Challenges and Opportunities for Offshore Wind Turbine Port Infrastructure

The UK government has called for the addition of 15,000 offshore wind turbines over the next 15 years, creating tremendous traffic and infrastructure challenges for the conventional port sector. Not only are existing ports and harbours inadequate in terms of capacity, they often lack the necessary equipment and technical expertise to transport the specialized components needed for the offshore wind industry from land to see. But perhaps most troubling is the severe lack of available land which is necessary for the manufacture, assembly, and maintenance of turbines at sea.

Nevertheless, both port owners and offshore wind turbine manufacturers are responding to the challenge by creating innovative solutions that attack the various problems at present.

Three Roles of Ports in Offshore Wind Energy Development

The opportunities for port expansion and job creation for meeting offshore wind turbine industry demand are substantial. Given that 1% of the cost of an installed offshore wind farm is port-related, the potential UK market for offshore wind turbine development is more than £150 million annually, with a total expenditure of £800 by 2020.[i]

Not only can revenues from the offshore wind industry be used for port expansion, there are opportunities for increased activity throughout the lifecycle of each turbine. This is especially true given that 5% of all turbines will require maintenance within the first year of operation. As such, there are three main roles ports play in the development of the offshore wind energy sector: manufacturing, construction, and operation and maintenance.

The manufacturing stage is perhaps the first and most important phase in which the ports play a role, as well as the most land intensive. Given the challenges of transporting massive turbine components, most manufacturers are looking to locate their plant and facilities as close to harbours as possible. Consider that the size and shape of turbine components far outstrips that of conventional sea cargo containers.

And since these components are generally not stackable, the space they require is enormous.

As a result the ideal is for manufacturers to locate their operations directly adjacent to ports. This minimizes the land transportation and storage of massive, heavy components, which helps to lower costs associated with the construction of each turbine. However, in urban centres this is often impossible due to the lack of available land. When manufacturing plants cannot be located directly next to a port, land is required for staging and storage of turbine components. In either case, ports with available, prime land are more likely to be viable solutions for the offshore wind industry.

For the construction phase, port resources and space are required for moving components from land to sea where they are installed. Quay space and size for specialized vessels used for turbine and foundation installations will all put pressure on the size and capabilities of conventional ports. Those ports with deep water, reinforced quaysides, large storage areas, and suitable space for moving components around as needed will be looked upon most favourably for development. While much debate continues as to whether turbines should be assembled before transport to sea or assembled at sea, the fact remains that ports will play a role during the initial phases of every turbine's life.

During the operations and maintenance phase, ports are required to move people and equipment between land and the turbines. While this phase doesn't require the same space as the first two phases, it will still involve a significantly increased number of transports, thereby requiring increased small vessel capacity.

Initial fears were that the UK lacked the necessary land to accommodate the increased orders for offshore wind turbines. However, in a recent report produced by BVG Associates, it was determined that there were at least 20 ports that met the necessary criteria for use in the offshore wind industry (more than necessary), but that super-hubs would need to be developed on these sites in order to accommodate the increased demands.

The challenge is that the wind industry is demanding quality quay space and prime manufacturing land for all three phases, but is generally not willing or able to pay the premium rates port owners want for their space. This is an obstacle that will need to be overcome with more efficient turbine designs and innovative solutions both onshore and offshore at every phase of the value chain.

Overcoming Port Challenges for Wind Turbine Deployment

To meet the increased demands of large scale offshore wind turbine manufacture, assembly, and transport, both manufacturers and port owners are developing solutions. For instance, some manufacturers have developed specialized trailers that fit the latest turbine components exactly, thereby making it easier for road transportation personnel to lift and move the components as needed. Nicolas, a French manufacturer, for instance, has developed special wheeled dollies with telescopic adapter technology that are bolted to each end of a tower section or nacelle.[ii]

This same company has developed a GIS service that can be used to map out a route ahead of time to determine what path a turbine component will travel. This is used to ensure a truck driver can negotiate tight turns when transporting large components, such as a turbine blade which requires steerable axles during road transport. Routes are analysed to determine any potential obstacles so that impassable routes are eliminated in favour of routes that will pose few to no problems at all.

SCHEUERLE InterCombi SP Blade Adapter Grip

Another ingenious solution for hairpin turns and road obstacles is the Scheuerle's blade adapter grip. Gripping the root of the blade, this trailer-mounted grip can adjust the position of the blade during transport to float over obstacles such as trees, buildings, or walls. It can lift a blade to 23 degrees, as well as turn it left and right.[iii]

All of these road-related transport solutions makes it possible to locate the manufacturing facilities further afield form the port, thereby potentially diminishing the land requirements for manufacturing.

Another way to make it less necessary for manufacturing plants to be located directly adjacent to ports is to make the components smaller for land transport. Since turbines can be produced as individual components, one of the ways to overcome some of the turbine size and weight challenges is to keep the weight of each section as low as possible.

Additionally, individual components can be designed to include parts that assist with the transportation requirements. Blades, for instance, can be built with clamping and lifting points that can withstand the horizontal and vertical movements during transport. These will also help to mitigate loading and stress on the blade during transport on a ship traveling through a storm at maximum tilt. Further, by designing special carriers and racks that secure the components without damaging them, manufacturers can simplify some of the transportation challenges.

One manufacturer overcoming the size and weight challenges is Enercon. Their 63 meter blades for 7.5 MW E-126 turbines are some of the longest in the market today. To take the edge off the length problem, Enercon designed the blades to fold in half for transport. They are then delivered in sections and commissioned on site.[iv]

Not only are the components a challenge for the manufacture of offshore wind turbine components. So is the size of cranes necessary for lifting components into sea. One innovation being used to overcome this is to build the entire turbine onshore and tow it out to see fully assembled where it is hooked up to its mooring and electrical infrastructure. This eliminates the need for specialized heavy-lift crane work.

This is an idea being developed by VertiWind. They've developed a commercial floating structure with a nine-metre draft that can be fabricated with cylindrical steel columns set on hexagonal concrete heave plates. Instead of requiring up to 100 metres of water, which is what spars require, this structure would be constructed and commissioned complete with the turbine quayside. This also opens up the possibility of using ports with shallower waters around the world.[v]

More Needed to Meet Demands of Growing Offshore Wind Energy Sector

Despite all of the innovations currently being deployed in the wind energy sector, more needs to be done in order to create the capacity necessary for the UK and other European countries to meet their renewable energy goals through offshore wind development. Tweaks to existing ports and modifications of turbine component design aren't enough to keep transport costs to a minimum and speeds where they need to be.

More importantly, there are limitations in the number of ports which can be expanded into super-ports. As such, perhaps one of the most promising solutions is to look to non-traditional ports. Perhaps only by exploring alternatives to traditional freight, passenger, fishing, and cargo ports, and instead looking to new port options, can the wind energy sector overcome this significant logistical challenge.

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