Energy and Climate Change Select Committee Inquiry: The future of marine renewables

About Aquamarine Power

Aquamarine Power is a wave energy company, headquartered in Edinburgh.

Last month the company successfully installed its second full-scale device – the 800kW Oyster 800 – as the first part of a 2.4MW Oyster array, located at the European Marine Energy Centre (EMEC), Orkney. The array will comprise three Oyster wave power devices, with two further devices to be installed in 2012 and 2013.

The project is being supported through a groundbreaking £3.4 million loan with Barclays Corporate - the first time a UK marine energy project has succeeded in securing bank debt finance. The loan will be repaid over five years from revenue generated by the 2.4MW array.

The company previously installed a single full-scale 315kW Oyster 1 device at Billia Croo in 2009.

Aquamarine Power's Oyster wave power technology captures energy in nearshore waves and converts it into clean sustainable electricity. In simple terms, Oyster is a wave-powered pump which pushes high pressure water to drive a conventional onshore hydro-electric turbine.

Aquamarine Power has raised over £50m of private and public funding to date including £8m investment in 2010 by global power and automation company ABB. Aquamarine Power's investors also include SSE (Scottish and Southern Energy plc), the UK's leading generator of renewable energy, and Sigma Capital Partners plc.

The company has a clear route to market for its Oyster device. In 2009, Aquamarine Power signed a development agreement with SSE Renewables to develop up to 1GW of Oyster wave farms. In 2010, Aquamarine Power was awarded a 200MW lease option in partnership with SSE Renewables as part of world's first seabed leasing round for wave and tidal projects. This year, the company was also awarded a 40MW lease option for a proposed wave energy site on the Isle of Lewis.

The company's Chief Executive Officer Martin McAdam and Chief Finance Officer Richard Round would both welcome the opportunity to meet with members of the Select Committee and give evidence if required.

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Executive Summary

The United Kingdom has a global lead in the marine renewables market, drawing on an extensive skills base, developed supply chain and some of the best wave and tidal resources in the world. However, domination of this potentially global industry is an opportunity, not a right, and decisive action is needed to cement the UK's position and maintain its lead over other nations developing interests in the sector.

The marine energy sector is a good example of the UK leading world innovation and it is vital that the commercial benefits are retained. Policy to date has bought forward the first pre-commercial devices and the current challenge is to advance the industry to commercial scale. This path is well trodden by renewable energy technologies, but marine energy needs key support right now.

The industry is at a critical stage and government support is crucial to achieving a thriving industry. The announcement of £20 million of funding through the Department of Energy and Climate Change (DECC) Low Carbon Innovation Fund was welcomed by industry, yet it is less than half the funding previously offered through the Marine Energy Delivery Fund (MRDF). Furthermore, it falls well short of the £120 million capital support the industry needs to deliver on its massive potential. Experience has shown that for every £1 funding by the public sector, the private sector raises £6 and government capital support is essential to developing the industry.

There are a number of key actions the government can take. These include:

- Deliver continued targeted innovation and cost reduction funding
- Ensure a long term, consistent and sustainable revenue support package
- Encourage involvement of utilities and project management teams, which improve investor confidence
- Apply lessons learnt in offshore wind such as enhancing the transmission grid to keep pace with technology development

The sector offers significant economic benefit for UK plc. British companies such as Pelamis, Aquamarine Power and Marine Current Turbines are leading the way in deploying their technologies in UK waters, with six out of the eight full scale prototypes in the world being installed here. While the large-scale benefits of marine may not materialise for a decade or more we must invest political and financial capital now to ensure it becomes a key part of our move to a low carbon energy supply.

1. What are the potential benefits that marine renewables could bring to the UK and should Government be supporting the development of these particular technologies?

1.1. The UK's substantial wave and tidal resources present an opportunity to build a world leading industry, with significant benefits to the nation in terms of reducing carbon emissions and furthering economic development. In particular, a thriving marine energy industry would offer the potential to capitalise on the UK's significant global lead in marine energy technologies, utilising our existing supply chains and revitalising the wealth of its maritime legacy.

1.2. A number of recent reports have concluded that the sector could deliver:

- 4.5GW by 2030 and up to 60GW by 2050 (Carbon Trust, 2011)
- Cost parity with nuclear and onshore wind by as early as 2025 (Carbon Trust, 2011)
- 10,000 jobs and revenues of nearly £4bn per year by 2020 (RenewableUK, 2010)

- 68,000 jobs and £76bn revenue to the UK economy by 2050 (Carbon Trust, 2011)

1.3. The existing offshore wind and oil and gas industries have developed a supply chain that could be enhanced by the marine renewables industry. Most of the technology is home-grown and there is huge potential export value from technology sales and electricity revenue. The value of job creation would be of particular benefit for coastal communities supplementing other sources of income, some of which are declining (eg. fishing).

1.4. In addition, marine energy would contribute to increasing security of supply as a significant component of a balanced energy portfolio, mitigating issues such as intermittency of supply. Marine energy has highly forecastable resource characteristics which complement those of other renewables such as wind, and therefore will allow maximum total penetration of renewables on our electricity system.

2. How effective have existing Government policies and initiatives on marine renewables been in supporting the development and deployment of these technologies?

2.1. We are now entering a crucial phase where the industry needs to make the difficult transition from development and demonstration to full commercial scale operation. Government support has been effective in enabling a number of leading firms to move their technologies from the drawing board and into the water as full scale prototypes.

2.2. Aquamarine Power, Atlantis Resources Corporation, Pelamis Wave Power and Marine Current Turbines have received collectively a total of £33 million public funding over the last ten years which has in turn leveraged private sector investment of £189 million.

2.3. In the past, the industry failed to articulate its requirement accurately. As a consequence the DECC-led Marine Renewables Delivery Fund (MRDF) was not designed to support early projects as its criteria did not reflect the current state of the industry and marine technology had not at the time reached the stage of development where it could access the funding and progress to small arrays.

2.4. However, other schemes such as the Wave and Tidal Energy Support Scheme (WATES), Wave and Tidal Energy: Research, Development and Demonstration Support (WATERS), and the Carbon Trust's Marine Renewables Proving Fund (MRPF) have been extremely successful with a range of resulting technologies either in the water or about to be installed.

2.5. These initiatives, systematically delivering projects, have stimulated cost reduction and improved the viability of the industry. Examples of projects where Government support has been crucial to the development of the project are: Aquamarine Power's recently-installed Oyster 800 which utilised over £5 million support from Scottish Enterprise and the MRPF; the Orcadian Wave Project, using Pelamis wave technology and benefitting from a £3m WATES grant and the Hammerfest Strøm, which obtained a £4m grant from the MRPF,

2.6. Other initiatives such as the Technology Strategy Board's programme, the Engineering and Physical Sciences Research Council (EPSRC) and The Crown Estate's leasing rounds have been helpful in demonstrating a route to commercialisation for those technologies which are successful at the testing stage as well as promoting the UK marine energy sector internationally.

3. What lessons can be learnt from experiences within the UK and from other countries to date in supporting the development and deployment of marine renewables?

3.1. The best place to learn lessons is from other similar sectors such as wind which have already gone through the commercialisation process. A study into the success of the Danish wind industry undertaken by Aquamarine Power offers a useful comparison of the approaches taken to support the nascent wind industry in the two decades from 1980.

3.2. Although both countries invested similar sums in R&D in support of early stage technologies, Denmark was much quicker in putting in place a stable and well-understood market support mechanism. This was the critical factor which enabled Denmark to create a stable market price for wind energy thereby incentivising early investment and innovation and allowing Denmark to build a global export market worth nearly €6 billion in 2008.

3.3. The lesson for the UK is that a complete support package is required for marine energy, combining grants and revenue support. The UK's current regime of ROCs is well understood and offers a clear price signal to investors. However, the application of marine energy ROCs is applied inconsistently - in Scotland there are five ROCs per MWh for wave energy and three for tidal, whilst in the rest of the UK there are only two ROCs per MWh for each technology. It is crucial the level of support for marine energy delivered through the Electricity Market Reform offers a consistent and long-term price signal which will incentivise investment in the sector.

3.4. Other factors that have been shown to have an impact in the development of a renewables industry are:

- Funding support for testing and demonstration, ensuring that world-leading projects are built on home soil.
- Institutional and policy support in areas such as planning and grid, reducing risks and cutting down timescales.
- Industry-led academic support from universities and research programmes to boost industrial developments and embed technology developers and manufacturers nearby.
- Direct support for manufacturing including supply chain initiatives to help local companies get onto the supply chain ladder.
- Maximum use of existing expertise and synergies
- Support for infrastructure development such as ports

4. Is publicly provided innovation funding necessary for the development of marine technologies and if so, why?

4.1. Public finding is essential for the growth of the sector, and to leverage more private funding. The RenewableUK report “Channelling the Energy” and the Carbon Trust Report “Accelerating Marine Energy” (reference in footnotes) both articulate the requirement for public sector revenue and grant support to enable marine energy to reach commercialisation.

4.2. The UK Government’s commitment to the sector now needs to continue in a different guise as commercial scale projects are developed. There is a rich variety of technologies available now with most of the serious ones either completing or entering their

demonstration phases. The fittest of these will survive but will need to be able to move seamlessly into commercial scale projects if those companies are to survive.

4.3. The particular public funding needs over the next few years are:

- Market support at 5 ROCs for both wave and tidal power.
- Grant support at 25% of capital cost for the very first small arrays (5MW to 10MW likely to cost £40m - £80m), plus some form of low cost debt - potentially from the Green Investment Bank.
- Continued grant support at 40% for prototype testing, to bring forward sufficient concepts to ensure the best ideas make it through to commercialisation.

4.4. It is important to point out that this support is only needed to start the sector. Once development gets underway we expect costs to reduce both due to economies of scale, and to learning rates as designs are optimised, manufacturing techniques advance, and risk premiums reduce.

4.5. Over time we expect the grant requirements to be replaced by private financing from the market. However, commercial scale projects require a different scale of investment from the private sector – tens of millions instead of millions. A healthy level of capital investment support is required to soften the risk profile for private sector investors. It is very clear from various discussions with project investors that Government support will make or break their corporate investment decisions.

4.6. However the Government can, and should, rely on the private sector continuing to support the sector strongly provided that the key Government policy implementation is in place and remains so. As with other technologies before, the industry will ultimately be able to stand on its own two feet once economies of scale have been achieved.

5. What non-financial barriers are there to the development of marine renewables?

5.1. There a number of non-financial barriers across a range of fronts and urgent action is needed to eliminate or mitigate those that are within our control.

5.2. **Technical issues (installation and deployment):**

5.2.1. These are being addressed by technology developers with an overall focus on improving reliability and driving down cost. R&D should be focussed on industry-led research to drive down cost and improving reliability and which do not require unnecessary collaboration or loss of IP which could result in unutilised funds. Forcing unnecessary collaboration or loss of IP means funds are not utilised.

5.3. **Grid:**

5.3.1. The nature of many of the sites identified as being suitable for marine energy projects is that they are often in remote locations where the transmission network is weak. In general the capacity of the transmission network to accommodate additional large scale generation is going to be a significant issue.

5.3.2. Action is required on two fronts:

- Transmission upgrades to ensure the capacity is put in place by 2015/16 – particularly in the Pentland Firth and Western Isles.

- Transmission charging which ensures a fair transmission charging regime which does not penalise generators on the periphery of the UK.

5.4. **Consenting:**

5.4.1. The consenting process could prove to be one of the most significant constraints to development. At present the signs are positive as regulators and statutory consultees seem keen to work with developers to get projects consented. However, the system has not yet been properly tested and it is only when larger array projects start going through the consenting process that we will know its efficiency.

5.4.2. The planning system procedures need to be efficient, transparent and easily understandable. Dialogue need to be set up to ensure that renewables can coexist with other marine users, such as the shipping and fishing industries. Public understanding of the issues need to be enhanced as the expansion of the renewables industry needs support at both local and national levels. It would be beneficial to the industry if Marine Scotland and Scottish Natural Heritage policy is aligned with UK and Scottish renewables targets Clarity is still to be delivered by Marine Scotland on the operation of its Survey, Deploy and Monitor policy.

6. To what extent is the supply chain for marine renewables based in the UK and how does Government policy affect the development of these industries?

6.1. Much of the existing supply chain is in the UK. More than 90% of the supply chain for the Oyster 800 device was within the UK, Some specialist components cannot currently be sourced within the UK and this represents an opportunity to support supply chain development here.

6.2. The next challenge will be to attract the supply chain that can deliver multiple devices to the cost and quality that customers will demand. The supply chain will be looking at the level of subsidies that will be put in place to stimulate the deployment of the first farms of tidal turbines and react accordingly.

6.3. Government policy can have a direct and strong bearing on supply chain prospects, through providing market confidence and maximising the prospects of UK supply chain involvement. The critical enabler for the growth of the UK supply chain in marine renewables lies in the success of marine energy technology. If the leading technologies do not get the support they require there will not be a UK marine energy industry. If the industry is enabled to grow, the supply chain will follow.

6.4. Maximum use should also be made of established expertise in sectors such as oil & gas and offshore wind. This is not always easy given this sector is currently highly focused on its own core business needs. Government encouragement could play a key role.

7. What approach should Government take to supporting marine renewables in the future?

7.1. Government should continue to engage with industry through fora such as the MEPB, RenewableUK and Scottish Renewables to understand the sector's needs. There is a strong requirement for a more joined up approach across Government to ensure that all policy areas are aligned, for example BIS, DECC and HMT should cooperate to provide a unified vision for marine energy.

7.2. There is little demand from marine energy developers for the concept of Marine Energy Parks. In one sense, the whole of the UK is a marine energy park – the supply chain for Oyster 800 stretches from major facilities in Falmouth and Fife to specialist fabricators on the Western Isles and local contractors in Orkney. We cannot see what added benefit there would be from giving one region a greater comparative advantage to another. Marine energy development will take place in areas where there is the best resource and the best economic incentive. Investment and supply chain opportunities will stem from successful marine energy developments, not from Marine Energy Parks.

7.3. To date Government investment has supported the development and demonstration of a wide variety of ocean energy technologies. The task is now to change the focus and nature of public investment to take these technologies to commercial scale operation as the precursor to the sector establishing itself as a viable renewable energy source competing equally with the alternatives.

7.4. The costs of the first commercial scale tidal array are estimated to be in the region of £40-80m for a 5-10MW deployment of up to ten devices. A capital grant of at least 20-25% together with five ROC's for each MWh of generation plus some form of low interest debt, potentially from the Green Investment Bank, are conditions precedent to attracting the balance of private sector investment at a mid-teens IRR.

7.5. Although five ROCs implies high generating costs, there is robust evidence that can confirm the costs will fall to competitive levels given the usual economies of scale and learning curve effects that follow the "roll out" of a few reasonable sized projects. It is worth noting that typical project size is small enough to ensure that ROC costs remain small but that the ROC benefits will ultimately be very high if they can kick off a major new industry.

7.6. The industry has estimated that capital support of £120m is required build a thriving marine renewables industry. While the £20m funding provided by the DECC Low Carbon Innovation Fund is welcome support, it is less than half the amount provided previously through the MRDF and falls well short of providing the stimulus the marine industry requires to overcome the barriers to commercialisation. A coordinated funding approach, bringing together BIS, DECC and HMT would create opportunities to leverage the private sector investment and accelerate industry growth.

7.7. It is envisaged that key financial players such as the Green Investment Bank will be able to make significant contributions beyond 2015 and broaden the pool of investors for large scale marine energy projects. The GIB could play an important role in enabling developers to access guaranteed debt for projects. To date, the GIB has not considered support for early-stage marine energy projects and it should be encouraged to take on higher risk projects than commercial financial institutions otherwise the GIB will be merely be in completion with existing banks.

7.8. Furthermore, the committee should examine what other support could be made available from the UK Government to enable other leading developers to deploy the first pre-commercial arrays. It is vital that support is considered during the current CSR, or there is the real danger government will have funded a number of technologies to the point at which they fail.

8. Are there any other issues relating to the future of marine renewables in the UK that you think the Committee should be aware of?

8.1. The marine energy industry is a massive opportunity to build on the maritime legacy that the UK has developed over a substantial period of time. The developed supply chain, high level of expertise and first mover status gives the UK a competitive edge that should be enhanced through positive government action.

8.2. However, the uncertainty around the sector is allowing other nations to erode the lead the UK has built up and current developments are further impacting confidence in the sector. The lower than expected capital grant and the upcoming Electricity Market Reform has reduced the feasibility of the industry. Government needs to act now to ensure that funding support given up until now is not wasted.

8.3. Time is absolutely of the essence. It is no exaggeration to say that the future of this sector is likely to be determined in the next 2-3 years. Unless the industry can establish a couple of commercial scale tidal array projects, it is very difficult to see how companies will be able to sustain investment. Provided that the revenue support and capital support mechanisms are activated in the next few months and efforts are made to eliminate barriers, marine energy can deliver on its potential.

9. References

- Carbon Trust accelerating marine energy report;: http://www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTC797

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- RenewableUK report Channelling the Energy: http://www.bwea.com/pdf/publications/RenewableUK_MarineReport_Channelling-the-energy.pdf

- The Danish wind industry 1980-2010: lessons for the British marine energy industry: http://www.aquamarinepower.com/sites/resources/Published%20papers/2914/The%20Danish%20wind%20industry%201980%20-%202010%20Lessons%20for%20the%20British%20marine%20energy%20industry%20International%20Journal%20of%20the%20Society%20for%20Underwater%20Technology.pdf