Appendix C: Marine Renewables

C1.1 Introduction

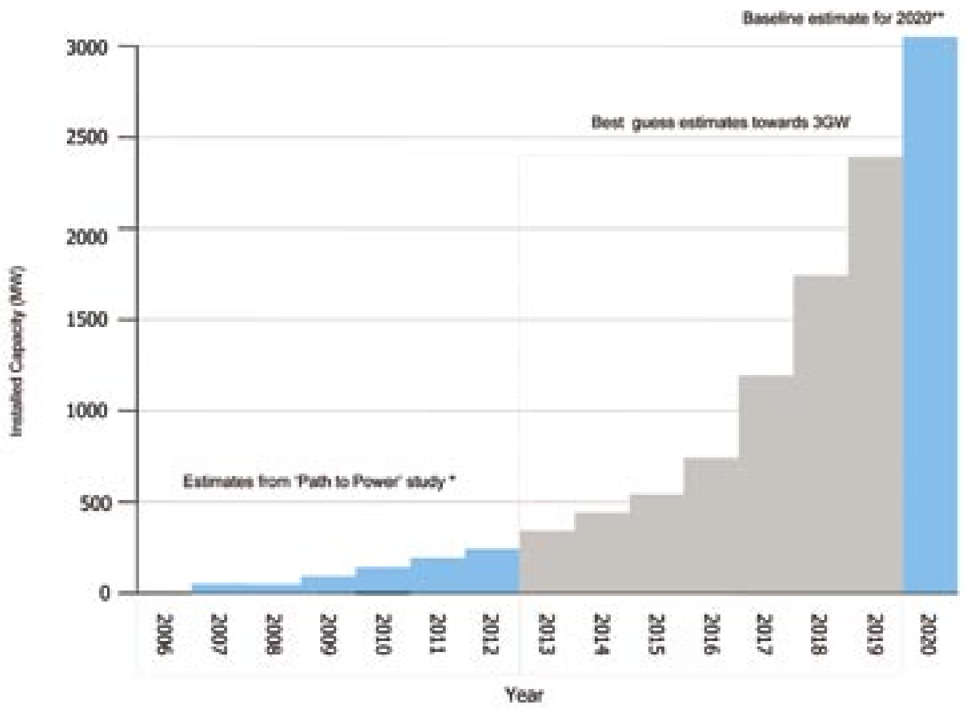
The UK is uniquely well placed to maximise the potential benefits stemming from the development of the new marine renewable energy technologies. It has the best wave and tidal stream resources in Europe and a significant skills base applicable to offshore engineering and project development. The offshore wind programme for the UK is also presently larger than any other country in the world, and this is helping to enhance the experience of UK companies involved specifically in the development of offshore renewable electricity installations. On top of this the UK is also home to the world's most advanced wave and tidal stream technology developers, who have, over the past few years, been increasingly supported, both directly and indirectly, by many bodies on a national, regional and local level.

C1.2 Potential deployment

In terms of future growth, the Carbon Trust's Marine Energy Challenge states that on present estimates between 15% and 20% of current UK electricity demand could eventually be met by wave and tidal stream energy. It also states that by 2020, up to one sixth of the UK Government's aspiration of 20% renewable electricity could be met by marine renewables (i.e. about 3% of total UK electricity supply). The Carbon Trust suggests further that between 1.0 GW and 2.5 GW of each of wave and tidal stream energy could be installed across Europe by 2020 and that a large share of this deployment could occur in the UK. On the basis of this BWEA estimates that a baseline figure of 3 GW (7.88 TWh using a conservative capacity factor of 30%) of wave and tidal stream could be installed in the UK by 2020, this represents 2.1% of UK electricity supply in 2020 based on a total supply estimate of 374 TWh in 2020 (see Figure C.1).

It is clear that the market potential is sufficiently large to merit considerable interest in its commercial development. These levels of deployment are, however, dependent on adequate, timely and suitably designed Government support mechanisms as outlined in section C3 of this submission.

Figure C.1: Potential deployment for marine renewables in the UK out to 2020



* Figures from Stage 1 of 'The npower Juice Path to Power' following interviews with industry

** Based on conservative estimate of Carbon Trust Marine Energy Challenge figures for 2020

(Sources: Stage 1 – 'The npower Juice Path to Power' (This BWEA managed project will be launched in June 2006 and will present a route-map for the development of marine renewables in the UK); The Carbon Trust – 'Future Marine Energy', www.thecarbontrust.co.uk/carbontrust/about/publications/FutureMarineEnergy.pdf)

C1.3 CO_2 reduction potential

Reducing CO_2 emissions in the electricity supply sector will involve the substantial expansion of a diversity of renewable energy generation technologies. Present support ensures the least cost (currently) renewable technologies are developed first – this means onshore renewables are the most likely to substantially contribute to CO_2 reduction targets in the short term, particularly onshore wind and landfill gas. In the medium term these technologies will begin to reach natural capacity levels and the UK will begin to rely heavily on its offshore strengths in order to maximise its supply of bulk power from the renewables sector. Without offshore renewables, the UK is unlikely to meet its aspiration of 20% renewables in the supply mix by 2020 or any further targets for bulk generation going forward. This has the potential to substantially and negatively affect CO_2 reductions in the larger general energy mix.

Taking the deployment estimates outlined in C1.2, the Carbon Trust suggests that reductions of several tens of million tonnes of CO_2 are likely from 15-20% marine renewables in the UK supply mix in the longer term. By 2020 several gigawatts of wave and tidal stream energy across Europe should lead to annual CO_2 abatements of 2-7 mt CO_2, most of which is expected to be recorded in the UK. The global potential for emission reductions stemming from the development of marine renewables is also considerable.

C1.4 Adding to security of supply

Marine renewable energies are indigenous sources of supply. They will not run out and are not exposed to political risk. For this reason their existence alone adds to energy security in the UK. To transform this to security of supply they must be suitably and responsibly harnessed for power production.

As part of the Carbon Trust's Marine Energy Challenge a study into the variability characteristics of the UK's wave and tidal current power resources and their implications for large scale development scenarios was commissioned. This was conducted by the Environmental Change Institute (ECI) at the University of Oxford. This states that a strategic approach to development between developers and industry, between planners and network operators and between financiers and market policies should allow for an ability to supply meaningful and reliable electricity at times of peak demand from wave and tidal stream energy. Understanding the resource is central to this planning and Government should look to increase support in this area in order to ensure a reduction in variability from the marine environment and an increase in renewable base load security.

For more information go to www.thecarbontrust.co.uk/ctmarine3/res/Variabilityofwaveandtidalstream.pdf

Further research by ECI highlights that a mix that includes wind, wave and tidal stream energy can markedly reduce the variability of electricity supplied even further. It states that by building a balanced portfolio of technologies with wide geographical dispersion across the UK, renewable technologies such as wind, wave and tidal stream will together deliver smoothed electrical output, high reliability and a significant reduction in the need for fossil-fueled generation. Given that high wind and wave energy periods in the UK have a significant correlation with high energy demand in the winter months the argument for the development of offshore renewables for energy security is strengthened further.

C2.1 Where are we now?

The UK Government has been supportive of technology developers through the provision of capital grant funding since 1998. This has been successful in bringing a small number of indigenous companies to the forefront of this global sector. The DTI's Renewables Innovation Review also prioritised marine renewables for further support from the 2004 Comprehensive Spending Review due to the potentially significant environmental and economic benefits they could bring to the country. This was followed by the release of £50 million in August 2004 that was to be predominately utilised as revenue-based support in addition to the Renewables Obligation. The intention was to enhance incentives for multiple-device, grid connected project development through the reduction of financial risk in the early stages of deployment. By providing support mainly for power production, it was also intended to reduce the potential burden on the public purse should any failures occur. The need for this form of support was put forward by industry through *Into the Blue*, a BWEA project conducted by Climate Change Capital in early 2004 (see www.bwea.com/pdf/intotheblue.pdf).

This work led to the DTI putting its 'Wave and Tidal Stream Demonstration Scheme' out for consultation in early 2005. The funds became available for industry to bid into in March 2006.

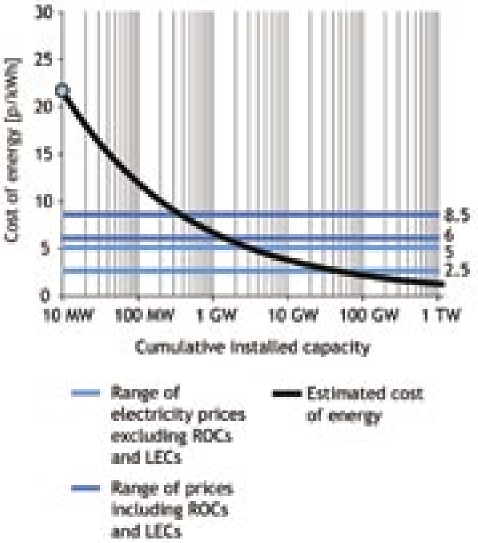
The terms of acceptance for this scheme have been regularly denounced as overly restrictive by industry since its conception, due mainly to the funding caps imposed on projects. These, it has been stated, do not provide the incentives necessary for the development of many technologies that have higher initial costs than others, regardless of their potential for significant cost reductions through larger deployment potential.

C2.2 Potential for cost reductions

The potential for cost reductions has been studied independently through the Carbon Trust over 18 months since early 2004. 'The Marine Energy Challenge' concluded that central estimates for current costs of wave energy projects were in the range 22-25p/kWh. Tidal stream projects' central current cost estimates, it states, are 12-15p/kWh. It must however be highlighted that there are a much larger range of wave energy technology types. This increases the range of current costs and has the potential to affect the central range figures. The large majority of tidal stream technologies, on the other hand, are beginning to consolidate around the horizontal axis turbine. This makes for a greater clustering of current cost potentials around the central estimates.

In relation to cost reductions for offshore wave energy, The Carbon Trust presents three scenarios based on differing starting costs and learning rates. Figure C.2 shows the central estimate scenario of starting at 21.6p/kWh with a 15% learning rate. This highlights a convergence with the high price RO market figures following the global deployment of hundreds of megawatts, which could occur reasonably quickly given the expected 2020 UK-only marine figure of 3,000 MW, much of which is expected to come from offshore wave:

Figure C.2: Offshore wave energy cost reduction scenario



21.6p/kWh starting point, 15% learning rate

(Source: The Carbon Trust, Future Marine Energy, 2006, www.thecarbontrust.co.uk/carbontrust/about/publications/FutureMarineEnergy.pdf)

The Carbon Trust states that there is potential for costs to reduce considerably in the future. Through a combination of engineering analysis and inference from other industries they have formed a view of the likely extent of these reductions for both offshore wave energy and tidal stream. Their conclusions are that:

- Marine renewable energy has the potential to become competitive with other generation forms in the future. In present market conditions it is likely to be more expensive than other renewable and conventional generation until at least hundreds of megawatts of capacity are installed
- Fast learning or a step change cost reduction is needed, and likely, to make offshore wave energy converters cost competitive for reasonable amounts of investment

- Tidal stream energy could become competitive with current base costs of electricity within the economic installed capacity for the UK of 2.8 GW.

C3.1 Support Requirements

Due to the emerging nature of the technology, marine renewables are presently high cost electricity providers operating in a relatively low cost market. For this reason, Government must support their development in order to help bring forward the private investment necessary to drive down costs as outlined above. This support must take into consideration the fact that investors will require suitable returns on their projects in order to release the investment levels necessary to bring wave and tidal stream energy costs down into the RO and beyond. Given that the potential for future growth globally is huge, support mechanisms in the early stages must allow for this investment to flow unrestrained towards the sector through the provision of adequate commercial returns. This is the only possible way to ensure the industry hits the cost reduction curves and deployment levels in the UK which, in turn, is the only way to embed the manufacturing, supply chain, project development and research skills base in this country. Given that cost reductions are expected to occur reasonably quickly, the return on the Government investment should be realised in the form of considerable economic, environmental and social benefits within a relatively short time frame.

C3.2 Targeted and timely support

At this early stage of development there are a number of risks for investors. It would therefore be prudent for Government to help minimise the most manageable ones. The problem with this lies in the fact that political risk is paramount. It would therefore be best to implement a long-term support system that works outside the process of Government spending reviews, which only assure resources for a few years with no guarantee of continuation at the next review, whilst in parallel providing funds to departments for the implementation of targeted support to specific aspects of project development. Such incentives would ensure that suitable private funds were drawn towards projects and that they could be developed with confidence and in a timely manner that ensures the momentum created in the manufacturing and project development supply chain does not decline (this would be very difficult and costly to re-create, if at all, given present global competition for this industry). By creating this momentum through a pump priming of the industry during early deployment, the UK would quickly be in a position to supply to the European market with technologies and experience which would in turn lead to greater cost reductions through economies of scale and increase the embedded nature of the industry.

Support should be targeted in the following areas, all of which will be outlined in greater detail through the release of the BWEA project 'The npower Juice Path to Power', which will be released in mid-June 2006. This project has been funded by the npower Juice fund and is intended to provide a route map to commercialisation for the marine renewables, through identifying where projects may concentrate around the UK, the consenting and grid issues they will face, and not least the means required to support the sector economically. BWEA hopes Government will pay close attention to the results of this work, and use it as a basis for putting in place the long-term policies this nascent industry requires.

C3.2.1 Market support

The DTI's demonstration support scheme is restricted, both in terms of funds and time. It does not provide the long term signals of support necessary to incentivise the necessary system outlined above. What is required immediately from Government is a statement of intent to address the long-term needs of the sector through revenue based support in a manner that does not impinge on the integrity of the RO. This must ensure a balance between the level of returns necessary for investors at this stage having to be above that for most other technologies (given the inherent risks of early stage development), and the level of deployment, so that this additional support can be reduced down to what the RO provides without adversely affecting the expected growth of renewables on the whole. Indeed the argument must be made that a net gain to UK plc will result from maintaining expected renewable growth with an expansion of marine technologies due to the benefits of industrial value creation for both an internal and external market.

This appears to be the approach being adopted by the Scottish Executive, which is looking to consult on how best to support marine in such a way. A number of suggestions are being put forward by industry as part of the preparatory work to the consultation, but the scope of the study is to look at all options available, including that of increasing ROC numbers specifically for wave and tidal stream.

Outside the necessity of a market based support mechanism for investors, more targeted support should be directed at the areas set out below.

C3.2.2 Consenting support

In November 2005 DTI released consenting guidelines to help marine renewable technologies enter English and Welsh waters as demonstration projects, without the need for Strategic Environmental Assessment. This was welcomed by industry as a positive step towards ensuring wave and tidal electricity production in the short term. DTI is also in the process of creating a research and monitoring programme that will be implemented with the support of £2 million from the original £50 million released in 2004. This should help slightly in the reduction of costs to developers and help increase the knowledge and confidence of stakeholders in what are essentially, at this stage, unknown technologies with unknown impacts on the environment.

Given the high financial risks at the demonstration level of development BWEA recommends that Government increases this pot of funds in order to ensure further monitoring and baseline assessments can be carried out as part of the consenting process for marine projects. A similar arrangement to the Collaborative Offshore Wind Research Into The Environment (COWRIE) fund for offshore wind could then be phased in; this would see developers increasingly contributing to the research funds as the industry expands. For more information on COWRIE see www.offshorewindfarms.co.uk.

At this early stage, investors require the confidence that any investment made now has the potential for increasing returns in the future. Without this confidence, capital injections will be at the high end of the risk-return spectrum. As any plan or programme for the development of marine renewables will require a Strategic Environmental Assessment (SEA), BWEA recommends that Government set in place a strategy for implementation of SEA in areas suitable for wave and tidal stream deployment at the earliest opportunity. This will send out positive signals that marine renewables are being considered in the medium to long term as potential power providers and therefore help companies in their discussions with investors. Of course such a strategy must be followed up by action in a timely manner in order to ensure that companies can hold onto their supply chain networks through their expansion from demonstration schemes to larger scale projects and beyond, without the risk of waiting for Government to put in place the required processes for deployment.

The Scottish Executive is already conducting a desk based assessment on a strategic level in order to build this confidence in the sector for the longer term. These signals are important for a high risk sector in its infancy, and could dictate how and where the industrial benefits are built. Without them, there exist constraints on development that manifest themselves in more expensive capital and therefore increased risk for projects at the earliest stages of project deployment.

It is also imperative that the Governments Marine Bill takes the UK's unique offshore renewable energy strengths into consideration. This must allow for future projects to develop in areas that combine excellent wind, wave or tidal resources with suitable onshore grid capacity. The implementation of the Marine Bill must not restrict the development of marine renewables.

To see BWEA's perspective on the Bill go to www.bwea.com/pdf/Marine-Bill.pdf

C3.2.3 Grid support

As the DTI's marine renewable energy atlas shows, the UK's wave and tidal stream resources are concentrated in certain areas around the UK. Correlation between these areas and the onshore grid capacity necessary to transfer the converted energy to centres of demand varies considerably between areas, and additional support of various kinds will be required if the UK's maximum marine potential is to be harnessed.

See www.bwea.com/marine/atlas.html

As part of 'The npower Juice Path to Power' project, Econnect has recently produced a study for BWEA that looks at these constraints and suggests what needs to be done in order to overcome them. Overall it states that grid issues for marine are the same as already identified for onshore wind. The key point is that much of the resource is in Scotland and will be competing with onshore wind for access to transmission system capacity from Scotland to the demand centres in England. It therefore joins the

Scottish queues along with the Scottish wind developments. Although some upgrades to the transmission system are planned, and allowing that some existing generation may close in the interim, capacity is already booked by wind projects.

Removing these bottlenecks will require either further reinforcement of the transmission system in Northern England and Scotland, a change to the regulatory arrangements for granting access to the network or, more likely, a combination of the two.

Grid issues are, however, unlikely to be a major barrier in the South West (Devon and Cornwall) so it may be that early marine renewable developments might focus on this area initially. The South West also has a significant wave and tidal stream resource. Nevertheless, given the expected time delays in grid reinforcement such development must be scoped early for Scotland in order to allow for penetration into the UK's best marine resources once the technologies are cost-competitive under the RO.

C4.1 Conclusions

The UK has the best wave and tidal stream resources in Europe. These hold the potential to supply up to 20% of the countries electricity supply needs in the long term. This would have substantial implications for CO_2 emission reductions from the electricity sector and security of supply concerns. There is also a large global market for technologies that can convert power from waves and tidal streams into electricity. This means early UK policy support for marine renewables could have a significant impact on global emission reductions in the long term.

Presently the UK is at the forefront of the technology market but ongoing Government support will be required in order to ensure private investment at the scale necessary to bring costs down into the RO. The potential for cost reductions is however significant and marine renewables could be cost competitive under the RO following the deployment of hundreds of megawatts. The majority of this early deployment must be in the UK if supply chain networks are to embed themselves in this country in support of a global market.

Political risk at this early stage of industrial development must be minimised and support mechanisms should be designed in reflection of this. Support must also be available for projects when required to avoid any decline in the momentum that must be created around the sector as a whole.

This support must take the form of:

- Market-based revenue support above the RO to help wave and tidal stream compete in the electricity market and allow costs to reduce via economies of scale. This must be long-term, UK-wide and ensure suitable returns for investors in order to provide incentives for further investment
- Increased support for monitoring and research at all stages of project development in order to help increase confidence with stakeholders and investors alike
- Conducting Strategic Environmental Assessment across the UK will be necessary for marine renewables to expand in the future. A clear strategy for its implementation is therefore required
- An assessment of grid reinforcement requirements and a strategy for their implementation must be conducted
- Changes to the regulatory arrangements for connecting projects to the grid will also be required to ensure the availability of onshore connection points in areas of suitable resource.

BWEA will be producing 'The npower Juice Path to Power' in mid-June 2006. This will address the above support requirements in greater detail. As this work will be based on substantial discussions with industry, stakeholders and Government departments we would recommend that Government pay close attention to the results of this work, and use it as a basis for putting in place the long-term policies this nascent industry requires.

For more information on wave and tidal stream energy go to www.bwea.com/marine