From its position as a world leader in offshore wind power, the UK has the potential to become a global centre of expertise, according to Maria McCaffery, chief executive of RenewableUK.

**FOREWORD**

The UK stands at an energy crossroads. It is clear that our old energy choices are no longer adequate for an age which will see fossil fuels rise in cost, energy security becoming an increasing concern and, of course, the dangers of climate change even more apparent. Alternative options are needed and difficult decisions must be taken.

The rest of the world joins us in this dilemma. Ambitious carbon reduction targets, coupled with policies promoting energy self-reliance, have prompted a worldwide rethink of the energy sector, spearheaded by some of the world's most prominent political leaders and thinkers.

From our own Prime Minister David Cameron to US President Obama and Germany’s Chancellor Merkel, the message is clear: renewable sources must play a much greater role in modern societies for the sake of economic growth, energy security and protection of the environment.

Offshore wind fulfils all three of these objectives. It is the epitome of a truly global source of renewable energy; as the greatest resource lies beyond coastal waters and requires international co-operation to harness it effectively. The UK is working with its North and Irish Sea neighbours to develop the cross-border grid infrastructure necessary to make the most of our wind resource.

This resource is extensive. The UK’s maritime exclusive economic zone covers 773,676 square kilometres, of which only 30,000 km² has been released for development – less than 4 per cent – yet this relatively small area of the sea will provide around 40 per cent of our annual electricity needs.

Progress so far has been rapid. From 568 turbines already installed and providing around 1.5 per cent of the nation's electricity today, the sector is set to reach a contribution of around 8 per cent in the next five years. By the end of the decade, the UK Government is calling for 18,000 megawatts of installed offshore wind capacity, contributing around 55 terawatt-hours of electricity and creating more than 40,000 jobs.

This is one of the most ambitious plans for the development of offshore wind resources in the world, and the rewards for achieving this vision will be great, with tens of thousands of jobs and billions of pounds of investment in play. But the rewards of ambition do not stop at 2020.

Offshore wind projects are enormous, complex endeavours, and successful delivery involves a wide range of skills, from project management, design, ecological assessment, electrical engineering, maritime expertise and many others, including financing. While many of these skills will be sourced close to where projects are built, others can be provided at distances of thousands of miles.

Development of the areas of the sea that have been released up to now has given the UK a head start wherever in the world an offshore wind farm is to be built, people will want to come to the UK first, to tap into our hard-won expertise. Our vision is for the UK to become, for the global offshore wind market, what the City is to financial markets: a global centre of expertise and protection of the environment.

This resource is the first of its kind and provides an international forum to showcase our world leadership in this Diamond Jubilee and Olympic Year.
Harnessing the power of wind?

Naturally.

Transforming the power of wind into electricity, integrating it efficiently into the grid and maintaining network reliability are key challenges. They drive the evolution of more flexible and intelligent power systems, aiming to balance unpredictable and intermittent supply with demand. ABB’s HVDC Light™ technology plays a central role in enabling long-distance transmission and cross-border grid connections, underground and underwater, to deliver reliable, high-quality power supplies with minimal losses. [www.abb.com/hvdc](http://www.abb.com/hvdc)
The Government has published its proposals for electricity market reform (EMR), with the aims of “keeping the lights on, consumers energy bills down and creating cleaner electricity to help tackle climate change”, according to Energy Secretary Ed Davey.

The reforms, which are crucial to the future of the offshore wind sector, “are designed to provide investors with transparency, longevity and certainty in order to attract £110 billion of investment to bring forward new low-carbon power generation for the 21st century”, he says.

The Energy Bill proposes:

- A new system of low-carbon generation revenue support – a feed-in tariff with contracts for difference (CfDs). A “strike” price will be set and, if electricity prices fall below this, CfDs will guarantee a minimum return for investors, removing the exposure to electricity price volatility and encouraging them to invest. CfDs will also limit price rises by clawing back support payments if market prices are higher than the strike price. The first strike prices will be published within the Delivery Plan in 2013;
- A Capacity Market will be established to reduce the likelihood of future blackouts by ensuring there is sufficient reliable capacity to meet demand;
- An Emissions Performance Standard (EPS) will prevent construction of new coal plants which emit more than 450g/kWh (grams of carbon dioxide per kilowatt-hour) - the most polluting form of electricity generation;
- A Carbon Price Floor that provides a clear economic signal to move away from high-carbon technologies by increasing the price paid for emitting carbon dioxide. It places an initial value on the price of carbon of around £16/tCO2 (per tonne of carbon dioxide in 2009 prices) in 2013, which will rise to £30/tCO2 (in 2009 prices) by 2020.

“With or without reform, household electricity bills are likely to increase over time, driven primarily by rising fossil fuel prices,” says Mr Davey. “However, electricity market reforms will help to reduce the amount that bills will increase. As a result of these reforms, electricity bills are estimated to be, on average, 4 per cent lower over the next two decades than they would otherwise have been.”

While the details of EMR were broadly welcomed, there are fears that the pace of change is too slow.

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“With or without reform, household electricity bills are likely to increase over time, driven primarily by rising fossil fuel prices,” says Mr Davey. “However, electricity market reforms will help to reduce the amount that bills will increase. As a result of these reforms, electricity bills are estimated to be, on average, 4 per cent lower over the next two decades than they would otherwise have been.”

While the details of EMR were broadly welcomed, there was some concern that investment will be delayed until the Bill has worked its way through Parliament and until strike prices, which will be administered by National Grid, are published in late-2013.

“While it is reassuring to see some progress on the Energy Bill, it’s now important that Parliament not only gets it right, but does so as a matter of urgency,” says Dr Neil Bentley, CBI deputy director-general.

“With over a fifth of the UK’s generating capacity coming off stream before 2020, we face a real risk of electricity shortages in the second half of the decade. The clock is ticking to create the market certainty that will unlock billions of pounds of private-sector investment, generating many new jobs across the UK and securing an affordable supply of energy.”

Dr Gordon Edge, director of policy at RenewableUK, adds: “The timeline the Government has laid out looks very challenging to bring in wholesale change to the electricity market.”


## Home-grown green power reduces reliance on imports

### Energy Security

<table>
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<tr>
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<th>Europe currently imports 50 per cent of its energy and that figure is forecast to rise to 70 per cent by 2030 as domestic sources, such as North Sea oil and gas run out, and countries like France and Germany start to phase out their nuclear power capacity.</th>
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<tr>
<td></td>
<td>Given the volatility of fossil fuel prices and political regimes of some of the countries that supply Europe, security of energy supplies is an issue that increasingly concerns policy makers.</td>
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<td>Offshore wind is seen as part of a portfolio of energy-generating options that would make Europe less reliant on imported energy and less vulnerable to pricing fluctuations.</td>
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<td></td>
<td>Wind energy is also renewable so it has the added benefit of contributing to the European Union’s 2020 energy targets: reducing greenhouse gas emissions by 20 per cent, improving energy efficiency by 20 per cent, and generating 20 per cent of energy consumption from renewable energy. So how large an impact can offshore wind have on Europe’s energy-generation mix?</td>
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<td>According to the European Environment Agency, installed capacity for offshore wind will be 44.2 gigawatts (GW) by 2020. The European Wind Energy Association comes to a similar conclusion, estimating that by 2020, 40GW of offshore wind power will produce 148 terawatt-hours (TWh) annually, equivalent to more than 4 per cent of the EU’s total electricity demand and avoiding 87 million tonnes of CO2 emissions.</td>
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<td>Between 2020 and 2030, a further 110GW of offshore wind capacity will be added in European waters. This would mean 150GW of wind power would produce 562TWh annually, covering 14 per cent of the EU’s 2030 electricity demand and avoiding 315 million tonnes of CO2 emissions.</td>
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<td>This is at the optimistic end of forecasts – 14 per cent is a substantial contribution to the renewable-generation mix – and much must happen to ensure this scenario becomes reality.</td>
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<td>At a time when Europe is at a major crossroads for its energy future, offshore wind provides a powerful domestic answer to Europe’s energy supply and climate dilemma,” says Gunther Oettinger, European commissioner for energy.</td>
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<td>“However, this development will not happen without ambitious national programmes and support from the European Union, underpinning the market promise.”</td>
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<td>One critical programme is the development of an offshore grid. There are 11 in existence with a further 21 others planned for the North and Baltic Seas. Linking them would create a pan-European electricity “super highway” that would enhance security of supply, both by allowing countries to buy, sell and deliver wind power when they had a surplus or shortage, and by reducing the need for energy imports from outside Europe.</td>
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<td></td>
<td>Policy makers must also commit to investing in the infrastructure and industry to turn the potential into reality. The pay-off for investment and regulatory support will be jobs as well as giving the EU “first-mover” advantage in the offshore wind global market. With offshore wind projected to grow the most rapidly of all renewable- technologies, with installed capacity multiplying 17 times between 2020 and 2030, its impact on reducing the eurozone’s reliance on imported energy and improving energy security will become an increasingly important one.</td>
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<td></td>
<td>“There is a major opportunity for Europe to harness its huge offshore wind resource, to ensure that we can generate the maximum amount of clean energy from a domestic source which will never run out,” says RenewableUK’s director of offshore renewables Nick Medic. “Wind gives us energy security because it reduces the need to rely on expensive imports of fossil fuels. The construction of new infrastructure, such as interconnectors between European countries, will help to maximise the benefits of this power source.”</td>
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## Pricing

### Industry battles to cut energy costs

**There is no getting away from the fact that offshore wind is currently an expensive way to generate electricity.**

**Figures from Bloomberg New Energy Finance show that the sector is more expensive than all technologies, except marine energy and solar thermal generation.**

Among the key areas that need to be tackled are the cost of finance, technological improvements and how the supply chain can contribute. The cost of finance will not fall until the industry has been deregulated, which means reliability must be established throughout the supply chain. And while technological innovation is needed, if the pace of change is too fast, the supply chain will not be able to keep up and the risk will remain.

“There are two main things that need to be worked on,” says John Sturman, chairman of the Offshore Renewables Group at the Institute of Marine Engineering, Science & Technology. “One is getting the cost of turbines down and the second is to reduce the cost of foundations.”

Initiatives such as the Crown Estate’s Offshore Wind Cost Reduction Task Force and the Government’s Offshore Wind Complementarities Development and Demonstration Scheme aim to cut the cost of offshore wind power to £300/MWh (per megawatt-hour) by 2020.
Generating jobs and exports

Concerns about costs and fears of a potential skills shortage are combining to create uncertainty around the impact of the offshore wind sector on the UK economy, writes Felicia Jackson.

In addition, forecasts suggest the offshore wind industry could provide 70,000 jobs by 2020. Martin Grant, chief executive of energy at consultancy Atkins, argues that, with the buoyancy of the oil and gas market and demand for maritime skills, these jobs will not be replacements but new jobs ranging along the east coast, from Kent to Scotland.

To enable the industry to fulfil this promise, private investors must be persuaded to back what are still high-risk projects. The challenge lies in understanding the industry’s potential to create jobs and a new UK manufacturing base.

The potential for the export of expertise is robust. Francois Hollandé, the new French president, has voiced support for increasing renewables; Germany’s retreat from nuclear power is leading to an increase in offshore wind deployment in German waters; and there is growing interest from Asia.

The UK Government hopes that the experience of creating a robust domestic offshore wind sector will translate into sales in other markets. According to Arnaud Bousillé, director of environmental finance at Ernst & Young, the important question is where value will be created. Research by the Boston Consulting Group says that, of the approximately £3 million per megawatt cost of offshore wind, 40 per cent comes from turbines (currently predominantly manufactured in Germany and Denmark), 30 per cent goes to foundations, cabling and other infrastructure, and the remaining 30 per cent to support services.

Companies like Atkins Global are retraining engineers from other sectors to enable them to move into offshore wind, while RenewableUK has launched a similar programme.

Mr Grant believes market intervention will be necessary to make the offshore wind industry a success. He says: “The best thing you can do is provide stability and consistency for planning of the long-term economic case.”

There are signs that the Government is having some success. The first quarter of 2012 saw Germany’s Siemens, Gamesa of Spain and Danish group Vestas announce manufacturing sites in the UK.

Doosan of South Korea, however, pulled a £170-million investment in Glasgow, due to falling confidence in the market. The question whether the UK can develop an industrial base to drive development of the supply chain is one of market volume, timing and certainty – and that means consistent support from Whitehall if the UK is to achieve its goals.

The challenge lies in understanding the industry’s potential to create jobs and a new UK manufacturing base.
Wind of change blows fair for sustainable future

Policymakers and opinion formers in the energy sector agree the Europe faces tough choices to meet the challenges of climate change, rising prices at a time of austerity and geopolitical instability. Here five leading supporters of offshore wind power assess prospects.

Michael Liebrich, chief executive of Bloomberg New Energy Finance, founded the company in 2004 and is a member of the World Economic Forum’s Global Agenda Council on Sustainable Energy

If I had a pound for every time I heard someone say “renewable energy can’t be built without huge subsidies” or “we’re not seeing the cost reductions renewable energy promised”, I think I could probably have built an offshore wind farm. Well maybe not quite, but I certainly wouldn’t be too worried about the global financial crisis.

The reality is that renewable energy has shown massive cost reductions and technological improvements. Indeed, if we saw the same sorts of improvements in another sector, there would be huge levels of excitement. Actually, we have, and we do. But for some reason the message that renewable energy isn’t and can’t be competitive often seems to linger.

And offshore wind is no different. It suffers from criticism that it is too expensive, too remote and too difficult to connect to the electricity grid. Or we hear that, if the wind stops, it will cause blackouts and all sort of chaos.

But offshore wind power, like other renewable energy technologies, has shown some impressive developments. While relatively new, compared with onshore wind farms, offshore wind farms have now been with us more than two decades.

Since the Vindvey wind farm, with 11 small 450-kilowatt (kW) turbines, was built off the Danish coast in 1991, we’ve seen offshore turbine capacity grow markedly. In March, a huge 615-megawatt (MW) turbine, capable of delivering the demands of 6,000 people, was installed 28 kilometres off the Belgian port of Oostende. A 135MW turbine, twice the capacity of the largest onshore turbine currently installed, is in development.

However, it is not just the size of turbines that has advanced. The first full-scale, deep-water floating turbine of 2.3MW is operating in 220 metre-deep water off the Norwegian coast. And in 2007, a wind farm of two 5MW turbines was built in the North Sea, 22 kilometres from the Scottish coast, to test the viability of building commercial wind farms in deep water and some distance from the shore.

We very often can’t imagine what future technological improvements will bring or the speed at which they will come. So, undoubtedly offshore turbines will be more powerful and more efficient, and deliver electricity at lower cost than any of the current forecasts suggest.

And this is vital. We mustn’t forget that governments are supporting the development of clean energy technologies, like offshore wind, because we must swiftly wean ourselves off fossil fuel-based energy that causes climate change and embrace a clean revolution.

Forecasts offshore wind capacity by 2020

<table>
<thead>
<tr>
<th>Capacity (GW)</th>
<th>10-13 GW</th>
<th>15-20 GW</th>
<th>Over 20 GW</th>
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<tbody>
<tr>
<td>Percentage</td>
<td>21%</td>
<td>19%</td>
<td>22%</td>
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## Offshore Wind Energy

### Offshore wind energy has a key role to play in improving Europe’s competitiveness, sustainability and security of supply.

We are only at the beginning of offshore developments. European Union member states’ National Action Plans indicate that installed capacity is to increase ten-fold, from an estimated 4 gigawatts (GW) in 2011 to around 40GW in 2020. However, more than half of the envisaged capacity in 2020 will be installed in only two countries, the UK and Germany.

Offshore wind energy brings opportunities in terms of emissions cuts as well as growth and employment. The industry estimates that around 170,000 offshore-related jobs will be created by 2020, mostly for the benefit of coastal regions.

#### EU power capacity mix 2011

<table>
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<th>Source: EWEA</th>
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<tr>
<td><strong>Wind offshore</strong></td>
</tr>
<tr>
<td>8,272.20</td>
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<tr>
<td>5%</td>
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<tr>
<td>10%</td>
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<td>26%</td>
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![Graph showing EU power capacity mix 2011](image)

**Shallow offshore:** Wind turbines are proving higher than expected, approaching €3,000 per kilowatt of capacity which means each unit of electricity produced costs about twice that from a conventional power station. Engineering rotating machines for the hostile marine environment is difficult and, although it will be done, our latest analysis suggests costs are likely to reduce by only 20 per cent over the next decade.

Secondly, there are still challenges to overcome with the variability of wind power which requires back-up or other power balancing systems.

And finally, offshore wind is not in the same places as our old coal-fired power stations. We need a substantial reinforcement of the national grid to move the power where it’s needed.

### Making offshore wind pay

The UK’s ambitious Round 3 programme should ensure that the industry can continue to scale up activities and reduce costs.

For the European offshore industry to stay at the forefront of this development it has to stay innovative and continue to look for solutions to new challenges such as installing turbines in ever deeper waters.

New players are entering the market, so technological as well as logistical advances need to continue. At the same time the highest quality and reliability standards need to remain the trademarks of EU offshore production, if they are to remain at the forefront in a highly competitive environment.

The EU is actively encouraging developments in this field, financing R&D and a number of flagship projects, for example under the European Energy Programme.

The European Commission is also a keen supporter of the North Sea Countries Offshore Grid Initiative, an integrated grid infrastructure connecting wind farms in the North Sea and the British, French and Irish Atlantic coasts.

Through its scale, this grid could not only help cut costs significantly, but also facilitate integration of large-scale offshore wind resources into grids, while keeping security of supply standards high.

In June, the European Commissioners will publish a new paper on a strategy for renewables which aims to take stock of progress in the development of renewables and identify policy choices for the 2012-2020 period. We hope this will lead to a wide public debate.

### Offshore wind developments

- **In Denmark, we have a long tradition of using wind energy and the Danish wind industry is a vital source of national growth and new energy efficiency directives.**

  This March, the Danish government secured broad political support for an ambitious energy plan. The agreement contains a wide range of initiatives, bringing Denmark a good step closer to the target of 100 per cent renewable energy in the energy and transport sectors by 2050.

  The agreement moves us up a gear, with large investments to 2020. By then approximately half of electricity consumption will come from wind power (today the share is 25 per cent), and energy consumption will decrease by more than 12 per cent compared to 2006.

  **One of the ways to get there is that we will construct two new large-scale offshore wind farms at Horns Reef (400 megawatts) and Kriegers Flak (600 megawatts).**

  And, as Denmark will be making huge investments, we will need contributions from competent companies all over Europe.

  We will welcome new bidders for the Danish projects. And we will design the tender process in an open dialogue, so that we can ensure strong competition and the best possible end result. Look at this as a very open and high level meeting, the tender to be published next year. So keep an eye out for Denmark.

  Green investments are investments in both the present and the future. More than 20 million Euro-pheric components, and was a corporate vice-president of the John Loughhead, executive director of the UK Energy Research Centre, is a past-president of the Institution of Engineering and Technology, and was a corporate vice-president with the Alstom Group.

  The UK Government pins much of its hopes for increasing exploitation of renewable energy on wind. Offshore installations have been encouraged due to their reduced impact on communities and the generally higher capacity factors which approach 40 per cent rather than the 25 per cent typical of onshore systems.

  Under its commitments to European Union targets, the UK must meet 15 per cent of its energy needs from renewables by 2020, which implies around 40 per cent of electricity.

  If all this was to be met by wind, around 33 gigawatts (GW) of capacity would be needed. Today, operational or in construction, there is 5.9GW onshore and 4.3GW offshore, with planning consent for a further 3.9GW onshore and 1.1GW offshore, a total of a little more than 14GW.

  Initial studies and projects are underway on a further 4GW of offshore wind farms (compared to almost 8GW for onshore) which, as well as highlighting that we still have more capacity to find, suggests that offshore wind is not yet the most attractive option for developers and electricity generators.

  Yet, potentially, offshore wind is a vast resource: estimates are that an average of 100GW of power could be generated from less than one third of UK waters shallower than 50 metres. That is more than twice the UK’s current typical electricity demand – so we can do it, but what impedes us from cracking on?

  Firstly, today’s cost of offshore wind turbines is proving higher than expected, approaching €3,000 per kilowatt of capacity which means each unit of electricity produced costs about twice that from a conventional power station. Engineering rotating machines for the hostile marine environment is difficult and, although it will be done, our latest analysis suggests costs are likely to reduce by only 20 per cent over the next decade.

  Secondly, there are still challenges to overcome with the variability of wind power which requires back-up or other power balancing systems.

  And finally, offshore wind is not in the same places as our old coal-fired power stations. We need a substantial reinforcement of the national grid to move the power where it’s needed.
UK ‘leading the world’ in offshore wind power

Q&A

We’ve opened the world’s largest offshore wind farm at Walney and seen 87 megawatts deployed since May 2010.

The Offshore Wind Component Scheme supports the development and demonstration of key component technologies that will reduce offshore wind costs. The first call for proposals closed in December 2011 and resulted in £4 million of grant awards to fire companies, including David Brown Gear Systems, NGenTec, OSBIT Power and OGN North Sea. The second round was launched on May 10 with a budget of up to £5 million. We also recently made an agreement with the United States to work together on the development and demonstration of floating offshore wind turbine technology. We made £60 million available to support the development of new offshore wind manufacturing projects on the English coast, in parallel with similar support by the Scottish Government.

What about the Offshore Wind Cost Reduction Task Force – how confident are you that the aims of the task force can be met?

The industry-led task force looks at how we can reduce the cost of offshore wind to £100 per megawatt-hour by 2020. This is challenging but I am optimistic it can be achieved. We shouldn’t forget that, as we are seeing with onshore wind, there is every expectation that costs will reduce as technology improves and mass-deployment takes place. The task force considered how we can best deliver cost reductions more quickly by focussing on a number of key areas with the greatest potential. Very much welcome the comprehensive task force report and we will be looking to work with industry to ensure we can all act on its recommendations.

How confident are you in the current planning system’s ability to process large amounts of consent applications for offshore wind projects in a timely fashion?

The Government is committed to giving a greater say to people, communities and councils through a faster and more democratically accountable planning system. This is why we have abolished the Infrastructure Planning Commission and replaced it with a new National Infrastructure Planning Directorate within the Planning Inspectorate. Round 3 will lead to a significant increase in applications and government will keep the issue of resourcing under review. I am confident that the reforms will streamline and speed up the planning system.

Finally, do you think the Government is doing enough to tell the “good-news” story around offshore wind in terms of job creation and manufacturing?

We want to see a substantial increase in UK content in offshore wind farms. The sector recently confirmed the vision that UK firms should provide more than 50 per cent of the content of future wind farms. This sends a strong signal of the confidence developers have in the UK supply chain and reflects recent progress. Having started from a low base, UK content in offshore wind is growing, for example, Robin Rigg wind farm reached a level of 22 per cent, but we want to improve on that further. I was pleased to see the NORSTEC network that was recently established, with the aim of creating a major new renewable energy centre in the North Sea.
Offshore wind plans: bigger, better, stronger

As the industry scales up, turbines will get bigger, more efficient and further out to sea in deeper water, writes Tim Probert

**TECHNOLOGY**

The offshore wind sector is not just driving the revitalisation of the manufacturing sector in the UK, it is also deploying some cutting-edge technology.

The latest offshore wind farms employ turbines with a typical power capacity of 5 to 6 megawatts (MW) but, targeting the Crown Estate’s 33-gigawatt (GW) Round 3 programme where construction is set to start in the middle of the decade, the world’s leading turbine makers are bringing to market machines with double the capacity.

These turbines will be taller than The Gherkin building in London and have turbine-rotor diameters larger than the London Eye. They will stand in waters up to 60 metres deep and, in some cases, more than 200 kilometres from shore.

French power generation equipment manufacturer Alstom has designed its first offshore wind turbine – the 6MW Haliade 150 – with Round 3 in mind. Once serial production commences in 2014, Alstom plans to install 200 of the turbines, which are designed to operate at a depth of around 35 metres and a wind speed of 9.5 metres/second, every year in the UK and France, equivalent to 1.2GW of new capacity per annum.

Frederic Hendrick, Alstom’s vice-president of offshore wind, believes 6MW is the optimum size of turbines for Round 3. “We looked at various power ratings up to 10MW and what is required in terms of blade length, the weight of the nacelle and the implications for the turbine substructure, which can account for 30 to 40 per cent of the total cost. We found 6MW to offer the best value in terms of total cost of electricity.”

Siemens is also launching a 6MW turbine, the SWT-6.0. The German company has started building two test machines at Danish utility Dong Energy’s Gunfleet Sands array off the Essex coast. When they come on line in November, these will be the biggest turbines deployed in the UK.

Both manufacturers have opted for direct drive permanent magnet generators rather than gearboxes, which are prone to malfunction in the harsh, turbulent environment of an offshore wind farm. Henrik Stiesdal, chief technology officer of Siemens Wind, says direct drive generators also make the nacelle lighter, thus reducing stress on the substructure.

“So far, large wind turbines have always been heavier per megawatt than small ones,” he says. “The SWT-60 breaks this rule and has a weight per megawatt similar to many machines in the 2-3MW range.”

It is not clear that ever-larger turbines will be cost-effective, says Alstom’s Mr Hendrick. “It would be easy to make a 10MW turbine, but it would have a poor capacity factor. Our customers need simple, robust, reliable and efficient machines to minimise maintenance costs, which are a killer for offshore wind.”

Alstom hopes the Haliade 150 will need to be maintained only once a year. Larger turbines need larger foundations and at depths of 30 metres or more, low-tech, relatively low-cost steel monopiles hammered into the seabed start to become impractical. Steel jacket foundations, which resemble miniature oil rigs, will play a significant role in Round 3.

To exploit the deeper waters off the north-west coasts of Scotland and Cornwall, however, something more radical will be needed: floating turbines. The Energy Technologies Institute is looking at proposals to build a £25-million floating wind turbine demonstration project, which will see the installation of a 5-7MW prototype in waters 60 to 100 metres deep by early-2016.

Current floating designs envisage using horizontal-axis turbines that look similar to current models, but floating vertical-axis wind turbines are under active exploration, says Dr Simon Harrison, Mott MacDonald’s director of energy. “If they show promise, they are going to be the way forward for deep-water offshore wind farms.”

The Gherkin and have rotor diameters larger than The London Eye

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Surfing the new wave can make offshore wind pay

Companies involved in the complex supply chain needed to successfully develop offshore wind power are rising to the challenge, as Tom Idle discovers

**SUPPLY CHAIN**

In the next decade, offshore wind power capacity in Europe will grow tenfold. But this huge growth will only be realised with the support of a strong network of suppliers. From subsea cable manufacturers, network transmission has developers and skilled installers, to project developers and consultants, electrical engineers and maintenance personnel, the supply chain for offshore wind is a complex one.

We need to double our capacity for critical components, like electricity cables, substations or cabling vessels

To build 25GW of capacity by 2020, the UK needs...

- 5 more foundation factories
- 13 cable manufacturers
- 20 installation vessels

Source: Douglas-Westwood

**CABLES**

The success of offshore wind projects pivots on getting the energy generated out at sea back to the shore and into the grid. For this, developers need the offshore cables sector, a highly specialised and lucrative industry dominated by just a handful of companies.

The £2.3-billion sector is in a healthy state, with demand for cables currently at around 800 cables per year, a stretching to around 1,000 cables per year, according to Bloomberg New Energy Finance. Three established players – infrastructure giant ABB, French group Nexans and Prysmian of Italy – make up more than 70 per cent of the market, with newcomers NCT and General Cable providing the rest.

Up to now, most of the cables linking wind turbines to shore have been high-voltage AC. But in the future, wind farms will increasingly call on high-voltage DC (HVDC) subsea cables that are capable of transmitting energy over long distances more economically. But with a limited number of suppliers, there are fears the HVDC cable supply chain could become a bottleneck, particularly in the second half of this decade.

The European Wind Energy Association’s recent study into the state of the market highlighted a need for “substantial” additional cable manufacturing capacity to meet future demand, especially with lead times for bringing new HV subsurface cable capacity online currently set at around two to three years.

ABB points out the need to upgrade the onshore cabling network to cope with increasing offshore power supplies.

“One of the key focus areas is the need to reinforce the onshore grid to enable integration of the power injected from offshore wind farms and transport it efficiently to consumers,” the company says. “This requires the existing grid to become stronger, smarter and more flexible.

“In terms of the electrical transmission system, it is suggested that over £34 billion of investment will be needed to deliver the offshore network connections. This means the need for not only of offshore infrastructure, but also significant onshore connection works and upgrades to the existing transmission infrastructure to accommodate the new offshore generation.”

Turbines must have support to turn wind into energy

Projects will not proceed unless all necessary elements are in place to tackle the significant manufacturing and engineering challenge ahead, as Tom Idle reports

Europe’s offshore wind market is dependent on infrastructure renewal projects coming to fruition in the next few years. From electrical cabling, maintenance and engineering operations, to substation construction, electricity grid upgrades and port expansions, it is critical that the appropriate infrastructure is in place to ensure offshore wind becomes a viable energy source.

Of course, manufacturing plants are needed for the turbines themselves. But other infrastructure needs attention too. According to a recent study by energy analysts Douglas-Westwood, the UK alone needs five foundations factories, 13 cables factories and 20 installation vessels to supply the necessary kit that will source 1 gigawatts of capacity by 2030.

The key challenge is to efficiently deliver the power harvested at sea to the onshore transmissions system. As Stefan Jonsson, head of offshore wind business at the power technologies business ABB, says: “Transporting electricity to the shore and then integrating it into the grid for supplying consumers is a key element in the success of this sector.”

As wind farms have got bigger and moved further away from the shoreline in recent years, high-voltage direct current (HVDC) cables have been increasingly sourced for their underwater capabilities and strong performance in transmitting power over long distances. But “substantial additional cable manufacturing capacity” is required, according to the European Wind Energy Association.

“The industry faces a number of challenges,” says Mr Jonsson. “There is an ongoing need for technologies that cater to offshore requirements, like specific auxiliary services such as cable-laying and crane vessels.”

Rhys Thomas, director of renewables delivery at RenewableUK, argues that cabling and electrical infrastructure does not receive the same amount of attention as things like turbines. “Perhaps it’s because they are out of sight, but their importance cannot be underestimated,” he says.

Ports are crucial to servicing a number of supply chain elements. Over the next ten years, more manufacturers and suppliers will be located at port facilities, and the ports need to be suitable.

To save on transport costs, turbines, blades, drives and other large, awkward and heavy components need to be built close to the shoreline, ready to be shipped out to sea. The ports will also have to cater for the increasing number of different vessels coming on stream to install, repair and maintain wind farm components.

Cabling and electrical infrastructure does not receive the same amount of attention as turbines
Green Investment Bank could be white knight

The core of any business model is a predictable return on investment, but uncertainty surrounds the cost of next-generation wind turbines, writes Tim Probert

As the UK prepares to build its 32-gigawatt Round 3 offshore wind programme, uncertainty over construction costs has raised concerns among investors that the £100-billion capital that is required may not be forthcoming.

Round 3 may seem a small step from Round 2 but, in terms of the amount of money needed, it is a giant leap and utilities will not be able to finance many projects at this scale from their balance sheets. As no other nation has attempted deep foundations, nobody can be exactly sure how much these pioneering projects will cost to build. Nobody can be exactly sure how much these pioneering projects will cost to build.

However, there may be a white knight on the horizon in the form of the Green Investment Bank (GIB). Investors view the GIB as having a crucial role to play in plugging gaps where the private sector is unable to bear the full construction risks of Round 3.

Anthony Marsh, head of transactions at UK Green Investments, set up by the Department of Business, Innovation and Skills last year to oversee the creation of the nascent GIB, says the bank could directly invest in Round-3 projects in partnership with the private sector.

“The plan is to prove it works so that private capital piles in and then we move on to another technology,” he says. “The Holy Grail is to get institutional, long-term funds into the offshore wind sector – they are not investing because they think the risk-reward profile is not appropriate. They need long-term certainty and we will encourage them to have it.”

As the GIB sits on the Government’s delicate balance sheet, the Treasury has capitalised the bank with just £3 billion. But, after 2015 when the GIB assumes full borrowing powers, liabilities are expected to increase substantially.

Andy Cox, head of power and utilities at KPMG, believes the GIB is the key to unlocking the £100 billion required for Round 3, but not necessarily as a front-line investor.

“At this stage, the GIB needs to be a pioneer focused on financing first-of-a-kind-type projects by underwriting construction risks via guarantees rather than capital,” says Mr Cox.

“The GIB could stand behind primary project contractors, which would assume a certain level of overrun risks, with a second tranche of construction support. By assuming some of the construction risks, more private capital will be forthcoming.”

Calculating some of the more exotic construction risks of Round-3 projects, like weather windows and non-availability of vessels, is proving such a headache that insurers are unable to step into the breach, according to Jerry Biggs, chief executive of UK renewable energy finance and insurance company Narec Capital.

“There are gaping gaps in insuring offshore wind farms and some projects have been uninsured,” he says. “This is particularly unpalatable for debt finance.”

Mr Biggs believes GIB should work with insurance companies and research institutions to develop models to underwrite challenging debt structures, and in turn lower the cost of premiums, which on average account for 26 per cent of operational expenditure. “Once they have that knowledge base, insurers will then undercut each other and bring down premiums rapidly,” he says.

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