Norfolk Boreas Offshore Wind Farm

Appendix 31.2

Supply Chain Assessment

Environmental Statement

Volume 3

Applicant: Norfolk Boreas Limited
Document Reference: 6.3.31.2
RHDHV Reference: PB5640-006-3102
Pursuant to APFP Regulation: 5(2)(a)

Date: June 2019
Revision: Version 1
Author: BVG Associates Ltd

Photo: Ormonde Offshore Wind Farm

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
04/03/2019	01D	First draft for Norfolk Boreas Limited review	BT	DS	CD
01/05/2019	01F	Final for DCO submission	BT	DS	CD/JL

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Glossary of Acronyms

AC	Alternating Current
Cefas	Centre for Environment, Fisheries and Aquaculture Science
DC	Direct Current
EA	East Anglia
EPCI	Engineering, Procurement, Construction and Installation
ES	Environmental Statement
FEED	Front End Engineering Design
FTE	Full Time Equivalent
LEP	Local Enterprise Partnership

1 Introduction

1. The supply chain assessment in Table 2.1 has been produced by Alun Roberts of BVG Associates on behalf of Royal HaskoningDHV. It is an updated version of the assessment previously provided for Norfolk Vanguard. Norfolk Boreas will be one of the later projects built as part of the New Anglia LEP Round 3 zone. The following assessment considers the impact that Boreas can have in attracting investment to meet the needs of the zone as a whole and indeed the southern North Sea as a whole. In particular, New Anglia LEP ports have the opportunity to become operational hubs much as Grimsby is doing further north. Many of the companies that could be attracted to the region also have business supporting the construction phase. These opportunities have been termed cluster opportunities and are presented in an additional column in the table.

2. This report sits as Appendix 31.2 to Chapter 31 Socio-Economics and is based on BVG Associate's experience in economic analysis of the UK offshore wind farm and their development of the UK Content method for RenewableUK.

3. The supply chain for the project has not been established at this stage of development. Therefore, the assessment is speculative and based on professional judgement of the UK offshore wind industry at time of writing rather than numerical modelling.

4. Probabilities have been assigned based on expected growth within the offshore wind market. However, investments and agreements that are not in the public domain may change this trend and cannot be accounted for. Therefore, there is a medium level of confidence in these probabilities.

5. Associated jobs are provided in Full Time Equivalent (FTE) Years. These differ from FTE in that they provide a figure for the entire stage of the project rather than an individual year. Figures for the construction phase are based on the period in the construction programme as per Chapter 5 Project Descriptio. Figures in operation are based on a 30 year design life of the project.

2 Supply Chain Assessment Table

Table 2.1 Supply Chain Assessment Table

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
Project management and development	Development studies	Development studies are typically undertaken by specialist consultancies. These will be in the same country as the wind farm but the location will depend on the location of offices and the suitably skilled individuals. Additional work will be undertaken by the developer	Low. There are no relevant consultancies in New Anglia LEP Vattenfall undertakes this work outside New Anglia LEP	Baseline Supply will almost certainly be from a UK supplier	About 100 direct FTE years About 300 indirect FTE years	None
	Surveys	Wildlife, geological and metocean surveys are undertaken by specialist data acquisition companies, typically using their own equipment. The companies may be based anywhere but are likely to be located close to hubs for other offshore sectors.	Medium. Gardline is a leading supplier and is based in Great Yarmouth Cefas is a major employer in Lowestoft	High Most contractors have a significant UK presence, even if they draw on skilled people from other parts of the company.	About 200 direct FTE years About 150 indirect FTE years	Limited. Existing companies may be able to grow their presence as a result of the development of the EA zone.
	FEED	FEED studies may be undertaken partially in house but significant elements are subcontracted to engineering houses and in some cases tier 1 suppliers. Engineering houses tend to be located close to large metropolitan areas where they have easy access to skills	Low. Engineering houses have only a limited presence in New Anglia LEP	High Most FEED is likely to be undertaken in the UK, with the possible exception of foundation design, which is highly specialist	About 150 direct FTE years About 100 indirect FTE years	None

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
	Project management and procurement	Project management and procurement is largely undertaken in house by the developer with some positions filled by sole traders or by contracts with companies.	Medium Preconstruction work is likely to be undertaken in the main project offices, often within corporate headquarters. Later, a construction office will be set up closer to the project.	High Most activity will take place in the UK, although some developers with a low UK footprint will draw on experienced individuals based overseas.	About 600 direct FTE years About 300 indirect FTE years	None
Turbine ex-works	Nacelle and hub	Nacelle and hub components are produced through a serial manufacturing process, as is assembly by the turbine manufacturer. The locations for this manufacture are based on long-term strategic decisions. Any new manufacturing facilities would only be built as a result of a new entrant to the market or if market growth meant that demand outstripped current capacity.	Low There is no supply of nacelle and hub components from New Anglia LEP and this is unlikely to change for the foreseeable future.	Low There is very little UK supply of nacelle and hub components and this is unlikely to change for the foreseeable future.	About 2,000 direct FTE years About 6,000 indirect FTE years	None
	Blades	Nacelle and hub components are produced through a serial manufacturing process, usually in house by the turbine manufacturer. The locations for this manufacture are based on long-term strategic decisions. Any new manufacturing facilities would only be built as a result of a new	Low There is no supply of turbine blades from New Anglia LEP. There is some potential for composite material supply, such as resins, although these are global commodities.	High Both Siemens Games and MHI Vestas have UK blade manufacturing plants. Whether the blades for Norfolk Boreas come from the UK will depend on how	About 2,000 direct FTE years About 1,500 indirect FTE years	None

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
		entrant to the market or if market growth meant that demand outstripped current capacity.		manufacturers meet demand from across Europe.		
	Tower	Towers are manufactured by specialist third parties. It is a volatile market because the low margins have meant that company failures are relatively frequent.	Low There is no New Anglia LEP supply of towers, although there is a theoretical opportunity in the supply of internal ladders and platforms. There a possibility that there may be new UK investment in a tower factory before 2025 but there are no particular reasons why it would be in New Anglia LEP.	Medium There is a single UK tower factory in Campbeltown, Scotland, owned by CS Wind UK. Some turbine manufacturers may prefer UK towers to meet political pressure for local content. Given the uncertain past of the Campbeltown factory, it is difficult to speculate whether it could supply towers to Norfolk Boreas	About 400 direct FTE years About 1,000 indirect FTE years	None

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
Balance of plant	Foundations	It is assumed that Norfolk Boreas will use jacket foundations. The market has matured and successful suppliers are typically those that have invested in serial manufacturing facilities. New investments are possible with the use of jackets likely to increase over the next decade.	Low There is no New Anglia LEPn supply of jacket foundations. Although the region has a track record in fabrication for the oil and gas industry, it is not clear that it would be a favoured location for future investments.	Medium Jacket foundations have long been considered an opportunity for the UK supply chain. Despite this, UK suppliers have not generally been competitive and in the longer term, UK supply is most likely to come from inward investment by the leading suppliers that wish to increase their capacity and offer greater UK content.	About 1,500 direct FTE years About 800 indirect FTE years	None
	Subsea cables	Subsea cable factories have typically been built to meet specific demand from interconnector projects, and several are in the Scandinavian and Baltic areas for this reason. Manufacturers have typically chosen to expand these factories to meet demand for offshore wind rather than invest at new sites.	Low JDR Cables has its headquarters in Cambridgeshire, although its subsea cable plant is in Hartlepool.	Medium JDR Cables has been one of the leading developers of 66kV array cables, which are likely to be the industry standard in 2025. There is a therefore a reasonable chance of UK content.	About 2,000 direct FTE years About 1,500 indirect FTE years	Cable plants typically have limited capacity for storage and there is likely to be a demand for cable storage facilities. These may be owned and operated by manufacturers, marine contractors or potentially developers.
	Transmission electrical	High and medium voltage electrical components are typically manufactured by global	Low	Medium Engineering and project management is	About 1,000 direct FTE years	None

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
		conglomerates at plants with the capacity to meet regional demand. Engineering and project management is typically undertaken in the relevant market country, with input from other locations as needed.	There are no know suppliers of electrical equipment in New Anglia LEP	highly likely to be in the UK. GE has the only significant manufacturing capacity in the UK, covering high voltage transformers and converters.	About 1,500 indirect FTE years	
	Transmission structural	Offshore platforms and their foundations are generally manufactured by companies with yards that have met demand from oil and gas and shipyards. The current generation of HVDC platforms are larger than most yards can accommodate and this may encourage new entrants to the market that have suitable infrastructure. Platform foundations are often supplied by a third party. Platform manufacturers have a significant supply chain, which are typically clustered around coastal infrastructure to meet demand from other offshore sectors.	Low Sembmarine SLP in Lowestoft has a track record in supplying substations but it is only one of a number of suppliers across Europe and the sector is highly competitive. HVDC technology is developing but it is unclear whether current developments to shrink DC converter platforms will have progressed sufficiently by 2025 for the company to be a viable supplier. It could be better placed to win the foundations contract.	Low Several UK yards have supplied AC platforms to the offshore wind market. The dimensions of DC platforms are such that it is debatable whether a UK supplier could construct a platform without investment	About 2,000 direct FTE years About 1,500 indirect FTE years	None

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
Installation and commissioning	Foundation installation	Foundation installation has been undertaken using a jack-up vessel or a floating heavy lift vessel. These jack-ups have typically been used for both turbine and foundation installation but in the future the high mass of foundations and the high hub height of turbines will mean that the fleets becoming increasingly distinct. Most contractors are based in Europe and they are a mixture of specialist vessel operators and larger EPCI contractors. Installers have a significant supply chain, notably for mobilisation and demobilisation services, sea fastening fabrication, staging port facilities and crewing services.	Low Great Yarmouth Seajacks operates the largest jack-up vessel currently in operation, which is well suited to large monopole installation. The trend towards large floating heavy lift vessels for foundation installation would erode Seajacks' competitiveness without further investment. New Anglia LEP has a number of relevant companies at tier 2 level.	Low There has been significant consolidation in the foundation installation market that is a threat to existing UK capability. Lower tier opportunities for UK companies could increase, particularly if overseas contractors seek opportunities to increase local content.	About 1,200 direct FTE years About 700 indirect FTE years	There are a range of construction support services needed for an offshore wind farm. There is the potential for investment in New Anglia LEP for companies offering: • Above water asset inspection • Catering • Environmental surveys • Fuel bunkering • Marine and maintenance coordination • ROV operation • Training and medicals provision • Vessel maintenance • Waste services
	Cable installation	Cable installation is provided by EPCI contractors, a small number of specialist operators and cable manufacturers that have their own vessels.	Low There are no installers based in New Anglia LEP. There is no significant relevant supply chain.	Medium The UK is likely to retain some cable laying capability to 2025. It has a strong	About 2,000 direct FTE years About 1,500 indirect FTE years	See subsea cables See foundation installation

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
		The work is increasingly being undertaken using newbuild vessels designed specifically for offshore wind. There is a significant supply chain for installers, including route clearance, remotely operated vehicles, crewing services, cable storage and handling equipment and services, vessel mobilisation and demobilisation, and electrical services.		supply chain and this is likely to be retained.		
	Turbine installation	The increasing size of turbines, and particularly the hub height, will put pressure on the competiveness of the vessel fleet unless there is significant investment and/or radical innovation in installation technology. Increasing turbine supply also shrinks the vessel market per MW because the MW carrying capacity for a vessel typically increases with larger turbines. (Note: Increased turbine size also shrinks the foundation and cable installation market for similar reasons.)	Medium Great Yarmouth Seajacks operates the largest jack-up vessel currently in operation, which is may be well suited to turbine installation, possibly with some modification.	Medium See Probability of New Anglia LEP supply.	About 1,000 direct FTE years About 500 indirect FTE years	See foundation installation

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
	Substation installation	Substation platform installation is generally undertaken by a floating heavy lift vessel, often with a single lift from a barge. The low volume of work typically means that the operation often uses vessels used in other sectors. Self-installing substations have been developed. The substation foundation installation is a similar process to turbine foundation installation and may be undertaken by the same contractor	Low New Anglia LEP has no relevant capability.	Low The UK has no relevant capability.	About 200 direct FTE years About 100 indirect FTE years	See foundation installation
Operations, maintenance and service	Wind farm operations	Wind farm operations is split between day-to-day activities directly concerned with the specific wind farm and asset management functions that my cover a number of wind farms. Day-to-day functions for Norfolk Boreas are likely to be undertaken from an offshore base, either a service operation vessel (SOV) or a fixed platform. Asset management functions may be UK and/or internationally based.	High Although SOV operations do not require a very local base, with crew and supply changes perhaps every two weeks, onshore activity is likely to be focused in New Anglia LEP.	High See Probability of New Anglia LEP supply.	About 2,500 direct FTE years About 1,000 indirect FTE years	There are a range of operational services needed for an offshore wind farm. There is the potential for investment in New Anglia LEP for companies offering: • Catering • Environmental surveys • Fuel bunkering • Marine and maintenance coordination • Training and medicals provision

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
	Turbine maintenance and service	Turbine maintenance and service is divided into: • Planned service and regular maintenance that can be undertaken using the equipment and workforce dedicated to the wind farm • Major service, typically involving replacement of major components using jack-up vessels. Work may be undertaken by the turbine manufacturer or third party service provider, or by in house by the wind farm owner, bringing in additional technicians as needed to meet peaks in demand.	High Planned service and regular maintenance is likely to be largely focused in New Anglia LEP, even if much of the activity is based offshore in SOVs or fixed platforms. For major service, components and vessels will probably be bought in from outside the region.	High See Probability of New Anglia LEP supply.	About 2,500 direct FTE years About 1,000 indirect FTE years	There are a range of operational services needed for an offshore wind farm. There is the potential for investment in New Anglia LEP for companies offering: • Above water asset inspection • Blade inspection and repair • Drone operation • Training and medicals provision • Turbine cleaning
	Balance of plant maintenance	Balance of plant covers: • Cable maintenance, replacement and repair • Foundation, inspection and remedial works • Substation maintenance (on and offshore) Export cables are substations will be owned by the offshore transmission owner. Array cables	Medium Although, balance of plant maintenance contractors may be widely dispersed across Europe, many have built up expertise in the oil and gas sector. New Anglia LEP's heritage in this sector and the potential for a clustering effect to meet the needs of the whole New Anglia LEP offshore wind	High There is competition from mainland Europe but UK companies should perform strongly.	About 500 direct FTE years About 200 indirect FTE years	There are a range of operational services needed for an offshore wind farm. There is the potential for investment in New Anglia LEP for companies offering: • Above water asset inspection

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
		and foundations fall within the remit of the wind farm owners. Balance of plant maintenance is typically infrequent and therefore contractors can be widely dispersed and not necessarily close to offshore wind farms.	zone means businesses there are likely to be successful.			• Autonomous underwater vehicle operation • Cable repair • Corrosion protection and repair • ROV operation • Subsea asset inspection • Training and medicals provision
Decommissioning	Engineering and project management	Offshore wind decommissioning has so far only been undertaken for small numbers of turbines. It is likely that the decommissioning engineering and project management will be undertaken using the same model as project management and development phase. There is a good chance that a large project such as Norfolk Boreas would be repowered.	Low Much of the work will be taken in the corporate offices of wind farm owners and within engineering consultancies. These are unlikely to be based in New Anglia LEP.	High The wind farm owner is likely to the work in UK offices. Engineering work is also likely to be done by UK based consultancies.	About 200 direct FTE years About 100 indirect FTE years	None
	Offshore works	The specific nature of the work is uncertain but it is likely to involve the same contractors as for installation (although after decades of operation, their identities will have changed in many cases).	Low The work will be undertaken by one of a number of contractors from across Europe.	Medium UK is likely to have competitive contractors but they will probably be up against other European contractors with cost	About 1,500 direct FTE years About 500 indirect FTE years	These are similar to those for installation and commissioning

Element	Subelement	Commentary	Probability of New Anglia LEP supply	Probability of UK supply	Associated jobs	Cluster opportunities
				the likely differentiator.		
	Salvage and recycling	Salvage of steel offshore structures is a well established process. Recycling of turbine blades was not developed far but there are likely to be solutions at the end of Norfolk Boreas's life. Given the volume of work fro, the mid-2030s onwards, specialist offshore wind salvage ports may develop.	Medium New Anglia LEPn ports could be used but much could depend on whether there was suitable facilities for salvage.	High Salvage and recycling of ships and offshore structures already takes place in the UK and it could be an attractive opportunity for port owners.	About 500 direct FTE years About 300 indirect FTE years	

3 Supply chain elements

3.1 Above water asset inspection

6. Above water asset inspections will monitor the foundation and its coating above the water line, including the platform, and the tower. Providers will probably not operate their own vessels but may work in partnership. Companies will expect to work offshore regularly and would benefit from a port location, although the service is likely to be one of a number they offer and their main offices need not be within the immediate area of the port.

7. A supplier offering subsea assets inspections alone would employ 12-15 people.

3.2 Autonomous underwater vehicle operation

8. Autonomous underwater vehicles (AUVs) may be stored off site and brought to the port as needed. They would be used a cheaper alternative to ROVs because they can be launched from lower cost vessels.

9. Suppliers would benefit from a port location, particularly if many of its customers were users of the port. Customers could be the wind farm operator or contractors inspecting subsea assets, including cables. The supplier would employ 15-20 people.

3.3 Blade inspection and repair

10. Blade erosion is a significant problem for offshore wind farms, with damage to the leading edge reducing yields and, therefore, wind farm revenue.

11. Providers do not need quayside access and are likely to travel via the marine co-ordinator.

12. Suppliers would benefit from a port location, particularly if many of its customers were users of the port. The customers of the service would be the wind farm operator, the turbine service contractor. A supplier would employ 15-20 people.

3.4 Cable repair

13. Cable repair service is a highly specialist activity. The cable manufacturers typically have their own service operations (and vessels), but there are independent providers also. Marine contractors may also have capability. The scope of work would usually involve the supply of the joint ands repair of the cable on the ship deck once it has been retrieved. The vessel used would depend on cost and availability but could be a 30m multicat or a larger cable vessel that was otherwise used for installation work.

14. The cable repairer would employ 25-30 people.

3.5 Catering

15. The offshore wind farms will create a significant demand for catering services from all users of the port. While suppliers do not have a need for quayside access, they would benefit from being close to their customers using the port.

16. A supplier would employ 20-30 people.

3.6 Corrosion protection and repair

17. Contractors will address corrosion above and below the water line. For work above the water line, access could by CTV or SOV, while below the water level the work is likely to involve the use of ROVs and potentially divers. Here a DP2 vessel would be needed.

18. The work is most likely to be contracted by the wind farm operator. The supplier would employ 15-20 people.

3.7 Drone operation

19. Drones have the potential to be used to inspect all wind farm and transmission assets (the substations) above the water line. They can be easily transported from inland storage to be taken offshore.

20. Suppliers would benefit from a port location, particularly if many of its customers were users of the port. The customers of the service would be the wind farm operator, the turbine service contractor, or the owner of the substation or its main maintenance contractor.

21. The supplier would employ 15-20 people.

3.8 Environmental surveys

22. There is a signification need for environmental monitoring at wind farms, during development, construction and in the early years of operation. Companies offering services need regular access to vessels and a port location is beneficial. Significant suppliers such as Cefas and Gardline already have bases in East Anglia.

3.9 Fuel bunkering

23. Fuel can be provided by pumps at he quayside or on pontoons or from a lorry. If the demand is regular and intensive, such as from day-to-day wind farm operations using CTVs then pumps are likely to be installed if a long-term contract is awarded to a supplier.

24. Fuel is likely to be sourced by the wind farm operator and free-issued to the vessel operators.

25. A fuel supplier is likely to employ about 10 people.

3.10 Marine and maintenance coordination

26. Coordination of maintenance and offshore construction coordination is offered by third party suppliers of specialist software. Companies that offer these services do not have a need for regular access to vessels but these is an advantage to being close to their customers and this could be from an office inside the port. If so, the company would look to employ about 10 people and these are likely to be located within the client's operations base.

3.11 ROV operation

27. Remotely operated vehicles (ROVs) are used for subsea inspection. They may be provided by the subsea asset inspection service or a third party provider, in which case, they may work in partnership. ROVs are likely to be stored away from the port and transported to customers as needed. Suppliers would benefit from a port location, particularly if many of its customers were users of the port. Customers could be the wind farm operator or contractors inspecting subsea assets, including cables. A supplier would employ 20-30 people.

3.12 Subsea asset inspection

28. Subsea assets inspections will monitor the foundation and its coating below the water line, scour and the cable close to the foundation base. Providers will not always operate their own vessels and equipment but may work in partnership. Companies will expect to work offshore regularly and would benefit from a port location although the service is likely to be one of a number they offer and their main offices need not be within the immediate area of the port. Within in the port, its facilities would need to accommodate a dynamically positioned vessel of about 60m in length.

29. The customers of the service would be the wind farm operator, or the owner of the substation or its main maintenance contractor.

30. A supplier would employ 12-15 people.

3.13 Training and medical provision

31. Most users of the port for offshore wind will have a need for training services. While not all activities require access to vessels, enough do to make a location in the port attractive given the benefits of being close to customers.

32. Training providers may also offer medical checks for offshore workers, although these services could be provided independently.

33. A supplier would and employ 10-20 people.

3.14 Turbine cleaning

34. Marine growth and bird guano can accumulate on the turbine foundation, which can become a significant slip hazard for turbine maintenance technicians. At some sites regular cleaning is important and it would be beneficial for a company providing cleaning services to be based within the port. A company would probably employ about 3-5 people.

3.15 Waste services

35. The offshore wind farms will create a significant demand for waste services from all users of the port. While suppliers do not have a need for quayside access, they would benefit from being close to their customers using the port.

36. A supplier would employ 10-20 people.

3.16 Disclaimer

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