

Offshore Wind: At a Crossroads

A report prepared for
BWEA and Renewables East by
BVG Associates and Douglas Westwood
April 2006





Renewables East - bringing the benefit of renewable energy to the East of England

Renewables East is a not-for-profit, independent company, grant funded by the East of England Development Agency, tasked with advocating the growth of renewable energy opportunities whilst simultaneously seeking to capture economic benefit in the East of England.

The company addresses issues underpinning the Government's long-term strategic vision for a national energy policy that encompasses a response to the threat of climate change, the need to address the security of the UK's energy supplies, and the opportunities to improve our economic competitiveness by the development and deployment of renewable energy technologies to achieve a low carbon future.

Given the East of England proximity to the Thames Estuary and Greater Wash Strategic Areas Renewables East has lead the region towards making substantial investments in offshore wind, wave and tidal. A new £6m business centre beginnings construction in Lowestoft in June 2006 that will house many of the business involved and seeking involvement in renewables. Renewables East has also been tasked with a further £545k to support the growth of companies in this area. For more information please visit our website at www.renewableseast.org.uk



BWEA is the UK's largest renewable energy body with over 300 companies in membership. Formed in 1978, BWEA is leading the UK debate on the wind and marine renewables industry, acting as a central point of information for members, government and public alike. BWEA's specialist team provides members with essential market information and in-depth technical support. In addition, BWEA lobbies on behalf of its members, conducts profile raising campaigns and organises business development opportunities throughout the year, including the industry's main annual conference and exhibition.

BWEA – Championing the UK wind and marine renewables industry



BVG Associates is a technical consultancy providing expertise in the design and economics of fuel-less renewable electricity generation systems. Clients include the market leaders in the wind turbine and tidal turbine sectors. The objective of BVG Associates is to help establish fuel-less renewable electricity generation as a major, responsible and cost-effective partner in a balanced UK energy portfolio. BVG Associates partners each have almost 20 years of experience working in the wind turbine sector.



Douglas-Westwood Limited carries out business research, market modelling and analysis work for the international energy industry; clients include the world's largest energy companies, leading industry contractors and manufacturing companies, financial institutions and government departments.

Douglas-Westwood's enterprise in the renewable industry spans the whole sector, from commissioned due-diligence work, market entry and product establishment. DWL renewable energy market publications, global online databases and information provision are used by many industry majors as their primary resource on renewable energy project information.

"One of the few firms which has a professional approach to the economic aspects of the renewable energy sector"
Councillor, European Commission

Assessment of UK Offshore Wind Deliverability to 2010 and Beyond

This document provides an assessment of the capability to deliver significant offshore wind capacity into the UK energy mix under two policy scenarios. The information upon which this assessment is based was obtained during detailed consultation with developers and the supply chain. Limited information on costs was also collected and will be reported later, along with suggestions for industry cooperation to improve the cost-effectiveness of the sector. This report underlines the need for new policy initiatives to unlock the potential for offshore wind in the UK.

“Credibility is the number one ingredient in our experience as a utility player. If you go to Government and ask for support you’d better be damn sure you know how to deliver. To date as a sector we have not quite achieved that.” npower renewables.

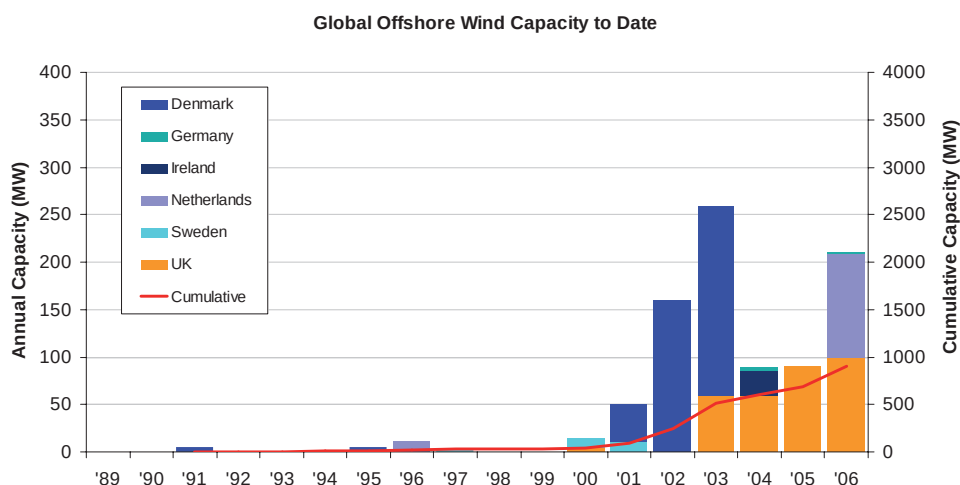
1. Offshore Wind Today

The first offshore wind project was installed in 1991 in Denmark. The first UK project in the water was the North Hoyle wind farm (60 MW), installed in 2003. Scroby Sands (60 MW) and Kentish Flats (90 MW) followed in 2004 and 2005 respectively. By the end of 2006, more than 900 MW of offshore wind will be in operation globally, all in Europe.

Today, the UK’s fourth offshore Round 1 project, Barrow (90 MW), is nearing completion and work offshore at Burbo Bank (90 MW) will start before the summer of 2006. By the end of 2006, the deeper-water Beatrice demonstration project (10 MW) is also expected to be operational. The result of consenting at Redcar is imminent and the five Round 2 consents applied for to date will be supplemented by another four applications in 2006.

Outside the UK, Egmond-aan-Zee (108 MW) off Holland should be completed in 2006 and an EPC contract has just been placed for Lillgrund (110 MW), off Sweden for completion in 2007.

The global growth of offshore wind capacity to date is presented below.



by end	1995	2000	2005	2006
GW operating	0.01	0.04	0.7	0.9 (est.)

2. At a Crossroads

Under the UK’s existing Renewables Obligation and the capital grants programme for Round One, offshore projects have been built at a rate of only one per year. The near-term future remains uncertain and in the absence of a capital grant or similar support programme for Round Two, there are no clear signs of the stable pipeline of projects that the supply chain requires to drive forward investment. In short, the economic gap between capital costs, expected operational costs and revenue for most projects remains too large for substantial industry commitment.

With the Energy Review in progress, the UK offshore wind industry is at a crossroads. Two possible outcomes of the Energy Review are considered:

Scenario 1 Continuation of current policies. No additional support is available for offshore wind. The consequence is that the current slow evolution of improving revenue would continue, but an economic gap would remain for the foreseeable future.

or

Scenario 2 **New policy impetus in 2006.** New policies emerge which result in an improved economic environment for offshore wind, sufficient to enable 'good' projects to be developed commercially.

Sections 3 and 4, present forecasts for installation of offshore wind in the UK under each of the above scenarios together with a discussion of the implications for the industry.

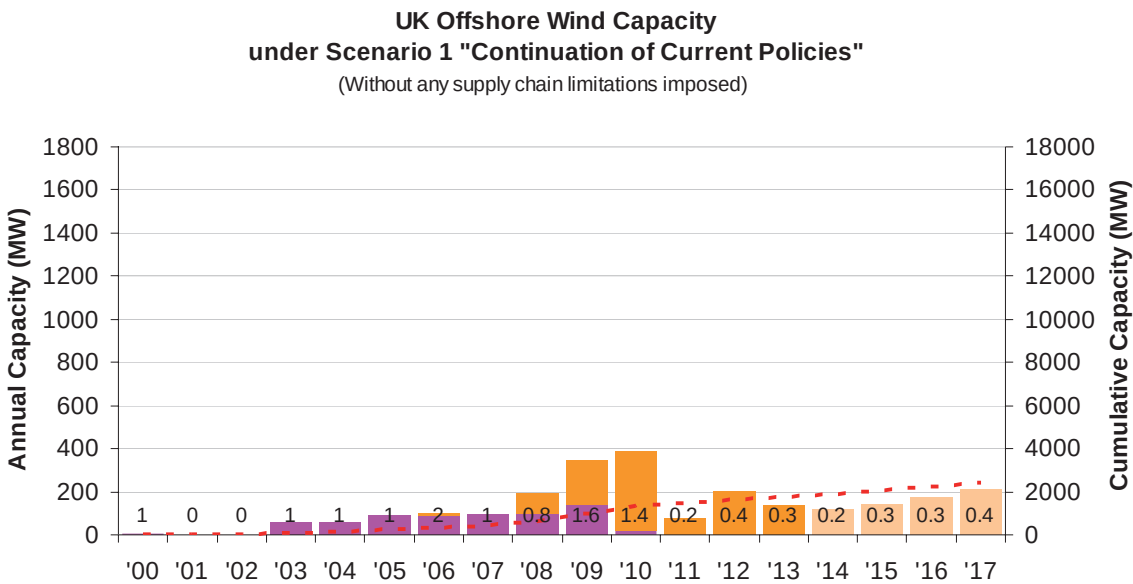
Section 5 considers supply chain capacity in the light of scenario 2.

Section 6 summarises the impact of any supply chain limitations.

3. Installation Forecast under Scenario 1 "Continuation of Current Policies"

3.1 Forecast

The aggregate forecast presented below assumes no significant change in the economics until mid-way through the next decade. It does not include the possible effects of supply chain limitations other than those assumed by the developer for each project. For an explanation of methodology used to arrive at these figures refer to Section 9.



'Continuation of Current Policies'

by end	2000	2005	2010	2015
GW operating (without any supply chain limitations imposed)	0.0	0.2	1.3	2.0

Key:

Pink bars UK offshore Round 1 projects.

Orange bars UK offshore Round 2 and other projects.

Tan bars UK offshore Round 3 and later projects. Total annual installed capacity (including Round 2) is assumed to be 100 MW in 2013, increasing by 20% per year, reflecting an eventual upturn in economic viability. Further discussion of post Round-2 licensing is provided in Section 4.

Broken red line Cumulative capacity.

Values The number of UK projects forecast to be completed per year. Note that as Round 2 and later projects come to dominate, the size of a typical project will be much greater than those installed to date.

The growth in 2008/09 is dominated by early Round 2 projects off the East Coast, coupled with installation of two further Round 1 projects.

3.2 Costs

There is a general (but not universal) consensus amongst developers that there is an economics gap equivalent to up to around 25% of installed project cost.

“No projects will run without additional support (grant) up to £0.3m/MW.” Offshore developer.

Simplistically, the economics can be split into capital expenditure, operating expenditure and revenue. Comments received regarding each of these are presented below.

Capital Expenditure:

- For onshore projects, turbine prices have risen by 10-20% in the last 2 years. These price rises have been driven by the PTC-induced activity in the US, the opening up of the Asian market and the global increased demand for wind turbines as electricity prices from wind approach those from carbon fuels.
- For offshore projects, the high cost of covering risk associated with inadequate reliability is becoming clearer, based on tough early experience from a number of (but not all) offshore wind farms. A high rate of new product introduction coupled with inadequate testing and poor build quality has led to series-faults for some turbines.
- Raw material prices are high, due to global demand driven especially by infrastructure growth in China.
- The industry is also learning from early shortcomings in specification and offshore processes which in many cases are driving up costs to more realistic levels in the short-term.
- Grid connection costs are uncertain, especially in the North West.
- At-risk upfront development costs are also proving significant.

Operational Expenditure:

- The industry is only now starting to build up a picture of the real costs of operations and maintenance.
- Operational costs for early projects have frequently exceeded original estimates, mainly as a result of unexpected levels of component failure.

Revenue:

- Developers report that they value working in a politically stable environment, with continuity of any support mechanisms. At the same time they recognize the uncertainty in future ROC prices, especially as 2015 (latest confirmed obligation) and 2027 (latest confirmed date for ROC scheme to be operating) are now very much within project lifetimes.
- Two other potential uncertainties were stated by developers. First, if legislation was to be changed to enable a higher percentage of biomass burnt in co-fired facilities to be counted as 'ROC-able', then this would have a major effect on the ROC market. Second, the effect of the utility portfolio approach to green asset development could mean a rapid switch away from offshore wind to the development a more cost effective asset or technology available near-term. Utility staff working in offshore wind now are not dedicated solely to this sector.

3.3 Supply Chain

Under Scenario 1, all parts of the current supply chain appear to have sufficient capacity to deliver. It is unclear however, whether the UK's offshore wind-specific supply chain could be sustained with generally no more than a single UK offshore project being completed each year. In addition, the offshore wind supply chain will be further threatened by the growth of competing infrastructure and oil and gas industry opportunities.

A healthy supply chain needs a stable ongoing pipeline of projects to support volume production. Without this, offshore-wind specific investment will be extremely limited. Major effects include:

- Minimal reduction in capital costs over time.
- Little or no benefit taken from economies of scale.
- Minimal development of offshore wind processes to reduce risk and operational costs.
- Limited resources (and inclination) to invest in improving cooperation and best practice within the industry.
- The best people and facilities will be focused elsewhere (oil and gas or other ROC creation).

“This scenario would not support supply chain sufficiently. It would be touch and go whether we would survive and certainly would not get the right investment to improve costs.” UK supplier.

3.4 Conclusions

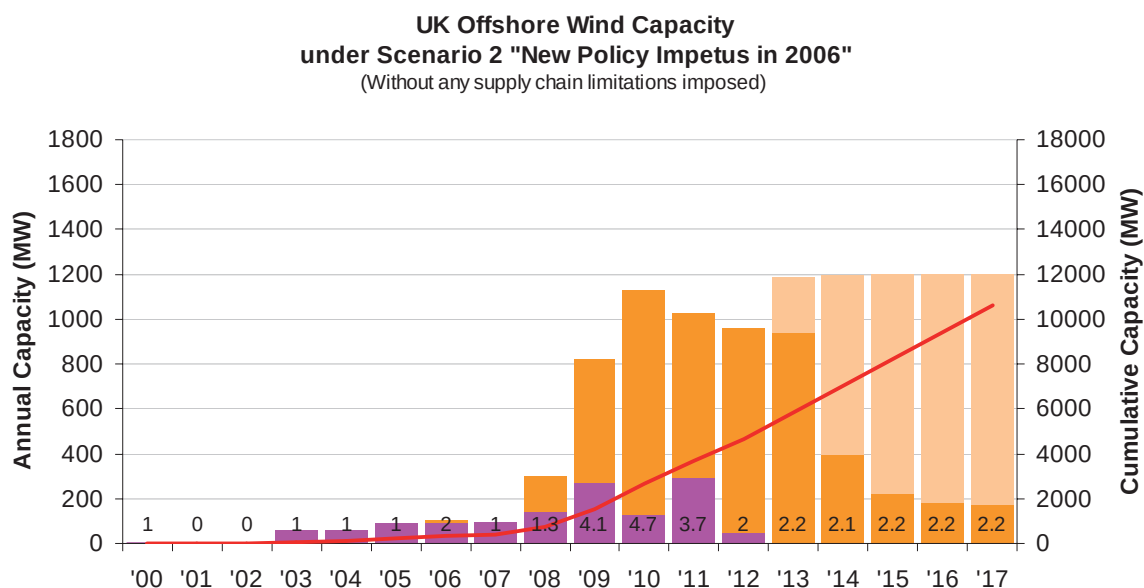
A small number of the more attractive or lower-hurdle Round 1 and Round 2 projects would be constructed. Many projects would be held post consenting until conditions improve, the value of the asset being judged higher un-built than built.

The contribution to RO targets would be low and offshore wind (and other marine renewable technologies) would not progress towards providing a significant contribution to the UK energy mix.

4. Installation Forecast under Scenario 2 “New Policy Impetus in 2006”

4.1 Forecast

The following aggregate forecast assumes that a new policy impetus in 2006 is sufficient to enable each ‘good’ project to be developed commercially. It does not include the possible effect of supply chain limitations other than that built into individual project plans by each developer.



“New Policy Impetus in 2006”

by end	2000	2005	2010	2015
GW operating (without any supply chain limitations imposed)	0.0	0.2	2.7	8.2

Key:

- Pink bars** UK offshore Round 1 projects.
- Orange bars** UK offshore Round 2 and other projects.
- Tan bars** UK offshore Round 3 and later projects. Indicative of potential future installation. Annual total (including Round 2) is assumed to remain at 1200 MW from 2013 to reflect the development of Round 3 and later projects.
- Red line** Cumulative capacity.
- Values** The number of UK projects forecast to be completed per year. Note that as Round 2 and later projects come to dominate, the size of a typical project will be much greater than those installed to date.

This forecast is not simply an optimistic view. It is a mid-forecast based on the industry response to a new policy impetus. Such an impetus may consist of a number of different mechanisms. Key mechanisms (generally but not universally agreed within the wind industry) include:

- Improved support for offshore wind projects.
- No significant change to environment for onshore wind.
- Encouragement of stability and long-term investment in the industry.
- Early and improved licensing procedures for offshore projects beyond Round 2.

4.2 Costs

The assumption under this Scenario is that the ‘economic gap’ has been closed for ‘good’ projects by the new policy impetus. Over time, the ‘economic gap’ will close, thereby requiring less and less additional support to be provided.

Opportunities for the industry to improve economics over time are considerable, but will only be realized during the implementation of a reasonable pipeline of projects.

4.3 Supply Chain

A key question is whether the wind industry supply chain can physically deliver within an improved economic environment. This is discussed in detail in Section 5.

With confidence of a gradually increasing pipeline of economically viable projects at varying stages of development, the supply chain can learn and invest, bring costs down and grow in communication with the developers.

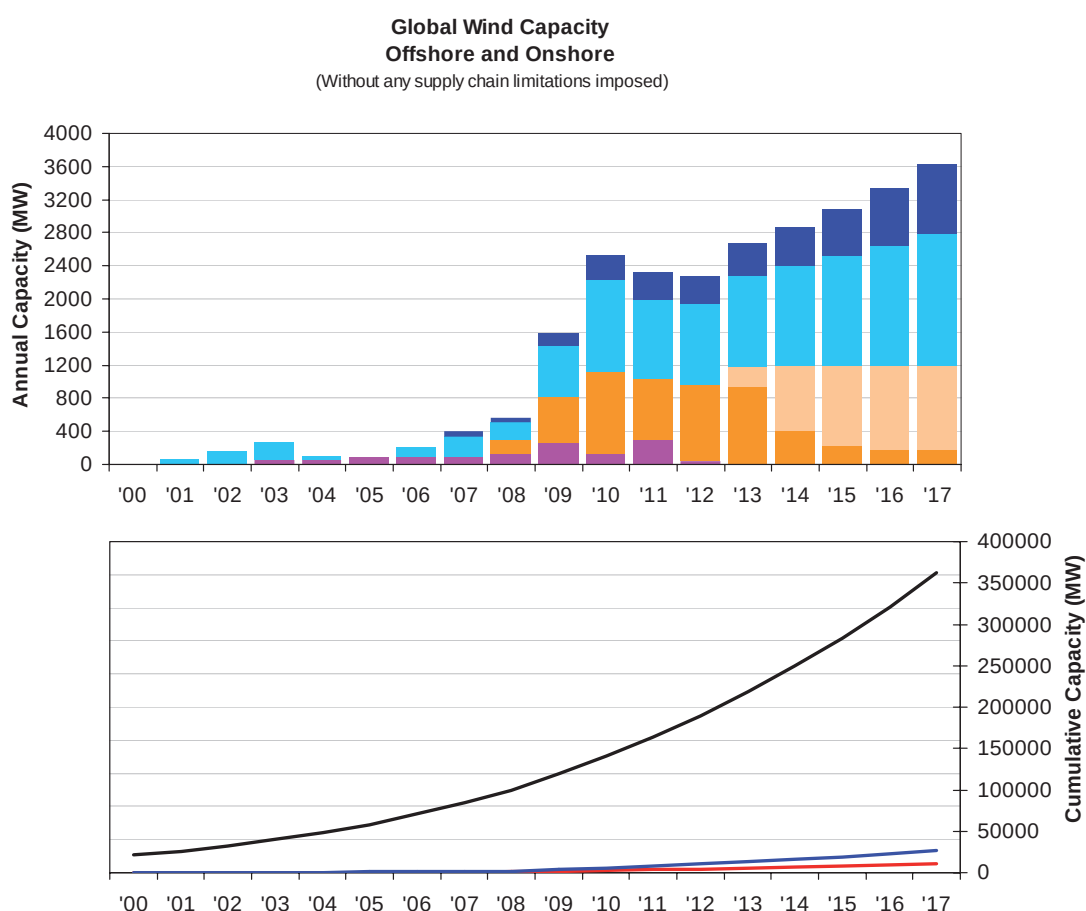
4.4 Conclusions

The result of the new policy impetus is that offshore wind:

- Provides a significant contribution towards the UK's renewable energy targets by 2015.
- Has the chance to establish as a mature industry and a cost effective part of the UK energy mix.

5. Supply Chain Capability under Scenario 2 “Policy Impetus in 2006”

The question of what the wind industry can physically deliver cannot be addressed for the UK offshore wind industry in isolation from the global wind industry. This section looks at the supply chain capacity in the context of the project time plans from developers of UK offshore projects, conservatively coupled with an optimistic forecast of the global onshore and offshore wind markets.



Key and Notes:

- | | |
|----------------|--|
| Pink bars | UK Round 1 projects. |
| Orange bars | UK offshore Round 2 and other projects. |
| Tan bars | UK offshore Round 3 and later projects (indicative). |
| Turquoise bars | EU non-UK offshore projects, planned and forecast. |
| Blue bars | Non-EU offshore projects, planned and forecast. |
| Red line | Cumulative UK offshore. |
| Blue line | Cumulative global offshore (inc. UK). |
| Black line | Cumulative global onshore and offshore (inc. UK). |

Non-UK offshore data generated using similar approach to UK offshore data.

Global onshore cumulative data based on international predictions.

A number of key areas of the supply chain are considered below.

5.1 Wind Turbine Supply

Wind Turbine Supply is recognized as the most critical supply chain issue by most developers.

Global demand is high and currently, only three suppliers are both interested in- and capable of supplying to the UK offshore market. All three are stretched in delivering to the lower-risk onshore market. In this context, UK offshore wind is suffering short-term due to the extraordinary success that the wind industry is achieving globally. By 2015, there are likely to be at least 6 offshore turbine suppliers in the UK market, new entrants being a mix of upcoming and established onshore players. Balance sheet strength is likely to become even more important for turbine suppliers.

Gearbox supply is highlighted as the key bottleneck relating to turbine supply. It is also a focus area regarding reliability. Loss of independence of key suppliers Winergy and Hansen further heightens the potential for gearbox supply issues.

A number of turbine suppliers use carbon fibre in blade manufacture, a material currently in short supply globally. This had an effect on turbine sales in 2005, though further capacity is now starting to come on stream.

The rate of growth of new turbine size coming out of R&D departments is generally slower in the last two years than had been predicted, with much increased focus on testing, resolution of faults and engineering for increased reliability. The vision to use turbines rated 4.5 MW and larger for many Round 2 sites in 2009/10 may be incompatible with sales release rates for these products by wind turbine suppliers keen to manage risks carefully. Though smaller turbines (3MW class) may compromise economics, these may be the only turbines that offer rational levels of reliability in the offshore environment in the timeframe.

With optimistic average global annual installation rate for offshore wind of 2 GW between 2009 and 2012, offshore wind would still only take 10% of the global wind turbine market. In the same period, offshore UK would take less than 8% of the total wind turbine supply capacity of the players active in the UK offshore market. Physically being able to supply turbines to the UK offshore market is not likely to be a limiting factor. More important is whether turbines of the desired size are made available by wind turbine suppliers at an acceptable cost.

Turbine supply is recognised as having the greatest inertia of any element in the supply chain, with development times of over five years to series production and involving significant development commitment (man-hours and external cost). The next generation of turbines suitable for offshore applications is likely to be solely for offshore use, hence decisions regarding pace of their development are highly dependent on global offshore market expectations,

Inertia within the supply chain for some key components is also significant (for example, to accelerate the rate of manufacture of gearbox casings), whereas the timescales for establishing new turbine assembly facilities are generally short.

Following discussion with all relevant turbine suppliers in the light of global demands, it is anticipated that **the growth of the UK offshore market between 2009 and 2012 will be limited by turbine availability** in the scenario "New Policy Impetus in 2006. It is estimated that the limit is of the order of 600 MW in 2009, rising to 1200 MW in 2012. The effect of this limitation is presented in Section 6.

As the industry moves to implementing projects that are larger and further offshore, developers advise that they will be less inclined to be the first to use latest turbine designs. There is a need for smaller, lower-risk projects to prove such turbines in the offshore environment, as these turbines are in general unlikely to 'fit' remaining Round 1 sites.

Concerns were also raised regarding the potential of the German offshore wind sector to take available turbine capacity. The German offshore wind sector will be supported via a secure feed-in tariff arrangement that has stimulated much onshore activity in Germany.

It is recognized that turbine supply is the element least within the UK sphere of influence.

5.2 Installation Vessels

Between developers, there is a wide variation in views as to whether suitable vessel supply is a major concern. In general it falls second only to the concern about turbines. Some developers are taking creative action to mitigate this risk; others seem simply to be following the industry trend in predicting problems.

There are clear indications that the lack of work in offshore wind is pushing vessels back into the oil and gas sector and limiting investment in vessels suitable for 5 MW+ turbines. The investment time to prepare suitable vessels is significant; hence a steep ramp up in capacity is unlikely to be available.

In assessing capability for turbine installation, it is assumed that the average turbine size will be 3.6 MW in 2007 then will drop to 3.4 MW 2008 before rising by 0.2 MW per year for the foreseeable future. This trend is summarized below.

	2000	2005	2010	2015
Average turbine size installed (MW)	2.0	3.0	3.8	4.8

From discussion with the supply chain, any bottleneck is likely to be around 2009-10. Sufficient availability of suitable vessels is dependent on the exact mix of turbines used (even between the different 3.6 MW turbines available), water depths and hub heights as well as whether particular vessels remain available to the sector or are contracted to the offshore oil

and gas sector instead. The best estimate today based on an optimistic usage rate of 70 turbines per vessel per year is that **sufficient installation vessel capacity will only just be available.**

In time, vessels capable of installing smaller turbines will need to be used for any retrofit work required. If vessels suitable for installation of large turbines are tied up with maintenance activities, then sufficient capacity will not be available for installation.

DTI has recently commissioned a separate detailed review of this area of the supply chain. A summary of results (courtesy of ODE Ltd and DTI) follows:

- Looking at UK developments alone, there is sufficient capability within the current industry installation vessel fleet.
- The potential impact on the UK market by proposed European developments (particularly offshore Germany) is significant and could cause considerable shortfall from around 2008 onwards.
- Currently, there is a potential future shortage of heavy lift vessels for the next generation of turbines (5 MW+) and deep-water operations (30m+).
- Co-operation/Co-ordination by all major stakeholders regarding project timing, development plans etc., could help control potential problems.
- Fleet reduction due to loss of vessels to other markets or through long-term contract/commitments would aggravate this situation further.

5.3 Cables

The third most common supply chain concern raised by developers is subsea cables. Two specific products make up the sector – medium voltage (MV), intra-turbine array cables (typically around 33kV) and high voltage (HV), substation to shore cables, where relevant (typically 132kV+).

“Lots of promise from the industry but not coming through – has been frustrating to continue bidding.”
Cable supplier.

With a generous estimate of average 0.4km MV subsea cable per MW installed, peak global installation rates of 2 GW per year would require approx. 800km per year. Messages from suppliers are somewhat conflicting, partly due to the number of potential bottleneck processes involved and the wish to spread production across different sectors to minimize demand risk. Overall, global supply capacity is advised to be of the order of 3000km per year, with current offshore wind players supplying over half of this.

Supply of HV subsea cable is limited to fewer players but demand for offshore wind is lower.

Current lead times are of the order of 12 months, with pressure on supply coming from oil and gas sector and subsea interconnects. Feedback from the supply chain is that UK developers have at times not communicated early enough and asked for too short lead times – the bottleneck being lead time, not supply capacity.

“UK developers generally open enough, though not overwhelmed by information from them. Often information passed around as rumours. Hear about ideas then silence – would be helpful if people would tell why project being postponed etc.” Non-UK supplier.

Though current capacity is significantly greater than demand, expansion is likely to be required to meet optimistic EU offshore wind forecasts coupled with growth in non-wind sectors. There is a willingness to invest with the right conditions, taking 1-2 years before increased production is realized. Open communication and early commitment will be vital in ensuring sufficient supply in this scenario.

UK capability for MV subsea cable exists. JDR Cable Systems, suppliers to the Beatrice demonstration project, are keen to supply also to shallower water projects.

5.4 Structural Steelwork

Supply of steelwork is not raised as a particular concern by developers. The offshore-specific supply item is the monopile. Notwithstanding their size, the demand for offshore towers is only a small fraction of the EU total demand for wind turbine towers.

Currently, only small pool of EU players have supplied monopiles. Between them, they currently have capacity for approx. 350 4 MW monopiles per year. All have significant growth / redirection capability that could be brought on line in less than 1 year from date of investment decision. Other potential entrants exist if the market required them. UK companies could quickly cover half of the above capacity.

5.5 People

Because of the limited experience of developers/owners in managing offshore multi-contracts, there is a developing market for external project management contracting – current EPC contractors ‘moving across the fence’ to manage the contract on behalf of the owner.

This function and the ‘in-house’ teams within developers need to have a pipeline of projects in order to stay engaged and learning. It is not possible to learn ‘off the job’, so late, rapid acceleration may well lead to skills shortages. Related to the issue of the skills base is the evolution of contracting strategy to date which has delayed some projects but is a sign of the maturing of the sector, as seen previously in the offshore oil and gas industry. There is now significant focus in this area. Due to past experience, there is reluctance from some members of the supply chain to embark on repeat high-cost tendering exercises.

5.6 Grid

Getting a grid connection is a project specific issue. In the majority of Round 2 projects the final form, capacity and/or cost of the grid connection arrangement will be one of the last items to be resolved. This does not sit comfortably with the long-lead and final sums issues facing developers today and could lead to delays of projects forecast to be installed before the end of 2010.

Although costs and lead times are uncertain, in general policy is understood and an eventual successful outcome is assumed by developers.

5.7 Consenting Process

Generally there is high confidence that by going ‘through the process’ and addressing any issues arising, Round 2 projects will receive planning consent.

Some parts of the consent approval process are recognized as potential bottlenecks due to limited resource provision by key stakeholders. To date, developers awaiting consent for Round 2 projects have not received much feedback from approval authorities.

5.8 Dock Facilities

This area is not addressed in detail, though space requirements for Round 2 projects will be significant (typically 80,000 m²) and suitable locations limited.

The common expectation is that the Great Yarmouth Outer Harbour will not be available to service wind projects in 2008. It is also anticipated that East Coast projects could be serviced cost effectively from the continent even if the Great Yarmouth Outer Harbour is available.

5.9 Conclusions

The dominant supply chain limitation is wind turbines themselves. Installation vessel availability also may prove to be limiting.

The key ingredients in mitigating supply chain limitations are:

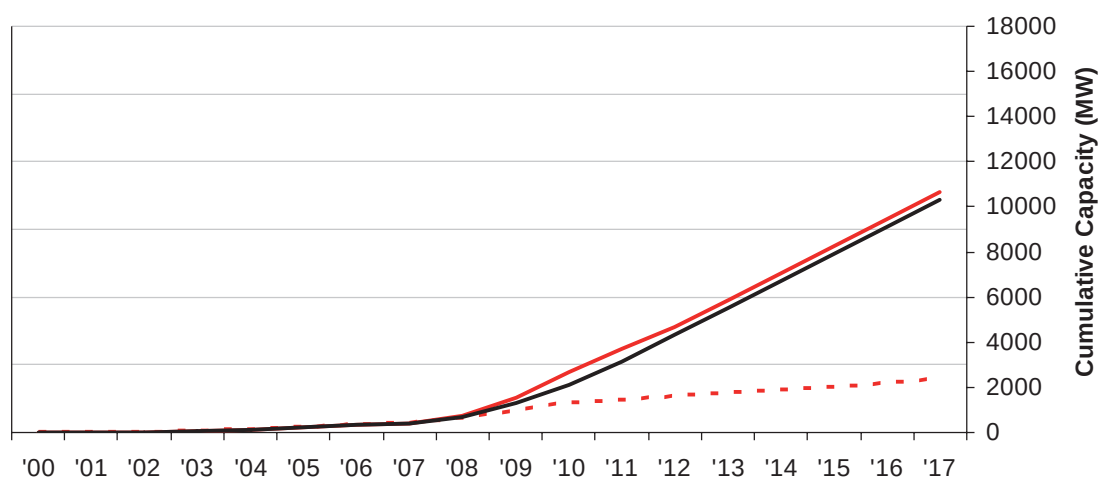
- Build confidence in long-term stable market (through early formulation of Round 3 etc.).
- Ensure active two-way communication between developers and the supply chain.
- Facilitate early involvement from- and commitment to the supply chain on any given project.
- Enable all-party cooperation on grid and consenting.

6. Effect of Supply Chain Limitations

The cumulative installation forecast for the scenario “New Policy Impetus” is shown below, along with the forecast with supply chain limits imposed, showing that the limitations have only a minor effect. Also shown for reference is the cumulative installation forecast for the scenario “Continuation of Current Policies”. Installation rates for this scenario are not limited by the supply chain.

Annual installation capacity is modeled by delaying projects if sufficient supply chain capacity is not available, assuming a 30% mortality rate per year for installations delayed.

UK Offshore Wind Cumulative Capacity
under Scenarios 1 "Continuation of Current Policies"
and 2 "New Policy Impetus in 2006"
(Without- and with supply chain limitations imposed)



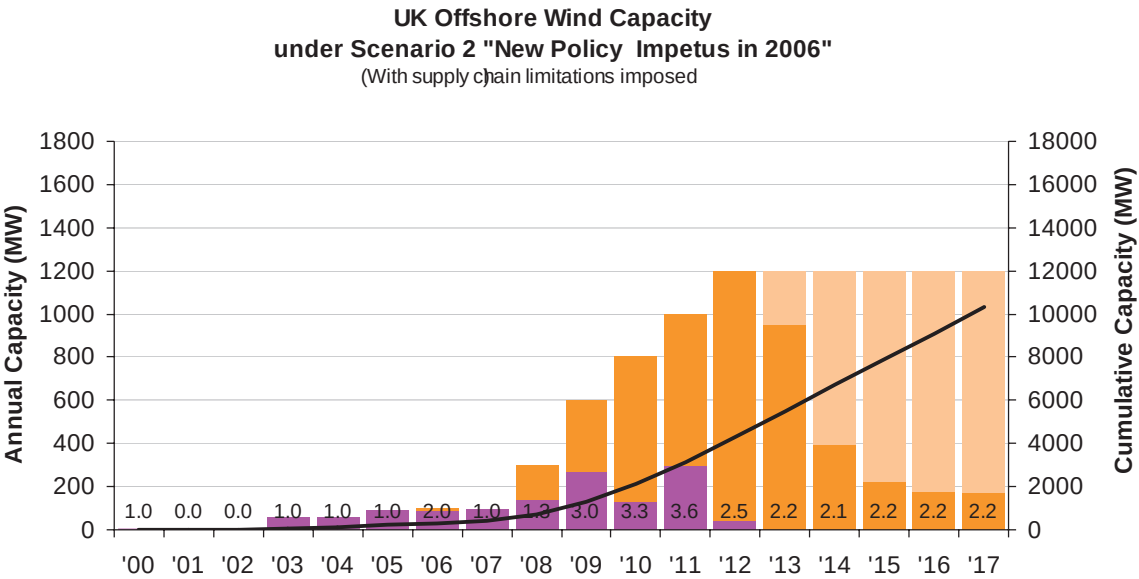
Key:

- Red line** Cumulative capacity Scenario “New Policy Impetus in 2006” (without any supply chain limitations imposed).
- Black line** Cumulative capacity Scenario “New Policy Impetus in 2006” (with supply chain limitations imposed).
- Broken red line** Scenario “Continuation of Current Policies” (unaffected by supply chain limitations).

The only supply chain limitation that has an effect on installation is the turbines themselves. Installation is limited in the period 2009-12. Availability of installation vessels during the period 2009-10 is also marginal even taking into account the turbine supply limitations.

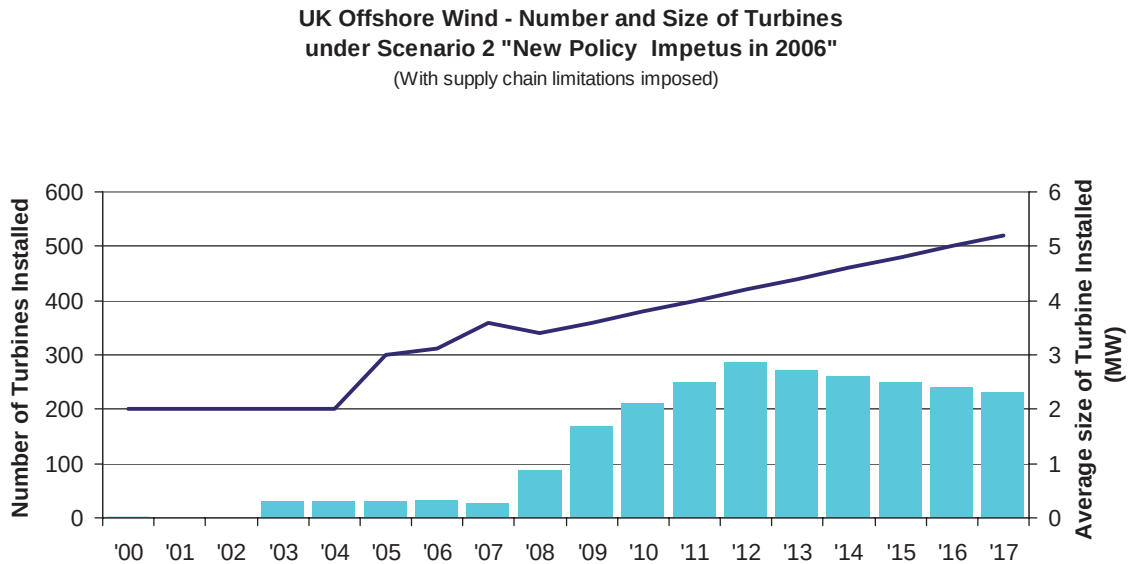
The installation forecasts under the two scenarios do not diverge significantly until after 2010, but the effect of decisions now, is far-reaching in terms of meeting the Renewables Obligation and contribution to the UK energy mix.

The annual installation rate under the scenario “New Policy Impetus in 2006” with supply chain limitations imposed is presented below, followed by an estimate of what this means in terms of number turbines per year and average size of



“New Policy Impetus in 2006”

by end	2000	2005	2010	2015
GW operating (with supply chain limitations imposed)	0.0	0.2	2.1	7.9



Key:

Turquoise bars Number of turbines installed per year.

Blue line Average size of turbine installed in year.

7. Conclusions

Under the UK's existing Renewables Obligation and the capital grants programme for Round One, offshore projects have been built at a rate of only one per year. The near-term future remains uncertain and in the absence of a capital grant or similar support programme for Round Two, there are no clear signs of the stable pipeline of projects that the supply chain requires to drive forward investment. In short, the economic gap between capital costs, expected operational costs and revenue for most projects remains too large for substantial industry commitment.

A new policy impetus is needed in 2006 which would result in an improved economic environment for offshore wind, sufficient to enable 'good' projects to be developed commercially.

With confidence of a gradually increasing pipeline of economically viable projects at varying stages of development, the supply chain can learn and invest, bring costs down and grow in communication with the developers. The result of this is a much earlier delivery of economic offshore wind power.

The only supply chain limitation that has an effect on installation is the turbines themselves. Installation is limited in the period 2009-12. Availability of installation vessels during the period 2009-10 is also marginal even taking into account the turbine supply limitations.

An active offshore wind sector is essential for the successful development of the nascent marine renewables sector.

The result is that offshore wind provides a significant contribution towards the RO and by 2015 is established as a mature industry and a cost effective part of the UK energy mix.

"With extra support offshore wind can deliver significant amounts of power quickly, and with wave and tidal we have the chance to establish world-beating industries that can export to the rest of the world. As North Sea oil and gas run down, the UK's seas can again provide this country with vital home-grown energy that is carbon-free and won't run out." BWEA.

8. Feedback

Input received and the openness with which it has been given to date has been much appreciated, as has the care given by many in offering constructive feedback on the draft report.

Specific comments regarding the Energy Review and RO have been passed on to BWEA, respecting anonymity where requested.

Specific suggestions regarding cooperation within the industry and target areas for cost reduction are being turned into proposals for action, which will be published in the next stage of this work.

9. Notes on Methodology

Background:

BWEA held a one day workshop in November 2005 which was attended by key players in the industry to review current status, successes and failures and gain consensus on the key focus areas to improve rates of installation, which were identified as:

- Project economics.
- Alternative forms of contracting are needed to spread the risk more equitably.
- More communication within industry required and earlier involvement desired by the supply chain.
- Grid issues (for some projects/areas).

With the Climate Change Programme Review and Energy Review imminent, BWEA wanted to present to Government a unified industry view about what can be delivered, what cost improvements the industry can achieve and what areas of support are needed from Government in order for offshore wind to provide a significant contribution to the UK's energy mix and economy.

The purpose of the project, commissioned jointly by BWEA and Renewables East (RE) was to address two specific areas:

- (1) Supply chain capability and key issues against realistic installation forecasts under two different scenarios of project economics.
- (2) Wind farm costs and to explore the rational and value of setting a stretch cost target for the industry to work towards, in the context of interim support to the economics of offshore wind farms.

Accurate and objective information on these two crucial areas must be available in presenting the case for policy development to the Government as part of the Energy Review.

The principle method of collecting the information for this study was by confidential interview with all of the major offshore wind developers and supply chain companies. Factual input, company and personal views were received and mirrored back in writing to interviewees for approval.

The following companies have been interviewed as part of the study:

- ABB, Bendalls, BiFab, Bladt, Camcal, CB&I, Centrica, DONG, EDF Energy, Elsam, Energi E2, E.ON UK Renewables, Eurus Energy, Gamesa, GE Wind Energy, Isleburn Mackay & Macleod, JDR Cable Systems, KBR, Multibrid, Nexans, Nordex npower renewables, Prysmium, REpower Scira, ScottishPower, Siemens, SIF, SLP, Talisman, Total, Shell Wind Energy, Vestas Wind Systems and Warwick Energy.

Forecasts:

Forecasts were generated based on the following assumptions:

A - Economic scenarios:

Scenario 1 **Continuation of current policies.** No additional support is available for offshore wind. The consequence is that the current slow evolution of improving revenue would continue, but an economic gap would remain for the foreseeable future.

or

Scenario 2 **New policy impetus in 2006.** New policies emerge which result in an improved economic environment for offshore wind, sufficient to enable 'good' projects to be developed commercially.

For each of these economic scenarios, a probability of completion was estimated for each project. These were derived as follows:

- First, each developer was asked to provide these probabilities for each project, as well as a milestone plan for the project and summary of key issues. (In some cases the interviewee was unwilling or unable to suggest a figure.)
- Second, the probabilities were moderated based on our view of progress to date, company intent and site viability for each project.
- Finally, the probabilities were moderated by relative comparison with other projects.

Overall, for the projects where developers provided probabilities, the moderation process decreased the installation forecast by 20% in scenario 1 and 10% in scenario 2, reflecting the optimism of staff closely involved with projects.

On presentation of the aggregate forecast in Scenario 1 to developers for comment, some recognised the inconsistency between their comments regarding the economic gap and the aggregate forecast. In order to correct for this, where a developer firmly highlighted a significant economic gap the probability of installation of a project was set to 0. Where a developer confirmed the probability of installation upon challenge, the probability was unchanged. Where a developer did not express a further view, a mid value was taken.

B - Time plans for each project:

Mid time plan (set to assume 20% of wind farms installed according to realistic optimistic time plans from developers (target plan; 20% chance of meeting), 20% to pessimistic time plans from developers (fall-back plan; 20% chance of missing, but not including open-ended delays due to economics) and remaining 60% half way between these two).

It is recognised that the current model allows for open-ended delays only by low probability of completion of project, not by long delays shown in project time plan. In order to track progress of offshore wind as accurately and fairly as possible, the above process could be repeated at regular intervals. A future analysis could include a range of time plans for each economic scenario.

Aggregate UK forecasts were then combined with EU and global offshore and onshore forecasts in order to form the basis of interviews with the supply chain.

Once input had been received and aggregated, a draft summary was issued to all involved for comment. In many cases, detailed feedback was received, which was used in preparation of this final summary.

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