OFFSHORE WIND POWER IN INDIA
OPPORTUNITIES AND CHALLENGES

The need of the hour in India is a clean and renewable sources of energy, in which offshore wind power can play a major role. The objective of this study is to understand the prospects of offshore wind power in India and the related challenges.

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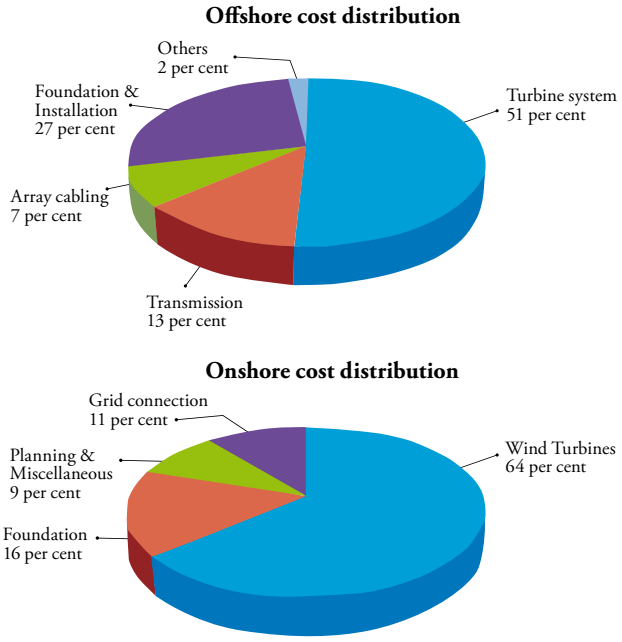
The electricity demand-supply mismatch in India has been at a peak these last few years. The country depends on its coal based thermal power stations to quench its rocketing demand. With the economy realising 7-8 per cent growth rates, India is looking for means to enhance its generation capabilities. Added factors that the country must consider are international pressure and a moral responsibility towards the environment, before it chalks its electrical infrastructure plans.

The objective of this study is to understand the prospects of offshore wind power in India and the related challenges. A detailed study of various European countries, that have already gained excellence in offshore wind power projects has been done and based on that study, different cost reduction potentials in India have been listed. The study also suggests a few possible potential sites, a list of probable clearances required for setting up of offshore wind farms in India, and the need for a regulatory framework for such high capital cost projects.

INTRODUCTION

About 53 per cent of electric power in India is generated from coal and lignite based steam thermal plants, which contribute a lot to air pollution. The need of the hour is a cleaner and renewable source of energy, in which offshore wind power



Cost distribution of offshore and onshore wind power projects

can play a major role. The offshore wind power potential for India has been estimated as 15000 MW (<60m depth) (Dolf Gielen, Nathalie Trudeau, Dagmar Graczyk and Peter Taylor, October 2009). There are many potential sites in Indian waters and still this huge potential remains untapped.

Nothing much has been done in this field in India as the capital cost of such projects is very high and the necessary supply chain is also not established. There is lack of data and it is not clear from which departments clearances are required.

ADVANTAGES OF OFFSHORE WIND

The offshore wind carries certain advantages over the onshore wind.

Greater area available for setting up large projects: One primary reason for moving towards offshore projects is the lack of suitable wind turbine sites on land.

Higher wind speed than onshore locations: Wind speeds are significantly higher at offshore locations. An increase of about 20 per cent some distance away from the shore is not uncommon.

Lower turbulence intensities: Wind is less turbulent at sea than over land which results in lower mechanical fatigue load and thus longer lifetime for the turbines.

More consistent wind speed: It is a frequent misunderstanding that wind power generation requires very stable winds. In most wind turbine sites around the globe, in fact, the wind varies substantially, with a high occurring rather infrequently, and low winds occurring most of the times. At sea, periods of complete calm are generally extremely rare, and quite short-lived. Thus the effective use

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of wind turbine generating capacity will be higher at sea than on land.

Less visual impact: As these sites are located far from land they have less visual impact which helps with public acceptance issues.

Close to load centres: The Offshore wind farms are usually located near to the cities and load centres and thus transmission losses are minimised.

Short gestation period: A mega size and ultra mega size thermal or hydro power project may have a gestation period of 3-6 years whereas as an offshore wind project has a gestation period of 1-2 years, depending upon depth and distance from shore.

The foundation and installation cost in offshore projects is much higher as compared to that of onshore. It can be as high as up to 25-30 per cent of the project cost.

CHALLENGES

The offshore wind power faces many challenges.

Cost: The capital cost of such projects is very high as compared to onshore wind power projects. The average capital cost in Europe in 2006 was around 2.1 million € per MW at 37.5 per cent capacity utilisation factors (CUF) (www.wind-energy-

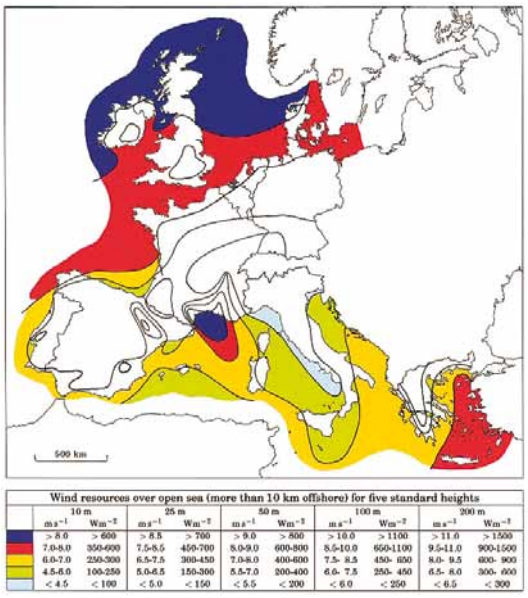

Fig 1. Wind resource map of Europe

the-facts.org), however, the average capital expenditure has doubled in UK in the last 5 years mainly because of commodity prices, less accessible locations and other bottlenecks (Reuters). The cost in India might be on the higher side because of various factors like absence of Turbine Installation Vessels (TIVs), construction support vessels, lack of sub-structure manufacturers, lack of trained man power etc.

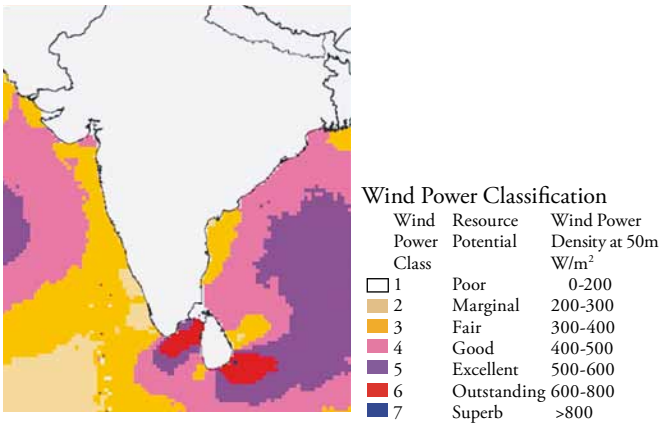

Fig 2. Wind density at 50 m height

DATA: The data required for the calculation of offshore wind potential and identification of suitable sites is not available. The data can be divided into 2 parts:

- Wind resource map
- Bathymetric data

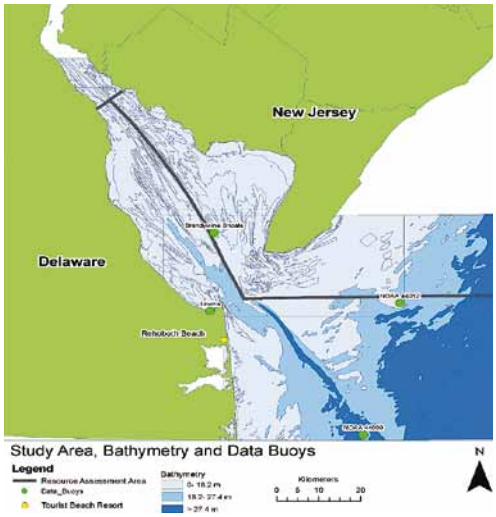

Fig 3. Bathymetric data for Delaware, USA

Wind resource map: This consists of the wind speed and wind density at certain levels above the sea. Figure 1 shows the wind resource map for Europe.

Centre for Wind Energy Technology (C-WET) is now monitoring potential sites for offshore projects but at present there is no resource map available. However, some data was available from the website of Remote Sensing System (www.remss.com) which has given monthly and annual information of offshore wind speed and density for the world. Figure 2 shows the annual wind density map for India at 50 m height. Similar maps have been obtained for wind speed and density at 50 and 10 m height.

> **The offshore wind energy also needs dedicated frameworks and policies for its promotion and to establish a presence in the Indian power market.**

The map in Fig 2 shows some potential sites in the Gulf of Kutch and the region between Tamil Nadu and Sri Lanka. C-WET has done a study at the Kanyakumari and Rameshwaram region but no study has been done inside the sea, which is the exact location for an offshore wind farm.

Bathymetric Data: This data gives the information about the sea depth at various positions. Figure 3 shows the bathymetric data for offshore wind power assessment at Delaware, a US state.

At present there is no such data available for the Indian sub-continent and no such data was available from any other source.

After preparing the necessary wind resource map and obtaining the bathymetric data, they are compiled to identify the potential areas. There are particular zones like the shipping lanes, military exercise areas, dredging regions, oil exploration areas, exclusive fishing zones, areas with underlying submarine communication cables, and dumping grounds for ammunition, explosives and other hazardous material that have to be considered before finalising the exact potential sites.

Regulatory and policy framework: The Electricity Act 2003 defines various sections like, sec. 3, sec. 61 and sec. 86 (1)(e) which mandate the policy formulation and optimal use of all resources including renewable sources of energy.

Jawaharlal Nehru National Solar Mission (JNNSM) is a dedicated framework for the promotion of the solar energy. Similarly "India Hydrocarbon Vision-2025" is a strategical model for oil exploration in the Indian sedimentary basins. The offshore wind also needs such dedicated frameworks and policies for its promotion and to establish a presence in the Indian power market.

COST REDUCTION POTENTIALS

The cost of the offshore projects can be brought down in the Indian market with various cost reduction factors like:

Table 1. Probable list of clearances required

Agency	Issues
Ministry of Environment and Forests	Environment Impact Assessment Forest clearance CRZ clearance
State Government	Clearance for working under approved CZMP
Ministry of Defence	Security clearance for vessels in Indian waters
Coast Guard	Security and hazards issues of offshore installation
Directorate General of Shipping	Approval for hiring foreign vessels
Directorate General of Lighthouse and Lightships	Clearance for onshore construction
Directorate General of Hydrocarbons	Clearance for operating outside oil and gas exploration zones
Ministry of Petroleum and Natural Gas	Clearance for operating outside oil and gas exploration zones
Ministry of Civil Aviation	Aviation safety
Department of Telecommunication	Clearance for operating outside sub-sea cable zones
Chief Conservator of Forests	Forest clearance
State Pollution Control Board	Pollution control clearance
Directorate of Explosives	Importing/stocking explosives
Geology and Mining Department	Environment hazards
Ministry of Finance	Issues on tax, custom, excise
District Commissioner	Land use permission Public hearing for environment clearance Law and order issues
Land Revenue Officer	Purchase/use of land
Commissioner of Income Tax	Income taxation
Registrar of Companies	Registration of company Statutory returns
Commissioner of Customs and Excise	Import/export
Reserve Bank of India	Payment in foreign currency

Cheap labour, material and production cost: A report published by Global Wind Energy Council (GWEC) and the Indian Wind Turbine Manufacturers Association (IWTMA) on the wind energy industry in India reveals that turbine prices have always been lower than the global average due to lower labour and production cost in the country.

Economies of scale: Another factor favouring the cost reduction is the mass production of turbines. The current annual production capacity of onshore wind turbines manufactured in India is about 3000-3500 MW, including turbines for the domestic as well as for the export market.

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Learning-by-doing: The process of gaining experience from a project and applying it in an improvised manner to other projects count for learning-by-doing. At Horns Rev and Nysted wind farms (Denmark), the world's two largest offshore wind farms built until the end of 2003, for the first time purpose-design ships were used for turbine erection, both by the same contractor.

Horns Rev was build in 2002 and 80 turbines were installed in the farm. The average installation time was reduced from over 3 days per turbine for the first few turbines to a final average of 1.4 turbines per day. This time was greatly reduced by learning-by-doing.

The Nysted wind farm was installed in summer of 2003 and 72 turbines were installed in the farm. The installed capacity doubled once with the second wind farm. The learning curve shows that the installation time decreased by 23 per cent. As the equipments are based on day-rates, the decrease in installation time can be translated into cost reductions.

CLEARANCES REQUIRED

On the basis of clearances required for an onshore wind farm in India and for setting up offshore oil rigs, as well as taking into account the Coastal Regulation Zone (CRZ), the 1982 UN Convention on the Law of Sea and the international experience of countries like UK, Denmark and Germany, a probable list of clearances required for an offshore wind farm is prepared. Table 1 gives a probable list of clearances required for setting up of an offshore wind power farm in India.

CONCLUSION

The need of the hour is a clean and sustainable energy source and offshore wind power can play a significant role. In India offshore wind power still remains untapped and given the power deficit in the country this huge potential needs to be tapped.

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