SUBMISSION FROM AQUAMARINE POWER

About Aquamarine Power
Aquamarine Power is a wave energy company, with head offices in Edinburgh and further operations in Northern Ireland, Orkney and the USA. In 2009 the company successfully deployed its flagship technology, known as ‘Oyster’, at the European Marine Energy Centre (EMEC), in Orkney. The device operated successfully for 6000 hours over two winters. In Autumn last year the company installed its next generation device – the 800 kW Oyster 800. It is currently being commissioned.

Aquamarine Power’s goal is to develop commercial Oyster wave farms around the world.

Aquamarine Power has signed an agreement with SSE Renewables to develop up to 1,000MW of Oyster wave farms by 2020. Discussions are in progress with further potential development partners.

Oyster is designed to capture the energy found in nearshore waves and convert it into clean usable electricity. It uses a simple hinged flap connected to the seabed at around 10m depth. Each passing wave moves the flap which drives hydraulic pistons to deliver high pressure water via a pipeline to an onshore turbine which generates electricity.

Multiple Oyster devices will be deployed in wave farms typically of 100MW or more.

Aquamarine Power offers a wave farm site development service to support the growth of Oyster. The company’s innovative computer modelling system allows it to identify and develop the best sites for wave energy production around the globe.

Targets

- Are the 2020 renewables targets (for electricity and heat) achievable? If not, why not?

We believe the 2020 renewable electricity target for Scotland is achievable. In particular we believe the Scottish Government’s 1 GW target for marine energy can be achieved.

However government plays a crucial role in ensuring the marine energy target is met. If the industry is to progress, it is important that government puts in place the support mechanisms to enable the first marine energy arrays to be developed, and a long-term revenue signal to incentivise investment in the sector.

As our response will show, securing access to finance is the second major challenge to the industry, in addition to the technical challenge of proving new technologies which can successfully harness the power of the seas.

In Scotland there are currently five gigawatts (GW) of renewable projects operational, under construction or consented. In addition to this there is a pipeline of
23.5 GW of generating capacity, either in planning and scoping or already consented. The current target to generate the equivalent of 100% of Scotland’s own electricity demand from renewables by 2020 roughly equates to 16GW of installed capacity. It is quite clear that there is more than sufficient industry interest in developing Scotland’s renewable capacity to ensure the target is achieved. This is not to suggest there aren’t challenges to be faced but to recognise that there is confidence in Scotland’s renewable sector and if the current strong political support is maintained the targets can be met.

**Challenges**

- **Technology**

- **Is the technology to meet these targets available and affordable? If not, what needs to be done?**

Scotland has a genuine global lead in marine energy technologies, both wave and tidal. In addition to some of the best wave and tidal resources in Europe, Scotland boasts a world-leading test facility at the European Marine Energy Centre in Orkney. Scotland is also home to the world’s largest commercial leasing round, with 1.6GW consented by the Crown Estate in the Pentland Firth and Orkney waters, plus further leased areas around Skye, the Western Isles and Shetland.

The opportunity for Scotland is tremendous. If a number of firms are able to prove their technologies within the next few years, Scotland will have consolidated its lead and will have begun creating a global market with multi-£billion export potential.

The key challenges for marine energy are:
- **Technical.** Proving early stage technologies at scale at sea, and bringing down the cost of power.
- **Financial.** Raising the necessary combination of grants, debt and equity to enable the first arrays.
- **Financial.** A long term revenue signal via a marine energy feed in tariff.
- **Grid.** An appropriate charging regime which does not disadvantage generation at the periphery of the UK and enables transmission upgrades to go ahead.
- **Consents.** Ensuring timely and appropriate consents are gained.

These challenges are closely linked. The leading marine energy companies have already successfully installed single full scale devices and a number of companies, including Aquamarine Power, are installing next-generation devices.

The next step for the industry is to install small arrays of 3MW to 10MW scale by 2015, in order to demonstrate technology viability, bring down the cost of power and give confidence to attract new investment into the sector. At present costs are high. Single full scale prototype devices can cost around £10 million, with first arrays at around £5 million to £8 million per MW installed.
To get these projects off the ground a number of non-technical challenges will need to met and will be covered in the questions on finance, supply chain, planning.

- **Are electricity generating or heat producing technologies compatible with the need for security of energy supplies?**

  Yes, the generation or renewable energy insulates customers from volatile global commodity markets and reduces the flow of money out of Scotland. The UK currently depends on imports for 48 per cent of its gas imports with this figure expected to increase despite interest in shale gas and coal bed methane. Scotland is faced with the enviable opportunity to be energy independent and renewable at the same time, the opportunity must be seized.

  By having a greater diversity of renewable energy sources, including hydro, pumped storage, wind, offshore wind, wave and tidal issue of variable supply become much less significant.

  The Committee on Climate Change estimates that even with 65 per of our energy provided by renewables in 2030, intermittency may cost just 1p per kilowatt hour. Other countries within Europe have successfully integrated higher proportions of renewables within their energy mix.

  Furthermore, future energy scenarios can still include base load generation which can be switched off at times of high renewables supply. During Hurricane Katia, for example, many UK fossil fuel power stations generated significantly less electricity than normal, as their generation was replaced by higher output from wind turbines. This illustrates the role that renewables can play in reducing fossil fuel consumption in power generation and UK carbon emissions.

- **Are our universities and research institutes fully geared up to the need for technological development, innovation and commercialisation?**

  Scotland has a very positive and joined up approach to energy research. The Scottish Energy Laboratory and the Energy Technology Partnership already enable companies to identify appropriate research and test facilities and draw upon world-class research expertise.

  More recently the launch of the Offshore Renewable Catapult Centre in Glasgow significantly enhances this existing capability. This TSB-funded centre will bring together Scottish research facilities with highly respected partners the Carbon Trust and Narec to bring focus and cohesion to the UKs research and development capability in offshore renewables.

  The Catapult centre will not only draw in significant public and private funding, but will bring industry and academia closer together – with the clear goal of commercialisation of the offshore renewable sector.
Aquamarine Power maintains very strong links with leading Scottish universities, and also has an in-house research and development team at Queen’s University, Belfast as well as a world-leading wave resource assessment team in Edinburgh.

This team works alongside the specialist marine energy research team at Queen’s University, Belfast, with whom we have a long-standing research partnership. The team at Belfast is led by one of our technical advisors Trevor Whittaker, Professor of Coastal Engineering.

b. Supply chain and infrastructure

- Is the supply chain in Scotland in place to meet the targets?

More than 90 per cent of the Oyster supply chain was UK-based, with expertise and components from as far afield as Falmouth, Arnish, Fife and Orkney.

There is currently sufficient supply chain capability in marine energy, but significant strides will need to be made to grow capacity in Scotland as offshore wind comes on stream. There may be significant competition within Scotland for scarce resources.

The Scottish Government has made positive strides through the development of the National Renewables Infrastructure Plan which has identified the locations across Scotland which offer the biggest potential for private developers to base their manufacturing operations, with rapid job growth scheduled for 2014 and 2015.

As part of this plan, Scottish Enterprise has established a £70m National Renewables Infrastructure Fund to support private sector investors in the development of manufacturing locations. For marine energy, it is essential we are not ‘crowded out’ by offshore wind.

- What further improvements are needed to the grid infrastructure or heat supply networks both at a national and a local level? Additionally, are we confident that the necessary infrastructure can be developed and financed so that Scotland can export any excess electricity generated to the rest of the UK and/or the EU? What is the role for the Scottish Government here?

The lack of grid infrastructure, and the closely related issue of transmission charging to Scottish islands are areas of critical importance to Scotland’s marine energy aspirations. Two thirds of the leased areas for marine energy are based on Orkney, Shetland or the Western Isles. The Crown Estate has granted 1600 MW of seabed leases to wave and tidal developers in its Pentland Firth and Orkney Waters leasing round and a further 125 MW leases elsewhere. Of these, 1150 MW are island based.

The energy regulator Ofgem has put forward proposals on how to redraw the map on how generators pay for access to the UK grid. Their proposals, part of their consultation known as Project TransmiTr, go some way to levelling out the charges across the UK - but still leave very high tariffs for the islands.
The proposed charge is £10 per kW per annum for the north of Scotland, and £77 per kW for the Western Isles. To put this in context, under Ofgem’s proposals a 10MW wave project in Wester Ross would face transmission charges of £100,000 per year. But move the project 40 miles to the Western Isles, and the project would face an annual charge of £770,000 – nearly eight times the cost, and more than enough to stop it leaving the drawing board. This is a big concern. The majority of proposed wave and tidal development in the UK is island based and would face swingeing island charges.

In other words 66 per cent, or two thirds of the UK’s total projected wave and tidal energy development aspirations, are dependent on island connections, at a rate which is unaffordable.

We think this is not only unfair, but is discriminatory to island communities and the marine energy sector, and may be in breach of EU directives. It also misses the point that marine renewables are a major opportunity for UK plc. If fully socialised, the £400 million cost of the Western Isles interconnector would increase average consumer bills by 2 pence per annum.

The issue is not restricted to the marine energy sector. Wind developers in the islands face the same issue, and our concern is that if the charges remain high, there will not be sufficient developers willing to underwrite the cost of grid infrastructure to the Scottish islands, and plans to put interconnectors in place will fail.

We would encourage the Scottish Government to explore every avenue possible – ideally to solve the issue of transmission charging, but if this is not possible, to find some other solution which can enable renewable development to take.

We would also encourage an approach which would enable transmission and distribution companies in Scotland to make anticipatory upgrades to the grid.

c. Planning and consents

- **Is the planning system adequately resourced and fit for purpose?**

The Scottish Government has been very positive in putting in place a framework for ensuring a timely and consistent marine energy consents process in Scotland. The formation of Marine Scotland has given focus to the requirement for marine consents and has to date dealt with consents in a timely and efficient manner.

There have, however been concerns regarding the roles of Marine Scotland and Scottish Natural Heritage which have been addressed by the Scottish Government’s short life task force on consents.

We continue to have concerns over the lack of appropriately qualified personnel in Marine Scotland and recognise this is related to the current very high demand from the private sector for similarly-qualified individuals. We would encourage the government to think innovatively how it can address this shortfall.
We would also like to see, as soon as possible, a draft of Marine Scotland’s survey, deploy and monitor policy and a more positive approach to demonstration development in the vicinity of Natura 2000 designated sites. The precautionary principle precludes putting in place a single device with the intent of discovering how it interacts (if at all) with relevant species. It is impossible to demonstrate no harm, and therefore no development can take place.

- **How can national priorities be reconciled with local interests?**

In particular, we would like to see SNH and Marine Scotland publish clear, concise procedural guidelines to give developers a very clear and straightforward understanding of what information is required and when, and to understand what information is required for statutory purposes and what information is ‘nice to have’.

This would have the added benefit of reducing workload for all organisations involved.

With marine energy, we believe there is a much closer alignment between national priorities and local interests than with some other forms of energy, particularly because the economic benefits of marine energy can be felt very close to where development takes place.

In the example of Orkney, Aquamarine Power has spent over £3 million directly and employed over 40 local businesses in the deployment of two marine energy devices at EMEC. This type of economic activity and capacity building is closely related to the development which takes place, and local people can feel the benefit of developing marine renewables.

This is analogous to Denmark, for example, where early, small-scale wind developments meant people could become involved in and enthused about renewable energy at an early stage in the industry’s development.

**d. Access to finance**

- **Will sufficient funds be available to allow investment in both the installation and the development of relevant technologies? What can the Scottish Government do to influence this?**

There are considerable challenges in the financing of marine renewables.

The goal of the industry is to be cost competitive with other forms of energy generation but in the period to 2020 costs will be relatively high and deployment rates will be low. Beyond 2020, when new technologies are fully proven, their generation potential will be high.

The attraction for Scotland is that, in addition to a new form of renewable energy, Scotland has the potential to consolidate its existing global lead in marine energy
technologies and build a world-leading export industry with up to 19,000 UK jobs by 2020 and 68,000 UK jobs by 2050.

A study of the wind energy in Denmark undertaken by Aquamarine Power\(^1\) showed that one of the key factors in Denmark’s success story was that the government put in place a long-term, stable revenue incentive to encourage early development.

Scotland has already taken this leadership position with 5 ROCs for wave energy and 3 for tidal, which it is anticipated will be harmonised at 5 ROCs across the UK. This, however, will only give sight of the incentive for projects installed by March 31 2017.

Beyond that, the view is unclear. The critical enabler for our industry will be the long-term signal of a suitable marine energy feed in tariff (FIT). The shift from ROCs to FITs has already unsettled potential investors, and what we need now is a stable tariff that will stay in place, and not be tinkered with for a number of years.

The UK Government has already signalled it will provide certainty on this issue by 2014. The Energy and Climate Change Committee has urged DECC to deliver its decision in 2013. We agree with this position. There is no doubt this industry can deliver investment and growth, but early sight of the marine energy FIT will be key.

In addition to a revenue incentive, early stage array projects will require grant funding. As stated earlier, first arrays will cost in the range £5 million to £8 million per MW. We believe early stage projects will need a combination of 5 ROCs, grants of 25 per cent or higher, plus potentially some form of soft loan or government equity.

There are currently a number of grant schemes available - £20 million from DECC via the Marine Energy Array Demonstrator fund (MEAD); £18 million from the Scottish Governments Marine Renewables Commercialisation Fund (MRCF) and further funds from the European FP7 programme and NER 300 scheme.

Whilst on the face of it, this support seems large, together these funds may enable a maximum of five 5MW projects, or a total of 25MW up to 2015.

We believe that, if the UK has genuine aspirations to grasp a leadership position in marine energy, further funding should be provided to encourage more than 25MW of deployment in the next four years.

To put it in context, DECC will provide a total of £20 million grant support for marine energy in the current CSR period. DECC provides a grant of £2 billion per annum to the nuclear decommissioning authority.

\(^1\) [http://www.aquamarinepower.com/sites/resources/Published%20papers/2014/The%20Danish%20wind%20industry%201980%20-2010%20Lessons%20for%20the%20British%20marine%20energy%20industry%20International%20Journal%20of%20the%20Society%20of%20Underwater%20Technology.pdf](http://www.aquamarinepower.com/sites/resources/Published%20papers/2014/The%20Danish%20wind%20industry%201980%20-2010%20Lessons%20for%20the%20British%20marine%20energy%20industry%20International%20Journal%20of%20the%20Society%20of%20Underwater%20Technology.pdf)
This is an area where the Scottish and UK governments should continue to work closely together where support could be provided in the form of government-backed loans or government equity.

To date, leading marine energy developers have leveraged £5 of private sector investment for every £1 of government support. Aquamarine Power has raised more than £70 million of investment of which just over £12 million has been grant support.

If the UK is seeking a potential industrial growth narrative, marine energy offers significant potential.

- **What will the impacts be on consumers and their bills?**

We believe the impact of renewable support has been grossly overstated. In the average annual domestic electricity annual bill of £581, the total cost of the Renewable Obligation (RO) is just £20. Wind receives less than half of that £20 (or 1.8% of current consumer bills). By 2017, the RO will cost some £50 which would be the equivalent of 5.2% of electricity bills if other fossil fuels remain flat.

From 2000 to 2010, and after adjusting for inflation³:
- Average electricity bills increased in real terms by 30%
- Average gas bills increased in real terms by 78% - peaking at 91% above 2000 levels in the year 2009

This has been overwhelmingly driven by one factor alone: the rising costs of fossil fuels. From 2000 to 2010, and again after adjusting for inflation:
- The price paid by power producers for coal increased in real terms by 71%
- The price paid by power producers for natural gas increased in real terms by 90% - peaking at 123% above 2000 prices in the year 2008

Coal and gas are used to produce 73% of our household electricity, and gas for heating 80% of our homes, leaving us vulnerable when wholesale fossil fuel prices rise, as they have done in recent years. The price power producers pay for gas has gone up 90% in real terms in the last ten years⁴.

Ofgem anticipates that the lowest 2020 domestic fuel bills would be likely to be realised under a ‘Green Stimulus’ scenario in which the UK reaches its 2020 renewable energy target⁵.

Contrary to much media coverage, the latest YouGov Sunday Times poll (Nov 2011)⁶ of nearly 1,700 people showed a clear and significant majority remained firmly in favour of renewable energy subsidies, wind farms, and solar installations.

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⁴ All figures are in 2005 prices. Source for all figures: DECC Energy Price Statistics:


⁵ DECC, Quarterly Energy Prices, table 3.2.1:


⁶ http://www.ofgem.gov.uk/markets/whlmkt/discovery/Documents1/Discovery_Scenarios_CONDOC_FINAL.pdf
Nearly three quarters want to see more solar power and 56 per cent want more wind farms, compared to only 35 per cent who want more nuclear and 16 per cent who want more coal power.

More significantly, 60 per cent think it is right for the government to subsidise wind farms to encourage investment in new capacity, compared to just 26 per cent who oppose such policies and 15 per cent who don’t know.

Similarly, 47 per cent think wind farms are a realistic way of combating climate change, compared to 36 per cent who don’t, with the remainder unsure. Meanwhile, over two thirds think solar power can realistically combat climate change.

e. Skills and workforce development

- Will Scotland have sufficient home-grown skills to attract inward investment? Are current policies producing the move towards Science technology Engineering and Maths subjects at schools and universities? Is the skills transfer from the oil and gas sector being realised?

Aquamarine Power has a workforce of 58, of which 85 per cent has a degree as a minimum qualification. 48 per cent staff have a masters or PhD.

We have had a very positive experience in recruiting graduates from Scottish universities and from offering paid work placements to undergraduates. We have also had some success in recruiting experienced staff from the oil and gas sector, although our capacity to offer competitive reward packages is a challenge.

f. Energy market reform and the subsidy regime

a. Are the reforms of the energy markets and subsidy regimes at both UK and EU level sufficient?

As the previous answer on finance refers, the proposed introduction of a feed in tariff under the EMR to replace ROCs in 2017 has created further uncertainty for potential investors – the very opposite of what the marine energy sector requires.

The sooner the UK Government can give an indication of the level of the marine energy FIT the better.

The reform of transmission charging by Ofgem under Project TransmiT is also a significant cause for concern for the marine energy sector on particular. Together,

the uncertainty created by these reforms, and the lack of clarity on their outcome, has the potential to delay new investment in the sector – at the very moment where high levels of financial support are required.

In Europe, the announcement in November 2011 of an agreed position paper on ocean energy, supported by Belgium, Denmark, Norway, France, Ireland, Netherlands, Portugal, Spain and the UK, showed that the potential of marine energy is moving up the European energy agenda.

The paper “Towards European industrial leadership in Ocean Energy in 2020” highlights the potential of ocean energy to satisfy 15 per cent of EU energy demand and create 314,000 new jobs across Europe by 2050, and calls on the European Commission to fully recognise this potential by including the sector in the EU’s Strategic Energy Technology (SET) plan.

The paper also has the full support of the Scottish Government, the British-Irish Council and the European Ocean Energy Association.

SET plan inclusion is an important goal. It would recognise the potential for ocean energy to make a contribution to Europe’s carbon reduction goals - and would unlock significant new funding to support the sector’s growth.

Aquamarine Power
29 February 2012

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