North East LEP

Research Study into the North East Offshore Wind Supply Chain

Final Report

March 2020

Cambridge Econometrics
Cambridge, UK

jd@camecon.com
www.camecon.com

Cambridge Econometrics' mission is to provide clear insights, based on rigorous and independent economic analysis, to support policy-makers and strategic planners in government, civil society and business in addressing the complex challenges facing society.

Cambridge Econometrics Limited is owned by a charitable body, the Cambridge Trust for New Thinking in Economics. www.neweconomicthinking.org

Authorisation and Version History

Version	Date	Authorised for release by	Description
1.0	22/11/19	Jon Stenning	First draft of final report
1.1	19/12/19	Jon Stenning	Further draft of final report, incorporating changes in response to client comments.
1.2	24/01/19	Jon Stenning	Final report, incorporating a further, final round of client comments.
1.3	24/03/20	Jon Stenning	Final report, incorporating some client final comments and a revised executive summary.

Contents

Page

Executive Summary

The UK government has recently updated the Climate Change Act, to increase the rate of decarbonisation of the UK economy and reach net-zero GHG emissions by 2050. This will require stringent policy in order to be realised, and the UK electricity generation network will have to decarbonise more rapidly than previously anticipated in response. At the same time, the government's Industrial Strategy has outlined key priorities for the coming years, including the Offshore Wind Sector Deal, detailing ambitious aims for the offshore wind sector. Local authority and LEP-level economic strategies are seeking to prioritise good quality jobs and increasing local productivity. In the context of this national and regional policy, the offshore wind sector can play a major role in the economic development of the North East.

The research study into the North East offshore wind supply chain seeks to provide a better understanding of the opportunities the offshore wind sector presents for economic growth and employment in the North East, and how the North East LEP and other regional stakeholders can support the local supply chain and deploy the wider regional asset base to realise this value.

What local economic impacts are created by future offshore wind sector opportunities?

The offshore wind cluster located in the North East has many existing strengths, such as an extensive and well-connected supply chain, leading innovation and testing facilities, good infrastructure, and an extensive skills and knowledge base built upon a long maritime and engineering heritage. Given the current capabilities and competitive advantages of the North East's offshore wind industry, the Offshore Wind Sector Deal (the Deal) offers a major opportunity for the region, with the North East also recognised as a key region for delivery of the Deal's national ambitions. A key question is precisely how large the impact on the North East economy could be under different assumptions about the level of involvement of the region's supply chain in delivering future projects within the UK and overseas.

The potential GVA and employment effects from future expansions in the offshore wind installed capacity in the UK were estimated using a purpose-built Offshore Wind Model, originally developed by Cambridge Econometrics (CE) for RenewableUK.

In the next decade, total offshore wind employment in the UK could peak at around 25,000 jobs

Based on the expected future installed capacity up to 2030, Cambridge Econometrics' Offshore Wind Model estimates that total employment in the UK's offshore wind sector will peak in 2024, driven by peaks in demand for labour-intensive installation and manufacturing output. In 2024, total UK employment across all stages of the offshore wind direct supply chain reaches just over 24,500 jobs, over twice the current number of jobs in the sector. In 2030, when 35 GW of UK installed capacity is expected, there are estimated to be just over 19,000 jobs across the UK in the direct supply chain of the offshore wind sector. These estimates are based on projects which are currently consented or under construction.

A range of scenarios are explored to investigate the impacts in the North East

To estimate the contribution of the North East to the development, production, installation, operation and decommissioning of future UK offshore wind sector developments, assumptions were made on the relative contribution of businesses located in the region to each stage of the supply chain. A range of scenarios were developed in which the contribution the North East makes to the overall UK offshore wind supply chain is assumed to change, in most cases reflecting efforts to increase obtained market share:

- Scenario 1 is a 'positive' scenario in which the North East region successfully attracts a manufacturer, and/or associated supply chain, of nacelles, rotor blades or towers for large wind turbines into the region.
- Scenario 2 is a further positive scenario in which the North East's share of global activity increases steadily.
- Scenario 3 is another positive scenario where it is assumed that there is consolidation of the offshore wind industry, in response to a larger UK pipeline but at tighter margins, leading to the North East's share of the UK market increasing.
- In Scenario 4 it is assumed that as the global industry expands, so do the benefits of large volumes of manufacturing taking place in low-cost parts of the world, and hence the North East's region's position in balance of plant and decommissioning is diminished, leaving the North East with a smaller portion of the global industry than currently.

A peak in employment is reached in 2025 across all scenarios

In all scenarios, employment gradually increases between 2019 and 2025, as the deployment of offshore wind energy increases across the UK. While the model estimates a decline in the number of jobs existing within earlier stages of the offshore wind life cycle between 2025 and 2027, employment in earlier stages of the supply chain could reasonably be expected to continue momentum past the 2025 peak estimated by the model. This is because the model only takes in to account current planned projects and does not take in to account future projects which enter the pipeline. After 2027, total employment in the sector is also strengthened by a growing number of jobs in later stages of the supply chain, such as operations and maintenance and decommissioning services.

Strengthening the North East's overseas offering and attracting manufacturers offers the greatest direct economic opportunities

Scenario 2, in which the North East's share of global activity increases steadily, is the scenario in which the highest number of jobs are created within the direct offshore wind supply chain, reaching a peak of 4,600 in 2025. The general trend in the levels of gross value-added follow that of employment in the region over the period 2019 – 2030, with a peak in all scenarios noticed in 2025. In terms of GVA, Scenario 1, in which the North East region successfully attracts a manufacturer and/or supply chain of nacelles, rotor blades or towers for large wind turbines into the region, generates the highest levels of economic output of all the scenarios.

Further, knock on economic benefits are also experienced in the North East

The knock-on impacts of the increased investment in installed offshore wind capacity, once the effects have fully circulated through the economy are also considered. These wider economic impacts include the impact on the wider supply chain considering upstream providers (indirect impacts) and the impacts on household spending considering increased employment leads to higher aggregate household incomes (induced effects).

The results of the analysis show that in 2025, when a peak in direct economic benefits is experienced, up to a further 2,500 jobs may be created and up to an additional £144m GVA generated (in Scenario 2 for example) in additional sectors such as construction, employment services, architectural and engineering services, management consulting services and land transport services located within the North East, as an indirect result of a growing North East offshore wind sector. Furthermore, within the North East region, up to 1,600 additional jobs may be generated in the most optimistic of the scenarios (Scenario 2) in 2025, as a result of increased household spending. These jobs will typically be created in sectors in which households spend a large proportion of disposable income, such as retail and leisure activities.

A number of international opportunities exist

The global offshore wind sector has expanded significantly in recent years, with installed capacity more than tripling globally between 2011 and 2017. By the end of 2017, nearly 84% of all offshore installations were located in the waters off the coast of eleven European countries, the rest being located mainly in China and other Asian countries. Europe is expected to continue the expansion of its offshore wind sector installed capacity, but the bulk of future expansion is expected to come from China. Other countries with ambitions in the offshore wind sector are South Korea, Japan, Taiwan and the US. Untapped markets represent sizeable opportunities for the North East offshore wind sector, which could gain market shares thanks to favourable business conditions, government support and its specific strengths.

In particular, given the presence of trade barriers and focus on local content by individual governments, the North East could benefit from the provision of services and expertise, to help countries with nascent offshore wind industries to develop a local supply chain. The US is deemed to be the most attractive destination for North East's exports because of a local supply chain needing advice and lower linguistic and cultural barriers which would facilitate the establishment of joint ventures between North East and American companies. However, all export markets present potential opportunities for the region.

Key takeaways of the analysis

- The North East cluster has many **existing strengths and opportunities**; it is a **strong player** in the UK industry and a key region for delivery of the Deal's ambitions, with fir**st mover advantages** and has the opportunity to lay the groundwork for **further development during the global expansion** of the industry.
- **Assuming a continuation of its current position** in the UK sector, in the next decade employment in the North East cluster's direct supply chain could reach **3,500 jobs and be worth up to £140m in GVA**
- **Further development of the sector**, by strengthening the supply chain, strengthening the region's export offering or using existing strengths to dominate the UK market **could reap additional economic rewards**
- With further strategic development, the number of jobs existing in the direct supply chain of the sector could reach **4,600 jobs and generate up to £180m in GVA**
- Furthermore, **an additional 3,000 – 4,000 jobs could be supported by the offshore wind sector through indirect supply chains and other economic impacts** within the region
- Therefore, total jobs in both direct and indirect supply chains for offshore wind could reach over 8,500 with strategic development of the sector.
- **Plus an additional 2,000 – 3,000 jobs could be supported in the rest of the UK** as a result of increased activity in the North East's offshore wind sector

Recommended strategic interventions

Finally, all the key findings have been brought together to form evidenced policy recommendations, which could support the development of the North East's offshore wind industry:

- The North East would benefit from enhanced coordination and cooperation between local firms. Such collaborations should focus on business development, skills and innovation, in order to play to the region's existing strengths. Cluster bodies should coordinate collaborative programmes across these topics between firms. Current cluster structures, such as the Energi Coast cluster body, should build on its current position and provide the platform for development of focused programmes of cluster development action including in skills and innovation.
- The North East offshore wind cluster can be strengthened by developing stages of the supply chain where it is currently less well represented. Currently, no wind turbine manufacturing takes place within the region. Attracting inward investment from a manufacturer or the supply chain of either nacelles, rotor blades or towers for large wind turbines would strengthen this stage of offshore wind development, completing the North East's offering. However, attracting inward investment should not be

limited to turbine manufacturing stage of the supply chain, but sought across all stages.

- There is the need to provide certainty for potential investors by ensuring the required infrastructure is in place to support manufacturers and supply chain businesses. The creation of a port infrastructure fund would ensure that the ports located within the region can facilitate large scale manufacturing and installation.
- A skills programme should be developed, to ensure pathways are in place to meet the anticipated needs of offshore wind firms. Such a programme should be designed in collaboration with project developers, existing local firms operating in the offshore wind sector and local universities and educational institutions.
- An innovation programme should be developed, with central involvement of key innovation organisations. This should be supported and coordinated under the umbrella of a cluster body, to include the wider ecosystem of firms surrounding the core offshore wind supply chain.
- A stronger relationship should be built with central government, in order to be able to draw attention to matters important to the North East. In the context of this study, such matters include the aims of the North East's local industrial strategy and the development of its offshore wind cluster.
- The UK's future trading relationship with the EU is currently uncertain. The negotiated deal will have inevitable consequences for trade between the UK and other European countries, including trade in goods and services related to offshore wind. Export opportunities in developing markets further afield would become increasingly important in a no-deal scenario. Local policy makers can assist firms in the North East by consulting with them to fully understand what support would be required in the event of the introduction of substantive trade barriers, and to understand the desired requirements when negotiating trade deals with other countries. Furthermore, greater support from cluster bodies can also be extended to help the North East cluster strengthen its export offering. By promoting the region's supply chain capabilities, innovative technologies and practices, and existing infrastructure, the region can be showcased to overseas developers.

1 Introduction

1.1 The background to the study

Policy background

The UK government has recently updated the Climate Change Act, to increase the rate of decarbonisation of the UK economy and reach net-zero GHG emissions by 2050. This will require stringent policy in order to be realised, and the UK electricity generation network will have to decarbonise more rapidly than previously anticipated in response. At the same time, the government's Industrial Strategy has outlined key priorities for the coming years, including the sector deal for the offshore wind industry. Local authority and LEP-level economic strategies are seeking to prioritise good quality jobs and increasing local productivity. In the context of this national and regional policy, the offshore wind sector can play a major role in the economic development of the North East, including helping to mitigate any economic losses that are felt as a result of the shift away from conventional carbon-intensive technologies and towards new low-carbon alternatives.

Offshore wind in the North East

The North East has, for a number of years, been a major hub of activity for the UK offshore energy and subsea technology sectors. The North East LEP's Strategic Economic Plan (2014, updated in 2017 and 2019), and *Energy for Growth* strategy (North East LEP Undated) highlights the region's strategic importance in the global offshore and subsea industries and its potential importance in delivering against key regional economic objectives including more and better jobs and enhanced regional productivity, listing a range of local companies delivering projects worldwide in the sector, including those covering the design and fabrication of pipelines and umbilicals, the laying of offshore foundations, the development of remotely-operated subsea vehicles and more.

The region's strong pedigree extends to offshore wind specifically. The UK's first offshore wind farm was constructed off the coast of Blyth in 2000, and the region has since become a national centre for offshore renewable energy technology and innovation. Leading the way in terms of offshore wind innovation is the Offshore Renewable Energy Catapult (OREC), located in Blyth, which offers unique facilities for offshore renewable energy research and development. Since the construction of the first windfarm in Blyth, the North East region has also established dedicated supply chains and supporting infrastructure as the offshore wind industry has grown. Energi Coast was established in 2011, to promote the regional industry offering through business development, and rapid expansion has been achieved as the role played by offshore wind in the UK electricity generation mix has grown (from 0.8% of generation in 2010 to 8.0% in 2018 (The Crown Estate 2018)).

In this context, the Offshore Wind Sector Deal, announced by BEIS in March 2019 (HM Government 2019), offers a major opportunity for the region. Key aims of the Sector Deal include;

- Delivering increased offshore wind capacity (up to 30GW by 2030) through continued government funding of Contracts for Difference
- Increasing the proportion of UK content in offshore wind farms to 60% by 2030

- Increasing exports fivefold to £2.6bn by 2030.
- Generating good jobs and greater earning power within the industry, broadening the UK offshore wind skills base, and increasing diversity in the sector's workforce.

If these aims are achieved, it will lead to substantial increases in employment and output of the sector. Existing research suggests that such a deployment would support around 27,000 jobs across the UK (Vivid Economics 2018). As one of eight offshore wind clusters recognised in the Offshore Wind Sector Deal, a substantial proportion of these benefits would be expected to be realised in the North East. A key question is precisely how large the impact on the North East economy could be under different assumptions on the delivery of projects in the pipeline and the level of involvement of the region's supply chain.

Aims of this study

The overarching aim of this study was to better understand the opportunity the offshore wind sector presents for economic growth and employment in the North East, and how the North East LEP and other regional stakeholders can support the local supply chain and deploy the wider regional asset base to realise this value.

This study achieves this aim by first directly quantifying the potential socioeconomic impacts, in terms of job creation and gross value added (GVA), of future opportunities. The study then considers the strengths and weaknesses of the local sector, what these mean in terms of realising potential socioeconomic impacts, and who the sector should engage with to realise them. It examines a number of potential strategic scenarios for future regional growth through this sector. The study concludes with various recommended policy interventions to assist the sector in fully realising its potential.

1.2 Overview of the approach to the study

Geographical scope of this study

This study covers the geographical area falling under the remit of the North East LEP which includes the territorial geography of the seven Local Authorities identified in Figure 1.1. It is recognised that the North East cluster covers a geography which also includes the territory covered by the Tees Valley Combined Authority and many of the findings will be of relevance to the wider geography. However, when referring to the 'North East', the study is referring to the North East LEP area presented in Figure 1.1.

Figure 1.1 The North East LEP area

Source: North East LEP

The analysis presented in each chapter was carried out using well-defined and rigorous approaches, combining elements of quantitative and qualitative methods. Information used to inform the findings was collected from various evidence streams, including secondary data, literature reviews, quantitative modelling and a substantial focus on stakeholder engagement. Further details about the approach taken is provided within each chapter.

1.3 Structure of the report

This rest of this report presents the findings of the study, and is structured as follows:

- Chapter 2 presents an overview of the North East's supply chain businesses and capabilities across the components and processes involved in the development of an offshore wind farm, and presents an assessment of the strengths and competitive advantages of the existing supply chain.
- Chapter 3 considers future possibilities for the North East's offshore wind supply chain in terms of changes to the level of contribution the region makes to planned offshore wind developments. The analysis considers the

economic impacts of various future scenarios, in terms of changes to GVA and jobs.

- Chapter 4 considers the potential export opportunities available firms operating within the North East's offshore wind supply chain.
- Chapter 4 explores the strengths and weaknesses of the North East offshore wind supply chain in more detail by exploring sub-regional clusters.
- Chapter 0 identifies the key developers and tier 1 and 2 contractors for the North East supply chain to engage with, to capitalise on the most significant job and GVA creation opportunities identified earlier in the study.
- Finally, Chapter 7 recommends various strategic interventions which could help realise the economic opportunities identified in the study.

2 The capabilities and competitive advantages of the North East's offshore wind supply chain

2.1 Introduction

The North East has a strong history in energy-related and industrial innovation and engineering, stretching back to the industrial revolution and, more recently, including the modern offshore oil and gas industry. The UK is one of the leading countries in the offshore wind industry and the North East continues to be essential to this. The North East benefits from a rich mix of local enterprises and global organisations operating in this sector, many of which are innovative in their field and provide high-value, bespoke engineering capability.

In addition to the supply chain companies, on which this study focuses, the North East has a world class presence in terms of skills, infrastructure and innovation, including in the offshore sector in particular. There are numerous colleges and universities with leading expertise in offshore technology. The North East is home to three major ports with excellent road, air and rail connections. In combination, these skills, infrastructure and supply chain organisations come together to form a high calibre innovation hub.

As a first step in this research, we have undertaken an assessment of the North East's capabilities in the offshore wind market to identify the capabilities and competitive advantages of the local supply chain in the sector. Our approach and findings are presented below.

2.2 Methodology

Definition of components and processes in development of offshore wind projects

The development stages of an offshore wind farm were taken as defined in the "Guide to an offshore wind farm" document produced by The Crown Estate and the Offshore Renewable Energy Catapult. This defines six over-arching development stages:

- Development and project management
- Turbine manufacture
- Balance of plant
- Installation and commissioning
- O&M and servicing
- Decommissioning

These development stages were used as the basis for analysis across the different supply chain stages. In total, the stages are composed of 29 sub-stages, which are further split into sub-components and sub-processes.

Table 2.1 Offshore wind development stages

P Development and Project management	T Wind Turbine	B Balance of Plant	I Installation and Commissioning	O Operation, maintenance and service	D Decommissioning
P.1 Development & Consenting Stages	T.1 Nacelle	B.1 Cables	I.1 Foundation Installation	O.1 Operations	D.1 Turbine Decommissioning
P.2 Environmental Surveys	T.2 Rotor	B.2 Turbine Foundation	I.2 Offshore Substation Installation	O.2 Maintenance and Service	D.2 Foundation Decommissioning
P.3 Resource & Metocean Surveys	T.3 Tower	B.3 Offshore substation	I.3 Onshore Substation Construction		D.3 Cable Decommissioning
P.4 Geological and hydrographical surveys		B.4 Onshore substation	I.4 Onshore Export Cable Installation		D.4 Substation Decommissioning
P.5 Engineering and consultancy		B.5 Operations Base	I.5 Offshore Cable Installation		D.5 Decommissioning port
			I.6 Turbine Installation		D.6 Reuse, Recycling or Disposal
			I.7 Construction Port		
			I.8 Offshore Logistics		

Information gathering on North East offshore wind supply chain businesses and capabilities

A number of primary and secondary research sources were used to compile a comprehensive list of the companies participating in the offshore wind supply chain. These include:

- Energi Coast Regional Capabilities database
- NOF Supply Chain Directory
- Guide to an offshore wind farm
- 4COffshore
- Renewable UK
- Energy for Growth prospectus
- DueDil
- Kompass GB
- Companies House

- Company Websites

For the purpose of this study, supply chain businesses were considered to be companies that participate in the core activities in the development of offshore wind farms. We did not consider in detail the surrounding, auxiliary businesses and institutions, such as education and research facilities and the infrastructure providers such as the ports themselves. These organisations may clearly have a further, indirect impact on job creation and GVA.

We also note that there are a range of emerging technologies and innovations in the digital and smart systems space, including automation through artificial intelligence, machine learning and robotics, that are not fully captured by the definition of the offshore wind supply chain presented above. The impact of these innovations is difficult to predict, and hence not included in detail in this study. However, we note that the North East is a significant player in these areas and is likely to derive substantial value from these innovations as they enter the mainstream across the offshore wind sector and a wide range of other sectors, and could accelerate this through strengthened co-ordination in the region as a particular opportunity.

The methodology used to gather information on supply chain businesses and capabilities was based on these primary and secondary data sources using the following workflow:

1 Map the relevant stages and sub-stages from the ‘Guide to an offshore wind farm’ document

2 Aggregate data from online sources (Energi Coast, NOF, Energy for Growth prospectus)

3 Identify historical supply chain participants from the ‘4Coffshore’ website

4 Identify key business data

5 Use address data to identify companies located in the North East LEP area

6 Allocate companies based in the North East to relevant stages and sub-stages

This resulted in a comprehensive data set including company name, company number, registered address, trading address, alternative address, facility type, SIC code, net assets, number of employees and turnover. The facility type and SIC codes were used to help identify the activity of the organisation, alongside desk-based research. We note that the data on turnover and number of employees proved to be of limited use in the assessment of the level of activity and strength of the sector in the North East. The main reason for this is that typically the turnover and employee data cover all the activities of the company. Hence, discerning the turnover or number of employees active in the offshore wind industry for large companies operating across multiple industries, as in many cases identified, is not possible without further information from the organisation. In addition, smaller companies are not required to publish their financial information, creating numerous gaps in the turnover data.

In total, data was collected for 532 companies based across the UK that were identified as being active in the offshore wind supply chain. After matching registered, trading or alternative addresses to postcodes within the North East LEP area, 130 relevant North East companies were identified and brought forward to the next stage of the research.

The companies that were brought forward to the next stage of research were also mapped across the North East area, as a visual aid to identify clusters. The mapping process was limited by the data available. In most cases, the companies had registered or trading addresses available. However, some companies had alternative email addresses that were listed in online registers or on the company websites. In other cases, the companies may have had alternative facility addresses which were not listed and may have been omitted. While the maps reflect the best locational information available to us, there remains the potential for omissions and propagation of any inaccuracies in source data. The maps should therefore be considered indicative of the distribution of activity across the North East rather than exhaustive.

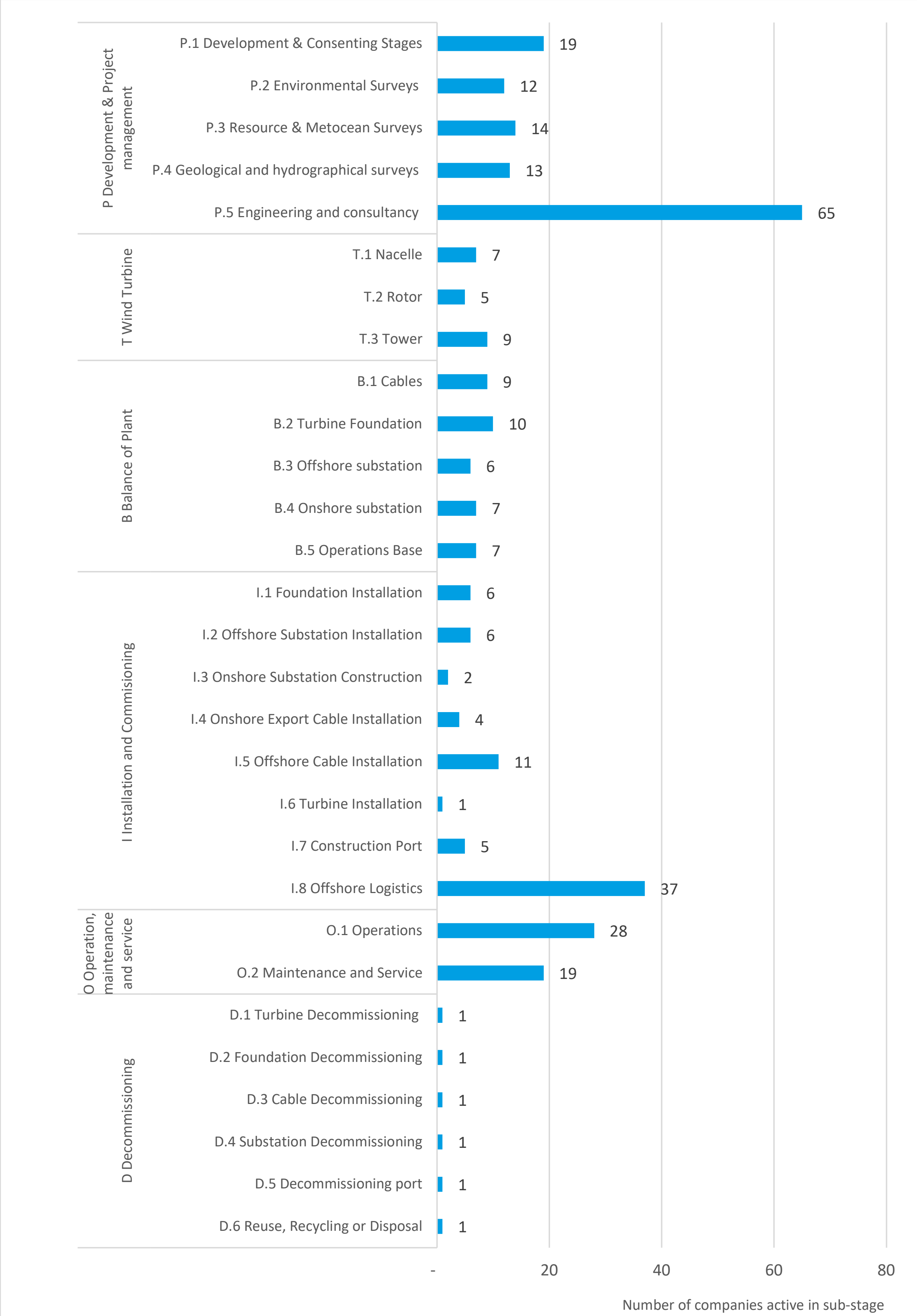
Mapping of the supply chain to the relevant components and processes

We carried out desk-based research, including a review of individual company websites, to understand the activities of each identified organisation and thereby map each organisation to one or more of the stages and sub-stages of the offshore wind development supply chain.

In some cases, the limited availability of data on company websites and other sources means that there was some uncertainty over the most appropriate allocation of the company to the development stages and sub-stages. However, we were able to better define the activity of many of those companies through the stakeholder engagement process, and the final dataset produced incorporates this information. The stakeholder discussions were also used to identify additional facilities not identified through the process described in Section 0.

The resulting data set allocated the 130 companies to 308 sub-stages, with a minimum of one and a maximum of seven sub-stages per company.

Figure 2.1 Overview of company allocations to stages and sub-stages



Assessment of strengths of the region and competitive advantage versus other UK regions and internationally

We have also compared the relative strengths and weaknesses of the offshore wind sector in the North East with those of the rest of the UK and of major international competitors, thereby identifying key regional competitive advantages. This was completed through desk-based research and supported by the stakeholder engagement process.

A range of relevant stakeholders, drawn largely from organisations in the North East with some representatives of the sector at a national level, were asked the following questions, the responses to which were used in our assessment of the regional strengths and competitive advantages as summarised in the following section.

Questions for supply chain businesses and infrastructure providers:

Who are your main clients?

What is the average value of these contracts?

Who are your main subcontractors?

What is the average value of these contracts?

Do you expect the number of contracts to increase in the next 10 years?

Do you expect to be able to capture more value through your contracts in the next 10 years?

Questions for national/international stakeholders:

Do you have an overview of the total value of contracts in the UK/ NE offshore wind market?

Do you know who are the biggest players in the NE market?

Questions for project developers:

What is the total value of the supply chain of your projects in the NE?

How many of your suppliers for these projects are situated in the NE?

How much value of your supply chain is distributed in the NE?

2.3 Findings

As described above, data was gathered on the activity of 130 companies active in the offshore wind sector in the North East LEP area to inform an assessment of the capabilities and competitive advantages of the region’s supply chain in this sector. Below, we present the findings of the assessment in relation to each of the six over-arching development stages.

Development and Project Management

The Development & Project Management stage of an offshore wind project is broken down into 5 substages:

- P.1 Development & Consenting Stages
- P.2 Environmental Surveys
- P.3 Resource & Metocean Surveys
- P.4 Geological and hydrographical surveys
- P.5 Engineering and consultancy

The table below shows the number of organisations found to be active in each sub-stage. Our research identified 70 companies in the North East active in this stage. The most common sub-stage activity was found to be P.5 Engineering and consultancy, with 65 companies considered to be working in this area.

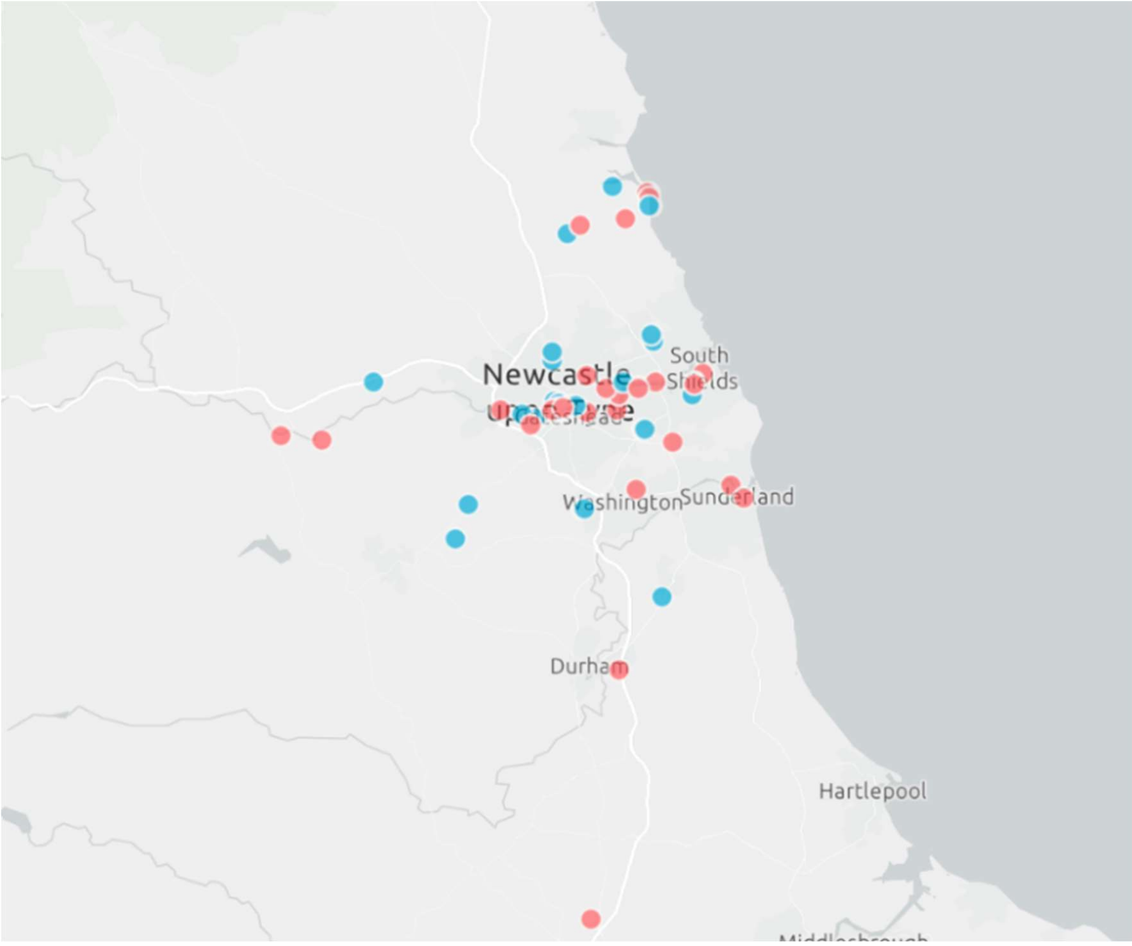
Table 2.2 Development sub-stages

Development sub-stages	Count
P.1 Development & Consenting Stages	19
P.2 Environmental Surveys	12
P.3 Resource & Metocean Surveys	14
P.4 Geological and hydrographical surveys	13
P.5 Engineering and consultancy	65

The location of the 70 companies active in this development stage has been mapped, as shown in the figure below. The location of each relevant address has been allocated to a facility type of either 'Office' or 'Manufacturing/Operations' based on desk research.

The map shows a high concentration cluster forming within Newcastle and along the Tyne. There is a secondary cluster further north in the Port of Blyth, and a third less distinct cluster in Sunderland and on the Wear. The manufacturing/operations facilities in particular are clustered along the rivers for easier access.

Figure 2.2 Map of companies active in the Development and Project Management stage (Red=Manufacturing/operations, Blue=Offices)



Much of the Development and Project Management stage is focused around collecting and interpreting data for the planning of the project. The strength of the North East supply chain in this area results from the extensive experience in offshore project development, including the oil industry, which has given rise to an ecosystem of local, national and international companies. The most active organisations identified include AECOM, Natural Power, Ramboll, Royal Haskoning, Fugro Geoservices, DeepOcean, Cathie Associates, Texo, Royal IHC and DNV GL. The presence of numerous organisations in the area working at this early stage of project development presents an opportunity for the rest of the offshore wind supply chain in the region to leverage the market intelligence generated by these organisations. It is also worth noting that many of these organisations operate internationally, and so the intelligence generated is relevant for the North East's export offer. An objective should therefore be to ensure that the companies active in this stage are well-connected to the rest of the local supply chain.

The region is also home to companies using technical innovation to contribute to offshore wind project development. For example, using robotics and artificial intelligence (AI), organisations such as Fugro and DeepOcean have advanced the Remotely Operated Vehicles (ROVs) industry and as a result have reduced the time and costs of conducting certain surveys. Companies such as Cathie Associates have invested heavily in R&D to advance the ways in which this data is processed and used. Organisations such as Natural

Power, Ramboll, Royal Haskoning, and AECOM use their extensive engineering and project management experience to streamline early-stage project workflows and to create value in the planning and development of offshore wind farms.

It is worth noting that many of these organisations, including AECOM, Ramboll, Royal Haskoning, Texo, DNV-GL, Balmoral Offshore Engineering have offices outside the North East, and the portion of the planning and development work actually undertaken in their North East offices is not known.

Wind Turbine

The Wind Turbine stage of an offshore wind farm is broken down into 3 substages:

- T.1 Nacelle
- T.2 Rotor
- T.3 Tower

The table below shows the number of organisations active in each sub-stage. Our research identified 13 companies in the North East active in this stage.

Table 2.3 Wind Turbine sub-stages

Wind Turbine sub-stage	Count
T.1 Nacelle	7
T.2 Rotor	5
T.3 Tower	9

The map below presents the companies active in the Wind Turbine stage. It shows that there is a strong presence of 'Manufacturing/Operations' facilities out of which four are based on the Tyne and only two 'Office' type facilities, one in North Tyneside and another in Blyth.

Figure 2.3 Map of companies active in the Wind Turbine stage (Red=Manufacturing/operations, Blue=Offices)

The research suggests that the wind turbine development stage is relatively under-represented in the North East. While there are a small number of organisations operating in this stage of the value chain, there is no turbine manufacturing site in the region, and these organisations rather provide auxiliary services to the main turbine suppliers which are based outside of the North East LEP area.

ThyssenKrupp, DNV GL, Rolls Royce and ABB A/S are the biggest organisations in this stage of the supply chain with a presence in the North East. ThyssenKrupp provides a host of components for the nacelle, DNV GL provides control systems for the nacelle, whereas Rolls Royce provides elements such as bedplates and hub casting to manufacturers. However, due to the fact that these organisations have multiple locations, it is difficult to understand exactly which facilities produce these components. Other smaller companies such as Freudenberg Sealing Technologies (sealing) and Barrier Limited (Coating) provide smaller components or services to this stage.

Stakeholders reported that the strength of the North East in the wind turbine stage lies in the bespoke engineering sector where companies such as Osbit and Responsive Engineering provide engineering support and problem solving for issues arising during installation of the wind turbine.

Balance of Plant

The Balance of Plant stage of an offshore wind project is broken down into 5 substages:

- B.1 Cables
- B.2 Turbine Foundation
- B.3 Offshore substation
- B.4 Onshore substation
- B.5 Operations Base

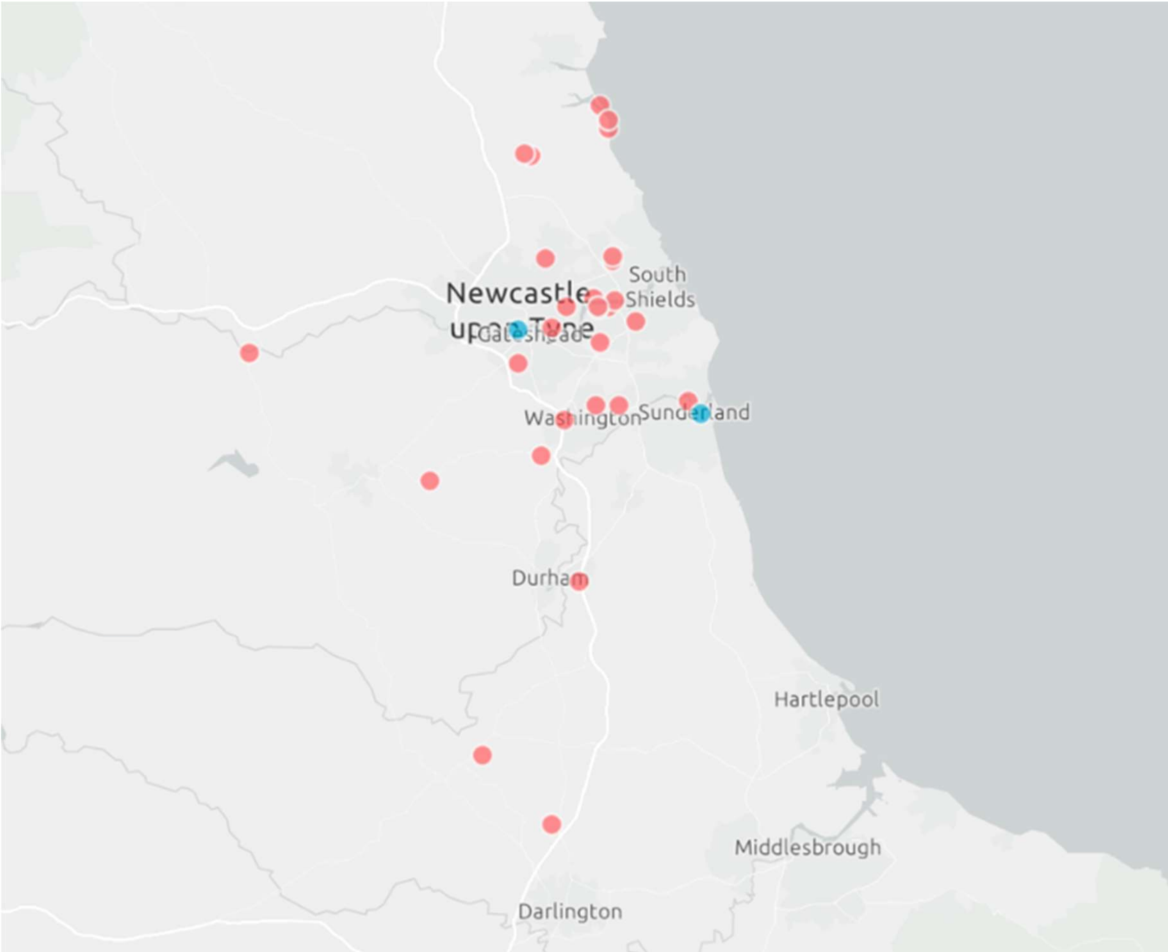
We have identified 30 companies that are active in this stage, reflecting a broad base of activity in the region in turbine foundations, cables and electrical systems. The table below shows how they are allocated across the sub-stages.

Table 2.4 Balance of Plant sub-stages

Balance of Plant sub-stages	Count
B.1 Cables	9
B.2 Turbine Foundation	10
B.3 Offshore substation	6
B.4 Onshore substation	7
B.5 Operations Base	7

The map below shows the type of facilities in this stage and how they are distributed across the North East LEP area. The ‘Manufacturing/Operations’ facilities outnumber the ‘Offices’ in the area. Three distinct clusters form in the Port of Blyth, in Newcastle along the Tyne and along the Wear in Sunderland.

Figure 2.4 Map of companies active in the Balance of Plant stage (Red=Manufacturing/operations, Blue=Offices)



The turbine foundation is one of the largest cost components of this stage, requiring about 50% of the total capital expenditure. In the North East LEP area, Smulders is a large and well-known manufacturer of components for this stage, building foundation jackets. Several other companies also serve this sub-stage, including Kloeckner Metals UK (metal supply) and Barrier Limited (Coatings).

Cables are an important part of the local supply chain for this development stage. In the North East, there are two significant players operating in this area: Tekmar, which is a specialist in cable protection coatings, and JDR Cables, which creates inter-array cable systems (note that JDR's main manufacturing facility is in Teesside, but its main corporate office is in Newcastle).

ABB A/S is an international player with facilities in the North East, supplying the electrical systems for offshore substations. Aggreko is another international company which supplies the equipment and machinery for the installation of the substations. ABB A/S also supplies the electrical systems for onshore substations, and Balfour Beatty Capital Limited provide the substation housing. It is worth noting that onshore substations are significantly less capital intensive than offshore substations, and hence generate less value per project.

The operations base for offshore wind projects is usually built by local construction companies. The key organisations in the North East are Balfour Beatty Capital Limited and Portakabin Limited.

Installation and Commissioning stage

The Installation and Commissioning stage of an offshore wind farm is broken down into 8 substages:

- I.1 Foundation Installation
- I.2 Offshore Substation Installation
- I.3 Onshore Substation Construction
- I.4 Onshore Export Cable Installation
- I.5 Offshore Cable Installation
- I.6 Turbine Installation
- I.7 Construction Port
- I.8 Offshore Logistics

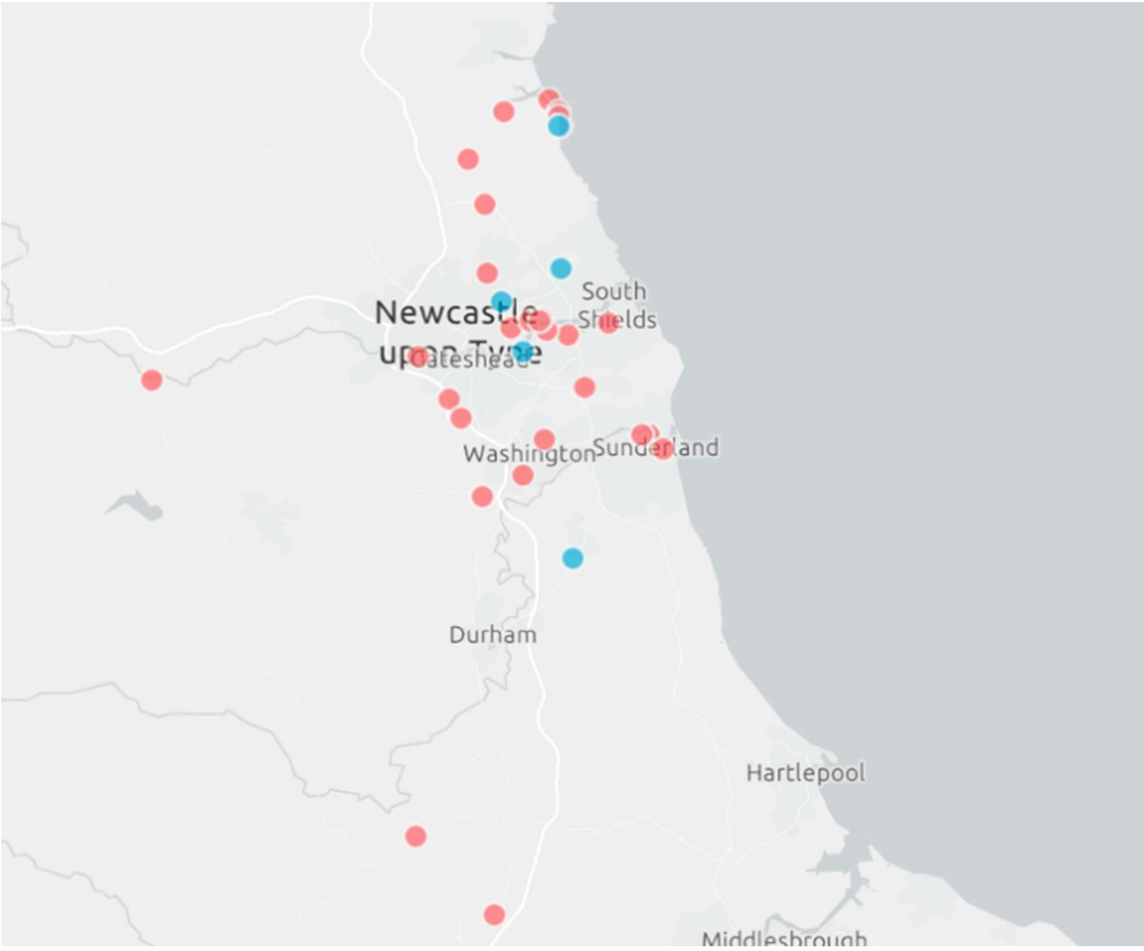
Our analysis identified 46 companies that are active in the over-arching Installation and Commissioning stage. The table below shows how they are distributed across the 8 sub-stages. The most common sub-stage activity has been found to be 'Offshore Logistics' with 37 companies considered to be active in the sector.

Table 2.5 Installation and Commissioning sub-stages

Installation and Commissioning sub-stages	Count
I.1 Foundation Installation	6
I.2 Offshore Substation Installation	6
I.3 Onshore Substation Construction	2
I.4 Onshore Export Cable Installation	4
I.5 Offshore Cable Installation	11
I.6 Turbine Installation	1
I.7 Construction Port	5
I.8 Offshore Logistics	37

The map below shows the distribution of the companies active in Installation and Commissioning. The companies are spread out across the North East LEP area, with clusters forming around the Port of Blyth, the Tyne and the Wear. The offshore logistics companies are distributed across all three ports. However, there is a particularly large concentration in the Port of Blyth, which hosts a range of prominent organisations active in subsea technologies and related services such as cable laying, trenching and repair.

Figure 2.5 Map of companies active in the Installation and Commissioning stage (Red=Manufacturing/operations, Blue=Offices)



The Installation & Commissioning stage of an offshore wind farm is an essential part of the North East's competitive advantage in the industry. This stage is heavily reliant on assembly and transport. Due to the close proximity to projects, the North East benefits from reduced site access costs, making it much more competitive in the national and international market.

There are clear offshore wind industry leaders in the North East active in this stage. These companies include Balfour Beatty, DeepOcean, Global Marine, Osbit, Royal IHC, SMD, Tekmar, MPI Offshore, Natural Power and DNV-GL. The companies listed above are leaders in the most capital-intensive parts of this stage, such as foundation installation (Osbit, MPI Offshore), offshore substation installation (ABB A/S), onshore substation construction and onshore cable installation (Balfour Beatty) and offshore cable installation and protection (DeepOcean, SMD, OSBIT, Royal IHC, Tekmar). We have not identified organisations active in turbine installation.

The ports play a key role in this stage. They have strong existing expertise in installation and commissioning, developed through prior projects in the offshore wind industry and due to the presence of an established oil & gas industry, particularly in the Port of Blyth and the Port of Tyne. While the Port of Blyth is currently deemed the most well-equipped in terms of the variety of offshore operations, the Port of Tyne is currently best-placed in terms of infrastructure for heavy lifting, and is the only port in the North East deep enough to accommodate floating windfarm foundation deployment.

The offshore logistics element is of clear importance to the North East and is a strength of the area. This is an important value capture opportunity as it arises in both the installation and operations stages. It is also highly geographical dependent and should be dominated by local companies. However, there are vessels that operate in the area which are registered in other ports or even abroad. These vessels reduce the value the North East can capture from offshore logistics activities, since the revenue generated by them flows into the country where they are registered, rather than the country in which they operate. Companies such as Royal IHC, Palfinger Marine, Clarkson Overseas Shipbroking Limited and Global Marine have offshore logistics facilities in the North East allowing them to capture a significant amount of value from this stage.

Operations, Maintenance & Service

The Operations, Maintenance & Service stage of an offshore wind farm is broken down into 2 substages:

- O.1 Operations
- O.2 Maintenance and Service

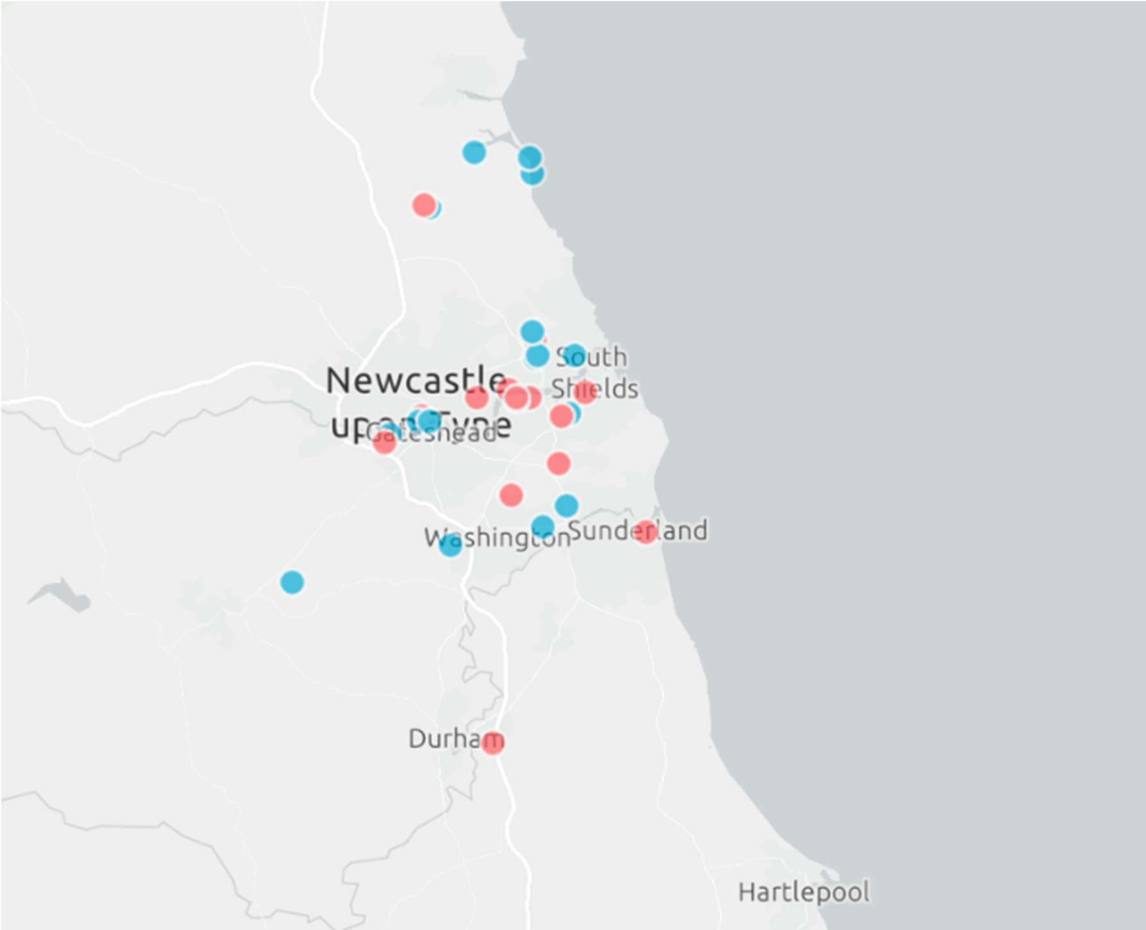
Our analysis identified 36 companies that are active in the over-arching Operations, Maintenance & Service stage. In this stage, 25 companies are active in just one substage with 11 companies being active in both. The table below shows how they are distributed across the 2 substages.

Table 2.6 Operations, Maintenance and Service sub-stages

Development sub-stage	Count
O.1 Operations	28
O.2 Maintenance and Service	19

The map below shows the companies active in the Operations, Maintenance and Service stage. This stage has a higher concentration of ‘Office’ facilities, similar to that of the Development and Project Management stage. The facilities are spread out across the North East, with clusters forming in the Port of Blyth, on the Tyne and Wear.

Figure 2.6 Map of companies active in the Operations, Maintenance and Service stage (Red=Manufacturing/operations, Blue=Offices)



The operations, maintenance & service stage of an offshore wind farm presents a very significant opportunity for the North East. Due to the proximity to a number of large offshore wind projects and existing infrastructure and expertise, the North East is well positioned to continuously capture value over the lifetime of the projects.

With respect to operations, an important component of this stage is made up of the training services provided by industry leaders. As described by many stakeholders, the North East has significant amounts of experience in offshore activities and engineering. This experience is capitalised by leading training providers such as Maersk Training and the Port of Blyth training services.

Offshore and onshore logistics are essential components of offshore wind farm operations and maintenance. The experience of the North East coupled with the existing infrastructure place them in an advantageous position to capture value, with the ports being a very important asset and some of the main strengths of the area.

Companies such as Royal IHC, Palfinger Marine, Clarkson Overseas Shipbroking Limited and Global Marine have offshore logistics facilities in the North East. These port facilities are among the main strengths in the North East as are the vessels that are registered there. The close proximity of these facilities to the assets based off of the North East coast offer a competitive advantage for these companies to win contracts and capture value over the long life of the assets.

Stakeholders also highlighted the important role that the North East has to play in innovation in Maintenance and Service sub-stage. The North East has a notable strength in innovation and high-value, bespoke engineering in sectors such as sub-sea and robotics, and across a broader range of sectors, including digital, big data and artificial intelligence, and is expected to play an important role in applying new technologies to reduce the costs of inspecting and maintaining offshore wind farms. Companies such as JDR Cable Systems, SMD and Tekmar are key players in this stage, offering innovative solutions such as revolutionary cable protection systems and high-tech asset monitoring and inspection services.

The businesses in the ports in the North East could benefit substantially from O&M operations associated with the planned projects in Dogger Bank. This is true of each of the ports, but perhaps particularly for the Port of Blyth, which has the most established industry in offshore energy support.

Decommissioning

The Decommissioning stage of an offshore wind farm is broken down into 6 substages:

- D.1 Turbine Decommissioning
- D.2 Foundation Decommissioning
- D.3 Cable Decommissioning
- D.4 Substation Decommissioning
- D.5 Decommissioning port
- D.6 Reuse, Recycling or Disposal

Our analysis identified only one company active in this stage. The company is active in all six sub-stages. The data and stakeholder engagement show that the decommissioning stage is in a nascent stage, with only one project being decommissioned in the North East, the Blyth offshore wind farm. This company active in this stage, John Lawrie Metals, is located at the Port of Blyth, as shown in the map below.

Figure 2.7 Map of companies active in the Decommissioning stage (Red=Manufacturing/operations, Blue=Offices)

Due to the lifetime of offshore wind assets and the short history of offshore wind deployment, decommissioning in this sector has not had the opportunity to develop. Offshore wind and offshore oil and gas share many similarities in terms of operations and best practices, which suggests much of the knowledge and expertise between the two sectors could be transferable at the decommissioning stage. The Port of Blyth is already licensed to decommission oil and gas farms and these skills are likely to be transferable to offshore wind farms in future.

While there are several decommissioning specialists in the UK, our research identifies only one organisation located in the North East: John Lawrie Metals. This company, which has traditionally focused on metals recycling, has recently invested in specialist decommissioning infrastructure in association with the Port of Blyth. As the decommissioning stage matures over time, this will present a significant opportunity for the North East area due to its close proximity to the North East coastal wind farms.

After 25-30 years, a wind farm reaches the end of its useful life. This presents an opportunity for decommissioning as described above, or an opportunity for full or partial repowering. Repowering a wind farms maximises the use of the more durable aspects such as foundations, sub-sea cabling and towers while replacing the less durable components such as nacelles and blades. As the capacity of nacelles increases, fewer foundations need to be used to maintain the existing capacity, or the overall capacity can be increased using the same foundations. This would likely require upgrades to the existing transmission infrastructure. Repowering of wind farms can be a more financially beneficial operation than decommissioning and could benefit the North East in stages such as Turbine, Balance of Plant, Installation and Commissioning and Operations.

3 The local economic impact of future offshore wind sector opportunities

3.1 Introduction

Given the capabilities and competitive advantages of the North East's offshore wind industry, the Offshore Wind Sector Deal (the Deal) offers a major opportunity for the region. The Deal is expected to support substantial increases in employment and output across the UK offshore wind sector, through both increases in offshore capacity installed within the UK, and through strengthening the export offering of the UK's offshore wind sector. As one of the largest hubs of UK offshore wind activity in the UK, a substantial proportion of these benefits could reasonably be expected to be realised in the North East. A key question is precisely how large the impact on the North East economy could be under different assumptions about the level of involvement of the region's supply chain in delivering future projects within the UK and overseas.

In this chapter we present the results of a quantitative modelling exercise, carried out to quantify the potential socioeconomic impacts, in terms of job creation and gross value added (GVA), of future opportunities. The findings allow us to better understand the opportunity anticipated investment in the offshore wind sector presents for economic growth and employment in the North East, and subsequently how the sector can be supported to realise this.

3.2 Scenario development

Future UK installed capacity

The potential GVA and employment effects from future expansions in the offshore wind installed capacity in the UK were estimated using a purpose-built Offshore Wind Model, originally developed by Cambridge Econometrics (CE) for RenewableUK.

Installed capacity in 2030

First, future investment in installed capacity across the UK was informed by Renewable UK's database on contracts awards and projections of project installation and commissioning dates, supplemented by information sourced from The Crown Estate[1]. Figure 3.1 shows the capacity installed, planned or projected for each year between 2005 and 2030 while Figure 3.2 shows the cumulative increase in installed capacity up to 2030. A gradual increase in installed capacity is expected in the next decade, with a sharp increase in capacity installed between 2024 and 2027. According to the pipeline data, in 2030 installed capacity reaches just over 35 GW. The pipeline data includes not only projects that are under construction but those that are also in the planning stage. Hence, the total level of installed capacity by 2030 is subject to some uncertainty. The total level of installed capacity in 2030 may ultimately be below or above the 35GW projection.

[1] The Crown Estate, Project Listings (August 2019 update). Available at: https://www.thecrownestate.co.uk/media/3308/offshorewindprojectlisting_201908.pdf

Figure 3.1 Annual offshore wind installed capacity (GW)

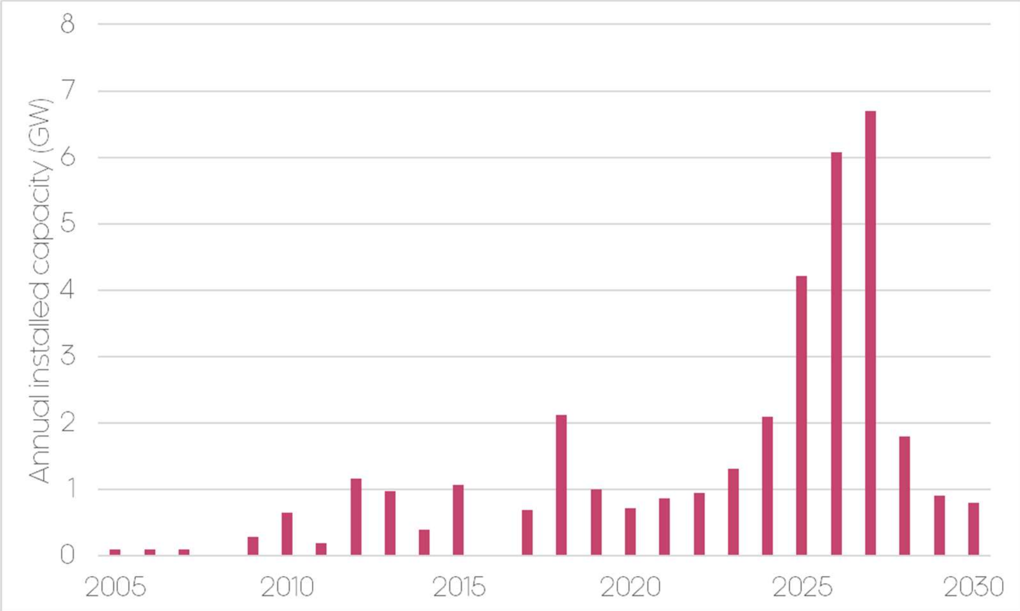
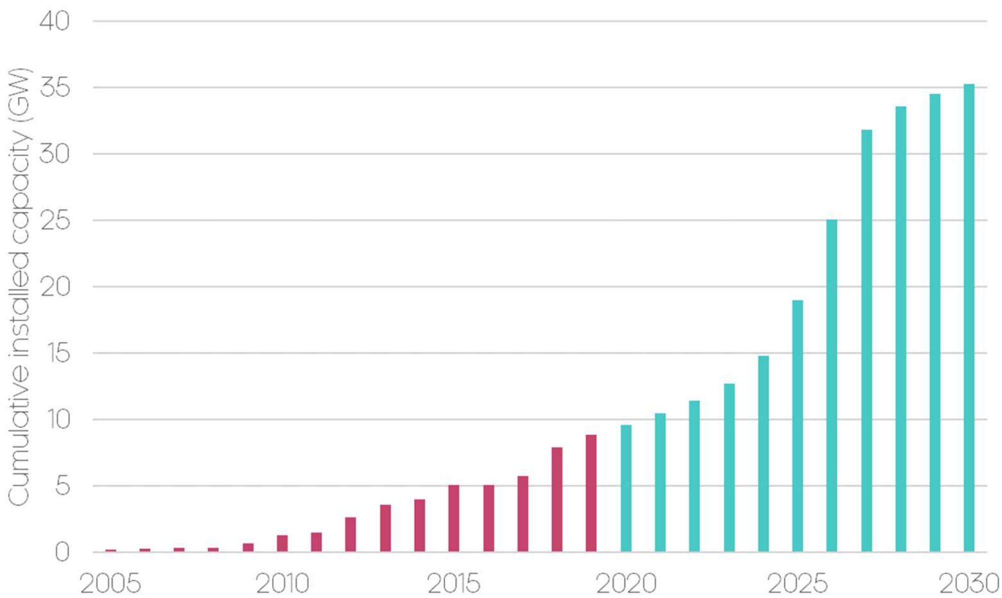


Figure 3.2 Cumulative offshore wind installed capacity in the UK (GW)



The model also includes assumptions of growth in global capacity, and the degree of content supplied by UK-based firms. Therefore, as well as increasing in line with UK installed capacity, UK offshore wind economic activity increases in line also with growth in global installed capacity. The extent to which economic activity increases due to global installed capacity depends on how much of global activity is 'captured' within the UK.

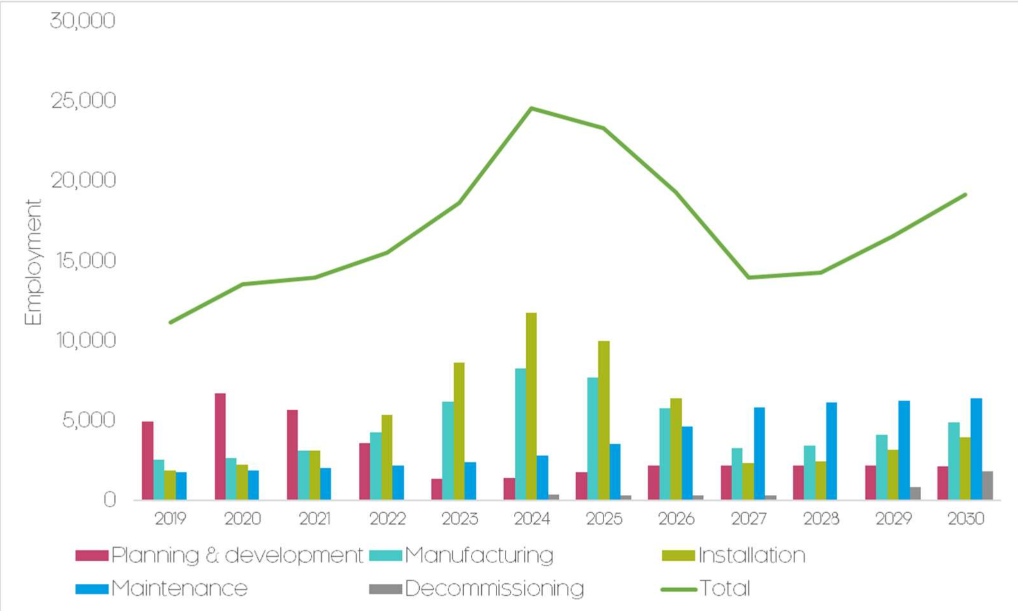
Installed capacity further ahead

Looking ahead, to aid the transition to a net zero emissions economy in the UK by 2050, the Committee on Climate Change recommends that installed capacity of offshore wind in the UK is at least 75 GW by 2050 (Committee on Climate Change 2019). As well as expected high growth in UK-based offshore wind projects, high growth is expected globally, creating increased export opportunities for firms based in the North East. It is estimated that global offshore wind capacity could increase fifteen-fold to 342 GW by 2040, supported by individual country policy targets and falling technology costs (International Energy Agency 2019).

Future installed capacity and consequences for UK employment

Based on the expected future installed capacity up to 2030, CE's Offshore Wind Model estimates that total employment in the UK will peak in 2024, driven by peaks in demand for labour-intensive installation and manufacturing output (see Figure 3.3)[2], which takes place in advance of the UK capacity being installed in later years (i.e. between 2025 and 2027 – see Figure 3.1 and Figure 3.2). In 2024, total UK employment across all stages of the offshore wind sector reaches a peak of just over 24,500 jobs, over twice the current number of jobs in the sector.

Figure 3.3 Total employment estimates by stage of the offshore wind supply chain in the UK



In 2030, when 35 GW of UK installed capacity is expected, there are estimated to be just over 19,000 jobs across the UK in the offshore wind sector. This estimation is broadly consistent with the 27,000 jobs estimated within the Offshore Wind Sector Deal. The differences between the two estimations stem from the precise timing of when capacity is installed, and the lag between stages of the development of the offshore wind farm, for example the manufacturing stage and the installation stage.

Of the 19,000 jobs expected to exist in 2030, a third of the jobs will be in the maintenance stage of the supply chain. The geographic location of wind farms will therefore be increasingly more important for employment levels in the North East towards the end of the estimation period, since maintenance jobs will typically be created in close proximity to the wind farm itself.

The employment estimates produced by the model are based on baseline increases in UK installed capacity, as well as global growth in installed

[2] Note that the model does not differentiate between manufacturing of the wind turbine and manufacturing of other components for the balance of plant (cabling, foundation and substation). This differentiation has been introduced in the next step.

capacity, and the extent to which this growth is captured by UK firms. The actual level of employment in each stage of the offshore wind supply chain in the region may differ according to how the North East, UK and global offshore wind sectors develop. For example, the North East may strengthen its export offering, allowing it to capture more of the UK's export offering overall, leading to higher employment in some stages of the supply chain in the North East. For this reason, various alternative scenarios are analysed in this study, to examine the changes in employment under different conditions. These scenarios are described in further detail in the paragraphs below.

Looking beyond 2030

It should be noted that since the model uses existing pipeline data up to 2030, it does not account for the fact that additional offshore wind projects will be added to the pipeline post-2030, and that these additional projects will create additional jobs in the period up to 2030, particularly in the earlier stages of the supply chain. For instance, if the UK is to reach a target of 75GW of installed offshore wind capacity by 2050, as recommended by the Committee on Climate Change, regions with a specialisation in the offshore wind sector, such as the North East, stand to continue to benefit from new additional projects. While our model estimates a peak in jobs in 2024, if the pace of installed capacity continues to increase, there are opportunities for the region to continue momentum in the sector and continue to experience an increase in employment. Similarly, further increases in global capacity post-2030 will present further opportunities for the North East offshore wind sector in the period up to 2030. In Chapter 4, various export opportunities are explored in further detail which, if exploited, could enable the North East to continue the momentum of increased employment and output beyond the peak in 2024 estimated by the model. These additional opportunities would lead to a revised trajectory in the total employment projections depicted in Figure 3.3 (total UK employment) above and in each of the figures depicting employment estimates under various scenarios in Section 3.3 below. From 2024, the employment trajectory would be expected to continue to rise upwards throughout the next decade, reflecting increasing installations of offshore wind capacity in the UK and globally.Direct economic impacts

The contribution of the North East

To estimate the contribution of the North East to the development, production, installation, operation and decommissioning of future UK offshore wind sector developments, assumptions were made on the relative contribution of businesses located in the region to each stage of the supply chain. This was initially approximated by using the Renewable UK's database on contracts awards, reporting all the companies that were commissioned for the realisation of past and planned offshore wind farms in the UK together with key complementary information (location, activity, project, etc). These estimates were further refined based on stakeholder feedback received at stakeholder workshop and individual stakeholder calls.

These estimated contributions refer not just to the share of UK installations activity that is delivered in the North East, but also the contribution of the North East to UK economic activity which ultimately contributes to offshore windfarms installed in other countries. The model baseline scenario includes assumptions about global growth in installed capacity, and the extent to which this growth is captured by UK firms. In that sense, the estimated contributions include contributions to both UK-based developments and overseas exports.

The scenarios

A range of scenarios were developed in which the contribution the North East makes to the overall UK offshore wind supply chain is assumed to change, in most cases reflecting efforts to increase obtained market share. The scenarios allow us to explore a range of future possibilities in terms of the development of the North East cluster and determine how the economic benefits of each possibility might differ. The following paragraphs describe these scenarios in more detail. Further details about the scenario, including the numerical assumptions about the contribution of the North East to the UK offshore wind industry can be found in Appendix B.

The baseline

Our baseline assumes that the North East's share of UK offshore wind activity will remain, in the period through to 2030, the same as we estimate it to currently be. In the baseline scenario the North East has competitive advantages in the balance of plant and installation and commissioning stages. While there is activity in the development and project management, operations and maintenance and decommissioning stages, the North East does not have a strong competitive advantage in these areas. A key competitive disadvantage of the North East offshore wind cluster is the lack of wind turbine manufacturing.

In the baseline case, the North East offshore wind cluster retains this balance of activity up to 2030, implying that the cluster does not obtain increased market share in future, in any stage of the offshore wind supply chain. In further scenarios, the contribution the North East makes to the overall UK offshore wind supply chain is assumed to change, reflecting efforts to increase obtained market share. The details of these further scenarios are explained in the following paragraphs.

Scenario 1: Attracting a turbine manufacturer

Currently, the wind turbine stage of the offshore wind supply chain is weak in the region. While there are a small number of organisations operating in this stage of the value chain, there is no turbine manufacturing site in the region, and these organisations rather provide auxiliary services to the main turbine suppliers. Scenario 1 is a 'positive' scenario in which the North East region successfully attracts a manufacturer of either nacelles, rotor blades or towers for large wind turbines into the region, strengthening its offering in Turbines and Decommissioning stages, plus further strengthening the Installation & Commissioning stage. Scenario 1 is potentially a high value-added scenario. Wind turbine manufacturing itself has high value added, while it also drives demand for supporting industries and services (which could also have relatively high levels of value added). Consequently, the potential for jobs and skills development from attracting a turbine manufacturer to the region could be substantial.

Scenario 2: Strengthening the export offering

Scenario 2 is a further positive scenario in which the North East's share of global activity increases steadily. As a result, the output of the UK-wide offshore wind sector grows, with the North East leading this export growth and therefore increasing its contribution to the total output of the UK-wide offshore wind sector. Installation & commissioning, Development & Project Management and Decommissioning gain further traction, reflecting that the North East's offering in these stages is world-leading.

Scenario 3: Dominating the UK market

Scenario 3 is another positive scenario where it is assumed that there is consolidation of the offshore wind industry, in response to a larger UK pipeline but at tighter margins, leading to the North East's share of the UK market increasing. The region's existing strengths are further reinforced; Balance of Plant, Installation & commissioning, and the emergent Decommissioning stage, while activity in the Development and Project Management and Wind Turbine Manufacturing stages remain the same as the baseline.

Scenario 4: Commoditisation of the industry

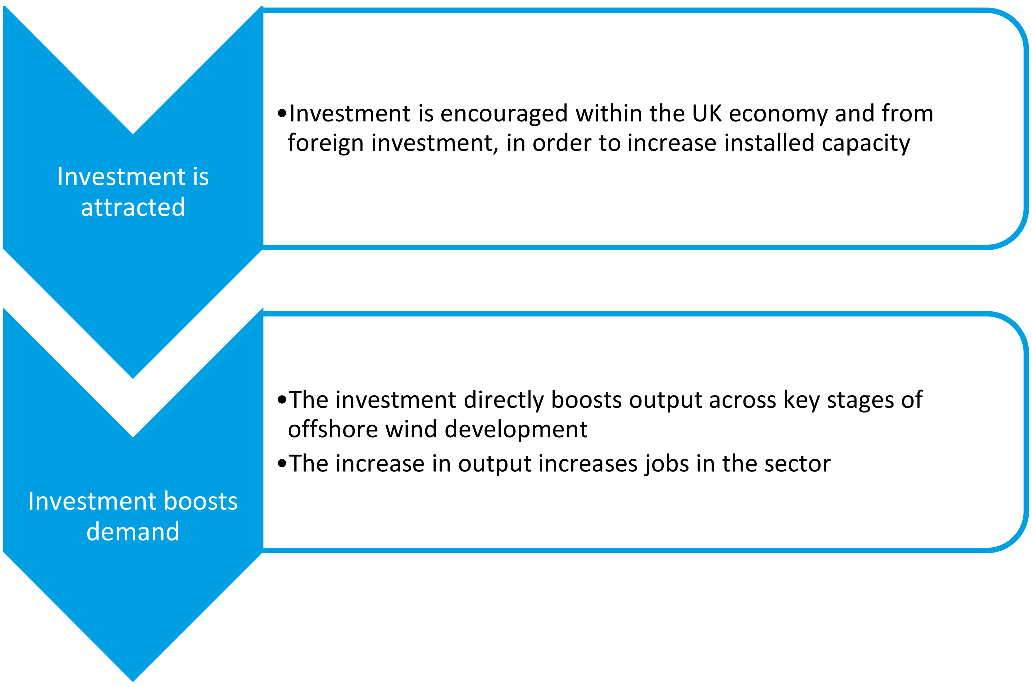
Scenario 4 differs from other scenarios in that it represents a more negative outlook for the North East offshore wind cluster. In Scenario 4 it is assumed that as the global industry expands, so do the benefits of large volumes of manufacturing taking place in low-cost parts of the world, and hence the North East's region's position in Balance of Plant and Decommissioning is diminished, leaving the NE with a smaller portion of the global industry than currently. Activity linked to local offshore wind projects being developed within the North East region remains largely unchanged, however.

3.3 Direct economic impacts

For each of the scenarios detailed in Section 3.2, the direct economic impacts were assessed using CE's Offshore Wind Model.

Direct impacts can broadly be defined as the effects of investments made to increase installed capacity in the UK, including tier 1 suppliers, but excluding those further down supply chains or the knock-on impacts in the wider economy (see Figure 3.4).

Figure 3.4: Direct economic impacts



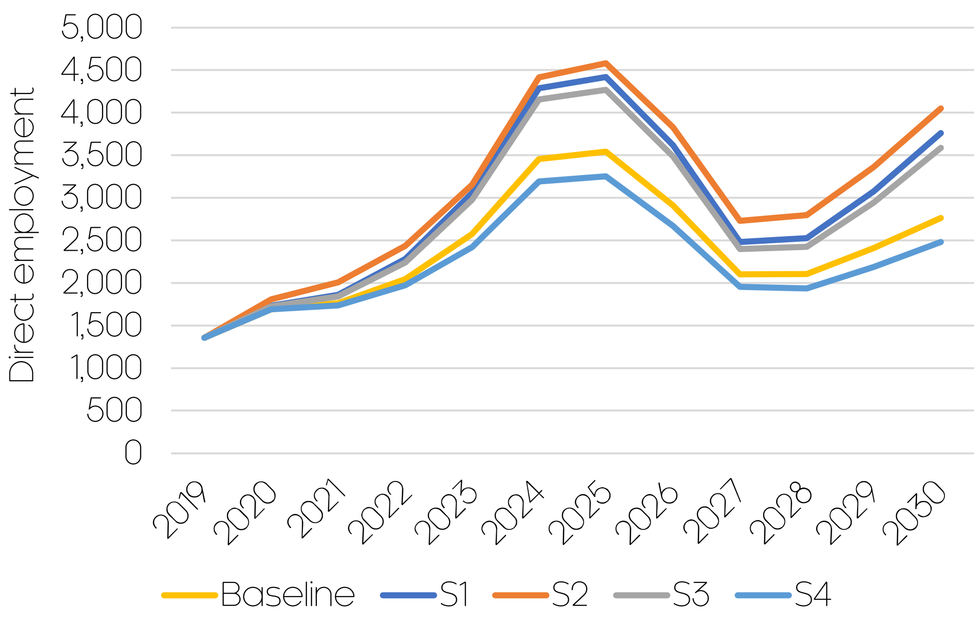
Direct employment impacts

Employment in the North East in each stage of the supply chain is assumed to be in line with the contribution the North East makes to the overall UK offshore wind sector.

Figure 3.3 shows the employment results for the North East region in each scenario. In all scenarios, employment gradually increases between 2019 and 2025, as the deployment of offshore wind energy increases across the UK. In these years, employment in the North East is growing moderately across all scenarios in the wind turbine manufacturing and balance of plant stages of the supply chain and is growing particularly strongly in the installation and commissioning stage. Due primarily to the nascent nature of the offshore wind industry, growth in the decommissioning stage of the supply chain continues to remain static during the 2019-2025 time period. Growth in employment in the development and project management stage of the supply chain varies depending on the scenario in question. In all scenarios, employment in this stage of the offshore wind lifecycle diminishes between 2019 and 2025, as offshore wind developments move on to later stages of the project, i.e. the installation and balance of plant phases. However, as new projects enter the planning stage, employment picks up again after 2025. As previously noted, employment in earlier stages of the supply chain could reasonably be expected to continue momentum past the 2025 peak estimated by the model. This is because the model only takes in to account current planned projects and does not take in to account future projects for completion after 2030, and which enter the pipeline before this cut-off.

From 2027 onwards, total employment in the sector is strengthened by a growing number of jobs in later stages of the supply chain, such as operations and maintenance and decommissioning services. This is because it is expected or likely that many future offshore wind developments will be located within the North East region or within close proximity, creating high demand for local firms supplying these services. For example, the scenarios take account of the Dogger Bank wind farm developments, which provide a boost to employment in operations and maintenance sectors in the North East post-2025.

Figure 3.5 Potential employment creation



Of the three positive scenarios (Scenarios 1-3), in which the contribution the North East makes to offshore wind projects improves, Scenario 2 presents the largest increase in employment compared to baseline. In this scenario, firms located in the North East are encouraged to expand their offering overseas, directly creating an estimated peak of 4,600 local jobs in 2025, over 1,000 more jobs than in the baseline. The 4,600 jobs that exist in scenario 2 account for 19% of all UK jobs in the offshore wind sector, compared to 2019 estimates which suggest employment in the North East accounts for 12% of total offshore wind employment. In Scenario 2, 60% of the jobs in 2025 are created in the installation and commissioning stage of the supply chain.

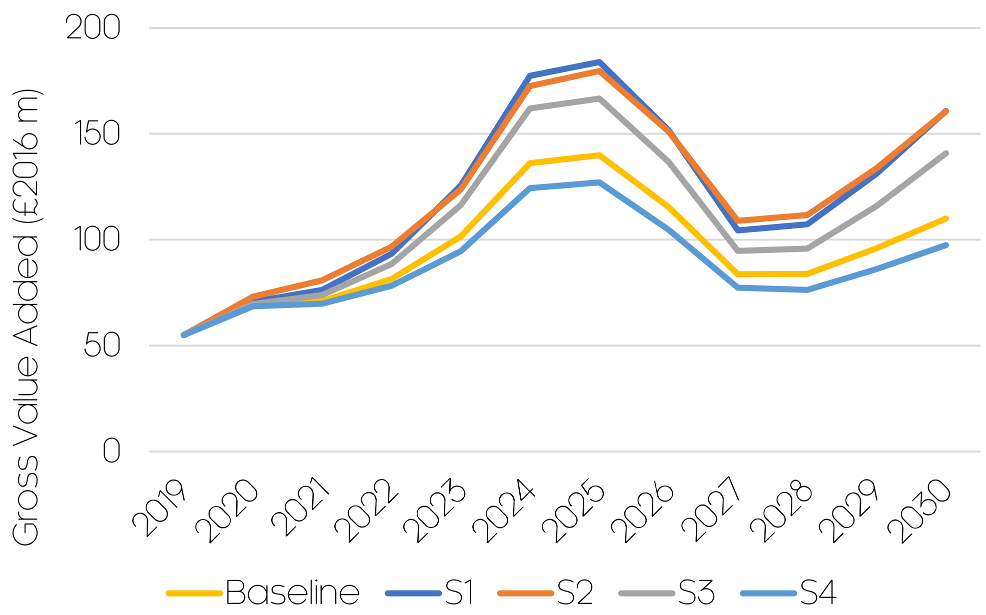
Direct GVA impacts

Direct GVA impacts were estimated by applying region and sectoral-specific productivity levels to the employment results detailed above.

Figure 3.6 shows the GVA results for each scenario. The general trend in the levels of value-added follow that of employment in the region over the period 2019 – 2030, with a peak in all scenarios noticed in 2025. Across each stage of the offshore wind lifecycle, economic impacts in terms of GVA follow the same trends as the impacts on employment. There is rapid growth in GVA between 2019 and 2025 in the installation and commissioning stage, while more moderate growth is seen for the balance of plant and wind turbine manufacture stages (the exception being Scenario 1, in which a turbine manufacturer is successfully attracted to the region, and hence GVA in this stage of the life cycle reaches higher levels compared to other scenarios). In all scenarios, GVA in the development and project management stage declines between 2019 and 2025, as current projects move into later stages of the offshore wind lifecycle, before a new wave of projects kick start after 2025, boosting GVA in this stage. It should be noted that further additional projects are expected to be added to the UK pipeline, as offshore wind becomes a more prominent part of the energy mix in future. The model used in this analysis does not take account of projects which are not yet known. Additional projects will boost GVA further in the earlier development and project management stages of the life cycle, in reality, continuing momentum in economic activity in these stages.

However, the ranking of scenarios in terms of the economic benefits provided to the North East region differs when considering value added, since some stages of the supply chain feature higher productivity levels than others (and therefore the same labour inputs can produce different levels of value-added). When looking at employment impacts alone, Scenario 2, in which the region’s export offering is increased, provides the highest benefits to the region. However, when considering the impacts on GVA, Scenario 1, in which the North East successfully attracts a large turbine manufacturer to the region, presents the largest economic growth opportunity in 2025. After 2025, this scenario, as well as the scenario in which a stronger export offering is developed, both show substantial economic growth.

Figure 3.6 Potential GVA creation



The table below presents the productivity rates for each life cycle stage, to provide further context to the benefits of strengthening various stages of the life cycle. This measures the GVA generated per employee, providing an indication of the economic return of each stage of the offshore wind life cycle. The first two stages of the offshore wind cycle are more productive in terms of GVA generation than the remaining stages (which all have quite similar levels of productivity). It is therefore intuitive that the scenarios in which these first two stages of the supply chain are strengthened (Scenario 1 and Scenario 2) are the most beneficial in terms of GVA.

Table 3.1 Estimated GVA generated per employee, for each stage of the offshore wind cycle

	Productivity (£2016)
Development and project management	40,770
Wind turbine	71,820
Balance of plant	36,210
Installation and commissioning	37,150
Operation, maintenance and service	39,030
Decommissioning	39,030

Continuing momentum

The GVA generated by the industry show a clear trend across all scenarios, with a peak in value-added in 2025. Considering only the known projects in the current pipeline, after 2025, the number of jobs existing within the North East offshore wind industry falls, along with levels of GVA, as the rate of new UK installations levels off. The model estimates that falls in the number of jobs in turbine manufacturing, balance of plant and installation and commissioning underpin the general downturn in the economic impacts.

There is a question about what the North East can do to ensure the peak in the capacity of the region's sector in 2025 can be maintained, and how employment and economic output can remain at or move above the levels estimated in 2025. It should be noted that a slowdown in activity is unlikely to happen, as further Contracts for Difference rounds are expected to lead to further offshore wind installations within the UK. Given the UK's legally binding commitment to reaching net zero by 2050 and the Committee on Climate Change's recommendation that, as part of the low carbon transition to reach net zero, installed capacity of offshore wind in is at least 75 GW by 2050 (Committee on Climate Change 2019), it is expected that investment in offshore wind capacity will increase substantially in the UK over the coming decades. Furthermore, the North East can ensure that it maintains momentum by promoting the North East's expertise in the stages of the supply chain mentioned above in other overseas markets, as an avenue for generating additional jobs. Overseas markets which are in their infancy would be particularly good markets to enter, where local knowledge and expertise may be inadequate.

3.4 Wider economic impacts

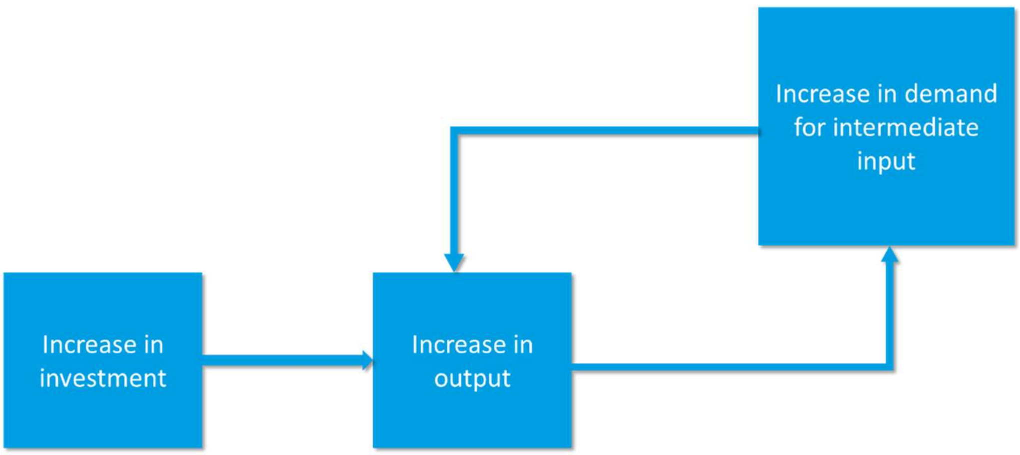
What is meant by wider economic impacts?

Wider economy impacts are the knock-on impacts of the increased investment in installed capacity, once the effects have fully circulated through the economy. This includes:

- the impact on the wider supply chain considering upstream providers (indirect impacts); and,
- the impacts on household spending considering increased employment leads to higher aggregate household incomes (induced effects).

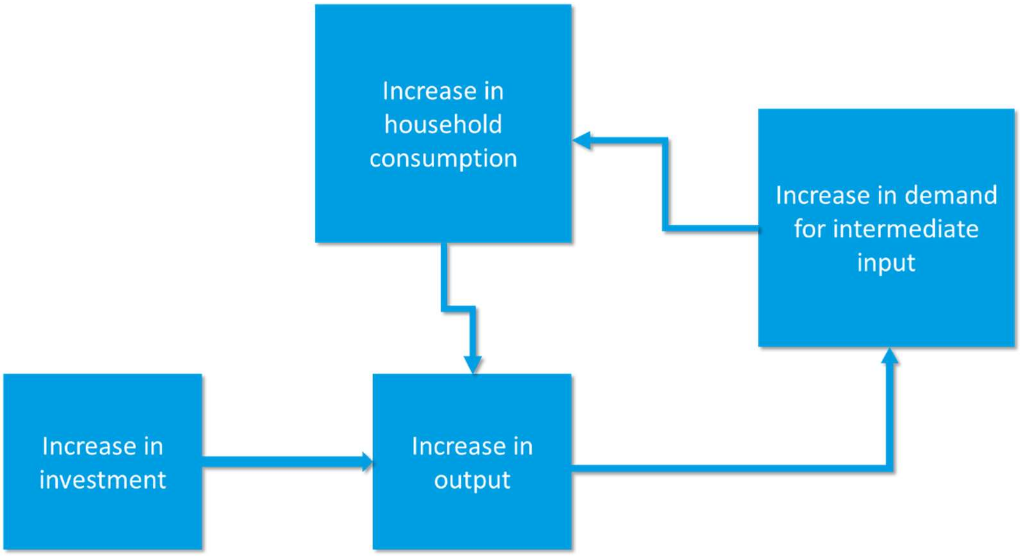
Indirect impacts occur due to the relationship between demand for inputs to production and output. When output increases in a given sector, so too does its demand for components and support services. If these inputs are sourced domestically, this leads to a further increase in output, which then leads to additional demand for inputs, and so forth. For example, a boost to output for turbine manufacturing, might lead to an increase in demand for generators, which might then lead to an increase in demand for metals etc.

Figure 3.7: Supply-chain feedback loop



Induced effects relate to the relationship between wages/salaries paid by firms to employees and goods/services purchased by households. The premise of this effect is that, as output increases, firms require additional labour[3] and therefore the total wage bill increases. As, in aggregate, households are paid more, they then spend a portion of their additional earnings on products and services. The additional household demand in the economy then increases output further, which increases employment, wages and spending further.

Figure 3.8: Household-demand feedback loop



Calculating wider economic impacts

To calculate the wider economic impacts of increased investment in installed capacity of offshore wind, we apply an input-output (IO) model. The IO model measures the historical purchases of goods and services from each industry within the economy, capturing supply chain links. An initial investment or expenditure creates output in specific sectors, and the IO model is used to quantify the increase in purchases of goods and services required to deliver that output, and consequently additional impacts further upstream in the supply chain. For this study, CE developed a tool based upon a 2015 UK-level IO table (i.e. captures UK-level supply chain relationships between sectors), to estimate the economic impacts of increased investment in offshore wind capacity.

Isolating local impacts

The modelling approach also allows us to estimate the indirect economic impacts felt within the local area, for example the number of indirect jobs retained within the North East region. Further coefficients are applied to the IO modelling results, to estimate the local impacts. Our approach is based on broad sector-level assumptions of how much of a given industry's inputs are sourced from within that same region. This approach allows an assessment of how much value added and employment could be created locally in the North East, as preferred to created across the UK as a whole.

Indirect impacts

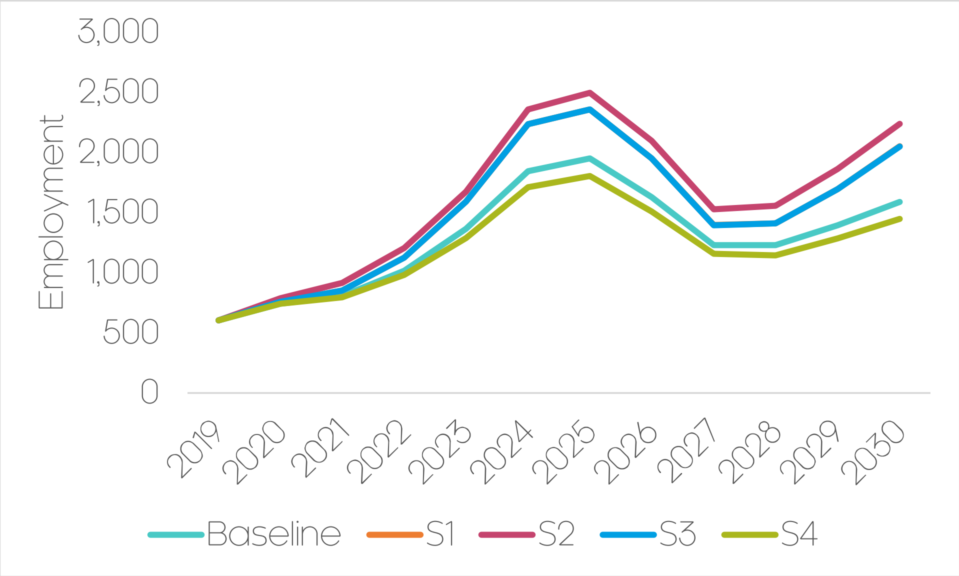
…within the North East region

Figure 3.9 and Figure 3.10 show the local indirect impacts of the initial investment in offshore wind, on employment and GVA respectively. These

[3] This could be through an increase in employees, an increase in the hours worked by each employee or by an increase in the skills and productivity of each employee.

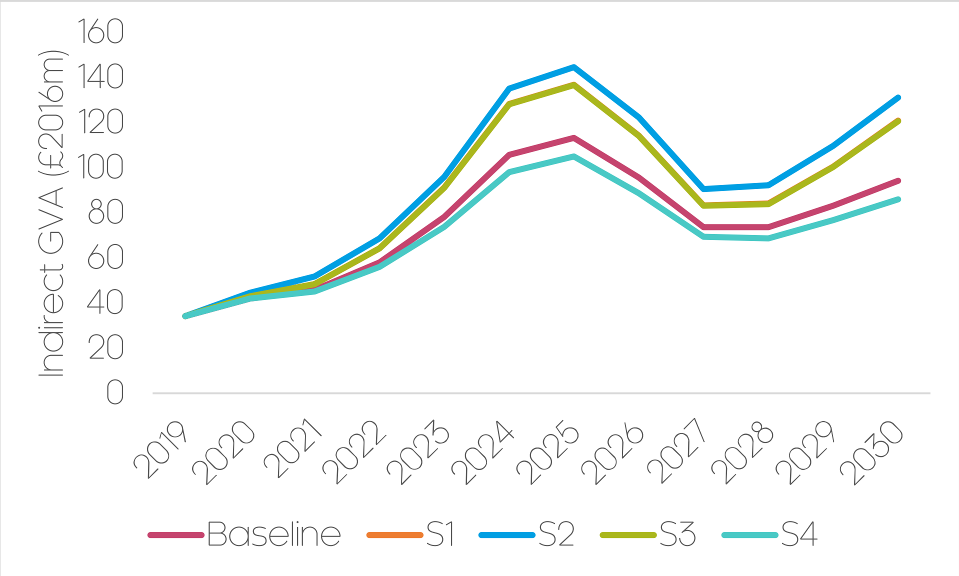
impacts are felt within sectors further upstream in the supply chain, located within the North East region itself.

Figure 3.9 Local indirect employment impacts



The trends in the levels of employment and GVA naturally follow the same patterns as those seen for direct employment and GVA impacts. This is because the indirect effects derive from the direct effects; as output increases in the sector in which initial investment is made (a direct impacts), output increases in line within other sectors which are further upstream in the supply chain (indirect impacts). The results show that in 2025, when a peak in direct economic benefits is experienced, up to a further 2,500 jobs may be created and up to an additional £144m GVA generated (in Scenario 2 for example) in additional sectors such as construction, employment services, architectural and engineering services, management consulting services and land transport services, as an indirect result of a growing North East offshore wind sector.

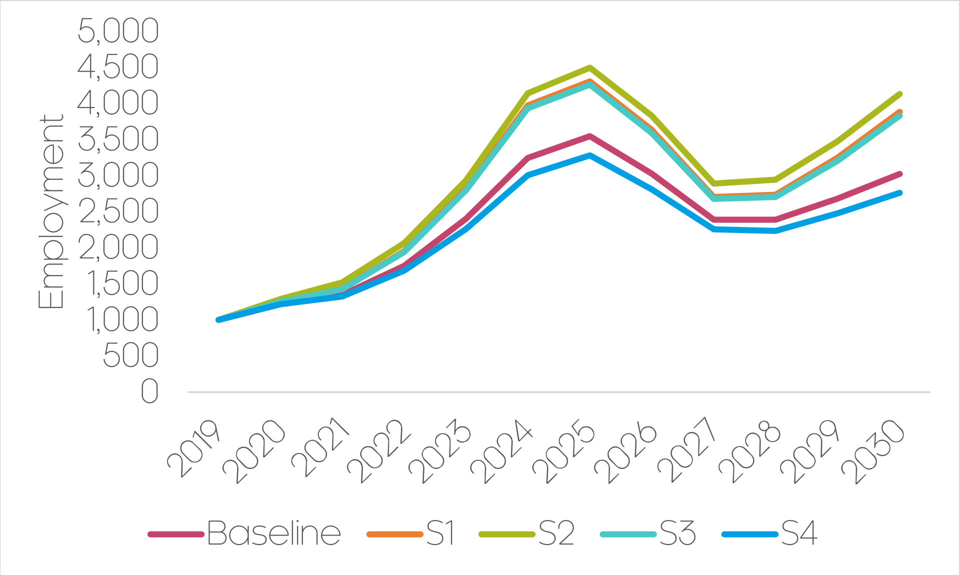
Figure 3.10 Local indirect GVA impacts



…across the UK as a whole

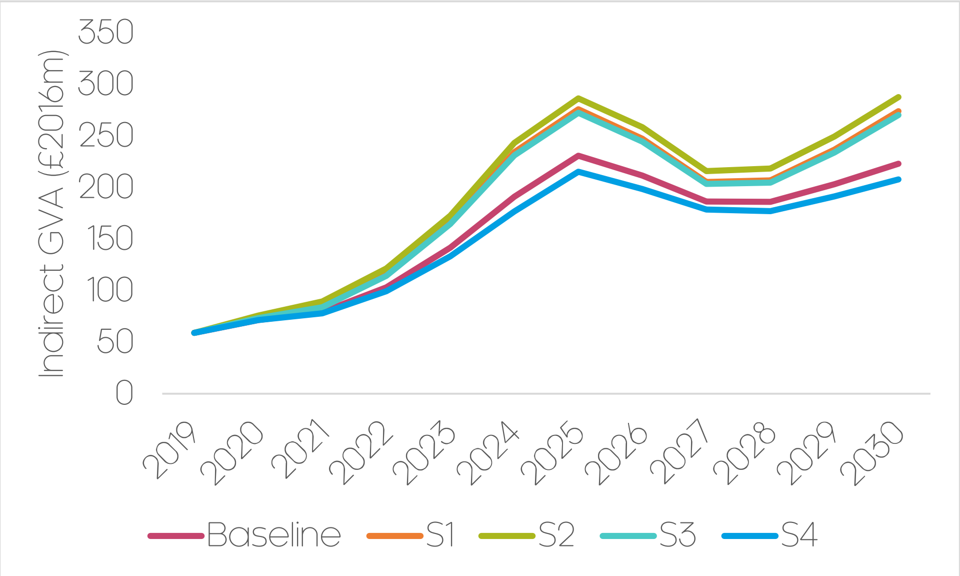
Supply chain links will extend beyond the borders of the North East region, therefore it is beneficial to also consider the jobs and GVA that may be generated elsewhere in the UK, as a result of increasing output of the North East offshore wind industry. Figure 3.11 demonstrates that across the UK, up to an additional 4,500 jobs may be generated indirectly in sectors such as construction, employment services, architectural and engineering services, fabricated metal products, throughout the extended offshore wind supply chain, while in 2030 this figure could be up to around 4,100.

Figure 3.11 UK-wide indirect employment impacts



Additional GVA is also generated throughout the extended UK supply chain, as shown in Figure 3.12. In Scenario 2, the most economically beneficial of the scenarios modelled in this study, an additional £286m GVA is generated in 2025. Note that this is just linked to offshore wind activity in the North East – additional activity elsewhere in the UK would lead to additional indirect and induced benefits.

Figure 3.12 UK-wide indirect GVA impacts



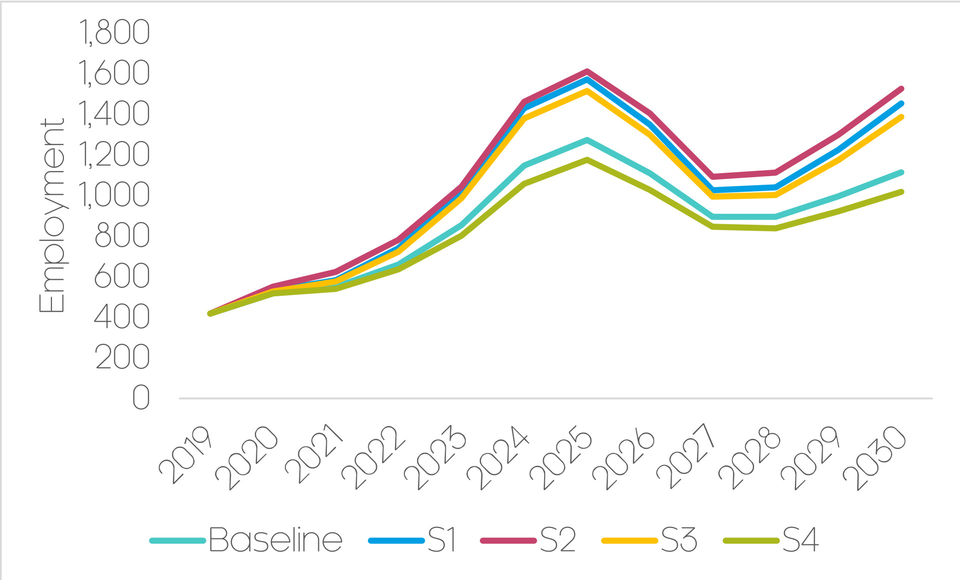
Induced impacts

The increased levels of employment generated in each scenario, whether directly or indirectly, leads to higher household incomes and subsequently higher household spending. These 'induced' economic impacts of additional spending is illustrated in the following charts.

…within the North East region

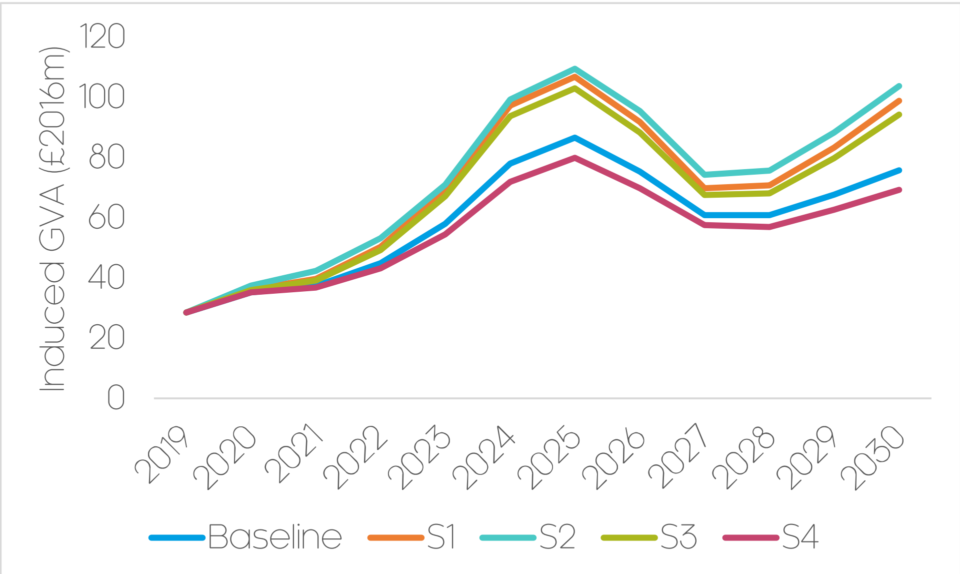
Within the North East region, up to 1,600 additional jobs may be generated in the most optimistic of the scenarios (Scenario 2) in 2025, as a result of increased household spending. These jobs will typically be created in sectors in which households spend a large proportion of disposable income, such as retail and leisure activities.

Figure 3.13 Local induced employment impacts



Similarly, additional GVA is created within these sectors. Within the region, GVA levels also reach a peak in 2025, when between £87m and £110m additional GVA is created (depending on which scenario is considered).

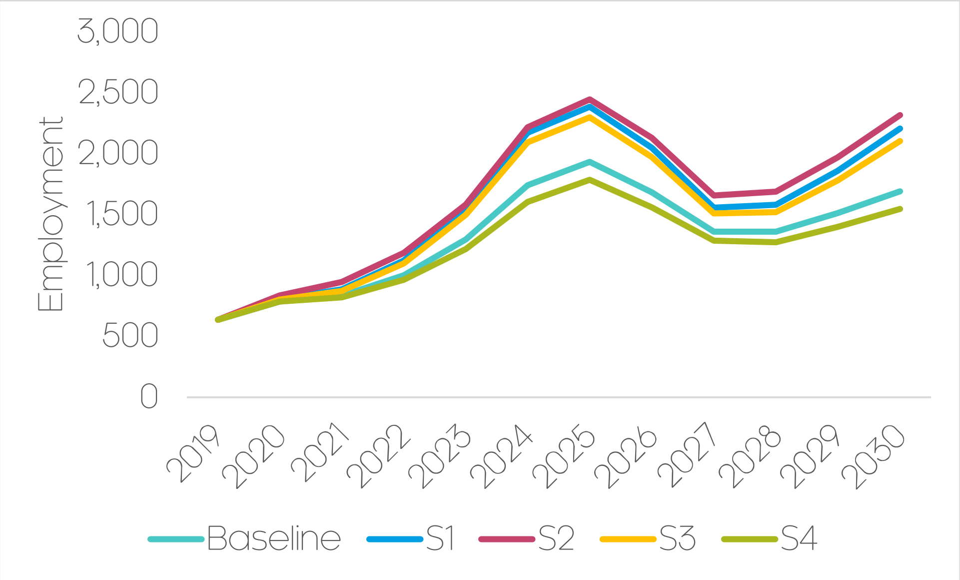
Figure 3.14 Local induced GVA impacts



…across the UK as a whole

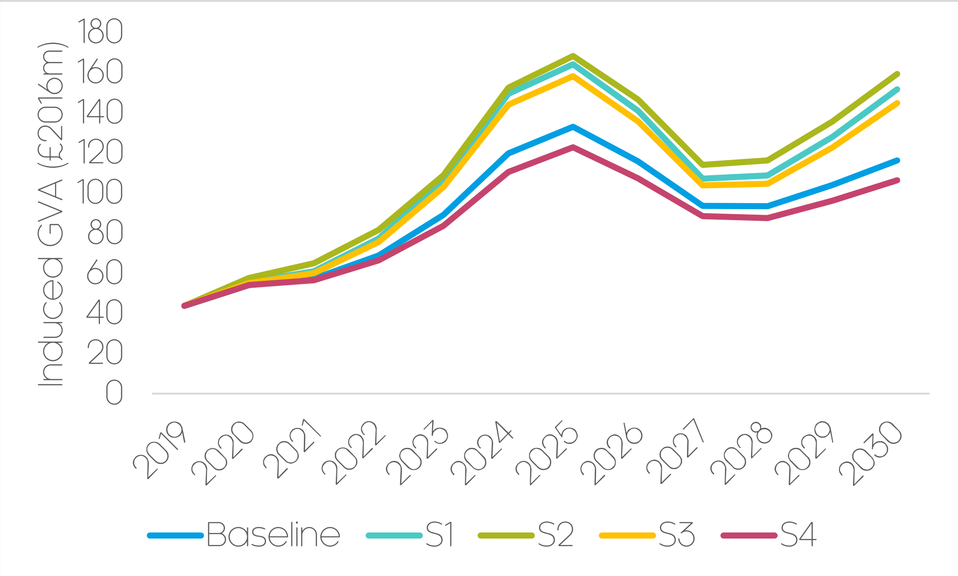
As a result of indirect supply chain changes in employment across the UK, induced effects are also experienced in sectors such as retail, food & drink, and leisure activities across the UK. The additional induced impacts for the UK as a whole are depicted in Figure 3.15 and Figure 3.16.

Figure 3.15 UK-wide induced employment impacts



Up to 2,500 additional jobs and £168m of GVA may be generated in the most optimistic of the scenarios (Scenario 2) in 2025, as a result of increased household spending.

Figure 3.16 UK-wide induced GVA impacts



3.5 Conclusions

The scenarios developed within the study allow us to investigate how employment and GVA may be impacted within the North East region under different future circumstances. In each of the scenarios, different stages of the offshore wind supply chain are assumed to experience growth or contraction compared to their current position vis-à-vis the UK industry at large; leading to a change in terms of the contribution the North East offshore wind sector makes to the UK sector as a whole. In all but one of the scenarios, the changes in contribution are positive compared to a “business as usual” baseline case, while in Scenario 4, we explore what might happen if the North East loses its competitive advantage in some stages of the supply chain.

Table 3.2 below summarises the economic impacts across all scenarios in 2025, when the benefits of current projects in the pipeline are expected to peak in the North East.

Table 3.2 Summary of economic benefits in 2025

Scenario	Total jobs (% growth 2019-25)	Total jobs as a % of total UK jobs	Total GVA, absolute (% growth 2019-25)
Baseline	3,544 (161%)	15%	£140m (154%)
Scenario 1: Attracting a turbine manufacturer	4,420 (226%)	19%	£184m (234%)
Scenario 2: Developing a strong export offering	4,581 (238%)	19%	£180m (226%)
Scenario 3: Dominating the UK market	4,270 (215%)	18%	£167m (203%)
Scenario 4: Commoditisation of the industry	3,255 (140%)	16%	£127m (131%)

In the baseline scenario, we assume the North East retain its current balance of activity in the offshore wind sector up to 2030, implying that the regional cluster does not obtain increased market share in future, in any stage of the offshore wind supply chain. Under this scenario, the region benefits from projected increases in installed capacity across the UK, with a total of 2,800 jobs in 2030 (with a peak in employment of 3,500 jobs in 2025), and £110m generated in GVA in 2030 (again, with GVA peaking at £140m in 2025).

Of the ‘positive’ scenarios, i.e. Scenarios 1-3, in which the North East increases its share of the UK offshore wind industry by attracting a manufacturer of either nacelles, rotor blades or towers for large wind turbines to the region, by strengthening its export offering, or by capitalising on the consolidation of the offshore wind industry, the scenario focusing on entering new overseas markets generates the highest economic benefits for the region. In all scenarios, there is a clear pattern in the economic benefits to be gained, with a peak in employment and GVA impacts in 2025, followed by a brief dip in activity, before jobs and GVA pick up once more. These patterns result from the demand for output from certain stages of the supply chain, as UK projects are developed in accordance with the current pipeline. However, it should be noted the estimated economic benefits are based solely on the current project pipeline up to 2030, so does not take account of projects that may be developed post-2030. Given the UK’s legally binding commitment to reaching net zero by 2050 and the Committee on Climate Change's recommendation that, as part of the low carbon transition to reach net zero, installed capacity of offshore wind in is at least 75 GW by 2050 (Committee on Climate Change 2019), it is expected that investment in offshore wind capacity will increase substantially in the UK over the coming decades. Therefore, a dip in activity around 2025 is in practice unlikely, since new projects will enter early stages of the offshore wind life cycle around the same time.

The findings presented in this chapter point towards a focus on export markets providing the greatest expansion potential for the North East region. Attracting a manufacturer of either nacelles, rotor blades or towers for large wind turbines also has the potential to create substantial economic benefits for the North East region. Although this opportunity would not create as many jobs as an increase in the North East's export offering, direct impacts on GVA would be larger. While a consolidation of the offshore wind industry, in response to a larger UK pipeline but at tighter margins, would lead to increases in employment and GVA in the North East's, these benefits are not as large as in the previously mentioned scenarios.

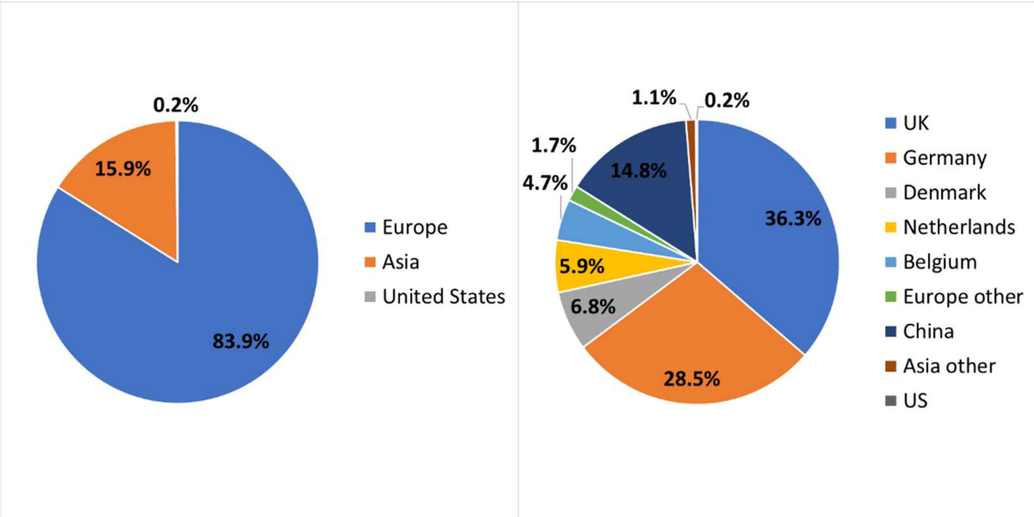
In subsequent chapters we consider what interventions or investments could be used by local policy makers to help realise the opportunities with the highest economic benefits and maximise these economic benefits, while continuing the expected momentum felt in the first half of the 2020s.

4 Potential export opportunities to be exploited

4.1 Global market

The global offshore wind sector has expanded significantly in recent years, with installed capacity more than tripling globally between 2011 and 2017. In 2017, a historical record 4,334 MW of new offshore wind power was installed across nine markets globally. At the end of 2017, nearly 84% of all offshore installations were located in the waters off the coast of eleven European countries. The remaining 16% was located largely in China, followed by Vietnam, Japan, South Korea, the United States and Taiwan. The UK is the largest offshore wind market in the world, accounting for 36% of installed capacity, followed by Germany and China, accounting for 29% and 15% of total installed capacity respectively (see Figure 4.1) (Global Wind Energy Council 2018).

Figure 4.1 Shares of installed capacity in 2017, by broad country group (left panel) and individual country (right panel)



Source: Cambridge Econometrics elaboration based on (Global Wind Energy Council 2018)

Europe In Europe, the UK accounted for 53% of the increase in installed capacity in 2017, followed by Germany with 40%. Five countries (UK, Germany, Denmark, Netherlands, Belgium in order of capacity) represent 98% of all grid-connected offshore wind installations in Europe (Global Wind Energy Council 2018). The European offshore wind sector is expected to expand further, reaching 70 GW of capacity by 2030 (WindEurope 2017) (Offshore Wind Industry Council 2018).

Asia In the near future, Asia is expected to become the engine of growth in offshore wind sector's installed capacity, driven mainly by China and Taiwan (Asia Wind Energy Association 2019) (Norwegian Energy Partners 2018). China's offshore wind industry is expanding at a rapid pace, now in third place worldwide in terms of total capacity after the UK and Germany, and is likely to reach the national target set by its government of 5 GW of installed capacity before 2020. Japan has 12 GW of offshore wind projects currently under various stages of development, and the Japanese government has set a target of 10 GW of installed capacity by 2030. Taiwan's government is actively promoting clean energy (in particular through feed-in tariffs) and has a new target of 5.5 GW of installed capacity by 2025, which was ambitiously revised upward after the previous 3 GW target was exceeded through an over-subscription of projects. India has prepared a roadmap for the development of offshore wind power and needs large-scale clean national energy generation to maintain support for its growing economy in a sustainable way (Global Wind Energy Council 2018). South Korea, as part of a broad plan of increasing the share of renewable energy, aims to build 12 GW of capacity by 2030 (Linklaters 2019).

North America

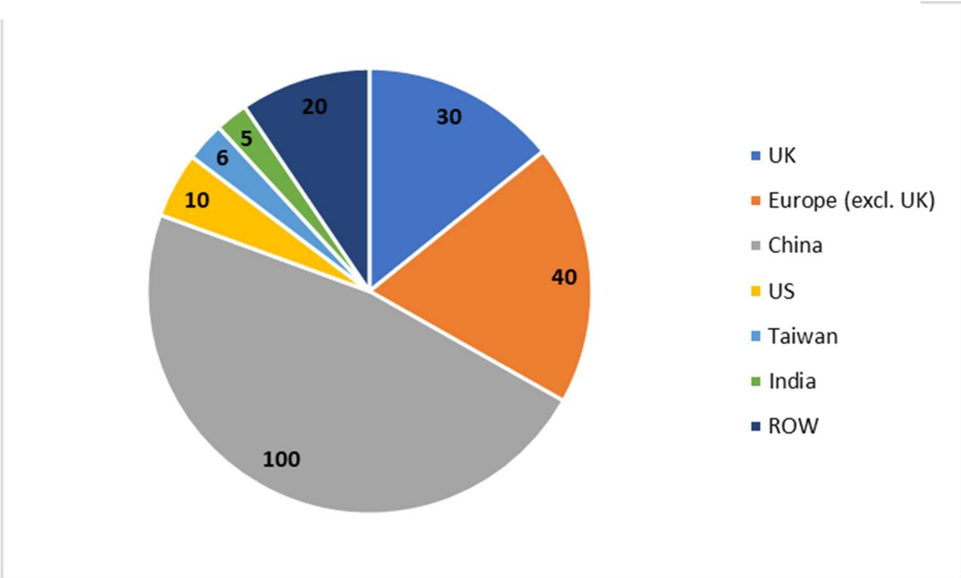
The first offshore wind farm in the US started operating in 2016 with a capacity of 30 MW, and various plans and targets have been adopted along the north-east coast, with the state of New York at the forefront of the developing industry. At the end of 2018, the US offshore wind project pipeline amounted to 26 GW of capacity (U.S. Department of Energy 2019). High wholesale electricity prices and demand (Global Wind Energy Council 2018) and the reliance on the European supply chain (U.S. Department of Energy 2019) represent favourable conditions for the European offshore wind sector, including suppliers based in the North East of England, where strengths in various stages of the offshore wind life cycle offer a substantial competitive advantage. Although the US offshore wind market is still in its infancy, new large-scale opportunities are likely to develop in the near future, and the market could offer substantial opportunities for North East offshore wind suppliers to tap in to.

The potential for European suppliers to use their competitive strengths to gain market share in the developing US market is demonstrated by Norwegian-based offshore wind firm Equinor, winning the first large-scale offshore wind bid in the state of New York in 2019. The Empire Wind project is expected to deliver 816 MW of installed capacity and to begin commercial operations in 2024 (Equinor 2019).

Future developments

Overall, the trends described are likely to continue in the future, with a global expansion of the sector and the rise of an extra-EU market, particularly China. Looking at the short-term, in 2018 there were 9.5 GW worth of projects under construction around the world, of which 43% were located in China, 27% in the UK and 15% in Germany. One estimate points to 63 GW of installed capacity globally by 2024, with similar proportions (U.S. Department of Energy 2019). In the longer-term, all forecasts expect a substantial expansion of the global offshore wind sector well above 100 GW of installed capacity. For example, (Global Wind Energy Council 2018) forecast 120 GW of total global installed capacity by 2030, while (U.S. Department of Energy 2019) provides two other forecast of 154 GW and 194 GW, with 47% represented by Europe, 27% by China and 19% by other Asian markets Figure 4.2 compares the 30 GW target of the UK sector deal with other country estimates provided by (Offshore Wind Industry Council 2018). Although considerable uncertainty exists, the picture that emerges is quite clear; Europe and the UK will continue to be key players in the offshore wind sector and will continue to expand capacity, but the bulk of the expansion will come from Asia, especially from China.

Figure 4.2 Global installed capacity in GW by 2030



Source: Cambridge Econometrics based on (Offshore Wind Industry Council 2018)

4.2 Specific overseas opportunities for the North East LEP region

Several opportunities for offshore wind suppliers located in the North East will arise following the expected expansion of the global offshore wind sector. As well as the rapidly expanding offshore wind market in China (which relies on European technologies), the offshore wind industries in other expanding markets in Asia are still in their infancy and generally lack infrastructure, local expertise and technology (Asia Wind Energy Association 2019). Since the North East is already home to a globally important offshore energy and subsea technology supply chain cluster, it is well-positioned to profit from future developments in overseas markets. Firms based in the North East region could provide technology and expertise in stages of the supply chains such as subsea engineering, robotics, planning and development, as well as design and fabrication of components such as pipelines, umbilicals and wind turbine foundations, thus building the basis of the offshore sector in currently untapped overseas markets. In all likelihood, the export of components will be a viable strategy only in the early stages of development in the new markets, while there are still gaps in local capabilities, and inputs have to come from abroad. In the medium term, as the local offshore wind sector develops and authorities implement policies favouring local contents, the North East's focus should switch to providing expertise, knowledge, project development and specialised engineering skills rather than components.

The general business environment of the North East is supportive of growth in the offshore wind sector. The North East attracted 5.4% of all FDI projects in the wind sector secured in the UK during the period 2003-2017, meaning that investors are keen to provide funding which could increase the competitive advantage of the North East's supply chain. In addition, both the industry and the government are supporting the UK's offshore wind sector through an ambitious industry-set target of 30 GW of capacity delivered by 2030 and through the government's plan to support, with Contract for Differences auctions, the creation of 2 GW of additional capacity per year in the period 2020-2030 (North East Local Enterprise Partnership 2019). Total UK exports in the offshore wind sector stood at approximately £0.5 billion in 2017, and the Offshore Wind Industry Council (OWIC) estimates that they have the potential to reach £2.6 billion by 2030, with UK expertise, components and services being exported to a growing global offshore wind market (Offshore Wind Industry Council 2018). All these factors should guarantee a solid foundation for the outward development of the North East offshore wind sector.

The UK exiting the EU will have consequences for trade within the UK offshore wind sector. Changes in UK energy policy and support schemes, uncertainties over the financing of existing and future projects, changes in environmental standards are only some of the issues that might affect the UK offshore wind sector (Norton Rose Fulbright 2016). British and European markets so far have been interconnected to trade in electricity, through supply chains linkages and through carbon prices (Renewable UK). Although there is still considerable uncertainty, an increase in tariffs on both sides following a departure from the EU will cause disruptions in the offshore wind supply chain within the UK, given that many inputs are imported. In the worst case of an extremely limited trade agreement with the EU, the most-favoured-nation (MFN) clause under WTO prescribes a 2.7% tariff on the components making up an offshore wind farm (e.g. nacelles, blades and towers). Although this tariff might not seem particularly high, it is worth noting that a high share of capital expenditure in recent projects was non-UK based (Wood Mackenzie 2019), suggesting a high share of future project value could be subject to a tariff in this scenario Developing a local supply chain more independent from European inputs would be a key strategy to avoid major negative implications from the imposition of such tariffs. Moreover, exporting and developing projects in other European countries would become more costly and difficult. Therefore, diversifying exports toward extra-EU markets might partially compensate for the impact of such a scenario.

Proposals have been made by the government to create ten free trade ports in the UK (BBC 2019). Within a free trade port, import duties don't apply and the administrative burden of imports is reduced. Goods could therefore be imported (without tariffs), processed and then re-exported from the free trade port area. Should one of the port sub-regions of the North East become a free trade port/ free trade zone, this could potentially be beneficial for the region's offshore wind sector, in the case of the imposition of import tariffs on EU goods. Firms operating inside the port could manufacture using components imported from overseas with no tariff applied and with simplified documentation. However, while this aids the continued competitiveness of firms based in the region, import duties will still apply to firms based in other countries importing the finished good, and to UK companies based outside of the free port zone. How beneficial the free port would be to the offshore wind sector in the North East would also depend on whether competitor ports in other regions, such as Hull and Grimsby, were given the same status. If other competitor ports do not receive the same status, the North East would have a significant competitive advantage within the UK's offshore wind sector.

The economic benefit of such free trade areas is unclear, supporters claim that free trade ports help create jobs and economic activity in the region while critics claim that they merely divert economic activity from elsewhere in the country and that they are of little benefit if the level of tax is already low, and that it could foster illegal activities (Institute for Government 2019).

Existing export capabilities

The North East offshore wind sector has already demonstrated its ability to attain market share overseas. Some notable products, organisations and overseas projects include (North East Local Enterprise Partnership 2019):

- Remotely operated vehicles (ROV's) from Wallsend-based SMD, with capabilities for both sea salvage and oil and gas operations, utilised in projects across the globe
- Newton Aycliffe-based Tekmar, a global market leader in offshore cable protection, which has supplied systems and services across Europe, the US and Asia
- Stocksfield-based Royal IHC Limited, the UK arm of Dutch parent company Royal IHC, which designed its 80-metre J-lay system in the North East.

The North East offshore wind sector is equipped with specific strengths which are suited to face the challenges often arising when further developing an offshore wind supply chain (Chinn 2014):

- The foreseen expansion of the global offshore wind sector and relative pipeline projects, especially in Asia, should provide sufficient scope for additional investment. Moreover, industry participants have already set a target of 30 GW of installed capacity to be met by 2030. Thus, the availability of pipeline projects to enable investment should be granted.
- The North East LEP region is located in proximity to UK offshore wind developments sites such as Dogger Bank, has efficient infrastructure and a cluster spanning most key areas of the supply chain (North East Local Enterprise Partnership 2019). These features should grant a substantial economic advantage in terms of innovation and cost reduction.
- The North East's energy sector is supported by an extensive skills, research and education base, with strong links into local, national and global industry (North East Local Enterprise Partnership 2019). The availability of a skilled workforce supports the engineering excellence of the North East and constitutes a comparative advantage.
- The North East region features a number of facilities for testing, demonstrating and validating energy technologies, challenges and processes, such as the ORE Catapult's National Renewable Energy Centre (North East Local Enterprise Partnership 2019). Given the development of offshore wind foreseen, the capabilities to innovate and to test new technologies will be fundamental.

4.3 Regulations and barriers

Looking ahead, the opportunities for offshore wind suppliers based in the North East to gain market share in the global offshore wind sector are sizeable. However, the same features that make new markets attractive (such as the offshore wind sector being in the early stages) can also represent obstacles to overcome, and the local policy setting should be taken into account. From a policy point of view, an OECD study identifies various trade policies which could present challenges or barriers to international investment in the clean energy sector (OECD 2015):

- Local Content Requirements (LCR) have been used as means for promoting domestic manufacturing but have resulted in lower international trade and higher costs, which in turn cause reduced price competitiveness, reduced international investment and increased wholesale electricity prices
- Preferential access to finance and export subsidies can increase inefficiencies and hamper international competition
- Trade remedies can reduce international trade volumes, increase prices and increase investment risk
- Technical barriers to trade such as divergent national standards and certification requirement can drive up costs and impede entry in the market

The presence of government interventions such as those listed above, could present North East-based offshore wind firms with substantial barriers to entering some overseas markets, due to a lack of competitiveness.

Barriers in China

In China, wind turbine producers have to comply with local government standards and certifications in order to be eligible to participate in domestic wind projects, meaning that FDI using foreign technology (based on international standards) will be penalised. Moreover, local firms possessing the Chinese intellectual property certificate qualify for priority in government procurement, implying a low chance for foreign investors to participate in government procurement (OECD 2015). These restrictions could represent a severe hindrance to the entry of European firms, including those located in the North East region, in the economy with the fastest growing offshore wind sector.

From 2003 to 2009, China had in place an LCR system whereby 20-35% of the score in a tendering process was contingent on ensuring a 70% share of local content in production. While this seems to have supported the growth of the domestic wind sector, it has also hindered high-tech imports and technology transfer from more experienced foreign manufacturers, generally slowing quality improvements (OECD 2015).

Barriers in India

India’s standards, certifications and administrative procedures do not seem to discriminate significantly between local and foreign enterprises. The main obstacles to the wind sector development are represented by the burdensome issuance of environmental permits subject to multiple local authorities and communities, and the lack of a unified national grid (OECD 2015).

India has also recently approved very heavy thresholds of LCR in renewable energy projects developed by the government: preference should be given to domestically manufactured products; local content required for the gear box, blades, rotor, generator, tower, hub, parts of controller, bearings, yaw machine components, nacelle and hub is 80% and assembly/manufacturing facilities should be located in India (Mercom India 2018).

Barriers in Japan

The Japanese government is committed to expanding its share of renewable energy in the energy mix, following the Fukushima disaster and the subsequent reduction in nuclear energy generation. However, key challenges for the development of an offshore wind sector include a lengthy and costly

Environmental Impact Assessment, which could take three to four years to complete, and the insufficient grid transmission capacity: wind supply is located in remote parts of the country, while the grid is not equipped to transmit energy nationwide (Carbon Trust 2015).

Barriers in Taiwan

Taiwan lacks a proper harbour infrastructure and needs investment in grid upgrades to handle the potential installed capacity (Asia Wind Energy Association 2018). Moreover, heightened political uncertainty could slow down investments in offshore wind, given the reduction in feed-in tariffs applied by the government after the recent local election defeat and the uncertain outcome of political elections in 2020 (Asia Wind Energy Association 2019) (Renewable Energy World 2019).

Taiwan is also pushing developers to meet LCR. The standards required are not yet clear, but some European developers are facing challenges regarding local content because of the under-developed local supply chain (Recharge 2019)

Barriers in South Korea

In South Korea, key challenges include the limitations in the "top-down" approach implemented by the government in managing projects, by meteorological impediments (low intensity of wind) and opposition from local residents (Linklaters 2019).

Barriers in USA

The United States offshore wind industry is still in its infancy, and the main challenges are represented by the lack of a proper port infrastructure and from the need to update the grid to meet the requirements of offshore wind installations (Business Network for Offshore Wind 2019). Moreover, the 1920 Jones Act imposes severe limitations in the use of foreign vessels for domestic maritime trade (Burke 2018). An example of difficulties the Jones Act can impose upon the construction of offshore wind can be highlighted within the Block Island offshore wind project. Since the US lacked necessary heavy-lift jack-up vessels, a work-around strategy was implemented when constructing the wind farm in 2016. Nacelles were moved from Europe without stopping in a US port, inevitably increasing the cost of the project. Future solutions to difficulties like this, as a result of the Jones Act, are either an amendment of the Jones Act or the construction of local heavy-lift jack-up vessels (Burke 2018).

LCR are determined at the state level. In the past, some states have used LCR in the context of Feed-in-Tariffs (OECD 2015). Given that the US offshore wind industry has yet to develop it is inevitable that many parts and components will be imported from Europe, and for now there are no explicit LCR targets. However, discussions about which components could be built locally are continuing (Greentech Media 2019).

Table 4.1 Opportunities and challenges for entry in selected markets

Opportunities	Challenges
China	
• Fastest growing market • Local sector relies on European Technologies	• Series of regulatory barriers favouring local enterprises over foreign ones
India	

• Completely new market • Absence of discriminatory regulation	• Burdensome issuance of environmental permits • Lack of unified national grid
Japan	
• Government support and commitment to renewable energy • Huge wind resources	• Lengthy and costly Environmental Impact Assessment • Insufficient grid transmission capacity
Taiwan	
• Ambitious target set by the government • Abundant wind resources	• Political uncertainty • Lack of infrastructure
South Korea	
• Government policy to expand offshore wind sector • Strong legal system	• Difficult negotiations with local population • Projects usually led in a "top-down" format by the government
United States	
• Dependence on European supply chain, at least in the short-term • High wholesale electricity price and demand	• Lack of appropriate port infrastructures and necessity of grid updating • Uncertainty about future state policies, also regarding permits

Sources: Cambridge Econometrics, based on references

4.4 Conclusions

The global offshore wind energy is expected to flourish in the short- and medium-term, with many countries entering the sector for the first time. What is lacking in developing overseas offshore wind markets, beside equipment, is expertise, skills and problem-solving capabilities. Firms based in the North East have the potential to service these needs. Since the North East is expected to focus on the provision of services rather than components, the establishment of bases of operation in foreign markets to avoid local content requirements is not strictly necessary, although it could facilitate operations.

In Asia, the opportunities for North East firms are sizeable, including countries such as Japan, South Korea and Taiwan. China represents a huge market, but obstacles such as regulation on intellectual property are challenging. However, the gain for those firms that take the time and resources needed to enter such a complicated market could be large. Moreover, exports to Asia could take the form of services, advice and problem-solving capabilities, rather than equipment. The development of floating technologies will be a key element for the expansion of offshore wind in Asia, since many sites are located in deep water.

Europe will continue to expand, with German, French, Polish and Irish markets being particularly active. Except for Germany, these markets are still nascent and could be serviced by equipment and expertise from the North East.

Among the markets evaluated, the US seems to be the most attractive destination for the North East's offshore wind exports. The US offshore wind sector is in its infancy yet is expected to be one of the key markets in the near future. The US has a total pipeline of projects totalling 26 GW, spanning ten states off the East and Great Lakes coast. From this pipeline, eleven projects totalling 7.5 GW are expected to be operating in 2026. Several states have adopted specific timelines to increase their offshore wind capacity (American Wind Energy Association 2019). Given that local content will be a concern in all export markets, cooperating with local companies to develop the supply chain could be the most viable option for meeting these targets. In the US, language and cultural barriers are lower, and UK-based firms' expertise in offshore wind is well-known. Therefore, forming joint ventures with US players should be relatively easier than in other parts of the world. Local operators don't know yet the gaps in the supply chain that must be filled in order to develop the required capacity, and the North East could offer its expertise to identify such gaps and how to address them. To enter the US market, North East firms would benefit from a coordinated approach, in order to present themselves and their offer. In this context, the North East LEP could play an important coordinating and supportive role. An example of this approach is the recently signed intent of collaboration between the Delaware Prosperity Partnership and the North East LEP, which aim at supporting joint business developments. The two organisations will work together to promote their partner area as a location for local firms looking for international business expansion opportunities in areas such as life science, advanced engineering, Fintech, innovation, skills and wind supply chains (Delaware Prosperity Partnership 2019).

5 The strengths and weaknesses of the offshore wind industry clusters in the North East

5.1 Introduction

The purpose of this chapter is to establish the strength and weaknesses of the sub-regional clusters within the North East, their current and potential future contribution to the region's economy, and how potential opportunities for these clusters could be exploited.

The aim of our approach is to develop an independent view of the strengths and weaknesses of the clusters, and through an understanding of their position within the value chain, assess their potential to increase the share of value-added within the sector; either at the expense of foreign firms (i.e. by increasing the UK's share of domestic and foreign installations) or by out-competing domestic firms (either within the North East or across the UK). Moreover, we aim to identify the supporting interventions that could help each cluster to realise its potential.

Sub-regional clusters

The identified clusters are Blyth, Tyne, and Sunderland. Figures 5.1 to 5.3 show the maps of the three clusters, where the dots represent the location of the firms identified in chapter 2. Blyth has a large focus on offshore logistics and subsea surveys and operations, making it mainly a construction and logistics hub. The Tyne cluster has a significant amount of development company headquarters (located in Newcastle city centre), while downstream on the River Tyne, the companies are more focused on engineering, manufacturing and offshore logistics. Sunderland has electrical workshops (ABB) and subsea services (surveying, cable laying, foundations).

Figure 5.1 Blyth cluster

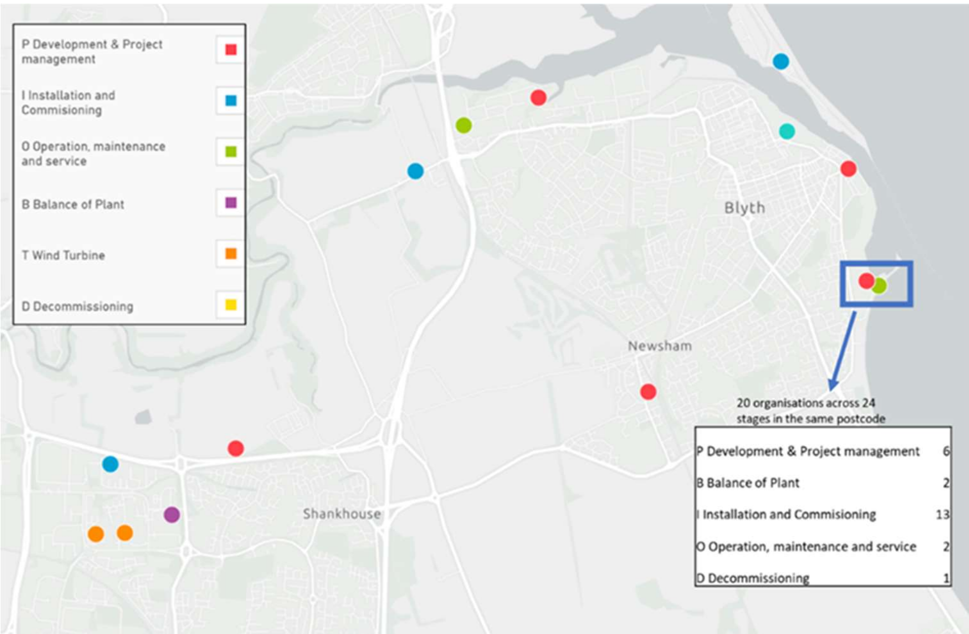


Figure 5.3 Tyne cluster

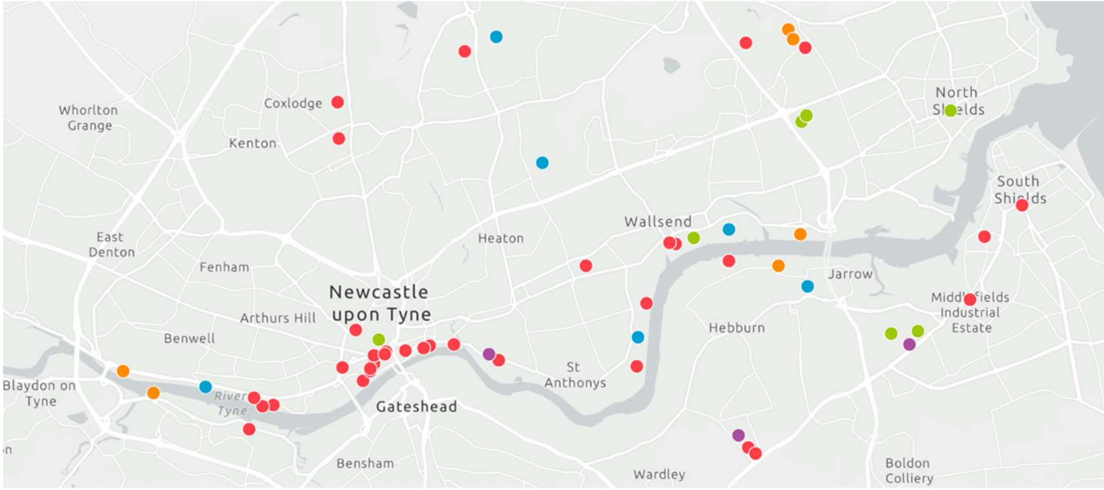
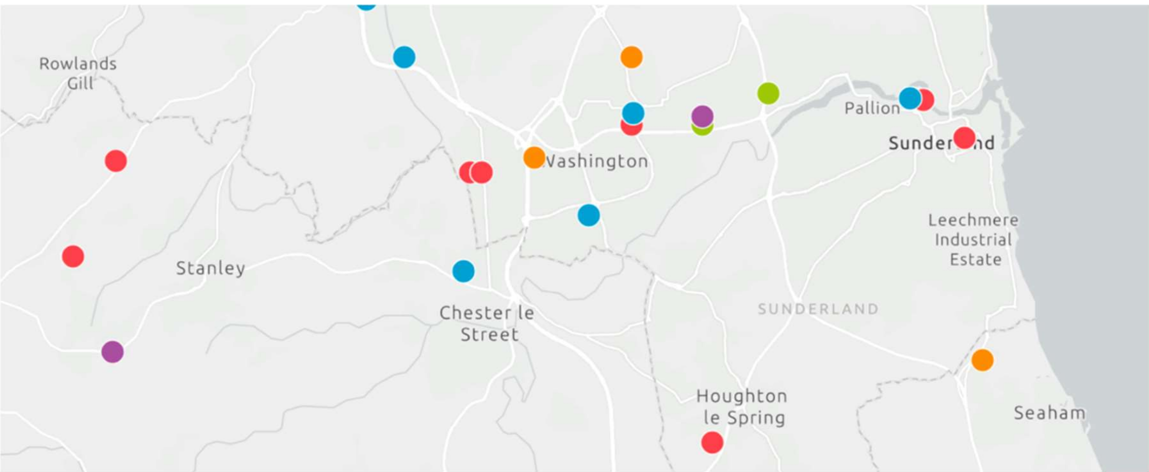


Figure 5.2 Sunderland cluster



The analysis carried out allowed us to highlight the main features of each cluster. However, all three clusters are affected by the same trends in the offshore wind sector, both at the national and global level. Looking ahead, the clusters share the same overarching threats and opportunities, and many of the current weaknesses and strengths are common across the North East. Therefore, a SWOT analysis for the North East offshore wind sector as a whole is presented, followed by analysis of the specificities of each cluster in relation to the overall regional picture.

Information sources

Our analysis is based on insights gathered from desk-research and stakeholder engagement. The desk research, whose outcome is presented in paragraph 5.2, focused on material found online and allowed us to have a general overview of the offshore wind sector in the UK and in the North East. The stakeholder's engagement, whose outcome is presented in paragraph 5.3, provided us with further information about sub-regional clusters and hence allowed us to analyse in greater detail the North East offshore wind sector.

5.2 Desk research on the strengths and weaknesses of the UK offshore wind sector

Strengths

Various factors are contributing to a very positive outlook for the UK offshore wind sector as a whole, benefitting UK clusters of expertise in the sector, such as the North East.

The offshore wind sector is experiencing a phase of expansion worldwide. The UK is the world leader in installed capacity with 8.5 GW in 2019 and a substantial pipeline of projects planned, including an additional 2.9 GW under construction and 11.3 GW consented. In the UK, the offshore wind sector contributed 8% to electricity generation in 2018 and its exports amounted to £500m in 2017.

Moreover, costs in the offshore wind technology have decreased substantially in recent years and are expected to continue to fall, along with falling costs of capital which have resulted as a consequence of lower perceived risk attached to the sector (Noonan 2019).

Within this context of global expansion, stages of the supply chain such as balance of plant and installation and commissioning are well represented in the North East. The region hosts some very strong entities such as the Tyne-based JDR Cables, which is a dominant player in the array cable market (Whitmarsh 2019), and SMD, Tekmar (Sunderland) and Deepocean (Blyth) which have world-class reputations. The port infrastructure is adequate for the performance of operations along the offshore wind supply chain (e.g. in foundation fabrication) and the business environment is favourable thanks to the Enterprise Zone Status and the availability of land in the areas adjacent to the ports. Finally, the North East produces a reliable supply of skilled labour for the energy and the offshore wind sector. (Invest North East England 2019). These features make the North East a strong player in the industry and lay the ground for further development during the global expansion of the industry.

Weaknesses

Although the outlook for the offshore wind sector is positive, the UK offshore wind sector shows various shortcomings.

Many UK businesses in the industry are SMEs with a small number of clients. Given the expected growth in demand, the increasing volume of services required by contracts and the increase in assets' dimension they will need to scale up operations and employment if they want to seize the opportunities brought by new projects and avoid bottlenecks in production (Noonan 2019). Keeping the same dimension might entail losing contracts in favour of larger suppliers. The same is true in the North East where the size of firms is usually relatively small (for example Osbit, Tekmar and Cathie Associates).

Development and project management activities tend to be local to the area in which the project is taking place, so these stages of the supply chain will be outside of NE firms' reach if future offshore wind installations occur outside of the region. Stakeholders argued that a "critical mass" of projects is needed to establish a clear expertise and to export it.

The main weakness of the UK offshore wind sector is the lack of large British-owned firms, particularly in the stage of blade and turbine manufacturing. Currently, very few offshore wind portfolio owners are headquartered in the UK. The largest one is Ørsted, a Danish company, with a 24% ownership share of the UK market (Whitmarsh 2019). The relative scarcity of UK-based offshore wind developers might somewhat limit the economic benefits for the UK, since foreign developers are more likely to use inputs from abroad. There are a limited number of players in wind turbine manufacturing, which are also not UK-based. Indeed, no wind turbine manufacturers is present in the North East. Given the large scale of investment needed, entrance of new players to wind turbine manufacturing is difficult (Whitmarsh 2019), therefore it could be challenging to increase wind turbine manufacturing capabilities in the UK.

Moreover, barriers to entry exist which limit the ability for small and specialised suppliers to enter the market. Barriers include: difficulties in finding the appropriate contact within the supply chain to provide specialised products; the need of a track record to attract funding for new entrants perceived as more risky; innovation fatigue given the small size of the workforce and availability of funding for micro SMEs (Whitmarsh 2019).

Opportunities

Looking ahead, significant opportunities exist which can be seized by the UK and NE's offshore wind sector. The UK government has clearly expressed its support through the Offshore Sector Deal, which sets a target of 30 GW of installed offshore wind capacity by 2030, a target of 60% of UK content in the supply chain and ambitions to increase exports to £2.6bn per year. Currently, the UK is on track to meet the capacity targets (Noonan 2019). Therefore, the availability of projects in the pipeline is strengthened by the political will to support the sector.

Considerable gains lie in the exploitation of synergies and transfer of knowledge from other UK-based sectors such as oil and gas (Offshore Wind Industry Council 2018), and the wealth of experience from the onshore wind sector could be put to use without the need for overseas suppliers (Whitmarsh 2019). The presence of a strong legacy of oil and gas in the North East thus represents a significant advantage over other areas of the UK.

Moreover, the sector could improve productivity and reduce costs thanks to technological advancements in the realms of artificial intelligence and robotics (Whitmarsh 2019). The North East is well-positioned to benefit from a long-established heritage of engineering skills in the energy sector (North East Local Enterprise Partnership 2019), and could lead innovation in offshore wind thanks to world-renowned facilities such as Offshore Renewable Energy Catapult in Blyth and Tyne Subsea in Newcastle, and universities specialised in research in the energy sector such as Newcastle University (North East Local Enterprise Partnership 2019). A strong presence of digital and advanced manufacturing companies (Invest North East England 2019) could also contribute to the development of the offshore wind sector in the North East. Given the small size of many UK and North Eastern firms, the provision of goods and services of local firms to larger suppliers could strengthen the UK position (Whitmarsh 2019) and could partially compensate for the lack of big local producers.

The greatest opportunity for firms operating in the North East's offshore wind sector is represented by the location of the next round of projects planned at Dogger Bank and Hornsea (The Crown Estate 2019), which could be serviced by the NE's ports both during construction and operation. Looking further ahead, decommissioning and repowering services could also become important in the UK and the North East (HM Government 2019), as wind farms within the UK come towards the end of their initial life. Stakeholders consulted during the course of this study argued that global opportunities for decommissioning services are likely to accelerate within the next decade, as older wind farms in other parts of the world reach the end of their lifetimes. The North East could capitalise on these global opportunities by focusing on the region's capabilities in this stage of the supply chain, potentially developing first mover advantages in decommissioning and recommissioning services. Estimates point to a significant expansion of employment in the UK offshore wind sector, from the current figure of 7,200 to 27,000 jobs by 2030 (HM Government 2019), and if UK content were to reach 65% by 2030 it could yield £2.9bn of GVA per GW (Noonan and Smart 2017).

Threats

The expected further decrease in the costs of offshore wind might also have some negative effects. Firms in the offshore wind sector are under increasing pressure to reduce costs in order to be able to compete, which in turn could squeeze margins and reduce the ability to invest. In the worst case, the strike price auctions could encourage a "race to the bottom" to provide the lowest possible price at the expenses of quality and sustainability, thus eroding the tradition of high standards and innovation which represent the unique selling point of the UK. Moreover, as projects are deployed in increasingly challenging sites, costs could actually increase (and/or load factors decrease).

Since wind is an intermittent source of energy, questions regarding the level and type of energy storage required naturally arise, and it is possible that the cost of grid balancing services could increase depending on the type of storage chosen (Noonan 2019). The need to maintain low costs while providing quality products and services is key in a phase where new players such as China are expected to gain market shares at a quick pace (see Chapter 4).

Finally, it must be considered how to smoothen the level of activity in the NE, i.e. how to keep similar level of activities after the next round of installation is over. This could be done either by expanding the offer of products or by gaining larger shares of global markets (NE LEP workshop).

Table 5.1 summarises the SWOT analysis detailed above.

Table 5.1 SWOT analysis of offshore wind sector in the UK and the NE

Strengths	• UK is the world leader in installed capacity • Costs in the sector are on a decreasing path • Offshore wind sector perceived as low risk • Balance of plant, Installation and commissioning well represented • Strong local realities • Good port infrastructure, equipment and favourable business environment • Reliable supply of skills
Weaknesses	• Size of UK businesses generally small, they need to increase in size to meet future demand • Ownership of firms in the NE is often of foreign origin • Development and project management tend to be outside of the NE • More projects are needed in the NE to reach a 'critical mass' of expertise

	• Very few offshore wind portfolio owners are headquartered in the UK • Limited number of players in wind turbine manufacturing • No wind turbine manufacturers present in the North East • The scale of the investment needed might hinder the entrance of new players • Difficult entry to the market for small specialised suppliers • The need of a track record to attract funding, innovation fatigue, availability of funding for micro SMEs are significant barrier to entry
Opportunities	• Offshore Sector Deal sets the government's ambitions for the sector and reassures over the availability of a project pipeline. • Possibility of synergies and transfer of knowledge from other sectors such as Oil and gas and the Onshore wind sector • Technological developments in AI and robotics can improve the competitiveness of the sector • Incorporation of a larger share of Intellectual Property of smaller UK businesses into larger suppliers • Employment growth in the sector • Increase in local content might bring significant gains in terms of GVA per GW • Potential for development of decommissioning stage in the North East • Future round of projects to take place in Dogger Bank and Hornsea, near NE's coast
Threats	• Costs might increase as projects are deployed in increasingly challenging sites • Pressure to reduce cost might reduce ability to invest • Questions about the level and the type of storage, which could increase the cost of grid balancing services • Increased global competition as Asia (particularly China) gains shares of the market (see export case) • Strike price auctions encouraging a reduction in quality/sustainability • 'Lumpy' nature of activity in the North East

5.3 Stakeholder views on the strengths and weaknesses of the North East cluster

The North East is an important cluster within the UK offshore wind sector, with specific strengths compared to other clusters in the UK such as Hull and Grimsby. Our consultation with stakeholders highlighted various additional strengths, weaknesses, opportunities and threats facing the North East offshore wind cluster to those defined above for the UK as whole. These points are discussed in detail in the following sub-sections.

Strengths

First, the North East benefitted from first mover advantages, enabling it to grow a developed supply chain before other competing regions. Since many stages of the supply chain are located in the NE, it is possible to achieve significant cost reductions.

The NE is particularly strong in Balance of plant, Installation and commissioning and Operation and maintenance stages (where the share of local content is particularly high). Indeed, cables, foundations, cable coating, jackets and relative equipment (e.g. robots) are all produced in the NE by well-known companies such as JDR, Smulders, Tekmar and SMD.

The engineering expertise of the NE is widely acknowledged and a key asset, with firms like Osbit providing bespoke solutions to engineering bottlenecks.

The NE has advanced R&D capabilities and specialises in subsea technologies and testing thanks to world-class institutions such as the ORE Catapult in Blyth. The availability of engineering skills is aided by the presence of local public and private training facilities supplying qualified labour (although it is not clear if this will be enough to meet the increased demand for skills).

The region has a strong legacy of oil and gas and automotive companies which, thanks to transferrable skills and expertise, could transition into renewable energies and increase the overall capability of the cluster. In addition, the existing energy assets and relatively large energy generation capabilities in the North East region mean additional offshore wind farms can potentially be more readily connected to the energy grid than wind farms located in other UK offshore wind clusters. The North East's wider innovation, research, science and demonstration capabilities across the energy system also offer unique opportunities for offshore wind sector organisations. Particularly developers and firms wishing to explore supply chain opportunities associated with systems integration of offshore wind and the broader transition to clean growth

Finally, the North East has been described as a good place to do business in the energy sector thanks to the presence of industry organisations, financial incentives (e.g. Enterprise Zone Status) and good infrastructure (e.g. ports for offshore activities). Stakeholders highlighted how the North East cluster is focused in delivering what the industry needs and on quality products. Hence, the North East cluster has the potential to acquire an important role in the global offshore wind sector.

Weaknesses

However, stakeholders have also highlighted several shortcomings that exist within the North East cluster.

The main weakness of the cluster is the absence of large wind turbines manufacturing, which is the most employment-intensive stage of the supply chain and where the highest share of gross value added is captured. Currently, towers, monopiles, nacelles, rotor, gearboxes and components for blades are imported into the NE. Other manufacturing gaps exist in cable manufacturing, which although is one of the North East's strong points, is not providing some key products such as HVDC cables. Project development is mostly carried out by utilities firms based elsewhere in Europe, with only some surveying activities conducted by local firms. Many of the past investment opportunities were filled by international groups and European suppliers, limiting somewhat the impact of supply chain development on the local community, given also that many of the production inputs are imported.

In terms of land and infrastructure, high value manufacturing requires a lot of land, which is not always available, and land prices are in general higher than elsewhere in Europe. Also labour costs are higher in the UK than in other European countries, while productivity is lower. Although port infrastructure in the North East is good, some stakeholders have highlighted issues with the depth of water and the marshalling capabilities, given that large vessels will be needed for the construction of windfarms.

Stakeholders also stated that there is the need for local firms to work together and to undertake joint projects, the kind of collaboration which, currently, is infrequent. For example, firms in the North East could jointly tender for projects in order to present a stronger offer, thus increasing the chances of winning bids.

For the reasons stated above, the positive impact of the offshore wind sector on the NE's economy has been somewhat limited to date.

Opportunities

Overall, the North East has a lot to gain from a further development of the offshore wind sector. Looking ahead, stakeholders identified significant opportunities to develop the NE's offshore wind cluster. The Sector Deal has affirmed the UK government's support for the sector, thus easing concerns about the availability of projects. Within this context, the main opportunity for the North East is represented by the next round of windfarm construction in Dogger Bank. Given the geographical proximity to this development, the North East offshore wind supply chain would be well-positioned to contribute its products and services. In particular, stakeholders have highlighted the sizeable gain that could come from servicing the new platforms with local operations and maintenance.

Transport costs considerations might prevail over production and labour costs in the future, thus possibly attracting manufacturing to the North East, to be close to the location of offshore wind developments.

Innovation will be key for the NE. Various stakeholders suggested competition should be based on innovation instead of traditional sectors where other countries are already more cost competitive. IT, robotics, subsea technology, floating technology, artificial intelligence and analysis of big data are all technologies that the North East could pursue thanks to its expertise and R&D capabilities.

Costs in the sector are forecast to continue to decrease, with offshore wind expected to soon become cheaper than gas and with floating technologies expected to become more widespread and less costly.

The NE could fill the gap in its supply chain by attracting wind turbine and HVDC cable manufacturers, thus creating more value added. The biggest increase in local value added could be gained if the region were to attract a large turbine manufacturer, similar to past achievements in the automotive industry. Indeed, favourable business conditions (fostered by government's effort) and the availability of skilled workforce convinced Nissan to open a factory in Sunderland. As outlined above, these features are still present in the North East and provide a good basis to attract blade and turbine manufacturers in the region.

Industry coordination could be strengthened in the region in order to create a specific NE identity to export overseas and to compete more effectively.

Although port infrastructure is generally of good quality, additional investment to make it more suitable for the next round of projects and, possibly, for manufacturing of wind turbines will be key to secure a comparative advantage beyond O&M. Ports will need to be able to marshal large vessels in order to transport blades and components of increasing dimension, and suitable land close to the harbour will be needed to expand the existing manufacturing activity and attract new ones. Getting the infrastructure right will greatly strengthen the ability of North East's cluster to satisfy the growing demand.

Finally, there is substantial scope for the NE to provide its expertise and services to overseas markets such as Asia and the US.

Threats

There is a chance that the opportunities described above might not materialise. In particular, many stakeholders were sceptical about the 60% share of local content target set by the government in the sector deal, given that many inputs are currently imported, that there is no large wind turbine manufacturer located in the North East and that in some stages of development, such as O&M, it will be difficult to increase local content. The GVA potential of future projects might thus be lower than expected if the percentage of local content is not increased in the more productive stages of the supply chains.

The expected reduction in offshore wind costs on the one hand will increase demand but on the other it will imply lower margins, therefore lowering the return to investment. The lack of coordination within the North East might erode its competitive advantage versus other more coordinated areas like Humber and Great Yarmouth. Hence, not being politically aligned within the North East region might threaten the development of the sector.

Finally, other European countries continue to develop their offshore wind offering and will compete to gain further market shares. North East firms may find it increasingly difficult to maintain market share, particularly in the case of a no-deal UK exit from the EU, which would undoubtedly make tendering for EU-based projects more difficult.

Table 5.2 summarises the SWOT analysis conducted above.

Table 5.2 Strengths, weaknesses, opportunities and threats relevant to the offshore wind sector across the North East

Strengths	• *Supply chain strengths* o Possibility of cost reduction brought by proximity of various supply chain stages o First mover advantage and accumulated experience o Renowned companies such as JDR, Smulders, Osbit, Tekmar and others o Installation and commissioning o Foundation manufacturing o Operation & Maintenance, with a high share of local content o Subsea engineering and equipment (companies such as DeepOcean) o Connectivity and cabling o Jackets and columns • *Expertise and R&D* o World-class engineering expertise o R&D facilities such as ORE Catapult o Skills in big data and data handling o Link with university education, availability of skills o Geotechnical marine surveys o Test and design of turbine blades • *Business environment and infrastructure* o Developed traditional industries such as Oil & Gas, automotive, shipbuilding, which could transition into renewables o Sites with Enterprise Zone status o Broader range of companies than other clusters o Good port infrastructure o Region well-served by the grid o Industry organisations such as Energi and NOF

	○ NE LEP open and transparent, easy to do business
Weaknesses	• *Supply chain shortcomings* ○ Lack of turbine manufacturers ○ Lack of monopiles and towers manufacturing ○ Lack of nacelles, rotors, gearboxes ○ Lack of component fabricators for blades ○ Lack of HVDC cables manufacturing ○ Project Development went mainly to European utilities • *Competitive weaknesses* ○ Many past opportunities fulfilled by international firms rather than local ones, hence lack of local suppliers ○ Large manufacturing takes place elsewhere (e.g. Hull), therefore most GVA outside of the region ○ Limited opportunities for firms in the region to work together ○ Land more expensive in UK than in Europe ○ UK not competitive in terms of costs or productivity ○ Less trickle-down from offshore wind because many inputs are imported ○ Monopiles lacking in all the UK ○ No raw source of materials for blades in the UK, imports of materials limits trickle-down • *Infrastructural weaknesses* ○ Little landbank for big scale manufacturing ○ Lack of marshalling facility ○ Issues with depth of water
Opportunities	• *General developments* ○ Next round of projects to be built in Dogger Bank ○ Reduction of costs through innovation ○ Wind farms becoming increasingly cheaper to build (compared e.g. to gas farm) ○ Transport costs possibly prevailing over labour costs and productivity, hence possibility to attract manufacturing because of proximity to sites ○ Diffusion and cost reduction of floating technology • *Supply chain opportunities* ○ Sizeable O&M potential for the new round of projects ○ Innovation opportunities in advanced technologies such as robotics, AI, drones, sensors, devices, remote monitoring ○ Ability to analyse and monetise data ○ Becoming a supplier of components for wind turbines ○ Start manufacturing of HDVC ○ Cables will be required in all the new markets, so sizeable export opportunities ○ Decommissioning in the long term (potentially short term for global decommissioning opportunities) • *Actions and policies* ○ Government support as embodied by the Sector Deal ○ Increase local content ○ Increase coordination between firms ○ Coordinate the transition of firms from oil and gas to renewable ○ Repeating what has been done before (e.g. Nissan), convince big manufacturers to come ○ Creating a precise identity for the NE ○ Compete in the right area and play on NE's strengths (e.g. expertise and innovation) ○ Provide expertise to new markets ○ Improve port infrastructures in the right way ○ Transform R&D efforts into products and services ○ Win projects to have money to spend in innovation
Threats	• *Competition* ○ Competition from mainland Europe and also from the Middle East (where production is subsidised)

- Competition within the UK, e.g. Humber and Great Yarmouth, which could put an offer together
- Local competition in O&M in export markets once local staff is trained

- *Targets*
  - 60% detailed in Sector Deal of local content might not be feasible
  - Reaching 75 GW by 2050 will be challenging
  - Increasing local content in some segments will be challenging (e.g. O&M is already at 70%)
- *Lost opportunities*
  - Low prices might translate into low margins
  - Lose EU projects after Brexit (how will EU tendering work?)
  - Not being politically aligned within the NE
  - Don't invest in time and thus missing opportunities
  - Not exploiting the legacy of traditional industries because (e.g. in oil and gas)
  - Not winning projects and thus not having funds to innovate
  - Manufacturing operations not being created, firms winning projects in the UK but producing elsewhere

5.4 Sub-regional clusters

Here we analyse in more detail the three identified sub-clusters, namely Blyth, Tyne and Sunderland. The views on the three sub-clusters were informed mainly through stakeholder engagement, since we did not identify specific information relating to the sub-clusters through the desk research.

The three sub-clusters, overall, are fairly similar: their outlook broadly coincides with the outlook for the entire North East cluster, given also the geographical proximity between each other. Therefore, we avoid repeating observations already made in the previous paragraphs and instead focus on specifics emerged from stakeholder's interview

Blyth

Existing strengths

Among the three sub-regional clusters identified in Section 5.1, Blyth is the most responsive, dynamic, and well-equipped in term of offshore operations, with a specific expertise in subsea technologies and related services such as cable laying, trenching and repair. Blyth is a leader in offshore energy support, which represents its core business. Indeed, Blyth stands to benefit substantially from O&M operations following the next round of projects in Dogger Bank, thanks to its geographical proximity to the site. Blyth is also well-known for its R&D and testing capabilities thanks to the siting of ORE Catapult in the area.

Other capabilities highlighted by stakeholders include vessels operations, fabrication, high-value electronic engineering and geotechnical cable protection. The presence of training services and the availability of development land complete the offering of Blyth.

The port of Blyth has benefitted from the collaboration with Advance Northumberland in developing land (e.g. Northumberland energy parks) supporting inward investment opportunities and providing favourable conditions for offshore wind development (Energy Central).

Future opportunities

The Port of Blyth is already licensed to decommission oil and gas farms and these skills are likely to be transferable to offshore wind farms in future. Moreover, the Blyth cluster has the potential to expand its capabilities into the installation phase, and it is investing in infrastructure to support primary manufacturing and port mobilisation for the next round of projects.

Current weaknesses and future threats

The main shortcoming of the cluster is the difficulty to host the large vessels needed for the construction of wind farms and the low water depth of the quayside.

The port of Blyth has the right characteristics to be a key supplier of products and services for the next round of projects and to lead innovation in the offshore wind sector. However, as long as big blade manufacturers will not locate in the area, the scope to increase the economic impact of the offshore wind will be somewhat limited. The increasing importance of transport costs, given the increasing size of blades, could be induce the manufacturers to locate activities in the area. Thus, having the right infrastructure to accommodate them will be fundamental.

Tyne

Existing strengths

Compared to Blyth, the Tyne cluster is more complex, showcasing a wide variety of firms and services, with key strengths lying in foundation manufacturing with renowned companies such as Smulders and A&P, and in the presence of traditional industries like oil and gas, which could potentially utilise existing skills and expertise to transition towards the offshore wind sector. Tyne's port is not as focussed as Blyth in offshore operations but is in a more favourable position in terms of infrastructure for heavy lifting and it is well-equipped to produce jackets. It has also companies active in manufacturing of subsea vehicles.

Weakness

Like Blyth, the Tyne cluster has potential to expand its offering into installation, but there are problems with the size of vessels it could host and has problems of accessibility because of naval traffic. Moreover, a perceived lack of coordination between firms in the North and South side of the Tyne river, due to mixed land ownership across both banks, limits somewhat the potential of the cluster. The Tyne region is situated across a number of local authorities, with the two banks of the river and the Port of Tyne located in different authorities. This fragmentation of the sub-regional cluster means there is a unique weakness in terms of coordination and common governance. Improved coordination between the various local authorities and firms in this particular sub-regional cluster is therefore more important than in the Blyth or Sunderland clusters.

Future opportunities

The wide array of companies present in Tyne will be a key advantage in the near future. While blade and turbine manufacturing may still be lacking, Tyne could supply components for blades and turbines, thus capturing a higher share of value added within the offshore supply chain. The legacy of the oil and gas and automotive industries represents a specific comparative advantage of the Tyne cluster, and transitioning skills and expertise into renewable energy will be essential to strengthen the local supply chain. Finally, a better coordination among stakeholders could allow the cluster to provide a more focussed offer, exploiting synergies between different kind of firms.

Sunderland

Existing strengths

Sunderland is the smallest of the three identified sub-regional clusters. The main strength of the cluster comes from its port, which is well equipped to facilitate the offshore wind activities of manufacturers from the rest of the region. Coordination of activities within the port is easier compared to the other two clusters because of the presence of one owner (the city council) and one operator. The cluster is home to a number of tier 2 and 3 suppliers (e.g. Liebherr Cranes) and has 265 acres of development sites that could be further exploited. Moreover, businesses are supported through its Enterprise Zone Status. In the past it was used as a base for feasibility surveys (performed by Cathie Associates), and it has companies active in promising product segments such as floating technologies (e.g. Frontier Technical).

Future opportunities and threats

Sunderland has a strong skill base thanks to a developing higher education sector and heavy manufacturing and engineering legacy. For example, the Nissan factory has aided the development of specific skills that could be transferred from the automotive industry to the manufacturing of turbines and related components. The establishment of the Nissan's factory sets a positive precedent for large manufacturers, which could be hosted in the development sites close to the port. As with the other two clusters, Sunderland could take advantage of its geographic position to serve the O&M requirements of the new farms to be built in the next round of projects. Threats to Sunderland's development come from the competition between regional ports, which is particularly tough given the push to reduce costs.

5.5 Conclusions

In this chapter we have analysed the features of the UK and North East offshore wind sector. Overall the picture is positive. The North East offshore wind sector is a strong cluster and will benefit from the next round of projects. The new farms to be built in its proximity will need ports capable of performing installations, cables, foundations, crews to operate and maintain the farms and, most of all, engineering expertise. Since these elements are already present in the North East, the economic impact of offshore wind in terms of GVA and employment will be substantial. However, the supply chain stage with the greatest potential in terms of employment and GVA, namely blade and turbine manufacturing, is missing from the region. Convincing a turbine and blade manufacturer to locate in the North East would complete the offer of the local offshore wind sector but, as of today, there is no plan to build a blade or turbine factory in the region. Hence the North East clusters will have to expand GVA and employment in other stages of the supply chain. The easiest way to do this is to play on the strengths of each sub-cluster. Blyth has significant O&M potential, and should further specialise in providing support for the construction and operations of wind farm. In fact, the port authorities are already moving in this direction. Moreover, it would benefit from finding a way to translate R&D and testing activities performed at ORE into manufacturing jobs, i.e. ensure that the innovation efforts result in the opening of local production lines. Tyne could exploit the legacy of the oil and gas industry: as fossil fuels demand decreases, oil and gas firms could transition to renewable energy and exploit the expansion of offshore wind, thus supporting GVA and employment. The production of components for turbines and blades is another activity that could capture some of the GVA produced elsewhere in the UK or in foreign markets. Sunderland could benefit from the transfer of the engineering expertise accumulated in car manufacturing to offshore wind, and further develop offerings in segments such as feasibility surveys and floating technologies. One of the distinctive features of the North East clusters is their focus on quality and innovation. Engineering skills coupled with advancements in technology (e.g. AI, big data and robotics) could become the unique selling point of the North East, and could represent a significant source of comparative advantage vis a vis foreign competitors, given that the region will likely be exporting services rather than components (see Chapter 4).

6 Analysis of offshore wind developers and suppliers

6.1 Introduction

In order for the North East supply chain to capture the value on offer, it will be necessary to engage with the developers and tier 1 and 2 contractors who will be driving the associated offshore wind projects. Based on our assessment of the key areas of strength of the North East, we have used the available information on the UK project pipeline to identify a priority list of developers and contractors for the North East supply chain to focus its engagement.

6.2 Owners - Investor and developer analysis

The first step in the process was identifying the known UK project pipeline and removing projects which have already passed key procurement milestones. The resulting list included projects allocated to the following stages by Renewable UK[4]:

- Pre-construction
- In planning
- CfD eligible
- RO eligible
- Support secured

We have identified 19 projects allocated to these stages, comprising a total capacity of 15 GW of capacity. Of these 19 projects, 12 are based in the English North Sea, five in the Scottish North Sea, one in the Irish Sea and one in the English Channel. The projects are shown in the table below.

Table 6.1 List of UK Offshore Wind Farms in development

Project	Capacity (MW)	Current status	Location	Owner(s)
Rampion Extension	400	In Planning	English Channel	E.ON Climate & Renewables GmbH (50.1%); Green Investment Group (25%); Enbridge Inc (24.9%)
Gwynt Y Mor Extension	576	In Planning	Irish Sea	Innogy AG (50%); Stadtwerke Bad Vilbel (SWBV) (30%); Green Investment Group (10%); Siemens Financial Services (10%)
Dogger Bank Creyke Beck A	1200	Awarded	North Sea (England)	Equinor ASA (50%); SSE plc (50%)
Dogger Bank Creyke Beck B	1200	Awarded	North Sea (England)	Equinor ASA (50%); SSE plc (50%)
Dogger Bank Teesside A	1200	Awarded	North Sea (England)	Equinor ASA (50%); SSE plc (50%)

[4] Renewable UK provided Cambridge Econometrics with a proprietary UK Offshore Wind pipeline database.

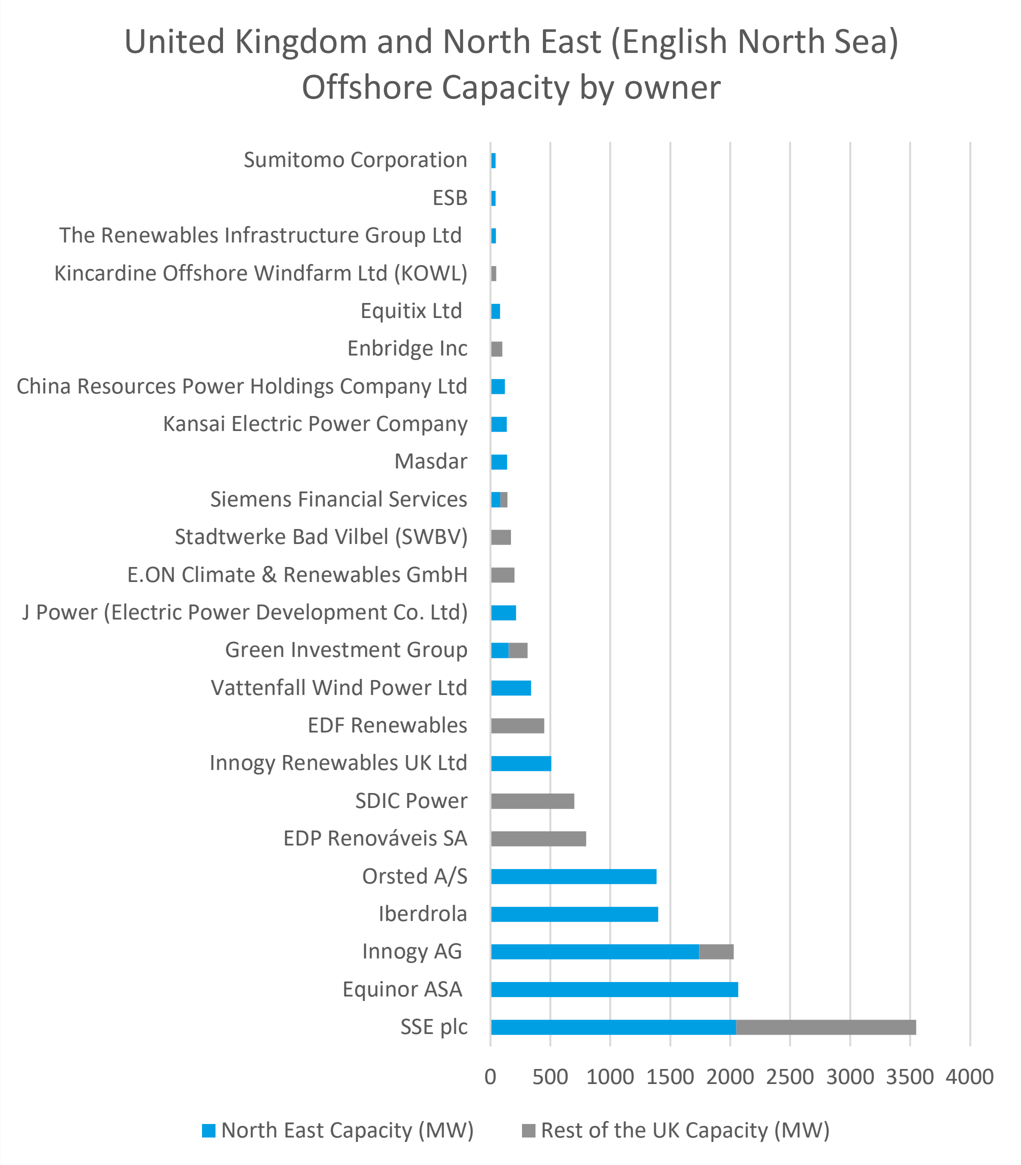
Dudgeon Extension	402	In Planning	North Sea (England)	Equinor ASA (100%); Equinor ASA (35%); Masdar (35%); China Resources Power Holdings Company Ltd (30%)
East Anglia THREE	1400	CfD eligible	North Sea (England)	Iberdrola (100%)
Galloper Extension	353	In Planning	North Sea (England)	Green Investment Group (25%); Innogy AG (25%); Siemens Financial Services (25%); ESB (12.5%); Sumitomo Corporation (12.5%)
Greater Gabbard Extension	504	In Planning	North Sea (England)	Innogy AG (50%); SSE plc (50%)
Hornsea Project Two	1386	Pre-Construction	North Sea (England)	Orsted A/S (100%)
Sheringham Shoal Extension	317	In Planning	North Sea (England)	Equinor ASA (40%); Equitix Ltd (25.3%); Green Investment Group (20%); The Renewables Infrastructure Group Ltd (TRIG) (14.7%)
Sofia	1400	CfD eligible	North Sea (England)	Innogy AG (100%)
Thanet Extension	340	In Planning	North Sea (England)	Vattenfall Wind Power Ltd (100%)
Triton Knoll	860	Pre-Construction	North Sea (England)	Innogy Renewables UK Ltd (59%); J Power (Electric Power Development Co. Ltd) (25%); Kansai Electric Power Company (16%)
Firth of Forth 1 Alpha & Bravo	1500	CfD eligible	North Sea (Scotland)	SSE plc (100%)
Inch Cape	700	CfD eligible	North Sea (Scotland)	SDIC Power (100%)
Kincardine Phase 2	48	RO feasible	North Sea (Scotland)	Kincardine Offshore Windfarm Ltd (KOWL) (100%)
Moray Firth Western Development Area	800	CfD eligible	North Sea (Scotland)	EDP Renováveis SA (100%)
Neart Na Gaoithe	448	Support Secured	North Sea (Scotland)	EDF Renewables (100%)

The information provided on the pipeline by Renewable UK includes a list of the project owner(s), which refers to the investors and/or developers, and the share of equity owned by each.

The analysis identified 24 separate owners across the 19 wind farms in the pipeline, with up to five owners listed for each project[5]. Using the share of equity ownership and the capacity of the project, we have estimated the capacity associated with each project owner as shown in Figure 6.1.

[5] Note that Innogy SA and Innogy Renewables UK Ltd are listed as separate companies.

Figure 6.1 Offshore wind farm capacity by owner and location



6.3 Contractor Analysis

In order to develop a list of contractors active in the various development stages, we carried out a review of the companies contributing to completed projects and projects still under development. The range of projects covers approximately 26 GW of capacity, of which 15 GW are still in the development phase. The lists of contractors developed through this process should not be considered comprehensive but provides insight into the parties with whom the North East supply chain may benefit from engaging.

Development and Project Management

The Development and Project Management stage of an offshore wind farm is directly led by the developer. In order for the North East supply chain to win contracts in this stage, they must create and maintain good relationships with the leading national and international developers who are active in the UK market.

The list of leading developers below has been compiled from the Renewable UK pipeline and desk research. This list differs from the above-mentioned owners list as some of the owners may not be involved in developing the project if they are only acting as investors (such as, for example, the Green Investment Group).

Table 6.2 Offshore Wind Developers

Developers
E.ON
EDF Renewables
Equinor
Greencoat UK Wind
Iberdrola
Innogy
Masdar
Ørsted
SSE
Vattenfall

Wind Turbine

The wind turbine stage is usually contracted out by the main developer of the offshore wind farm to one tier 1 contractor. A report by the Offshore Wind Industry Council outlines that the wind turbine market is dominated by a small number of key players and in the UK is dominated by Vestas, Siemens Gamesa and General Electric. Senvion and Samsung Heavy Industries have also participated in the UK market; however, they have not gained a significant market share.

Organisations in the North East supply chain aiming to win work in this development stage would benefit from building a relationship with the main tier 1 contractors in the North East (Vestas, Siemens Gamesa and General Electric).

The stakeholder engagement discovered a research partnership between General Electric and the Blyth Offshore Renewable Energy Catapult named "Stay Ashore!". Companies in this stage should closely monitor this development to identify areas where they could provide value.

Balance of Plant

The Balance of Plant stage is usually led by several tier 1 contractors who specialise in specific sub-stages. The foundation sub-stage is dominated by a few large contractors such as Sif Offshore Foundations, EEF SPFC and Bladt. The array cables sub-stage follows a similar market structure but is somewhat more diversified than for foundations. In the UK, JDR Cables is a leading company based in the North East, along with Prysmian whose manufacturing sites are outside the North East. Currently, there are no export cable manufacturers based in the UK. The onshore cable market is led by UK companies with significant civil engineering experience such as Balfour Beatty, Volker Infra and J M Murphy's.

However, Renewable UK research has listed other companies that have been awarded contracts in previous projects, as shown in Table 6.3:

Table 6.3 Balance of Plant contractors

Foundation	Transition Piece	Substation transformer topside	Substation electrics	Converter station topside	Array cable
Sif	Sif	Sif	Babcock	Sembmarine SLP	Prysmian
BiFab	Gridin's	BiFab	CG	Babcock	JDR
BAM Nuttall	Wilton	Iemants	Siemens T&D	Orsted	Nexans
EEW SPC	EEW OSB	Smulders	GE Grid Solutions		ABB
Harland & Wolff	Bladt	Sembmarine SLP	RXPE		Draka
Boskalis	TAG	Navantia	ABB		Nexans
ZPMC	Smulders	Heerema	Alstom Grid		NSW
Bladt	Steel Engineering	Bladt			AEI Cables
TAG	ST3 Offshore	Harland & Wolff			Parker Scanrope
Navantia	EEW SPC	Semco			nkt
Principle Power		GE Grid Solutions			
Steel Engineering		McNulty Offshore			
Lamprell		Iemants			
BiFab		Siemens T&D			
Steelwind		Babcock			
Global Energy		Fabricom			
Smulders		STX France			
Lamprell					
Windar (Daniel Alonso)					

Installation and commissioning

The Installation and Commissioning market is similarly constrained to a small number of key players. Some of the same tier 1 companies such as Sif Offshore Foundations, EEW SPFC and Bladt dominate the market while passing on contracts to the smaller companies in the industry.

Below is a list of the companies that were identified to participate in the installation and commissioning stage from the Renewable UK database:

Table 6.4 Installation and Commissioning contractors

Installation and commissioning
Sif Offshore Foundations
EEW SPFC
Blatd
MPI
Seaway 7
Strukton Immersion Projects
Mammoet
Van Oord
Seajacks
Boskalis
GeoSea
MT Hojgaard
Ballast Nedam
Boskalis
DEME
Technip
Graham Construction
A2SEA
Scaldis
Swire BO

Some of the projects in the pipeline listed above already have been through an initial contracting stage. The developers have therefore already chosen the main tier 1 & 2 contractors for certain stages of the supply chain.

Operations, Maintenance and Service

The Operation, Maintenance and Service of an offshore wind farm is contracted out to multiple parties who are responsible for various components of an offshore wind farm. The North East can also benefit from proximity to projects in this stage of the supply chain.

Table 6.5 Operations, Maintenance and Service contractors

Training	Offshore Logistics	Health and Safety Inspections	Turbine Maintenance and Service	Balance of plant maintenance and service
AIS	SeaRoc	Bureau Veritas	DWT	CWind

ARCH	Vissim	DNV-GL	James Fischer Marine Services	Fred. Olsen
B&FC	Windandwat er.dk	SGS	3Sun	James Fisher Marine Services
CWind		TÜV SÜD		WindCarrier
Falck Safety Services				3Sun
Heightec				
Maersk Training				
MRS Training and Rescue				
National Wind Farm Training Centres				
Offshore Marine Academy				
ProntoPort				

De-commissioning

The Decommissioning sector is still under development, with a few of the early stage offshore wind farms having reached the end of their useful life. Our research has identified several companies which are active in this area.

Table 6.6 Decommissioning Contractors

Decommissioning Contractors
A2Sea
Boskalis
CRS Holland
Delta Marine
DUC Marine Group
Geosea
Global Marine
Jan de Nul
John Lawrie Metals
Pharos Offshore
Saipem
Scaldis Salvage & Marine
Seajacks
Subsea 7
Subsea Environmental Services
Van Oord Offshore Wind

6.4 English North Sea Projects

Some of the development stages are expected to be more accessible to organisations based in close proximity geographically. This is expected to be most relevant to the 'Installation and Commissioning', 'Operations, Maintenance and Service' and 'Decommissioning' stages.

We have therefore presented below further information on the contractors identified as having been awarded contracts for pipeline projects in the English North Sea, which are closest geographically to the North East.

The 12 projects shown in Table 6.7 are drawn from the 19 listed in Section 6.2, and reflect those that are located in the English North Sea. Among these 12 projects, to the best of our knowledge, only Hornsea Project Two, Triton Knoll and some aspects of Dogger Bank have undergone a tendering process and appointed contractors. Table 6.8 lists the allocated suppliers for those projects, to the best of our current knowledge. Figure 6.2 shows the capacity associated with each supplier listed across those three projects, estimated to the best of our current knowledge.

The remaining projects listed in Table 6.7 present an opportunity for the North East supply chain to leverage its geographic advantage and win contracts in the Installation and Commissioning, Operations, Maintenance and Service and Decommissioning stages.

Table 6.7 Projects in the English North Sea

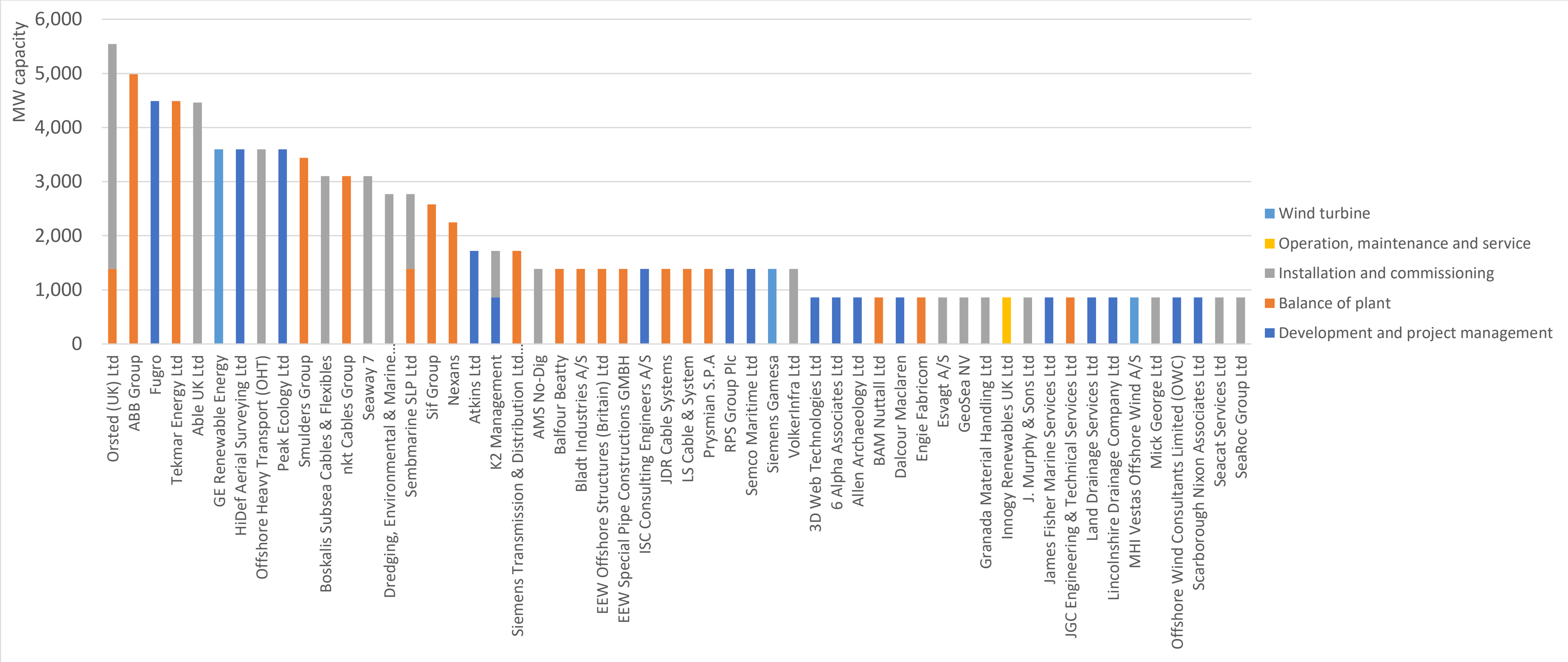
Project	Capacity (MW)	Current status
Dogger Bank Creyke Beck A	1200	Awarded
Dogger Bank Creyke Beck B	1200	Awarded
Dogger Bank Teesside A	1200	Awarded
Dudgeon Extension	402	In Planning
East Anglia THREE	1400	CfD eligible
Galloper Extension	353	In Planning
Greater Gabbard Extension	504	In Planning
Hornsea Project Two	1386	Pre-Construction
Sheringham Shoal Extension	317	In Planning
Sofia	1400	CfD eligible
Thanet Extension	340	In Planning
Triton Knoll	860	Pre-Construction

Table 6.8 Allocated suppliers for North Sea projects

Project	Hornsea Project Two	Triton Knoll	Dogger Bank
Development and project management	Fugro	3D Web Technologies Ltd	HiDef Aerial Surveying Ltd

	ISC Consulting Engineers A/S RPS Group Plc Semco Maritime Ltd	6 Alpha Associates Ltd Allen Archaeology Ltd Atkins Ltd Dalcour Maclaren Fugro James Fisher Marine Services Ltd K2 Management Land Drainage Services Ltd Lincolnshire Drainage Company Ltd Offshore Wind Consultants Limited (OWC) Scarborough Nixon Associates Ltd	Peak Ecology Ltd
Balance of plant	ABB Group Balfour Beatty Bladt Industries A/S EEW Offshore Structures (Britain) Ltd EEW Special Pipe Constructions GMBH JDR Cable Systems LS Cable & System Nexans nkt Cables Group Orsted (UK) Ltd Prysmian S.P.A Sembmarine SLP Ltd Tekmar Energy Ltd	BAM Nuttall Ltd Engie Fabricom JGC Engineering & Technical Services Ltd Nexans nkt Cables Group Siemens Transmission & Distribution Ltd (Manchester) Sif Group Smulders Group Tekmar Energy Ltd Waves Group Ltd	ABB Group
Installation and commissioning	AMS No-Dig Boskalis Subsea Cables & Flexibles Dredging, Environmental & Marine Engineering (DEME) Orsted (UK) Ltd Seaway 7 Sembmarine SLP Ltd VolkerInfra Ltd	Able UK Ltd Boskalis Subsea Cables & Flexibles Esvagt A/S GeoSea NV Granada Material Handling Ltd J. Murphy & Sons Ltd K2 Management Mick George Ltd Seacat Services Ltd SeaRoc Group Ltd Seaway 7	Able UK Ltd Offshore Heavy Transport (OHT)
Operation, maintenance and service		Innogy Renewables UK Ltd	
Wind turbine	Siemens Gamesa	MHI Vestas Offshore Wind A/S	GE Renewable Energy

Figure 6.2 Estimated capacity associated with suppliers for Hornsea Project Two, Triton Knoll and Dogger Bank



7 Recommended strategic interventions

7.1 Introduction

In this chapter, we bring together all the key findings of the analysis, to form evidenced policy recommendations which could support the development of the North East's offshore wind industry.

The recommendations presented here not only reflect the findings of this study, but also the views and suggestions provided by local stakeholders as to what they think might be the most effective forms of strategic intervention.

7.2 Policy recommendations

Local membership organisations

Greater coordination and practical collaboration between firms operating in the North East, bringing out and further developing the strengths of the region's offshore wind industry, would increase the chances of realising the economic opportunities presented. This should include collaborative and focused programmes of action around business development, but also around skills and innovation which are competitive differentiators for the region's sector. Each regional sub-regional cluster should also be brought into this approach, with greater local coordination where necessary, particularly in the Tyne sub-regional cluster, which has unique weaknesses in terms of fragmentation due to its location across various local authorities. Coordination and collaboration between individual sub-clusters in the region, and between the region as a whole and other UK clusters, could be beneficial, to take advantage of synergies and developing opportunities and to encourage skills clusters to develop in a coordinated manner.

Bringing actors within an industry together is often the role of cluster bodies or organisations, forming links across stakeholders. Cluster bodies can support business development activity along the supply chains, making it easier for firms operating within the region to connect with other suppliers, tap into new projects and grow their business. Cluster bodies can also coordinate and define collaborative programmes of development work for the cluster, such as around skills and innovation, ensuring new technologies and innovations reach the marketplace and that future skills needs are met. Such support is currently provided to some degree to offshore wind suppliers in the North East via EnergiCoast, but there are opportunities to do more in the region to build on the regions current position and develop focused programmes of cluster development action including in skills and innovation which should be taken forward through the regional cluster partnership. It should ensure that regional sub-clusters are fostered, and a wide range of stakeholders are included in this approach. It should be noted that current coordination across supply chains is currently better in some sub-regional clusters (i.e. Blyth) than in others (i.e. Tyne) and levelling up to the best and co-ordinating across these smaller areas could create opportunities.

A cluster body could also be responsible for collecting and reporting better real-time, dynamic data on the size of the offshore wind sector in the North East region. Better data would be beneficial, since currently, more widely published data (such as the data used in this study) does not account for the offshore wind sector specifically, rather estimates of the low-carbon sector need to be derived from high level data. More accurate data would allow for better informed analysis of the sector, and therefore better-informed strategies.

Attracting inward investment

As well as capitalising on its existing competitive strengths by entering overseas markets, the North East offshore wind cluster can be strengthened by developing stages of the supply chain that are currently weaker than others. Currently, no wind turbine manufacturing takes place within the region. Attracting inward investment from a manufacturer of either nacelles, rotor blades or towers for large wind turbines would strengthen this stage of the supply chain, completing the North East's offering.

However, attracting inward investment should not be limited to just the turbine manufacturing stage of the supply chain. Other supply chain opportunities could be captured by increased inward investment, for example strengthening the presence of tier-2 suppliers. Increased inward investment across the supply chain in the region would help the cluster develop a more comprehensive offshore wind offering.

As depicted in Scenario 3, a larger UK pipeline but tightening margins may present an opportunity for the region to capitalise on consolidation of the UK's offshore wind sector. Existing competitive advantages in segments of the supply chain may be further strengthened by attracting new firms to the region. Facilitating an appealing business environment through financial incentives, such as tax breaks or grant funding, would encourage such inward investment across all stages of the supply chain. Within the region there are two Enterprise Zones offering specific benefits and opportunities for offshore wind firms, namely the Blyth Estuary and the North Bank of the Tyne. Development land located within these sites should be promoted to potential investors within relevant stages of the supply chain.

Improvements to port infrastructure

There is the need to provide certainty for potential investors by ensuring the required infrastructure is in place to support manufacturers. The creation of a port and riverside infrastructure fund would ensure that the ports and riversides located within the region are capable of facilitating large scale manufacturing and installation. Improvements that would strengthen existing capabilities include ensuring ports and riversides offer sufficient depth of water and improving marshalling capabilities and accessibility (despite high volumes of naval traffic).

Skills and training programmes

A skills enhancement programme should be developed, to meet the anticipated needs of offshore wind firms. Such a programme should be designed in collaboration with project developers, existing local firms operating in the offshore wind sector and local universities and educational institutions.

Transferrable skills and expertise exist in the North East region, due to the strong historical presence of sectors such as oil and gas, and more generally a wide manufacturing base. Skills and expertise from other strong sectors in the region can also be tapped in to, such as those being developed within the advanced manufacturing sector (which is predominantly focussed on automotive and pharmaceuticals). The skills and training programmes should focus on building on these existing skills and knowledge, to allow workers to transfer into the growing offshore wind sector. The programme should also focus on training new entrants to the jobs market, with a particular focus on increasing STEM skills.

Providing skills and training support will ensure local workers are equipped with the necessary expertise needed to fully realise future employment opportunities in the UK's offshore wind sector.

Innovation programme

In parallel, an innovation programme should be developed, supported and coordinated under the umbrella of a cluster body, to support the wider ecosystem of firms surrounding the core offshore wind supply chain. Coordination of innovation occurring throughout the supply chain is important, to ensure that valuable technologies make it to the marketplace. High-value, bespoke engineering, including in sectors such as sub-sea, robotics and artificial intelligence, is expected to play an important future role in applying new technologies to reduce the costs of inspecting and maintaining offshore wind farms. The North East currently has competitive strengths in the development of all the aforementioned technologies, strengths which should be reinforced by a supportive innovation programme. Innovations related to grid integration and balancing could also be a strategic opportunity for the North East offshore wind sector in particular, given the region's wider energy system and capacity for storage, and these opportunities should also be supported by an appropriate innovation programme. The innovation programme should not only support those innovations directly related to the offshore wind sector, but should also support innovations currently occurring across a broader range of sectors (with direct implications for the offshore wind sector), such as digital, big data and other artificial intelligence technologies.

A strong relationship with central government

A strong relationship should be built with central government to be able to draw attention to matters important to the North East. In the context of this study, such matters include the aims of the North East's local industrial strategy and the development of its offshore wind cluster. A strong relationship with central government allows for constructive dialogue, which may in turn ensure central policy facilitates growth in the regional cluster and allows the cluster to maximise the benefits of potential opportunities. Example measures which local policy makers may wish to discuss with central government include encouraging offshore wind as a major part of the future energy mix beyond the plans currently in place to 2030, while local policy makers simultaneously highlight the North East as a good place to deliver additional capacity, efforts that together will increase the opportunities for growth in the North East's offshore wind sector. However, the key measures which local policy makers should push central government to extend are local content requirements and increasing the pace of offshore wind deployment. Increased local content regulations, applied through stricter rules in contracts for difference, and/or by encouraging developers to increase local content, could be a key measure to enable and encourage growth in the sector. Stakeholders consulted during the course of this study suggested that increasing local content regulations is an urgent matter that needs to be addressed by central Government. Signs of the global commoditisation of the offshore wind sector are already emerging, creating a sense of urgency to ensure a future like the commoditisation scenario explored in this study (Scenario 4) is avoided.

Withstanding future trade uncertainties

The UK's future relationship with the EU is currently uncertain, with negotiations on a future trade deal due to be completed before the end of 2020. The UK's departure will have inevitable consequences for trade between the UK and other European countries, including trade in goods and services related to offshore wind. While it appears likely that trade with the EU will become more difficult for UK-based firms (compared to when the UK was an EU Member State), in the worst case, goods and services provided by the UK to EU-based firms will be subject to import tariffs and non-tariff barriers (e.g. increased administrative burden). In this scenario, World Trade Organisation rules suggest key components of an offshore wind turbine would be subject to import tariffs of 2.7%. The additional cost of importing UK goods and services will mean those goods and services are less appealing to EU offshore wind developers, and so offshore wind clusters such as the North East could become less competitive. In such a case, it would be likely that future employment and output levels in North East's offshore wind sector would be lower than in the current baseline case. Additional costs and administration linked to trade between the UK and the EU will disrupt existing, well-established supply chains, affecting firms who are both importing and exporting within the sector. Furthermore, the UK's offshore wind sector will face changes to policy as a result of exiting existing EU systems, which could have consequences for the North East region's sector. Changes in UK energy policy and support schemes, uncertainties over the financing of existing and future projects and changes in environmental standards are some of the issues that might affect the sector.

Export opportunities in developing markets further afield, such as those identified in Chapter 4 (in particular pursuing opportunities in North America), would become increasingly important in a no-deal scenario. Local policy makers can assist firms in the North East by consulting with them to fully understand what support would be required in the event of a no-deal departure from the EU, and to understand the desired requirements when negotiating trade deals with foreign countries.

Proposals have been made by the government to create ten free trade ports in the UK following the UK's departure from the EU. The development of a free trade zone around one of the North East region's ports is a strategy currently being explored by the region, and this could alleviate some of the issues related to trade barriers. With clusters of offshore wind sector activity already existing around the North East's port regions (see Chapter 5), the establishment of a free trade port would be beneficial for those firms already located in the port area. However, the free trade port would only benefit those firms located with that specific site and may divert existing jobs away from other parts of the North East.

International trade support

In general, and particularly given the uncertainties the UK's future trading relationship with the EU, strengthening the region's export potential is a key strategy for retaining and increasing employment and output in the sector. In addition to the possibility of creating a free trade port, greater support from cluster bodies can be extended to help the North East cluster strengthen its export offering, particularly in emerging markets. By promoting the region's supply chain capabilities, innovative technologies and practices, and existing infrastructure, the region can be showcased to overseas developers. Activities which could be arranged and coordinated by cluster bodies include:

- International trade missions, featuring one-to-one meetings with overseas industry executives and local policy- and decision-makers
- Networking events

- Site visits
- Briefings on foreign business practices and opportunities, with support particularly focused on doing business in emerging markets
- Overseas promotion of the region's strengths in the sector
- Assisting with creating a physical presence for the North East LEP in emerging markets

To carry out such activities, a cluster body would benefit from a closer relationship with the Department for International Trade (DIT). Through a close relationship, DIT and the cluster body could coordinate on advice and strategies offered to firms based in the North East offshore wind cluster; for example DIT could assist with identifying the best opportunities, offering useful insight on overseas business practices and connecting firms with the most relevant clients.

Firms in the North East cluster could also benefit from export finance products offered by DIT (UK Export Finance), such as access to attractive financing terms for overseas ventures, guarantee schemes to provide the support needed to fulfil a contract, or providing insurance in new markets where it may not otherwise be available. UK Export Finance (UKEF) has recently demonstrated its support for UK offshore wind companies. In 2019, UKEF announced it would provide a £230 million project finance guarantee to support the construction of Formosa 2, an offshore wind farm in the Taiwan Strait. As a result of UKEF's support for the project, UK companies have the opportunity to be involved in the construction of the new wind farm. Firms located in the North East cluster could tap into this current opportunity, or similar future opportunities created through the support of UKEF.

References

American Wind Energy Association. 2019. *U.S. Offshore wind industry status update - October 2019.* American Wind Energy Association.

Asia Wind Energy Association. 2019. *Case Study: ECAs to Lead the Way for Taiwanese Offshore.* 29 March. https://www.asiawind.org/case-study-ecas-to-lead-the-way-for-taiwanese-offshore/.

Asia Wind Energy Association. 2018. *Outlook for the Asia Pacific Offshore Wind industry.* 4th Asia Offshore Wind Day.

—. 2019. *Quarterly Update on the Asia-Pacific Wind Industry.* 20 February. https://www.asiawind.org/q1-2019/.

Burke, Brandon W. 2018. *U.S. offshore wind power: an industry in motion.* Kleinman Center for Energy policy, University of Pennsylvania.

Business Network for Offshore Wind. 2019. *Leadership 100 workplan.* Business Network for Offshore Wind.

Carbon Trust. 2015. *Appraisal of the offshore wind industry in Japan.* British Embassy Tokyo.

Chinn, Matthew. 2014. *The UK Offshore Wind Supply Chain: A Review of Opportunities and Barriers.* Offshore Wind Industry Council.

Committee on Climate Change. 2019. “Net Zero: The UK's contribution to stopping global warming.” Accessed December 11, 2019. https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf.

Delaware Prosperity Partnership. 2019. *Delaware and North East England Sign Economic Development MOU.* Accessed November 19, 2019. https://choosedelaware.com/press-releases/delaware-and-north-east-england-sign-economic-development-mou/.

Energy & Utility Skills . 2018. “Skills and Labour Requirements of the UK Offshore Wind Industry 2018-2032.”

Energy Central. n.d. Accessed December 16, 2019. http://energycentraluk.co.uk/.

Environment Agency. 2017. “Climate change agreements - Guidance.” Accessed Mar 21, 2019. https://www.gov.uk/guidance/climate-change-agreements--2#about-climate-change-agreements.

Equinor. 2019. *Equinor's Empire Wind.* https://www.equinor.com/en/what-we-do/empirewind.html.

European Commission. 2018. “A Clean Planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy.” Accessed March 4, 2019. https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_en.pdf.

Global Wind Energy Council. 2018. *Global Wind Report - Annual Market Update 2017.* Global Wind Energy Council.

Greentech Media. 2019. *Orsted: US Offshore Wind Supply Chain Decisions Coming Soon .* 28 May. Accessed November 19, 2019. https://www.greentechmedia.com/articles/read/orsted-us-offshore-wind-supply-chain-decisions-coming-soon.

HM Government. 2018. “A Green Future: Our 25 Year Plan to Improve the Environment.” Accessed February 28, 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf.

HM Government. 2019. “Industrial Strategy: Offshore Wind Sector Deal.” Accessed 11 7, 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790950/BEIS_Offshore_Wind_Single_Pages_web_optimised.pdf.

International Energy Agency. 2019. “Offshore Wind Outlook 2019.” Accessed December 11, 2019.

Invest North East England. 2019. https://investnortheastengland.co.uk/.

Linklaters. 2019. *Korea Offshore Wind: Looking ahead.* Linklaters.

Mercom India. 2018. *Make in India Products Compulsory for Government Developed Renewable Energy Projects.* 14 December. Accessed November 18, 2019. https://mercomindia.com/mnre-make-in-india-products-renewable-projects/.

Noonan, Miriam. 2019. *UK Offshore Wind: Realising the Sector Deal Opportunity.* ORE Catapult.

Noonan, Miriam, and Gavin Smart. 2017. *The Economic Value of Offshore Wind.* ORE Catapult.

North East LEP. Undated. “Energy for Growth.” Accessed 11 7, 2019. https://www.northeastlep.co.uk/wp-content/uploads/2019/09/exec-summary-energy-for-growth.pdf.

North East Local Enterprise Partnership. 2019. *North East Energy for Growth.* North East Local Enterprise Partnership.

Norton Rose Fulbright. 2016. *UK offshore wind: What impact is Brexit likely to have on the UK’s offshore wind industry?* December. Accessed November 21, 19. https://www.nortonrosefulbright.com/en/knowledge/publications/6561d296/uk-offshore-wind-what-impact-is-brexit-likely-to-have-on-the-uks-offshore-wind-industry.

Norwegian Energy Partners. 2018. *Global Offshore WInd Market Report 2018.* Norwegian Energy Partners.

OECD. 2015. *Overcoming Barriers to International Investment in Clean Energy.* Paris: OECD.

Offshore Wind Industry Council. 2018. *Offshore Wind Industry Prospectus.* Offshore Wind Industry Council.

Recharge. 2019. *Taiwan warns foreign offshore wind groups on local content .* 21 October. Accessed November 11, 2019. https://www.rechargenews.com/wind/1866428/taiwan-warns-foreign-offshore-wind-groups-on-local-content.

Renewable Energy World. 2019. *Offshore wind: is the future in Taiwan at risk?* 22 January. Accessed November 19, 2019. https://www.renewableenergyworld.com/2019/01/22/offshore-wind-is-the-future-in-taiwan-at-risk/#gref.

Renewable UK. n.d. *Preparing for Brexit.* Accessed November 2019, 21. https://www.renewableuk.com/page/Brexit.

The Crown Estate. 2018. "Offshore wind operational report." Accessed November 27, 2019.

The Crown Estate. 2019. "Project listing August 2019."

U.S. Department of Energy. 2019. *2018 Offshore Wind Technologies Market Report.* U.S. Department of Energy.

Vivid Economics. 2018. "Economic Impacts of the UK Offshore Wind: Scenarios for the Sector Deal ."

Whitmarsh, Martin. 2019. *The UK Offshore Wind Industry: Supply Chain Review.* Offshore Wind Industry Council.

WindEurope. 2017. *Wind energy in Europe: Scenarios for 2030.* WindEurope.

Appendices

Appendix A Stakeholder engagement

Table A.1 below details the organisations from which individual contacts provided valuable local insights and views, used throughout the study.

Table A.1: Stakeholder engagement

Type	Organisation
Local policy/ decision makers	North East LEP
	Advance Northumberland
	Newcastle Council
	Invest North East England
	South Tyneside Council
	Northumberland County Council
	Sunderland City Council
	Northern Powerhouse Investment Hub
Research and educational institutions	University of Newcastle
Firms operating in the region	GSP
	GHD
	WSP
	DEME Group
	Siemens Gamesa
	Smulders
	TSG Marine
	Wescott Industrial Services
Wind farm	Triton Knoll
Port representatives	Port of Blyth
	Port of Tyne
	Port of Sunderland
Industry bodies and organisations	Offshore Renewable Energy Catapult
	Renewable UK
Offshore wind developers	Equinor
	Burns Macdonnell
	Orsted
	Innogy

Appendix B Scenario assumptions

Table B.1 – Table B.5 provide more information about the assumptions used to calculate employment and GVA impacts in the scenarios detailed in Section 3.2. The relative contribution the North East offshore wind sector makes to each stage of the supply change varies in accordance with a strengthening (or in the case of Scenario 4, a worsening) in the North East's offering in each stage.

Table B.1 Relative contribution of businesses in the North East to each stage of the offshore wind supply chain in the UK, 2030 (Baseline scenario)

	Contribution of the North East (%)
Development and project management	14%
Wind turbine	5%
Balance of plant	17%
Installation and commissioning	19%
Operation, maintenance and service	1%
Decommissioning	13%

Table B.2 Relative contribution of businesses in the North East to each stage of the offshore wind supply chain in the UK, 2030 (Scenario 1)

	Contribution of the North East (%)
Development and project management	14%
Wind turbine	21%
Balance of plant	17%
Installation and commissioning	29%
Operation, maintenance and service	1%
Decommissioning	26%

Table B.3 Relative contribution of businesses in the North East to each stage of the offshore wind supply chain in the UK, 2030 (Scenario 2)

	Contribution of the North East (%)
Development and project management	28%
Wind turbine	5%
Balance of plant	17%
Installation and commissioning	34%
Operation, maintenance and service	1%
Decommissioning	26%

Table B.4 Relative contribution of businesses in the North East to each stage of the offshore wind supply chain in the UK, 2030 (Scenario 3)

	Contribution of the North East (%)
Development and project management	14%
Wind turbine	5%
Balance of plant	26%
Installation and commissioning	29%
Operation, maintenance and service	1%
Decommissioning	26%

Table B.5 Relative contribution of businesses in the North East to each stage of the offshore wind supply chain in the UK, 2030 (Scenario 4)

	Contribution of the North East (%)
Development and project management	14%
Wind turbine	5%
Balance of plant	17%
Installation and commissioning	19%
Operation, maintenance and service	1%
Decommissioning	13%

Appendix C Detailed results of quantitative modelling

In this appendix detailed results of the quantitative modelling exercise to quantify the potential socioeconomic impacts of future opportunities (described in Chapter 3), are provided.

Tables C.1– C.10 provide the direct employment and GVA results for the North East region, within the baseline scenario and the four alternative scenarios explored in the modelling exercise. Tables C.11 – C.14 provide further, wider economic impact results from the input-output modelling exercise (described in Section 3.4).

Table C.1 Baseline employment results (number of jobs)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	688	931	788	502	185	193	247	306	303	302	300	299
Wind turbine	66	70	81	113	162	217	202	152	86	91	108	128
Balance of plant	219	230	268	371	535	715	666	501	284	299	355	421
Installation and commissioning	357	435	598	1,034	1,665	2,263	1,924	1,229	454	475	613	762
Operation, maintenance and service	21	20	20	20	20	20	467	685	936	931	927	923
Decommissioning	6	6	6	6	6	48	38	38	38	6	105	232
Total employment	1,357	1,692	1,762	2,046	2,574	3,456	3,544	2,911	2,101	2,104	2,408	2,764

Table C.2 Baseline GVA results (£ 2016m)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	28	38	32	20	8	8	10	12	12	12	12	12
Wind turbine	5	5	6	8	12	16	15	11	6	7	8	9
Balance of plant	8	8	10	13	19	26	24	18	10	11	13	15
Installation and commissioning	13	16	22	38	62	84	71	46	17	18	23	28
Operation, maintenance and service	1	1	1	1	1	1	18	27	37	36	36	36
Decommissioning	0	0	0	0	0	2	1	1	1	0	4	9
Total employment	55	68	71	81	101	136	140	115	84	84	96	110

Table C.3 Scenario 1 employment results (number of jobs)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	688	931	788	502	185	193	247	306	303	302	300	299
Wind turbine	66	89	126	205	340	513	533	442	274	313	402	511
Balance of plant	219	230	268	371	535	715	666	501	284	299	355	421
Installation and commissioning	357	454	652	1,175	1,968	2,777	2,448	1,620	619	670	891	1,142
Operation, maintenance and service	21	20	20	20	20	20	467	685	936	931	927	923
Decommissioning	6	7	8	8	9	70	58	62	65	12	201	463
Total employment	1,357	1,732	1,862	2,281	3,056	4,288	4,420	3,616	2,482	2,526	3,076	3,760

Table C.4 Scenario 1 GVA results (£ 2016m)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	28	38	32	20	8	8	10	12	12	12	12	12
Wind turbine	5	6	9	15	24	37	38	32	20	23	29	37
Balance of plant	8	8	10	13	19	26	24	18	10	11	13	15
Installation and commissioning	13	17	24	44	73	103	91	60	23	25	33	42
Operation, maintenance and service	1	1	1	1	1	1	18	27	37	36	36	36
Decommissioning	0	0	0	0	0	3	2	2	3	0	8	18
Total	55	71	76	93	126	177	184	152	104	107	131	161

Table C.5 Scenario 2 employment results (number of jobs)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	688	1,015	931	639	252	280	382	501	524	549	574	598
Wind turbine	66	70	86	122	176	235	224	178	117	125	147	171
Balance of plant	219	230	283	401	580	774	739	588	385	413	483	562
Installation and commissioning	357	464	679	1,246	2,119	3,034	2,710	1,816	702	767	1,030	1,333
Operation, maintenance and service	21	20	20	20	20	20	467	685	936	931	927	923
Decommissioning	6	7	8	8	9	70	58	62	65	12	201	463
Total employment	1,357	1,807	2,008	2,436	3,156	4,414	4,581	3,829	2,728	2,797	3,362	4,051

Table C.6 Scenario 2 GVA results (£ 2016m)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	28	41	38	26	10	11	16	20	21	22	23	24
Wind turbine	5	5	6	9	13	17	16	13	8	9	11	12
Balance of plant	8	8	10	15	21	28	27	21	14	15	17	20
Installation and commissioning	13	17	25	46	79	113	101	67	26	28	38	50
Operation, maintenance and service	1	1	1	1	1	1	18	27	37	36	36	36
Decommissioning	0	0	0	0	0	3	2	2	3	0	8	18
Total	55	73	81	97	124	173	180	151	109	112	134	161

Table C.7 Scenario 3 employment results (number of jobs)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	688	931	788	502	185	193	247	306	303	302	300	299
Wind turbine	66	70	81	113	162	217	202	152	86	91	108	128
Balance of plant	219	241	292	421	632	878	847	660	387	421	516	631
Installation and commissioning	357	454	652	1,175	1,968	2,777	2,448	1,620	619	670	891	1,142
Operation, maintenance and service	21	20	20	20	20	20	467	685	936	931	927	923
Decommissioning	6	7	8	8	9	70	58	62	65	12	201	463
Total employment	1,357	1,723	1,842	2,239	2,976	4,155	4,270	3,485	2,397	2,426	2,944	3,587

Table C.8 Scenario 3 GVA results (£ 2016m)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	28	38	32	20	8	8	10	12	12	12	12	12
Wind turbine	5	5	6	8	12	16	15	11	6	7	8	9
Balance of plant	8	9	11	15	23	32	31	24	14	15	19	23
Installation and commissioning	13	17	24	44	73	103	91	60	23	25	33	42
Operation, maintenance and service	1	1	1	1	1	1	18	27	37	36	36	36
Decommissioning	0	0	0	0	0	3	2	2	3	0	8	18
Total	55	70	74	89	116	162	167	137	95	96	116	141

Table C.9 Scenario 4 employment results (number of jobs)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	688	931	788	502	185	193	247	306	303	302	300	299
Wind turbine	66	70	76	96	126	155	135	96	52	51	56	62
Balance of plant	219	230	249	316	416	512	444	315	172	168	185	203
Installation and commissioning	357	435	598	1,034	1,665	2,263	1,924	1,229	454	475	613	762
Operation, maintenance and service	21	20	20	20	20	20	467	685	936	931	927	923
Decommissioning	6	6	6	6	6	48	38	38	38	6	105	232
Total employment	1,357	1,692	1,737	1,974	2,419	3,191	3,255	2,669	1,956	1,934	2,186	2,481

Table C.10 Scenario 4 GVA results (£ 2016m)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Development and project management	28	38	32	20	8	8	10	12	12	12	12	12
Wind turbine	5	5	5	7	9	11	10	7	4	4	4	4
Balance of plant	8	8	9	11	15	19	16	11	6	6	7	7
Installation and commissioning	13	16	22	38	62	84	71	46	17	18	23	28
Operation, maintenance and service	1	1	1	1	1	1	18	27	37	36	36	36
Decommissioning	0	0	0	0	0	2	1	1	1	0	4	9
Total	55	68	70	78	95	124	127	105	77	76	86	97

Table C.11 Total indirect and induced GVA impact in the North East (£ 2016m)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	63	77	83	103	136	184	200	171	134	134	151	170
Scenario 1	63	79	88	115	160	225	244	206	153	155	184	220
Scenario 2	63	82	94	122	167	234	254	218	165	168	198	235
Scenario 3	63	79	87	113	158	222	240	202	151	152	180	215
Scenario 4	63	77	82	99	128	170	185	158	127	126	139	155

Table C.12 Total indirect and induced employment impact in the North East (number of jobs)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	1,023	1,257	1,354	1,675	2,217	2,989	3,222	2,735	2,123	2,122	2,389	2,700
Scenario 1	1,023	1,288	1,433	1,863	2,606	3,664	3,929	3,299	2,419	2,449	2,918	3,502
Scenario 2	1,023	1,337	1,534	1,984	2,715	3,816	4,107	3,497	2,617	2,668	3,159	3,760
Scenario 3	1,023	1,284	1,425	1,847	2,575	3,612	3,870	3,247	2,386	2,409	2,866	3,434
Scenario 4	1,023	1,257	1,333	1,615	2,087	2,766	2,980	2,533	2,001	1,980	2,203	2,463

Table C.13 Total indirect and induced GVA impact in the UK (£ 2016m)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	103	125	136	172	230	311	364	327	280	279	307	339
Scenario 1	103	129	145	192	272	383	440	388	312	315	364	425
Scenario 2	103	133	154	203	281	395	454	405	330	334	385	447
Scenario 3	103	128	144	190	267	375	431	380	307	309	356	415
Scenario 4	103	125	134	165	217	287	338	305	267	264	287	314

Table C.14 Total indirect and induced employment impact in the UK (number of jobs)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	1,639	2,002	2,181	2,750	3,694	4,985	5,479	4,710	3,746	3,745	4,190	4,710
Scenario 1	1,639	2,056	2,317	3,075	4,364	6,143	6,693	5,682	4,262	4,314	5,105	6,088
Scenario 2	1,639	2,126	2,466	3,251	4,518	6,355	6,940	5,961	4,548	4,630	5,446	6,445
Scenario 3	1,639	2,048	2,299	3,037	4,291	6,023	6,559	5,563	4,185	4,223	4,985	5,932
Scenario 4	1,639	2,002	2,145	2,649	3,474	4,608	5,068	4,367	3,539	3,503	3,874	4,307