Offshore renewables
Unlocking the potential

March 2010
Introduction

By ICE Energy and Marine Panels

The UK is facing an energy security challenge. By 2025 we must replace circa 35GW of electricity generation capacity. At the same time the threat of climate change requires rapid decarbonisation of our energy supply.

The UK has the opportunity to harness some of the world’s most abundant marine resources.

This report brings together four experts to consider:

- What are the barriers that engineers will have to overcome to deliver the infrastructure that is required to capitalise on these resources?
- How can we create and maintain the supply chain and supporting industries to fulfil the potential of our coastal waters?

Prof AbuBakr Bahaj looks beyond wind and surveys progress in the infant tidal and wave energy sectors. He notes that UK waters contain a potential for 0.25 TW of resource, which if one tenth was exploited, would equate to around half of the nation’s current electricity consumption. With an eye on this prize he reviews current progress with technology development and issues around deployment including finance, infrastructure, permitting and consents.

Peter Madigan, of Renewable UK, provides an overview of the opportunities for offshore wind development, following the Crown Estates January 2010 allocation of licences for the third round of offshore wind development in UK waters. The paper identifies the potential for creating 40,000 UK jobs in the period to 2020 but identifies major challenges relating to supply chains, grid connections and the planning system.

Captain Mathew Mazhuvanchery, of Clarkson Technical Services, also recognises the potential for UK PLC in the offshore sector but sounds several notes of caution. Major investment will be required in port facilities, vessels and plant to deliver offshore facilities. Practical problems, including two fatalities encountered during the second round of offshore installation, are also highlighted. Finally he bemoans what he sees as a lack of strong government vision, which it is feared will see many of the economic benefits from exploiting UK resources accruing to competitor countries in Europe and beyond.

National Grid set out their commitments for supporting the achievement of the UK’s 2020 renewable energy targets.

Our conclusion looks back at the lessons of the successful exploitation of North Sea oil and gas in the 1980’s and draws lessons for the offshore renewables sector. We also identify action required in three areas; continued government leadership, new thinking on regulation and the identification of key opportunities for the UK supply chain.
Wind
Annual Mean Wind Power Density at 100m

Wave
Annual Mean Wave Power Full Wave Field

Tidal
Average Tidal Power
The status of ocean energy conversion

By Professor AbuBakr S Bahaj, Professor of Sustainable Energy
The University of Southampton Sustainable Energy Research Group, School of Civil Engineering and the Environment

Introduction
Sustainability, energy security, environmental issues and the impact of climate change will require the development of low carbon technologies. Energy supply from renewable resources is central to sustainable development and emissions reductions. However, in the UK most policies are highly reliant on the expansion of large-scale wind energy generation, with only small attention being directed to other areas of renewable energy.

Ocean energy has many forms, and this paper considers only those found in tidal currents, driven by gravitational effects, and wind-driven waves, derived ultimately from solar energy. The former offers the advantage of a predictable resource and hence energy yield, which is unsurpassed by any other renewable resource in terms of reliability. If appropriately exploited, wave and tidal resources can deliver large amounts of electrical power that could contribute to national and international targets. Globally, tidal dissipation on continental shelves has been estimated at 2.5 TW. The waters around the British Isles are estimated to dissipate approximately 10% (0.25 TW) of this resource. If one tenth of this figure could be tapped for power generation (which would require a very large capital investment), tidal power could deliver around 220 TWh/annum, which roughly equates to half of the UK current electricity consumption. While most incident wave energy is dissipated in deep water, where economic exploitation is yet to be demonstrated, there is nevertheless a significant nearshore resource estimated by the European Thematic Network on Wave Energy at 1.3 TW globally, with a technically exploitable resource of 100-800 TWh/annum. The UK has amongst the most energetic of wave climates, which could provide up to 50 TWh/annum.

There is a thriving research and development community around the world undertaking both fundamental, applied research and technology development of tidal and wave energy conversion. However, at present most technological innovation aimed at exploiting such resources are at an early stage of development, with only a handful of devices that can be classified to be at the commercial demonstration stage. Technology development is further complicated by a plethora of conversion technology variants that seem to dilute effort and compete for the scarcely available financial resources resulting in high inertia holding back the technology from an accelerated path to commercialisation.

This report attempts to provide a summary of the current status of tidal current and wave energy conversion technologies. It also highlights research and development areas and includes some insight into other related issues such as permitting, consent, finance and infrastructure.

Technology development issues
In order for the wave and tidal energy conversion technologies to be brought into the mainstream and embedded into our electricity delivery systems, important issues need to be considered and overcome. Table 1 relates these issues in terms of device-and project-specific issues. The former are related to the conception of the original idea. In order for this to be thoroughly developed, it will need to go through various steps and be subjected to technology readiness assessment (TRA).

<table>
<thead>
<tr>
<th>Device specific issues</th>
<th>Project specific issues</th>
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<tbody>
<tr>
<td>Energy capture</td>
<td>Resource assessment</td>
</tr>
<tr>
<td>Power take-off</td>
<td>Financing</td>
</tr>
<tr>
<td>Control systems</td>
<td>Consents and permits</td>
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<tr>
<td>Electrical conversion</td>
<td>Environmental Impact Assessments, stakeholder consultation, etc</td>
</tr>
<tr>
<td>Electrical connection to sea-bed</td>
<td>Cable-routing</td>
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<tr>
<td>Cable fixings</td>
<td>Deployment</td>
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<tr>
<td>Fixing / moorings</td>
<td>Maintenance</td>
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</table>

The project-specific issues are much more complicated to deal with, requiring a developer to identify a project site, undertake the various steps needed under the regulation and have a robust plan for deployment and maintenance. Obviously a site could be selected due its partially known energetic potential: high or moderate flow velocity or energetic wave climate. In addition, there are many factors which also need consideration: proximity to a grid connection and ports, availability of vessels and understanding of sea bed conditions. The grid connection issue is similar to that encountered with other renewable energy technologies such as offshore wind and, hence will not be discussed here. Furthermore, unlike fossil fuelled electricity generation, the fuel – water flow or waves
– for producing electricity is free and the revenue stream is governed by the energy yield of the project. In addition, the overall cost of an ocean energy project is totally dominated by capital and operating costs.

Since the revenue is mainly dependent on the flow or wave conditions, the profitability of a project is highly dependent on clear understanding of site conditions including flow field characteristics. Hence resource assessment is crucial to arrive at an economical analysis of the viability or otherwise of an ocean energy project.

Resource assessment

Resource assessment is one of the crucial components of any development project. Resource assessments produced by developers tend to be subject to commercial confidentiality and the methodology used to characterise the resource is in the early stages of being standardised through protocols, co-ordinated by academia and industry6,7. However, these are still in the early stages of development. The gathering and analysis of field data on tidal streams is continuing with ADCP surveys carried out in favourable locations. Many aspects of resource assessment remain the subject of research, such as the possible impacts on the site by the generators8; the interactions between devices in arrays or farms9,10; the effect of turbulence, wave and velocity profiles on the performance of devices11,12. In the area of wave energy resource assessment, research has been focused on effectively processing satellite altimetry data to give robust estimates of wave resource with error bounds13,14.

Commercial and prototype devices

Publicly available information on commercial, prototype device development and deployment are summarized:

- Project SeaGen (Marine Current Turbines Ltd, (MCT Ltd)) at Strangford Lough, Northern Ireland, UK has successfully deployed a second generation device consisting of a piled twin horizontal-axis two-bladed turbine converter of capacity 1.2 MW14. Seagen report that the systems are now working well, in spite of initial delays, re-design of the piling process and a blade failure15.
- Pelamis Wave Power Ltd have been forced to suspend the operation of their world-first three-device farm off the coast of Portugal, due to financial difficulties with the overseas backers and some technical problems. The company is now concentrating on the manufacture of its UK-based four-device array to be installed in Scotland in 2012/1316,17.
- Aquamarine (UK) has installed its first prototype wavemaker-like device at the European Marine Energy Centre (EMEC) for performance testing in autumn of 200918.
- The Irish company Open Hydro has been testing their open centred, rim generator device, capacity 250 kW, at EMEC in the Orkneys for over two years. No news has been forthcoming on performance19.
- Several developers are eyeing the Pentland Firth for commercial scale deployments; Atlantis Resources Corp are looking for a partner in an innovative project to develop a 20 MW tidal farm to power a proposed new data-centre located in the far north of Scotland20. In addition, several new wave and tidal current devices have also entered the field recently. For a full update on these developments see the IEA report21.

Looking further into the future, there seem to be few significant activities in developing or accelerating projects at farm scale for exploiting wave energy — the exception being the Pelamis Wave Power 3 MW farm mentioned above – when compared with tidal current energy. Considering the latter, Lunar Energy announced (in March 2008) that it had signed a Memorandum of Understanding with Korean Midland Power to develop a 300 MW farm in South Korea by 2015. If this project goes ahead it will by far be the largest tidal current development in the world22. Korea also has two other projects: firstly a newly installed 254 MW tidal scheme retro-fitted into an existing 11 km barrage in Sihwa Lake, due to be completed in 201023 and secondly, a plan for converting three barrages, total capacity of 1.8 GW, by 201424. These developments will launch Korea as the world’s leading nation for tidal energy generation.

A flurry of activities in the UK have followed an announcement by the Crown Estates in November 2008, inviting developers to apply for leases to deploy their technology in Scotland’s Pentland Firth25. For example MCT Ltd plan to have an array of up to 50 MW by 2015 expanded to 300 MW by 202026. This is subject to securing the required finance, meeting the necessary approvals and the availability of an appropriate local grid connection at the site. Several consortia are also in the running for a tidal generation scheme on the River Severn, with proposed capacity varying from to 1-8 GW27. Not
strictly in the UK, but closely related, Open Hydro and Alderney Renewable Energy plan to develop a 285 MW array in the waters of the Channel Island of Alderney28.

Research and development
Fundamental research and development are the backbone of both generating new knowledge and assessing devices at their early stage of development. Hence, in parallel with the developments in the commercial sector, many aspects of wave and tidal current energy conversion remain active areas of research. As highlighted above, this research divides naturally between fundamental understanding; research on individual devices; device interactions and resource assessment. In the first and second categories are the tests of the University of Strathclyde 2.5 m CoRMaT contra-rotating turbine29. The University of Southampton has carried out extensive tests on side-by-side dual 0.8 m rotors, as part of a UK, Technology Strategy Board funded programme to determine wake interactions; 30. Several teams are working on CFD simulations of tidal turbines, using a variety of methods, linked to experimental results 31,32,33.

In wave energy there are also new developments such as those of the Anaconda34 and the OWEL devices35. The fundamental work on both is being carried out at the University of Southampton.

Conclusions
Ocean energy—limited here to tidal current and wave energy technologies—and their associated industries are still in their infancy. Some people believe that the current status of the technology is comparable with that of the emerging wind energy development in the 1980s. However given the availability of favourable regulatory regimes, the progress should be much faster than that of wind. Nevertheless the issues that will need addressing:

- Most important is for the technology to prove itself within the operating environment; there is an urgent need to gain operational experience in the sea. This experience is paramount as it gives confidence to investors; energy utilities and governments in the viability of the technology.
- The viability of the technology will depend, in the long term on operational reliability of the devices, their maintenance and operating costs, permitting and consent for projects, availability of grid infrastructure and most importantly (in the age of the current credit crunch) the availability of finance.
- There is a paucity of domestic manufacturing capacity for both systems and components. The UK will need to build up a capacity in these areas to avoid the similar fate of offshore wind supply chain of which most of the predicted UK expansion is likely to be supplied from overseas.
- Technology developers and stakeholders will need to establish a robust supply chain for design and manufacture, transport to site and appropriate installation vessels.
- There are however, many drivers that are likely to play a major role in assisting the development and the roll out of ocean energy technology. These initiatives are mostly related to new energy and climate change legislation in many countries, the prevalence of feed in tariffs in many EU countries, the change in policy in the USA, the requirements for energy security and fulfilling internationally negotiated carbon reductions.

As indicated above, we have recently seen important milestones for ocean energy conversion. We have seen the first deployment of two grid connected, large scale pre-commercial devices in the sea, albeit limited to sheltered test sites. Nevertheless this progress is extremely important for the technology as it has stimulated many activities including joined-up thinking for developing sites with arrays.

The change of administration in the USA, and the ambitious funding of US $18.5 billion for renewables36, may help to awaken other countries to invest in such areas for the creation of jobs and the exploitation of non-fossil fuel sources for electricity production, notwithstanding the unfavourable economic climate. This will have implications for the UK. As indicated above, the UK has a huge resource in wave and tidal currents. At present, it also has a clear lead in wave and tidal energy conversion activities, which is a result of a first class research and development community both within universities and industry. However, this lead is under threat due to the inflexible and sometime incoherent support mechanisms for research, development and the route to commercialisation.

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Delivering offshore wind - Renewable UK

By Peter Madigan, Head of Offshore Renewables, Renewable UK

Introduction
8 January 2010 marked the announcement of the winners of the third tender round for offshore wind sites in the UK. Nine development zones were allocated to companies and consortia to start the development process. The scale of this project represents a step change for the global industry and to understand the implications we need to explore what can be delivered over the coming years and what this means in terms of jobs and opportunities for the UK.

Round 3
Offshore wind is developed in a series of competitive leasing rounds. Two rounds have been completed and these projects are now being developed. At the end of 2007 the government initiated the process for starting a third competitive round. The Crown Estate as landlord and steward of the seabed started the round 3 process in June 2008. This announcement represents the conclusion of this competitive tender process.

This round was structured differently from previous leasing rounds as tenders were put forward for nine zones of development each potentially containing multiple projects. The scale of some of these zones is much larger than anything seen before with some zones potentially yielding 10GW of projects. In total the size of round 3 is 32 GW compared to the combined total of 8 GW from rounds 1 and 2.

Another new feature of round 3 is that within this process the Crown Estate will co-invest with developers, with the aim of facilitating efficient delivery of the wind farms.

The benefits of offshore wind
The UK is already the leading market for offshore wind development in the world, with just under 700MW operational, over 1,000MW under construction and a further 3,500MW consented.

Development of round 3 represents an investment of £100 billion of private sector investment. Renewable UK commissioned Bain and Company to produce a report that modeled the number of jobs that could be created in the UK by the growth of wind energy. In a scenario where 20GW of offshore capacity were constructed by 2020 and 70% of the design and manufacturing took place in the UK then nearly 45,000 British jobs would be directly created, with an additional 14,000 created by onshore wind industry growth.

### Round 3 Offshore Wind Zones

<table>
<thead>
<tr>
<th>Wind farm</th>
<th>Region</th>
<th>MW capacity</th>
<th>Developer (owner)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol Channel</td>
<td>South West</td>
<td>1,500</td>
<td>RWE Npower Renewables</td>
</tr>
<tr>
<td>Dogger Bank</td>
<td>North Sea</td>
<td>9,000</td>
<td>Forewind Consortia (SSE Renewables, RWE Npower Renewables, Statoil and Statkraft)</td>
</tr>
<tr>
<td>Firth of Forth</td>
<td>Scotland</td>
<td>3,500</td>
<td>SeaGreen Wind energy Ltd (SSE Renewables, Fluor)</td>
</tr>
<tr>
<td>Hastings</td>
<td>South</td>
<td>600</td>
<td>E.On Climate and Renewables</td>
</tr>
<tr>
<td>Hornsea</td>
<td>North Sea</td>
<td>4,000</td>
<td>Mainstream Renewable Power, Siemens Project Ventures</td>
</tr>
<tr>
<td>Irish Sea</td>
<td>Irish Sea</td>
<td>4,200</td>
<td>Centrica</td>
</tr>
<tr>
<td>Moray Firth</td>
<td>Scotland</td>
<td>1,300</td>
<td>EDP Renovaiveis, Seaenergy Renewables</td>
</tr>
<tr>
<td>Norfolk Bank</td>
<td>Southern North Sea</td>
<td>7,200</td>
<td>East Anglia Offshore Wind Ltd (Scottish Power Renewables and Vattenfall)</td>
</tr>
<tr>
<td>West of Isle of Wight</td>
<td>South</td>
<td>900</td>
<td>Eneco New Energy</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>32,200</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Job role</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning and development</td>
<td>3,382</td>
</tr>
<tr>
<td>Design and manufacturing</td>
<td>20,909</td>
</tr>
<tr>
<td>Construction and installation</td>
<td>10,598</td>
</tr>
<tr>
<td>Operations and maintenance</td>
<td>6,734</td>
</tr>
<tr>
<td>Technical, financial and legal services</td>
<td>1,121</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42,745</strong></td>
</tr>
</tbody>
</table>

Paper 2
Challenges for offshore wind

Supply chain

The scale of round 3 will require a dramatic increase in manufacturing capacity for offshore wind, such as turbines, foundations, offshore electrics and installation vessels. Building confidence is key to persuading companies to invest in increased supply chain capacity.

The government’s role is central in providing a stable policy framework against which investment decisions can be made. The UK is already beginning to see examples of new factories being built such as JDR Cable’s new interarray cable facility at Hartlepool and Skykon’s investment in new capacity at their Welcon Towers subsidiary in Campbeltown. However, the size of the UK’s round 3 alone represents a step change in demand. Industry will need to dramatically increase capacity in the key supply chain constraint areas including offshore specific wind turbines, installation vessels and in manufacturing capacity for cables to link the wind farm to shore.

A major concern is whether new manufacturing facilities will actually be built in the UK close to the new market, or whether they will be based on the continent where there are already established onshore wind turbine manufacturing facilities. While onshore wind manufacturing is dominated by Denmark, Germany and Spain, as a new area of business offshore wind offers opportunities to new entrants from both overseas and the UK to emerge as market leaders in innovation and the supply of technology to create a British based supply chain.

Key to attracting this new investment is the creation of coastal manufacturing hubs, much like Aberdeen is a centre for the North Sea oil industry through the development of improved UK ports to provide companies with the space and quay facilities they need – a key requirement for offshore wind construction. If offshore wind turbine manufacturers decide to locate new factories in the UK, then new opportunities will also arise for existing manufacturing companies in other sectors such as automotive and aerospace to enter the market for components such as gearboxes, bearings, castings and other internal components. A solid skills base will be required to build the industry. The emerging offshore wind industry can draw on the engineering excellence and maritime history of the UK. However, industry will need to be mindful of potential shortages in the number of suitably qualified and experienced new candidates. Addressing the most immediate demand for installation, operation and maintenance skills will be prioritised. Support for the wind industry’s efforts in developing a UK wide training scheme for apprentices is central to ensuring that there is a big enough pool of skilled workers in the UK to meet demand.

Grid

Every power station requires a connection to the electricity grid to supply customers in homes, offices and factories. The expansion of offshore wind will mean that new connections will need to be made. The new grid connections will be managed by Offshore Transmission Operators (OFTOs), and the system is designed to encourage competition and reduce prices. New grid connections should be tailored to the needs of each project. If the transmission regime is not developed on the right scale and timing for delivering projects, those grid connections could reduce the efficiency of the process.

The planning system

The expansion of the offshore wind sector will put huge pressure on the government departments and statutory bodies that need to assess each of the proposed projects. They already face staff and funding shortages and this will become much more serious as their workload increases.

The creation of the Infrastructure Planning Commission (IPC) invested a new body with the power to foster a streamlined, transparent and fair consenting process. The Marine and Coastal Access Act regime creates policy tools intended to protect the marine environment and consider all marine interests in one place. The offshore renewables industry is competing with a large number of interests for the use of the seabed, including the fishing, oil and gas industries, maritime industries, the Ministry of Defence and conservation. In order to deliver the potential expansion expected these policy tools must take into account the likely impact on the ability to site wind farms.

By Peter Madigan
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Paper 3

**Offshore wind: challenges and opportunities for the UK marine sector**

By Captain Mathew Mazhuvanchery, Operations Director, Clarkson Technical Services Ltd

The delayed round three site announcements earlier this year received a warm but muted response from the British marine sector. Port managers, coastal fabricators, divers, small vessel suppliers and others in the offshore wind supply chain have diligently waited for the renaissance repeatedly promised by the government on the back of the publically subsidised development of offshore wind. Of the roughly £100 billion investment expected in the sector by 2020, realists quickly pointed out that once capital expenditure costs for turbine and subsea structures had been taken out of the pot along with large project vessel chartering, the windfall for the UK’s marine sector would probably be even optimistically less than £20 billion. Most of this sum will be deployed towards the end of the decade as deployment hits an anticipated 3GW per year and earlier installations emerge from their five year warranty periods into the Offshore and Marine (O&M) sector.

However, there are more deep rooted issues the UK will have to tackle to ensure this promised rejuvenation and job creation in and around its ports takes place. With little strategic oversight of the sector’s growth, the UK lags far behind countries like Germany, where streamlined planning, infrastructure investment and clear long term policy direction has, for example made Bremerhaven the port of choice for German wind farm installation, created thousands of jobs and rejuvenated the town and port. In the UK, when round three gets underway, operations are likely to be limited to three or four main ports with little spare for everyone else. Unlike round one and early round two projects that could be run out of the nearest port, as vessels were relatively small and turbines and monopiles limited in scale and number, round three will require major investment in portside facilities. Turbine and monopile weights will increase, with other larger and/or heavier substructures such as jackets becoming more commonplace, so cranes and other dockside handling facilities will have to grow to match. Vessels will get larger and more numerous, requiring greater draft and space to navigate. Ship fastening, personnel supply, stevedoring and repair capacity will have to increase, even at our largest existing ports and this will focus investors on a small number of key ports rather than spreading investment up and down the coast.

There is also some scepticism of the existing models for deployment and installation. Much has been said of the technical challenges of round three, but even round two has seen two fatalities in the last year. Projects, running to tight schedules and even tighter budgets have suffered from inadequate vessels and inexperienced crews occasionally to the detriment of health and safety. Coastal vessels stretched beyond their capabilities, overoptimistic estimates for bringing together complex supply chains, and inclement seas have seen costs per Megawatt installed rise, bucking the expected experience curve cost reductions. It is yet unclear how realistic round three deployment at scale really is. Round two installations have used up to 29 vessels on a single project, focused around a project vessel with supporting barges, jack ups, crew vessels, mammal spotters, etc. What is the round three fleet going to look like? As heavy lift vessels grow in size for example, they will encroach on Oil and Gas (O&G) assets (indeed the Stanislav Yudin is already an example of this) with dramatic increases in day rates and crewing levels.

O&M is often touted as the great source of longer term revenue for the UK marine sector. But again, the shape of this sector is yet to be defined. We have already seen small coastal O&M bases and permanent offshore facilities built into projects like those at Horns Rev. Will manufacturers continue to compete for maintenance contract after warranty aiming to service their whole fleet of turbines or will new service sector players make a land grab for the business? There is a huge spectrum of outcomes both in business and implementation models going forward and a big slice of the pie for UK ports is by no means guaranteed.

Finally, the round three announcements made it very clear that the majority of big players in this sector continue to be based on the continent. From turbines to heavy engineering partners, consortia are predominately not UK based and so, aside from a healthy consultancy sector, the British taxpayer is at risk of subsidising foreign growth. This disparity is not soley down to the dominance of European utilities; large fabrication facilities in Holland and Germany have made it very clear that the majority of offshore facilities built into projects like those at Horns Rev. Will manufacturers continue to compete for maintenance contract after warranty aiming to service their whole fleet of turbines or will new service sector players make a land grab for the business? There is a huge spectrum of outcomes both in business and implementation models going forward and a big slice of the pie for UK ports is by no means guaranteed.

The overall picture is one of a lost opportunity. The North Sea O&G boom gave rise to a British industrial sector which learnt its lessons from the pioneering work being
done in offshore drilling, and then used that technical expertise and human assets to build a global presence. Taxpayer monies that helped develop North Sea O&G saw manifold returns from the development of UK companies that became bywords for excellence throughout the global O&G sector. There is little chance we will see a similar flowering in the offshore sector unless the government acts with some urgency.

Beyond their tepid progress to what is now a healthy top line subsidy, the government has been bereft of a real vision for the UK offshore wind sector. Where Governments in Germany, Holland and Denmark nurtured ports, provided infrastructure, and showed leadership and vision, the Labour Government have come late to the party and despite the UK sitting on the best wind resources in Europe, have left UK PLC last in the queue to reap the benefits of new investment and the valuable first mover advantage for UK companies which could lead to UK dominance in the sector worldwide.

Admittedly, even a small percentage of the huge investment to 2020 and beyond into offshore wind will significantly stimulate our ports, supply chain and service businesses and the government of the day will be quick to claim credit. But unless the government of today acts soon to lay out a clear vision, make tough choices and focus development and investment, we will see this taxpayer funded enterprise delivering nothing more than a bare minimum for UK PLC. Looking back in 2025 when the renewable energy business will be a pillar of the global economy, the abiding legacy of this Government’s energy and business policy could be the huge missed opportunities in this sector.

By Captain Mathew Mazhuvanchery
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As part of its commitment to meeting 2020 renewable energy requirements, the UK has ambitious targets to increase the growth of renewable energy, necessitating the efficient harvesting of 33GW of offshore wind. The major challenges facing developers of offshore transmission infrastructure are:

1. Capital investment (Ofgem estimates £15 billion for offshore assets alone);
2. Delivering efficient and coordinated network infrastructure configurations;
3. Swiftly progressing the required technological developments;
4. Meeting the time pressures for connecting wind-power generators;
5. Utilising economies of scale and coordination in procurement and supply chain activities to ensure that UK doesn’t end up at end of queue (behind other countries) and unable to deliver within timescales;
6. Optimising the connection of offshore networks to the onshore system through difficult and environmentally constrained terrain, shorelines and sea bed.

Whilst it may be suitable for discrete projects with limited scope for future extension/interconnectivity, the competitively-tendered franchise approach administered by a single buyer is NOT the optimal approach for delivering multi-party assets – the “trunk roads” – which could form part of a larger interconnected offshore grid, capable of interconnection with the continent.

An integrated approach to developing the multi-user assets, with coordinated management of technological developments, an extremely pressured supply chain, a limited pool of skilled engineering resource, and activities in sensitive terrain/shoreline/seabed would be better managed by a single developer, not just because of the cost savings to UK consumers and UK plc which would result, but also from the point of view of delivering this infrastructure on time for generators to connect, for users to benefit from cleaner energy, and for the process to be managed in a way which minimises disruption to the environment.

Coordination with Europe is another key area to consider – the North Sea Grid initiative will require input from the UK and under the currently proposed regime it is not clear who would provide that. If numerous UK offshore infrastructure developers are to be involved then it is difficult to see how the UK will be able to be as influential in this development as if it were a coordinated, single-developer approach.

National Grid not only has the expertise to deliver this integrated solution to multi-user assets, but also has the willingness to take substantive financial exposure by sharing the consequential risks and benefits of such strategic decisions.

The objectives are challenging but achievable, and will require:

- A clear plan to ensure efficient delivery;
- An integrated approach throughout the supply chain;
- Coordination of activities on “trunk roads” by a single, financially-committed developer; and
- A stable, transparent regulatory regime.

By National Grid
Conclusions

By ICE Energy and Maritime Panels

Introduction
The United Kingdom possesses some of the richest wind, wave and tidal resources in Europe which could supply up to 50% of UK electricity demand. The move to a low carbon economy and the need to improve energy security requires the UK to exploit these resources. The expansion that is currently planned also presents the UK with an opportunity to stake out a position as a leader in a growing industrial sector.

Scaling up development – the example of North Sea oil and gas
Unlocking the potential of offshore marine technologies will require development on a scale similar to rapid growth experienced by the North Sea oil and gas sector from the 1960’s to the 1980’s.

At the beginning of the 1960’s the United Kingdom had no significant indigenous production of oil and gas. The centres of world production lay in the Middle East, the Caribbean and North Africa. The spatial imbalance and economic interdependency created an environment that raised energy security as an economic and political issue.

The barriers to the development of the oil and gas industry in the 1960’s were similar to those, faced by the offshore marine renewables sector today, including:
- high development costs
- risk
- technology costs

At the beginning of the 1960’s the search in the North Sea was predominantly for gas. A large gas field had been found in Slochteren, Groningen (Netherlands) in 1959, establishing opportunities for gas in the North Sea. In 1965, British Petroleum announced the discovery of the West Sole gas field in British waters. At the same time rising energy prices on the global market began to make the sector more attractive, establishing a commercial opportunity for the United Kingdom in the North Sea.

Government facilitated the exploitation of this opportunity with policies that promoted the commercialisation of the North Sea. The Continental Shelf Act 1964, clarified ownership, allowing speedier exploration and exploitation of the continental shelf. By selling leases the government created an environment which allowed long term investments to be made with security for the investor and income for the exchequer.

In 1975, the UK first produced oil from the North Sea, and by the 1980s was a net exporter. Revenues from royalty payment, concessions et al meant that the exchequer was receiving over £12 billion per year by 1984-5.

Repeating this exercise for offshore renewables
Rising prices on the global market were the catalyst for exploitation of North Sea oil and gas. Government’s role was to provide a clear legal framework in which development could take place.

By contrast the development of offshore renewables is primarily a response to the need to reduce carbon emissions and improve energy security, imperatives which are fundamentally changing the way the energy sector is viewed and managed. Once again government has attempted to provide a clear framework but has also had to intervene in the market via the Renewables Obligation.

In other aspects the current approach to offshore wind in UK waters by the Crown Estate is similar to the approach taken in the development of the oil and gas industry. Exclusive licences have been granted to companies willing to make the necessary investment to exploit these resources. The first round of projects is now complete and operating successfully; a second round of projects is under way and in January 2010, licences for a third and much larger round of projects were issued. A significant difference with this third round of licences is that Crown Estate will be co-funding developments. Having missed out to mainland European companies in the development of wind turbine supply capacity, the UK is fast becoming the market leader in offshore wind services, but we will not be the market leaders in all services. Rapid expansion of the offshore wind industry in South East Asia may cede some of this position to our competitors.

The UK will need to reflect on the experience of the development of wind power if this situation is not to repeat itself in the fledging wave and tidal sectors.

What needs to happen?
To deliver the goal of a secure decarbonised electricity supply the UK will need to fully develop its offshore wind, wave and tidal resources. As with North Sea oil and gas, this also presents an opportunity to create a
major new industrial sector, with significant export potential. To ensure that the UK grasps this opportunity ICE believes that action is needed in three broad areas.

1. Continued government leadership
Without intervention in the market electricity from offshore renewables can not compete with lower cost fossil fuel generation. Until such a time as the cost of carbon and the value of energy security are directly reflected in energy prices, government will need to continue to provide a financial framework to support wind, wave and tidal power.

In relation to offshore wind, the Renewables Obligation (RO) after successive changes, has provided the necessary catalyst for investment and should remain in place. ICE recognises that the RO has been criticised as a costly means of expanding renewables supply but believes that continuity and certainty of policy is vital during a period when developers are considering whether to make very large investments in the UK.

In addition, while the RO is an adequate means of support for technically more mature sectors such as offshore wind, this is not the case for wave and tidal power where technology is in its infancy. In these sectors direct capital grants to support R&D and trial deployments will need to be continued.

Alongside this financial support, government will need to ensure that the planning and consenting regime for offshore facilities is able to deliver timely and predictable decisions. Onshore port facilities will also have to be developed to support the construction phase of projects. We believe that the market is responding to this need but again, delay or uncertainty around planning must be avoided.

2. New thinking on regulation
Since 2003 ICE has been warning that the UK faced a real threat of energy demand outstripping supply. In 2009, we conducted a major inquiry into the security of all UK infrastructure networks. This inquiry found much frustration at the narrowness of the factors considered in assessments of acceptable Return on Investment (RoI) for regulated utilities. The subsequent report, State of the Nation: Defending Critical Infrastructure called for reform to the remit of OFGEM and other regulators to encompass improved long term resilience.

It is therefore pleasing, if overdue, that OFGEM’s February 2010 report Project Discovery - Options for delivering secure and sustainable energy supplies does look at future patterns of demand and includes proposals for tackling both uncertainty about future carbon prices and long term security of supply.

Whichever party wins the forthcoming General Election, the incoming government must embrace this opportunity and reform the role of OFGEM. This in turn will provide a further boost for the development of offshore renewables.

3. Identify key opportunities for UK supply chain
In their contribution to this publication Renewable UK find that if 20GW of offshore capacity is constructed by 2020 and 70% of the design and manufacturing takes place in the UK then nearly 45,000 British jobs will be directly created. There are obvious question marks as to whether these figures will be achieved. Even if 20GW is constructed it is by no means certain that 70% of design and manufacturing will take place in the UK. This highlights the importance of making an early and realistic assessment of the opportunities for the domestic supply chain and putting in place measures to support UK companies looking to scale up their activities to support the offshore programme.

The UK through the development of the oil and gas sector in the North Sea has experience in the development of offshore engineering. The need to develop ports and services that can supply and support the sector will be as important as the offshore sector itself. The need to harness the expertise in the engineering sector and to deploy it so the skills are not lost as the supply chain grows to deliver the offshore wind sector will be important.
References

Paper 1


35. Leybourne M.T., Batten W.M.J., Bahaj A.S., O’Nians J., Minns N. (2009)


Conclusion

1. 100TWh/year from 33GW of installed windpower capacity. 50TWh/year from 20GW of installed tidal power capacity (tidal stream and tidal range) and perhaps 20GW/year from wave power. Note that while the wave power resource is much larger than 50TWh/year, the future economics remain uncertain

2. Continental Shelf Act 1964. Office of Public Sector Information

3. HMRC – Government Revenue from North Sea Oil and Gas Production. HMSO