Offshore Wind

Support infrastructure and supply chain

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Introduction

Development of an offshore wind industry represents a big opportunity for Korea not only for its benefits as a reliable long term form of clean energy but also for its impact in the wider economy

Benefits of and requirements for developing an offshore wind industry

- Renewable energies and offshore wind in particular must play an important role in energy mix
- Offshore wind presents some key benefits:
  - It can constitute a cost-effective part of Korean long-term electricity mix
  - With a big potential in Korea, it represents a clean energy source that helps the Government to meet its renewable energy targets
  - Building a competitive supply chain sustains jobs, exports and economic benefits
- However it presents intense capital requirements and development of supporting / associated industries and investments
  - Installation
  - Commissioning
  - O&M
  - Decommissioning
- Associated infrastructure and logistics
  - Manufacturing of wind farm components
  - Ports
  - Installation and support vessels

Supply Chain in offshore wind

With the development of offshore wind in Korea, new business activities across the supply chain have to emerge to support that growth or will constitute bottlenecks contributing to cost differentiator

Offshore wind supply chain map

Design	Build	Operate	Decommission
Developer(s)	Installation contractor / project manager	Operation and maintenance	Project Management
Project Management	Detailed design and procurement	Support vessels	Design engineering / analysis
Development Design	Wind turbine and tower supply	Ports	Marine lifting / crane vessels
Offshore engineering Design	Turbine components	Turbine components	Support vessels
Environmental assessment and monitoring	Support structures / foundations	Inspection and testing	Ports
Geological surveys	Subsea cables		Diving and underwater services
Resource analysis and modelling	Turbine installation		Geological surveys
Grid interface consultant	Foundation installation		Environmental assessment and monitoring
Planning, legislation & regulation consultant	Cable installation		
Design certification	Logistics and transportation		
	Support vessels		
	Ports		
	Scour protection		
	Weather forecasting		
	Grid connection		

Source: *Offshore Wind Key Facts*, Scottish Enterprise

Supply Chain in offshore wind (cont.)

The supply chain not only involves direct costs in the construction of an offshore wind farm but also all associated studies, engineering activities, materials and logistics that are key for cost efficiencies

Offshore wind involves a great number of activities

- Development
  - General development services (feasibility, licensing, planning, radar, etc.), Front End Engineering and Design (FEED)
  - Geophysical and geotechnical campaigns, Ornithological and mammal surveys, benthic surveys, onshore environmental surveys, human impact studies
  - Wind measurements, metocean conditions assessment
- Construction
  - Engineering services, detailed design and certification process
  - Supply of materials (structural composite materials, steel plates, steel tubulars, fibre optic, copper / aluminium cores, epoxy / polyester resine, adhesives, consumables, etc.) and manufacturing of wind farm components (cables, foundations, substations, turbines)
  - Onshore construction (design, civil works, manufacturing of electrical equipment, installation)
  - Offshore installation activities (transportation barges, trenching vessels, cable laying vessels, support vessels, heavy lift vessels, jack up barges, etc.) and associated services (weather forecasting, marine coordination services, birds / mammals monitoring activities, noise measurement campaigns, etc.)
- Operation and maintenance
  - Technician and equipment transfer, CTVs
  - Jack up vessels for major overhauls and scheduled maintenance campaigns
  - Offshore accommodation, SOVs

Manufacturing of a 80m blade from MHIV

Transportation of jacket foundations for the Wikinger project (Germany)

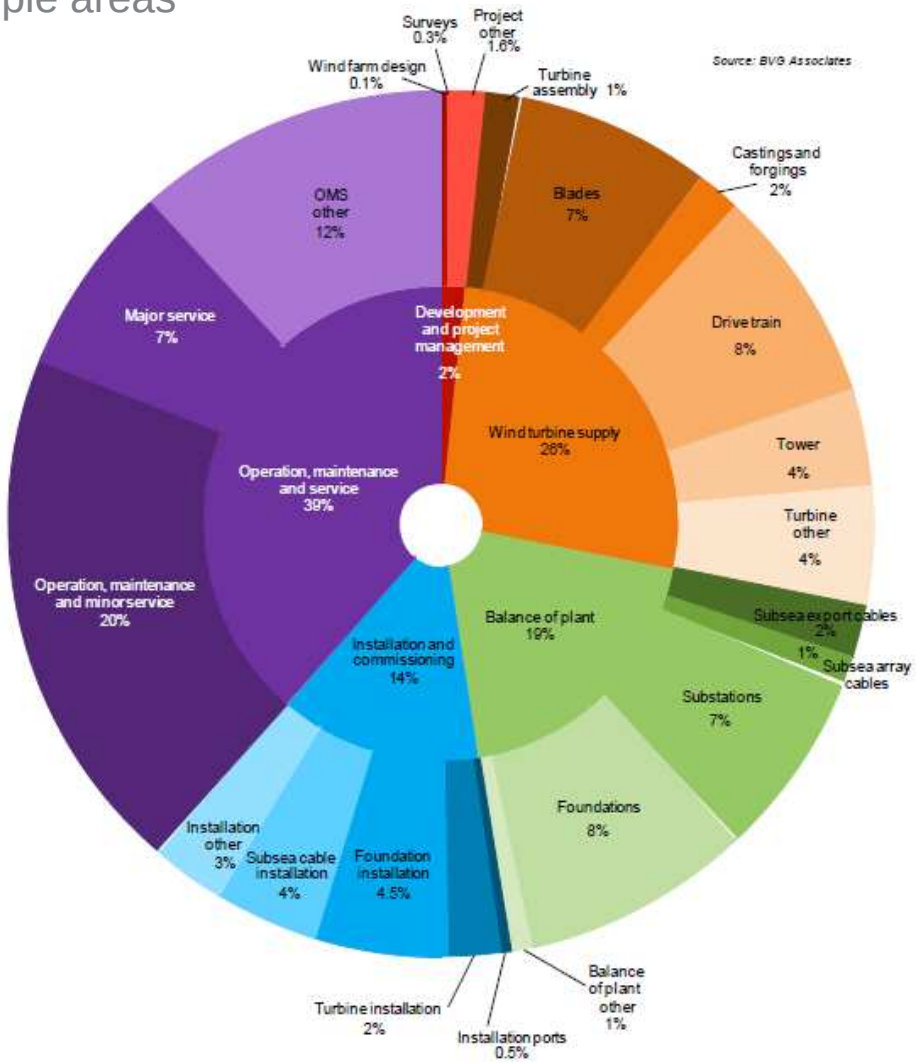
Offshore wind lifetime costs

Lifetime costs in offshore wind are spread across multiple areas

Lifetime costs in offshore wind

- The assessment presented represents undiscounted Capex and Opex for an average wind farm of 500MW, using a 6MW WTG with jacket foundations
- The contribution to the total is quite spread between Turbine supply costs (26%), BOP supply costs (19%), installation and commissioning activities (19%) and O&M costs (39%), with the remaining 2% corresponding to general development and project management activities
- Manufacturing of foundations, blades, substations and drive train represent the single activities with bigger contribution to the total Capex
- Foundations and subsea cables have the biggest contribution to the cost of installation activities, representing more than 60% of the total installation activities

Offshore wind presents a wide range of activities that could be developed in different degrees to contribute to its development and cost efficiency



Source: UK *offshore wind supply chain: capabilities and opportunities*, BVG associates

Ports and logistics

As offshore wind develops in Korea clusters and dedicated hubs will have to arise to minimise logistical costs across all activities, which key to achieve a sustainable Levelised Cost of Energy

Creation of clusters in offshore wind

- If quality conditions are met, in offshore wind there will always be preference for local supply because of the high logistical costs
- As the offshore wind industry develops in Korea clustering will naturally appear to reduce costs, representing good opportunities for the country to help decentralising economical activities
- Cluster are beneficial in all stages and activities of the projects, from the manufacturing phase , to pre-assembly / installation and operations
- Even during the engineering phase offshore wind farm electrical systems are bespoke and suppliers benefit from locating engineering teams close to their customers

Clear vision and commitment is needed

- Existing lead time for a new factory by an existing supplier is about 4 years, and about 2 years for an extension to an existing facility
- Investments must therefore be made ahead of confirmed supply contracts for specific projects
- Most fabricators will not invest in significant infrastructure speculatively
- Short term revenue of a single project insufficient to justify a significant investment
- Premiums to established markets will naturally be required in the short term
- So in the long term visibility on the market in the long term and clear commitment from the Government with established policies still makes a major impact

Case study
Belfast Harbour (UK)

Belfast Harbour was the first purpose-built installation port in the UK, and has been already used for a number of projects in the UK's Irish Sea

Designed and built to support offshore wind operations

- First ever purpose-built port specifically designed for offshore wind
- Key to lower the logistics risks of a project by storing components closer to the project site
- £53m investment
- 12 months construction process
- 480m long quayside, reinforced to support heavy loads
- 221,000m2 storage capacity, with sufficient bearing capacity to accommodate storage of large foundations / turbine components
- Seabed protection to facilitate repeated jacking up and jacking down operations
- Initially used for the construction of West of Duddon Sands but used for other projects since then

Joint development approach

Belfast Harbour

SCOTTISHPOWER RENEWABLES

DONG energy

Case study: Hartlepool (UK)

Hartlepool constitutes one of the most important offshore wind hubs and has played a key role in the growth of the offshore wind industry in the UK and generally in the North sea

New generation for installation vessels

- The east coast of the UK has been the area with highest activity in construction of offshore wind farms to date, and a significant number of projects are in addition under development or planning phase
- The abundance of free space and the experience gained during the construction of EDF's 62MW Teeside project gave the port authority the vision to become a major hub in the support of this growing industry
- Its great location and a moderate investment allowed it to attract a number of related offshore wind companies given the port and the wider region and important boost in economic activity

Meeting the needs to become an offshore wind hub

- 360m quay length and 8m water depth supported by a 15t/m2 heavy lift pad and five general cargo berths
- 80 acres of idle land are now hosting manufacturing facilities for steel tubulars, jacket foundations, topsides and cables
- Great transport links, with direct access to the UK rail network
- Ro-ro berth with Linkspan access within the main port area
- 1,000,000 sq ft of covered warehousing and substantial open storage areas

Installation and support vessels

With the development, construction and operation and maintenance of offshore wind farms there is a big demand for all kinds of vessels, and Korea is very well placed to satisfy that demand

Demand for specialised vessels

- The offshore wind industry requires the use of specialised vessels during all phases of the projects:
  - During the engineering and development phase, survey vessels for geophysical studies, mammal surveys, geotechnical campaigns, etc.
  - During the construction phase, all wind farm components will need to be transported from the manufacturing centres to installation hubs or directly to the site, to then be installed with specialised installation vessels
  - During all these activities, support vessels are also required
  - During the O&M phase, personnel and equipment must be transferred to the different turbine locations and the offshore substations with the use of Crew Transfer Vessels, and depending on the logistical set up selected for each project, Service operation Vessels may be also used
- Korea is extremely well placed to support the growth of the offshore wind industry satisfying the demand for specialised vessels throughout the lifetime of projects

Case study: Orion installation vessel

GeoSea, one of the most experienced installation companies in the industry, is currently manufacturing the Orion vessel, a purpose built heavy lift installation vessel

New generation for installation vessels

- As the offshore wind industry is maturing, the complexity of the projects is increasing:
  - Projects located further away from shore and in deeper waters
  - Upscaling of the turbines
  - Use of XL monopiles and bigger jacket foundations

Vessel features must support future requirements

- 216.5m length, 49m breadth and 16.80m depth
- 3,000 ton crane capacity at 50m
- DP3 dynamic positioning, 4x4,500 kW azimuth thrusters, 2x4,200 kW retractable thrusters, 2x2,500 kW tunnel Thrusters
- 30,000 tons maximum pay load, 11m maximum draft, 8,000m2 free deck area
- 131 people accommodation, helideck, 2x100 tons auxiliary cranes, 8 points mooring system