wind farm
- Construction opportunities
- Operations and maintenance
- Unique opportunities

Feasibility Studies and Project Development

Wind farm developers are responsible for developing the wind project from concept to commissioning, and they undertake all the planning, design and project development work in this regard. Some developers perform services beyond the commissioning stage as well, such as operations and maintenance support.

As part of their role, wind power project developers also take up the role of establishing access to capital for investment. In addition, they also assist in the construction of roads and related infrastructure that can accommodate the transport of heavy industrial equipment and components.

Depending on the nature of contract, the wind project developer sometimes has a managing interest in the project when it is complete, but in most cases the real ownership lies with the wind farm owner.

Wind power feasibility studies and project development for commercial-scale wind farms is a multifaceted, lengthy process, often requiring collaborative efforts among several companies. Project developers perform the following:

- Wind power feasibility analysis,
- Site selection,
- Wind farm design and layout,
- Wind turbine selection and acquisition,
- Obtaining state permits,
- Construction contracting,
- Acquiring wind rights and leases,
- Energy production estimates, and
- Project financing

All the above present opportunities for Indian entrepreneurs keen on benefitting from the wind energy sector. While some integrated wind energy companies such as Suzlon provides most of the above-mentioned services, opportunities are available for other businesses to be sub-contractors to such companies for some of the services.

Geotechnical Services

Geotechnical services deals with the geological analysis and examines the suitability of a certain location for the proposed wind farm infrastructure. These services mainly include the analysis of the stability of the subsoil and foundation advice.

While geotechnical services are a part of project development, owing to the specific importance that these services carry in the context of wind farms, this has been mentioned as a separate section.

For onshore wind farms, geotechnical services include:

- Geotechnical and geo hazards aspects of site selection, master planning and environmental impact assessment and management
- Geotechnical and geo-environmental site investigation, including terrain evaluation and contaminated land assessment
- Foundation and ground improvement design for static and dynamic load conditions
- Access road and cable routes - selection, investigation and design
- Geo hazard assessment and mitigation – unstable slopes, surface and groundwater, seismic hazards.
- Site reinstatement and restoration, including erosion control and planting regimes
- Construction supervision
- Due diligence and expert witness services

As mentioned earlier, integrated wind energy companies provide the above services as part of their development portfolio, but opportunities exist for Indian construction and civil engineering companies to be sub-contractors for specific services.

Offshore wind farms could require a few more geotechnical services, in addition to most of what are required for the onshore wind farms:

- Foundation and design assessment
- Subsea cabling
- Sea bed geotechnical service

Currently, offshore wind is in its infancy in India and is more relevant to countries in north Europe and to a certain extent, for the United States. It is however expected that the offshore wind industry could start gaining momentum during the next few years, so entrepreneurs will do well to watch that space.

Logistics Support for Wind Power

Transporting wind turbines presents unique challenges and opportunities. Transporting these machines involves handling components that have an unusual weight, length and shape; thus companies that serve the industry must have equipment to transport very large and heavy cargo. The nacelles, blades, and turbine towers must be transported from the manufacturing facility to the wind farm location. The wind turbine industry needs to rely on collaborative transportation management processes, whereby manufacturers, logistics companies, transportation companies, and shipping ports share information and integrate their functions to achieve an effective delivery process (Tremwell & Ozment, 2007). Modes of transportation for the wind industry include trucking, shipping and rail freight.

There are considerable opportunities for transportation providers in all sectors to serve the industry. A single wind turbine can require up to eight hauls, and for a large project of 150 MW, transportation requirements could be as much as 689 truckloads, 140 railcars, and eight ships (Tremwell & Ozment,

2007). As the wind power industry continues to grow, demand increases for companies that are capable of transporting heavy and large loads. This could lead to the emergence of a specialized sector in the transportation industry.

Construction Opportunities

Turnkey construction contractors provide engineering, procurement and construction services, including civil works, laying cables for electrical infrastructure, and installing wind turbines.

Over the past decade, a number of construction companies in India have contributed to and benefitted from the wind energy sector growth, and this trend is expected to continue in future as well.

Operation and Maintenance

The reliability of the turbine system is essential to a wind power project; thus, operation and maintenance (O&M) services are critical. Operations include scheduling site personnel, observing turbine operation, dealing with equipment failure, and coordinating with the utility to respond to curtailments or outages (Walford, 2006). Maintenance includes both scheduled (preventive) services, such as periodic equipment inspections, oil and filter changes, calibration of electronic sensors, blade cleaning, and unscheduled services to repair component malfunctions.

When wind turbines are installed and the wind farm is in use, routine maintenance is important to ensure maximum efficiency and lifespan of the machines. Generally, wind turbine manufacturers' service turbines during the first 2-5 years while the wind turbines are still under warranty. Thereafter, wind farm operators may perform maintenance on their own, or subcontract the service to independent service companies (Wittholz & Pan, 2004).

Some companies in India are focused on offering only repair and maintenance services to existing wind farms, as they see a potential to add significant value owing to their focus. In future, one can also expect companies specializing in the repair and maintenance of specific wind turbine components, for instance, just the gearbox.

Unique Opportunities

With its fast pace of growth, even a mature sector such as wind could open up unique opportunities in future. For instance, the growth in offshore wind could provide opportunities even for sectors such as helicopter aviation sector, where helicopter services could be required under certain conditions for the maintenance of offshore wind farms.

2.2.3 Trading Opportunities

Trading opportunities – in the form of value added sales - for wind energy components and parts are presently limited owing to the way the industry supply chain is structured – most of the parts procured are business-to-business transactions with the OEMs directly procuring from the component manufacturers. Should a market for micro-wind turbines emerge in future, opportunities could arise for traders and small system integrators, similar to what is happening in the solar PV industry in India where rooftop solar systems are set to take off soon.

Opportunities to trade in the power produced are however likely to expand significantly. Currently, it is possible for wind power producers to sell electricity to the grid, use it for captive consumption or sell it to third parties. With the emergence of independent power exchanges and with the likely liberalization and streamlining of power distribution across states, the opportunities to trade in power are likely to increase and become more lucrative.

With the advent of the RPO/REC mechanism in India, there has been significant demand for non-solar (wind, small hydro, biomass etc.) over the past few months. The high demand for non-solar RECs is mostly met through wind energy based REC. In light of this, REC accreditation, advisory and trading services present a significant opportunity waiting to be capitalized.

2.2.4 Opportunities in R&D

Relative to solar photovoltaic, which has seen tremendous and disruptive innovations in the last two decades – in the form of thin film, concentrated PV, dye-sensitized solar cells, etc – the innovations in the wind industry have been more incremental in nature.

This is not to infer that there have been no significant innovations. Tremendous progress have been made in the context of gearless wind turbines, original concepts such as the FloDesign's Jet Engine-inspired Wind Turbine, attempts at vertical axis wind turbines for utility scale, innovation in wind towers resulting in significant reduction in amount of materials used, innovations that are attempting to increase the efficiency of generators (ex: ExRo), and interesting innovations in wind turbine blades (ex: shape-shifting blades designed by Purdue University and Sandia National Laboratories).

Other innovations include the development of the **vertical axis wind turbine (VAWT)**. Researchers at CalTech have conducted studies that setting up wind farms with smaller (as compared with traditional turbines) VAWT help in exploiting the typically lower wind velocities at lower altitudes. Further, these turbines can be placed closer together thereby increasing the energy density by reducing the turbines' footprint. The research indicates that these turbines could provide as much as 10 times the power output of traditional wind farms.

The above inputs on innovations point to the range of opportunities that exists for R&D within the wind energy sector. Large wind energy companies have their own dedicated R&D teams, but research opportunities also exist for Indian entrepreneurs and businesses that have research in their business DNA.

2.2.5 Other Opportunities

Some of the other opportunities along the value chain include:

Leasing Land

When you lease your land to a wind energy developer, you receive compensation for the commercial-scale project on your land. The land owners usually perform feasibility studies on the land and provide micro siting/ wind flow data for that region thereby guaranteeing performance.

Insurance Services

Companies specializing in underwriting, loss adjusting and risk engineering wind power projects provide insurance services. These include:

- Insurance Cost Estimating
- Insurance Brokerage/ Risk Management
- Contract Review/ Analysis/ Document Drafting
- Underwriting/ Marketing
- Fire Protection/ Property Preservation
- Risk Assessments
- Life/ Safety Risk Control

HVDC Transmission Systems

The emergence of the offshore wind energy market presents a significant opportunity for companies involved in setting up of transmission and distribution infrastructure. Offshore wind farms are usually located a few kilometres off the mainland and hence efficient evacuation of power from these farms pose a significant problem. High Voltage DC (HVDC) transmission systems aim to overcome this problem by providing a means of highly efficient power evacuation from offshore wind farms. Companies such as ABB have already won large orders in this emerging field. For instance, in July 2011, ABB won an order worth $700 million to supply a 800 MW HVDC power link to connect an offshore wind farm to the German grid.

2.3 Summary

India is already a leading player in wind energy. Estimates suggest that the potential for wind energy in India could be much higher than current estimates, with larger turbines operating at increased heights. This is likely to ensure an even faster for the wind energy sector in India.

The growth in wind energy sector is expected to bring forth a whole range of opportunities for Indian entrepreneurs and businesses, and these opportunities are present along the entire wind energy business value chain. Significant opportunities are expected to open up in the manufacturing segment, especially for the manufacture of wind turbine components, with a move towards greater indigenization in the wind industry. Attractive opportunities – some of which are niche in nature – are available in the services sector as well, and these opportunities are available for diverse entities such as small businesses, landowners and entrepreneurs.

A brief analysis of the opportunities in manufacturing of components used in the wind turbines throw up interesting insights. **Blade manufacturing involves a high level of technical expertise**, hence this requires significant capital costs for entry. For gearboxes and generators, while the market demand is significant, **it should be noted that there are large and well entrenched players in these segments, and thus there exist high entry barriers for new companies**. The tower segment is quite fragmented, and is currently being catered to by small and medium companies**, thus offering attractive opportunities for newcomers**. Outside of these, **a number of subcomponents are not yet well researched**, and these are indeed the ones that could present significant business opportunities to small and medium businesses. We thus see that the opportunities and risk profiles in component and sub-component manufacturing are diverse.

Outside of the traditional repair and maintenance opportunities, other unique opportunities could open up in the service industry. **With the possible emergence of offshore wind in future, there could be service opportunities for diverse businesses.**

Trading opportunities for products are limited currently owing to the current structuring of the industry supply chain, but with the opening up of the Indian electricity sector, **wind power producers can expect more options available for the trading of the power produced by them.**

Annexure I

Tariff rates and RPO of various states in India

Table: Comparison of Tariffs and Policies for Wind Power in Key States			
States	**Tariff rates per KWh**	**Annual tariff escalation**	**Percentage Renewable Portfolio Standard for Wind**
Andhra Pradesh	Rs. 3.50	Constant for 10 years for the PPAs to be signed during 01-05-09 to 31-03-2014	5% for all RE(2011/2012)
Gujarat**	Rs. 3.56	No escalation for 25 years of project life	5% (2011/2012) 5.5% (2012/2013)
Haryana	Rs. 4.08	With 1.5% per year for 5th years	10% (2010/2011) for all RE
Karnataka*	Rs. 3.70	No escalation for 10 years	7-10% (2010/2011) for all RE
Kerala	Rs. 3.60	No escalation for 20 years of project life	3% (2011/2012 &2012/2013) for all RE
Madhya Pradesh**	Rs. 4.35	No escalation for 25 years of project life	6% (2011/2012)
Maharashtra	Wind Zone I-Rs. 5.07 Wind Zone II-RS. 4.41 Wind Zone III-Rs. 3.75 Wind Zone IV-Rs. 3.38	No escalation for 13 years	7% (2011/2012) 8% (2012/2013) for all RE
Orissa	Rs. 5.31	No escalation for 13 years	5% for all RE (2011/2012)

Punjab	Rs. 3.49	With base year 2006/07 with 5 annual escalation @5% up to 2011/12	4% for all RE (2011/2012)
Rajasthan**	Rs. 3.87 &Rs. 4.08	No escalation for 25 years of project life Rs. 3.87 for Jalsalmer, Jodhpur &Balmer districts while Rs. 4.08 for other districts	7.5% (2011/2012)
Tamil Nadu	Rs. 3.39	No escalation for 20 years of project life	14% for all RE (2010/2011)
Uttarakhand	Wind Zone I-Rs. 5.15* Wind Zone II-Rs. 4.35* Wind Zone III-Rs. 3.65* Wind Zone IV-Rs. 3.20*	Rs. 5.65 for first 10 years &Rs. 3.45 for 11th year onward Rs. 4.75 for first 10 years &Rs. 3.00 for 11th year onward Rs. 3.95 for first 10 years &Rs. 2.55 for 11th year onward Rs. 3.45 for first 10 years &Rs. 2.30 for 11th year onward	4.53% for all RE (2011/2012)
West Bengal*	Rs. 4.87	No escalation for 10 years	3% for all RE (2011/2012)
*RPS for Bengaluru Electricity Supply Company Ltd (BESCOM), Mangalore Electricity Supply Company Ltd (MISCOM), Calcutta Electricity Supply Company Ltd (CISCOM) is 10% while for HebM Electricity Supply Company Ltd (HESCOM) and Hukari, it is 7%			
**RPS specific only for Wind			

Annexure II

Detailed Cost Breakup and Projections for Various Components of a Wind Farm

The data also represent the possible revenues to manufacturers of each component; the total cost of a 1 MW wind turbine is taken as a constant for the five years under study.

Year		**2011**	**2012**	**2013**	**2014**	**2015**
Annual Installations (MW)		2273.42	2613	3003	3452	3967
	% of total	Estimated Costs (Billion INR.)				
Total Station Cost	68.3%	89.98	103.42	118.85	136.62	157.01
Rotor	15.3%	20.22	23.24	26.70	30.70	35.28
Blades	10.0%	13.19	15.16	17.42	20.03	23.01
Hub	2.8%	3.73	4.29	4.93	5.67	6.51
Pitch & bearings	2.5%	3.30	3.79	4.36	5.01	5.75
Drive train, nacelle	40.9%	53.97	62.03	71.29	81.95	94.17
Spinner, Cone	0.3%	0.35	0.40	0.46	0.53	0.61
Low speed shaft	1.4%	1.82	2.09	2.41	2.77	3.18
Bearings	0.8%	1.04	1.20	1.38	1.58	1.82
Gearbox	10.1%	13.28	15.26	17.54	20.16	23.17
Mech brake, HS coupling etc	0.2%	0.26	0.30	0.34	0.40	0.45
Generator	6.5%	8.50	9.77	11.23	12.91	14.84
Variable speed Electronics	7.8%	10.33	11.87	13.64	15.68	18.02
Yaw drive & bearing	1.3%	1.74	1.99	2.29	2.64	3.03
Main frame	6.1%	8.07	9.27	10.66	12.25	14.08
Electrical connections	3.9%	5.21	5.98	6.88	7.90	9.08
Hydraulic, Cooling system	1.2%	1.56	1.80	2.06	2.37	2.73
Nacelle cover	1.4%	1.82	2.09	2.41	2.77	3.18
Control, Safety System	2.3%	3.04	3.49	4.01	4.61	5.30
Tower	11.7%	15.40	17.70	20.35	23.39	26.88
Total Balance of Station Cost	31.7%	41.85	48.10	55.28	63.55	73.03
Financial Cost	0.7%	0.92	1.05	1.21	1.39	1.60
Grid Connection	6.9%	9.09	10.45	12.01	13.80	15.86
Foundations	3.0%	3.99	4.59	5.27	6.06	6.96
Transportation	3.3%	4.34	4.99	5.73	6.59	7.57
Roads, Civil Work	5.2%	6.85	7.88	9.05	10.41	11.96
Assembly & Installation	2.5%	3.30	3.79	4.36	5.01	5.75
Electrical Interface/ Connections	8.0%	10.59	12.17	13.98	16.07	18.47
Engineering & Permits	2.1%	2.78	3.19	3.67	4.22	4.84
Total Cost/ MW (INR Million)	100.0%	57.98	57.98	57.98	57.98	57.98
Source: NREL, EAI						

EAI - Assisting Your Company for Attractive Manufacturing Opportunities in Wind Power Sector

The Wind Team at EAI has worked extensively on all segments of the wind energy value chain. With our exceptional understanding of the Indian wind energy industry and our partnerships with technical industry experts, EAI will be the ideal research and consulting partner for your company's foray into wind energy manufacturing.

EAI offers intelligence on manufacturing opportunities in the Indian wind sector

- Core components – Blade, Gearbox, Generators
- Support Components – Mainframe, Shaft, Tower
- BoS Manufacturing – Variable Speed Electronics, Power Conditioning Systems, Monitoring Systems
- Small Scale Wind Turbines

Identifying the most attractive opportunities for your company

- Understanding your company's aspirations in the context of wind energy sector
- Understanding your company's manufacturing competencies
- Evaluating the fit between your *aspirations + competencies* and the available opportunities
- Clearly identifying the attractive opportunities appropriate for your company

Feasibility study for shortlisted opportunities

- Demand and supply analysis
- Costs and returns estimates
- Strategic dimensions and key success factors – extent of competition, buyer and supplier power, dominant designs and industry concentration, degree of innovation, barriers to entry
- Possibilities of JVs and technology partnerships
- Identification of key success factors

EAI Strengths

- In-depth wind sector knowledge – Our team has worked along the entire wind energy value chain
- Dedicated Focus on Renewables - We work only in renewable energy, and nothing else.
- Wide Expert Network - We work with over 100 technical and business experts across all primary renewable energy sources.
- Financial Assistance - We work with over 25 different PE, VC firms and banks providing our client easy access to finance.

Clients

EAI's consulting team has been assisting several organizations in diverse renewable energy domains. Some of our esteemed clients include:

- PepsiCo
- Reliance Industries
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- Bill & Melinda Gates Foundation
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Prominent companies that have benefitted from our research and reports:

- Accenture
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- Shell
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- Exxon Mobil
- Boston Consulting Group
- Schneider Electric
- Bosch
- GE
- Danfoss Solar
- IFC
- Siemens
- Sharp
- Gehrlicher Solar AG
- Reliance Solar
- Emergent Ventures
- Videocon
- Q Cells
- Emerson Network Power
- Indian Railways

Business Intelligence Reports

EAI India Solar PV Advisor

This comprehensive report has been prepared for companies and businesses keen on investing in the Indian solar photovoltaic based power plants.

- Investments and returns required for solar PV projects in India
- Government incentives and mandates
- Indian Solar PV market status and forecast

EAI India Solar PV Modules Market Intelligence

This report provides extensive market data, insights and perspectives for the fast growing solar PV modules sector.

- Global and Indian supply-demand data for solar PV modules
- Cost data for setting up solar PV module production plants
- Government regulations and incentives

Replacing Diesel with Solar

Market scenario, technical and market feasibility inputs for companies, industries and institutions keen on solar PV based captive power as a replacement for diesel .

- Key market segments for solar PV captive power production
- Cost data for setting up captive solar power plants
- Government incentives

India Biomass Gasification Based Power Production

A detailed report providing complete techno-economic details for biomass gasification based power production.

- Detailed inputs on cost and economics.
- Data for various biomass feedstock that could be utilized.
- Case studies and examples of biomass gasification in India.

For more information on how EAI can be of assistance to you, contact:

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