BVGassociates

Offshore wind opportunities in the Port of Lowestoft

An independent report for Associated British Ports

January 2019

BVGassociates

Document history

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BVG Associates

BVG Associates is an independent renewable energy consultancy focussing on wind, wave and tidal, and energy systems. Our clients choose us when they want to do new things, think in new ways and solve tough problems. Our expertise covers the business, economics and technology of renewable energy generation systems. We're dedicated to helping our clients establish renewable energy generation as a major, responsible and cost-effective part of a sustainable global energy mix. Our knowledge, hands-on experience and industry understanding enables us to deliver you excellence in guiding your business and technologies to meet market needs.

- BVG Associates was formed in 2006 at the start of the offshore wind industry.
- We have a global client base, including customers of all sizes in Europe, North America, South America, Asia and Australia.
- Our highly experienced team has an average of over 10 years' experience in renewable energy.
- Most of our work is advising private clients investing in manufacturing, technology and renewable energy projects.
- We've also published many landmark reports on the future of the industry, cost of energy and supply chain.

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Executive summary

The UK's world-leading offshore wind sector continues to mature, with over 6.8GW of fully installed capacity at the end of 2017, meeting about 5% of the UK's electricity demand. There are now over 30 operational offshore wind farms in the UK, and most of these are in the southern North Sea and the Irish Sea.

The Port of Lowestoft is already benefitting substantially and offshore wind is now an important business sector for it. East Anglia ONE offshore wind farm is currently under construction and will use the port for both construction and operations, maintenance and service (OMS). It is likely to be the first of a series of major new wind farms off the coast of East Anglia. Other European countries have ambitious plans also, and together, these provide a major opportunity for the Port of Lowestoft, as shown in Figure A.

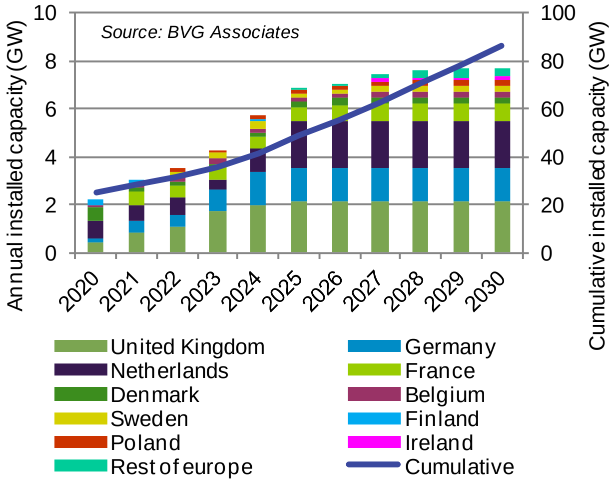


Figure A European offshore wind installed capacity to 2030 under the WindEurope market upside scenario.

Lowestoft can further benefit from the development of wind farms off the East Anglia coast by attracting operators of local wind farms to the port, and by attracting suppliers that want a well-located base to serve the wider European market.

This study sought to quantify this opportunity and calculate the job creation for Lowestoft that would result.

The future demand from the offshore wind industry for facilities at the Port of Lowestoft depends on:

- Turbine design. Larger turbines mean less demand for technicians and therefore vessels
- Wind farm size, location and vessel strategy, which determine the number and type of vessels needed
- Market growth. A growing market can lead to new investments in port-associated land by suppliers looking to benefit, and
- Supply chain maturity. Manufacturing and installation of wind farm components is relatively mature and many investments in port-associated land have already been made. OMS is less mature, because:
  - The demand for services comes later than for construction
  - Many projects have been isolated geographically and owners and suppliers are dispersed, and
  - Operational strategies for wind farms further from shore, with wind farms more than about 40nm likely to use offshore bases rather than crew transfer vessels (CTVs).

The analysis shows that the Port of Lowestoft could attract the operators of a further five wind farms by 2030. To meet their needs and those of their suppliers, the study shows that total demand for CTV berths could reach 50.

It also shows that the port could be an attractive location for a wide range of company types, including:

- Blade inspection and repair
- Cable repair
- Fuel bunkering
- ROV operation
- Subsea asset inspection
- Training and medical provision
- Vessel maintenance, and
- Waste services

Conservative analysis shows that operators and suppliers could create a demand for about 5ha of port land. They would bring the total number of jobs created by offshore wind in Lowestoft to 1,100. Most of these would be employed in and around the port.

These jobs will be secure in the long term (even beyond 25 years) because wind farm owners are likely to ‘repower’ wind farms at the end of their lives.

Most of the Port of Lowestoft’s current offshore wind tenants are located in the outer harbour. There is little available space for future tenants there; so future demand by offshore wind tenants would have to be met through the use of the inner harbour. This would be most likely to be on the Shell Quay.

Many offshore wind operational activities are time critical and anything that adds transit time to the wind farm potentially leads to lost electricity generation and increases in personnel and equipment costs. The Lake Lothing Third Crossing, proposed by Suffolk County Council, is likely to impede access to the wind farm and act as a significant disincentive to investment by both operators and suppliers. Analysis shows that the port land demand would fall from 4.9 ha to 1.3 ha and the total jobs supported by the industry would fall from about 1,100 to less than 400.

1. Introduction

The UK's world-leading offshore wind sector continues to mature, with over 6.8GW of fully installed capacity at the end of 2017, meeting about 5% of the UK's electricity demand.[1] There are now over 30 operational offshore wind farms in the UK, with the majority of these operational wind farms located in the southern North Sea and the Irish Sea. The UK will achieve 10GW of offshore wind installed capacity by the end of 2020, with a number of new projects currently under construction.

The growth in the offshore wind sector has been driven by four main factors: strong offshore wind resources, strong policy support, The Crown Estate's desire to maximise the value of its marine assets, and an industry that has risen to the challenge of becoming a mature power player.

Offshore wind now accounts for a significant proportion of the Port of Lowestoft's annual revenue. This revenue currently comes from its role in supporting:

- Greater Gabbard (offshore operations, maintenance and service (OMS) base and additional work arising from grouted connection repairs), and
- Galloper (construction coordination base).

Day-to-day operations for an offshore wind farm are most efficiently undertaken from a nearby port. As Figure 1 shows, Lowestoft is well located to support current and future offshore wind developments.

To date, the wind farms built in the southern North Sea have mostly been to the north of East Anglia in the Greater Wash and to the south, in the Greater Thames area (see Figure 1). This reflects the good wind resource and relatively shallow water in these areas.

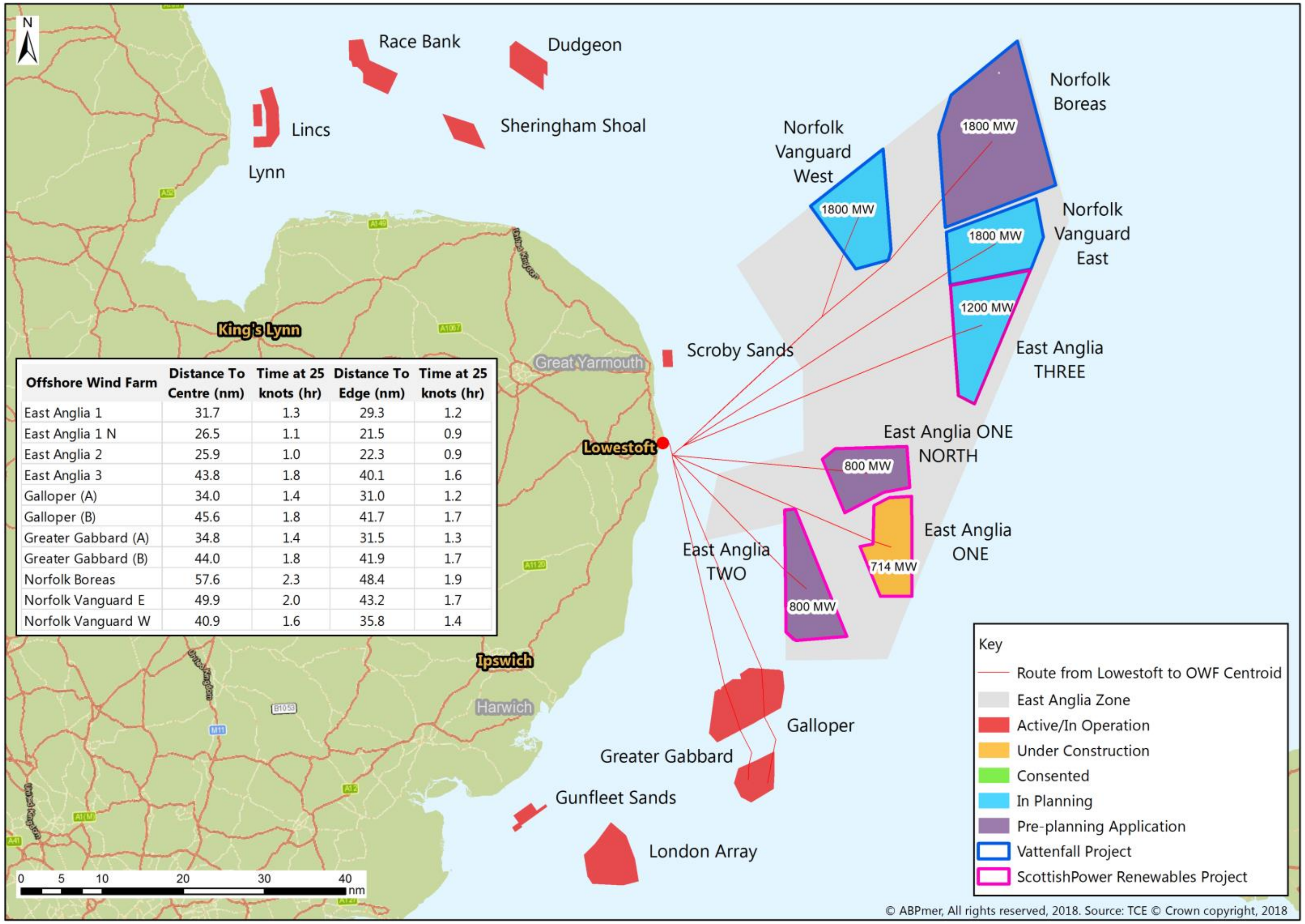
That trend is set to change, with the construction of the first project in the large Round 3 East Anglia zone (East Anglia ONE) which started in April 2018. Scottish Power Renewables has chosen Lowestoft as its construction coordination and OMS base for this wind farm project. The impending growth in the East Anglia wind farm sector will create a considerable need for port facilities in East Anglia, and the ports of Lowestoft, Great Yarmouth and Harwich have already attracted significant preparatory business.

To help it understand the opportunities now arising for the Port of Lowestoft, Associated British Ports (ABP) commissioned BVG Associates to undertake this study, the brief for which was to consider the potential for the use of the Port of Lowestoft in terms of the expanding offshore wind energy market – and the employment opportunities which could thereby arise.

In 2009, BVG Associates undertook a demand and need study for 1st East (an economic development company focused on the Lowestoft and Great Yarmouth areas) with the aim of identifying the optimum energy sector activity at the proposed Lowestoft 'PowerPark' area, which incorporates part of the Outer Harbour of the Port of Lowestoft.[2] In the nine years since that study, the offshore wind industry has been transformed and it is timely to revisit how Lowestoft can continue to benefit from the growth of the sector.

[1] Digest of UK Energy Statistics (DUKES): renewable sources of energy, 2017, Department for Business, Energy & Industrial Strategy. Available online at https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

[2] PowerPark Demand & Need Report. BVG Associates for 1st East, October 2009. Available online at http://www.eastsuffolk.gov.uk/assets/Planning/Waveney-Local-Plan/Background-Studies/PowerPark-Demand-and-Need-Report.pdf



Offshore Wind Farm	Distance To Centre (nm)	Time at 25 knots (hr)	Distance To Edge (nm)	Time at 25 knots (hr)
East Anglia 1	31.7	1.3	29.3	1.2
East Anglia 1 N	26.5	1.1	21.5	0.9
East Anglia 2	25.9	1.0	22.3	0.9
East Anglia 3	43.8	1.8	40.1	1.6
Galloper (A)	34.0	1.4	31.0	1.2
Galloper (B)	45.6	1.8	41.7	1.7
Greater Gabbard (A)	34.8	1.4	31.5	1.3
Greater Gabbard (B)	44.0	1.8	41.9	1.7
Norfolk Boreas	57.6	2.3	48.4	1.9
Norfolk Vanguard E	49.9	2.0	43.2	1.7
Norfolk Vanguard W	40.9	1.6	35.8	1.4

Figure 1 Existing and proposed offshore wind projects in the southern North Sea and their proximity to Lowestoft.

2. Industry trends

The offshore wind industry has developed rapidly since the construction of the first commercial offshore wind farm in the southern North Sea, Scroby Sands (located directly to the east of Great Yarmouth), in 2003. In considering the potential future demand from the offshore wind industry for facilities at the Port of Lowestoft, developments in the following areas are relevant:

- Turbine design
- Wind farm size, location and vessel strategy
- Market growth, and
- Supply chain maturity.

2.1. Turbine design

Scroby Sands was built using 2 megawatt (MW) turbines that were "marinised" versions of models that were being marketed to the onshore wind market. The first turbines subsequently developed specifically for the offshore market, however, had a capacity of 6MW. This recognised that the cost per MW of manufacturing and installing wind farm infrastructure and the cost of wind farm OMS decreases with an increase in turbine size.

Turbine development continues at a pace. The Triton Knoll wind farm (located east of the Humber estuary) will begin construction in 2021 using 9.5MW turbines. Within a few years, 12-15MW turbines are expected to be the norm. By 2025, 18MW are likely. The recent offshore turbines have also been designed for greater reliability and lower maintenance, in order to drive down the cost. As a consequence, as the technology advances, the demand for technicians will be lower per MW for wind farms built in the future and the number of support vessels needed per MW for a given wind farm size will be lower than older offshore wind farms.

Thus, in modelling demand, we have based our analysis on a recent development using 7MW turbines, serviced using crew transfer vessels (CTVs), one CTV is needed for every eight turbines. For a wind farm using turbines in the 12-18MW range, however, one CTV is needed for only every 6.5 turbines. For a wind farm using 7MW turbines, there is one CTV for every 56MW; whereas for a wind farm using 18MW, there is one vessel for every 117MW.

2.2. Wind farm size, location and vessel strategy

As the industry matures, wind farms will become larger and further from shore where there are fewer constraints and wind speeds are higher.

Most early wind farms, such as Scroby Sands and Greater Gabbard (Figure 1) are serviced using CTVs that travel daily from a port's operations base. Each CTV carries up to 12 technicians. This limit was previously imposed by the limit for passenger vessels, as classified by the Maritime and Coastguards Agency. While these rules have changed to enable more passengers for CTVs, the carrying capacity for CTVs may not increase significantly because this would mean technicians spending on average a higher proportion of their time on the vessel while technicians are dropped off at other turbines. However, as identified in the previous section, one of the benefits of larger turbines is that they need fewer technicians per MW to maintain and service them. Fewer technicians mean fewer vessels.

A CTV will travel at about 20 knots. A wind farm 20 nautical miles (nm) (approximately 37km) from the port will therefore have a transit time of around an hour. For wind farms more than 40nm from port (approximately 75km), each technician will spend more than four unproductive hours a day in transit. This is costly in terms of human resource. There are also risks that the technicians will not be fit for work when they arrive at a wind farm site (due to the effects of sea-sickness) or that the sea state will be too rough for safe turbine access. These factors serve to place a practical limit on the operational range of CTVs of around 40nm from a port operations base for routine activities.

Given that a number of offshore wind farms are likely to be constructed beyond the practical range of CTVs, the industry developed new strategies. Over the past two years there has been a substantial development of service operation vessels (SOVs), which are currently about 80m long with accommodation for 40 technicians and walk-to-work gangways. SOVs typically come in to port once every fortnight with wind farm maintenance crews living on-board for the duration of their tour of duty. Downsides to the SOV operating model are their higher charter rates when compared with CTVs and the high fuel usage of the dynamic positioning systems which are required to keep SOVs at their predetermined location.

For the purposes of this analysis, we have assumed that offshore wind farms located more than 40nm from port will use SOVs. Greater Gabbard and East Anglia ONE, which both utilise CTVs, are consistent with this operating model.

For future wind farms the choice of vessel strategy is uncertain. We have assumed that East Anglia TWO and ONE North will also use CTVs, while East Anglia THREE and Norfolk Vanguard and Boreas will use SOVs, again consistent with the operating model assumption.

2.3. Market growth

Offshore wind has been successful in reducing costs dramatically in recent years. As a result, it is receiving strong political support in countries close to Lowestoft - Belgium, Germany and the Netherlands, as well as the UK. Figure 2 shows offshore wind installed capacity projections to 2030 using a scenario developed by WindEurope that most closely aligns with industry expectations. It shows that offshore wind will continue to grow in all the countries around the North Sea. This upside is consistent with the buoyant mood of the industry.

The size of this future market is crucial in that it creates an appetite for supply chain investments at optimal locations. As a consequence, some investors will be looking to meet demand from the whole southern North Sea from a single location.

The significance for the Port of Lowestoft is that it is well-located and has available space in the Inner Harbour to accommodate the supply chain. In a growing market, the port has an opportunity to attract companies seeking to extend their market share.

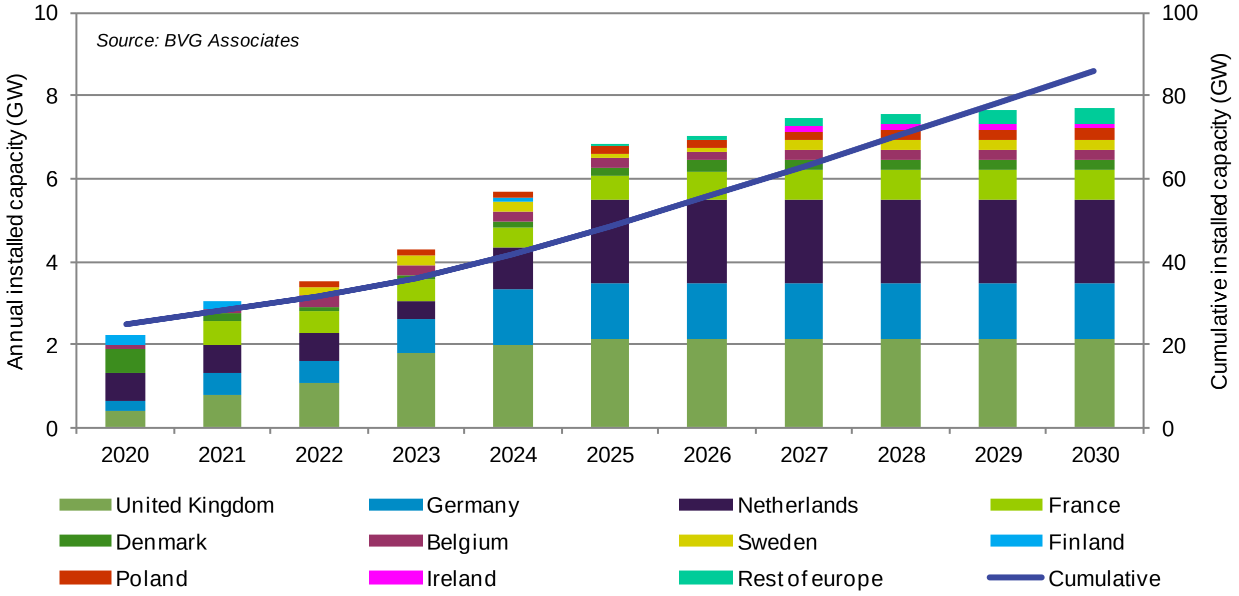


Figure 2 European offshore wind installed capacity to 2030 under the WindEurope market upside scenario.

2.4. Supply chain maturity

Supply chain maturity is important because it helps us understand whether companies have established a market share and formed a view of the future demand from offshore wind.

In a mature sector, most companies will have ensured that they are optimally located to maximise the opportunity from the industry and reduced their logistic costs. As a result, they are less likely to physically move their operations. Conversely, an immature supply chain is more fluid. A port will have more chance of attracting an immature supply chain than a mature one.

There are two distinct supply chains in operation in the offshore wind market. The first is the construction supply chain. The second is the OMS supply chain.

For the construction phase of offshore wind farms (component manufacture and project development and installation), the supply chain is close to maturity, although some further consolidation is likely.

For the OMS phase, the supply chain is relatively immature. This means that many companies have yet to make a location decision and there is an opportunity for the Port of Lowestoft to attract businesses that see an expanding opportunity in offshore wind but are not currently optimally located.

The reasons for the current supply chain immaturity are:

- The demand for services comes later than for construction
- Many projects have been isolated geographically and owners and suppliers are dispersed, and
- Operational strategies for wind farms further from shore are still evolving, for example the deployment of SOVs to service more distant wind farms.

Many of the companies looking to expand into offshore wind have a background in servicing the offshore oil and gas sector and are currently based in the north east of England or Scotland (which have not, to date, seen significant offshore wind development). This is likely to change but the ‘centre of gravity’ of the industry is likely to remain further south. Such companies are not, therefore, currently optimally located to service the southern North Sea offshore wind projects. As a result, the Port of Lowestoft is likely to be of interest to these companies as they make commercial decisions on where to locate their OMS bases, competing against other ports in the region.

3. Demand for vessel berths at Lowestoft

The demand for vessel berths was calculated by establishing:

1. The wind farms that create a demand for vessel berths in Lowestoft
2. The project timings for each wind farm
3. The Owner commitments to specific ports
4. The size and number of turbines for each wind farm
5. The vessel choice for each wind farm (CTV or SOV), and
6. The number of vessels needed per turbine.

In theory, non-UK projects are accessible from Lowestoft using SOVs, in particular those in Dutch waters. However, given the availability of coastal industrial sites in the Netherlands, there is no compelling reason why Lowestoft would be used as a base for non-UK projects. We have therefore not assumed any demand for vessel berths for non-UK projects.

3.1. Wind farms creating a demand for vessel berths in Lowestoft

The Port of Lowestoft's location, central on the East Anglia coast makes it an attractive site for wind farm owners because good access to wind farms lowers operational costs and decreases turbine down time. It follows that there is likely to be a demand arising from all wind farms off the coast of East Anglia both under development and planned to start construction in the next few years.

Demand at the Port of Lowestoft is demonstrated by the fact that, as of December 2018, CTVs are currently berthed in both the Outer Harbour (for East Anglia ONE and Greater Gabbard) and the Inner Harbour (for Galloper).

While the Outer Harbour is almost at capacity, the Inner Harbour has considerable capacity to accommodate CTVs in future, especially at Shell Quay. Table 1 shows the projects that are operational, under construction or in development in the East Anglia sector of southern North Sea, representing a total of about 8GW. The offshore wind industry's success in reducing costs has given it significant political backing. It is therefore reasonable to assume that all the projects in development will get built - the question as to which port or ports could service each development is dealt with later in this report.

Given the location of these offshore wind projects, we assumed that East Anglia ONE, East Anglia TWO, East Anglia ONE North and East Anglia THREE are operated from the Port of Lowestoft, and that Lowestoft captures associated supply chain work.

Table 2 identifies those additional potential offshore wind projects that are anticipated to be developed, subject to agreement with The Crown Estate, planning consent and confirmation of a commercial case. These projects could account for up to 10GW. The Crown Estate has been in discussion with owners for extensions to existing projects and some of these could be added to the East Anglia business "pipeline" before long. Some extensions could be built before the last of the projects currently in development. A new leasing round ('Round 4') has also been announced by The Crown Estate that could add further capacity.

To model the demand for the Port of Lowestoft, we have assumed that an extra 2.5GW of wind farms are built as extensions or from a new leasing round and that all wind farms are repowered at their end of their design lives, typically 20-25 years (this is considered realistic, given current industry trends and the likely re-powering of Round 1 and 2 projects).

Table 1 UK wind farms built or in development that create a demand for Lowestoft berths, the number of turbines and the assumed vessel choice.

Wind farm	Status	Operational date	Wind farm capacity	Turbine capacity	Distance from centre to Lowestoft	Assumed primary vessel choice
Greater Gabbard	Operational	2012	504MW	3.6MW	40nm	CTV
Galloper	Operational	2018	336MW	6MW	40nm	CTV
East Anglia ONE	Under construction	2021	714MW	7MW	32nm	CTV
East Anglia THREE	Consented	2024*	1,200MW	12MW*	44nm	SOV
Norfolk Vanguard	Consent decision due 2020	2025*	1,800MW	13MW*	45nm	SOV
Norfolk Boreas	Consent application expected June 2019	2026*	1,800MW	13.5MW*	58nm	SOV
East Anglia TWO	Consent application expected March 2019	2027*	900MW	14MW*	26nm	CTV
East Anglia ONE North	Consent application expected March 2020	2028*	800MW	14.5MW*	22nm	CTV

* Operational date and turbine capacity are assumed and are not necessarily the same as the information used publicly by developers.

Table 2 Potential future UK wind farms that create a demand for Lowestoft berths, the number of turbines and the assumed vessel choice.

Wind farm[3]	Assumed operational date	Assumed wind farm capacity	Assumed turbine capacity	Distance from centre to Lowestoft	Assumed primary vessel choice
New sites (Round 4 or extensions)	2031	2,500MW	18MW	30-60nm	CTV or SOV
Repowered Greater Gabbard and Galloper	2039	857MW	18MW	40nm	CTV
Repowered East Anglia ONE	2048	714MW	18MW	32nm	CTV
Repowered East Anglia THREE	2055	1,200MW	18MW	44nm	SOV
Repowered Norfolk Vanguard	2057	1,800MW	18MW	45nm	SOV
Repowered Norfolk Boreas	2058	1,800MW	18MW	58nm	SOV
Repowered East Anglia TWO	2059	900MW	18MW	26nm	CTV
Repowered East Anglia ONE North	2060	800MW	18MW	22nm	CTV

[3] Repowered wind farms are assumed to have the same capacity as the original project. The spacing of turbines is approximately proportional to the turbines' rated capacity. A repowered wind farm will therefore have a similar capacity to the original wind farm (even though the number of turbines is expected to be less). It may also use the same transmission assets.

3.2. Project timings

The timing of these projects is important in determining the timing of the opportunity for the Port of Lowestoft. The project timetables shown in Table 1 and Table 2 are based on public information from developers, practical constraints (such as the timing of CfD auctions) and the value to developers in sustaining a smooth project pipeline. Offshore wind farms typically have a design life of 20-25 years.

3.3. Owner commitments to competitor ports

Future wind farm development in the southern North Sea will be serviced from a number of ports competing with each to attract business. Both Lowestoft and Great Yarmouth are well located in this regard (see Figure 1). In order to arrive at sensible estimates of demand, we have assumed that core developer-led operations for Boreas and Vanguard are run from Great Yarmouth (because Vattenfall has signed a memorandum of understanding with Peel Ports Great Yarmouth for their Norfolk Boreas and Norfolk Vanguard projects). It is, however, realistic to assume that a small amount of Boreas and Vanguard-related supply chain work will use CTVs operating out of Lowestoft.

3.4. Size and number of turbines

The number of turbines installed at a particular wind farm is dependent on their rated capacity. As discussed in Section 2.1, the benefits of larger turbines are such that we expect that 18MW turbines will be available to the market in 2030, a factor reflected in our analysis.

3.5. Vessel choice

The most important variable in estimating berth requirements is the distance from port (and therefore the transit time) but several other factors affect the vessel strategy for these wind farms and therefore the potential berthing demand at Lowestoft:

- The size of the wind farm, and therefore the number of technicians needed to operate it
- The method of access of technicians to the turbine
- The cost of chartering vessels
- The comfort of technicians while travelling, and
- Vessel fuel consumption.

The two options considered here are:

- CTVs operating out of an onshore base, used for projects that are within two hours from shore. These are generally up to 24m long and carry up to 12 technicians and return to base daily, and
- SOVs, providing an offshore base for projects further from shore. These are up to 80m long and typically have accommodation for about 30-40 technicians. They will stay out on a wind farm for typically two weeks before returning to port for crew change, reprovisioning and refuelling.

As shown in Table 1 and Table 2, we have assumed that of the projects in development, East Anglia ONE North and East Anglia TWO use CTVs primarily, while East Anglia THREE, Norfolk Vanguard and Norfolk Boreas use SOVs primarily.

It is normal for the wind farm owner to take responsibility for port selection and for agreeing long-term contracts for berthing and port access for routine tasks. To mitigate financing risks, it is typical for wind farm owners to secure port agreements for the design life of the wind farm. These agreements will usually include a fixed number of berths. There may also be additional tasks and activities which fall outside the owner’s port agreement and for which separate short-term arrangements are required by the wider supply chain. We have assumed that wind farm owners ensure that there are sufficient berths for their supply chains. Even if their suppliers are located elsewhere, they will still need to use Lowestoft as the base for their operations for the duration of the contract, irrespective of whether or not the suppliers are based in Lowestoft. The demand for berths in the port is primarily driven, therefore, by the decision by wind farm owners to use Lowestoft as an operations base.

3.6. Vessels per turbine

To model berth demand, we used as our starting point the stated requirement for East Anglia ONE, which uses ‘next generation’ turbines that were designed specifically for the offshore wind market. They are twice the capacity of their predecessors (such as those used at Greater Gabbard) and designed for significantly improved reliability. East Anglia ONE therefore provides a good model upon which to base future berth demand. Earlier projects (such as Greater Gabbard) have experienced a greater requirement for CTVs, owing to technical issues associated with the turbines and their foundations.

For the construction period, East Anglia ONE will use up to eight CTVs, that is 0.08 CTV per 7MW turbine. For OMS, it will also need up to eight CTV berths. These numbers take into consideration the potential requirement for higher vessel numbers during peak periods and allow for operational flexibility within the port.

Future projects will use larger turbines and these will lead to a higher demand for vessel berths per turbine but this does not scale up proportionately due to gains arising from the economies of scale. We assumed that the larger turbines require 0.08 berths per turbine during construction and 0.11 berths per turbine during the OMS phase. We also assumed that the developer secures berths for its supply chain but that the additional requirement is small.

For SOV projects, we assumed that there would be an additional demand for each project of two CTV berths to provide flexibility and to cover the period when the SOV is in port.

SOVs are likely to come into port once a fortnight for 24 hours. A single SOV therefore needs 1/14 of a berth. In theory, a single berth could accommodate 14 vessels but in practice the demand is likely to overlap and, given the costs of having an SOV not being active servicing a wind farm, owners may wish to have dedicated access. We made a pragmatic assumption that a single berth can be used by two SOVs.

Turbine decommissioning will become a significant industry from the mid-2020s onwards. The Port of Lowestoft will be well positioned to support this activity and we consider it is likely that it will have similar Port requirements to offshore wind farm construction.

3.7. Number of berths at Lowestoft

Below, we set out our estimates of CTV and SOV berth demand at the Port of Lowestoft. As explained above, any business arising from offshore wind operations outside UK waters would be additional to the numbers presented here.

Crew transfer vessels

Figure 3 shows the demand for CTVs (and hence overnight CTV berths) from wind farms that are accessible to Lowestoft. Demand is for just over 30 berths, but this figure reaches 50 berths if, as can be reasonably anticipated, more projects are developed and the existing wind farms are repowered (together, described as 'future projects' below). Figure 3 does not show the demand from the repowering of new projects (not yet operating), which is why the demand reduces in the 2060s. If offshore wind continues to be competitive then repowering of these projects is possible and there will not be such a drop-off. There will, however, be a long-term decline in vessel demand per MW installed caused by the increase in turbine size.

Figure 3 also shows a high short-term demand for supply chain CTVs. This is largely from a campaign to address problems with the grouted connection between the monopile and the transition piece. This has been a problem for a number of projects but we have assumed that it has been resolved in the design of current and future wind farms.

Service operation vessels

Figure 4 shows the demand for berths for SOVs (or vessels of a similar size). We assumed that each berth supports two SOVs. Demand ranges from one to two SOV berths, depending on the mix of projects. Given the port configuration and existing tenancy agreements in place, this berthing demand can only be met by using both the Inner and Outer Harbours. The Inner Harbour is limited to vessels with a draught of 6.0m and a beam of 22m but with some flexibility over the specific choice of vessel, this is unlikely to be a significant issue.

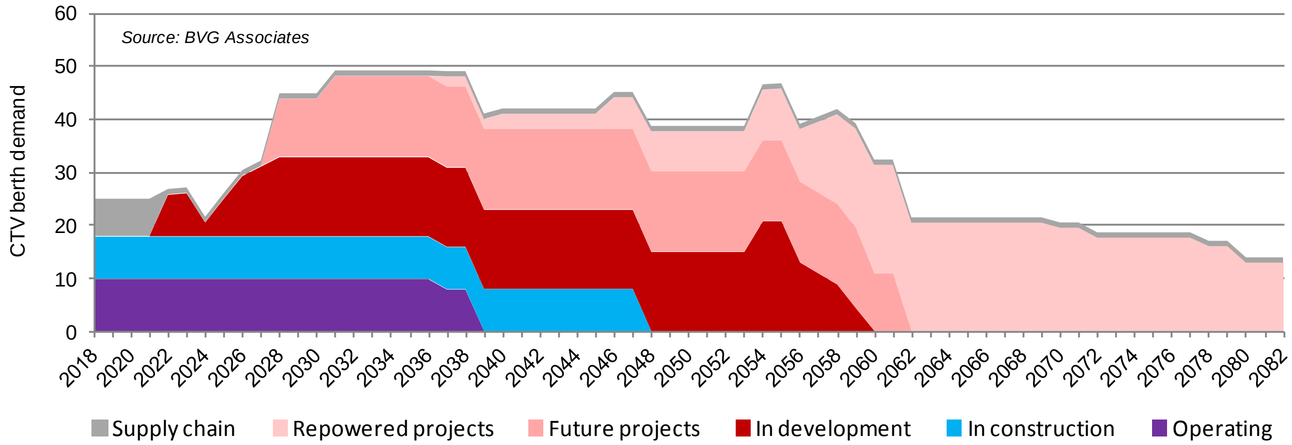


Figure 3 Berthing demand for crew transfer vessels from wind farms off the coast of East Anglia that could be met by the Port of Lowestoft. The high demand for supply chain berths to 2022 is to support foundation grout remediation work for Greater Gabbard wind farm.

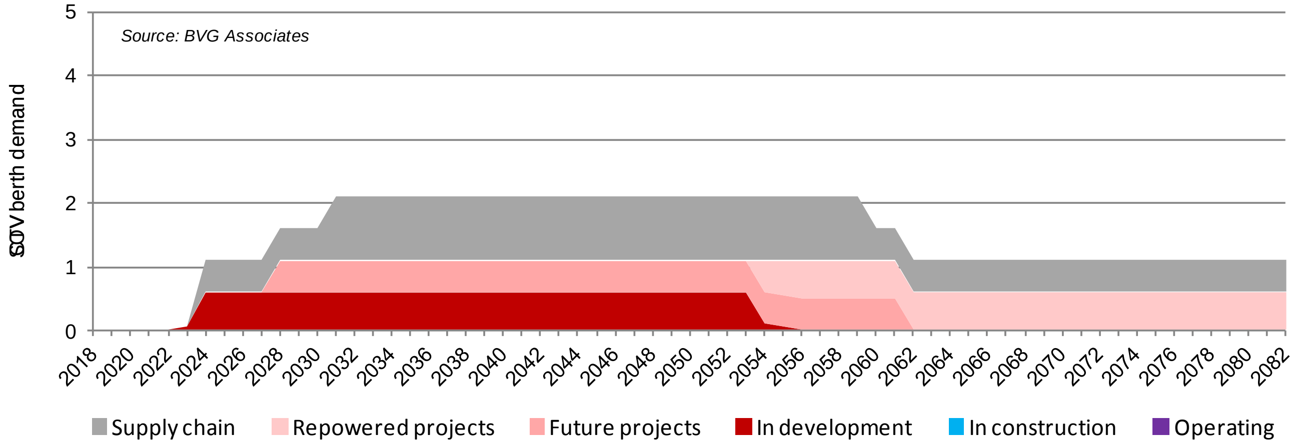


Figure 4 Maximum berthing demand for service operation vessels (or similar) from wind farms off the coast of East Anglia that could be met by the Port of Lowestoft.

4. The demand for port space in Lowestoft

This section explores the demand for space within the Port of Lowestoft created by the offshore wind industry.

The demand for port space will come from:

- East Anglia wind farms, and
- The wider industry supporting wind farms in the southern North Sea and English Channel as a whole.

4.1. East Anglia wind farm demand

Demand for port space from East Anglia wind farms is created because wind farm owners and their suppliers that access the wind farm daily need to be as close as possible to the wind farm location. We calculated demand by considering:

1. The wind farms that would need a base in East Anglia
2. The commitments made by owners to specific ports
3. The day-to-day activities at the base, and
4. The space needed by each activity.

East Anglia wind farms

Wind farms listed in Table 1 and Table 2 are those that would need a base in East Anglia.

Owner commitments

Vattenfall has signed a memorandum of understanding with Peel Ports Great Yarmouth (for their Norfolk Boreas and Norfolk Vanguard projects). In line with our approach to berth calculations, we assumed that all other projects listed in Table 1 and Table 2 create a demand for port space at Lowestoft.

Day-to-day activities

We identified a demand for the following activities that arises solely because of the presence of specific wind farms off the coast of East Anglia.

Wind farm operations

Wind farm operations involves a range of tasks associated with operating the wind farm:

- Administration
- Wind farm control
- Engineering
- Maintenance and logistics coordination, and
- Procurement.

Operations are undertaken by the wind farm operating company, which may be a wholly owned subsidiary of a power company (such as East Anglia ONE Ltd) or a joint venture (such as Greater Gabbard Offshore Wind Ltd). The operating company will procure all the products and services needed by the wind farm, although some large contracts, such as turbine service, may be managed by a parent company.

An operations base is likely to be dedicated to a specific wind farm, although an owner may seek to combine functions for different wind farms if they have the same ownership structure.

We estimate that the operations base for a large wind farm would be about 8,000m^2, which includes offices, storage and car parking and employs a team of about 30 (excluding service technicians who travel each day to the wind farm). This assumption is based on BVGA experience from a number of wind farms.

Turbine maintenance and service

Turbines are generally bought with a service agreement, which is typically five years but can vary from two years to 15 years. At the end of the agreement, the owner may extend the agreement, bring the service in house or, potentially, contract a third party provider.

The maintenance team is typically accommodated within the operations base. There are about 0.4 technicians per turbine.

Service providers will look for synergies with work on other wind farms wherever possible.

The turbine maintenance provider will procure health and safety and training services, and depending on the scope of the agreement, vessels, crew and fuel.

For major repair activities, the work will be based offshore with jack-up vessels or SOVs, depending on the nature of the work. In undertaking the work, contractors are likely to draw on other services from within the port, for example catering and fuel supply.

Vessel operation

CTVs are generally not owned and operated by the wind farm owner and it is more likely that long-term contracts (two to five years) will be awarded to a CTV operator (such as James Fisher in Lowestoft), which will provide crew and, usually, vessel support and maintenance services.

A CTV has a crew of two for two shifts. Allowing for holidays and sickness, there are usually five crew members per CTV in operation. The CTV berths will generally lie inside the footprint of the operations base. The CTV operator may need additional maintenance facilities with a dry dock. Additional CTVs will be brought in to meet peak demand or for use by the supply chain.

SOVs typically visit a port once every two weeks. This means there is no pressing need for local operational support. Fleet management can be undertaken anywhere and is generally inland.

Total space

The total footprint (gross plot area) of an operations base is generally around 8,000m^2 (0.8ha or 2.0 acres). We estimate that there is demand for about five additional operations bases at Lowestoft. (This depends on how future wind farms are built because extensions could, for example, be built as one large wind farm or three to four small ones). The total demand from these wind farms would therefore be about 40,000m^2 (4ha or 10 acres).

4.2. Wider industry demand

The southern North Sea and English Channel have seen significant wind farm development and this is likely to continue. The offshore wind industry therefore will create a significant demand for offshore wind services, which could operate out of the Port of Lowestoft. These 'wider market' opportunities cannot easily be associated with specific wind farms. It is possible that Lowestoft could be an attractive location, even if no further wind farms are built off the coast of East Anglia. Typically, these are activities that require port access but the demand for them from a single wind farm may only be for a few weeks or months.

To establish the demand for port space, we:

1. Identified the activities that could be attracted to the Port of Lowestoft
2. Prioritised those activities most likely to be attracted and the probability in each case, and
3. Researched the space required for each.

Activities

To establish which activities could be attracted to the Port of Lowestoft, we identified 40 types of activity involved in the construction, operation and decommissioning of offshore wind farms (see Appendix A). We excluded activities that involved the use of large vessels, such as jack-ups and heavy lift vessels, or the manufacture of equipment such as sea fastenings and blade racks used on such vessels because this activity is more likely to be accommodated in other ports that have more space and can be accessed by large deep-draughted construction vessels.

All investments are commercial decisions and a key factor is the land rent. For the purposes of this analysis, we assumed that rates at the Port of Lowestoft are competitive with those elsewhere.

As well as the specialised services to operate the wind farm, the operations base will also need generic business services such as hotel accommodation, travel, utilities and IT. We have assumed that these services will meet demand from a wide range of businesses in the town and there is unlikely to be any logic for locating these services in the port.

Prioritisation

Not all businesses that undertake these activities would consider or need facilities within a port. For each activity, we considered the:

1. Requirement for a permanent port location
2. The frequency of berth use and requirement for CTV use
3. Benefit of clustering at the Port of Lowestoft, and
4. The location of current suppliers.

1. Requirement for permanent port location

If there is no benefit from being located in the port, then it is unlikely that a company would seek premises in the Port of Lowestoft. Any company that does locate in the port will, however, create indirect local jobs outside the port.

2. The frequency of berth use and requirement for CTV use

If the activity uses CTVs regularly, it is more likely to be attracted by a location in the Port of Lowestoft because of the inefficiencies of moving personnel and equipment from inland locations on a regular basis.

3. Benefit of clustering at the Port Lowestoft

Clustering benefits companies by helping them build relationships with customers, partners and suppliers. It also enables companies to share facilities and lowers the barriers to investment by the supply chain.

4. The location of current suppliers

The opportunity for Lowestoft will depend on whether companies already have port facilities, either to help them meet demand from offshore wind or from other sectors such as oil and gas.

Using these criteria, for each scenario, we ranked activities that could form part of a Lowestoft cluster as being high, medium or low probability opportunities, where

- High probability (H) = 60% likely
- Medium probability (M) = 35% likely and
- Low probability (L) = 10% likely.

Using these probabilities, we calculated a weighted overall demand for space. This method is not intended to indicate the land demand arising from any one supply chain activity, rather the exercise has been undertaken to provide an estimate of supply chain activities as a whole.

Space required

The demand for space for each activity will be variable and will depend on the size of the business, its ambition, the location of its headquarters and to what extent it undertakes more than one activity from the location. We researched space requirements by considering the premises of companies that undertake these activities currently and this research forms that basis of our typical port space requirements assumptions for each activity.

Results

From the initial list of 40 activities, we identified 16 activities for further consideration and these are described below and summarised in Table 3.

1. Above-water asset inspection

Above water asset inspections will monitor the foundation and its coating above the water line, including the platform, and the tower. Inspection providers will probably not operate their own vessels but may work in partnership with a vessel operator. Companies will expect to work offshore regularly and would benefit from a port location, although this service is likely to be one of a number of services they offer and their main offices need not be within the immediate area of the port, although such a location would be preferable. Within the port, it would need access to a 20m quayside to be used by a vessel.

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

A supplier offering above-water inspections alone would need a facility for office space, storage and parking of a combined area of about 1,200m^2 and employ 12-15 people.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

2. Autonomous underwater vehicle operation

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

Suppliers would benefit from a port location, particularly if many of its customers were users of the port. Customers could be the wind farm owner or contractors inspecting subsea assets, including cables. Within the port, the supplier would need some office space, storage and parking with a combined area of 1,200m^2 and would employ 15-20 people. An AUV could be launched from a CTV and a supplier would probably use a berth provided by the wind farm owner.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

3. Blade inspection and repair

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

Providers do not need quayside access and are likely to travel on vessels provided by the wind farm owner or chartered directly from vessel owners.

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 owner, or the turbine service contractor.

A supplier would need back office storage requirement for rigging and a small administration office. Within the port, the supplier would need some office space, storage and parking with a combined area of 1,100m^2 and would employ 15-20 people. A supplier would access the turbine from a CTV and it would probably use a berth provided by the wind farm owner.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

4. Cable repair

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 to undertake cable repairs. The scope of work would usually involve the supply of the joint and 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.

The cable repairer would have office space for administration, a workshop and covered storage and parking, covering about 1,600m^2. A provider might employ 25-30 people.

The industry will see the development of specialist cable repair service operations and this may see partnerships between marine contractors and cable manufacturers or independent providers.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

5. Catering

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.

A supplier would need a facility about 1,200m^2, covering offices, preparation area, storage and parking and employ 20-30 people. Many of these could be temporary staff to enable the company to be flexible to meet demand.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

6. Corrosion protection and repair

Contractors will address corrosion above and below the water line. For work above the water line, access could be made by CTV or SOV, while below the water level the work is likely to involve the use of ROVs and potentially divers deployed from a specialist DP2 vessel (a vessel that is able to stay in the same place using a combination of bow thrusters, rudders and propellers, all coordinated by computer).

The work is most likely to be contracted by the wind farm owner. A port location would be attractive in terms of the relationships it would enable with customers and from providing easy access to the wind farms. Within the port, the supplier would need office space, storage and parking with a combined area of about 1,100m^2 and would employ 15-20 people. It would need access to a 20m quayside.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

7. Drone operation

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.

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 owner, the turbine service contractor, or the owner of the substation or its main maintenance contractor.

Within the port, the supplier would need office space, storage and parking with a combined area of 1,100m^2 and would employ 15-20 people. A drone could be launched from a CTV and a supplier would probably use a berth provided by the wind farm owner.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

8. Environmental surveys

There is a significant 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. CEFAS is already a major employer in Lowestoft and has space inside the port. It employs about 520 at its Pakefield Road site in Lowestoft. It is likely to support about 50 local supply chain jobs also.

A new investment in facilities for environmental surveys is likely to need 1,100m^2.

There is a high probability that this company type would be interested in a location in the Port of Lowestoft.

9. Fuel bunkering

Fuel can be provided by pumps at the quayside, 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.

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

A fuel supplier is likely to need fuel storage facilities, office space and parking, with a combined area of about 1,250m^2. It is likely to need access to a 60m quayside.

There is a high probability that this company type would be interested in a location in the Port of Lowestoft.

10. Marine and maintenance coordination

Offshore construction coordination and the coordination of maintenance 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 there 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.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

11. ROV operation

Remotely operated vehicles (ROVs) are used for subsea inspection. They may be provided by the subsea asset inspection service (see below) 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 owner or contractors inspecting subsea assets, including cables. A supplier would need a facility about 1,250m^2, covering offices, preparation area, storage and parking and employ 20-30 people.

There is a high probability that this company type would be interested in a location in the Port of Lowestoft.

12. Subsea asset inspection

Subsea asset inspections 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 the port, its facilities would need to accommodate a dynamically positioned vessel of about 60m in length.

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

A supplier would need a facility about 1,150m^2, covering offices, preparation area, storage and parking and employ 12-15 people.

There is a medium probability that this company type would be interested in a location in the Port of Lowestoft.

13. Training and medical provision

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 to these providers given the benefits of being close to customers.

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

A supplier would need a facility about 1,000m^2, covering offices, preparation area, storage and parking and employ 10-20 people.

A facility in the Inner Harbour to the west of the existing bascule bridge would be feasible.

There is a high probability that this company type would be interested in a location in the Port of Lowestoft.

14. Turbine cleaning

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 if local bird populations use the turbine platform and it would be beneficial for a company providing cleaning services to be based within the port. A company would probably employ three to five people in an office and workshop of about 500m^2.

There is a high probability that this company type would be interested in a location in the Port of Lowestoft.

15.Vessel maintenance

If there is a large fleet of CTVs using the Port of Lowestoft, it is likely to create demand for third party boat maintenance services. Lowestoft already has a vessel maintenance facility owned by SMS, which employs about 15 people and covers an area of 4,000m^2, including a dry dock. Windcat Workboats undertakes its UK vessel maintenance in a dedicated facility at the Lowestoft Haven Marina.

A further facility is unlikely within the port but the existing facilities are likely to be used by new tenants.

16. Waste services

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.

A supplier would need a facility about 1,000m^2 and employ 10-20 people. It would need to have lorry access and the site could be shared with a fuel bunkering service.

There is a high probability that this company type would be interested in a location in the Port of Lowestoft.

Summary of wider industry demand

Table 3 summarises the results of the analysis. It shows that if all the wider industry demand activities were undertaken in the Port of Lowestoft, about 19,750m^2 (2.0ha or 4.9 acres) would be needed. Given that that investment would be incremental and that an optimal layout is unlikely, it is reasonable to assume that about 22,000m^2 (2.2ha or 5.6 acres) of space would be needed.

A total weighted demand for space, calculated using the probability percentages identified earlier in this section, is about 9,400m^2 (0.9ha or 2.4 acres).

Summary of the overall demand for port space in Lowestoft

We have calculated in section 4.1 that the demand for five operations bases for an East Anglia wind farm would require about 40,000m^2 (4ha or 10 acres).

Combining the demand from East Anglia wind farms and from activities to support the wider industry, the total unweighted demand is 6.2ha (15.6 acres). The total weighted demand is 4.9ha (12.4 acres).

The potential area available in the Inner Harbour is about 10ha or 25 acres. With investment likely to be incremental, an optimal port layout is unlikely. Even so, the Inner Harbour of the Port of Lowestoft should be able to meet anticipated demand from the offshore wind industry.

Table 3 Prioritised activities that can access the wider offshore wind market, the probability that they will occur and the port space required.

Activity	1. Requirement for permanent port location	2. Frequency of offshore activity	3. Benefit of clustering at Lowestoft	4. Current supplier locations	Typical port space required (m^2)	Probability of Lowestoft interest	Weighted port space required (m^2)
1. Above-water asset inspection	No	Less than weekly	Medium	Industrial estate	1,200	M	420
2. Autonomous underwater vehicle operation	No	Weekly	Medium	Industrial estate	1,200	M	420
3. Blade inspection and repair	No	Weekly (seasonal)	High	Industrial estate	1,100	M	385
4. Cable repair	No	Less than weekly	Medium	Industrial estate	1,600	M	560
5. Catering	No	None	Medium	Industrial estate	1,200	M	420
6. Corrosion protection and repair	No	Weekly (seasonal)	High	Industrial estate	1,100	M	385
7. Drone operation	No	Weekly	Medium	Industrial estate	1,100	M	385
8. Environmental surveys	No	Daily (for periods)	Low	Industrial estate	1,100	H	660
9. Fuel bunkering	Yes	Daily	Low	Port	1,250	H	750
10. Marine and maintenance coordination	No	None	High	Industrial estate	0	M	0
11. ROV operation	Yes	Weekly	Medium	Industrial estate	1,250	H	750
12. Subsea asset inspection	No	Less than weekly	High	Industrial estate	1,150	M	402.5
13. Training and medicals provision	Yes	None	High	Port or industrial estate	1,000	H	600
14. Turbine cleaning	Yes	Weekly	Medium	Industrial estate	500	H	300
15. Vessel maintenance	Yes	Less than weekly	High	Port	4,000	H	2400
16. Waste services	Yes	None	Low	Port	1,000	H	600
Total					19,750		9,437.5

5. Job creation

We calculated job creation by researching the number of people that would be employed for each of the activities identified in the previous section. We then used the probabilities of the activities occurring at Lowestoft as a means of estimating the number of jobs created and the time at which those jobs are created. As for the port space area analysis, job creation from different activities was judged to be:

- Assumed = 100% likely
- High probability (H) = 60% likely
- Medium probability (M) =35% likely, or
- Low probability (L) = 10% likely.

Jobs can be:

- Direct (assumed here to be those working for the wind farm owner or large contractors, such as the wind turbine supplier)
- Indirect (assumed here to be those working elsewhere in the supply chain), and
- Induced (those created from the expenditure of direct and indirect workers).

Our analysis of port space focused on the supply chain activities that need to be undertaken within the port. Companies of all kinds draw on a range of local services, which includes finance and administration, PR, accommodation, travel and consultancy. We assumed that for every job created in the port (either direct or indirect), a further 0.1 of an indirect job was created elsewhere in the town. We assumed that for every direct and indirect job, a further 0.05 of an induced job was created in the town. These assumptions are consistent with Government guidance.[4]

Table 4 shows that about 1,100 offshore wind jobs could be supported in Lowestoft as a result of investments in the port. It does not purport to show the number of jobs arising from each activity. Instead, by weighting the figures by probability, it provides an estimate of the number of jobs arising across the wind industry activities through the supply chain and operational bases. Most of the jobs created will be during the operational phase. The job creation during the construction and decommissioning periods are significant, but these are transient and it is investments to meet demand from operational activities that will have the biggest impact on jobs.

Table 4 The number of jobs created by each activity weighted by probability.

Activity	Probability	Weighted Jobs
1. Above water asset inspection	M	5
2. Autonomous underwater vehicle operation	M	6
3. Blade inspection and repair	M	6
4. Cable repair	M	10
5. Catering	M	9
6. Corrosion protection and repair	M	6
7. Drone operation	M	6
8. Environmental surveys	H	0
9. Fuel bunkering	H	6
10. Marine and maintenance coordination	M	4
11. ROV operation	H	11
12. Subsea asset inspection	M	5
13. Training and medicals provision	H	9
14. Turbine cleaning	H	2
15. Vessel maintenance	H	24
16. Waste services	H	9
New operations base (at peak)	Assumed	819
Additional indirect (at peak)	-	93
Induced (at peak)	-	51
Total (at peak)		1,081

[4] Additionality Guide. Fourth Edition, Homes and Communities Agency, 2014. Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/378177/additionality_guide_2014_full.pdf

Jobs from local wind farm opportunities will depend on the timing of specific projects. Jobs from the wider market opportunity will depend on the speed of development in the southern North Sea. Generally, high probability opportunities are likely to be realised first, we assume these investments in the port will occur in the years 2023-2025. This is followed by medium probability opportunities in the years 2026-2028 and low probability opportunities in the years 2029-2031.

Figure 5 shows that the number of jobs created in Lowestoft peaks in the mid-2030s. After this, the numbers fall to about 1,000 because the larger turbines used require fewer technicians per MW. About 75% of the jobs are direct, that is those employed by the wind farm owner, the turbine service contractor (usually the wind turbine supplier) or the vessel operator. Most of the remainder are indirect, either working for suppliers in the port or in the town more widely.

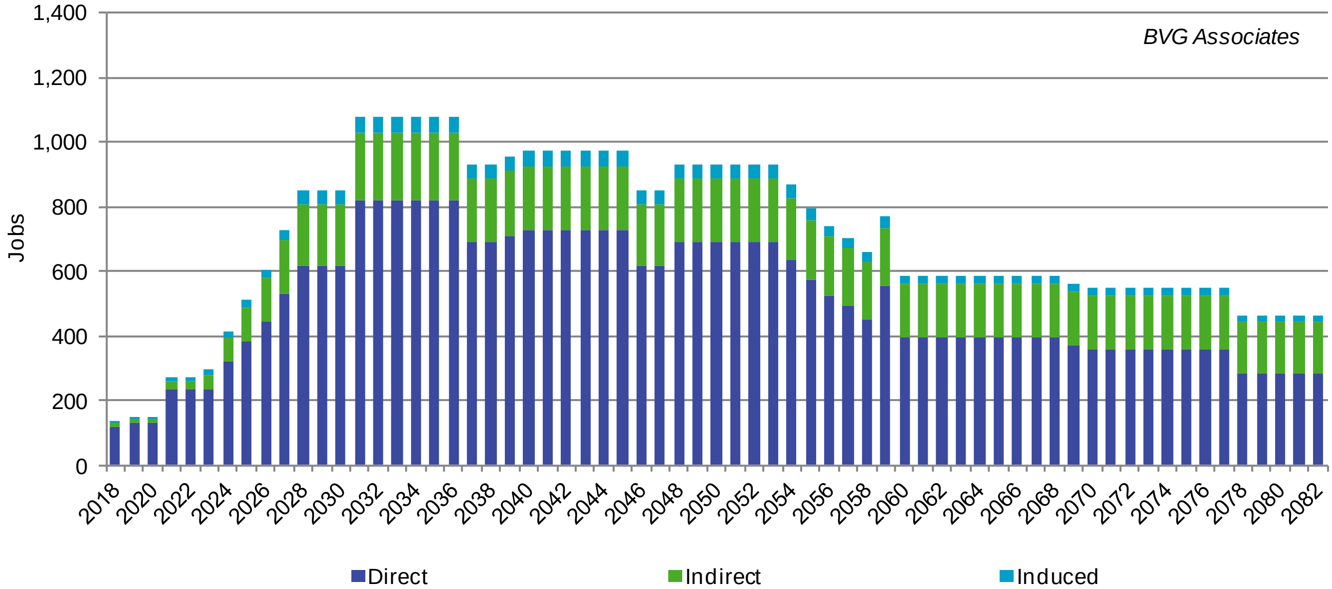


Figure 5 Offshore wind jobs (FTE years per year) created in Lowestoft by probability between 2018 and 2082. The figures are weighted by probability.

6. Impact of the Lake Lothing Third Crossing

6.1. Demand for vessel berths at Lowestoft

Suffolk County Council is proposing a new bascule bridge across Lake Lothing. The bridge will have an air draught of 12m (less a safety margin to be determined) above highest astronomical tide and a minimum width of 32m between bridge pier fenders.

ABPmer has researched the potential for the proposed bridge to interact with vessel movements through a requirement for bridge opening[5]. In particular, the research considered whether the bridge would need to be opened for CTV traffic, since it is this type of vessel which is involved in the most time-critical wind farm operations and therefore has the potential to be most impacted by delays introduced by waiting for bridge openings. The study by ABPmer found that larger CTVs would require the bridge to be opened: for some large CTVs this would only be necessary at high water, whereas for others (especially those with whip aerials), would require the bridge to be opened at all states of the tide. The research also shows a trend towards increasing CTV size and it is anticipated that the frequency with which bridge openings will be required will also be increased over time by sea level rise.

Having determined the proposed new bridge would require opening for some CTVs (and therefore increase vessel journey times), ABP held interviews with offshore wind customers to understand the willingness of investors to take berth space to the west of the proposed SCC bridge. It was found that appetite for sites to the west of the new bridge would be substantially depressed due to the risk of CTV delay caused by bridge lifts. We have independently investigated this issue through discussion with our own industry contacts and have arrived at the same conclusion as ABP.

The extent to which the bridge could limit the future offshore wind related business that might otherwise be expected to be based in the Port, depends on the layout of the Port and in particular, where CTV berths are available. We held discussions with ABP with the findings summarised below and in Figure 6. The Outer Harbour has capacity for 26 CTV berths (assuming vessel length 23m), of which 10 are situated in Hamilton Dock and 16 in Trawl Dock. The Outer Harbour is currently close to capacity with existing berthing commitments for Greater Gabbard (Trawl Dock) and East Anglia ONE (Hamilton Dock)

The Inner Harbour has capacity for 18 CTV berths (assuming vessel length of 23 m) on Shell Quay. In future (assuming no new bridge), we understand that up to 26 berths could be created along the western sections of North Quay without adversely impacting existing operations. However, the eastern end of North Quay, Silo Quay and Town Quay cannot be utilised for permanent CTV berthing, owing to existing long-term tenancy agreements and to port operational requirements (such as retaining usage of the deep water berth on Town Quay).

On the basis of the above information from ABP, future demand for CTV berths (which analysis provided in this report shows may be up to 50 berths; see Section 3.7) has to be accommodated in the Inner Harbour as the Outer Harbour is already very close to full capacity. Under a no new bridge scenario, most of this demand would be met through berths at Shell Quay (which can provide up to 18 berths) and towards the middle or western end of North Quay (which can provide up to 26 berths) (see Figure 6). However, with a new bridge in place, there will be very limited demand for this space to the west of the new bridge from owners or their supply chains.

[5] Overview of CTV Characteristics (R.2006TM), ABPmer, 2018)

Figure 6 Existing CTV berthing areas at the Port with a new bridge at SCC's preferred location.

Given the lack of available quays for CTV berthing between the new bridge and existing bascule bridge, this effectively means that CTVs could only be accommodated in the Outer Harbour, which provides only 26 CTV berths (Figure 7). This could be up to 24 berths less than the anticipated demand (Figure 8) and it follows that this business would go to competitor ports, with a consequent effect on jobs creation and GVA in Lowestoft.

The anticipated demand for CTV berths if the new bridge were to be built is shown in Figure 9. However, the impact of the bridge would largely be confined to those projects and activities relying on the use of CTVs in time critical operations: those projects utilising SOVs would, for the most part, be unaffected as small delays introduced by bridge openings would have less impact on operations.

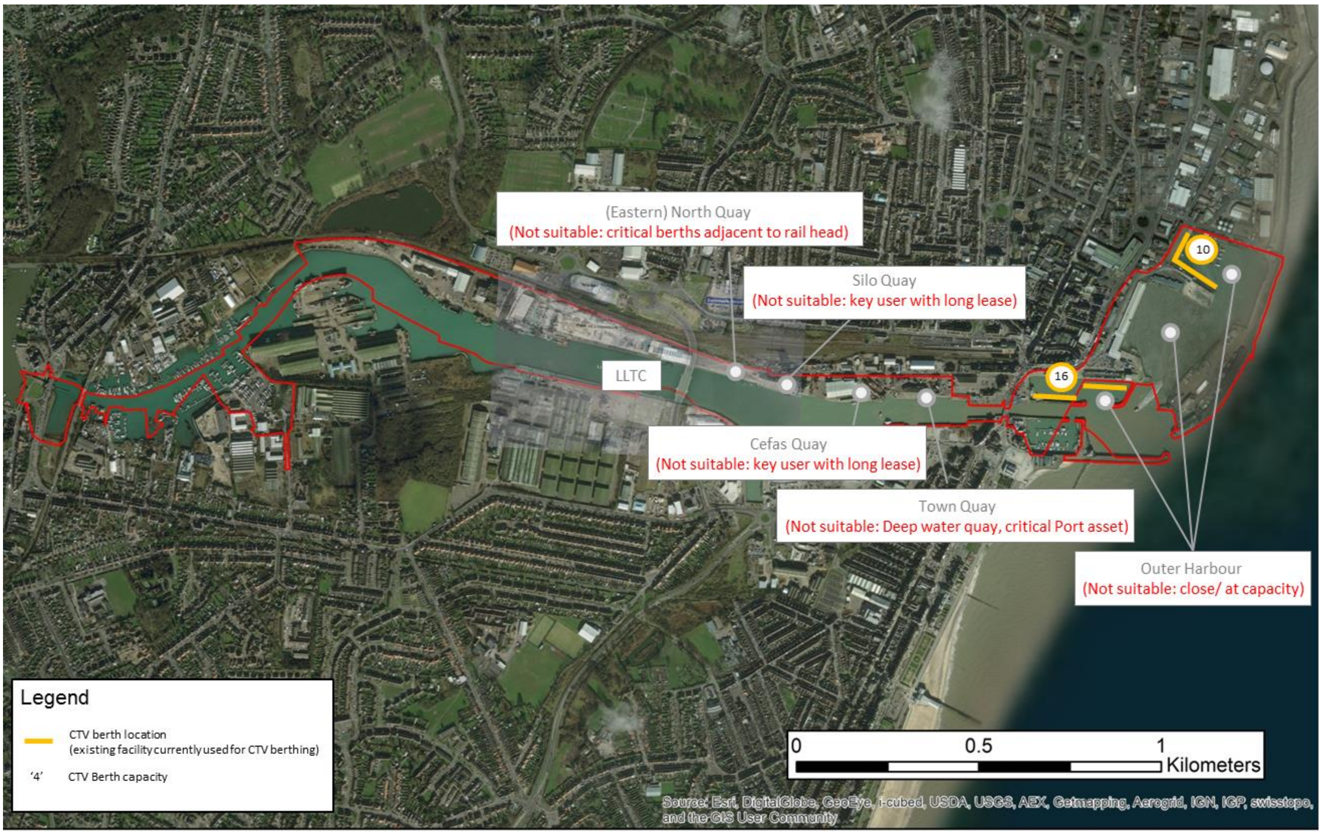


Figure 7 Suitable areas for new CTV berthing at the Port with a new bridge at SCC's preferred location.

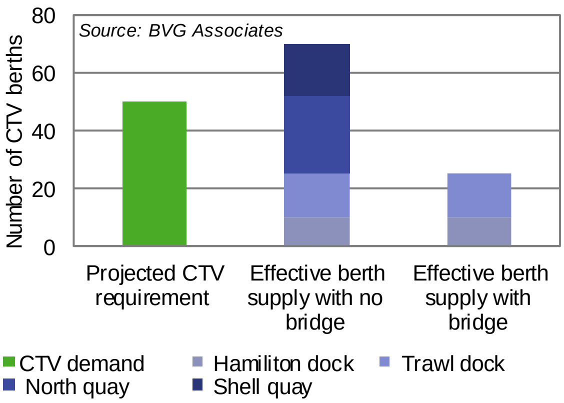


Figure 8 Berth capacity with and without the new bridge.

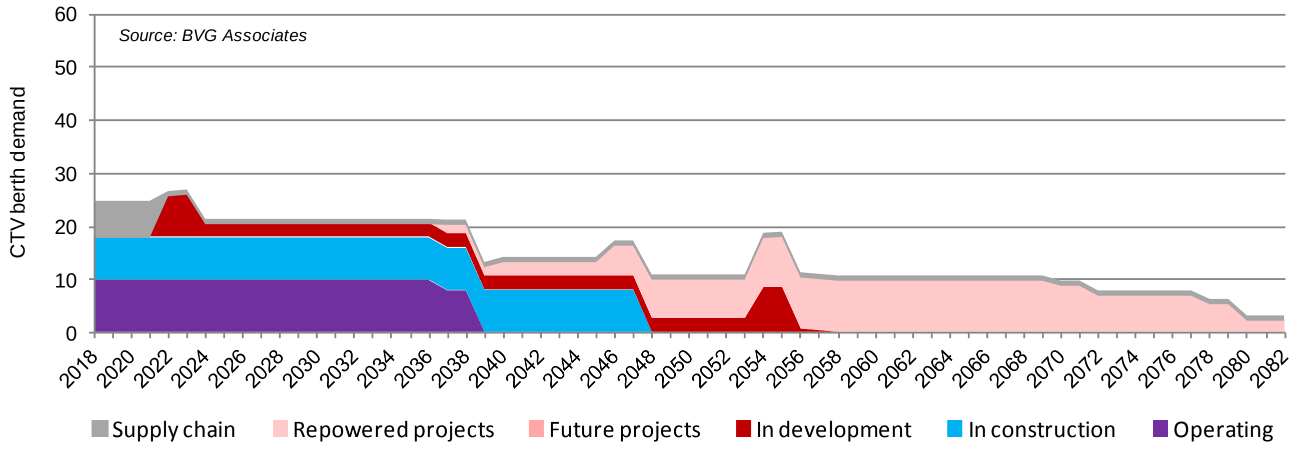


Figure 9 Demand for CTV berths if the Lake Lothing Third Crossing is built. The high demand for supply chain berths to 2022 is to support foundation grout remediation work for Greater Gabbard wind farm.

6.2. Demand for port space and jobs created

Any suppliers that needed regular access to vessels (especially CTVs) would be deterred by the presence of second bridge in SCC's preferred position. Given that vessel access would be one of the main drivers for investment at the port, we concluded that only low probability opportunities were viable if the activity needed CTVs. These were primarily those activities for which relationships with their customers were crucial and for which personnel and equipment could be readily moved by road within the port. The two bridges combined would risk significant delays in reaching open water. In theory, some administrative functions could be undertaken in a separate facility west of a second bridge if space is constrained. Table 5 shows how the probability of investment is reduced for most activities.

Table 5 Impact of the Lake Lothing Third Crossing on the probability of suppliers investing in the Port of Lowestoft (jobs and space).

Activity	No new crossing			New crossing		
	Probability	Weighted space (m^2)	Weighted Jobs	Probability	Weighted space (m^2)	Weighted Jobs
17. Above water asset inspection	M	420	5	M	420	5
18. Autonomous underwater vehicle operation	M	420	6	L	120	2
19. Blade inspection and repair	M	385	6	L	110	2
20. Cable repair	M	560	10	M	560	10
21. Catering	M	420	9	M	420	9
22. Corrosion protection and repair	M	385	6	L	110	2
23. Drone operation	M	385	6	L	110	2
24. Environmental surveys	H	660	0	M	385	0
25. Fuel bunkering	H	750	6	M	438	4
26. Marine and maintenance coordination	M	0	4	M	0	4
27. ROV operation	H	750	11	M	438	6
28. Subsea asset inspection	M	402.5	5	M	403	5
29. Training and medicals provision	H	600	9	M	350	5
30. Turbine cleaning	H	300	2	M	175	1
31. Vessel maintenance	H	2400	24	M	1,400	14
32. Waste services	H	600	9	M	350	5
New operations base (at peak)	Assumed	40,000	819	Assumed	6,913	251
Additional indirect (at peak)	-	-	93	-	0	32
Induced	-	-	51	-	0	18
Total		49,437.5	1,081	0	12,702	377

6.3. Offshore wind sector jobs implications of the SCC bridge

Figure 10 shows the jobs supported by the offshore wind sector if a bridge is built at SCC's preferred location. The number of baseline jobs is significantly reduced, and based around the existing wind farm owners that are already committed to Lowestoft. The jobs associated with the wider opportunity from offshore wind in the southern North Sea are also significantly reduced, and the probability that the jobs come to Lowestoft is lower, and as a result come later. Compared with about 1,100 jobs if no bridge is built, less than a third of this number are created.

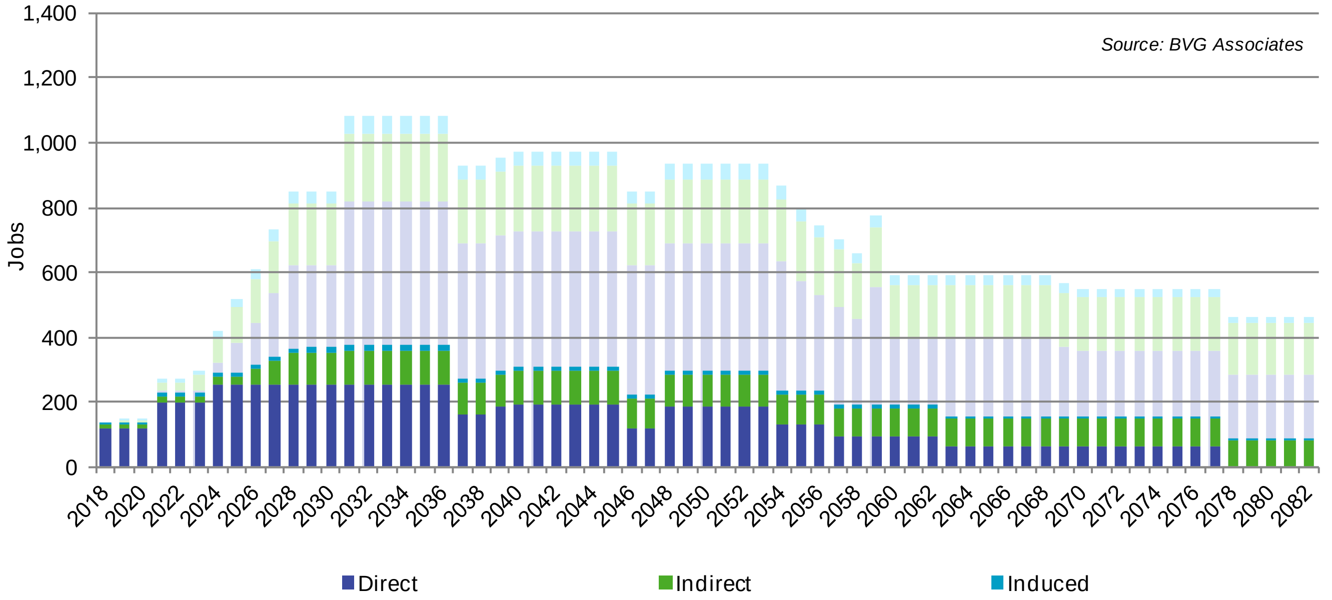


Figure 10 Offshore wind jobs (FTE years) created in Lowestoft by probability between 2018 and 2082 if a bridge at SCC's preferred location is built. The figures are weighted. The data for the without bridge scenario is shown behind.

7. Discussion and conclusions

The Port of Lowestoft is well located to benefit from the significant offshore wind developments that are likely to take place in the 2020s. Even for wind farms that may use other ports as their primary construction and operational bases – for example, ports closer to the more northerly East Anglia offshore wind farms – Lowestoft would still be a logical location to base some activities involved in the construction, operation and decommissioning of offshore wind farms.

BVGA estimates that the offshore wind sector will require up to 4.9 ha of land at the Port of Lowestoft, with the potential to create up to about 1,100 direct, indirect and induced jobs as a result.

The opportunity for the Port of Lowestoft comes primarily from the operational phase of the wind farms. Some of the demand will be for activities directly associated with wind farms off the coast of East Anglia; the rest will be to meet demand for services to wind farms in the southern North Sea, not all of which will be in UK waters. Companies may be attracted to Lowestoft because the supply chain for operational services is still maturing, with the result that many suppliers have not yet made strategic decisions on the best location for their operations as they seek to grow their market shares.

Both types of activity would be affected by the proposed Lake Lothing Third Crossing. There is little space in the Outer Harbour of the port for further offshore wind tenants, and so for Lowestoft to attract new tenants to the port, the Inner Harbour needs to be used. If the proposed LLTC is located such that all new offshore wind tenants in the port have to be located to the west of the new bascule bridge then response and transit times to the wind farm will be increased. This will lead to lost revenue through greater turbine downtime and increased costs because of the time spent reaching the wind farm site.

The reduced revenue and additional cost associated with this scenario is likely to mean that Lowestoft is no longer attractive to most of the new offshore wind tenants, although it may be possible to locate a few activities to the west of a new crossing if they do not need regular quayside access. The Lake Lothing Third Crossing therefore represents a potentially serious threat to the attractiveness of the Port of Lowestoft for the off-shore wind sector.

This analysis has taken a conservative view of the demand for the Port of Lowestoft. The following pragmatic assumptions were made:

- Future offshore wind farms are assumed to use a combination of vessel strategies
- Any agreements between wind farm owners with port owners are assumed to endure (for example Vattenfall will use Great Yarmouth for the operational bases of its projects and any extensions or repowering for the Galloper wind farm will use Harwich as its operational base).
- The analysis does not assume that the Port of Lowestoft attracts all parts of the supply chain. The study considered 40 activities, of which 16 were considered for further analysis. The job creation and space requirements for Lowestoft were calculated using a probabilistic approach in which no activity was more than 60% likely.
- The analysis does not assume that the LLTC deters all investments in the Inner Harbour. It assumes that East Anglia THREE can use the Inner Harbour because SOVs only need access to a berth once a fortnight. Some supply chain investments are also assumed to be possible if berthing requirements are infrequent or if equipment can be moved easily within the port.
- The analysis assumes that two SOVs can share a berth. In practice, this will depend on wind farm owners coming to agreements on the scheduling of SOV visits and shared access to the berths.

Appendix A: Offshore wind activities

- Above water asset inspection services
- Ad-hoc fabrication
- AUV operators
- Blade inspection services
- Blade repair services
- Cable inspection services
- Cable jointing
- Cable repair services
- Cable storage
- Catering
- Chandlery
- Communications
- Consultancy
- Corrosion protection and repair
- Crewing services
- CTV maintenance boat yard
- CTV operation
- Drone operators
- Environmental Monitoring / Surveys
- Fuel bunkering
- Generator/power supply
- Grouting remediation services
- Helicopter services
- IT Support
- LiDAR maintenance
- Lifting, climbing & safety equipment inspections
- Main component replacement
- Marine surveyors
- Metocean services
- PPE and safety equipment
- Refurbishment of main components and larger spares
- Rope access services
- ROV operators
- SAP and marine coordination
- SCADA and condition monitoring services
- Scour inspection services
- Shipping services
- Subsea asset inspection services
- Substation electrical maintenance
- Training providers and medicals
- Turbine cleaning and guano removal
- Turbine commissioning
- Turbine consumables and parts
- Turbine maintenance
- Waste services