

UK Offshore Wind: Building an Industry

Analysis and scenarios for industrial development

June 2010





RenewableUK is the trade and professional body for the UK wind and marine renewables industries. Formed in 1978, and with 600 corporate members, RenewableUK is the leading renewable energy trade association in the UK. Wind has been the world's fastest growing renewable energy source for the last seven years, and this trend is expected to continue with falling costs of wind energy and the urgent international need to tackle CO2 emissions to prevent climate change

In 2004, RenewableUK expanded its mission to champion wave and tidal energy and use the Association's experience to guide these technologies along the same path to commercialisation.

Our primary purpose is to promote the use of wind, wave and tidal power in and around the UK. We act as a central point for information for our membership and as a lobbying group to promote wind energy and marine renewables to government, industry, the media and the public. We research and find solutions to current issues and generally act as the forum for the UK wind, wave and tidal industry, and have an annual turnover in excess of four million pounds.

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Executive Summary & Conclusions

Introduction

In the first quarter of 2010 turbine manufacturers Siemens, Clipper, Mitsubishi and GE all committed to a UK presence. Fundamental to these decisions was the UK's excellent market outlook. Considerable follow-on supply chain development is expected in the UK considering the size of the domestic market and the confidence now demonstrated by the turbine manufacturers.

A requirement for these companies and their investors is a long-term market outlook and confidence in government policy. The massive development cycle the UK has set off on must be seen as the beginnings of a long-term and stable industry.

This report presents scenarios of UK offshore wind installation for the 2015 to 2030 period. Detailed assumptions have been developed to show both the hardware and the installation services that will be required to meet these delivery scenarios.

Extensive consultation with project developers, stakeholders and supply chain companies has been conducted to develop and review project dates and assumptions for hardware requirements, and to make policy recommendations.

“The massive development cycle the UK has set off on must be seen as the beginnings of a long-term and stable industry.”

Executive Summary

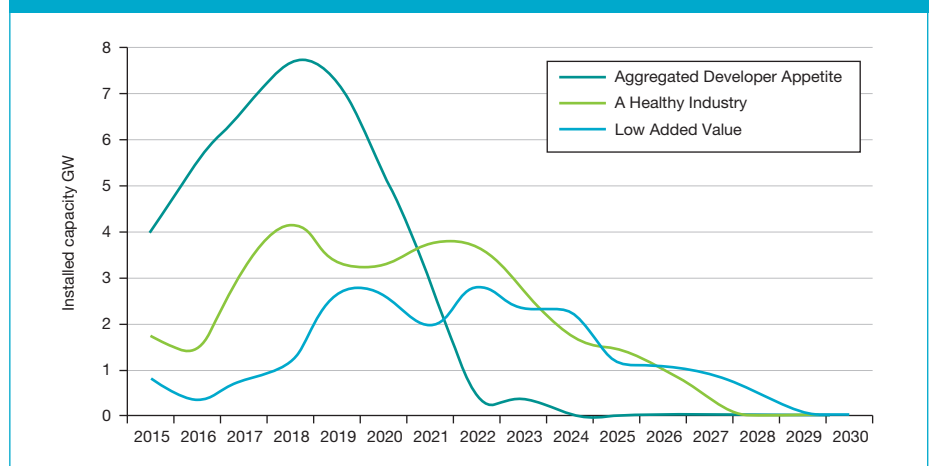
Comparison of Scenarios

Figure 1 compares delivery profiles for the 2015–2030 period for Round 2, Round 2.5, Round 3 and Scottish Territorial Waters (STW) projects. It excludes any post-Round 3 capacity, such as new projects built in a Round 4 or similar, or repowering of old sites.

The “Aggregated Developer Appetite” build profile shows rapid development from the outset with 4GW of new capacity expected online in 2015. Installations peak in 2018 at almost 8GW before declining sharply over the next three years. It uses the dates given to The Crown Estate for R3 submissions plus additional capacity expectations from The Crown Estate for the other ongoing rounds. It is clear that there is an early need for Round 4 or equivalent to avoid a sharp drop in activity. If such a build profile can be achieved it is expected to result in a strong domestic market given prompt investment decisions on new UK manufacturing facilities.

In comparison, “A Healthy Industry” and “Low Added Value” scenarios show a less dramatic ramp up in capacity followed by a longer period of relatively stable activity, with a more gradual tail-off from 2022.

Figure 1: Capacity Scenarios – Annual Installations 2015-2030



Source: Douglas-Westwood

A Healthy Industry scenario shows a strong and sustainable level of deployment that will encourage significant UK supply chain development. The long-lasting build profile will help attract leading players and ensure the UK benefits from the large amount of offshore wind capacity that will be built off its shores. The slower growth rate than the Aggregated Developer Appetite scenario will make ramping up supply chain capacity more achievable. In addition, the longer period of activity gives confidence of a long-term market to manufacturers and other supply chain companies considering setting up or expanding in the UK. A Healthy Industry scenario is expected to require at least five turbine plants to be established.

In the Low Added Value scenario, additional delays and increased project attrition slow the delivery rate. With less capacity being added the market opportunity for supply chain companies is reduced. There is lower demand for turbines, which means there is less room for multiple turbine manufacturers supplying the UK market from a UK location. This scenario represents a missed opportunity for the UK.

Beyond Round 3

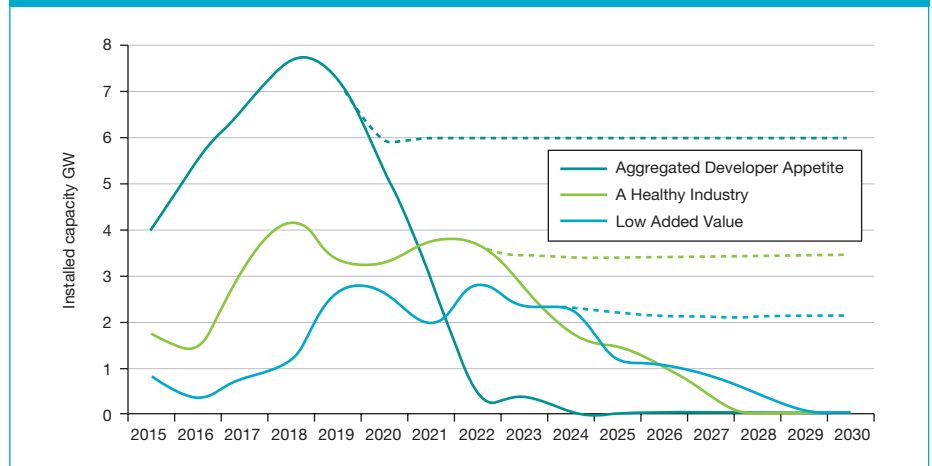
Figure 2 indicates what level of additional capacity might be required post-Round 3 to ensure the UK's supply chain is maintained.

Repowering would also expect to contribute to industry demand as sites are repowered with new technology where sufficient economic benefit exists.

The Healthy Industry scenario has been extended at a level of 3.3 GW per year and the Low Added Value scenario at a level of 2 GW per year.

To ensure continuation of the momentum built in the industry, future rounds would ideally begin from around 2023. This implies applications for Round 4 should be open by 2018 for A Healthy Industry scenario, or earlier, by 2015 for the Aggregated Developer Appetite scenario.

Figure 2: R3 Capacity Scenarios – Post-R3 Requirements



Source: Douglas-Westwood

The Aggregated Developer Appetite scenario is shown here with future annual requirements of 6GW per year in order to maintain the UK industry. The capability of the UK industry created is unlikely to be fulfilled through UK additions alone, due to the impact this amount of capacity would place on the electricity system. To allow this to take place there needs to be rapid investment in grid development made. It would also accelerate the need for establishment of an integrated European Grid.

The wider European market will be of great importance to UK manufacturers and service companies if long-term domestic activity cannot be maintained at peak levels. Investment decisions on at least five turbine plants will be required by 2014 to deliver the expected market demand. Long-term vision is required to ensure the UK can attract these manufacturers.

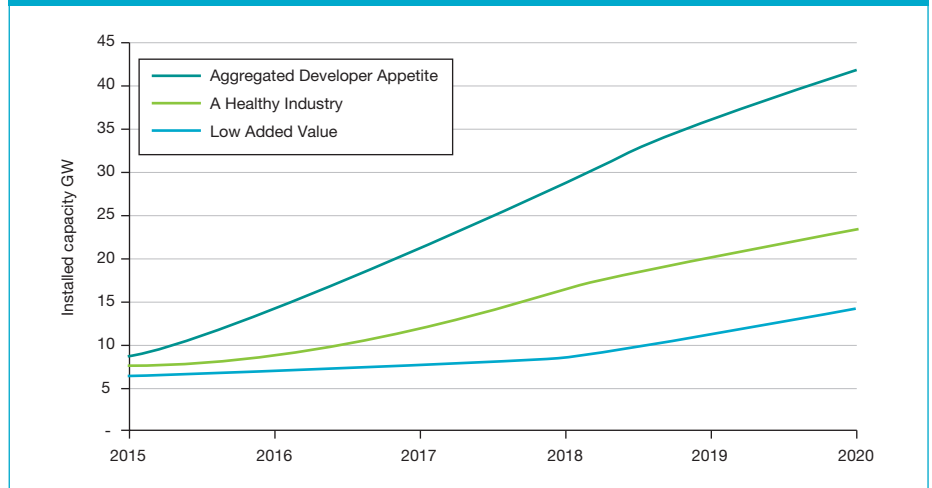
Cumulative Capacity

Cumulative levels of installed UK capacity are shown in the above chart. We have shown up to 2020, as this is the data limit for the Aggregated Developer Appetite scenario.

By the end of 2015, the Aggregated Developer Appetite scenario sees 10GW installed, rising to 42.7GW by the end of 2020. In A Healthy Industry scenario 7.7GW is installed in 2015 and 23.2GW by 2020. In the Low Added Value scenario 6.6GW is installed in 2015 and 14.1GW by 2020.

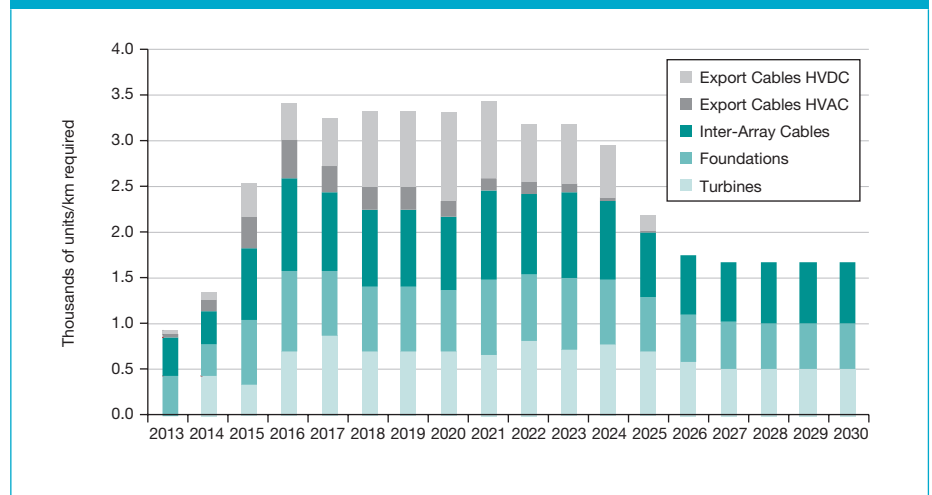
All scenarios begin with the figures produced for RenewableUK by Garrad Hassan in 2009. The starting point differs only due to different levels of capacity brought online in 2015. No assumptions have been made to change figures for years previous to 2015 because of this.

Figure 3: Cumulative Installed Capacity



Source: The Crown Estate and Douglas-Westwood

Figure 4: A Healthy Industry – Hardware Requirements 2015-2030 by Delivery Date



Source: Douglas-Westwood

Hardware and Factory Requirements

For UK capacity installed between 2015 and 2030 almost 10,000 turbines and foundations will be required.

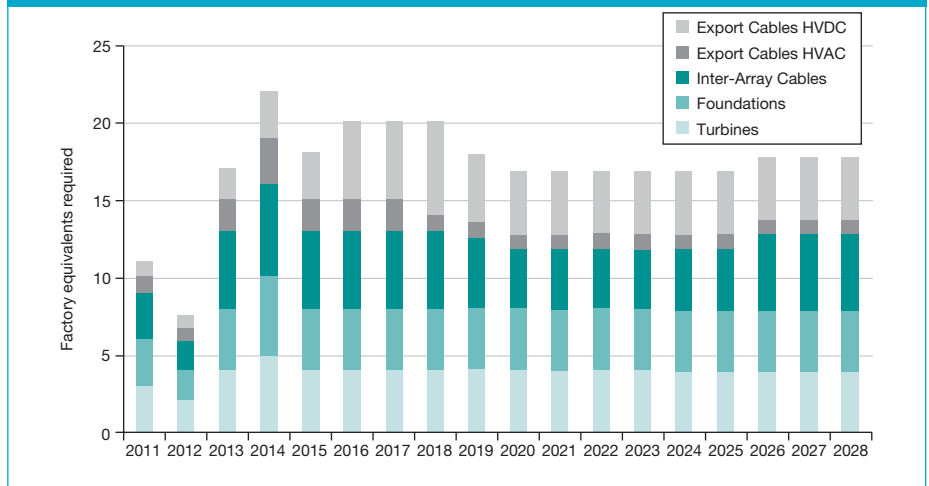
Over 12,000km of array cabling is needed and export cable lengths are well in excess of 8,500km. Potential export cable requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements. A major challenge for the industry will be in delivering these requirements. Figure 4 shows delivery dates for these major components. The hardware delivery date requirements have been set at the year they are required on a project. The period to 2016 will be critical in ensuring sufficient production capacity can be brought online to meet project requirements and avoid lengthy lead times and upwards cost pressures.

With the fast growth expected of the UK between 2016 and 2018 it is imperative that factories are established well in advance. The UK's forecast growth will require the equivalent of 22 factories for just the turbines, foundations and cables. Investment decisions on plants are required straight away. It is expected that some government investment will be required to help establish these facilities. The cost of building the necessary plants (for these major components only) is estimated at in excess of £1 billion.

Given the relatively early peak in factory production capacity it is important that any factories established in the UK are then able to take advantage of further UK development rounds and the wider European export market.

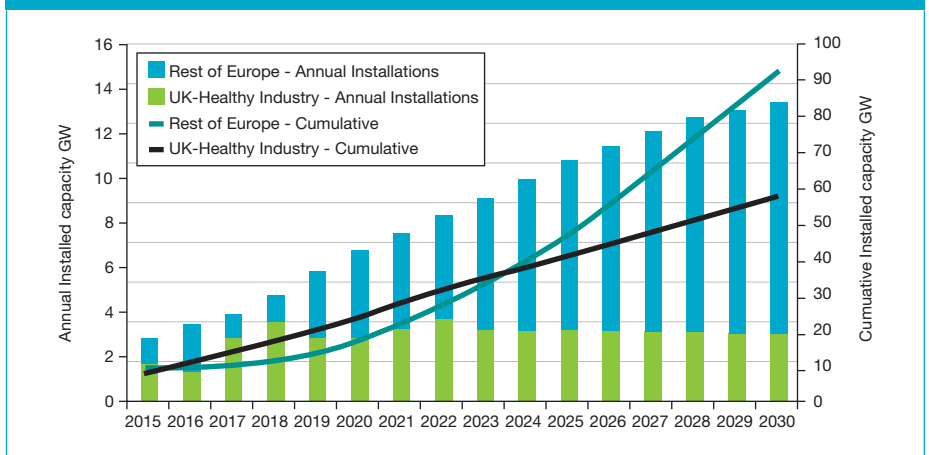
If the Aggregated Developer Appetite build profile is to be realised, more rapid decisions need to be made. By 2015, there will, for example, be a need for eight turbine plants, which alone will cost an estimated £720 million.

Figure 5: A Healthy Industry – Indicative Factory Requirements 2015-2030 by Investment Decision Date



Source: Douglas-Westwood

Figure 6: European Offshore Wind Capacity



Source: Douglas-Westwood and EWEA

“For UK capacity installed between 2015 and 2030 almost 10,000 turbines and foundations will be required.”

A European Perspective

Figure 6 shows European offshore wind installations with the Healthy Industry scenario for the UK split out. The chart uses EWEA's offshore wind forecasts from its 2009 report Pure Power. We have replaced EWEA's UK forecast with that of the Healthy Industry scenario. The total UK and rest-of-Europe cumulative installed capacities are also shown. The importance of the UK in the wider European market is clear.

The proportion of annual installations elsewhere in Europe grows rapidly from 2019. It should be noted that when Round 3 installations are being completed the market elsewhere in Europe is expanding at a healthy pace. Indeed, from 2022, annual capacity installations elsewhere in Europe exceed the UK's annual installations. By 2024, cumulative capacity installed in the rest of Europe exceeds the UK's total installed capacity.

The timing of the growth of the wider European market is relevant as it is when annual Round 3 installations begin decreasing in the UK. The chart suggests that the production capacity built up within the UK for currently announced rounds would have a strong export market potential.

However, if the UK only manages to achieve the capacity additions shown in the Low Added Value scenario the risk would be that manufacturers choose not to establish in the UK. A continental base may provide a stronger location given the size of the future market there.

UK Oil & Gas Activity 2015–2030

Over the next decade the offshore wind sector is likely to face competition for two main resource assets – Heavy Lift Vessels and Engineering Services – with the offshore oil & gas sector. Within the oil & gas sector the two main components of demand for heavy lift are field development activity and decommissioning.

Oil prices are at a high enough level to support conventional UKCS field developments – given the maturity of this region we expect relatively stable activity levels over the next five years.

The UK is now past peak and in the midst of declining production. Between 2000 and 2007 a total reduction of 41% oil and 22% gas reduced total output to just less than 2.7 million boe/day from 4.2 million boe/day at the start of the period. Heightened oil prices at this time incentivised operators to maximise output and kick-start additional developments, which caused a brief growth to 2.9 million boe/day in 2008.

Although future Exploration & Production (E&P) activity will place some strain on the offshore supply chain, the key area of concern for the development of the offshore wind sector should be regarded as the decommissioning market. This is expected to see substantial activity with 1.6 million tonnes-worth of facilities due to be removed between 2010 and 2025. This volume of work will require an estimated 8,900 vessel-days (excluding potential time-saving following the introduction of single lift vessel capability).

There is substantial crossover between the offshore wind and fixed platform decommissioning markets, particularly in areas such as heavy lift and engineering services. The same vessels will be used for oil & gas decommissioning that will be used for renewable energy heavy lifts (e.g. transformer stations). The increase in heavy lift vessel activity will also require substantial support from onshore infrastructure such as ports, waste handling facilities and engineering houses.

While decommissioning has started to happen now there is still uncertainty on the timing of decommissioning activity and the effect that this competition will have on the offshore wind sector. At this stage it is not clear if this will mean more or less vessels are available to the offshore wind business.

Knowledge Transfer from Oil & Gas

With over 40 years experience in the oil & gas sector the UK has an established base of large international and national energy companies supported by a well-developed supply chain offering a wide range of operations, services and technologies.

The offshore wind sector can learn lessons from an oil & gas industry that has a diverse skill set and offers a wide range of services covering all aspects of offshore work. There are a number of synergies that the offshore wind sector has and can accrue from the oil & gas industry, such as the Health & Safety issues working in an offshore environment and adapting to new technology. Until recently (January 2010), a leading Oil & Gas Academy had administered on behalf of RenewableUK its Health & Safety training standards and approvals. The sector should continue to engage with the other industries with experience in the offshore sector including oil and gas to ensure that relevant experiences can be shared and communicated across the lifecycle of projects.

Skills present in the oil & gas sector in the UK will be crucial for the offshore wind industry and they will be highly sought after. For the offshore wind sector to attract oil & gas workers they will have to offer the same high salaries that the oil & gas sector can. This may prove to be a problem, as the commercial returns are much smaller in offshore wind.

The offshore wind sector is suffering from similar issues to those effecting the UK offshore oil & gas sector during its early days with cost overruns, timing delays and a lack of standardisation. Commonality in the structure and practice of the sector throughout the life cycle of offshore infrastructure is something the offshore wind sector needs to embrace if it is going to keep some control over costs.

Conclusions

Scenarios

The Aggregated Developer Appetite scenario sees rapid deployment of offshore wind capacity and necessitates very high investment into the supply chain. This scenario is seen as possible by industry but would require major commitment from government to overcome the issues surrounding grid infrastructure and the OFTO regime, and to provide a well-resourced planning system. The supply chain would need to begin building now and without delay to be ready to deliver for this scenario with the financial sector's support. The other prerequisite would be the further growth of the UK domestic and European export market to sustain the supply chain that would be developed in the UK.

The challenges of consenting, financing, contracting and building the UK's large project portfolio are considerable. Given past and current project activity it is reasonable to expect some level of delays (and potentially reduction in size) to some projects from one or more of these challenges.

The Healthy Industry scenario shows long-term sustainable demand in the market. This build profile shows strong demand with sufficient space for multiple competing companies. At

least five turbine plants will be required for the capacity expected in the UK, which will allow healthy competition between manufacturers. For the industry, this level of competition will help drive technology progression and should result in cost reduction. Whilst some successes have been made with turbine manufacturers choosing to locate in the UK, it is important that more are attracted and that the rest of the supply chain is not ignored.

The Low Added Value scenario shows the effects of an average two year delay to many projects together with a scaling back in project size. Although the slower delivery curve will ease the scaling up of capacity that is required, for the UK, the market entry of turbine manufacturers and their continued success is fundamental to further supply chain growth. In the Low Added Value scenario, the much lower rate of delivery makes it more difficult for the UK to support multiple turbine manufacturers and will limit the extent to which the UK supply chain can develop.

Meeting the stronger build profile in the Healthy Industry scenario will lead to a stronger UK industry, as it increases the likelihood of supply chain companies locating in the UK as opposed to elsewhere in Europe. The German supply

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chain is seen as highly competitive given its earlier investment provision and support, so the UK must immediately build upon its excellent market prospects to ensure the domestic supply chain is grown quickly and sustainably. To ensure that the Healthy Industry scenario can be achieved, much commitment by government and progress within the industry is required.

Policy Requirements

It is clear that the UK now has a tremendous opportunity to build a world-leading supply chain to service the huge domestic market and export to the burgeoning European markets and beyond.

There are, however, many challenges to overcome to ensure a healthy market and a strong domestic supply chain.

Despite the current financial challenges facing the Coalition Government, some spending commitments are necessary now (such as the £60m ports/infrastructure competition used to attract turbine manufacturers such as Siemens and GE to the UK) to start to attract the £1 billion of private investment suggested by this report, which will be required from 2011 onwards to build the main plants required in the Healthy Industry scenario.

Further analysis, by industry or government, is necessary to put a value on the level of investment that is required, in areas such as planning, skills and training, research, design and demonstration, to achieve a healthy industry.

Ensuring long-term government commitment

Actions required:

- The new Coalition Government will need to reaffirm its support for offshore wind as part of the UK's future power generation plans. Early indications are that offshore wind is seen as a key part of the UK's future energy security.
- Timely clarification of the support mechanisms that will be used to help develop and maintain the

sector's growth in the future is required. The RO remains the preference of the industry.

- The new Coalition Government will need to review the support mechanism for offshore wind and be prepared to extend the current level of 2ROC/MWh. A decision on the support level post-2014 will need to be made by 2011, so investment decisions can be made by the supply chain and other stakeholders.
- If we are to change to a Feed-in Tariff (FIT) this needs to be implemented quickly and effectively to avoid a stall in the market.
- Targets for installed capacity need to be agreed by government and industry working together. The Government has indicated that it wishes to increase targets subject to advice from the Climate Change Committee.
- Clarity post-2020 – the Government needs to set targets beyond 2020 for the offshore wind industry, which should include plans for either a Round 3.5 and/or a Round 4.

Ensuring sufficient resourcing and support during planning

Actions required:

- Sufficient funding from government will be required to make sure bodies involved in assessing offshore applications are adequately resourced to carry out their work without delay.
- Offshore wind farms are pivotal to the UK's ability to meet its renewable energy targets and therefore the designation of marine conservation zones should take this into account when making their assessments over seabed usage.

Ensuring continuing finance

Actions required:

- A strong and stable policy is the most important factor in inducing banks and institutional investors to direct the flows of finance required into the sector.
- A 'green bank' has been proposed to help accelerate private sector investment in low-carbon projects.
- The bank must be well designed

and implemented to ensure that it does not compete with existing investment banks and private equity.

- It should invest alongside private capital and be targeted to only address areas in which the market has failed to drive sufficient investment.
- It should advise government on the financial impact of policy changes.

Ensuring grid infrastructure

Actions required:

- Wind farm developers should be given the option to design and construct their own grid connection before transferring it to an OFTO.
- The assessment of projects on an individual basis, for fear of stranded assets, rather than as part of a wider renewable network needs to be reviewed. This has been criticised by the sector for delaying investment decisions at a time when the network needs to accelerate to meet the needs of current and future rounds.
- There must be strong incentives for the onshore Transmission Owners (National Grid, Scottish Power, and Scottish and Southern Energy) to commence detailed planning and long lead time construction works for onshore upgrades in advance of user commitment. Recent moves in this direction by Ofgem are welcome but need to go further.
- A review of the charging methodology is required to ensure renewable energy suppliers are not being charged unfairly for using the network. Under the current system wind generators and offshore wind generators in particular are charged disproportionately more than conventional generators for grid usage through a combination of local and capacity charging.

Port development

Actions required:

- Government needs to accelerate the identification and selection of the regional ports that will become manufacturing hubs for offshore wind. A focused approach has been advocated, whereby three or four key ports are selected for targeted

investment.

- Decisions over which ports will receive funding from the £60m pledged in the March 2010 budget needs to be expedited and further funding should be made available for ports looking to develop other facilities for the sector no cuts should be made to the £60m pledged during the current spending review.
- Incentives need to be provided to ensure supply chain companies cluster around key port areas e.g. Marine Energy Parks or similar.

Supply chain development

Actions required:

- Cohesive action for the supply chain from a central body is required.
- Assistance is required to locate turbine manufacturers' supply chains where appropriate – the UK needs more high-value-added than assembly work.
- Supply chain funding for other manufacturers (such as the recent awards to Burntisland Fabrication and Tees Alliance Group) is needed.
- The use of tax breaks (corporate tax and capital allowance) for manufacturers, possibly tied to BIS's Low Carbon Economic Area (LCEA), could be used to further stimulate private investment.

Creating a skilled workforce

Actions required:

- A new national skills strategy is required by the Government in light of the House of Commons Audit Committee report of December 2009.
- This strategy must prioritise the skills needed to drive the economy through the low-carbon transition.
- Greater collaboration between government, industry and learning providers to deliver a cohesive approach to skills and education is needed.
- Funding should be responsive to industry needs.
- Delivery of specialist industry courses should be along a centre of excellence model open to competition from public sector providers across the UK. Industry

needs to communicate regional preferences.

- To help the transfer of labour from sector to sector, a standardised approach to training is required across the renewable energy and hydrocarbon offshore industries.

Establishing a national RD&D programme

Actions required:

- The development of a national wind energy RD&D programme is seen as an important way of building a research network that has a high-level expertise and knowledge base. Countries that have established RD&D programmes with funding and a long-term focus have seen major private sector growth.
- Facilities for testing and demonstration are currently not sufficient to support manufacturing in the UK.
- Government needs to fast track the development of onshore test sites for initial tests of new offshore turbines, providing early results at sites that can be readily accessed for maintenance and inspection.
- Funding will be required to support the construction of offshore demonstration wind farms, which could come from both government and the European Union.
- The promotion of Joint Industry Projects, in which multiple parties work together to overcome challenges by sharing the expensive costs of research, will ultimately benefit the sector and help reduce costs in the long term.

Methodology

Overview

As a starting point in assessing future UK offshore wind activity, The Crown Estate's anticipated build profile was examined. This is built from dates submitted to The Crown Estate by Round 3 developers as part of their application process. This has been called the Aggregated Developer Appetite build profile.

An updated evaluation of each UK offshore wind project's timetable was then conducted. Initially done using the most recent publicly stated dates, project timelines were then reviewed by developers. This was then used to build a profile of UK offshore wind build.

Two further scenarios were then developed:

- A Healthy Industry scenario; and
- Low Added Value scenario.

Each scenario shows potential build rates for offshore wind and the supply chain requirements necessary, given an element of delay and attrition to projects.

Project timings, assumptions and policy recommendations were all developed through comprehensive consultation with developers, manufacturers, contractors and stakeholders. Once

draft scenarios and assumptions were complete, these were tested at RenewableUK group strategy sessions and on a one-to-one basis with industry. The views and recommendations in this report are that of RenewableUK – member companies, the wider wind industry supply chain and selected industry stakeholders.

Project Timing

The Aggregated Developer Appetite build profile uses the project timings given to The Crown Estate by project developers as part of their Round 3 submissions.

The Healthy Industry and Low Added Value scenarios draw from the same base data set of project timings. Each project/zone for the 2015–2030 period was identified and split into phases where applicable. Construction and completion dates were given for each project and phase. This was done using publicly stated project details and development timeframes from developers.

As part of the consultation with industry, project developers were consulted over their current project timelines and phasing (where applicable).

“Once draft scenarios and assumptions were complete, these were tested at RenewableUK group strategy sessions and on a one-to-one basis with industry.”

This raw data was then fed into the main model where an attrition factor and period of delay was applied as part of developing the scenarios. No attrition or delay was applied to the Aggregated Developer Appetite build profile.

It should be noted that all scenarios use the 2015 capacity installation figures from RenewableUK's (formerly BWEA's) 2009 report UK Offshore Wind: Staying on Track, produced by Garrad Hassan, as the starting point to ensure continuity.

It should be noted that the 700MW Bell Rock project has been removed from the model.

Attrition

For the Healthy Industry and Low Added Value scenarios a level of attrition has been applied. This is to account for a reduction in overall capacity coming out of the consenting phase, for example, if developers choose to scale back the size of their projects.

- For the Healthy Industry scenario we have used an attrition factor of 20% for Round 2, Round 3 and STW projects.
- For the Low Added Value scenario we have used an attrition factor of 33% for Round 2, Round 3 and STW projects.

It is important to note that these rates of attrition have been applied across all projects in each round equally; no individual projects are treated differently. The rate of attrition applied was developed in consultation with the industry.

With completion of Round 3 zones in some cases being 15 years away it was agreed that the rate of attrition would be applied to account for the possibility of less capacity than anticipated ultimately being installed.

In the development of Round 3, The Crown Estate made efforts to create a dynamic market environment with the flexibility to reshape projects

and relocate within overall zones. This is designed to help developers adjust their project deployment within zones if difficulties occur with parts of their sites. It should be recognised, therefore, that the design of Round 3 provides upside potential to the figures presented in this report.

Delay

For the Healthy Industry and Low Added Value scenarios a level of delay has been applied to projects. This delay has been applied to the project dates provided by developers as part of this study. The delay has been implemented to account for potential delays to projects through consents, contracting and potentially, construction. The precedent for this can be seen in the UK's Round 1 and 2 projects, where significant delays to original timescales have been common. For example, the London Array project was originally timetabled to come online in 2008 - the first phase will be completed in 2013.

- For the Healthy Industry scenario we have built in a delay of 1 year affecting 20% of all Round 2 capacity, 50% of all Round 3 capacity and 35% of STW capacity.
- For the Low Added Value scenario we have built in a delay of 2 years affecting 50% of all Round 2 capacity, 100% of all Round 3 capacity and 75% of STW capacity.

The delay factor changes between rounds due to the relative progression of each round at the current time. With Round 2 projects being much closer to realisation the chances of additional delays are less than for STW and Round 3 projects, which are further from construction. Given the size and the number of zones under development at the same time there is increased potential for capacity issues with grid development, finance, planning, procurement and supply chain capability. The ramp up required is significant and the potential for delay larger. For these reasons Round 3 projects have got the greatest level of delay applied to them.

It is important to note that these rates of delay have been applied across all projects in each round equally; no individual projects are treated differently to others.

Assumptions

A set of detailed assumptions was developed to establish the industry requirements (hardware and vessels) generated by UK offshore wind projects. These assumptions were developed through in-depth discussions with project developers, manufacturers, contractors and stakeholders. For any item, such as turbines, the assumptions can change each year over the 2015–2030 period and per round e.g. R2 or R3.

The assumptions used and the reasoning behind them is discussed for each item later in this report.

Timing of Hardware Requirements

The forecast hardware and vessel requirements have been set at the year they will be required on a project.

The following timings have been used:

- Turbines: 1 year before online date;
- Foundations: 2 years before online date;
- Array cables: 2 years before online date; and
- Export cables: 2 years before online date.

The assumptions used in determining hardware requirements are discussed in detail later in the report.

Policy Recommendations

The policy recommendations made in this report are based upon interviews with the industry.

Capacity Scenarios

Examination of The Crown Estate Figures

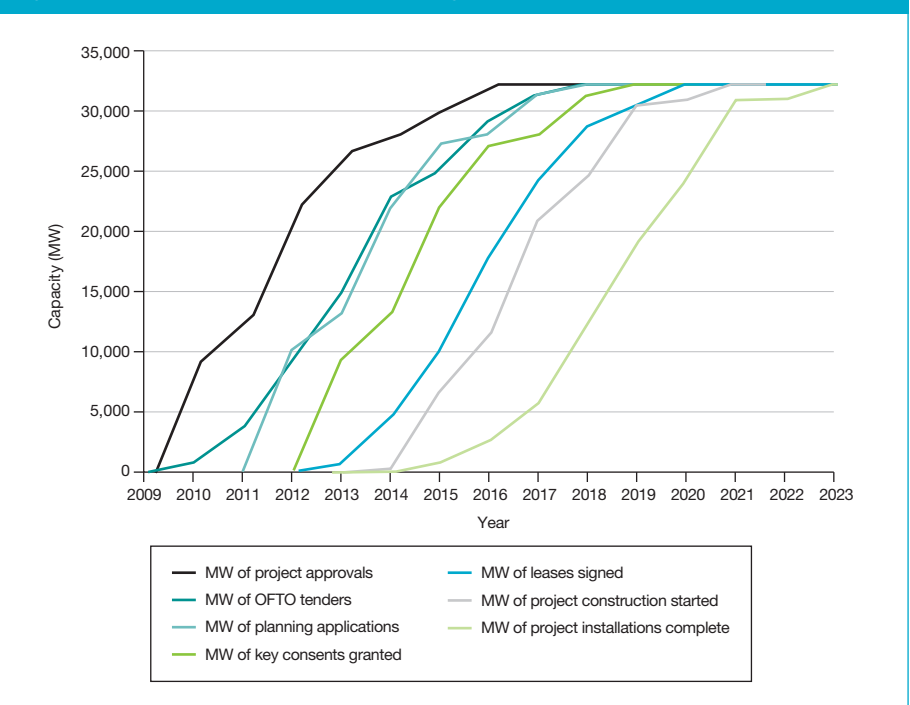
The build programme in figure 7 comes from dates given to The Crown Estate during the application process for Round 3 zones. It shows extremely fast development and construction. For this to occur, the supply chain must be capable of this very intense growth. Whilst industry believes this is possible given heavy investment, in reality it would be difficult to achieve. This very fast ramp up is seen as challenging due to the potential cost increases that could occur given the heavy competition for components and services. It would also require follow-on activity in the form of a Round 4 at the same level of intensity to sustain the industry or demand from the wider European market.

Using these figures, by 2023, when all Round 3 projects are installed, cumulative offshore wind capacity in the UK will have reached almost 50GW.

The aggregated developer appetite profile in figure 8 would see the vast majority of projects completed across a five-year period.

Whilst very challenging, the build profile is not impossible for the industry to achieve – with sufficient investment and

Figure 7: Crown Estate – Round 3 Build Programme



Source: The Crown Estate

market clarity the supply chain could scale up production. However, such a rapid growth is undesirable for the UK industry as it provides less time for supply chain development to occur in this country.

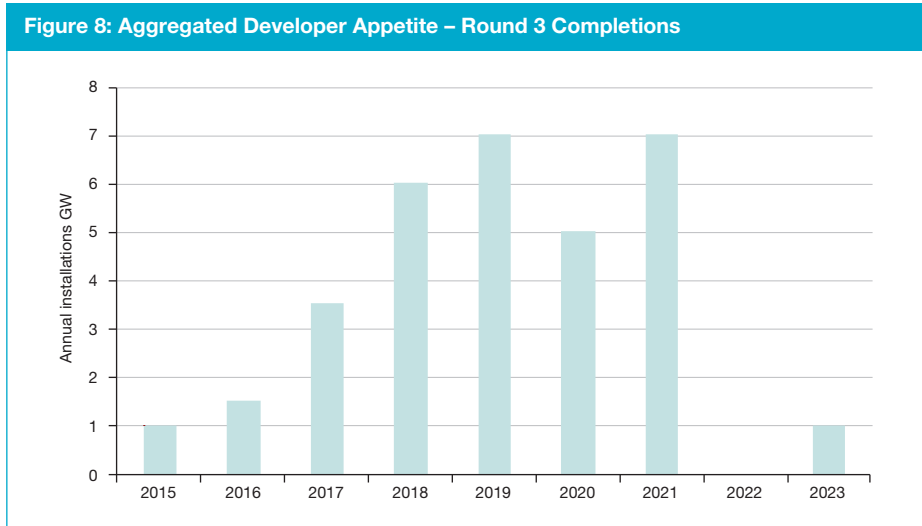
If this were to happen there would need to be significant follow-on opportunities for the supply chain. Without future potential, this build profile would not instil the confidence required to invest. Whilst there are challenges to the grid for this capacity profile to be built this can be overcome with sufficient timely investment.

The delivery dates given to The Crown Estate would necessitate a fast ramp up in turbine production. Figure 9 shows delivery dates, so the production capacity required would need to be in place at least two years ahead of this.

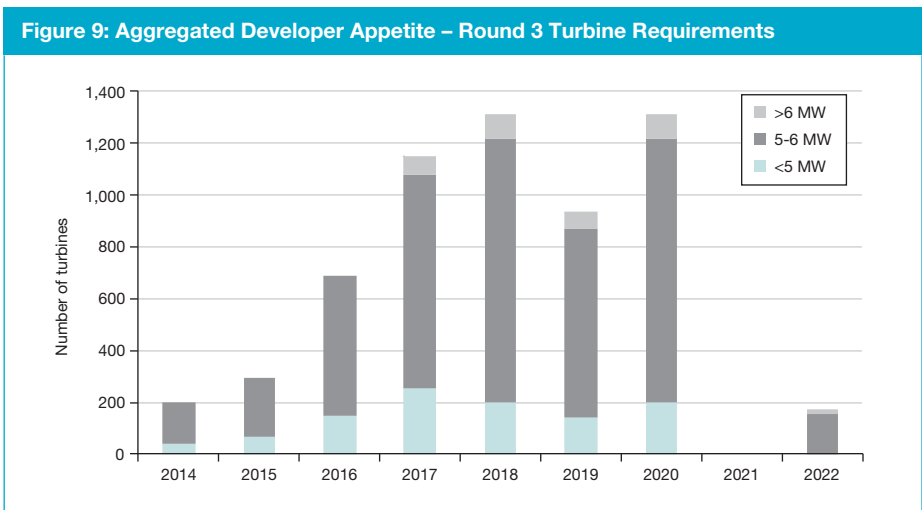
Given that the majority of Round 3 will be built using 5MW or bigger turbines, the required production rate is especially challenging given current manufacturing capacity. However, companies such as Siemens have recently announced plans for production facilities, and this new capacity could potentially meet requirements or could be scaled to do so.

The Aggregated Developer Appetite only shows a short intense period of activity for turbine manufacturing. Such a situation would likely cause high competition for hardware, potentially pushing prices up further if constraints in the supply chain exist.

After producing over 1,300 turbines a year in 2020, the turbine manufacturers will not necessarily have a market for this level of production capacity in the period beyond. This lack of clarity may harm investment decisions for turbine manufacturers and the component suppliers within the supply chain. There must, therefore, be early announcement of Round 4, ideally coupled with major development elsewhere in Europe. This will ensure that turbine production capacity could be applied elsewhere once the UK's Round 3 projects are completed.



Data Source: The Crown Estate



Source: Douglas-Westwood

Even if there was an additional round introduced or significant repowering activity, it is not expected to be at the same level of intensity as the above expectations of Round 3, given the amount of wind capacity installed by this time in relation to the UK's overall electricity demand. This level of large-scale deployment of offshore wind in UK waters would necessitate major investment in both the Smart Grid and the Supergrid. Investment in the Smart Grid will help increase the amount of intermittent wind acceptable in the UK. If commitment to the Supergrid (or equivalent) is made this would support the high growth potential of the UK, as it offers the potential to vastly increase the amount of capacity the UK can generate from offshore wind. Major investment should also be made in RD&D for energy storage solutions.

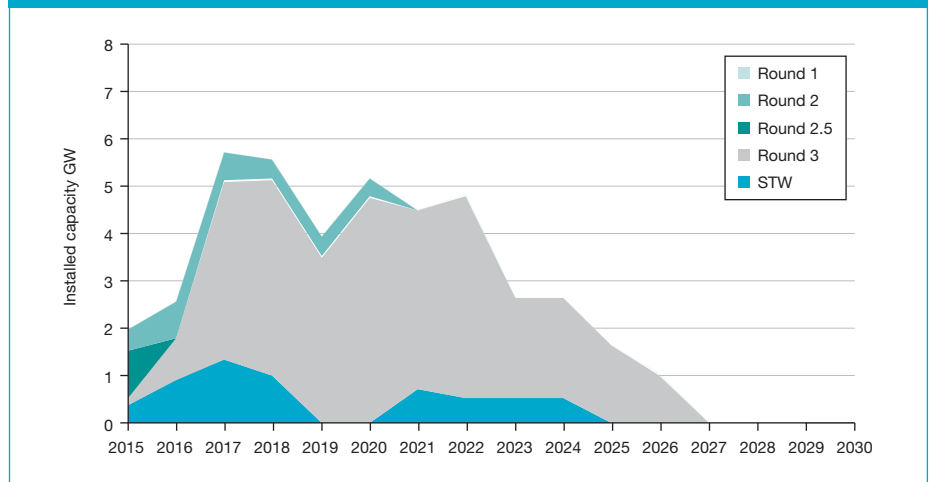
Developer-Stated Dates

From examination of project dates submitted to The Crown Estate it is apparent that this would represent a significant challenge for the industry to achieve. Whilst individual projects are capable of such development timeframes, it will be challenging for all developers to build their projects in such a short period. The main implications are the requirement of an extremely sharp ramp up in production capacity and availability of installation vessels.

The second major implication is that the high volume of activity is relatively short lived. After 2021 there will be no projects in the UK for which manufacturers and contractors could use their capacity and availability. As such, an early announcement of Round 4 or similar will be important to the industry.

Following assessment of the dates originally submitted to The Crown Estate, DWL identified all projects (and phases) in the 2015–2030 period. Using stated timescales given by developers, dates were given to each phase of each project in the period. These dates were reviewed with developers and adjusted if necessary.

Figure 10: Developer-Stated Dates – Annual Installations 2015-2030



Source: Douglas-Westwood

Figure 10 shows the consolidation of developers' timetables.

Remaining Round 2 activity is expected to be completed at a rate of between 400 and 780MW per year from 2015 to 2020. Development of Scottish Territorial Waters projects is split across two periods, 2015–2018 and 2021–2024.

Many Round 3 developers are optimistic of significant early completions of project phases. This creates a big rise in annual capacity between 2016 and 2017, where installations jump from just over 2GW per year to almost 6GW. Round 3 installations peak in 2020 when developers expect 4.7GW of capacity to be added.

This rapid increase relies upon fast progression through the consenting stage, a fast ramp up within the supply chain and a strong investor appetite. This high level of activity is expected to last through to 2022 before declining through to 2026 when Round 3 installations are complete.

Given experiences from Round 1 and Round 2 projects, it can, however, be expected that delays will impact upon developers' anticipated timescales.

To this effect, two further scenarios were then produced, which take these stated dates and introduce an element of delay and project attrition – to account for some projects scaling back in size between now and construction.

A Healthy Industry

The Healthy Industry scenario is so called because it represents a long-term sustainable offshore wind industry. It takes the dates and phase breakdowns from developers and applies a degree of attrition and delay to present a more reasonable delivery scenario.

Capacity

The Healthy Industry scenario in figure 11 has a more steady build profile than the Aggregated Developer Appetite delivery curve. This profile gives the potential for a more sustainable industry. The scenario results in a total cumulative installed offshore wind capacity of 23.2GW by 2020. Rapid growth is still expected as the first Round 3 and STW projects are installed. Installation rates double between 2016 and 2017.

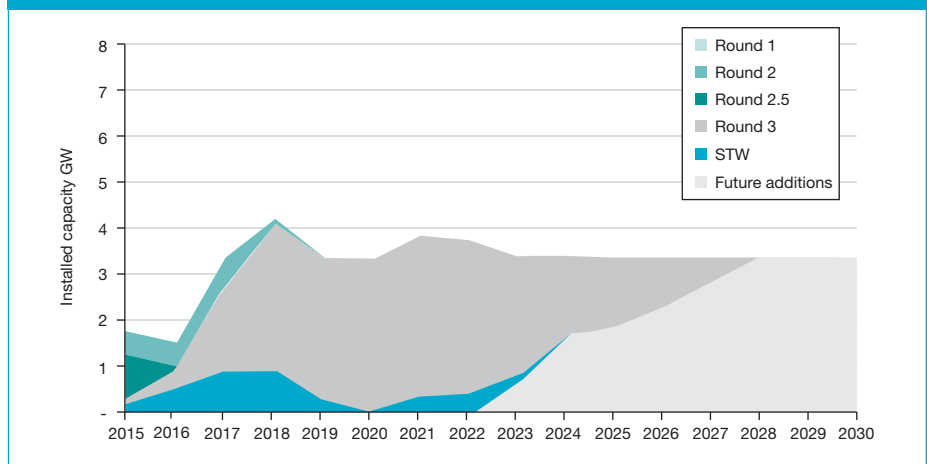
The main characteristic of this scenario is an initial period of rapid industry activity between 2016 and 2018 when first Round 3 phases and a large proportion of STW projects come online. This peak of activity reduces slightly through 2019 before growing slowly from 3.3 to 3.7GW to 2021. Activity then declines again slightly to 3.3GW by 2023. Assumed future capacity additions then maintain this level of activity.

The remaining Round 1 capacity is completed in 2015, with Round 2 completed in 2018. All of Round 2.5 capacity is expected to be installed, split equally between 2014 and 2015.

Scottish Territorial Waters projects start to come online from 2015 and installations here peak in 2017 with just less than 1GW of STW projects built. With over half of STW projects completed by 2019, the larger and more challenging Scottish projects will be completed between 2021 and 2023.

The first significant Round 3 capacity comes online from 2016 and sees activity grow quickly through to 2018 when most projects will have at least one phase completed. Round 3 installations peak in 2021 when 3.4GW of capacity comes online. All Round 3 capacity is installed by 2027.

Figure 11: A Healthy Industry – Annual Installations 2015-2030



Source: Douglas-Westwood

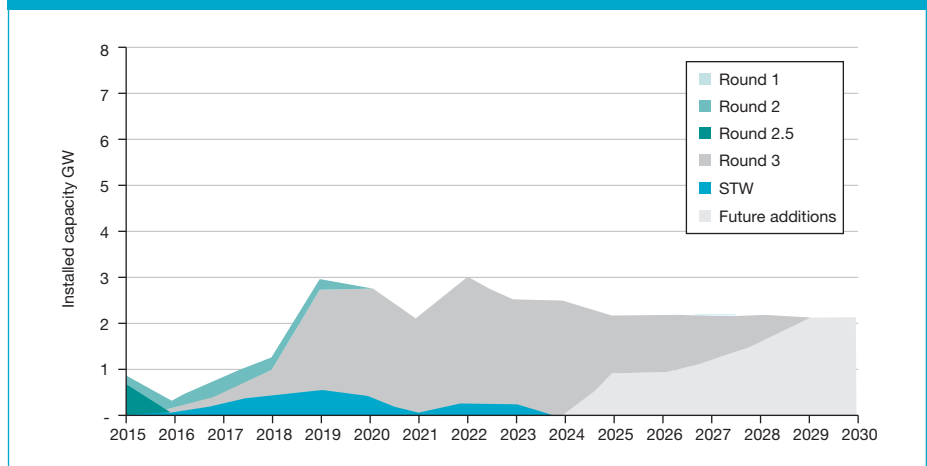
From 2023 new capacity beyond Round 3 is expected to begin coming online. This capacity is expected to be a mixture of new projects and repowering of existing sites.

The level of capacity delivered in the Healthy Industry scenario is similar to that of Bain & Company's 2008 report that forecast 57,000 UK jobs from an assumed installed capacity of 20GW by 2020 (assuming 70% domestic content).

Assumptions used

- For the Healthy Industry scenario an attrition factor of 20% for Round 2, Round 3 and STW projects has been used.
- A delay of 1 year affecting 20% of all Round 2 capacity, 50% of all Round 3 capacity and 35% of STW capacity has been built in.
- All 2GW of Round 2.5 is installed, split equally between 2014 and 2015.
- Starting in 2023, capacity additions of between 2GW and 3GW per year have been assumed. This is expected to be a mix of future licensing rounds and repowering activity on projects. This additional capacity has been added to the scenarios to avoid a fall-off in activity, which would otherwise emerge. The level of additional capacity is consistent across the different scenarios, although starts at different points.

Figure 12: Low Added Value – Annual Installations 2015-2030



Source: Douglas-Westwood

Low Added Value

The Low Added Value scenario portrays the effects of more significant delays to construction and a moderate degree of attrition to overall capacity.

Capacity

In the Low Added Value scenario, installations grow more gradually initially before the ramp up begins through 2018 and 2019, when the first Round 3 phases come online. It is accepted that some Round 3 zones will face difficulties, but given the large number of phases (46) some slippage will serve to lengthen the period of activity for the supply chain. The slower development of sites spreads

activity over a longer period and results in a steady growth rate through to 2024, as successive Round 3 phases are built. Additional capacity from 2025 would help maintain this steady momentum.

In the Low Added Value scenario, 14.1GW of offshore wind capacity is installed in the UK by 2020. This is in line with outputs from the Government's 2009 Renewable Energy Strategy.

Whilst it is significantly lower than the Healthy Industry scenario, it should be noted that there are at least six years of between 2GW and 2.8GW of activity per year.

Will this level of activity result in supply chain development in the UK? Testing the scenario with supply chain companies suggests this is the case, to an extent. With a smaller amount of capacity installed each year there is less space for multiple manufacturers to secure the market share they would require. This is particularly relevant for turbine manufacturers who are looking for a market share of around 1GW per year. The build profile in the Low Added Value scenario makes it difficult for the multiple turbine manufacturers considering setting up UK plants to secure sufficient market share.

This scenario is heavily reliant upon activity elsewhere in Europe. A steady base of UK capacity will help support establishment and sustainability of UK-based manufacturing and servicing, but export will be important for these companies. Expectations of the German market are greater than this build profile, so the risk of the UK missing out on supply chain growth to Germany is heightened.

Assumptions used

- For the Low Added Value scenario an attrition factor of 33% for Round 2, Round 3 and STW projects has been used.
- A delay of 2 years affecting 50% of all Round 2 capacity, 100% of all Round 3 capacity and 75% of STW capacity has been built in.
- 1.5GW of Round 2.5 is installed, split equally between 2014 and 2015.

- Starting in 2025, capacity additions of between 2GW and 3GW per year have been assumed. This is expected to be a mix of future licensing rounds and repowering activity on projects. This additional capacity has been added to the scenarios to avoid a fall-off in activity, which would otherwise emerge. The level of additional capacity is consistent across the different scenarios, although it starts at different points.

Industry Requirements

This section describes the core assumptions used to define industry requirements from the capacity scenarios. They have been developed through consultation with companies throughout the supply chain.

Turbines

Assumptions used

The turbine assumptions used in this report have been based on industry consultation with developers of Round 2, Round 3 and Scottish Territorial Water (STW) projects that have a planned online year during 2015–2030.

As explained in the methodology section, hardware dates in these forecasts show the delivery date for the type of component rather than the online date of the project in which they are being used.

Turbine class and average size

Turbines have been split into three class categories for this report, with an average size in each class used to calculate hardware requirement based on current and future planned turbine models:

- <5MW – average size 3.7MW, based on Siemens, Vestas and GE models.
- 5–6MW – average size 5.5MW, based on Repower, Siemens, Vestas, Multibrud and Gamesa (Bard) models.
- >6MW – average size 7.5MW, based on Clipper, Siemens and Gamesa (Bard) models.

Turbine class by round

Round 1 – it is assumed that R1 projects will continue to use <5MW-class turbines in 2015, due in part to the likely use of monopile foundations in these shallow water sites.

Round 2 – first R2 projects in this period (2015–2017) have specified an even split between <5MW- and 5–6MW-class turbines. Later R2 projects, such as Triton Knoll, will look to use 5–6MW-class turbines exclusively.

Round 2.5 – it is expected that <5MW-class turbines will be used for this round due to the quick build timescale that has been stipulated by The Crown Estate. There is potential for some developers to test larger turbines on their R2.5 extensions to gain experience, which has been factored in for the 5–6MW turbine class.

Round 3 – the majority of R3 projects are planning to use 5–6MW turbines. The first phases of some R3 projects may, however, use smaller turbines in order to ensure quick construction. Turbines greater than 6MW have been factored in from 2018 onwards.

Scottish Territorial Water (STW) – the first smaller STW projects have specified

3MW-class turbines for a number of reasons such as water depth allowing for the use of cheaper foundation type, distance from shore and possible turbine size restrictions, and turbine availability. The larger projects, many of which are further from construction, are currently specifying 5–6MW devices. Some developers are considering turbines bigger than 6MW for their projects.

Comparison of Scenarios

Figure 13 overleaf shows a comparison in turbine requirements between the initial Aggregated Developer Appetite profile and the two further scenarios with project attrition and delays applied. The same turbine assumptions have been applied to each scenario.

The delivery profile for turbines is markedly different. Whilst the Healthy Industry scenario does ramp up quickly, it doesn't reach close to the same requirements as the Aggregated Developer Appetite build profile would demand.

The most important points to note are the lengthened period for turbine production activity in the Healthy Industry and Low Added Value scenarios in comparison to the Aggregated Developer Appetite build profile. They

show turbine production required for Round 3 projects extending well into the 2020s. The more stable and consistent market in these scenarios is more attractive to the supply chain.

A Healthy Industry

In the Healthy Industry scenario, over 650 turbines per year are required from 2016 throughout the lifetime of Round 3. Annual requirements are fairly consistent suggesting a stable long-term market and sufficient market space for multiple manufacturers.

There is, however, still a sharp jump in requirements between 2015 and 2016. This is due to the big increase in project activity at this time, with multiple Round 3 phases in construction, along with several STW projects.

The increase from around 350 turbines in 2015 to around 700 turbines in 2016 is viewed as challenging but possible, especially given the new turbine manufacturing facilities expected online in the UK ahead of this. Production will be spread out over multiple years for big contracts initially smoothing delivery of the large turbine requirements for 2016. Given the lead times involved it is critical that turbine manufacturers establish production facilities promptly.

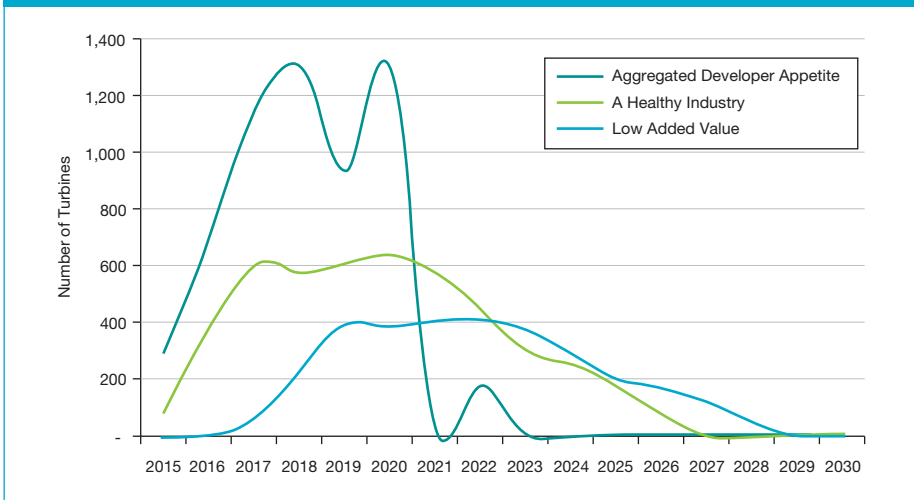
Looking at the size of turbines expected, 3MW-class units will be required in lower numbers from 2017 onwards. Developers are specifying them for around half of STW projects, particularly the earlier ones, and they are expected to be used on several Round 3 phases.

From 2017 it is the 5MW-class of turbines that is predominant, with requirements of over 500 per year through to when Round 3 installations begin to reduce.

Low Added Value

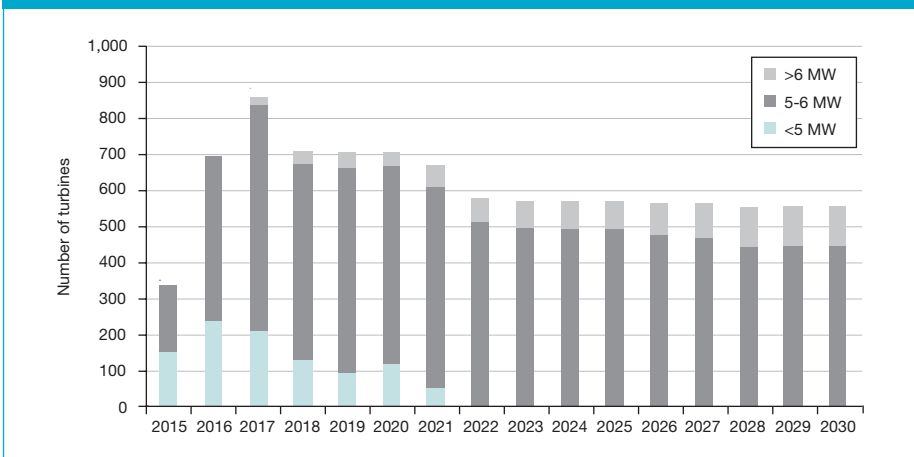
The turbine market resulting from the Low Added Value scenario is seen as difficult for the sustainability of multiple UK-based turbine manufacturers. From 2019 in the Low Added Value scenario, over 400 turbines per year will be

Figure 13: Round 3 Turbine Requirements 2015-2030



Source: Douglas-Westwood

Figure 14: A Healthy Industry – Turbines 2015-2030 by Delivery Date



Source: Douglas-Westwood

“In the Healthy Industry scenario, over 650 turbines per year are required from 2016 throughout the lifetime of Round 3.”

required in the UK. Most manufacturers are looking for around 1GW (200–300 turbines) per year from a facility (although much less for some very large turbines).

For turbine manufacturing and the associated supply chain, post-Round 3 activity will be extremely important. If this scenario were to occur, the export market would be of equal or greater importance to manufacturers.

Foundations

Assumptions used

The foundation assumptions used in this report have been based on industry consultation with developers of Round 2, Round 3 and STW projects that have a planned online year during 2015–2030.

Foundation type

Foundations have been split into four category types for this report:

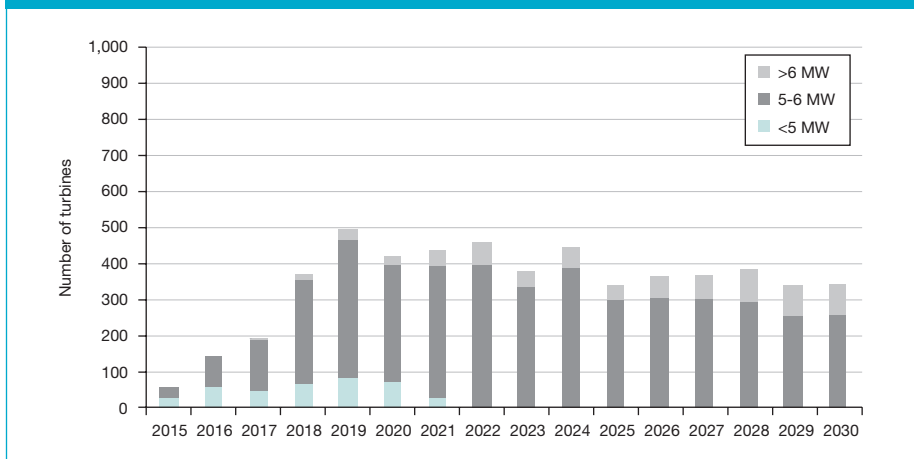
- Monopile – traditionally the foundation of choice for projects in shallow waters using <5MW-class turbines.
- Jacket – use of these foundations has been restricted to demonstration sites until recently, but with projects moving into water depths above 25m and the use of 5–6MW turbines, their use is expected to increase significantly in the future.
- Tripod – to date their use has been restricted to a number of demonstration sites, but they are expected to be used in the future as an alternative to jackets.
- Other – this covers possible use of Gravity Base Structure (GBS) and any new designs that could come from RD&D programmes such as the Carbon Trust's Offshore Wind Accelerator.

Foundation type by round

Round 1 – it is assumed that the remaining R1 projects in the period will use monopile foundations.

Round 2 – the first R2 projects in this period (2015–2017) are expected to use an even split of monopile and jacket

Figure 15: Low Added Value – Turbines 2015-2030 by Delivery Date



Source: Douglas-Westwood

foundations according to developers' current plans. Beyond 2018 jackets are being favoured by developers, although some allowance for tripods has been made in the assumptions to cover their use.

Round 2.5 – it has been assumed that monopiles will be the predominant foundation choice for these project extensions, based on the fact that most R1/R2 projects use monopiles. A small allowance has been made for the use of jackets, tripods and other designs.

Round 3 – it has been assumed that monopile foundations will be used on some R3 projects through to 2021, in shallow waters, if 3MW-class turbines are used. Generally, however, developers have indicated that jacket foundations are the most likely choice for their projects throughout the period, due to a combination of water depths in excess of 30m and turbine size. Again some allowance for tripods has been made to cover their use as an alternative to jackets. Other foundation types have also been included, which covers any new designs.

Scottish Territorial Waters (STW)

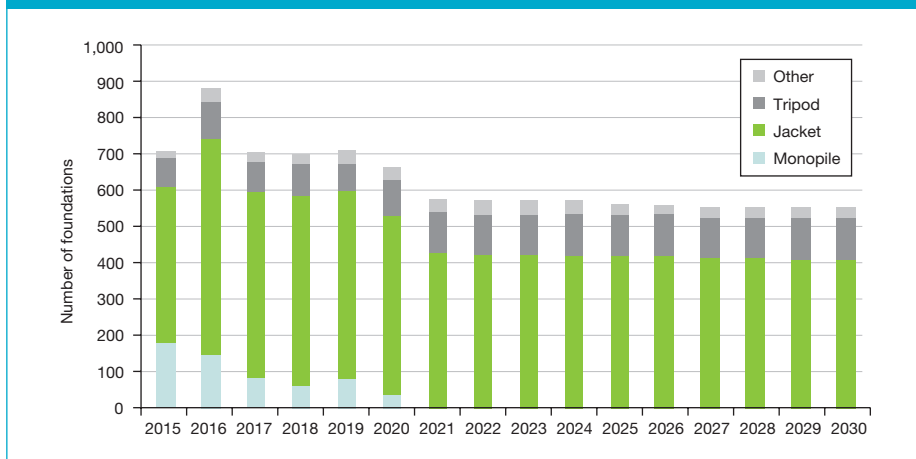
– developers have suggested that monopile foundations will be used on a number of the smaller projects during the period 2015–2021 where <5MW turbines are to be used. On larger projects where >5MW turbines are to be used, jackets are expected to be used. A small allowance for other designs has also been made.

A Healthy Industry

Based on production dates, by 2015 monopiles lose their status as the most commonly used foundation type on projects. Over 400 jackets need to be produced in 2015. Monopiles continue to be used on remaining Round 2 projects, some of the STW projects and early phases of Round 3 projects, but their use declines gradually from the outset.

Whilst a common view was that Round 3 projects would not utilise monopile foundations, discussions with individual developers revealed that several are

Figure 16: A Healthy Industry – Foundations 2015-2030 by Delivery Date



Source: Douglas-Westwood

planning to use monopiles where possible on early phases coupled with 3MW-class turbines.

Throughout the study period an increasing number of Round 3 developers came out in favour of jackets rather than tripods for their >5MW turbine projects. There was strong belief that significant cost savings will be possible through the standardisation of jacket design and fabrication, and through growing economies of scale. We did not have any responses from developers stating that they plan to use tripods.

There is an allowance in the foundation assumptions model for other foundation types. This includes Gravity Based Structure (GBS) foundations and other future designs. Whilst usage is expected to be small, it was felt important to include a provision for their potential use. Whilst it is likely that some will be installed each year as shown in the chart above, it is not possible to allocate their use to specific projects and years so they are spread across the period.

Low Added Value

In the Low Added Value scenario annual requirements are less but still significant. Despite the slower and smaller build profile the scenario is still encouraging. It shows a more gradual increase in foundation supply, but one that arguably is more realistic in terms of companies' scaling-up potential.

Cables

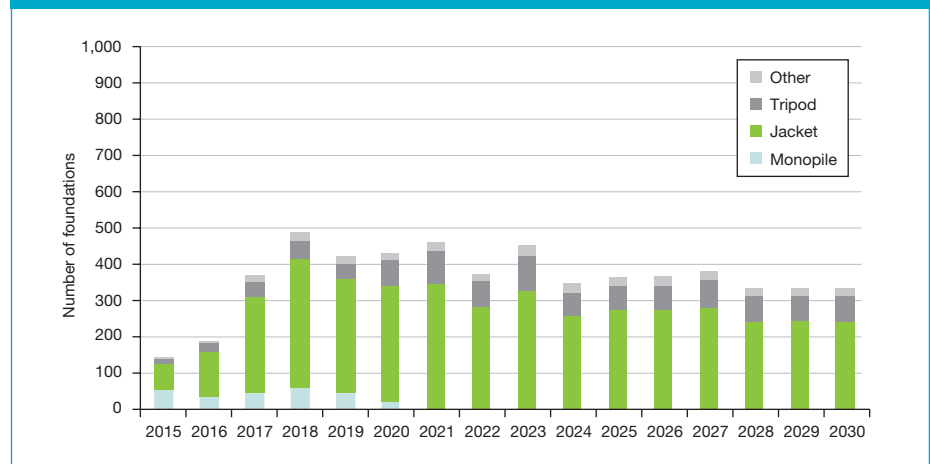
Assumptions used:

Cable type

Cables have been split into two categories in this report:

- Inter-array – the size of an array is based upon standard wind farm turbine spacing of four rotor diameters apart across the prevailing wind direction and seven rotor diameters apart in the direction of the prevailing wind (i.e. downwind). An allowance of 10% for both non-direct cabling and distance to connector has also been added.

Figure 17: Low Added Value – Foundations 2015-2030 by Delivery Date



Source: Douglas-Westwood

- Export – the methodology behind the export cable assumptions has been taken directly from the Offshore Development Information Statement (ODIS, 2009), which looks at the use of HVAC and HVDC cables for Round 2 and Round 3 projects. The general assumption used is that an HVDC transmission solution is more suitable for projects further than 60km from shore, with AC technology the best option for projects closer to shore.

Inter-array cables length (km) by round

All rounds – for the purpose of this report a single array cable spacing length has been used across all rounds, starting from 1km per turbine in 2015 through to 1.3km by 2030. This increase in length per turbine should reflect both the increasing diameter size of turbines installed throughout the period and increased array spacing in larger zones, which has been indicated by some developers during the consultation process.

Export cable length (km) and type by round

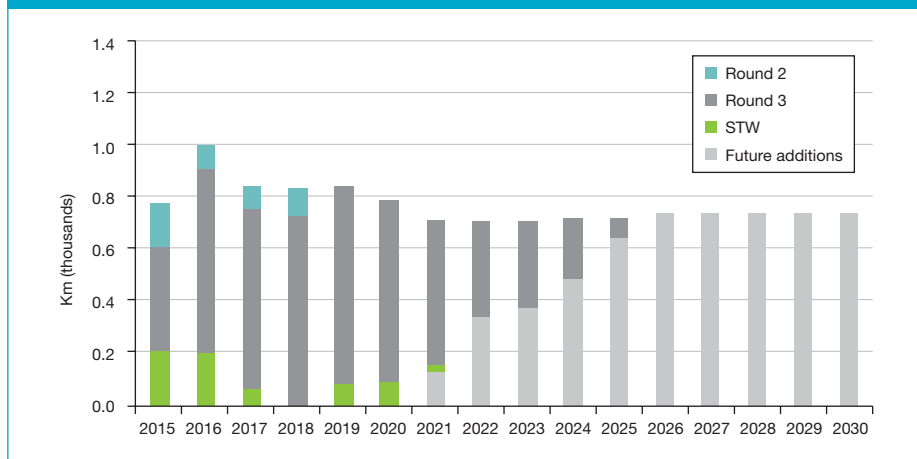
Round 1 – the single R1 project in this report will be connected using AC cables. The distance to shore has been used to calculate the length of cable required.

Round 2 – the type of cable required for these projects has been based on assumptions made on the likely connection methods for specific R2 projects in the ODIS. All R2 projects in this report will be connected using AC cables energised to either 132kV or 220kV. The distance to shore has been used to calculate the length of cable required for each project.

Round 2.5 – it is assumed that AC cables energised to either 132kV or 220kV will be used for this extension round of projects.

Round 3 – the Offshore Development Information Statement report looks at the different connection design options for all R3 projects. This report has based the cable choice and length for each R3

Figure 18: A Healthy Industry – Array Cable 2015-2030 by Delivery Date



Source: Douglas-Westwood

project on the first design option in the ODIS report. R3 projects use a mixture of AC and DC cables to transmit the power to shore.

Scottish Territorial Waters (STW) –

It has been assumed that these projects will all be connected using AC cables energised to 132kV or 220kV due to the short distances to shore (less than 25km). The distance to shore has been used to calculate the length of cable required.

A Healthy Industry

From just under 400km of array cable installed by 2013, projects built in 2015 will require almost 800km of cable. Cable requirements peak in 2016 at over 1,000km. The following four years through to 2020 are fairly consistent at around 850km per year on average. Given the lead times on cables, by 2021 manufacturers will be looking to the next round of projects.

Low Added Value

The Low Added Value scenario shows very low initial cabling demand, but by 2018 this has grown to almost 600km per year. It stays around this level through to 2022 before year on year reductions as the final Round 3 zones are completed in 2029. Cable production for Round 4 or other new capacity will need to be ongoing by 2023.

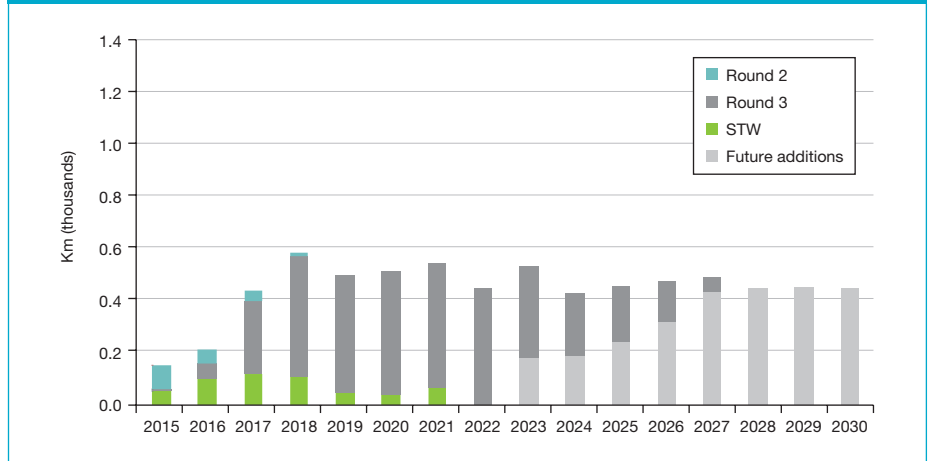
A Healthy Industry

HVAC export cables required

Demand for HVAC cable grows very quickly from a very small initial requirement in 2015. Installations peak in 2016 when over 400km are required before declining gradually to 2025 when currently announced installations are complete. With many Round 3 zones using HVDC, much of the demand comes from Round 2 and STW projects.

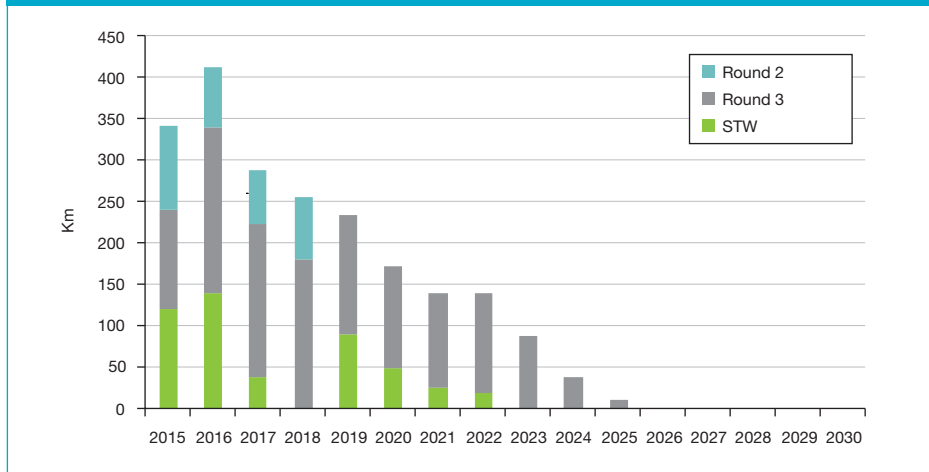
Potential requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements. Round 1 and 2.5 requirements are not included as they will be needed prior to 2015.

Figure 19: Low Added Value – Array Cable 2015-2030 by Delivery Date



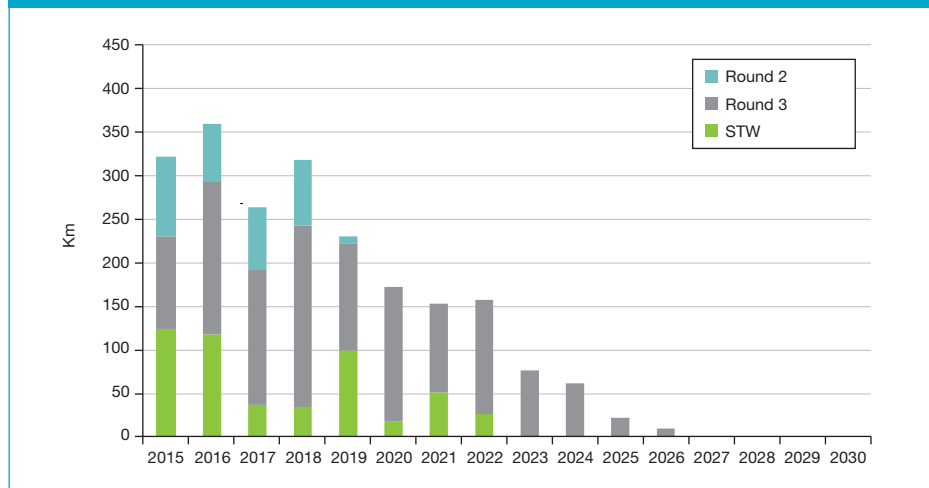
Source: Douglas-Westwood

Figure 20 : A Healthy Industry – HVAC Export Cable 2015-2030 by Delivery Date



Source: Douglas-Westwood

Figure 21: Low Added Value – HVAC Export Cable 2015-2030 by Delivery Date



Source: Douglas-Westwood

Low Added Value

HVAC export cables required

In the Low Added Value scenario, HVAC cables required grows to just over 350km per year in 2016 before annual demand begins to reduce.

Potential requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements. Round 1 and 2.5 requirements are not included as they will be needed prior to 2015.

A Healthy Industry

HVDC export cables required

Demand for HVDC export cable is expected to grow year on year to 2020 where it peaks at just below 1,000km/year. This represents major demands upon cable manufacturers. Whilst majors such as Nexans and Prysmian have been gearing up for growth in HVDC cabling, the market is expected to be tight, with few companies currently capable of producing large amounts of HVDC. Competition for capacity with interconnector cabling is also expected. Massive investment is required and it is essential there is long-term visibility in the market to allow these investments to be made. Costs for HVDC cable will be sensitive to demand and could rise sharply if new production capacity is not brought online quickly. Long lead times are to be expected.

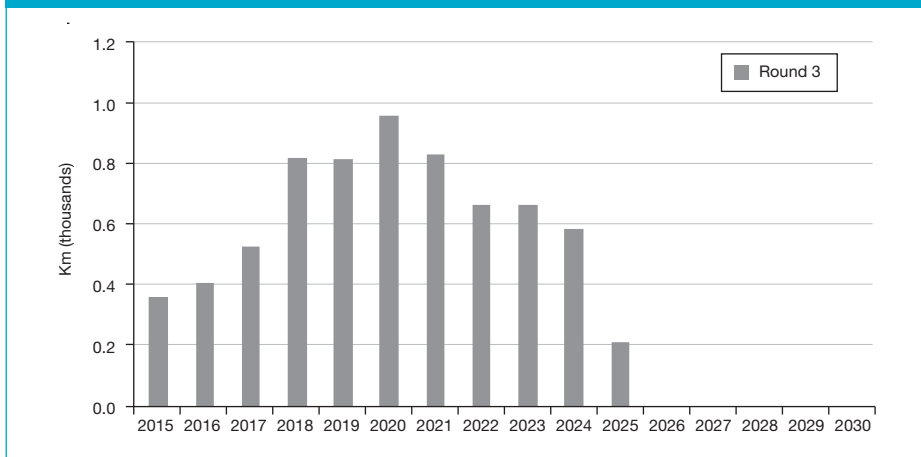
Potential requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements.

Low Added Value

HVDC export cables required

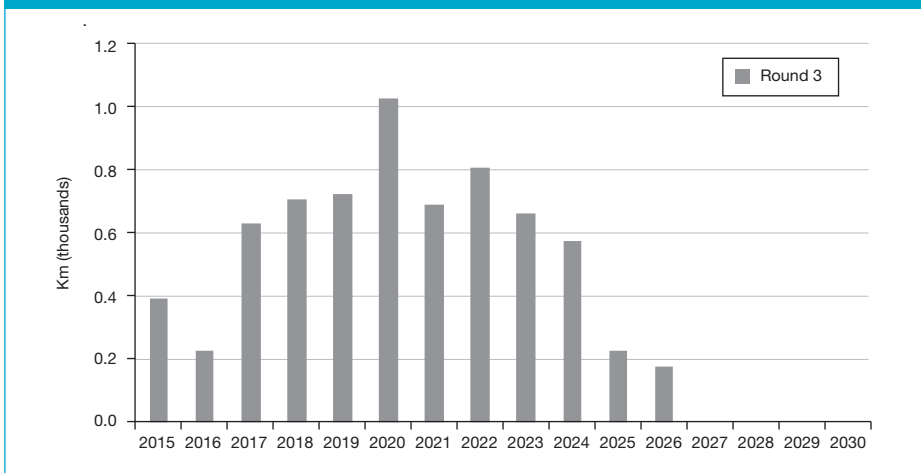
HVDC requirements are more than double that of HVAC. From 2017 to 2024 almost 600km or more of HVDC cable is required, with a peak in 2020 of over 1,000km. This represents an extremely strong market for cable manufacturers considering the currently low market demand for HVDC.

Figure 22: A Healthy Industry – HVDC Export Cable 2015-2030 by Delivery Date



Source: Douglas-Westwood

Figure 23: Low Added Value – HVDC Export Cable 2015-2030 by Delivery Date

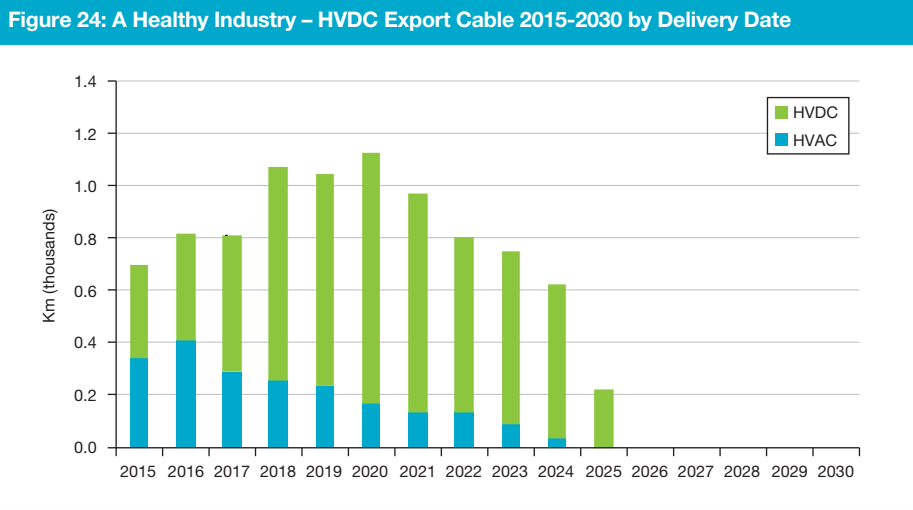


Source: Douglas-Westwood

Potential requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements.

A Healthy Industry
Export cables required

The changing nature of the export cable market is seen in Figure 24. Standard HVAC cables will see growing demand through to 2016 when just over 400km per year is required. From this point HVAC usage reduces due to increasing use of HVDC on Round 3 projects.

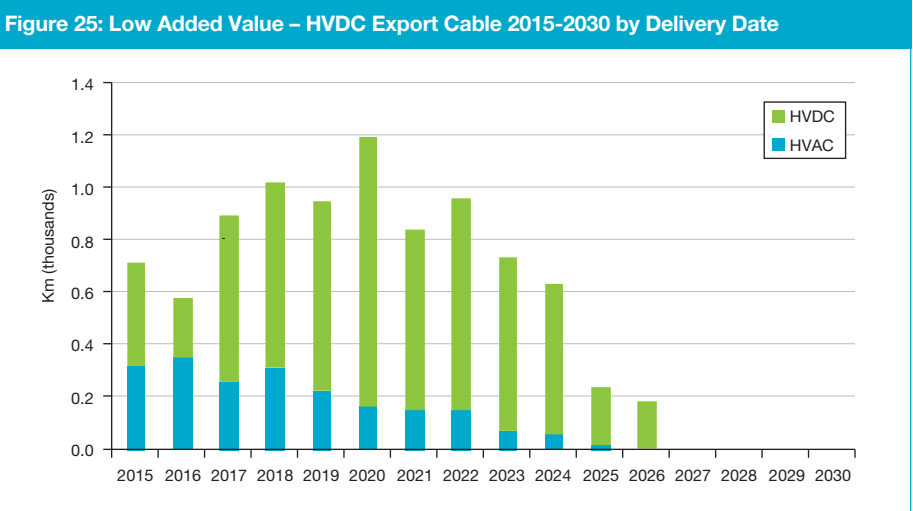


Source: Douglas-Westwood

Potential requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements. Round 1 and 2.5 requirements are not included as they will be needed prior to 2015.

Low Added Value
Export cables required

In the Low Added Value scenario, overall requirements are similar with a slightly slower ramp up in HVDC demand as seen in Figure 25.



Source: Douglas-Westwood

Potential requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements. Round 1 and 2.5 requirements are not included as they will be needed prior to 2015.

Vessels

Assumptions used

As explained in the methodology section of the report, all vessel requirements are offset from the projects' online dates to show when they will be needed.

Turbine installation

The rates used combine both industry demand for vessels capable of installing at least 100 units per year and the reality that all year round installation work will not be possible for all projects. The installation rates used in this report have been reviewed by a leading installation company.

- <5MW – current industry rates of 3.5 days per turbine or 104 turbines per vessel per year have been assumed for the period 2015–2019. Improvement is expected, through larger projects and more capable vessels, with this rate improving to 3 days (121 per year) by 2020 and 2.5 days by 2026.
- 5–6MW – an installation rate of 4 days per turbine per vessel for 5–6MW devices is assumed in the period up to 2020, with improvement expected through experience. 3.5 days per turbine (104 per year) is expected to be reached by 2020.
- >6MW – a rate of 5 days per turbine (73 per year) has been used initially, with 4.5 days and 4 days assumed by 2017 and 2020 respectively. This slower rate is due to size and implications on vessel capability. However, improvements are expected, e.g. “one-lift” installations.

Foundation installation

The rates used combine both industry demand for vessels capable of installing at least 100 units per year and the reality that all year round installation work will not be possible for all projects. The installation rates developed for this report have been reviewed by a leading installation company.

- Monopile – an assumed rate of 3.5 days per monopile (104 foundations per vessel per year) for the period

2015–2019 has been used based on project experience to date.

Improvements are expected through economies of scale and increased vessel capability with 3 days (121 per year) achieved by 2020. This level is maintained through to 2030.

- Jacket – an assumed rate of 5 days per jacket (73 per vessel per year) has been used for the period 2015–2017 based on limited experience to date. Improvement is expected throughout the period with 4 days (91 per year) and 3.5 days (104 per year) per installation assumed by 2020 and 2026 respectively.

- Tripod – as with jackets, an assumed rate of 5 days per tripod (73 per year) has been used for the period 2015–2017 based on limited experience to date. Improvement is expected throughout the period with 4 days (91 per year) assumed by 2020 and 3.5 days (104 per year) by 2026.
- Other – this category allows for new foundation types: timings as with jackets/tripods.

Cable installation

- Inter-Array – it has been assumed that one cable every two days is an acceptable average for inter-array cable installation. This makes allowance for utilisation, load-out, sailing times, burial, pull-through etc. It is possible to surface lay one cable per day (12 hours) whilst simultaneous burial can take 1.5 days. Global Marine Systems provided the information regarding the installation rates for the various formats.

- Export – although 12km a day is possible (500m/hr, surface laying only) a more typical rate of 5km per day (200m/hr, ploughing) has been used in this report. These installation rates have come from both Subocean Group (ODIS Report, 2009 Appendices) and Global Marine Systems (Round 3 Offshore Wind Farm Connection Study Report, 2008). Based on installation capability, few vessels are required

to meet annual demands. Demand will be dictated more by the number of projects each year.

O&M vessels

- Operations & Maintenance – it has been assumed that one vessel per 25 turbines is required for continued maintenance requirements over projects' 20–25-year lifetimes.

A Healthy Industry

Requirements for turbine installation

Between five and ten turbine installation vessels will be required on UK projects between 2015 and 2030. Foundation installation will require seven to thirteen vessels and array cable installation three to seven. Between two and four vessels are needed for export cable lay.

It should be noted that vessel requirements are calculated using their installation capability over a year for units of turbines, foundations or cables. We have not factored in the number of projects that a vessel can work on over a single year. There is, therefore, upside potential for higher vessel demand as some vessels may have downtime between projects depending on how they are contracted. Due to the potential for construction delay, vessel operators cannot accurately plan moving straight from project to project.

Low Added Value

Requirements for turbine installation

Vessels range from two to six per year, with the peak in 2020. Three to seven foundation installation vessels will be needed; one to four cable installation vessels for array cables and one to three for export cables.

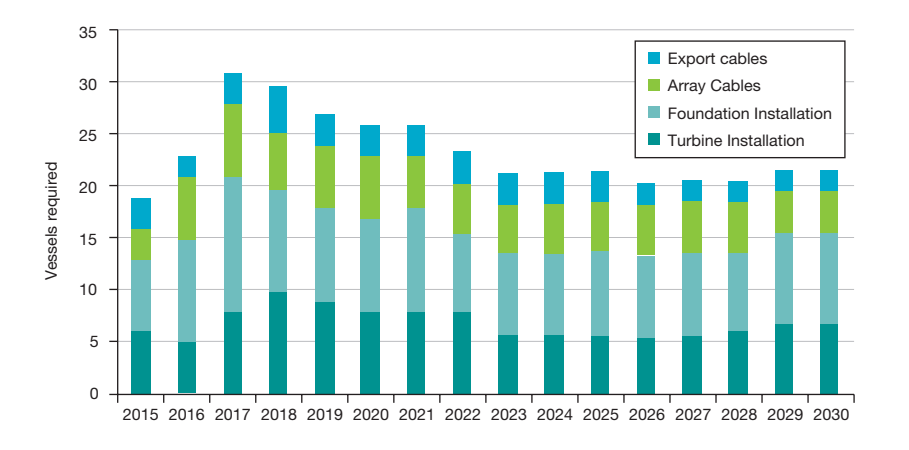
A Healthy Industry

Personnel Transfer Vessels for O&M

Figure 28 shows the new personnel transfer vessels (PTVs) that are required each year for the new capacity coming online. The assumptions used in the forecasting process allow for larger vessels being used in the future. Today, 12-person vessels are standard but many vessel providers have larger versions planned.

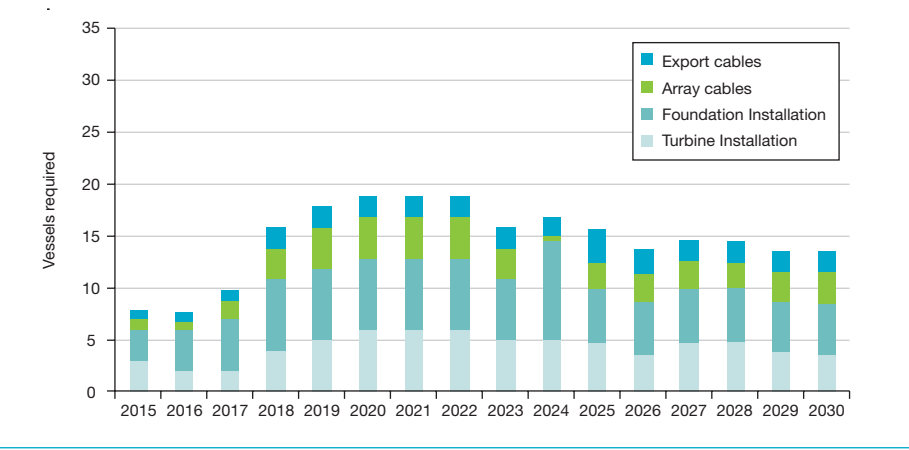
New capacity additions in 2015 require 17 new PTVs and the annual requirement quickly ramps up to 31 in 2018. Capacity expected online between 2015 and 2030 will require a total of 309 new PTVs for O&M.

Figure 26: A Healthy Industry – Installation Vessels 2015-2030 by Installation Date



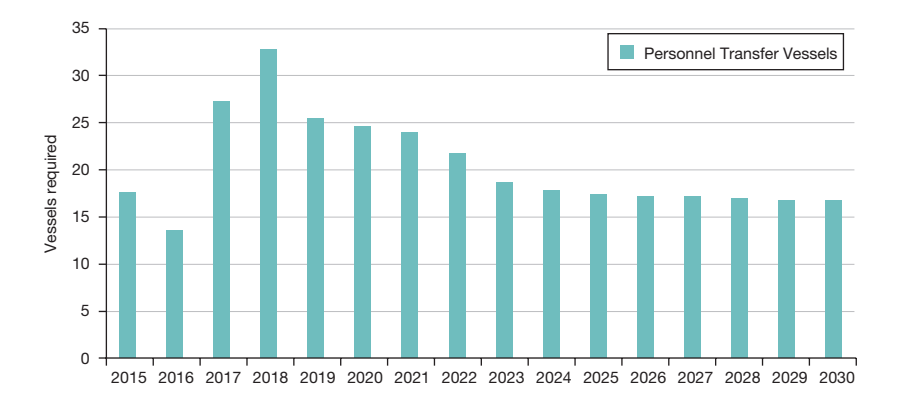
Source: Douglas-Westwood

Figure 27: Low Added Value – Installation Vessels 2015-2030 by Installation Date



Source: Douglas-Westwood

Figure 28: A Healthy Industry – Personnel Transfer Vessels for O&M



Source: Douglas-Westwood

There are many suppliers in Europe at present, with UK company Windcat Workboats being the market leader. This number of new vessels signifies a major opportunity for shipyards and boat-builders. As projects increase in size and move further from shore the use of offshore O&M and accommodation platforms/vessels are expected. The transfer of personnel to these facilities would likely be done in larger vessels than used for personnel transfer today. Smaller vessels would then transfer maintenance personnel to the turbines. The UK has a strong capability in vessel design and also in accommodation platforms/vessels from the oil & gas sector.

Low Added Value Personnel Transfer Vessels for O&M

The Low Added Value scenario requires 167 new PTVs for O&M activity, with more gradual year-on-year requirements as a function of the slower capacity delivery being achieved.

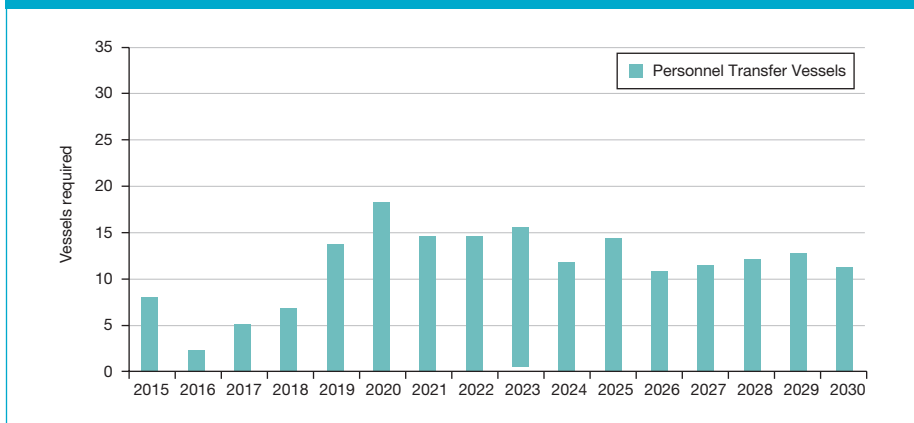
Summary of Hardware Requirements

Figure 30 shows delivery dates for these major components. The hardware delivery date requirements have been set at the year they are required on a project. The period to 2016 will be critical in ensuring sufficient production capacity can be brought online to meet project requirements and avoid lengthy lead times and upwards cost pressures.

For UK capacity installed between 2015 and 2030 almost 10,000 turbines and foundations will be required. Over 12,000km of array cabling is needed and export cable lengths are almost 9,000km. Potential export cable requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements. A major challenge for the industry will be in delivering these requirements.

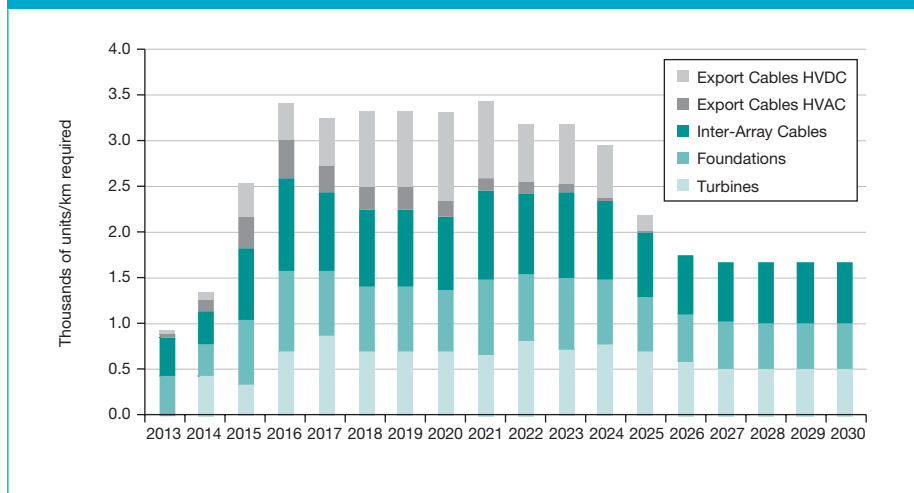
The Low Added Value Scenario will require just over 5,500 turbines and foundations between 2015 and 2030.

Figure 29: Low Added Value – Personnel Transfer Vessels for O&M



Source: Douglas-Westwood

Figure 30: A Healthy Industry – Hardware Requirements 2015-2030 by Delivery Date



Source: Douglas-Westwood

Approximately 7,000km of array cabling and almost 9,000km of export cable length will be required. Potential export cable requirements from post-Round 3 capacity have not been added, as it is not possible to speculate on distances to shore and export requirements.

Although the slower delivery curve will ease the scaling up of capacity that is required, for the UK, the much lower rate of delivery makes it more difficult to support multiple turbine manufacturers and will limit the extent to which the UK supply chain can develop.

Factory Requirements

Assumptions used

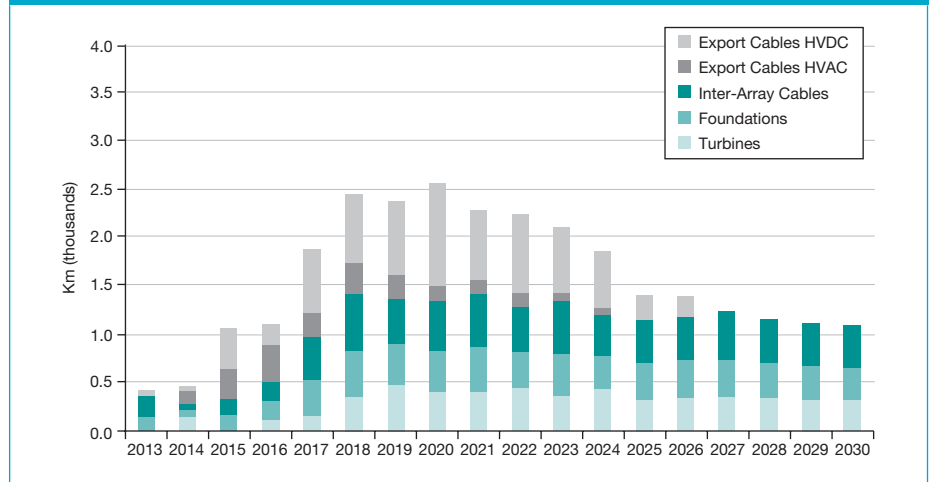
This section shows the indicative number of factories that are needed to produce the identified component requirements.

Assumptions have been made for the production capacity of each factory. These are broad indicative assumptions given the wide range of capability that different factories can have. It should be recognised that opportunities exist for companies to establish in the UK with a lower production capacity than these numbers. The production capacity figures used are:

- Turbine plant: 180 units per year;
- Foundation plant: 180 units per year;
- Array cables: 200km per year; and
- Export cables: 300km per year.

- The charts presented show the investment decision dates necessary to ensure factories are producing components in time to supply projects. These dates are based upon the hardware requirement dates as follows:
- Turbine plant: 3 years before turbines required;
- Foundation plant: 2 years before foundations required;
- Array cables: 2 years before cables required; and
- Export cables: 2 years before cables required.

Figure 31: Low Added Value – Hardware Requirements 2015-2030 by Delivery Date



Source: Douglas-Westwood

A Healthy Industry

Figure 32 shows the investment decision date for the factories. It should also be noted that no capacity before 2015 is accounted for here.

In the Healthy Industry scenario, 22 factory “equivalents” will be required for turbines, foundations and cables for UK offshore wind farms.

Capacity coming online in 2015 requires factories to be signed off by 2011. Decisions on at least three turbine plants must be made by 2011 and five plants are required by 2014 to support the large increase in activity that happens when the first Round 3 projects move into construction. At least five factories are required between then and 2023 for turbine production.

Using the same production capacity assumptions for foundations means the requirements here are the same as for turbines. Cabling requirements mean that up to six cable plants will be needed for array cables alone by 2014, based on present production capacities. Seven export cable plants are needed in 2018 when demand peaks. The requirement for HVDC capability is significant – by 2018, six of the cable plants need to be producing this type of cable.

Given the relatively early peak in factory production capacity it is important that any factories established in the UK are then able to take advantage of the wider European export market.

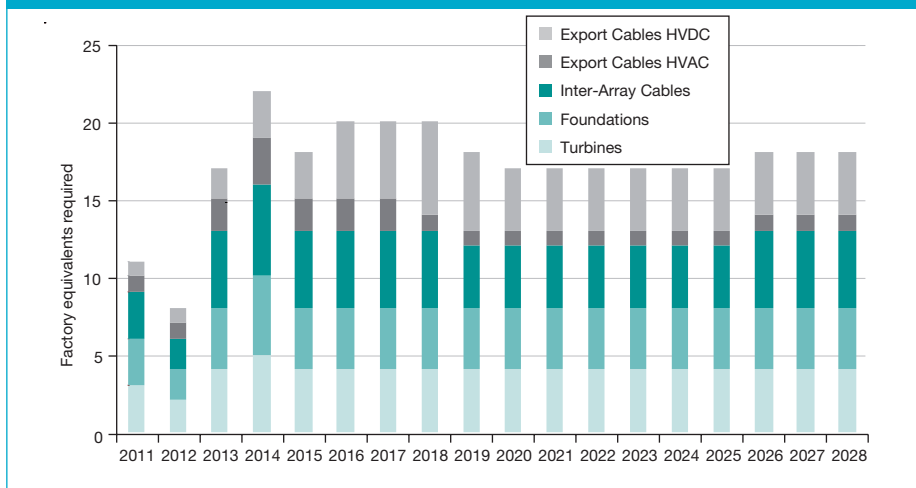
It should be noted that export cable factory requirements for 2023–2030 are extended from 2022’s requirements given the project-based methodology used for forecasting export cable lengths (e.g. no details of project cable specifications beyond Round 3).

Cost of factories

Based on costs of recent comparable plants we have estimated the total construction cost for the indicative new factories that will be required for these major components.

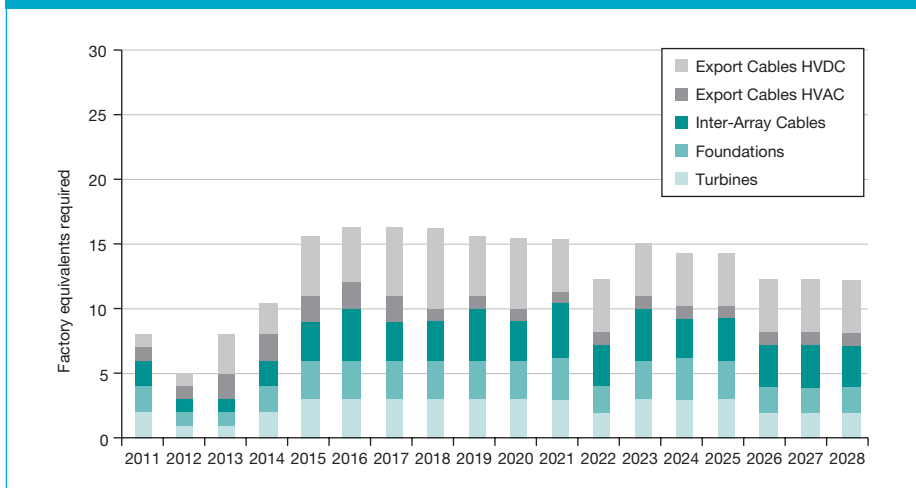
In total, five turbine plants, five foundation plants, six array cable plants

Figure 32: A Healthy Industry – Indicative Factory Requirements 2015–2030 by Investment Decision Date



Source: Douglas-Westwood

Figure 33: Low Added Value – Indicative Factory Requirements 2015–2030 by Investment Decision Date



Source: Douglas-Westwood

and seven export cable plants will be required to build the UK's 2015–2030 offshore wind capacity. It should be noted that these are only indicative plant requirement totals and that it is likely that plant capacity will vary between manufacturers. This is estimated to require capital expenditure of £1 billion.

Low Added Value

Requirements in the Low Added Value (figure 33) scenario are much lower. Whilst four turbine plants (or a larger number of smaller plants) are ultimately required, only decisions on two are required in the period from 2015 and three from 2020. This leaves little room for additional UK facilities – the 2GW to 2.8GW installation rate per year makes it difficult for the establishment of multiple UK plants.

Without the higher early requirement as per the Healthy Industry scenario there is concern that major manufacturers may not choose to establish within the UK initially.

It should be noted that export cable factory requirements for 2023–2030 are extended from 2022's requirements given the project-based methodology used for forecasting export cable lengths (e.g. no details of project cable specifications beyond Round 3).

The risk in the Low Added Value scenario is that the UK misses out on supply chain development, with manufacturers choosing to locate or expand facilities in continental Europe. Figure 6 on page 6 shows the anticipated development of the wider European market. Manufacturers may choose to focus on the Continent, where a strong market is building and where existing supply chains for the wind industry are already located.

Cost of factories

Based on costs of recent comparable plants we have estimated the total construction cost for the indicative new factories that will be required for these major components.

In total, four turbine plants, four foundation plants, five array cable

plants and six export cable plants will be required to build the UK's 2015–2030 offshore wind capacity. This is estimated to require capital expenditure of £705 million.

Factory requirements in the Aggregated Developer Appetite profile

If the Aggregated Developer Appetite build profile is to be realised, rapid decisions need to be made on new production facilities. By 2015, investment decisions will need to have been made on eight turbine plants, eight foundation plants and nine cable plants (for array cables alone) to meet the requirements of UK offshore wind projects. This would represent major industrial development in a very short time and lead to high levels of domestic content on projects. Having scaled up quickly for the massive demand of the domestic market, the supply chain would then depend on future UK rounds being announced in time for investment decisions to be made as well as growth in the wider European export market.

This large-scale industrialisation will require massive investment. The turbine plants alone will cost an estimated £720 million and foundation plants £200 million.

“The risk in the Low Added Value scenario is that the UK misses out on supply chain development, with manufacturers choosing to locate or expand facilities in continental Europe.”

Policy Requirements

Introduction

The commitment in the last few months from a number of turbine manufacturers to the UK clearly indicates the confidence they have in the market. Clipper Windpower, Mitsubishi, GE and Siemens have all committed themselves to the UK, with Repower and Bard also hinting at some future UK capacity. The progression over the last twelve months will mark a major change from the past, in which UK projects had very little UK content.

It is clear that the UK now has a tremendous opportunity to build a world-leading supply chain to service the huge domestic market and export to the burgeoning European markets and beyond.

There are, however, many challenges to overcome to ensure a healthy market and a strong domestic supply chain.

Despite the current financial challenges facing the Coalition Government, some spending commitments are necessary now (such as the £60m ports/infrastructure competition used to attract turbine manufacturers such as Siemens and GE to the UK) to start to attract the £1 billion of private investment suggested by this report, which will be required from 2011 onwards to build the main plants required in the Healthy

Industry scenario.

Further analysis, by industry or government, is necessary to put a value on the level of investment that is required from government, in areas such as planning, skills and training, research, design and demonstration, to achieve a healthy industry.

Ensuring Long-Term Government Commitment

Whilst it is unlikely that the new Coalition Government will reverse policy towards offshore wind, it is important that the support for the sector is strongly reaffirmed as a major contributor to the UK's future power generation mix.

Initial energy policy indications from the Coalition are supportive of renewable energy, with plans to increase the targets for energy from renewable sources, create a green investment bank, deliver an offshore electricity grid to support the development of offshore wind power and give an annual energy statement to Parliament to set strategic energy policy and guide investment.

The most recent increase to the level of Renewable Obligation Certificates (ROCs) was crucial to the industry, as

“Once draft scenarios and assumptions were complete, these were tested at RenewableUK group strategy sessions and on a one-to-one basis with industry.”

it enabled Round 2 developers to gain the financial support required to go ahead with these projects. The need for increased support was due to the rising costs in the offshore sector that have been driven by a lack of competition in the supply chain, a rise in the steel price and a fall in the value of sterling, which in itself had a huge effect on project costs.

The view amongst developers is that the current 2 ROC level needs to be maintained until the industry starts to see cost reductions. Fluctuations to market mechanisms can increase uncertainty amongst investors who must assess the long-term potential for a project. Therefore, a decision over the future level of ROCs, currently due to reduce to 1.5 after 2014, is needed within the next year to help the industry start construction of new projects and for investor confidence required for building up the supply chain.

It is likely that costs will increase or at least remain high during the initial stages of Round 3 projects, due a combination of factors such as increased project size, distance from shore and water depth. Increased competition in the supply chain will help to reduce costs, but for this to be achieved a consistent build programme is required. Further cost reductions will be realised through innovation in product designs, material selection, some standardisation and efficiency in manufacturing. For example, Bruntisland Fabrication and Atkins have produced a new offshore jacket foundation and transition piece combination that is said to cut manufacturing costs by up to 40%. The Carbon Trust's Wind Accelerator programme is another example of industry working together to reduce costs through innovation.

However, at present, 2 ROCs are required by the developer to start building, which in turn will help increase competition by attracting new suppliers to market. It should also be noted that developers understand that, as a supported industry, the reduction of the current support mechanism should begin when there is downward pressure on costs. To make sure this happens openness is required from the industry about where costs are heading.

“ The UK sector is already fairly well provided for. The 2 ROCs have given the supplier confidence to invest in manufacturing capacity. However, in the longer term, when the 2 ROCs expire in 2014 uncertainty may prevail again.”

Utility

“2 ROCs are required in the current market, with reductions coming when costs are reduced. But we need to know what is happening with them by 2011 not 2012/13, so capacity can be brought online in the supply chain. We will see cost reductions through 3–4 years of consistent building.”

Utility

The new Coalition Government has agreed to the establishment of Feed-in Tariff systems for electricity, as well as the maintenance of branded ROCs according to the Coalition's programme for government document. The decision over retaining the RO or replacing it with a FiT is still to be decided. The message from industry to the new Government is that changing the support mechanism for offshore wind from the RO to a FiT could be detrimental to the progress of Round

“A Feed-in Tariff would be okay, but it needs to be implemented quickly, as uncertainty will have an adverse effect on the sector.”

Utility

“Investor confidence is critical, so any changes need to be made quickly. Then leave them alone for at least five years.”

Utility

3 developments, as this comes at a crucial time for investment in projects. Clarification on the support mechanism for offshore wind will need to be made quickly to minimise disruption and to ensure investor confidence is not lost.

Government and industry needs to set an agreed installed capacity target for the UK. Currently, there are no official targets for renewable energy beyond 2020 and many people in the industry believe this needs to be addressed with a 2030 target. The new Government has stated that it will seek to increase the target for energy from renewable sources, subject to the advice of the Climate Change Committee.

The development of future targets also raises the question of what comes next. As the scenarios show, further capacity additions will be required from 2023 to ensure momentum in the supply chain is continued. While there is the possibility that repowering will begin towards the end of the Round 3 build programme, the planning for a Round 4 needs to begin by 2015, so that the planning processes (which will include a strategic environmental assessment) are complete

“Need to think about a Round 4 when Round 3 construction is underway so that the process is complete prior to the end of Round 3.”

Utility

before the end of Round 3. The Crown Estate has made indications of the potential for a Round 4 but at the time of publishing no dates or figures have been released.

Another possibility that was raised during industry consultation is a Round 3.5, which could take place if developers believe that areas within their current zones have extra capacity possibilities either now or in the future.

Actions required:

- The new Coalition Government will need to reaffirm its support for offshore wind as part of the UK’s future power generation plans. Early indications are that offshore wind is seen as a key part of the UK’s future energy security.
- Timely clarification of the support mechanisms that will be used to help develop and maintain the sector’s growth in the future is required. The RO remains the preference of the industry.
- The new Coalition Government will need to review the support mechanism for offshore wind and be prepared to extend the current level of 2ROC/MWh. A decision on the support level post-2014 will need to be made by 2011, so investment decisions can be made by the supply chain and other stakeholders.
- If we are to change to a Feed-in Tariff (FiT), this needs implementing quickly and effectively to avoid a stall in the market.
- Targets for installed capacity need to be agreed by government and industry working together. The Government has indicated that it

wishes to increase these targets subject to advice from the Climate Change Committee.

- Clarity post-2020 – the next Government needs to set targets beyond 2020 for the offshore wind industry, which should include plans for either a Round 3.5 and/or a Round 4.

Ensuring Sufficient Resourcing and Support during Planning

The assessment of new offshore wind farms will be carried out by the Infrastructure Planning Commission (IPC), which has been created to streamline the planning regime to enable nationally significant infrastructure projects (NSIPs) to be assessed in a quick and fair manner. Before the IPC there were eight consenting regimes for NSIPs, which took a minimum of 100 weeks to provide a decision. Now decisions are reached within a year, which has reduced the length of uncertainty on major projects. However, the huge increase in offshore wind and other energy projects means that bodies, such as the IPC, involved in the planning process will need to be properly funded and resourced, so the assessment processes required for these projects can be completed in good time and without delay.

The IPC, which was launched at the beginning of the year, is to be replaced by a Major Infrastructure Unit as part of a revised Department for Communities and Local Government structure that includes the Planning Inspectorate. This will mean that final decisions on nationally important infrastructure would be made by the relevant Secretaries of State. The new measures are expected to be introduced later this year in a Decentralisation and Localism Bill, and are likely to become law in 2011. In the meantime, the IPC have stressed that the existing process will continue without delays to applications and that they will ensure a seamless transfer to the new arrangements. The concern in

the industry is what effect this will have on project timescales.

The scale of the offshore wind sector will affect other maritime sectors that are also competing for use of the seabed – oil & gas, fisheries, shipping, Ministry of Defence and conservation. The Marine

“The planning regime needs proper resourcing to make sure projects, applications, etc are processed on time.”

Utility

“The scale of planning will affect other maritime sectors and if the Government is not strong about its policy on the sector timescales could slip. Tough decisions will need to be made to ensure these wind farms are built on time.”

Utility

and Coastal Access Act has been set up to consider all marine interests, and has established areas of development and environmental protection. It has been suggested that any assessment of offshore wind should consider the wider implications of the UK’s renewable energy targets.

Actions required:

- Sufficient funding from government will be required to make sure bodies involved in assessing offshore applications are adequately resourced to carry out their work without delay.

- Offshore wind farms are pivotal to the UK's ability to meet its renewable energy targets, and therefore the designation of marine conservation zones should take this into account when making assessments over seabed usage.

Ensuring Continuing Finance

The financial community has become more comfortable with offshore wind, with most projects built over the last three years having required pre-construction financing. Project financing is also increasing in use. The development of the industry will continue to require large amounts of private investment. Round 3 alone could cost in excess of £100 billion to build.

The difference with Round 3 is the successive nature of the phased development of zones. Several developers have stated the likely need to refinance phases as they are built in order to build successive phases.

Investment banks and private equity need to have long-term vision and confidence in the industry, whether for project financing or for investment into supply chain companies. This can be fostered through commitment to long-term offshore wind targets and market mechanisms. If Government feels it must switch to a FiT, then this must be done swiftly and transparently or it will lead to difficulty raising finance. There is already uncertainty in the investment community over this.

The Coalition Government's response has been to support the creation of a green bank to help fund the industry alongside the private sector and institutes such as the EIB. Parallel investment by a green bank should add confidence to private investment. The Coalition has stated that it "will create green financial products to provide individuals with opportunities to invest in the infrastructure needed to support the new green economy". The European Investment Bank's

involvement in offshore wind has been critical to projects going ahead. The EIB is actively supporting European RD&D projects as part of the EU's objective of building the world's leading knowledge-based economy and has financed some 16 wind farm projects (completed), totalling some €35bn since 2000. Most recently, it approved a £1bn loan for the London Array project.

“Round 3 will cost £80–90bn. Developers cannot put this on their books. It will need a fundamental change in approach towards the equity markets, and institutes such as the EIB.”

Utility

Actions required:

- A strong and stable policy is the most important factor in inducing banks and institutional investors to direct the flows of finance required into the sector.
- A green bank has been proposed to help accelerate private sector investment in low-carbon projects.
- The bank must be well designed and implemented to ensure that it does not compete with existing investment banks and private equity.
- It should invest alongside private capital and be targeted to only address areas in which the market has failed to drive sufficient investment.
- It should advise government on the financial impact of policy changes.

Ensuring Grid Infrastructure

In the UK, grid connection and availability has long been one of the offshore wind industry's most recognised challenges and will become increasingly prominent as the industry plans to

install over 40GW of new offshore wind capacity. The process of connecting these large wind farms to the grid will require significant new investment in both offshore and onshore transmission infrastructure.

The regulator, Ofgem, introduced the Offshore Transmission Operators (OFTO) regime last year as a way to encourage new investment to help share some of the costs (estimated to be £15 billion) of grid connections for 40GW of projects amongst multiple OFTOs.

However, industry bodies and manufacturers have all informed Ofgem that its proposals for the OFTO regime, specifically the enduring element, threaten to delay offshore wind development. To ensure that the offshore connection is built in time, developers have stated that they should be allowed to develop their own offshore transmission system before selling it on to the OFTO, which is how the current transitional element of the regime works and how all offshore generation and transmission has been built to date.

National Grid, as the GB System Operator, has been given the role of coordination by Ofgem and has published the ODIS as part of that coordination.

National Grid owns the electricity transmission network in England and Wales, and operates the entire transmission system throughout Great Britain. It is, therefore, responsible for reinforcing the onshore grid network to accommodate offshore wind farms, providing them with access to market. Each project must go through a grid connection application process, which

“Clarity/repeal/ reform of OFTO would be a great boost.”

Transmission & Distribution Company

“Developers should be allowed to develop their own offshore transmission system before selling it to the OFTO. This method will ensure that the project gets its offshore connection built.”

Utility

is initiated by the developer submitting an application to NGET. NGET will then make an offer (connection date) to the developer, who has three months to accept, reject or refer to Ofgem.

The regulator, Ofgem, has come under some criticism from industry for its pessimistic approach to approving finance for transmission reinforcements at a time when the network needs to be developed quickly. The recommendations from the Electricity Networks Strategy Group (ENSG) on what is required to upgrade the grid to accommodate a large increase in renewable energy, need to be expatiated by the regulator, given the scale and speed of change required. Even with the introduction of the IPC, it is estimated that a new overhead line and/or an onshore substation could take at least seven years from approval to connection.

Ofgem responded to the ENSG report in April 2009 by approving up to £12.5 million (outside the current TPCR) for NGET to begin feasibility studies and preparatory work. In January 2010 the regulator then approved additional funding of up to £1 billion for construction work on specific projects. Further investment will be funded through the next TPCR, due to begin in April 2013. In evidence to the House of Commons, Ofgem acknowledged that it was adopting a new approach that entailed making a judgement on the

level of “stranded asset” cost that was reasonable for consumers to incur, which represents “a fundamental philosophical shift” in its regulation of network investment. At present the contracted position (which is updated constantly to reflect signed connection offers and any project withdrawals, delays, etc.) for offshore wind projects is approximately 11GW by 2020, according to the Seven Year Statement – published annually and updated periodically throughout the year. Whilst the contracted position is currently some way off the scenarios in this report, this is expected to change significantly in the next few years when a number of Round 3 connection applications are completed.

The Offshore Development Information Statement (ODIS) is published annually by NGET, with the latest version being the 2009 Statement. An industry consultation (which closed in May 2010) asked for comment on which scenarios should be utilised in the 2010 Statement. The consultation document put forward four potential scenarios for inclusion in the 2010 statement. This would have been a good opportunity for the industry to suggest the use of the Healthy Industry scenario in the next ODIS, which would then encourage NGET to raise its working assumptions used for planning and initial research into reinforcement

It has been argued by some that the National Grid’s current charging methodology is based on traditional forms of power generation (fossil-fired or nuclear generation), and that this system is charging wind generators disproportionately more than conventional generators for grid usage through a combination of local and capacity-based charging.

The locational element was designed to encourage generators and developers to work within existing network capabilities and locate nearer to the source of demand. However, this means offshore wind owners in particular are penalised for the location of their wind farms.

Generators are currently charged according to their capacity; however,

wind generation, which is variable by nature, has a capacity factor of around 30–40%, which means they are paying for capacity they are not using. Wind generators would pay significantly less if a volume (energy-based) charging methodology were adopted.

A review of the charging methodology is required to ensure renewable energy generators are not being charged unfairly for using the network.

The combination of Ofgem and DECC’s proposed OFTO enduring regime, Ofgem’s risk-averse approach to network reinforcements for wind farms and the ability of the supply chain to provide both onshore and offshore grid markets are major concerns to the industry.

The Coalition Government has stated that it will deliver an offshore electricity grid, reform the energy markets to deliver security of supply and investment in low-carbon energy, review the role of Ofgem, instruct Ofgem to establish a security guarantee of energy supplies and deliver an annual energy statement to Parliament to set strategic energy policy and guide investment.

Actions required:

- Wind farm developers should be given the option to design and construct their own grid connections before transferring them to an OFTO.
- The assessment of projects on an individual basis, for fear of stranded assets, rather than as part of a wider renewable network, needs to be reviewed. This has been criticised by the sector for delaying investment decisions at a time when the network needs to accelerate to meet the needs of current and future rounds.
- There must be strong incentives for the onshore Transmission Owners (National Grid, Scottish Power, and Scottish and Southern Energy) to commence detailed planning and long lead time construction works for onshore upgrades in advance of user commitment. Recent moves in this direction by Ofgem are welcome but need to go further.

- A review of the charging methodology is required to ensure renewable energy suppliers are not being charged unfairly for using the network. Under the current system wind generators and offshore wind generators in particular are charged disproportionately more than conventional generators for grid usage, through a combination of local and capacity charging.

Port Development

The role of UK ports in the offshore wind sector has, to date, been confined to construction and O&M projects. The majority of UK wind farms to date have been built using UK ports, but recent examples have also included build from continental Europe. A current example is Thanet Wind Farm, off the east coast of Kent, which is being built out of Dunkirk. The proximity of ports in France, Belgium and The Netherlands to UK Round 3 zones makes them viable construction bases, especially with so much of the supply chain concentrated in Germany and Denmark (components can be transported by barge to these ports). A number of these ports – Esbjerg, Bremerhaven and Cuxhaven – have also been marketing themselves to the sector.

UK port owners have been reluctant to invest until Round 3 timescales have been clarified and possible manufacturers have made location decisions regarding new facilities. To accelerate this process, DECC used a £60m port competition (from the Department of Business, Innovation and Skills) to attract turbine manufacturers to a port location in the UK.

Siemens and GE have both responded to this competition with plans to establish manufacturing facilities in the UK. Once the locations have been finalised, some incentives should be made available to ensure the supply chain clusters around these coastal manufacturing hubs for offshore wind. Further funding at a similar level is likely to be required to help other entrants in the future, who are looking to set up facilities at coastal locations in the UK. There will also be the need for

port locations that can be used for construction and O&M in areas with good proximity to the various zones. One issue that was raised during the consultation process was the huge number of substations that will be needed for Round 3 projects. The offshore grid network is estimated to require a minimum of 75 offshore substations (according to the ODIS report), which could be built in other port locations that have traditionally supported the oil & gas sector. This is a real opportunity for the UK's manufacturing sector.

Actions required:

- Government needs to accelerate the identification and selection of the regional ports that will become manufacturing hubs for offshore wind. A focused approach has been advocated, whereby three or four key ports are selected for targeted investment.
- Decisions over which ports will receive funding from the £60m pledged in the March 2010 budget need to be expedited and further funding should be made available for ports looking to develop other facilities for the sector. No cuts should be made to the £60m pledged during the current spending review.
- Incentives are required to ensure supply chain companies cluster around key port areas e.g. Marine Energy Parks or similar.

Supply Chain Development

The lack of a UK offshore wind supply chain was compounded when 90% of the £1.75 billion-worth of contracts for the London Array wind farm went to companies outside of Britain. However, it is hoped that now a number of offshore wind turbine suppliers (Clipper, GE and Siemens) have committed to building manufacturing facilities in the UK, a world-leading supply chain can be built to service the huge domestic market and beyond. With three turbine manufacturers committed and a further three or four possible in the future, it is expected that the component suppliers

to these companies will set up in the UK and develop local content. Again, some support will probably be required to help locate these companies in the proposed manufacturing hubs.

While the size of the UK's future offshore build programme has attracted these companies, further incentives similar to the ports competition could be required to increase the development of the UK's supply chain. The use of tax breaks for manufacturers could be tied to the Department of Business, Innovation and Skills (BIS).

Low Carbon Economic Areas (LCEAs) are required to encourage companies to set up in proposed manufacturing hubs.

“The supply chain is one of the areas that needs government support and pushing to get going and be creative. There are huge opportunities for all types of companies, from SMEs upwards.”

Developer

Specific funding is also required to help develop other areas of the supply chain, such as foundations, cables (both array and export) and substructures. Some funding has already been released to Burntisland Fabrication and Tees Alliance Group, totalling £3m. A cohesive action plan from a central body could be used to identify areas of constraint.

At a regional level the new Coalition Government are looking to replace the regional development agencies with Local Enterprise Partnerships – joint local authority–business bodies brought forward by local authorities themselves to promote local economic development. A number of RDAs have played a vital role in the development of offshore wind

in the UK and it is likely that these may be retained.

Some current funding packages are tied to employment creation, but some hi-tech/highly automated manufacturers could lose out on required assistance because of this (e.g. cable manufacturing). It can be difficult for UK manufacturers to be cost competitive in highly labour-intensive subsectors due to competition from elsewhere in Europe.

Actions required:

- Cohesive action for the supply chain from a central body is needed.
- Assistance is required to locate turbine manufacturers' supply chains where appropriate – the UK needs more high-value-added than assembly work.
- Supply chain funding for other manufacturers (such as the recent awards to Burntisland Fabrication and Tees Alliance Group) is needed.
- The use of tax breaks (corporate tax and capital allowance) for manufacturers, possibly tied to BIS's Low Carbon Economic Area (LCEA), could be used to further stimulate private investment.

Creating a Skilled Workforce

With the UK looking to install over 40GW offshore over the next two decades there is a huge potential for the creation of domestic employment opportunities. However, the skills gap has become a key issue that needs to be addressed by the sector. The difficulties that the offshore wind sector faces are in reality a microcosm of the general chronic shortage of skills experienced by UK industry as a whole, compounded by the sheer scale of recruitment that the sector is experiencing. It is estimated that the offshore sector has the potential to create between 45,000 and 70,000 new jobs just over the course of ten years (Bain & Co, 2008, high growth scenario is ~45,000; Carbon Trust estimate is 70,000). Massive skills shortages exist at all levels, from the craft technicians through to chartered engineers. It has been widely reported that the UK simply

“The size of the market is attractive to supply chain companies. That’s the key about the UK – that it has both huge supply opportunities and end market.”

Manufacturer

does not have enough engineers, designers, scientists, physicists and mathematicians to do the job, let alone enough skilled technicians to install and connect the machinery.

The underlying cause is, in the opinion of many, that the UK education system has become unfit for the purpose of providing a suitably educated workforce for industry. This was further exasperated by the virtual collapse of apprenticeships. These issues are beginning to be addressed but will take some years to correct.

The previous Government set up a National Skills Academy for Power, a national coordination and administration hub, to work with regional clusters of training providers. Each may include power sector companies' internal training provisions and high-quality private, further education and higher education providers. But in their December 2009 report Green Jobs and Skills, the House of Commons Environmental Audit Committee said it was not nearly enough. “The evidence we have received suggests the skills gap still represents a major barrier to UK success in environmental markets”, it said. The training needs of the sector are compounded by the challenge of working in an offshore operating environment, and by the fact that the rate at which offshore businesses need to expand to meet 2020 installation targets exceeds that of the onshore industry.

In March 2010 the Department for Business, Innovation and Skills (under the Labour Government) launched the low-carbon skills consultation, which outlines plans for 3,500 co-funded apprenticeships (2,500 in advanced wind energy and 1,000 in the nuclear energy sector). It also outlines a range of existing initiatives that could be tailored to boost the supply of low-carbon skills, such as schemes to promote uptake of science, technology, engineering and maths courses, the recent unveiling of the new Power Academy in the Midlands and plans to launch an adult advancement and careers service.

However, the effectiveness of these initiatives has been restricted in the past by a disjointed skills and education landscape in which decision-making is fragmented. Regional initiatives are valuable but need to be linked to a national plan or strategy, which currently does not exist. Bureaucratic hurdles and the complexities of the funding system are creating barriers to key skills gaps being addressed, particularly at the vocational training level. Funding cuts for the higher education sector are also posing a new threat to engineering departments and post-doctoral training institutions in the UK – this is of great concern for the immediate supply of professional engineers and technical specialists to industry.

On the other hand companies are becoming increasingly proactive in addressing the industry's own skills needs, with more and more businesses investing in nurturing the development of new recruits through apprenticeships and graduate schemes. For example, Burntisland Fabrication introduced an apprenticeship scheme in 2007 and currently has 36 apprentices. According to the Bain & Co. report (2008), “between 10,000 and 20,000 construction, installation and O&M staff will be needed to support the British wind energy industry by 2020”. The report identifies a serious gap in skills in the UK, predominantly at the project management, electrical engineer and technician levels. To address the shortage of large-scale wind turbine

service technicians, companies in the O&M arena have joined forces to establish a competency benchmark for vocational training through the RenewableUK's Renewable Energy Apprenticeships Programme Group. Energy and Utility Skills and City & Guilds have worked with industry to develop the Electrical Engineering, Wind Turbine O&M Qualifications and Apprenticeship frameworks to support new entrants to the sector and provide an upskilling and reskilling pathway for the benefit of industry as a whole. The first cohort of Siemens Wind Power UK and Repower UK wind turbine service technician apprentices will be starting the course in the autumn of 2010 at Carnegie College in Scotland.

In the Northeast, NaREC provides an environment for training providers to deliver and develop new courses that equip personnel for safe working offshore. A collaborative training partnership with Northumberland College, NaREC and Mainstream Renewable Power, backed by Regional Development Agency One North East, installed a new 27m-high training facility, the country's first wind turbine training tower, in Blyth, Northumberland, as the next step in the development of a UK Centre for Wind Technician Skills. It is an open access facility, designed to allow education and training providers to deliver academic and industrial training programmes for technicians working in the wind industry and at height, both onshore and offshore.

The development of common Health & Safety training standards for the renewable energy industry is critical with so many people required to work offshore. Until recently, a leading Oil & Gas Academy had administered on behalf of RenewableUK its Health & Safety training standards and approvals. In January 2010, RenewableUK assumed full control of the standards and approvals protocols, and in conjunction with the Health & Safety training sub-group is now further developing a Health & Safety training framework comparable to the training and systems currently in use in industries such as oil & gas and construction. The Health &

Safety training sub-group is made up of industry stakeholders, and as such it is industry consensus that drives the Health & Safety standards.

As well as producing the revised guidelines for Health & Safety in both the wind energy and marine energy industries in October 2008, in conjunction with the Health & Safety Executive (HSE), RenewableUK-approved training standards for working at height, and rescue and arine safety training have been developed through consultation with the renewable industry.

It is clear that in order to close this gap a national approach is required, with consultation with industry over its needs and a funding system that will enable investment in people now for the future. But how will the skills gap be managed in the short term?

Actions required:

- A new national skills strategy is required by the Government in light of the House of Commons Audit Committee report of December 2009.
- This strategy must prioritise the skills needed to drive the economy through the low-carbon transition.
- Greater collaboration between government, industry and learning providers is needed to deliver a cohesive approach to skills and education.
- Funding should be responsive to industry needs. Delivery of specialist industry courses should be along a centre of excellence model, open to competition from public sector providers across the UK. Industry needs to communicate regional preferences.
- To help the transfer of labour from sector to sector, a standardised approach to training is required across the renewable energy and hydrocarbon offshore industries.

Establishing a National RD&D Programme

The UK has an opportunity to become a global leader in offshore wind RD&D. The development of national wind energy RD&D programmes is seen as an important way of building a research network that has high-level expertise and information that will attract private sector investment. Countries that have established RD&D programmes with funding and a long-term view will ultimately attract the private sector. This has been demonstrated by countries such as Denmark, which has developed a strong wind supply chain that last year exported technologies valued at £5.1bn.

Suitable onshore and offshore testing sites for new components, including deep-water foundations, will enable manufacturers and wind farm developers to identify best practice approaches across the supply chain for the development, deployment and O&M of new turbine technologies. Investment in RD&D is also seen as an important factor in helping to reduce costs, something that the sector must do in the future.

In response to concerns about raising costs, the Carbon Trust and five leading international offshore wind developers launched the Offshore Wind Accelerator, a research and development initiative that aims to reduce industry costs. Most recently, they ran a competition aimed at innovative, cost effective and robust turbine foundation designs for deeper water conditions.

NaREC has the only full-scale blade testing facility in the UK, with a capability developed over the last five years, which serves the global wind supply chain and industrial research community. Working with utilities, manufacturers and technology developers, NaREC undertakes accelerated full-life testing; composite analysis; damage assessment; blade and mould integrity inspection; and lightning protection system verification for blades at the current industry average length of 45–50m.

A number of recent funding announcements will see NaREC build a new 100m blade test facility, a 100MW offshore demonstration facility and the world's largest open access offshore wind turbine drive train test rig. The investment in NaREC at both governmental and regional levels is set to create a national hub in northeast England for the development of offshore wind technologies.

The success of RD&D programmes will be enhanced by the input of key players in the offshore wind market. Participation in RD&D projects by turbine manufacturers such as Siemens, Vestas and Repower will ensure that development of offshore wind technology is incorporated quickly into current turbines. The challenge is that the majority of the major turbine manufacturers conduct their own in-house RD&D studies, which ensure that any development advantages are retained in-house to ensure a competitive edge.

Although this is understandable, there are a number of wider industry issues in which knowledge sharing and reporting of best practices benefit the wider industry. As such, it is likely to be independent research groups and governmental organisations that can mediate between the manufacturers to ensure knowledge is shared, possibly by way of joint industry programmes (JIPs).

Demonstration projects are an important stage in the development of the offshore wind sector as they are a way of bringing a wide range of domestic companies together to showcase their technologies and abilities. In 2006/07 the Beatrice Demonstrator Project installed a 5MW turbine and its jacket foundation using a one-lift technique at a water depth of some 42m. This demonstration project had a positive effect on the UK-based companies that were involved, with JDR cable systems, Burntisland Fabrication, Global Marine Systems and IHC Engineering all developing their wind businesses further after showing their abilities at this project.

The Crown Estate ran a licensing round for offshore technology demonstration sites of up to 100MW, due to be announced later in the year, while NaREC's plan to deliver a 100MW grid-connected offshore demonstration platform, with the capacity to accommodate up to 20 large-scale prototypes has just received government funding of £18.5m.

could come from both government and the European Union.

- The promotion of JIPs will ultimately benefit the sector and help reduce costs in the long term.

“We need onshore test sites on the coast (probably in ports), so turbines can be tested in high winds and with sea salt, which will replicate offshore conditions. Multiple industry players sharing data would be beneficial to the industry.”

Offshore Installation Company

Actions required:

- The development of a national wind energy RD&D programme is seen as an important way of building a research network that has a high-level expertise and knowledge base. Countries that have established RD&D programmes with funding and a long-term focus have seen major private sector growth.
- Facilities for testing and demonstration are currently not sufficient to support manufacturing in the UK.
- Government needs to fast track the development of onshore test sites for initial tests of new offshore turbines, providing early results at sites that can be readily accessed for maintenance and inspection.
- Funding will be required to support the construction of offshore demonstration wind farms, which

Oil & Gas Activity 2015–2030

UK Offshore Oil & Gas Activity

Over the next decade the offshore wind sector is likely to face competition for two main resource assets – Heavy Lift Vessels and Engineering Services – with the offshore oil & gas sector. Within the oil & gas sector the two main components of demand for heavy lift are field development activity and decommissioning.

Oil prices are at a high enough level to support conventional UKCS field developments – given the maturity of this region we expect relatively stable activity levels over the next five years.

The UK is now past peak and in the midst of declining production. Between 2000 and 2007, a total reduction of 41% oil and 22% gas reduced total output to just less than 2.7 million boe/day, from 4.2 million boe/day at the start of the period. Heightened oil prices at this time incentivised operators to maximise output and kick-start additional developments, which caused a brief growth to 2.9 million boe/day in 2008.

Although future Exploration & Production (E&P) activity will place some strain on the offshore supply chain, the key area



Source: www.alpha-ventus.de

of concern for the development of the offshore wind sector should be regarded as the decommissioning market. This is expected to see substantial activity with 1.6 million tonnes-worth of facilities due to be removed between 2010 and 2025. This volume of work will require an estimated 8,900 vessel-days (excluding potential time-saving following the introduction of single lift vessel capability).

There is substantial crossover between the offshore wind and fixed platform decommissioning markets, particularly in areas such as heavy lift and engineering services. The same vessels will be used for oil & gas decommissioning that will be used for renewable energy heavy lifts (e.g. transformer stations). The increase in heavy lift vessel activity will also require substantial support from onshore infrastructure such as ports, waste handling facilities and engineering houses.

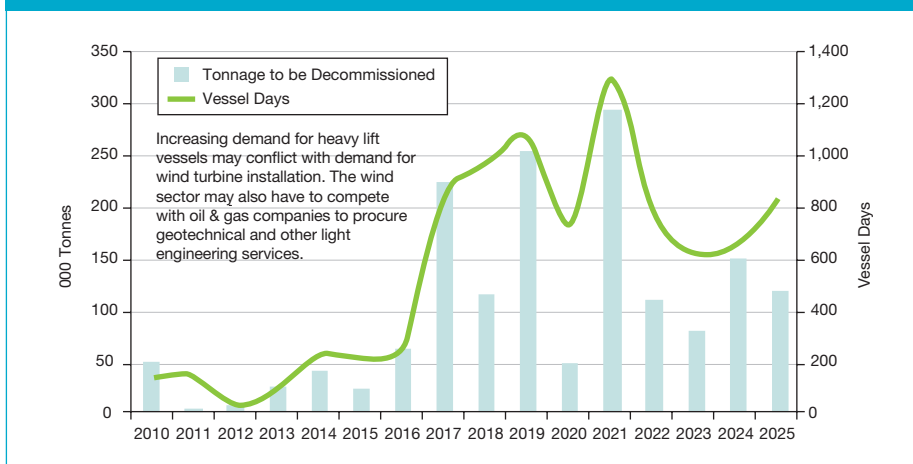
While decommissioning has started to happen now there is still uncertainty on the timing of decommissioning activity and the effect that this competition will have on the offshore wind sector. At this stage it is not clear if this will mean more or less vessels are available to the offshore wind business.

Knowledge Transfer from Oil & Gas

With over 40 years experience in the oil & gas sector, the UK has an established base of large international and national energy companies supported by a well-developed supply chain offering a wide range of operations, services and technologies.

The offshore wind sector can learn lessons from an oil & gas industry that has a diverse skill set and offers a wide range of services covering all aspects of offshore work. There are a number of synergies that the offshore wind sector has and can accrue from the oil & gas industry, such as the Health & Safety issues working in an offshore environment and adapting to

Figure 34: UKCS Decommissioning Activity 2010-2025



Source: Douglas-Westwood

new technology. Until recently (January 2010), a leading Oil & Gas Academy had administered on behalf of RenewableUK its Health & Safety training standards and approvals. The sector should continue to engage with the other industries with experience in the offshore sector including oil and gas to ensure that relevant experiences can be shared and communicated across the lifecycle of projects.

Skills present in the oil & gas sector in the UK will be crucial for the offshore wind industry and they will be highly sought after. For the offshore wind sector to attract oil & gas workers they will have to offer the high salaries that the oil & gas sector can. This may prove to be a problem, as the commercial returns are much smaller in offshore wind.

The offshore wind sector is currently repeating the mistakes witnessed during the early days of the UK offshore oil & gas sector with cost overruns, timing delays and a lack of standardisation. Commonality in the structure and practice of the sector throughout the life cycle of offshore infrastructure is something the offshore wind sector needs to embrace if it is going to keep some control over costs.

“In our sector, lots. Particularly offshore construction and seabed engineering, e.g. scour protection, installation and construction. Also offshore project management.”

Company from the Offshore Oil &
Gas Sector

Douglas-Westwood Limited

Douglas-Westwood is an independent company that carries out business research for the international energy industries. Its market analysis, surveys and forecasts are used by many of the world's major energy companies, the leading industry contractors and manufacturing companies, financial institutions and government departments. In total, DWL has clients in more than 70 countries and to date over 600 projects have been completed in oil & gas, renewable energy, conventional and nuclear power generation.

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