

Offshore Wind Industry Council



Strategic review of UK east coast staging and construction facilities

A report by BVG Associates for the Offshore Wind Industry Council

August 2016

Document history

Revision	Description	Circulation classification	Authored	Checked	Approved	Date
1	For release	Client discretion	CLW	BAV	BAV	20 Jul 2016
2	For release	Client discretion	CLW	BAV	GEH	3 August 2016

BVG Associates

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- Market leaders and new entrants in wind turbine supply and UK and EU wind farm development
- Market leaders and new entrants in wind farm component design and supply
- New and established players within the wind industry of all sizes, in the UK and on most continents, and
- Department of Energy and Climate Change (DECC), RenewableUK, The Crown Estate, the Energy Technologies Institute, the Carbon Trust, Scottish Enterprise and other similar enabling bodies.

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Front cover image courtesy of DONG Energy

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Executive summary

The review

On 9th February 2016, the Minister of State for Energy Andrea Leadsom announced in the House of Commons a strategic review to identify opportunities to develop the east coast as a staging and construction hub for the UK and European offshore wind industry.¹

This review was undertaken to support the work of the Offshore Wind Industry Council (OWIC). It was undertaken by BVG Associates on behalf of the jointly-led industry and government review team that was set up to conduct this investigation. It is not a statement of Government policy. As well as providing a detailed review of UK east coast port capability, this report considers three main questions:

- Is there demand for more staging capacity in UK east coast ports?
- How has the UK Supply Chain been stimulated by offshore wind?
- What options are there for unlocking greater levels of UK supply chain industrialisation?

In this document, we refer to two separate types of activity, which have different port requirements.

- **Staging:** this activity covers the storage and loading of offshore wind farm components onto vessels before final delivery to site for installation. This may also involve a range of pre-construction activities that take place in the port to minimise the amount of offshore work. Depending on the location and strategy of the developer, a project may choose to install components directly from manufacturing facilities.
- **Manufacturing:** in this context, this activity refers to the production of large offshore wind farm components in or near a port. These may be turbine nacelles, blades, towers, foundations, array cables, export cables or offshore substations (topsides or foundations). This has previously been referred to as *construction*.

Other offshore wind-related port activities, such as those involved during the long term operation and maintenance (O&M) phase, have not been considered in this study.

Methodology

This report is based on extensive consultation involving interviews with more than 50 project developers, suppliers, central and regional government agencies and port owners.

We undertook structured interviews to ensure the most consistent and comprehensive dialogue. The interviews were conducted in accordance with pre-defined confidentiality principles in which all feedback was anonymised or aggregated, unless specific permission was obtained. This approach resulted in interviewees giving open and honest responses on commercially sensitive issues.

Following the consultation, we undertook a thematic analysis of consultee feedback and drafted summary findings and conclusions.

These were discussed with the review team in workshops to gather their further feedback before the preparation of this report.

What is the capability of UK east coast ports to accommodate staging and manufacturing?

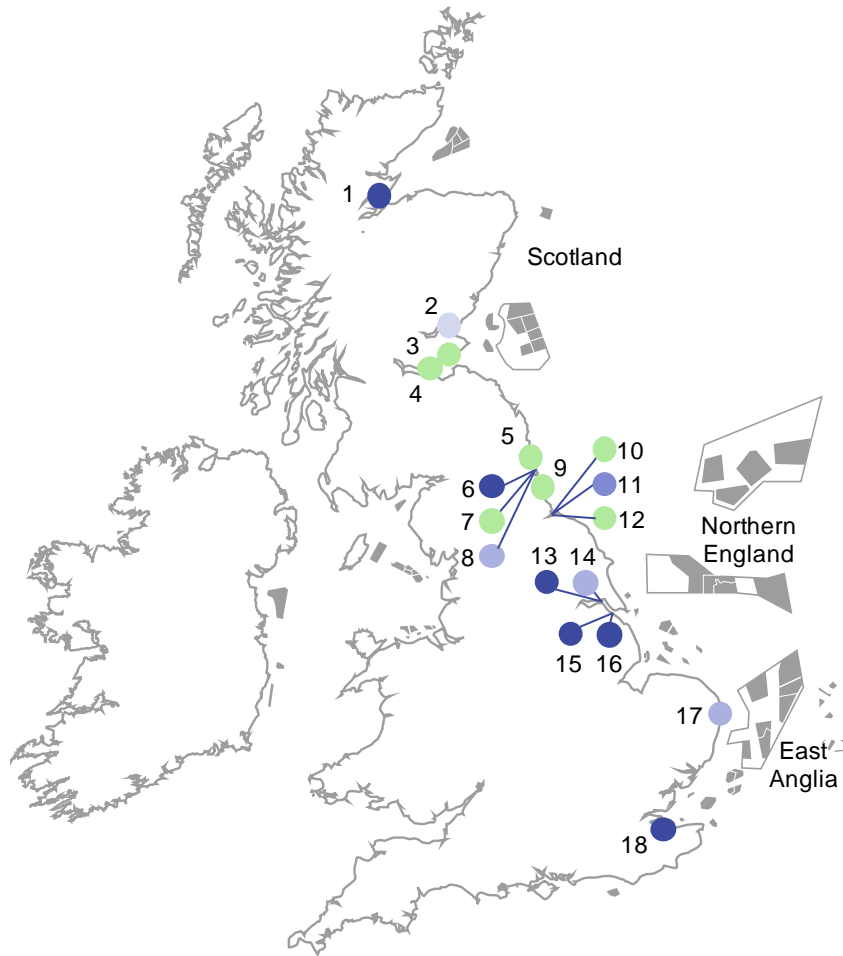
As part of the study, we assessed 23 east coast port locations. This involved comparing the capability of each port against a defined set of requirements that had been validated by industry. We gathered feedback from each port owner about its current facilities and the costs and timescales of any investment needed to upgrade the port to meet a range of industry requirements.

This study identified that offshore wind has already stimulated strong levels of investment in east coast ports. Over the last five years, owners of ten east coast ports have spent or committed more than £400 million on facilities that are either exclusively or partially focused on capturing offshore wind activity.² This is in addition to investment that has been made in west coast staging and manufacturing facilities, such as Belfast and Mostyn, and in 23 facilities located around the UK's coastline providing O&M services.

More than half of this investment has been speculative, based on the port owners' assessment of the potential opportunity from offshore wind and other sectors. The rest has been stimulated by firm contractual commitments by offshore wind players.

¹ DECC, *East Coast Review: Terms of reference*, May 2016, available online at <https://www.gov.uk/government/publications/east-coast-review-of-construction-and-staging-terms-of-reference>, last accessed July 2016.

² Based on consultation feedback from port owners.



1	C	Nigg Yard
2	S	Dundee
3	M	Methil
4	M	Rosyth
5	M	Blyth
6	C	North Shields
7	M	Wallsend
8	S1	Neptune Energy Park
9	M	Sunderland

10	M	Hartlepool
11	S2	Seaton
12	M	Middlesbrough
13	C	Alexandra Dock (Hull)
14	S1	Albert Dock (Hull)
15	C	Killingholme
16	C	Immingham
17	S1	Great Yarmouth
18	C	Sheerness

Map of headline regions and UK east coast ports (M - Manufacturing only, S - Staging only, S1 - Staging plus one manufacturing activity, S2 - Staging plus two manufacturing activities, C – Staging/manufacturing cluster).

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As shown in the map above, the study identified eleven east coast ports with the capability to accommodate turbine staging activity for one large project a year, almost half of which could be used with minimal further investment. Of these eleven, ten³ could also accommodate at least one manufacturing activity at a run rate sufficient for 100 turbines per year, and seven⁴ could accommodate two such manufacturing activities. Of these, six⁵ could accommodate a staging and manufacturing 'cluster', defined as a site with the capability to accommodate the staging activity of two large wind farm projects per year and also with enough contiguous land to support three manufacturing activities. It is noted that the staging area in Alexandra Dock at Hull (13) is under a long term lease to Siemens Wind Power so there are likely to be significant commercial challenges if a developer sought to use the facility to stage turbines from other suppliers, making this unlikely.

A further seven ports were also identified that did not meet the staging requirements defined by this study but could, however, host one or more manufacturing activities.⁶

Other ports that were reviewed but did not meet the requirements used in this study for either *Staging only* or *Manufacturing only* were Invergordon, Aberdeen, Montrose, Tees Dock and Lowestoft. This finding does not preclude these ports winning other offshore wind-related activity, which is in some cases already taking place.

Is there demand for more staging capacity in UK east coast ports?

To date, the UK has installed 5GW of offshore wind capacity and there are a further twelve projects with a total capacity of 5.2GW that are either under construction or have passed their final investment decision so that they will be built out by the end of 2020. Assuming the industry maintains its progress in reducing its levelised cost of energy (LCOE), industry expects the UK to achieve the Government's ambition of installing another 10GW of

capacity in the 2020s to reach a total installed capacity of 20GW by the end of 2030.⁷

Based on current leased sites, the large majority of this future capacity is expected to be installed in the North Sea off the UK's east coast.

In terms of turbine staging, there was clear industry feedback that developers have a strong preference for using ports that are local to the offshore wind farm site, if they have the capability and availability. This preference was based on the cost benefits of reduced transit time between the port and wind farm site and a lower risk of weather delay compared with working from a more distant staging port. This supports a shorter installation programme and lower vessel costs.

Taking into account this preference, industry feedback was that developers of Scottish and East Anglia projects were confident that their local ports would satisfy their turbine staging demand.

Similarly, industry feedback was that, notwithstanding other factors, projects in the Northern England region that use turbines from Siemens Wind Power will be able to use the port of Hull for their turbine staging should they wish to and it is available, following the significant investment that has been made in the Green Port Hull facility.

The area of industry uncertainty was about where developers of projects in the Northern England region will base turbine staging activity if they are not using turbines from Siemens Wind Power or if they choose not to use the port of Hull. Industry feedback, however, indicated that some developers have already identified other UK east coast ports that could be upgraded at a manageable additional cost to a single project. Although there are challenges with each of these alternative sites, these issues are not expected to be a major barrier to cost-effective deployment.

In terms of foundation and cable staging, industry feedback was that these components can be cost-effectively delivered to wind farm sites directly from their manufacturing sites, whether they are in the UK or elsewhere in Europe. As such, existing UK port options will be considered if they offer a cost benefit but there is no requirement for additional staging port capacity.

Developers' choice of staging facility will always be dependent on the competitive offers made by different ports, and the developer's assessment of the 'whole-life' cost of using a facility, including the lease cost, port fees, any capital contributions required for infrastructure

³ Nigg Yard, North Shields, Neptune Energy Park, Seaton, Alexandra Dock (Hull), Albert Dock (Hull), Killingholme, Immingham, Great Yarmouth and Sheerness.

⁴ Nigg Yard, North Shields, Seaton, Alexandra Dock, Killingholme, Immingham and Sheerness.

⁵ Nigg Yard, North Shields, Alexandra Dock, Killingholme, Immingham and Sheerness.

⁶ Methil, Rosyth, Blyth, Tyne (Wallsend), Sunderland, Hartlepool and Middlesbrough.

⁷ DECC, *Amber Rudd's speech on a new direction for UK energy policy*, November 2015, available online at <https://www.gov.uk/government/speeches/amber-rudds-speech-on-a-new-direction-for-uk-energy-policy>, last accessed July 2016.

development or upgrades, and the transport cost due to its proximity to the wind farm site.

Summary

There is a strong industry preference for using local ports for turbine staging activity, if they have suitable infrastructure and are available, or if such capability can be developed at a competitive cost.

Based on anticipated deployment rates and, assuming the prices charged by port owners are competitive, the UK has the capability to meet the turbine staging needs for all known future UK east coast projects.

Furthermore, the investment that has already been made by east coast port owners is likely to enable lower cost offshore wind projects.

How is the UK offshore wind industry currently stimulating supply chain industrialisation through port-related activities?

Industry feedback was that offshore wind supply chain development is taking place in the UK. This progress is being driven by the Government's requirement to deliver credible supply chain plans that support increased competition, rather than significant shortfalls in European supply.

As well as the existing or announced facilities, industry feedback was that there are further UK supply chain developments in the pipeline that are being stimulated by demand from projects supported under the Final Investment Decision enabling for Renewables (FIDeR) mechanism and the first Contracts for Difference (CfD) round. As contractual negotiations are still ongoing, details of these developments are not yet public but a number of these are likely to be announced before the end of 2016. Industry has also identified further UK supply chain opportunities that could be stimulated by the demand driven by the next three CfD auctions. Overall, industry expected that the UK could secure additional production capacity for towers, blades and jacket foundations. The development of additional blade manufacturing capacity in the UK is likely to be dependent on a supplier consolidating the demand of two or more turbine suppliers or an individual turbine supplier increasing their capacity significantly. To date, there has been little explicit discussion on how these might be linked to current or upgraded staging facilities to create a cluster. Some consultees also said that array and export cables production was also feasible, although this is dependent on additional parallel sector demand.

Industry considered the probability of securing nacelle assembly in the UK to be small under the current market conditions, but the significant potential economic benefits

further down the supply chain mean it remains an important opportunity for the UK.

In some cases, a supplier may initially establish only a few elements of the total production process in the UK, with the potential for later projects to expand the scope of activities undertaken. Similarly, developers are considering splitting supply contracts into smaller packages to support new suppliers while reducing their own exposure to delivery risk.

The large majority of active plans were focused on sites with existing port infrastructure. Industry feedback generally suggested that this is because of the lower cost of development, the reduced risk of delays to the development programme of the facilities and the opportunity for synergies with existing activity.

There are other models of development, and the notable exception to this trend is the large-scale re-development of the port of Hull for Siemens Wind Power. In this case, the company was the established market leader in turbine supply. It had also been able to build up a multi-gigawatt pipeline of projects before committing to the investment and it did not have sufficient, suitably located existing production capacity to meet anticipated demand elsewhere.

Summary

The UK's offshore wind industry is stimulating industrialisation by identifying lower risk, lower cost options that can be supported on a project-by-project basis.

There is no strong evidence to suggest that the creation of new staging capacity has enabled the development of new manufacturing activity, which would otherwise not set up on the east coast.

What options are there for unlocking greater levels of UK supply chain industrialisation?

Stimulating a large cluster

There is ongoing debate in the industry about how to stimulate more UK supply chain activity, within the context of strong downward pressure on the cost of offshore wind energy. This has included the question of whether the UK could secure more activity with the development of a single port facility with enough staging and manufacturing land to accommodate the majority of east coast staging activity and most new UK industrialisation. The only comparable example of a port development of this scale is the port of Bremerhaven in Germany, which has approximately 200ha of land available.

There was mixed industry feedback about the potential positive impact of this 'large cluster' approach, both on LCOE reduction and further UK supply chain development.

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Little positive evidence was provided by industry to support the large cluster approach, but this was potentially due to the industry focus on individual projects, which leads to a shorter-term focus.

Supporters of the large cluster approach said that developers can avoid the double-handling cost of transporting units from a separate manufacturing facility to a staging port. They also said that there will be synergies between tenants and that there is the potential for the site to develop a 'gravity' that means companies are attracted to the port because of the benefits of co-locating with other industry players. They also said the development of a single flexible staging facility with large amounts of high specification quayside could also allow developers to optimise their onshore activity, operate at greater efficiency than at older facilities, and minimise vessel downtime.

While acknowledging these benefits, other respondents said a challenge for this approach is how developers not already in possession of a CfD could support its initial development under the current policy framework. The CfD mechanism encourages a project-by-project approach, because CfD auctions give certainty to a developer only one project at a time. Industry feedback was that this dynamic remained even if the additional investment would reduce the LCOE of future projects in the developers' portfolios. Developers are unable to unilaterally take on any additional costs for the benefit of future projects without increasing the risk that they fail to secure a CfD. Such a facility would be more likely to be stimulated if demand arose from sufficient projects that were awarded a CfD and developers were able to align their demand and timescales with each other, or if the port owner could secure sufficient additional demand from one or more parallel sectors or find some other form of de-risking.

Other industry feedback highlighted that:

- No single staging location could efficiently service all (or the majority) of UK offshore wind farm sites
- Competition for CfDs between developers would restrict their ability to cooperate pre-CfD award, and
- The long lead times for major port developments would require speculative investment to be ready in time for start of the offshore wind activity of the first customer

Some respondents felt that the development of such a facility could displace activity that was planned to take place elsewhere in the UK, and would be unlikely to stimulate significant levels of additional manufacturing activity.

Building on existing infrastructure

Industry's current focus has been on identifying existing infrastructure that can be adapted to meet demand as cost effectively as possible.

Industry feedback was that the challenges for such an approach were that it is more likely to add some double-handling costs and may lose some of the large cluster benefits of co-locating suppliers. It was also noted, however, that synergies and reduced double-handling costs are still possible on smaller regional clusters, if activity is sensibly targeted on capable sites.

The most important benefit of this approach, however, is that the investment required can be facilitated on a project-by-project basis or even speculatively, in line with what we have seen to date.

More proactive industry involvement in industrialisation

The findings of this study have shown that there is sufficient UK east coast staging port capacity to meet anticipated demand. It has also shown that although the availability of staging ports is a benefit, it is not a dominant driver for stimulating manufacturing activity.

There has, however, been feedback from consultees about other ways that the sector could stimulate greater industrialisation in the UK. In particular, many consultees suggested that more could be done by industry to coordinate and accelerate inward investment through greater communication and information sharing. The UK Government is already playing an important role in working with developers and suppliers through the Department of Energy and Climate Change (DECC) and UK Trade and Investment (UKTI).

While consultees were unable to offer any clear suggestions about how such involvement could be structured, there was general agreement that a more engaged role for industry in this process would make it more likely that investment can be unlocked.

Conclusions

The key findings of this study are:

- Significant investment has already been made on the east coast and also in other locations across the UK. OWIC members agree that the current UK ports portfolio can support the anticipated pipeline, subject to the ports remaining competitive.
- Developers are driven to focus on project-by-project solutions and therefore support investment in port and supply chain facilities on an individual project basis, after government support has been obtained and a financial investment decision (FID) has been reached. Developers of offshore wind projects have tended to form strong relationships with nearby ports and industry expects this to continue.
- Given the availability of existing UK sites suitable for both staging and manufacturing activities, there is little evidence to suggest that the development of a 'large cluster' would have a significant marginal

benefit on the LCOE of the UK's portfolio of projects or on the level of UK industrialisation, compared with a vigorously pursued approach of supply chain development using existing infrastructure.

- Focusing on regional coordination of staging and manufacturing capability is likely to stimulate supply chain growth, with the potential to create regional staging and manufacturing clusters.
- Industry is motivated to support greater levels of UK industrialisation by identifying ways in which it can proactively contribute to the UK Government's work to accelerate supply chain investment and help stimulate export activity.

Recommendations

The overarching objective of these recommendations is to set out the actions that can be taken to mature the opportunities identified during this review. With the actions set out below, it is believed that the UK's current competitive staging and manufacturing offering will be enhanced.

These recommendations are made without prejudice to any other Government priorities, programmes or initiatives.

Step #1: A strategic industry solution

Reporting to OWIC, the Offshore Wind Programme Board (OWPB) will coordinate a **regional programme** of work, looking at ports and other offshore wind infrastructure for **staging activity** in **Scotland, Northern England** and **East Anglia** respectively. The OWPB will determine the membership of the regional discussion groups that should, as a minimum, involve the UK offshore wind farm developers most likely to use the ports in each region.

The OWPB will build on the findings of this study to prepare detailed assessments of the potential future offshore wind staging activities that could take place *within each region*, and what steps could be taken to make the ports more competitive.

The OWPB will, using much of the background from this study, examine the capability of the infrastructure in each region to meet anticipated demand and identify specific opportunities to stimulate or accelerate further supply chain

investment and industrialisation, including identifying potential suppliers, new or existing, that could invest in the region.

The OWPB, with guidance from OWIC, will consolidate key messages, identify interregional synergies and scope the most effective and appropriate ways to share information and support further progress, particularly in terms of sharing more information with ports. The OWPB will also consider how to broaden the benefits of this exercise to include companies located outside these three regions.

Step #2: Working with Government to deliver tangible results

Once specific further actions have been identified, the OWPB will engage with government bodies, including DECC, Scottish Government, UKTI and regional agencies, to share its consolidated findings and target and realise the main opportunities. The OWPB will determine the timescales for the overall programme, potentially linking future updates with the timing of future CfD auctions.

This approach is considered to offer the best opportunity for overcoming the challenges of the current project-by-project approach, by creating regional, long-term scenarios of demand. It will also focus industry and government attention on the most promising opportunities, offering a more strategic approach to UK supply chain development.

1. Introduction

On 9th February 2016, the Minister of State for Energy Andrea Leadsom announced in the House of Commons a strategic review to identify opportunities to develop the east coast as a staging and construction hub for the UK and European offshore wind industry.⁸

This review was undertaken to support the work of the Offshore Wind Industry Council (OWIC). It was undertaken by BVG Associates on behalf of the jointly-led industry and government review team that was set up to conduct this investigation. It is not a statement of Government policy. As well as providing a detailed review of UK east coast port capability, this report considers three main questions:

- Is there demand for more staging capacity in UK east coast ports?
- How is the UK offshore wind industry currently stimulating supply chain industrialisation through port-related activities?
- What options are there for unlocking greater levels of UK supply chain industrialisation?

1.1. Methodology

This report is based on an extensive consultation involving interviews with more than 50 project developers, suppliers, central and regional government agencies and port owners. The names of the organisations are listed in Appendix A at the end of this report

We undertook structured interviews to ensure the most consistent and comprehensive dialogue. The interviews were conducted in accordance with pre-defined confidentiality principles in which all feedback was anonymised or aggregated, unless specific permission was obtained. This approach resulted in interviewees giving open and honest responses on commercially sensitive issues.

Following the consultation, we undertook a thematic analysis of consultee feedback and drafted summary findings and conclusions.

These were discussed with the review team in workshops to gather their further feedback before the preparation of this report.

1.2. Terminology

In this document, we refer to two separate types of activity, which have different port requirements.

- *Staging*: this activity covers the storage and loading of offshore wind farm components onto vessels before final delivery to site for installation. This may also involve a range of pre-construction activities that take place in the port to minimise the amount of offshore work. Depending on the location and strategy of the developer, a project may choose to install components directly from manufacturing facilities.
- *Manufacturing*: in this context, this activity refers to the production of large offshore wind farm components in or near a port. These may be turbine nacelles, blades, towers, foundations, array cables, export cables or offshore substations (topside or foundations). This has previously been referred to as *construction*.

Other offshore wind-related port activities, such as those involved during the long term operation and maintenance (O&M) phase, have not been considered in this study.

⁸ DECC, *East Coast Review: Terms of reference*, May 2016, available online at <https://www.gov.uk/government/publications/east-coast-review-of-construction-and-staging-terms-of-reference>, last accessed July 2016.

2. Requirements for offshore wind ports

2.1. Port capability requirements

We assessed the capability of 23 UK east coast ports to meet the needs of offshore wind staging and manufacturing activity against a baseline set of requirements. These requirements were derived from industry consultation and reflect the realistic minimum that would be acceptable to an offshore wind port user, rather than the optimum requirement for maximum operational flexibility. In some cases, however, we have noted where potential port users provided details of higher specification infrastructure.

We have defined five levels of capability: staging only, staging plus one manufacturing activity, staging plus two manufacturing activities, a staging and manufacturing cluster and manufacturing only. We have not made any judgement about the location of the port relative to wind farm projects or the costs charged by the owner or operator.

Staging only (S in the port capability assessment)

The following are the baseline characteristics of a port capable of supporting the turbine staging activity for one large offshore wind farm per year (approximately 100 complete 8MW turbines per year). In total, a minimum land area of 12ha with 150m of staging quay is required.

Table 1 Baseline requirements for a port facility capable of support ‘Staging only’.

Requirement	Baseline	Justification	Notes
Horizontal clearance for a vessel carrying turbine blades transverse across its hull	110m	Based on an 80m blade with an uneven overhang on one side of the vessel, plus 15m clearance at either end	A site that was future-proofed against increases in blade length up to 100m would have a clearance of 130m
Vessel beam	45m	The majority of the current installation fleet have a beam of 45m or less	A site capable of accommodating the largest installation vessels currently in use would be able to accept vessels with a beam of 50m, while future vessels may have beams of up to 60m
Air draft	Unrestricted	A jack-up vessel must be able to access or leave the port with its legs raised and, potentially, carrying fully assembled towers	
Water depth at the quay	9m LAT	The majority of the current installation fleet have a draft of 6m to 7m and an operator will require an under-keel clearance of at least 2m	A site capable of accommodating the largest installation vessels currently in use would have a water depth at the quay of 13m LAT
Water depth in the approach channel	Access for a vessel with a draft of 7m for 90% of the time	The charter cost of installation vessels means that developers want to minimise waiting times	For full operational flexibility and the ability to accommodate the largest installation vessels currently in use, the port will offer access for a vessel with a draft of 11m for 100% of the time
Potential for vessels to repeatedly jack-up at the quayside	Yes	Installation vessels must be able to jack-up alongside the quay before using their onboard cranes to load components	There should be no risk of repeated jack-up operations undermining the quay wall or causing damage to the vessel

Staging quayside length	150m with exclusive access	The majority of the current installation fleet have a length of up to 150m. The charter cost of installation vessels means that developers want to minimise waiting time	Industry feedback indicated a preference for quay length of up to 200m per project to allow greater operational flexibility
Staging land area	12ha of contiguous land with direct access to the quayside	Based on industry feedback about the minimum area needed to store and move components	Industry feedback indicated a preference for staging area of up to 20ha per project to allow greater operational flexibility
Heavy lift quayside area (included within staging area)	3,000sqm	Based on an assumed quay length of 150m and a width of 20m from the quay edge	Industry feedback indicated a preference for a width of up to 30m from the quay edge to allow greater operational flexibility to give a total area of 4,500sqm
Ground bearing pressure (storage area)	6t/sqm uniformly distributed load (UDL)	Based on industry feedback about the minimum needed to store and move components around the site using self-propelled modular transporters.	Industry feedback indicated a preference for ground bearing pressure of up to 10t/sqm UDL to allow greater operational flexibility
Ground bearing pressure (heavy lift quayside)	15t/sqm UDL	Based on industry feedback about the minimum needed to store components safely at the quay and allow onshore cranes allow to operate	Industry feedback indicated a preference for a ground bearing pressure of up to 20t/sqm UDL to allow greater operational flexibility

Staging plus one manufacturing activity (S1)

As well as the requirements above, additional manufacturing land area is required. This will cater for a facility producing 100 units per year, whether they are nacelles, towers, blade sets, jackets or monopiles. In total, this site needs a minimum land area of 20ha with 150m of staging quay.

Table 2 Additional requirements for a port facility capable of support 'Staging plus one manufacturing activity'.

Variation from <i>Staging only</i>	Baseline	Justification	Notes
Additional manufacturing land area	A contiguous area of at least 8ha that can be leased on a long term basis that has direct access to the staging facility without using public roads	Industry feedback on minimum requirement for producing 100 units per year, whether they are nacelles, towers, blade sets, jackets or monopiles	Industry feedback indicated a preference for land area of 10ha for some manufacturing activities to give greater operational flexibility

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Staging plus two manufacturing activities (S2)

As above, but with enough available land to accommodate two manufacturing activities. In total, this site needs a minimum land area of 28ha with 150m of staging quay.

Table 3 Additional requirements for a port facility capable of support ‘Staging plus two manufacturing activities’.

Variation from <i>Staging only</i>	Baseline	Justification	Notes
Additional manufacturing land area	A contiguous area of at least 16ha that can be leased on a long term basis that has direct access to the staging facility without using public road	Two manufacturing sites, each of 8ha (16ha in total)	Industry feedback indicated a preference for land area of 10ha for some manufacturing activities to give greater operational flexibility. In this case, the land requirement would increase to 20ha

Staging and manufacturing cluster (C)

The following are the requirements to provide the capability to accommodate the turbine staging activity of two large wind farm projects per year (approximately 200 complete 8MW turbines per year) with enough additional available land to also accommodate three manufacturing activities. This site has the same horizontal clearance, vessel beam, air draft, water depth, jack-up and ground bearing pressure requirements as Table 1 above. In total, this site needs a land area of at least 48ha with at least 300m of staging quay.

Table 4 Additional requirements for a port facility capable of support a ‘Staging and manufacturing cluster’.

Requirements	Baseline	Justification	Notes
Staging quayside length	300m with exclusive access	Two quay lengths of 150m (300m in total)	Industry feedback indicated a preference for quay length of up to 200m per project to allow greater operational flexibility. In this case the quay length requirement would increase to 400m
Staging land area	24ha of contiguous land with direct access to the quayside	Two sites of 12ha (24ha in total)	Industry feedback indicated a preference for a staging area of up to 20ha per project to allow greater operational flexibility. In this case, the land requirement would increase to 40ha
Heavy lift quayside area (included within staging area)	6,000sqm	Based on two quay lengths of 150m (300m in total) and a width of 20m from the quay edge	Industry feedback indicated a preference for a width of up to 30m from the quay edge to allow greater operational flexibility. In this case, the land requirement would increase to 9,000sqm

Manufacturing land area	A contiguous area of at least 24ha that can be leased on a long term basis that has direct access to the staging facility without using public roads	Three sites of 8ha (24ha in total)	Industry feedback indicated a preference for land area of 10ha for some manufacturing activities to give greater operational flexibility. In this case, the land requirement would increase to 30ha
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Manufacturing only (M)

Where a port facility does not meet the requirements set out in Table 1 but industry feedback suggests it is still being targeted for offshore wind-related manufacturing activity (covering nacelles, towers, blade sets, jackets, monopiles, array or export cables), we have included it as a *Manufacturing only* site.

Table 5 Baseline requirements for a port facility capable of support 'Manufacturing only'.

Requirement	Baseline	Justification	Notes
Vessel beam	30m	A standard North Sea barge has a beam of 27.4m	Larger North Sea barges may have beams of up to 36m
Water depth at the quay	5m LAT	A standard North Sea barge has a maximum draft of 4.7m	Larger North Sea barges may have drafts of up to 6.5m. Non-jack-up heavy lift crane vessels may have a draft of up to 7.5m
Manufacturing land area	A contiguous area of at least 8ha that can be leased on a long term basis that has direct access to the heavy lift quayside without using public road	Industry feedback on minimum requirement for producing 100 units per year, whether they are nacelles, towers, blade sets, jackets or monopiles	Industry feedback indicated a preference for land area of 10ha for some manufacturing activities to give greater operational flexibility
Heavy lift quayside area (included within staging area)	900sqm	Based on an assumed heavy lift pad of length of 45m and a width of 20m from the quay edge	
Ground bearing pressure (storage area)	6t/sqm UDL	Based on industry feedback about the minimum needed to store and move components around the site using self-propelled modular transporters.	Industry feedback indicated a preference for a ground bearing pressure of up to 10t/sqm UDL to allow greater operational flexibility
Ground bearing pressure (heavy lift quayside)	15t/sqm UDL	Based on industry feedback about the minimum needed to store components safely at the quay and allow onshore cranes allow to operate	Industry feedback indicated a preference for a ground bearing pressure of up to 20t/sqm UDL to allow greater operational flexibility

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2.2. Port readiness

To assess the relative readiness of each port site against the different requirements for staging and manufacturing discussed above, we have graded it using the following scale.

Table 6 Port readiness grading definitions.

Grade	Definition
G	The site meets all requirements and is available immediately or investment has already been committed that means it will meet all requirements listed in the future.
Y	The site has the potential to meet all requirements listed and the port owner has provided plans with an investment budget of £15 million or less that includes land and quay design and considers capital costs and consenting requirements. This may require speculative early investment to be ready for project use, depending on the relative timescales of the port development and project build out.
A	The site has the potential to meet all requirements listed and the port owner has provided plans with an investment budget of more than £15 million that includes land and quay design and considers capital costs and consenting requirements. This may require speculative early investment to be ready for project use, depending on the relative timescales of the port development and project build out.
R	The site is unsuitable for the activity due to not meeting one or more of the requirements used in this review, and the port owner has provided no plans that address the shortfall.

2.3. Port assessment

This assessment is based on feedback from port owners about what land and quayside is commercially available for offshore wind port users, rather than from a simple assessment of the port's total estate. No detailed site inspections or engineering assessments have been undertaken to audit the feedback of the port owners. The sites have been listed according to their geographic location, running north to south along the UK's east coast. We have only noted that a site is suitable for *Manufacturing only* if there is industry feedback indicating interest in the site and if it is not suitable for *Staging only*, but meets the requirements set out in Table 5. The owner of Harwich and Thamesport has declined the opportunity to be included in this assessment.

Table 7 East coast port capability assessment.

Port (and owner)	Score	Notes	
Nigg Yard (Global Energy Group)	S	G	The port owner has speculatively invested £45 million in the site to upgrade existing quayside, construct new quayside and resurface the main 30ha site. This investment was completed in 2015.
	S1		
	S2		
	C	Y	The port does not currently have enough suitable land to accommodate this level of additional activity. It has plans in place to develop an additional 20ha of greenfield land that is zoned for industrial use and is adjacent to the existing site. This site could be prepared for use for £9 million.
Invergordon (Cromarty Firth Port Authority)	S	R	The port does not have enough available land to accommodate turbine staging activity and the port owner has provided no plans that address this issue. The port has, however, already accommodated offshore renewable projects (including wind) and has invested £25 million in the development of an additional 3.6ha site with 154m of heavy lift quayside at its Invergordon service base
Aberdeen (Aberdeen Harbour Trust)	S	R	The port currently does not have enough available land or quayside to accommodate this activity. Subject to a £400 million multi-user port extension targeted at a broadening of ports activity and diversification from the oil and gas industry that is expected to proceed in Q4 2016, the port could collaborate with the city council to secure additional land to meet the requirements but these plans have not been developed.

Dundee (Forth Ports)	S	G	The port currently does not currently have enough suitable land or quayside to accommodate turbine staging activity but is speculatively investing £10 million to upgrade the existing Prince Charles Wharf at the eastern end of the port to meet these requirements, with an anticipated completion date of mid-2017.
	S1	R	The port currently has no plans to allocate enough additional land to accommodate this additional activity, although there are contiguous land areas adjacent to the Prince Charles Wharf site that could be made available in the longer term.
Montrose (Montrose Port Authority)	S	R	The port does not have enough available land or sufficient water depth in its approach channel to accommodate turbine staging activity and the port owner has provided no plans that address these issues.
Methil (Scottish Enterprise and Fife Council)	S	R	The port does not have sufficient water depth alongside its quay or in its approach channel to accommodate turbine staging activity and the port owner has provided no plans that address these issues.
	M	G	Industry feedback is that this site is being considered for manufacturing. The port owners have speculatively invested £20 million in land and quayside improvements and the port is already being used for the production of offshore wind jacket foundations. There is 20ha of brownfield land available at the site to accommodate manufacturing activity, with direct access to heavy lift quayside. The owners have also undertaken site investigation and survey work looking to improve marine access and there is a future funding package of approximately £25 million in place for onshore infrastructure works.
Rosyth (Babcock International, Forth Ports, Scarborough Muir)	S	R	The air draft restriction of the Forth Bridge means this site could not accommodate turbine staging and the port owner has provided no plans that address this issue.
	M	G	Industry feedback is that this site is being considered for manufacturing. The port is already used for offshore manufacturing activity and there is 28ha of remediated brownfield land that could be made available to accommodate manufacturing activity, with direct access to heavy lift quayside.
Blyth (Blyth Harbour Commission)	S	R	The port does not have the water depth or horizontal clearance in its approach channel to accommodate turbine staging activity and the port owner has provided no plans that address these issues.
	M	G	Industry feedback is that this site is being considered for manufacturing activity. In collaboration with Arch (Northumberland County Council's wholly-owned property development company), the port owner is investing £22 million to redevelop a 35ha brownfield site adjacent to the port estate and to upgrade an existing quayside to offer deep water, heavy lift capacity.
North Shields (Port of Tyne)	S	A	The port does not currently have enough suitable quayside or land to accommodate these activities. The port has developed plans to upgrade 470m of existing quayside and to resurface a 59ha site, of which approximately a third is brownfield. The plans are currently unconsented but the port owner estimates it would have a 12 month consenting period and a build time of up to 16 months with a cost of approximately £25 million for the quayside infrastructure. The port has plans to speculatively invest £12 million in land remediation on the brownfield site.
	S1	A	
	S2	A	
	C	A	
Wallsend (OGN)	S	R	The port does not have sufficient water depth at the quayside to accommodate turbine staging activity. The port owner has provided no plans that address this issue.
	M	G	Industry feedback is that this site is being considered for manufacturing. There is 30ha of land that could be made available to accommodate manufacturing activity, with direct access to heavy lift quayside.

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Neptune Energy Park (Shepherd Offshore)	S	Y	The port currently does not have enough air draft due to an overhead power line to accommodate turbine staging activity. The port owner says that there are plans for the regional transmission systems operator to remove this restriction, if required, at a cost of approximately £1 million. To date, the port owner has speculatively invested approximately £40 million in land and quayside improvements, targeting offshore wind and other offshore sectors.
	S1	Y	The port currently does not have enough suitable land to accommodate this activity but has existing investment plans to upgrade additional areas of the site for less than £15 million.
	S2	R	The port currently does not have enough available land to accommodate this level of additional activity. The port owner does have a joint venture in place with Newcastle City Council to develop additional areas of land behind the existing site that are currently being remediated. There is also an additional quayside area adjacent to the existing site that is under separate ownership but could be combined with the main site. These plans are currently at an early stage of development.
Sunderland (Sunderland City Council)	S	R	The port does not have enough suitable quayside or sufficient water depth in its approach channel to accommodate turbine staging activity and the port owner has provided no plans that address these issues.
	M	G	Industry feedback is that this site is being considered for manufacturing. The port owner has speculatively invested approximately £3 million pounds in land and quayside improvements and there is 20ha of brownfield land available at the site to accommodate manufacturing activity, with direct access to heavy lift quayside.
Hartlepool (PD Ports)	S	R	The port does not have the capacity to accommodate the beam or draft of current installation vessels and the port owner has provided no plans that address these issues. It is noted that the port can accommodate installation vessels with a maximum beam of 40m.
	M	G	Industry feedback is that this site is being considered for manufacturing. There are large areas of brownfield land available at the site to accommodate manufacturing activity, with direct access to existing heavy lift quayside.
Seaton (Able)	S	G	The port owner has speculatively invested £75 million in the site to upgrade existing quayside and resurface the 51ha site (of which 10ha is a dry dock). This investment was completed in 2015.
	S1	G	
	S2	G	
	C	R	The port does not have enough available land to accommodate this level of additional activity and the port owner has provided no plans that address this issue.
Middlesbrough (Able)	S	R	The port has an air draft restriction due to an overhead power line and does not have the water depth in its approach channel to accommodate turbine staging activity and the port owner has provided no plans that address these issues.
	M	G	Industry feedback is that this site is being considered for manufacturing. There is 16ha of land that could be made available for manufacturing activity, with direct access to heavy lift quayside. A significant area of the site (4.2ha) has a concrete surface providing a ground load bearing capacity of 50t/sqm UDL.
Tees Dock (PD Ports)	S	R	The port does not have enough available land to accommodate turbine staging activity and the port owner has provided no plans that address this issue.

Alexandra Docks (Hull) (Associated British Ports)	S	G	The port is investing £150 million to create a 54ha site and 636m of staging quayside for Siemens Wind Power's Green Port Hull development. The site will be under the exclusive control of Siemens Wind Power and used for blade manufacture, turbine staging and other offshore wind-related support services.
	S1	G	
	S2	A	The port currently does not have enough available land with suitable ground bearing pressure that is not directly controlled by Siemens to accommodate further manufacturing activity. The port has proposed plans to prepare up to 257ha of greenfield and brownfield land that lies within the port estate and to construct an internal connecting road to allow large components to be transported to the Alexandra Dock staging quayside and other lock-restricted quays in the port. The port owner has speculatively invested £2 million to secure outline planning consent for manufacturing activity and completing environmental mitigation measures for 80ha of the greenfield land.
	C	A	
Albert Dock (Hull) (Associated British Ports)	S	A	The port currently does not have enough available land or suitable quayside to accommodate turbine staging activity. The port owner has plans to infill the existing dock to create a 22ha site and build a deepwater riverside quay. These plans are currently unconsented but the port owner estimates it would have an 18 month consenting period and an 18 month build time with a total cost of approximately £60 million.
	S1	A	
	S2	R	The port does not have enough available land or suitable quayside to accommodate this additional activity, even with the proposed development.
Killingholme (Able)	S	A	The port currently does not have enough quayside to accommodate this activity. The port owner has full planning consent in place to develop a 360ha site with up to 1,288m of staging quayside. The port owner has already speculatively invested £37.5 million in early enabling measures, including surfacing large areas of the site. The port owner estimates the cost of the first phase of quay development (550m) would be approximately £150 million and that it could be operational within 24 months of FID.
	S1	A	
	S2	A	
	C	A	
Immingham (Associated British Ports)	S	A	The port currently does not have enough suitable land or quayside to accommodate this activity. The port owner has proposed plans to create a staging quay up to 200m at its existing bulk handling jetty by infilling behind the existing quay, which could then be extended up to 400m. The 25ha site behind this quayside is currently being used for coal storage but could be resurfaced. There is also another 40ha site adjacent to this site that could be made available but there is an operational railway line between them so a crossing would need to be established. These plans are currently unconsented but the port owner estimates it would have a six month consenting period and a 12 month build time with a total cost of approximately £80 million for the site improvements and the first 200m of quayside.
	S1	A	
	S2	A	
	C	A	
Great Yarmouth (Peel Ports)	S	G	The port has a 12.5ha area that will be used for the turbine staging activity for Galloper and East Anglia ONE. As part of this contract, the port is investing £6 million to increase the load bearing capacity of the site and install a RoRo linkspan to import components. There is also an 8ha brownfield site suitable for manufacturing activity within the port estate.
	S1	G	
	S2	R	The port has proposed plans to develop additional land parcels in the port but these are not large enough to accommodate this additional activity.
Lowestoft (Associated British Ports)	S	R	The port does not have enough available land or quayside to accommodate staging activity and the port owner has provided no plans that address these issues.
Sheerness (Peel Ports)	S	A	The port does not currently have enough suitable quayside to accommodate staging activity. The port owner had proposed plans for a 70ha manufacturing and staging facility that were developed in 2012. The port is currently being used for other activities but the port owner says the 2012 plans could be fully or partial used.
	S1	A	
	S2	A	
	C	A	

2.4. Summary of findings

This study identified that offshore wind has already stimulated strong levels of investment in east coast ports. Over the last five years, owners of ten east coast ports have spent or committed more than £400 million on land and quayside infrastructure that is either exclusively or partially focused on capturing offshore wind activity. This is in addition to investment that has been made in west coast staging and manufacturing facilities, such as Belfast and Mostyn, and in 23 facilities located around the UK's coastline providing operations and maintenance services. More than half of this investment has been speculative, based on the port owners' assessment of the potential opportunity from offshore wind and other sectors. The rest has been stimulated by firm contractual commitments by offshore wind players.

As shown in Table 8 and Figure 1, the study identified 11 east coast ports with the capability to accommodate turbine staging activity for one large project a year, almost half of which could be used with minimal further investment. Of these 11, ten of the ports could also accommodate at least one manufacturing activity at a run rate sufficient for 100 turbines per year.⁹ Seven of the ports could accommodate two such manufacturing activities.¹⁰ Six ports could accommodate a staging and manufacturing 'cluster', defined as a site with the capability to accommodate the staging activity of two large wind farm projects per year and also with enough contiguous land to support three manufacturing activities.¹¹ It is noted that the staging area in Alexandra Dock at Hull is under a long term lease to Siemens Wind Power so there are likely to be significant commercial challenges if a developer sought to use the facility to stage turbines from other suppliers, making this unlikely.

A further seven ports were also identified that could not meet the staging requirements defined by this study but could, however, host one or more manufacturing activities.¹²

Other ports that were reviewed but did not meet the requirements used in this study for either *Staging only* or *Manufacturing only* were Invergordon, Aberdeen,

Montrose, Tees Dock and Lowestoft. This finding does not preclude these ports winning other offshore wind-related activity, which is in some cases already taking place.

⁹ Nigg Yard, North Shields, Neptune Energy Park, Seaton, Alexandra Dock (Hull), Albert Dock (Hull), Killingholme, Immingham, Great Yarmouth and Sheerness.

¹⁰ Nigg Yard, North Shields, Seaton, Alexandra Dock, Killingholme, Immingham and Sheerness.

¹¹ Nigg Yard, North Shields, Alexandra Dock, Killingholme, Immingham and Sheerness.

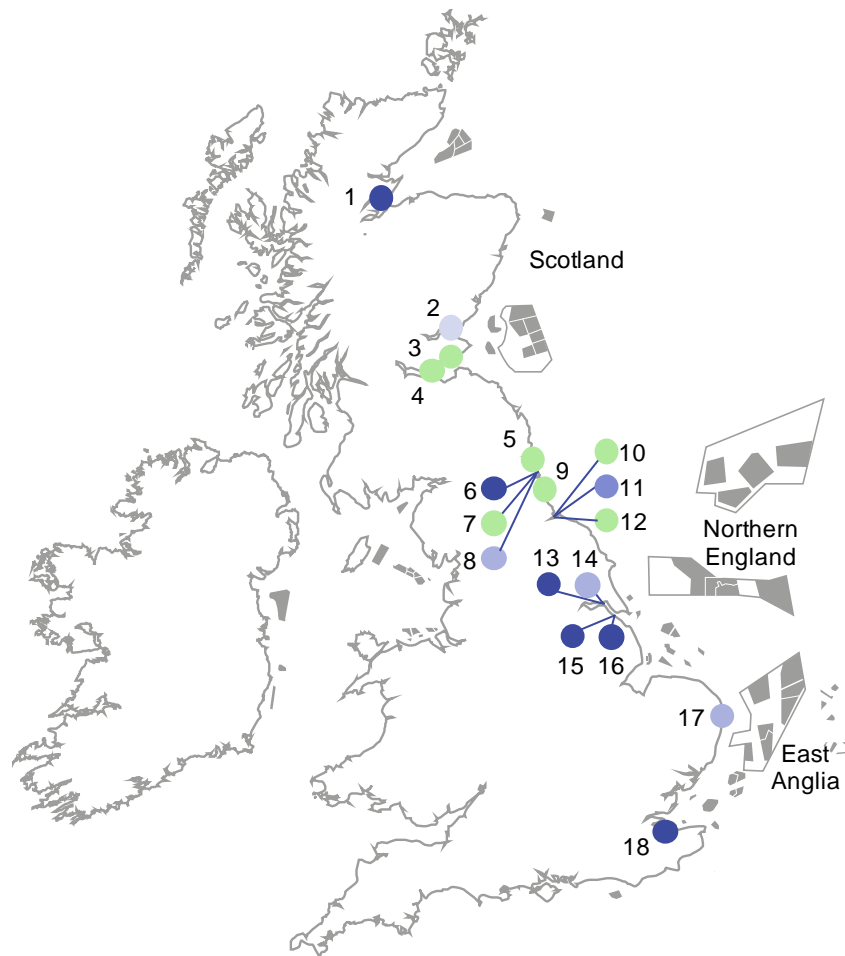
¹² Methil, Rosyth, Blyth, Wallsend, Sunderland, Hartlepool and Middlesbrough.

Table 8 Summary of east coast port assessment.

	Staging activity (S)	Staging plus one manufacturing activity (S1)	Staging plus two manufacturing activities (S2)	Staging/ construction cluster (C)	Manufacturing only (M)
Nigg Yard	G	G	G	Y	N/A
Dundee	G	R	R	R	N/A
Methil	R	R	R	R	G
Rosyth	R	R	R	R	G
Blyth	R	R	R	R	G
North Shields	A	A	A	A	N/A
Wallsend	R	R	R	R	G
Neptune Energy Park	Y	Y	R	R	N/A
Sunderland	R	R	R	R	G
Hartlepool	R	R	R	R	G
Seaton	G	G	G	R	N/A
Middlesbrough	R	R	R	R	G
Alexandra Dock (Hull)*	G	G	A	A	N/A
Albert Dock (Hull)	A	A	R	R	N/A
Killingholme	A	A	A	A	N/A
Immingham	A	A	A	A	N/A
Great Yarmouth	G	G	R	R	N/A
Sheerness	A	A	A	A	N/A
Number of ports	11	10	7	6	7

* The staging area in Alexandra Dock at Hull is under a long term lease to Siemens Wind Power so there are likely to be commercial challenges if a developer sought to use the facility to stage turbines from other suppliers.

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1	C	Nigg Yard
2	S	Dundee
3	M	Methil
4	M	Rosyth
5	M	Blyth
6	C	Tyne (North Shields)
7	M	Tyne (Wallsend)
8	S1	Tyne (Neptune Energy Park)
9	M	Sunderland

10	M	Hartlepool
11	S2	Seaton
12	M	Middlesbrough
13	C	Alexandra Dock (Hull)
14	S1	Albert Dock (Hull)
15	C	Killingholme
16	C	Immingham
17	S1	Great Yarmouth
18	C	Sheerness

Figure 1 Map of headline regions and UK east coast ports (M - Manufacturing only, S - Staging only, S1 - Staging plus one manufacturing activity, S2 - Staging plus two manufacturing activities, C – Staging/manufacturing cluster).

3. Is there demand for more staging capacity in UK east coast ports?

3.1. Market demand

To date, the UK has installed 5.1GW of offshore wind capacity and there are a further 12 projects with a total capacity of 5.2GW that are either under construction or have passed their final investment decision (FID) so that they will be built out by the end of 2020.¹³

Assuming the industry maintains its progress in reducing the levelised cost of energy (LCOE), the Government has stated its ambition of supporting another 10GW of capacity in the 2020s to give a total installed capacity of approximately 20GW by the end of 2030.¹⁴

Most consultees said that this level of deployment in the 2020s was achievable and a pragmatic level on which to plan future levels of supply chain and port development.

“If 10GW can be realised, then this is good and healthy. It can’t really be less if the Government wants to see ongoing strong cost reduction.” (Developer)

Many consultees said the biggest factor affecting levels of deployment in the short-to-medium term was Government funding as it decides how much budget to allocate to the CfD process, and hence the amount of capacity that can secure funding. In March 2016, the Government set out a £730 million budget for less established technologies in the next three CfD auctions and said it expects this to deliver up to 4GW of offshore wind capacity. It has also announced the price trajectory it expects the offshore industry to target over that timeframe.

A few consultees said that if the cost of offshore wind energy continued to come down, the UK could potentially exceed this ambition of 10GW in the 2020s if the Government decides to ramp up deployment. This may be because there is slower than expected progress with other generation technologies, particularly nuclear.

“Sticking to an assumption of 10GW in the 2020s is sensible and there will be the opportunity to do more if other sectors go slow.”
(Developer)

It is likely to be more than 10GW because it will be relatively inexpensive for the Government to support more. (Supplier)

Whereas offshore wind deployment to date has been spread around the UK’s coastline, based on sites that are currently leased the large majority of future deployment will take place in the North Sea off the UK’s east coast.

As shown in Figure 2, almost a third of all capacity that is installed or post-FID is located in the Irish Sea or the English Channel. In terms of future activity, there are 19 projects (or zone phases) with a total potential capacity of 18.4GW where the developer has either secured planning consent or is actively investing to secure consent.¹⁵ Of this potential future capacity, the only project not in the North Sea is the 700MW Isle of Man project.

¹³ Analysis by BVG Associates. Projects under construction or post-FID are: Beatrice, Blyth Offshore Demonstrator, Burbo Bank Extension, Dudgeon, East Anglia ONE, Galloper, Hornsea Project One, Hywind Scotland Pilot Park, Race Bank, Rampion and Walney extension 1 and 2.

¹⁴ DECC, *Amber Rudd’s speech on a new direction for UK energy policy*, November 2015, available online at <https://www.gov.uk/government/speeches/amber-rudds-speech-on-a-new-direction-for-uk-energy-policy>, last accessed July 2016.

¹⁵ Analysis by BVG Associates. Projects are: Dogger Bank Creyke Beck A, Dogger Bank Creyke Beck B, Dogger Bank Teesside A, Dogger Bank Teesside B, East Anglia ONE NORTH, East Anglia TWO, East Anglia THREE, European Offshore Wind Deployment Centre (Aberdeen), Hornsea Project Two, Hornsea Project Three, Inch Cape, Isle of Man, Moray Firth, Neart Na Gaoithe, Norfolk Boreas. Norfolk Vanguard, Seagreen Alpha, Seagreen Bravo and Triton Knoll

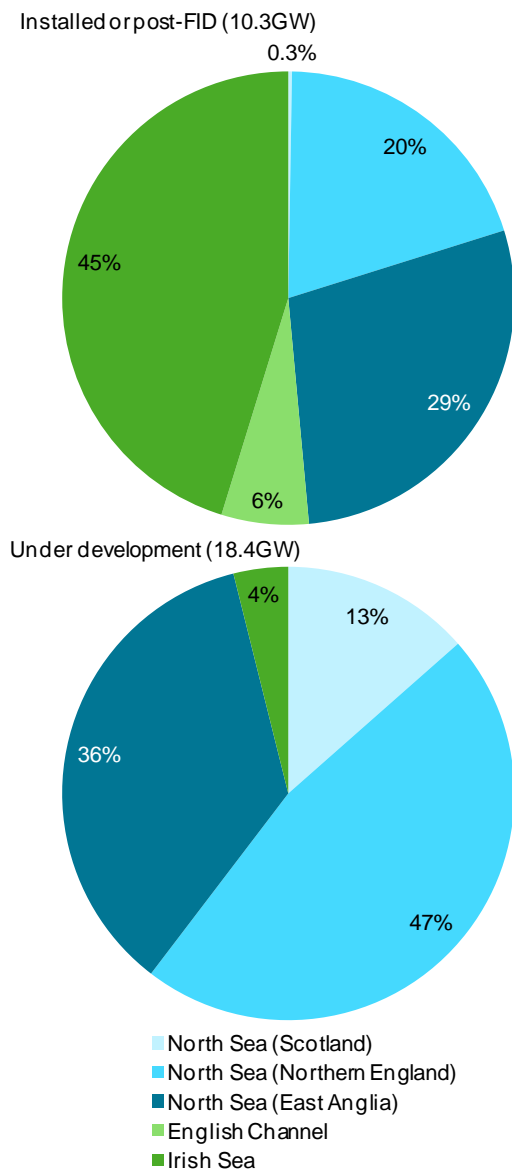


Figure 2 Geographic distribution of offshore wind capacity around the UK coastline.

Despite this east coast focus for future activity, industry feedback is that it is not possible to predict with confidence specifically where or when the activity will happen within different areas of the North Sea. This is because, to drive better value for consumers, the CfD auction mechanism allocates support based on the price bid by developers. The price at which a developer can bid is heavily influenced by the physical characteristics of its wind farm site (such as water depth and distance from shore) but is also affected by other issues, such as supply chain choices and the developer's appetite for risk. As such, while some consultees acknowledged that projects in deeper waters and farther from shore may be have more challenging conditions, no one believed it was possible to accurately predict the order in which projects are likely to secure support.

In addition to this UK activity, France, Belgium, the Netherlands, Germany and Denmark all have active offshore wind programmes in the North Sea. In each case, there is varying levels of political pressure to source components and services domestically but UK companies will still have the opportunity to compete for activity.

3.2. Supply and demand for UK turbine staging facilities

For turbine staging, there was clear industry feedback that developers have a strong preference for using ports that are local to the offshore wind farm site, if they have or can develop the capability and availability.

This preference was based on the cost benefits of reduced transit time between the port and wind farm site and a lower risk of weather delay compared to working from a more distant staging port. Given the high charter costs of the state-of-the-art jack-up vessels, this reduction in the installation programme has a significant cost benefit.

Consultees agreed that a developer would choose its port by assessing the 'whole-life' cost of using a facility, including the lease cost, port fees, any capital contributions required for infrastructure development or upgrades and the transport cost due to its proximity to the wind farm site.

“There is no sense in us investing in ports further away because the proximity of the port to the wind farm site is the biggest LCOE differentiator for a port. Other factors, such as the size or layout of the site, are less important.”
(Developer)

“Local ports will become increasingly important as larger turbine size means fewer units can be loaded onto a vessel and more trips are needed. It won't be feasible to shuttle across the North Sea.” (Developer)

Taking into account this preference, industry feedback was that developers of Scottish and East Anglia projects were confident that local ports would satisfy their turbine staging demand during the 2020s. Most of these consultees also said they expected the ports in those regions to be able to cope with any future peaks in local deployment. Assuming an average annual deployment of 1GW per year in the 2020s (consistent with the Government's ambition described in Section 3.1), this feedback correlates with our port assessment in Section 2 that suggests Nigg Yard and Dundee are well placed to deliver Scottish projects and Great Yarmouth will be available for projects in the East Anglia region.

“The Scottish Government should be recognised for supporting the development of port capacity through the NRIP process.”

(Developer of a project in the Scottish region)

There was also industry feedback that projects in the Northern England region that use turbines from Siemens Wind Power (Siemens) will be able to use the port of Hull for their turbine staging should they choose to and it is available, following the significant investment that has been made in the Green Port Hull facility.

“We would only use Hull for turbine supply if we were going with Siemens - we couldn’t justify the double handling on a cost or health and safety basis otherwise.”

(Developer of a project in the Northern England region)

The area of industry uncertainty was about where developers of projects in the Northern England region will base turbine staging activity if they are not using turbines from Siemens or if they choose not to use the port of Hull.

Industry feedback is that developers have identified other UK east coast ports that could accommodate staging activity although there were different issues affecting each of them that would need to be resolved.

- There is a risk that concurrent Scottish or East Anglia projects or parallel sector activity (particularly oil and gas decommissioning) could absorb the capacity of ports with infrastructure already in place, such as Great Yarmouth or Seaton.
- The staging area in Alexandra Dock at Hull is controlled by Siemens. While it is feasible that they could make this facility available to developers that are using turbines from other suppliers, there are likely to be additional commercial tensions in this situation. For example, they may choose not to offer the facility at a price that allows their rivals to bid competitively. Even if they do offer the facility at a competitive rate, they are unlikely to commit port capacity to others while there are still commercial opportunities to use the port themselves.
- The staging facilities proposed by a number of the Northern England port sites are currently unconsented.¹⁶ In these cases, the port owner would need to obtain the relevant consents speculatively to

secure contractual commitment from potential port users.

- A number of the Northern England port sites require an investment of more than £15 million to develop the necessary infrastructure for staging activity.¹⁷ In these cases, the port owner would not be able to recoup all of the investment in a single contract. As such, they would need to take account of the post-contract residual value when making a business case. The same ports also have anticipated construction programmes of 12 to 24 months. As such, the port owner may need to start investing before the project developer has reached FID to be ready for the start of offshore works.

Industry feedback is that developers are aware of these issues but do not expect them to be a major barrier to cost-effective deployment.

Many consultees said that Continental port facilities would still be considered when selecting a turbine staging port, particularly the Danish port of Esbjerg. Overall, however, most believed that the investment that has taken place in UK port facilities means that local ports would be more competitive than Continental ports when considering whole-life cost.

As well as the financial factors that affected port choice, many consultees also said that locating turbine staging in a UK port had important political benefits, as it is a highly visible activity. All of these consultees also said, however, that staging activity alone accounted for a relatively small amount of the overall project expenditure so would not significantly increase levels of UK content.

3.3. Supply and demand for UK balance of plant staging facilities

For foundation and cable staging activity, most consultees said that these components can be cost effectively delivered to wind farm sites directly from their manufacturing sites, whether they are in the UK or elsewhere in Europe.

For example, many consultees said that foundations produced in the North Sea or the Baltic Sea would be installed using a just-in-time feeder solution. This eliminates the need for a separate staging port as units are loaded onto barges at the manufacturing site and shipped directly to an installation vessel that is stationed at the wind farm site.

¹⁶ Albert Dock (Hull), Immingham and North Shields.

¹⁷ Albert Dock (Hull), Killingholme, Immingham and North Shields.

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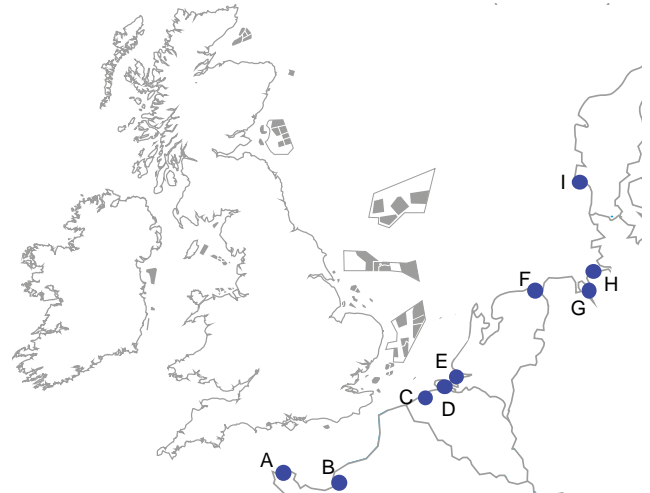
“When moving components like foundations, it is critical to avoid double handling so you don’t want to insert another step if you can avoid it. This just adds more cost and increases the risk of damage.”
 (Developer)

“Staging ports for foundations do not add value and there is an industry drive to avoid staging activity if possible. There is no case for bringing a monopile to a separate port, putting it down and then picking it up again to install.”
 (Installation contractor)

Consultees said that staging ports may be required if the foundations are produced further afield. Consultees said that, in this case (potentially with the exception of Scottish projects), they expected this demand would be met by Continental ports. In particular, consultees highlighted the ports of Ostend (BE), Vlissingen (NL) and Sif Group’s planned monopile manufacturing and staging facility at Maasvlakte 2 in Rotterdam (NL).

“Publicly owned Continental ports have infrastructure in place with vast amounts of quayside.”
 (Developer)

These ports, and others mentioned by consultees, are shown in Figure 3. Most consultees noted that all of these Continental port developments are either fully or partially publicly owned and have benefited from substantial public investment. This is in contrast to the UK, where the majority of ports are privately owned.



A	Cherbourg	F	Eemshaven
B	Le Havre	G	Bremerhaven
C	Ostend	H	Cuxhaven
D	Vlissingen	I	Esbjerg
E	Rotterdam		

Figure 3 Map of Continental port location with existing or planned capability to accommodate offshore wind staging activity.

Consultees said developers would still consider UK ports when selecting a foundation installation strategy (particularly if they were using a strategy using a jack-up vessel) but the availability of suitable Continental facilities meant that UK ports would face strong competition. As such, consultees said the likelihood of investment in new infrastructure purely for this activity may be low.

For array and export cable installation, the majority of consultees expected that separate staging ports would not be required if a developer is using a UK or Continental supplier. This is because the cable would be loaded onto the installation vessel at the manufacturing facility and taken directly to site.

Consultees said that a cable staging facility would be required if a developer selects a non-European supplier, but that this would probably only account for a small minority of activity.

“For cable installation, the vessel will go directly to the cable production facility most of the time. This is increasingly the case as next generation vessels come on line that have the capacity to carry more cable, go faster and load cable more quickly.”

(Installation contractor)

No staging facilities are required for the installation of offshore substation topside and foundations, which are likely always be delivered directly to site from the manufacturing facility.

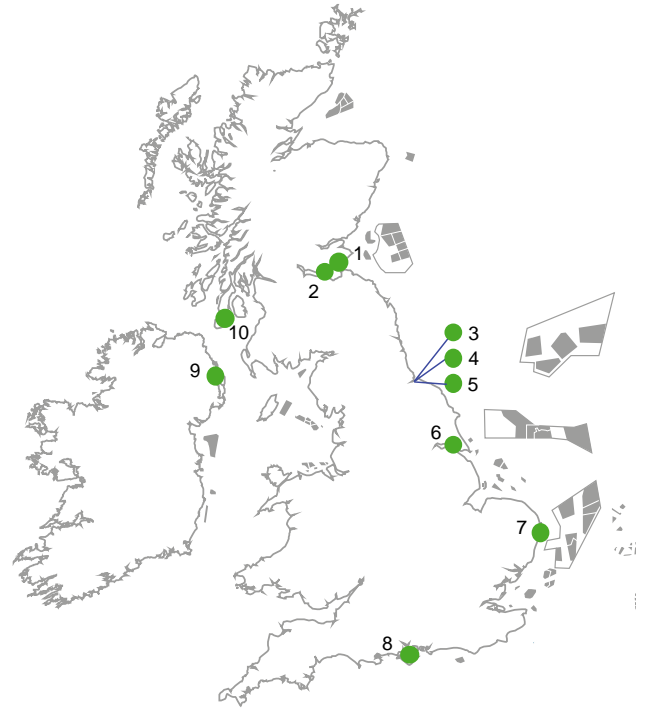
4. How has the UK Supply Chain been stimulated by offshore wind?

The opportunity to stimulate the development of manufacturing facilities (and hence jobs) has been an important factor in the UK and Scottish governments' long standing support for offshore wind.

Feedback from consultees was that the UK offshore wind industry recognises this political priority and is already committing a lot of effort to maximise the economic impact of projects.

It is estimated that there are more than 600 UK companies already active in the offshore wind industry.¹⁸ Of these, there are eight coastal manufacturing facilities that are already producing large scale components that cannot be cost-effectively transported by road. A further two (Siemens and CS Wind) have also committed investment that will mean they will start production within 18 months.

As shown in Figure 4, this activity is largely focused on the UK's east coast and covers blades, towers, turbine foundations, transition pieces and substation topsides and foundations. Consultees said that these UK-based facilities had strong capability and were competitive in the European market.



1	Burntisland Fabrication (BiFab)	Turbine foundations, substation foundations
2	Babcock International	Substation topsides
3	JDR Cables	Array cables
4	Heerema Fabrication Group	Substation topsides
5	Offshore Structures (Britain)	Transition pieces
6	Siemens Wind Power	Blades
7	SLP Sembmarine	Substation topsides and foundations
8	MHI Vestas	Blades
9	Harland and Wolff	Substation topsides and foundations
10	CS Wind (Wind Towers Scotland)	Towers

Figure 4 UK coastal manufacturing facilities for large offshore wind components.

As well as these existing or announced facilities, industry feedback was that there are further UK supply chain developments in the pipeline that are being stimulated by demand from the projects that already have secured support under the Final Investment Decision enabling for Renewables (FIDeR) mechanism and the first Contracts for Difference (CfD) round. As contractual negotiations are still ongoing, details of these developments are not yet public but a number of these are likely to be announced before the end of 2016.

¹⁸ Based on RenewableUK's estimate of UK supply chain activity. For more information, see <http://www.renewableuk.com/Page/SupplyChainMap>. Last accessed July 2016

Taking into account the progress in supply chain development described above, and the demand that will be stimulated by the next three CfD auctions, industry feedback is that there are some areas of supply where the UK is more likely to see further investment and industrialisation.

- **Towers.** Consultees said that the high cost of transporting completed tower sections means domestic supply is logical. In addition, the investment required for a new facility is lower than for many other large components.
- **Jackets and other non-monopile steel foundations.** Due to the legacy of North Sea oil and gas, the UK has a number of waterside manufacturing facilities that would be suitable for jacket production. Furthermore, demand for jackets from UK projects is expected to grow in the future as projects in deeper water are built out.
- **Blades.** Consultees said that the development of additional blade manufacturing capacity in the UK is likely to be dependent on a supplier consolidating the demand of two or more turbine suppliers or an individual turbine supplier increasing their capacity significantly.
- **Concrete gravity base foundations.** The Blyth Offshore Demonstrator project will be the first UK project to use this technology with five units being built at the Neptune Energy Park on the Tyne. Consultees said that there were also other suitable east coast facilities but industry feedback is that UK developers are not currently progressing with this technology on commercial scale projects.
- **Export cables.** A small minority of consultees said there was the potential for a non-European supplier to set up a new HVDC cable production facility in the UK if it could consolidate enough demand from the offshore wind market and northern European interconnector projects.
- **Array cables.** As with export cables, a minority of consultees thought a new UK facility could be possible if a company could consolidate demand from offshore wind and a parallel sector, like offshore oil and gas.

Most consultees said the probability of securing nacelle assembly in the UK to be low, as they believe that the leading turbine suppliers already have enough capacity to meet existing and future demand. For example, GE Renewable Energy has an operational facility in Saint-Nazaire (FR), MHI Vestas has an operational facility in Lindø (DK), Servion and Adwen have operational facilities in Bremerhaven (DE), and Siemens is investing €200 million in a facility in Cuxhaven (DE) with production expected to start in mid-2017. Despite this situation, a few consultees said the UK should continue to pursue opportunities with suppliers because of the significant

economic benefits that could be stimulated by such a facility.

No consultees thought that monopile fabrication would take place in the UK due to the existing Continental supply chain, particularly EEW Special Pipe Constructions (DE), Sif Group (NL) and Steelwind Nordenham (DE).

Similarly, no consultees thought that any new facilities would be established to assemble substation topsides or foundations. The UK already has five players with a track record in delivery and there is strong capability in the rest of northern Europe as well.

Importantly, for all types of manufacturing activity where there was an opportunity for a UK facility, some consultees said the existing supply chain (located predominately on the Continent), either has the capacity to meet anticipated Europe-wide demand already, or can increase capacity at a relatively low cost. Although some consultees indicated that this might create some barriers to market entry, it was generally acknowledged that internationally-competitive UK supply chains can nevertheless be developed. In some cases, consultees said that a supplier may reduce its risk by initially establishing only a few elements of the total production process in the UK. This then establishes a 'beachhead' on which the supplier can work with subsequent projects to expand the scope of activities undertaken.

Similarly, consultees said developers are in some cases splitting supply contracts into smaller packages to support new suppliers to enter the market while reducing their own exposure to delivery risk. For example, the supply of jacket foundations for the Beatrice wind farm has been broken into three separate packages, of which one has been allocated to Scottish fabricator BiFab.

Where suppliers were progressing plans to develop new facilities in the UK, industry feedback suggested there has been little explicit discussion about how activity might be coordinated to be co-located or linked with an existing or planned staging facility to create a cluster. Consultees said this is because such activity adds complexity and risk to a commercially-sensitive process with only a marginal benefit compared with proceeding independently.

Furthermore, the large majority of active supplier plans were focused on adapting existing sites rather than greenfield developments. Industry feedback suggested that this is due to a number of factors.

- **Lower cost of development.** Given the commercial risk involved in a new facility, including limited market visibility and established competition, consultees said suppliers were seeking to minimise expenditure. As such, a greenfield development might offer optimal infrastructure but the added cost would be factored against that.
- **Reduced risk of delays to the development programme.** As developers are only able to commit on

a project-by-project basis, any new supplier must either invest speculatively or be able to build their facility and start production in the time between the developer's FID and the point at which the components are required. As such, consultees said suppliers do not want to take on the additional risk that the port infrastructure also needs to be ready on time.

- *Opportunity for synergies with existing activity.* A number of consultees said that the opportunity to take advantage of the equipment, skills (both technical and managerial) and port infrastructure of operational neighbours would reduce the costs and risks of setting up a new facility.

“The more it is possible for a new facility to share with an existing facility, then the easier it is to make the business case. They can share some operational activities, connect to existing supply chain partners, benefit from the existing labour pool and share quayside activities.”

(Supplier)

One notable exception to this trend is the large-scale re-development of Alexandra Dock in the port of Hull for Siemens Wind Power. In this case, however, the company was the established market leader in turbine supply. It had also been able to build up a multi-gigawatt pipeline of projects before committing to the investment and it did not have sufficient, suitably located existing blade production capacity to meet anticipated demand.

5. What options are there for unlocking greater levels of UK supply chain industrialisation?

Stimulating a large cluster

There is ongoing debate in the industry about how to stimulate more UK supply chain activity, within the context of strong competitive pressure on the short term cost of offshore wind energy.

This debate has included the question of whether the UK could secure more industrialisation with the development of a single large port facility with enough land to accommodate the majority of east coast staging activity and new UK manufacturing.

The only comparable example of a port development of this scale is the port of Bremerhaven in Germany, which has approximately 200ha of land available. The only UK locations being considered by the industry that could make this amount of land available in the UK are the Able Marine Energy Park at Killingholme and Alexandra Dock (and environs) in Hull.

There was mixed industry feedback about the potential positive impact of this 'large cluster' approach, both on LCOE reduction and further UK supply chain development. Although little positive evidence was provided by industry to support the large cluster approach, we perceived this to be due to the industry focus on individual projects, which leads to a shorter-term focus.

The main benefits stated by consultees supporting the development of a large cluster approach were:

- *Reduced double-handling.* Consultees said that a supplier that is manufacturing components in a port facility with staging capacity would not need to transport the components to a separate staging site, thereby avoiding unnecessary costs and risks and reducing the project's carbon impact. In a large cluster, there is the potential that all major components could be manufactured and staged from the same facility.
- *Synergies between tenants.* Consultees said that it was likely that tenants co-located on a single site could achieve cost reductions through shared solutions to overlapping procurement and logistics requirements. For example, most suppliers of large components will require SPMTs, heavy lift cranes and storage space. A large cluster could create enough shared demand for a third party provider to have a pool of equipment that tenants could draw upon as required.
- *Creating a 'gravity' to attract companies.* Consultees said that a grouping of suppliers of large components in a single location would encourage their sub-suppliers to set up alongside them, particularly if it means they can serve multiple customers and further reduce logistics costs. Consultees said this concentration of activity would also focus political

attention and public funding for research and development activity and training facilities.

- *Higher specification staging infrastructure.* Consultees said that the cumulative demand of multiple port users in a large cluster would justify the development of higher specification staging infrastructure that would give port users greater operational flexibility and be more future-proofed against technology and market developments. Consultees said that this would help reduce the cost of energy of offshore wind projects by allowing developers to optimise their onshore activity and minimise vessel downtime.

Whilst acknowledging these benefits, other consultees said there were significant challenges with this approach:

- *Cost of development.* Consultees said it would be extremely difficult for a single developer to support the development of such a large facility under the current policy framework. The contracted spend required to trigger the port owner to invest in an individual port is commercially sensitive. Industry feedback, however, was that it would be significantly more than a developer would anticipate spending for a single project. Developers take a "project by project approach" under the CfD mechanism. The award of a CfD means that they can give their supply chains certainty on that specific project, but not beyond it as they do not know if they will win any subsequent auction. This also means suppliers setting up a new facility either have to cover their investment on a single project, coordinate with other projects that have won CfDs, or accept commercial risk about securing future contracts (some have been prepared to do this). Industry feedback was that even if additional investment by a developer in a port would reduce the LCOE of future projects in its portfolio, the company would be unable to unilaterally impose the necessary cost on the budget of its current project.
- *Market volume.* Given the feedback above, it follows that a large cluster is only likely to be stimulated by the offshore wind industry alone if enough projects are awarded CfDs at the same time and are able to coordinate their demand and timescales with each other. Industry feedback is that the anticipated average annual deployment of 1GW per year in the 2020s (consistent with the Government's ambition described in Section 3.1) would not provide the critical mass of project capacity required.
- *Developer cooperation.* As noted above, the competitive nature of the CfD auction, whilst driving costs down, means that pre-CfD award developers are unlikely to collaborate.

“There is no reason for developers to cooperate with each other on port development as they are in competition for CfDs” (Supplier)

- **Geographic distribution of North Sea projects.** As set out in Section 3, there is no certainty about the order in which UK projects will be built out and developers have a preference for using local ports for turbine staging.

“The fact that there are options in north and south undermines the case for a big hub. A central massive hub is going to be difficult to realise.” (Supplier)

- **Port construction lead times.** Consultees said it is extremely challenging for a developer to commit to using a port before it had reached FID for its wind farm project. Consultees said that this was because the availability of other UK and Continental ports meant the development of new port infrastructure was not an important enough issue to drive at-risk commitments or to risk late delivery of a port upgrade that would delay the project. Consultees said that the lead time between FID and first offshore works is typically 12 to 18 months so the port owner would almost certainly need to invest before getting firm commitment from a developer to provide sufficient certainty about being ready in time to avoid delaying the construction programme of the project.

“Pre-FID investment is extremely difficult. It can only really be relatively small, the activity would need to be on the critical path and it should have a significant impact. Port reservation fees may be possible but the impact needs to be compelling and ports are not considered a high risk issue.” (Developer)

“Ports were looking for reservation or termination feeds but these were strongly resisted as it is difficult to justify pre-FID investment unless it is absolutely necessary.” (Developer)

Consultees said that the only other ways for such a facility to progress would be to secure sufficient additional demand from one or more parallel sectors or find some other form of de-risking support.

In Bremerhaven, these issues were avoided by the regional government speculatively investing €180 million of public money in the development of deep water, heavy lift staging quayside based on the logic of capturing long-term value for its local economy. This level of public investment was only possible because the port is in public ownership.

A few consultees also said that, because supply chain development was taking place in existing east coast sites already (as described in Section 4), there was a risk that a large cluster could displace activity that may take place elsewhere in the UK anyway. Consultees also said that, given the level of supply chain development that has already taken place across Europe, it was unlikely that there were enough suppliers without efficient coastal facilities for the ‘gravity’ of a large cluster to stimulate significant levels of additional manufacturing activity in the UK.

Building on existing infrastructure

Industry’s current focus is on identifying existing infrastructure that can be adapted to meet demand as cost effectively as possible.

Industry feedback was that the challenges for such an approach were that it is more likely to add some double-handling costs and may lose some of the large cluster benefits of co-locating suppliers. Consultees said, however, that synergies and reduced double-handling costs would still be possible with regional clusters, if activity is sensibly targeted on suitable sites.

The most important benefit of this approach, however, is that the investment required can be facilitated on a project-by-project basis or even speculatively, in line with what we have seen to date.

“A one-stop shop is not the best solution. The UK needs three or four staging ports.” (Developer)

More proactive industry involvement in industrialisation

The findings of this study have shown that there is sufficient UK east coast staging port capacity to meet anticipated demand. It has also shown that although the availability of staging facilities is a benefit, it is not a dominant driver for stimulating industrialisation.

There has, however, been feedback from consultees about other ways that the sector could stimulate greater industrialisation in the UK. In particular, many consultees suggested that more could be done by industry to coordinate and accelerate inward investment through greater communication and information sharing. The UK Government is already playing an important role in working with developers and suppliers through the Department of Energy and Climate Change (DECC) and UK Trade and Investment (UKTI).

While consultees were unable to offer any clear suggestions about how such involvement could be structured, there was general agreement that a more engaged role for industry in this process would make it more likely that investment can be unlocked and an openness to support any new initiatives.

“Some method for sharing opportunities for helping to build up the pipeline for a potential new UK supplier would make a difference. Suppliers must be at the heart of the solution.”

(Developer)

“If the industry is going to have a long term future with UK content, it has to look at the way it shares relevant information to maximise opportunities for UK supply chain opportunities.” *(Developer)*

Offshore Wind Industry Council

Appendix A: Consultees

Name	Type
Department for Business, Innovation and Skills	Central Government
Department for Communities and Local Government	Central Government
Department for Energy and Climate Change	Central Government
Department for Transport	Central Government
HM Treasury	Central Government
UK Trade and Investment	Central Government
Highlands and Islands Enterprise	Regional government
Humber Local Enterprise Partnership	Regional government
New Anglia Local Enterprise Partnership	Regional government
Scottish Enterprise	Regional government
The Scottish Government	Regional government
North East Local Enterprise Partnership	Regional government
DONG Energy	Developer
E.ON Climate & Renewables	Developer
EdF Energy Renewable	Developer
EDP Renewables	Developer
Iberdrola Renewables Offshore	Developer
Mainstream Renewable Power	Developer
RWE Innogy	Developer
SSE	Developer
Statkraft	Developer
Statoil	Developer
Vattenfall	Developer
Adwen	Supply chain
Babcock International	Supply chain
Bilfinger Mars Offshore	Supply chain
Boskalis	Supply chain
Burntisland Fabrications	Supply chain
GE Renewable Energy	Supply chain
Jan De Nul	Supply chain
MHI Vestas Offshore Wind	Supply chain

MPI Offshore	Supply chain
Seaway Heavy Lifting	Supply chain
Sembmarine SLP	Supply chain
Siemens Wind Power	Supply chain
Smulders Projects	Supply chain
Aberdeen Harbour	Port owner/operator
Able UK	Port owner/operator
Associated British Ports	Port owner/operator
Cromarty Firth Port Authority	Port owner/operator
Fife Council/Scottish Enterprise	Port owner/operator
Forth Ports	Port owner/operator
Global Energy Group	Port owner/operator
Hutchinson Port Holdings	Port owner/operator
Montrose Port Authority	Port owner/operator
PD Ports	Port owner/operator
Peel Ports	Port owner/operator
Port of Blyth	Port owner/operator
Port of Tyne	Port owner/operator
Shepherd Offshore	Port owner/operator
Sunderland City Council	Port owner/operator