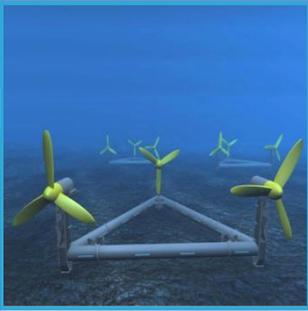


Marine Energy Infrastructure Study: Stage B – Final Report

December 2012



1. Executive Summary

1.1 Introduction and Background

The Welsh Government sees great potential in developing the marine energy (wave and tidal stream) resource around its coasts and strongly supports the development of a marine renewable energy industry in Wales. Facing the Atlantic and the Irish Sea, it has enviable wave and tidal energy resources. A rich marine heritage means that Wales can offer ports and supply-chain infrastructure that may be adapted to meet the needs of this nascent industry. The benefits that may be brought to Wales through expansion of the marine renewable energy industry relate not only to opportunities to reduce carbon emissions and promote sustainable energy, but also include the potential for industrial and economic regeneration.

The Welsh Government has commissioned Halcrow Group Ltd (a CH2M Hill Company) to undertake this Marine Energy Infrastructure Study. This is a review of the infrastructure needs of the marine renewable energy industry. However, through development of an understanding of industry requirements, it has been extended to consider any other areas of marine renewables project development that would benefit from government support. The study has made use of extensive consultation with stakeholders, together with a review of strategic data available through the previous MRESF project (see below).

This report records the findings of the study and presents information in support of further Welsh Government involvement in the development of the marine renewable energy industry. It progresses from the following milestones that have already been achieved by the Welsh Government in the development of marine energy policy.

- **Energy Policy Statement ‘A Low Carbon Revolution’ (March 2010)**. This identified the opportunities and challenges facing all parts of the green economy, and the potential for governmental involvement in encouraging the renewable energy industries in order to obtain the benefits of reductions in greenhouse gas emissions and to promote sustainable economic growth.
- **Marine Renewable Energy Strategic Framework (MRESF) project (Completed March 2011)**. This was a three year study that collated and mapped a broad range of energy resources and environmental data throughout Welsh Territorial Waters, together with the physical and environmental constraints that may apply to development.
- **Energy Policy Statement ‘Energy Wales : A Low Carbon Transition’ (March 2012)**. This sets out policy on the promotion

and development of all forms of energy. It restated the Welsh Government's commitment to the European Union's objective of reducing greenhouse gas emissions by 80-95% by 2050 compared to 1990, with a consequent impact on increasing low carbon electricity generation. It describes the Government's ambition to 'create a sustainable, low carbon economy for Wales', together with actions that it sees as necessary to promote energy generation and good management.

The Infrastructure Study has been prepared to consider the opportunities and constraints that apply to growth in the marine energy industry, and to identify ways to encourage further expansion for environmental and economic reasons. It specifically covers the emergent wave and tidal stream energy sectors, and does not include tidal range or offshore wind energy technologies as these are covered by separate investigations. The study has been delivered over two phases:

- **Stage A** - In coordination with the Welsh Government and supply-chain specialists, BVG Associates, we engaged with stakeholders to identify industry needs. This has allowed insight into the needs of the various parts of the marine renewable energy industry and forms the basis of the recommendations made by the study.
- **Stage B** - Having determined industry requirements and understood the appetite for provision of infrastructure and other intervention, the second phase has identified the primary resource areas in Welsh waters, together with a brief assessment of cost and likely constraints and risks to development. This report incorporates the cost estimates and initial outline feasibility work undertaken during Stage B into an outline Business Case.

The presentation of this stand-alone Stage B report has been targeted at readers who are from within the Welsh Government and who are seeking explanation of the need for government intervention in supporting growth in the marine renewable energy industry. The 'Stage A report – Industry Consultation and Concept Design' provides background information in a less abridged format that may be more accessible to the public.

At this stage of demonstrating the overall need for government intervention, the appraisal is deliberately non-specific as to the preferred regions or individual landfall sites to be developed. This is because discussion on the benefits or challenges associated with each site would distract from key points of the report. Furthermore, it has not been possible, within the scope of the study, to fully investigate and consult with stakeholders and local communities regarding the nature of the potential projects and their potential environmental impacts.

A number of other studies and investigations have been undertaken concurrently to the Marine Energy Infrastructure Study, by DECC, RenewableUK, the Crown Estate and the UK Government. There appears to be broad agreement in the recommendations and conclusions of these reports in relation to this Marine Energy Infrastructure Study and its investigations into the specific characteristics and requirements of Wales. Specifically, all of the studies indicate that substantial marine energy resources are available for use in generation, but there is a need for ongoing governmental support in terms of both grants towards the capital cost of projects and revenue subsidy.

1.2 The Welsh Opportunity

Strong wave energy resources are distributed throughout the world's oceans, but particularly in the Southern Ocean, Pacific, and North Atlantic, whereas the strongest tidal stream energy resources are concentrated at a small number of sites in Western Europe, Canada, and south-east Asia. However, much of the global energy resource is difficult to extract due to the practicalities of working in remote locations at sea. The UK, and Wales in particular, has an advantage in having energy resources close to centres of population and industry. Whilst this has obvious potential benefits with regard to finding suitable deployment sites, there are wider opportunities presented by establishing Wales as a centre for marine energy production. In assisting industry to develop generation technology from its current prototype testing stage to multi-device array deployments, opportunities will be presented for Welsh local industry and academics to expand their knowledge and capability to export services to other parts of the UK and abroad. The cost of energy generation by conventional fossil-based fuels is predicted to increase. As this occurs, the best opportunities will be initially presented to those regions that have first developed an integrated supply-chain with appropriate technical skills and academic support.

To operate generators effectively over long periods and transmit the energy to shore, a number of essential items of equipment and facilities are required. These include foundations, electrical cables, hubs, navigational marks, cable landfall, shore stations, grid upgrades and port facilities. It is the provision of this infrastructure that the study has considered with regards to its function in supporting growth in the marine energy sector. However, through consultation with industry and other stakeholders, we have also identified other, non-physical interventions that would also act to promote growth. These include supporting developers through the consenting process and procurement of strategic energy resource and marine environmental data.

Wales has the following important strengths and advantages that put it in a competitive position within the UK and Europe with regard to developing a marine renewable energy industry.

- Available marine energy resources
- Proximity of energy resources to population centres
- Existing energy industry capability
- Strong transmission grid infrastructure
- Local port facilities and associate supply-chain
- Environmental and consenting expertise
- Research partnerships
- Community awareness and engagement

1.3 Industry Challenges

To make full use of the marine energy resources that are available in Welsh waters, there would need to be expansion of the marine renewable energy industry and the generator technology on which it is based. Whilst the overall available energy resource does not present an obvious constraint to development, there are a number of challenges that are faced by the industry, as it grows from single-device prototype deployments through to commercial-scale arrays.

Deployment in Challenging Conditions

In order to maximise revenues from the sale of energy, it is common for developers to wish to deploy in the most powerful energy resource areas. However, the sites with powerful wave and tidal conditions can be difficult to access for installation and maintenance. Furthermore, there are greater risks (and costs) relating to the survival of equipment that is deployed in extremely aggressive environments.

Potential Environmental Impacts

Despite the locally available expertise and the significant investigation works undertaken to date, there remain significant gaps in knowledge with regard to the potential impacts of multi-device arrays on both the overall marine energy resource and the marine environment in general, and this is recognised as presenting a current constraint to the consenting of large array developments.

Supply-chain Development

As projects move into full commercial production, it is likely that developers will seek to appoint Single Contract Suppliers that would be contracted to manage all parts of the supply-chain. Whilst small local suppliers may be attractive to developers during early prototype development, there may be some reluctance to use them on larger contracts for reasons relating to production capacity, quality management, third party technical accreditation and insurance.

Shore-side Infrastructure

Each prospective marine renewable energy deployment requires a connection to the shore, together with landfall and control sub-station works, and then a connection to the local electricity distribution network. The planning and funding of such engineering works for each project is not economical when considered in isolation. Benefits would be presented by a strategic approach to the provision of infrastructure to support development in identified marine energy resource areas.

1.4 Options Considered

In our investigations to identify the most appropriate and effective means of intervention, the following high level options for intervention have been reviewed.

Do-nothing - In all government Business Cases, a Do-nothing option must be considered. In the appraisal, this acts to demonstrate the nature and full extent of the problem that is faced, and is used as a baseline against which all other options are compared.

Strategic Surveys - Discussions with developers and statutory stakeholders indicated that growth in the marine renewable energy industry is obstructed by a lack of marine environmental data relating to the primary energy resource areas. Whilst the information presented in MRESF is extremely useful in scoping broad environmental issues, this is not at a sufficiently high resolution to enable robust selection of deployment zones within each strategic area.

Research and Test Facilities - Discussions with academics, statutory stakeholders and developers, indicate enthusiasm for government support for ongoing research and test facilities. Furthermore, it is anticipated that this option would assist the resolution of difficulties relating to the consenting of marine renewable energy projects.

Onshore Infrastructure - Consultation with developers indicated support for Government involvement in de-risking the marine renewable energy sector through the provision of physical infrastructure. This option covers elements that can be constructed onshore, with a view that these components could be shared by or operated on behalf of several developers, or give access to several adjacent energy resource areas within a region.

Offshore and Onshore Infrastructure - This option would cover all onshore infrastructure together with all items from the landfall beaches to the deployment sites, but not include the energy generators themselves.

Each option has been assessed in accordance with its ability to meet or contribute towards strategic objectives drawn from published Welsh Government energy policy. Further assessment criteria relate to cost estimates for typical infrastructure projects to support arrays of notional

10MW and 30MW rated capacities. These capacities have been selected as representative of early arrays in that there are already a number of 10MW arrays in planning, and 30MW represents the scale beyond which projects are expected to become commercially viable without the need for government grants.

The high levels of uncertainty associated with estimation of both costs and benefits at this early stage of concept development have meant that much of the appraisal has been undertaken on a qualitative basis, rather than with a quantitative approach.

1.5 Preferred Option and Next Steps

The qualitative scoring of options strongly favoured all of the intervention options considered over the do-nothing option, and therefore the appraisal confirmed that some level of government involvement is required in order to meet the Welsh Government's stated objectives. The appraisal favours the provision of onshore infrastructure over offshore infrastructure due to the reduced benefits to the local supply-chain and increased risk associated with investing in offshore infrastructure.

The appraisal took a cumulative approach to the formulation of development options, such that the simpler options such as environmental research and test facilities were carried forward and embedded within the more comprehensive options involving the provision of physical infrastructure. Therefore, the recommended development concept incorporates a broad range of activities to promote the preparation of deployment areas for marine energy development. These include early environmental investigations, data collection and consultation, through to consent applications, then the provision of physical shore-side infrastructure improvements.

Key components of recommended option

- Strategic research into environmental impacts
- Data collection over strategic resource areas
- Continued support to stakeholder groups and supply-chain
- Onshore distribution network improvements
- Grid connection
- Shore station
- Cable landfall arrangements

For simplicity, this study has focussed on potential infrastructure development to support notional energy projects of 10MW and 30MW capacities. However, the actual rated capacity of specific projects will depend on a number of site-specific characteristics such as the capacity in the local electricity grid, environmental constraints that may apply, and potential for future upgrades and expansions in capacity. The definition of individual projects will emerge from Technical

Feasibility Studies that will be undertaken in future phases of investigative work that will follow on from this study.

In summary, the provision of physical infrastructure through direct government investment is recommended. Furthermore, there is equal merit in providing other kinds of support, including overcoming perceived consenting constraints and a lack of detailed deployment site data. There remains an important role for government in coordinating and encouraging the supply-chain to upskill and upsize to meet the needs of an expanding industry. In this way the full potential for economic growth can be captured, and the value of the energy that is present in Welsh waters may be returned to local communities.

This report makes the following recommendations as to the next steps necessary to bring forward the preferred option. A programme, indicating possible timescales for development, is provided in section 9.3.

Early/Immediate Recommendations (2013)

- Grid connection studies to investigate required grid upgrades to each of the primary resource areas
- Obtain strategic site data and analysis for potentially viable resource areas.
- Commence research into likely interactions between full-scale arrays and the marine environment
- Consult with stakeholders on the need for Strategic Environmental Assessment (SEA).
- Working with The Crown Estate, help to attract developers of commercial-scale projects to sites in Welsh waters, in preparation for leasing of such sites
- Consult with DECC to develop a stable funding mechanism for projects beyond 2017.
- Undertake a supply-chain study to identify and encourage Welsh suppliers who could adapt and expand into the marine renewable energy industry.
- Technical feasibility studies and consultation with communities and stakeholders on potential infrastructure projects
- Investigate funding options through discussions with WEFO, Green Infrastructure Bank, and other financing organisations

Medium-term Recommendations (2014 to 2017)

- Prioritise resource areas for development
- Select Landfall Sites
- Develop, construct and operate onshore infrastructure projects to support developer-led marine renewable energy installations within the identified primary resource areas
- Monitor of technical and environmental performance of installations