FREDS MARINE ENERGY GROUP (MEG)

MARINE ENERGY ROAD MAP

forum for RENEWABLE ENERGY development in Scotland

CONTENTS

Note

This document focuses on wave and tidal stream technologies, using the phrase “marine energy” to denote both of these generation technologies. The rationale for this focus is that Scotland has great potential for the development of wave and tidal stream energy (with around 25% of Europe’s tidal stream resource and 10% Europe’s wave resource), but that these technologies are thought to have very different development paths compared to other ‘wet renewables’ (e.g. tidal impoundment, marine biomass and offshore wind).

EXECUTIVE SUMMARY

In January 2009, the Forum for Renewable Energy Development in Scotland (FREDS) reconvened its industry-led Marine Energy Group (MEG). This Road Map reflects an up-to-date assessment of the status and potential of the marine energy industry in Scotland, alongside recommended actions to ensure its continuing growth. This new assessment is particularly timely given the increased pressures for the development of renewable energy flowing from the Climate Change (Scotland) Act 2009[1] and the new European Directive on Renewable Energy[2].

Although marine energy in Scotland has not developed as quickly as expected in the 2004 MEG Report "Harnessing Scotland's Marine Energy Potential"[3] – due in part to technical difficulties and financial constraints relating to technology development – the sector as a whole has made some significant steps forward over the last five years. Not least amongst these is the provision of strong public revenue support for marine energy projects in Scotland, and the fact that institutional investors have started to get involved in the sector. Additionally, Scotland is now seen as a global leader in marine energy, and this perception has been helped in no small way by the strengthening of facilities at EMEC to incorporate tidal testing. Significant progress has also been made in preparing the way for pre-commercial and commercial project development, with the completion of a Strategic Environmental Assessment (SEA) for wave and tidal energy[4] in Scotland in 2007, followed by the commencement of a commercial leasing process by The Crown Estate for sea-bed in the Pentland Firth/Orkney Waters area.

[1] http://www.scottish.parliament.uk/s3/bills/17-ClimateChange/index.htm
[2] Directive 2009/28/EC *'On the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC'* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF
[3] FREDS MEG (2004) 'Harnessing Scotland's Marine Energy Potential' - http://www.scotland.gov.uk/Resource/Doc/1086/0006191.pdf
[4] http://www.scotland.gov.uk/Publications/2007/04/SEA-consultations

This document sets out scenarios for growth of the industry, to build on these steps. It identifies five key issues – finance, grid, planning, infrastructure/supply chain and Europe – which will be vital in terms of realising the high growth scenarios. The following table outlines the Group's view on the priority recommendations:

- **THE SCOTTISH GOVERNMENT should introduce a flexible WATES style initiative as an open call with an increased budget and an annual allocation which developers must 'use or lose' within a 12-month window**
- **THE SCOTTISH GOVERNMENT should review urgently the level of ROC banding for tidal stream, as developer opinion on MEG is that tidal stream should attract 5 ROCs/MWh, in line with the band for wave energy in Scotland.**
- **THE DEPARTMENT FOR ENERGY AND CLIMATE CHANGE (DECC) should announce urgently the criteria for the £22 million Marine Renewables Proving Fund, with a call for funding proposals issued as soon as possible.**
- **SCOTTISH HYDRO-ELECTRIC TRANSMISSION LTD should continue its pre-construction design work, and on receipt of suitable applications for connection build:**
- **a new 132 kV line from the Northeast Caithness coast to Dounreay; and**
- **a new 132 kV line from the Orkney Islands to Dounreay**
- **MEG's GRID SUB-GROUP should carry out a strategic review of Scottish grid infrastructure for marine energy, identifying longer-term grid infrastructure upgrades on the basis of expected development locations. This should take as its context the ENSG Report[5] that describes the 2020 vision for the GB grid and the National Planning Framework 2.**

[5] Electricity Networks Strategy Group (2009) Our Electricity Transmission Network: A Vision for 2020 http://www.ensg.gov.uk/index.php?article=126

Over the coming months, MEG will continue with its work programme, set in the context of the recommendations within this Road Map. It will undertake a review of progress against these recommendations in Summer 2012.

INTRODUCTION

This document has been produced by the reconvened industry-led FREDS Marine Energy Group (MEG) with feed-in from the Marine Energy Spatial Planning Group (MESPG)[6]. The vision of the FREDS Marine Energy Group is:

'To create the world's leading marine energy industry, one that will provide a substantial contribution to the sustainable economy and environment of Scotland.'

In taking steps to achieve this vision, the FREDS Marine Energy Group recognises a distinction between two needs. The first is to promote market opportunities for marine energy generation in Scotland. The second is to ensure that Scottish companies and communities are well placed to capture these opportunities.

This report contains recommendations from the marine renewables sector on how to meet these two needs. These recommendations are made to:

- Scottish and UK Ministers
- Public bodies, including regulatory and enterprise agencies
- The private sector itself.

[6] The membership and remits of these Groups are outlined in Annexes 1 and 2.

It builds on the previous FREDS Marine Energy Group report of 2004, taking into account the advances in technology and understanding along with increased pressures for the development of renewable energy which flow from the Climate Change (Scotland) Act 2009[7] and the new European Directive on Renewable Energy[8].

This Road Map takes into account as far as possible existing road mapping work[9]. It sets out firstly the current status of the Scottish marine renewables sector, then possible scenarios for growth. The document concludes with actions which MEG recommends must be taken in order for the desired scenario to be achieved.

[7] http://www.scottish.parliament.uk/s3/bills/17-ClimateChange/index.htm

[8] Directive 2009/28/EC *'On the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC'* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

[9] Please see Annex 3 for references.

1. STATE OF THE INDUSTRY

In 2004, the previous incarnation of MEG produced the report "Harnessing Scotland's Marine Energy Potential" [10]. In the five years since then many things have changed. Certain developments have taken place as part of the work programme implemented on the basis of the first MEG report. Individuals and organisations involved in marine energy have also taken actions outwith the scope of that report which likewise affect the sector. Other developments have occurred due to external circumstances such as oil price fluctuations and the recession. Some of the key developments are outlined below.

Limpet device on Islay © Voith Hydro Wavegen

ACHIEVEMENTS

Since 2004 Scotland's marine energy industry has had some significant achievements – in attracting financial interest, better understanding the operating environment, overcoming certain technical and planning issues, and delivering results.

Investment

- The sector now attracts blue-chip and institutional investors. These are viewing Scotland as a preferred investment location because of Scotland's high support tariff, strength of commitment to the sector, and consistency of supportive messages from Government to local communities and industry.

[10] FREDS MEG (2004) 'Harnessing Scotland's Marine Energy Potential' - http://www.scotland.gov.uk/Resource/Doc/1086/0006191.pdf

- Utilities, many of which are overseas companies, have become closely involved with pre-commercial projects, indicating confidence in the sector's development potential and a belief that the very basic building blocks for growth are largely in place.
- Leading marine energy technology developers have become market listed, showing confidence that the investments meet wider economic performance standards.
- Maritime communities are taking an active interest in developing projects (e.g. on Islay, Shetland, Orkney).
- Scotland has delivered one of the most attractive revenue support schemes in the world with the Renewables Obligation (Scotland) banded ROCs (3 ROCs/MWh for tidal stream, 5 ROCs/MWh for wave).
- Assurance is being provided by National Grid and Transmission Operators about the recognised need for, and availability of, new grid connections in time for proposed technology deployments in the islands and coastal areas of Scotland
- Increased technology push funding has been allocated from The Carbon Trust, the Energy Technologies Institute (ETI) and Engineering and Physical Sciences Research Council (EPSRC), in recognition of the opportunity this sector provides for the UK energy mix

Delivery

- The announcement of the Scottish Government's Saltire Prize[11], the international innovation prize of £10m for development of wave and tidal technologies, has raised still further the profile of Scotland's marine renewables industry across the globe.
- The European Marine Energy Centre (EMEC) is now firmly established, with 5 wave berths, 5 tidal berths and a growing team of specialist experts. It has attracted global interest.
- The sector has developed valuable IP assets. Its portfolio is diversifying to components & services.

[11] www.saltireprize.com

- Marine energy companies have placed fabrication contracts and gained manufacturing experience.
- Leading technology and project developers have deployed wave and tidal devices in a number of demonstration projects in Scotland and abroad.
- Scottish technology developers have been successful in winning export contracts for projects in countries such as Portugal, Spain, Canada and South Korea.
- Significant academic and commercial expertise has been invested in addressing strategic planning challenges for the sector.
- Scottish marine energy service providers (e.g. consultancies, survey companies, vessel providers) are providing a high proportion of the advice and facilities to support the early deployment of technologies in Scotland.
- Scottish-based companies are increasingly capturing marine energy related work abroad (e.g. Portugal, Spain, Taiwan, Canada, New Zealand, USA, Chile, China, Ireland).
- Several leading technology developers originating in other parts of the world have based their operations in Scotland.
- A number of developers new to the sector are emerging and taking forward marine renewable projects.
- The marine energy sector is providing hundreds of jobs in Scotland alone[12].
- Scottish universities are leading in the field of underpinning/generic and applied strategic research for marine renewables, and take strong roles in national and international research programmes.
- Stability of the Scottish Government's ongoing support for the development of marine renewables in Scotland has been, and will continue to be, important for the future success of the industry.

Understanding

[12] Scottish Renewables (2007) Scottish Renewables Economic Impacts Report - http://www.scottishrenewables.com/MULTIMEDIAGALLERY/1DF99F66-E5BD-4823-82C3-10F3F501D30D.PDF
Bain & Company for BWEA (2008) Employment Opportunities & Challenges in the Context of Rapid Industry Growth
http://www.bwea.com/pdf/publications/Bain%20Brief_Wind%20Energy%202008_FINAL.pdf

- There is now greater understanding of distribution of resources as a result of current meter deployments, direct observation and remote sensing data.
- The scale of resource is now much better understood, through examination of exploitable resource areas taking into account other sea users, wildlife interests, technical feasibility and cost effective production.
- The character of resources has been investigated in much greater detail, revealing features that previously were not well described (e.g. divergent current directions, seabed current storms, wave induced pulses in tidal flows etc).
- A Strategic Environmental Assessment (SEA) for wave and tidal energy has been completed, which provides a pathway to leasing and licensing of projects.
- Bodies including Marine Scotland and Scottish Natural Heritage (SNH) have started assessments of baseline marine environment conditions.

Overcoming technical and planning issues

- There is now a better understanding of the operating needs of marine energy projects – in terms of, for instance: resource levels; site conditions; available ports and working areas; and supplies of skills and materials.
- The sector now has a better understanding of maritime requirements – in terms of, for instance: the number, type and size of vessels required; and the availability of appropriately skilled mariners to command vessels and undertake marine works.
- Consensus is being built on the requirements for grid connectivity for marine renewables over the next decade. Progress has also been made in finding consensus on wider grid reinforcements for renewables, through the Electricity Networks Strategy Group (ENSG) Report and the National Planning Framework 2 for Scotland.

- The international standards body IEC (International Electrotechnical Commission) has recognised the sector, and has established Technical Committee TC 114 to develop international standards for marine energy. This will help create export opportunities by providing international acceptance standards and procedure for marine devices.

CHALLENGES

Despite this significant progress, the growth of the marine energy sector in Scotland still faces several hurdles.

Proving technology

The most important hurdle for the sector to overcome remains proving the technologies. The marine energy sector needs devices to progress from the prototype stage in the near term if it is to make the contribution envisaged. The pace of advancement for technologies has not been as fast as predicted in the previous MEG report. MEG believes this is due in part to the underestimation of some technical challenges, as well as the fact that it took longer than expected to set in place sufficient financial support streams.

The main way in which the public sector can help provide the crucial step up in the pace of technology proof is by giving indigenous technologies access to larger and more accessible funding streams, to encourage proof of technologies at scale. If this does not occur, then imported technology may be still be encouraged to mature within the attractive revenue regime in Scotland, but Scottish technology export potential will be limited.

Financial Support

Given its emerging nature, the marine energy industry faces relatively high costs and the perception of high risk. This means that attracting private finance is more difficult than in other mature renewables sectors, particularly for prototype and pre-commercial developments. These difficulties now take place within the context of global recession.

Electricity Grid

Grid capacity is very limited in the North and North-West areas of Scotland, where much of Scotland's marine energy potential is located. Although crucial grid infrastructure projects for renewables have been identified in the National Planning Framework 2 and in the Electricity Networks Strategy Group Report, these do not generally account for extra generating capacity from marine renewables, and additional upgrades will be necessary to cater for this development.

Infrastructure

Existing infrastructure is thought to be insufficient to support future significant marine renewables project deployment. Key infrastructure requirements for the sector include: ports, vessels, fabrication facilities, control centres, office facilities and housing for personnel.

Skills

Companies across the UK involved in the renewable energy industry have reported difficulties in recruiting skilled personnel in, for instance, the fields of engineering (electrical, mechanical) and project management. This is due in part to a general shortage of graduates specialising in such disciplines in the UK, combined with a difficulty in attracting experienced personnel from other sectors due to competition with other more established industries (in particular, the oil and gas industry).

Planning Regime

The future of the marine planning regime remains somewhat uncertain prior to the agreement and implementation of a new Marine (Scotland) Bill. It is proposed that there will be a move towards greater simplification of the consents and licences system for marine renewables. However, there are concerns that marine regulators, and statutory consultees may not have the resources at present to deal with the expected growth in marine renewables casework. Additionally, some concerns remain within certain parts of industry about the availability of commercial seabed leases.

Europe

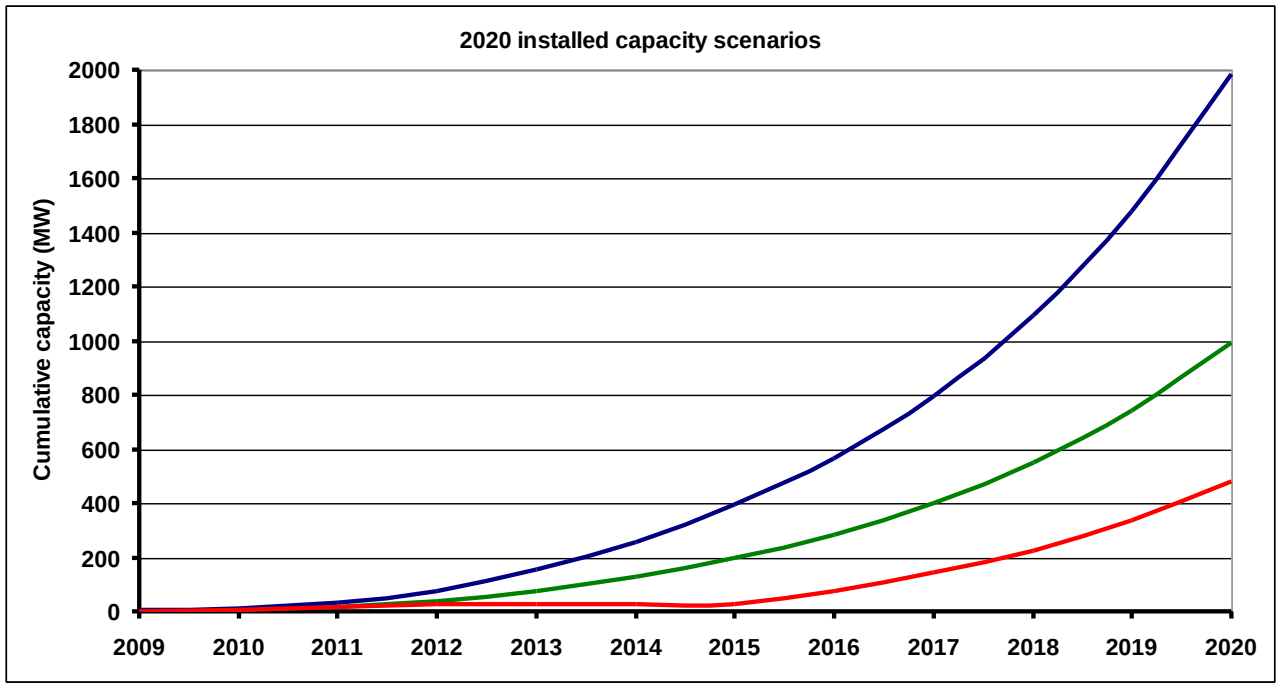
The sector lacks priority status in European strategic energy policy, compared with other renewables sectors.

2. WHERE WE COULD BE

Existing road mapping work for the UK marine energy sector has been based largely on 'target' rather than 'scenario' methodology. This existing work has suggested a possible installed capacity of roughly 1 GW of marine energy in Scottish waters by 2020 [see Annex 4].

In contrast, this document sets out scenarios demonstrating a range of possible deployment pathways, as set out in the graph and table below. The illustrative curves show illustrative overall deployment levels, starting with lower moving to more aspirational ambitions, progressing through the 3 scenarios. **Achieving any of these illustrative scenarios will depend on tackling a number of variables which are addressed in greater detail elsewhere within this document.**

P 1-A Pelamis machines at Aguçadoura © Pelamis Wave Power



These scenarios, developed by MEG, are broadly in line with road mapping work taken forward by other bodies[13] and are based on annual installed capacity increases to 2020. MEG considered that the growth of the marine sector could be broken down into three stages:

- Industry consolidation and proving;
- Up front project engineering; and
- Capacity building.

[13] Including work by the UK Energy Research Council

MEG modelled the growth of the sector on the basis of assumptions about progress through these three stages.

Progress would be determined by a very broad range of financial, regulatory and engineering-related factors. The scenarios were drafted to reflect speed of initial technology demonstration, and capacity growth thereafter. The scenarios include situations where growth is steady, where growth is capped, and where growth is delayed (because of, for instance, lead times for construction of essential infrastructure).

The table below summarises the factors modelled and the economic impact[14] of each scenario:

Scenario	Profile	Economic Impact
Low Scenario	**500 MW installed by 2020:** • steady early installation rate; • culminating in ~75 MW installed capacity by the end of 2013; • rapid growth in installed capacity rate of 30% per annum thereafter	▪ 1,500 direct Scottish jobs ▪ 2,850 direct jobs overall ▪ Up to £687m total expenditure in Scotland ▪ £1.3bn expenditure overall
Medium Scenario	**1000 MW installed by 2020:** ▪ rapid early installation rate; ▪ culminating in over 150 MW installed capacity by the end of 2013; ▪ rapid growth in installed capacity rate of 30% per annum thereafter	▪ 2,600 direct Scottish jobs ▪ 5,000 direct jobs overall ▪ Up to £1.3bn total expenditure in Scotland ▪ £2.4bn expenditure overall
High Scenario	**2000 MW installed by 2020:** • rapid early installation rate; • three year delay to ramp up – could be due to several factors, including: o technology or supply chain problems o lack of investment confidence o lack of grid access o delays to planning and consenting	▪ 5,300 direct Scottish jobs ▪ 10,000 direct jobs overall ▪ Up to £2.4bn total expenditure in Scotland ▪ £4.7bn expenditure overall

[14] A detailed assessment of the economic implications of each of the scenarios was carried out as part of the Supply Chain study commissioned by MEG from SgurrEnergy & IPA. Please see full report in Annex.

The ‘High’ Scenario would deliver the greatest benefits in terms of renewable energy generation and economic benefit. It is therefore MEG’s belief that the highest scenario, whilst very ambitious, should be aimed for and achieved. Achieving this outcome will depend on actions being taken to address market barriers. MEG’s recommendations on the actions necessary are set out in the following section of this document.

3. RECOMMENDATIONS

FINANCE

Context

MEG established a Finance Sub-Group, with strong input from technology developers, to analyse financial barriers to marine energy market development and propose actions to tackle these barriers.

Oyster device © Aquamarine Power Ltd

MEG's 2004 report recommended that the Scottish and UK Government work to create a market pull and reduce financial risk for marine energy, in order to stimulate the sector to make a significant contribution to the Government's renewable energy aspirations and targets beyond 2010.

MEG welcomes the Scottish Government's approach to the introduction of banding to the Renewables Obligation (Scotland) (ROS). This makes Scotland the most attractive long-term market for private investment in the marine energy sector anywhere in the world. Similarly, its Wave and Tidal Energy Support Scheme (WATES) is clear evidence of the Scottish Government's commitment, and the priority which it attaches to supporting this sector.

Scotland is home now to a cluster of world-renowned marine energy technology developers and academic support networks. This cluster is recognised for delivering results at every stage of the development process, from testing new concepts to

installing full-scale prototypes at sea. Scotland has the opportunity now to be the first country to deliver full-scale pre-commercial wave and tidal stream projects.

MEG believes that its key recommendations, set out below, will leverage the private sector investment needed to accelerate progress at every stage of development – from capturing IP on new solutions to accelerating pre-commercial demonstrations, which are a prerequisite to unlocking the large-scale private investments which the ROS will generate.

These measures are aimed at financing technical progress rather than funding enabling infrastructure. The importance of enabling infrastructure is addressed in the infrastructure and supply chain section of this Road Map.

Funding Context

The following Table sets out the standard funding options available in Scotland and the UK for technology developers and project financers through the four key stages of technology delivery - from concept to commercial operation. It also outlines the typical total costs associated with projects within these stages. **These figures are based on technology developer input on MEG, and should be taken as purely indicative.**

Although some of these funding schemes have been used effectively in the past none of the organisations listed - with the exception of the Carbon Trust which offers grant assistance up to £250k for R&D - has opened a call for marine energy support since the ETI's call in December 2007. However, the recent announcement from DECC of a forthcoming scheme called the Marine Renewables Proving Fund, is noted and welcomed by MEG.

Technology development stage	Typical project budgets	Scale	Typical Funding Schemes	Status
Stage 1: Proof of concept and "PreMEC" pre-prototype scale testing at sea	£500k to £5m	Numerical & tank testing / scale models at sea.	Energy Technologies Institute. The Carbon Trust Applied Research Fund	Last call Dec 2007 – 1 project funded Currently closed to Scottish projects
Stage 2: Full-scale prototype.	~£10m	<2 MW	Energy Technologies Institute. The Carbon Trust Applied Research Fund WATES DECC Marine Renewable Proving Fund	Last call Dec 2007 – 1 project funded Currently closed to Scottish projects Last call November 2006 – 8 projects supported. Funding announced July 2009 – awaiting call.
Stage 3: Demonstration project/array.	£10m - £50m	2-10 MW	WATES Marine Renewable Deployment Fund	Last call November 2006 – 8 projects supported. Announced 2004 – no awards made

			(MRDF).	yet.
Stage 4: Commercial project.	£20m+	5 MW+	Banded Renewables Obligation (Scotland). Banded Renewable Obligation.	Providing significant investor confidence and market pull

The capital requirements increase significantly as technologies progress through each stage, with capital and operational costs increased by the nature of the real marine environment, practicalities of large-scale fabrication and manufacturing as well as vessel rates. Capital risk peaks at Stages 2 & 3, where considerable residual uncertainty associated with commercial parameters – such as generator yield, supply costs, longer term reliability and operational costs – can remain, and is compounded by low volumes and high fixed overheads for suppliers. **Projects at Stages 2 and 3 therefore require dilution of up-front capital risk in order to attract the private sector commitment needed to deliver these essential projects.**

Technologies which generate successful results through Stages 2 & 3 will present low enough investment risks to investors for them to undertake increasingly undiluted capital risks, thanks to the existence in Scotland of enhanced revenue streams through the banded ROS. In parallel, technology developers will be able to access the larger inward investments needed to expand and prepare their businesses, facilities and supply chains to meet growing demand as market and technology confidence increases. Technology uptake will also be aided as suppliers demonstrate overall reduction in generation costs through advances in areas such as volume manufacturing, learning by doing, supply chain development and performance increases of generators.

It is important to note that, since projects in Stages 2 & 3 require the majority of capital risk to be borne by the private sector, the numbers of technologies progressing through the stages will likely see a significant rate of attrition owing to lack of investor confidence. This is a natural market process of technology convergence, through demonstration and due diligence, which will direct the industry towards lowest cost of marine energy generation.

At present, most projects in Scotland are at Stages 1 and 2. However, continued public funding support at all stages is required – as a successful marine energy sector will depend upon a diverse range of technology, supported throughout the cycle from research and development to commercial exploitation.

Stage 1 funding should be aimed at encouraging continuous innovation and an ongoing IP asset stream from new and more established firms, whilst major industry support is crucially needed now to ensure that Scotland progresses rapidly from single prototype deployment to delivering the first pre-commercial array demonstrations. This support will leverage the private sector investment required to de-risk the technology and progress to Stage 4. The credit crunch has made it more difficult for all industries to attract inward investment and intensifies the urgent requirement for public baseline funding.

MEG welcomes the recent announcement by DECC of £60 million for the marine renewable energy industry. The £22 million allocated to the new Marine Renewables Proving Fund (MRPF) will provide vital support to developers at Stage 2.

The potential returns on public investment are high. As well as being able to provide Scotland with up to 20 GW of green energy[15], a supply chain survey conducted on behalf of MEG found that a new Scottish marine energy technology sector of 1GW installed

[15] Garrad Hassan for Scottish Government (2001) Scotland's Renewable Resource http://www.scotland.gov.uk/Resource/Doc/47176/0014633.pdf

capacity by 2020 could generate around £2.4 billion of expenditure, of which £1.3 billion could be retained in Scotland. It could also provide more than 2600 direct jobs in Scotland[16]. Additionally, using these figures, Scottish Enterprise has estimated that approximately 12,500 gross jobs could be created, if indirect and induced jobs are taken into account.

Additionally, a new technology sector could create a valuable new export market for technology and services. Export of clean technology accounts for €7.1 billion annually in Denmark, whilst in Germany export of wind technology alone is worth over €5.1 billion. Wind industry employment in Germany stands at 100,000, whilst the renewables industry as a whole has created direct employment for over 230,000 people in that country. It seems reasonable to assume that Scotland, through establishing a technology and manufacturing lead in marine renewable energy, could benefit in a similar manner. If a technology lead is not achieved in Scotland, then other benefits may still arise from project development using imported technology. These might include geographical distribution of new investment to remote and peripheral areas, in terms of infrastructure investment, as well as the provision of business for service companies.

Recommendations

MEG recognises that insufficient or misdirected financial support is a key barrier to the pace of success of the marine renewables sector. Specific recommendations on funding for marine renewables are broken down into technology stages as follows:

[16] Sgurr Energy and IPA Energy and Water Economics (2009) Marine Energy Supply Chain Survey

Stage 1 support

The group welcomes stage one R&D funding to date and believes that continued investment is vital in order to ensure a consistent innovation pipeline. MEG recommends that:

- **THE TECHNOLOGY STRATEGY BOARD should open a funding round for marine energy technology development under its 'Technology Readiness' scheme.** This could include concept R&D, feasibility studies, component testing, and scale-testing in tanks and at sea, embracing development stages 1 and 2.
- **THE RESEARCH FUNDING COUNCILS** should continue to fund R&D in marine energy
- **THE EUROPEAN COMMISSION** should include funding for marine energy within future Work Plans under the EU's 7th Framework programme (FP7).
- **THE SCOTTISH GOVERNMENT** should consider the roles of the various public bodies (including Scottish Enterprise, Highlands and Islands Enterprise [HIE], The Carbon Trust, Scottish Government and others) providing funding for early stage technologies. It is a matter of concern for developers that The Applied Research Fund from The Carbon Trust is not at present supporting Scottish marine energy projects.
- **THE ENERGY TECHNOLOGIES INSTITUTE should award more funds for marine energy, while tackling concerns over its selection process and capture of intellectual property (IP) rights.** This public-private partnership has a £50m fund. Since announcing a call in 2007, there has only been one successful award of funding to a marine energy project.

Stage 2 support

This is a key stage for the Scottish marine energy industry. MEG recommends that:

- **THE SCOTTISH GOVERNMENT should introduce a flexible WATES** style initiative as an open call, with an annual allocation which developers must 'use or lose' within a 12-month window if they cannot demonstrate tangible effort to progress the project. The initial WATES awards, totalling around £13 million, were focused on technology demonstration projects. Developers strongly recommend that the scheme be re-run with an increased budget, to provide further opportunities for critical stage projects. Unutilised funds could be rolled over into the following year's pot.
- **DECC should announce urgently the criteria for the £22 million Marine Renewables Proving Fund, with a call for funding proposals issued as soon as possible.** The fund should operate similarly to a revised WATES, that is on a 'use-it-or-lose-it' basis.
- **SCOTTISH ENTERPRISE should lift the cap on its Scottish Venture Fund from £2m to £10- £15m**. This would enable stage 2 and stage 3 developers to 'de-risk' technology investment and attract inward private capital investment. This could be administered in a similar way to the WATES scheme.
- **TREASURY should include marine renewable energy devices in the Energy Technology Criteria List (ETCL)**. This would enable devices at stages 2 and 3 to attract a capital write down allowance of 100 per cent, as opposed to the 10 per cent they currently attract. At present 14 CO^2-reduction technologies are included in the ECTL, but not any marine energy technologies.

- **TREASURY should increase the maximum relief available for exempt investments in 'approved' marine renewables companies under the Enterprise Incentive Scheme (EIS).** Lifting the threshold for definition of 'small company' under the Scheme, to allow more marine energy companies to become eligible for EIS, would also help.
- **TREASURY should release funding for renewables projects, including marine energy, from the Fossil Fuel Levy account in a manner which will not impact on the Scottish Consolidated Fund. MEG supports this call from the Scottish Parliament's Economy, Energy and Tourism Committee in their report of 2009**[17]
- **THE EUROPEAN COMMISSION should make funds available to support commercial scale demonstration of marine devices and arrays at stages 2 and 3.**

Stage 3 support

This is a key stage for the Scottish marine energy industry. MEG recommends:

- **DECC should retain the entry criteria for the £42 million Marine Renewable Deployment Fund (MRDF) and lift the capital support cap from 25 to 40 per cent,** in line with the WATES model. It should be available for a range of developments from single devices to arrays, and should be topped up to enable continuous array deployment after the initial fund is used up.
- **THE SCOTTISH GOVERNMENT should introduce WATES-style stage 3 support** in recognition of the increased capital costs at this stage, and of developers' increased proximity to market.

[17] Scottish Parliament Economy, Energy and Tourism Committee (2009) Determining and Delivering on Scotland's Energy Future http://www.scottish.parliament.uk/s3/committees/eet/reports-09/eer09-07-vol01-01.htm

Stage 4 support

Long-term support through market mechanisms such as banded ROCs is welcomed, as it enables inward investment based on a clear and well-understood future renewable energy price framework. The Scottish Government's strong and positive support for marine energy in the banding of the Renewables Obligation (Scotland) is extremely helpful. MEG recommends:

- **<u>THE SCOTTISH GOVERNMENT</u> should review urgently the level of ROC banding for tidal stream, as developer opinion on MEG is that tidal stream should attract 5 ROCs/MWh, in line with the band for wave energy in Scotland.** Currently, there is no strong evidence to support a banding differentiation between the two technologies.
- **<u>DECC</u> should raise the banding levels in England, Wales and Northern Ireland for wave and tidal stream to the high levels seen in Scotland.** Offshore wind is soon to receive the same level of banding support under the UK obligation as wave and tidal stream developments. This means there is a lack of a strong financial signal to invest in marine energy in England, Wales and Northern Ireland.

GRID

MEG has established a Grid Sub-Group, which includes SSE Power Distribution and National Grid, to analyse grid-related requirements to marine energy market development, and to propose actions to progress the necessary reinforcements. Below are its key recommendations. MEG is recommending a series of actions targeted at delivering the first 1-10MW within the next three years and accommodating a ramp up in installation of up to 2GW by 2020.

Context

The majority of Scotland's marine energy resource is found on the Atlantic coasts of Orkney, Shetland, the Outer Hebrides and the Pentland Firth. There is currently limited grid capacity for connecting marine energy projects in these remote island locations.

AWS prototype deployment © AWS Ocean Energy

Capitalising on Scotland's natural advantage when it comes to marine energy will depend on building the transmission and distribution infrastructure needed to connect at remote locations. National Grid and Scottish Hydro-Electric Transmission Ltd (SHETL – responsible for building and maintaining the north Scotland transmission network) have advised MEG that they could build the infrastructure required to grid connect marine energy projects in line with project development goals **if they receive underwritten applications for grid-connecting viable projects on time.**

In the meantime, there are some short-term opportunities to connect small scale projects under existing, interim connect-and-manage arrangements. This offers limited capacity at the local distribution level to enable some pre-commercial projects to connect to the grid before wider transmission reinforcements are completed. However, overall, the Grid Sub-Group identified significant limitations to connecting even the first, small-scale projects in every one of the areas with the highest value marine energy resources pending network reinforcements.

The most immediate challenge for Scotland will be to connect marine energy projects in the Pentland Firth and Orkney Waters following the Crown Estate's leasing round, the results of which are due to be announced in September 2009.

Applications for grid capacity incur immediate costs, and set in train processes that result in increasing costs and liabilities associated with network companies undertaking reinforcements. For smaller scale developments, in the short and medium/long-term, such costs and liabilities can sometimes run ahead of the readiness or ability of smaller scale projects to accept them on an individual basis. To tackle this issue, the Grid Sub-Group is looking at contractual arrangements for such projects that could be developed within the existing framework.

One option which is being investigated by the MEG Grid Sub-Group in partnership with the Pentland Firth Grid Committee[18] is the feasibility of submitting 'umbrella' applications. An umbrella application would constitute a single private or public body (the 'consolidator') applying for a connection on behalf of several prospective generators. Such applications could provide the following potential benefits:

[18] A group established by the Pentland Firth Co-Ordination Group (itself comprising Scottish Government, Highlands & Islands Enterprise and The Crown Estate) tasked with taking forward actions on grid issues, to facilitate the development of marine energy projects in The Crown Estate's Pentland Firth/Orkney Waters Strategic Leasing Zone.

- Allow connection applications of sufficient megawatt scale, on a co-ordinated basis, to allow network licensees to progress necessary reinforcements in appropriate timescales;
- Allow smaller scale projects, that would not otherwise have been in a position to submit individual applications, to opt in and out of the consolidator's list without the network licensees constantly having to re-assess and re-specify the reinforcement requirement;
- Allow the consolidator, with suitable credit rating or ability to post underwriting liabilities, to accept them and so enable reinforcement works to be progressed; and
- If the consolidator specifies multiple required new connection points on the distribution network, still allow sufficiently small individual projects the choice of whether or not to participate in the Balancing Market (with the associated requirement to pay full transmission network use of system charges).

In the first instance, the MEG Grid Sub-Group is focusing on solutions that will deliver capacity to the Pentland Firth/Orkney Waters Strategic Area in the short to medium term. As a result, the Grid Sub-Group has identified the technical upgrades required to reinforce the export capacity from this area as a priority. Delivering this option will depend on prompt and coordinated action by the key players – project developers, network owners and operators and technology developers.

Should this approach prove feasible, the intention is that a similar model could be considered for securing connections at all of Scotland's high-value marine resource areas. Similar short-term infrastructure upgrades will be identified on the basis of intelligence gathered for the Orkney Islands, Western Isles, the West Coast and Shetland. The MEG Grid Sub-Group is currently assessing existing work on short-term connection possibilities for these areas, with a view to possibly commissioning extra studies

after Summer 2009. These studies would be supported by a strategic review of where and when longer-term demand for grid connection is expected, based on developers' information submitted to the Crown Estate and the Marine Energy Spatial Planning Group. This information should be available for analysis in Summer/Autumn 2009. The ENSG report, however, describes the vision of GB electricity networks for 2020 which is consistent with accommodating levels of renewable generation required from Scotland to meet UK obligations on renewable energy by 2020.

In the medium term, it will be possible for system reinforcements to be achieved and capacity access rights granted to allow some 300MW between 2013-2015 and potentially up to 2GW by 2016-2019, subject to ongoing progress of reinforcements already underway and referenced in the 2009 report by the Electricity Networks Strategy Group, "Our Electricity Network; a vision for 2020".

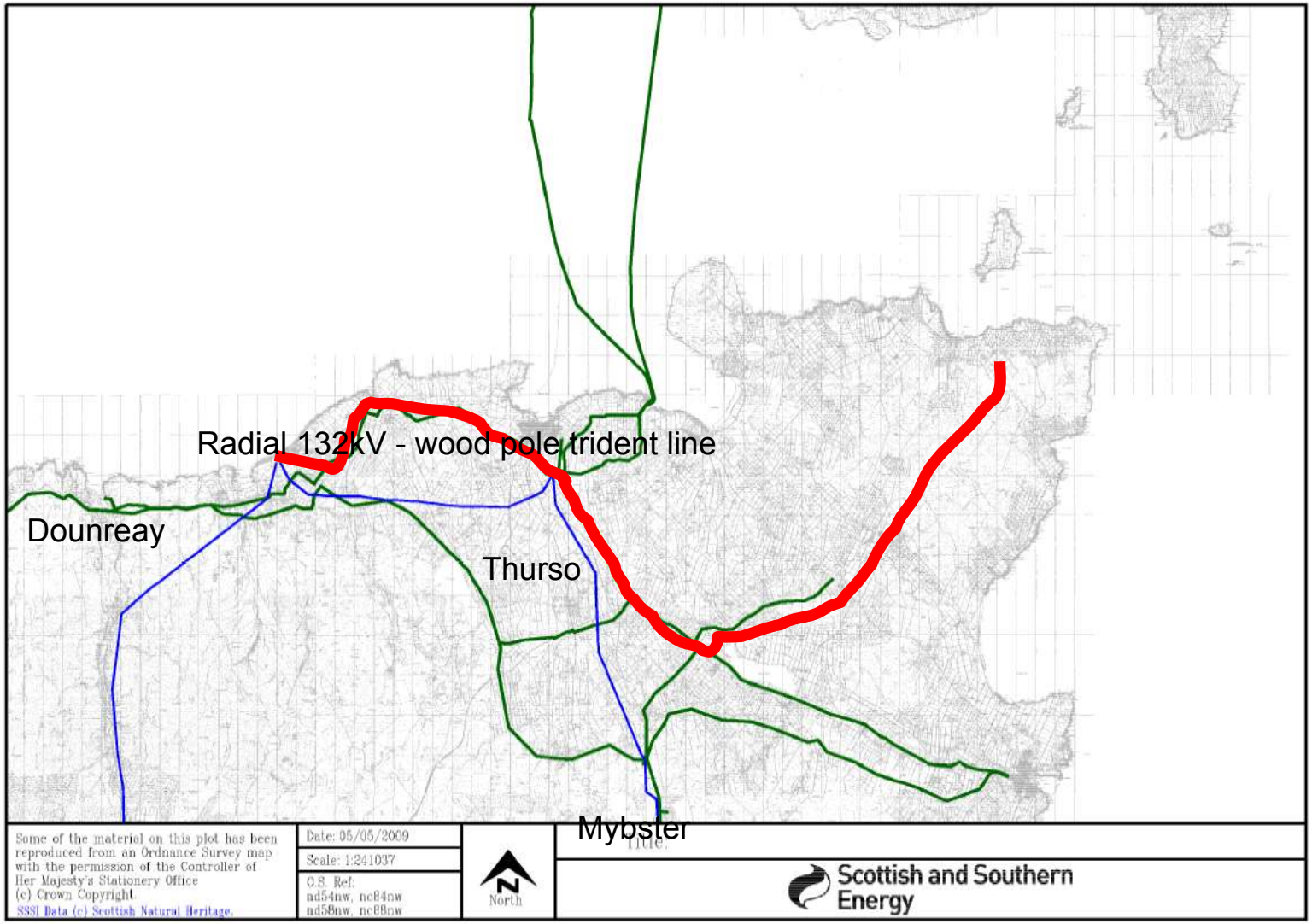
This will depend on a co-ordinated approach by all key players, coupled with strong signals of intent from marine project developers enabling transmission and distribution network licensees to continue investment in their networks to align grid infrastructure with good locations for marine technology. MEG also recognises that planning consents for the onshore strategic reinforcements works are on the critical path to enabling grid capacity for marine energy generation, and that appropriate arrangements will also be required in respect of connectees' liabilities for connection costs and underwriting liabilities.

The following table outlines the Grid Sub-Group's work, which focused on identifying regional grid infrastructure solutions and connection formats, for both the short and medium/long term.

	Location		Capacity availability			Key risks		Connection Application Format
Connection timescale	**Area & location Location**	**Reinforcement option**	**Pre-reinforcement**	**After reinforcement**	**Recommended Approach & priority actions**	**Locally**	**Wider**	
Short Term (to 2013)	Pentland Firth - North-East Caithness	New 132kV wood pole line to Dounreay. Partial routing work already undertaken. Potential delivery by 2013 subject to trigger applications and consenting.	N/A, reinforcement delivered in sufficient time to meet requirement	Over 100MW, subject to trip for 275kV circuit faults South of Dounreay	Submit applications to trigger work on local connection works and 132kV reinforcement.	Consent and build of 132kV wood pole line.	Wider network capacity subject to Interim Connect and manage. In the medium term (post connection) requires Beauly-Denny and Donreay-Beauly	Prevailing arrangements within the existing framework are available for use now by individual applicants. Also available to an aggregator seeking to co-ordinate several individual projects under an "umbrella" application. A model for "umbrella" connection arrangements has been developed for use within the existing framework.
	West coast of Orkney	Additional Orkney cable with direct connectivity to Dounreay. Desktop routing already investigated, 4/5 years for delivery subject to trigger applications.	Join RPZ, available for any party though non-firm connection may not be economic	Over 100MW, subject to trip for 275kV circuit fault south of Dounreay	Submit application(s) to trigger Orkney link build and local connection works.	Planning consent for lines on islands	Wider network capacity subject to Interim Connect and manage. In the medium term (post connection) requires Beauly–Denny and Dounreay-Beauly	
	Western Isles	Western Isles HVDC link in development for 2012 subject to windfarm willingness to underwrite & local public inquiry for converter shed at Beauly. Alternative smaller AC reinforcements to be progressed in the event of indefinite delays to HVDC link, and active network management (RPZ) pending delivery of AC alternatives.	Physical capacity exists now on 132kV circuit through Skye to Fort Augustus, but all currently transmission contracted.	Planned link capacity is 450MW for 423MW of contracted generation. (~280MW generation in in planning consent process, of which ~50MW approved.	Submit applications to underpin reinforcement case.	Consent for local line works.	Flows into Beauly from a link ahead of Beauly-Denny subject to Interim C&M. Full link export reliant on Beauly-Denny.	

	Shetland	HVDC link in development for 2013 subject to Viking windfarm willingness to underwrite shed at Beauly.	No current mainland link. New development reliant on establishment of link or replacement arrangements post 2015 for Lerwick Power Station.	Planned link capacity is 600MW for Viking Energy at 550MW. Spare link capacity subject to headroom and interaction with wind output.	Submit applications	Consent for local line works.	Establishment of HVDC link.	
	West Coast Scotland (Kintyre northwards (excluding Western Isles covered above.)	Very limited capacity on the coastal distribution network (hundreds of kilowatts) but no capacity without reinforcement at any of the inland nodes where the coastal distribution network interfaces with the transmission network. Candidate onward reinforcements would all involve substantial line re-builds at either 33kV or 132kV with timetables extending beyond the 2013 year taken here to define short term. Long term, large volume capacity provision (100MW – 2GW) should be taken account of in the pending ISLES study and planning for connection of territorial waters windfarms on the west..				Consenting of local line works.	Wider network capacity subject to Interim Connect and manage. In the medium term (post connection) requires Beauly Denny	
Medium - long term (2014 onwards)	All Scotland To be identified following Crown Estates and MESPG information gathering	Based on locations identified	Capacity can be delivered within timecales	Multiple GWs available post reinforcement	Submit applications to support case for regional works. Submit applications	N/A - adequate time to plan/build	Wider capacity build and associated consents.	Based on short term application format above. May be from individual parties or umbrella.

By way of example, the diagram (below) prepared by SHETL provides an indication of a new potential 132kV wood pole circuit that could be delivered in the medium term to get back to Dounreay from wherever in Northeast Caithness is determined by connection applications. For Orkney and the Pentland Firth area, the key to getting generation output away is to bring it to Dounreay to access the existing 275kV route southwards.



Recommendations

MEG intends that its Grid Sub-Group should continue to progress the positive work which has begun in this forum, to deliver a strategy for connecting marine energy projects from now until 2020. MEG also recognises that there may be opportunities to share infrastructure and connection costs with the offshore wind industry and that these should be investigated by the Grid Sub-Group as part of its ongoing work. MEG recommends that:

- **SCOTTISH HYDRO-ELECTRIC TRANSMISSION LTD** should continue its pre-construction design work, and on receipt of suitable applications for connection, build:
  - **a new 132 kV route from the Northeast Caithness coast to Dounreay**; and
  - **a new 132 kV route from the Orkney Islands to Dounreay, comprising subsea cable and onshore lines as required.**
- **MEG GRID SUB-GROUP** should seek to **identify other short-term grid infrastructure upgrades** for the West Coast, Outer Hebrides and Shetland Isles.
- **MEG GRID SUB-GROUP** should carry out a strategic review of Scottish grid infrastructure for marine energy, **identifying longer-term grid infrastructure upgrades** on the basis of expected development locations. This should take as its context the ENSG Report[19] that describes the 2020 vision for the GB grid, and the National Planning Framework 2.
- **MEG GRID SUB-GROUP AND THE PENTLAND FIRTH GRID COMMITTEE** should report to Scottish Government on the potential process and benefits of an **umbrella grid connection application,** including possibilities for underwriting grid pre-construction works.

[19] Electricity Networks Strategy Group (2009) Our Electricity Transmission Network: A Vision for 2020 http://www.ensg.gov.uk/index.php?article=126

- Additionally, it is the view of the **DEVELOPERS ON MEG** that it is essential that **the Beauly-Denny link must be consented urgently by Scottish Ministers** since not only does it provide capacity for renewable projects most ready for connection, but it is also key to unlocking further progress on network upgrades.

INFRASTRUCTURE AND SUPPLY CHAIN

Context

MEG recognises that the growth of the marine renewables industry, accompanied with the growth of offshore wind, will lead to significant new infrastructure and supply chain demands in Scotland. Key areas of new demand will include device manufacturing, enabling infrastructure, installation/decommissioning engineering services and operation/maintenance services. Coupled with the growth of the offshore renewables industry more widely across the UK and Europe, MEG believes strongly that Scotland has the opportunity now to secure itself as a leader in the development, manufacturing and installation of offshore renewable projects – bringing significant benefits to Scotland's economy and creating new skilled jobs.

OpenHydro device at EMEC tidal test site © OpenHydro

Infrastructure

Fit for purpose ports, harbours, vessels and manufacturing facilities will be required to enable and support the growth of a commercial marine renewables sector. Coupled with the emerging offshore wind opportunities around Scotland, the rewards for Scotland's economy could be high. Scotland has a relatively strong baseline from which to build a strong infrastructure base to support the marine renewables industry; EMEC is established in Orkney, there are a number of ports and harbours showing interest in marine renewables, and there already exist useful infrastructure and skills in the servicing of Scotland's oil and gas sector.

The Scottish Government, alongside Scottish Enterprise, HIE and Scottish Development International (SDI), is taking a co-ordinated approach to the development of Scotland's infrastructure and supply chain capabilities, addressing the needs of both the marine and offshore wind sectors. Part of this strategic work is the National Renewables Infrastructure Project, which will seek to define specific infrastructure requirements and develop solutions for targeting investment in the appropriate areas. The Project will develop a spatial framework for port and port-side land infrastructure (including sites for integrated manufacturing, and maintenance/vessel support bases) which can support the manufacturing, construction, operation and maintenance of commercial wave and tidal machines. This work involves Scottish Enterprise and HIE engaging directly with potential owners and investors to consider the facilities currently available in Scotland and future opportunities for expansion. The Project will report to the Scottish Government's Energy Advisory Board in October 2009, identifying, in the form of a map, an initial clutch of key National Renewables Infrastructure Projects.

In addition to this infrastructure review, work is also being taken forward to identify infrastructure dependencies such as the transportation of raw materials and finished components, power and other basic service infrastructure, locations for training facilities and the role and linkage between key testing centres such as EMEC.

EMEC, as the world's only accredited wave and tidal testing facility, has played a leading role in the development of the marine renewables industry in Scotland by providing grid connected testing facilities for wave and tidal stream devices as well as a source of increasing expertise in the deployment of marine devices. Interest and demand for EMEC's unique facilities continue to grow, as acknowledged recently in the UK Government's announcement that it was making available up to £8m for further development at EMEC of its testing and demonstration facilities. Interest has grown recently in the idea of "preMEC" facilities: a supported, perhaps more sheltered, environment in which earlier stage open-water testing may be conducted prior to devices deploying at EMEC.

MEG acknowledges that, given the scale of offshore wind, wave and tidal development required by 2020, there may be a strong need for public sector intervention to deliver enabling infrastructure. It is recognised that the costs will be considerable, putting additional pressure on public sector finances. However, MEG considers such public intervention is likely to be necessary to provide infrastructure owners with confidence that offshore renewables is a growing source of opportunity. It will also allow the necessary upgrades in ports, harbours, manufacturing and testing facilities to be achieved within a timescale that enables marine renewables and offshore wind projects to contribute to the 2020 targets.

Supply Chain

The large scale development, manufacturing, installation and maintenance of wave and tidal devices offers considerable opportunities to Scotland's supply chain. While the immediate focus is on the Pentland Firth and Orkney Waters as part of The Crown Estate's leasing round, activity throughout much of Scotland will be high.

Given the scale of the activity, it will be important that all of Scotland's relevant supply chain companies (either already active in the renewables sector or with relevant services to offer) are fully informed of the supply chain opportunities that will shortly become available throughout Scotland. To meet the scale of this opportunity, Scottish Enterprise and HIE are undertaking a Scottish-wide survey of companies across the renewables sectors, identifying their relevant services and skills. This information will be of use to the industry in the coming years, as developers look to develop and deploy their planned projects, and will also be of use for the Enterprise Agencies in targeting products and services to be attracted from overseas investors.

MEG Supply Chain Report

MEG commissioned a report from Sgurr Energy and IPA Energy + Water Economics to consider the supply chain and economic impacts of development of the marine renewables sector at a commercial scale (commercial projects were taken to be **at least 50MW projects, as an estimate**). The key findings from this report are referred to throughout this section and the full report is available on the Scottish Government's website[20].

[20] http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/19185/17853-1.

The study was compiled based on information obtained directly from wave and tidal developers, who were selected on the basis of having had direct experience of the procurement process and construction of full scale marine energy devices. Of the 10 developers identified, 6 participated in the study. Consultees were asked to provide input on the supply chain requirement for a 50MW project based on their respective technologies, as well as input on other supporting information such as research and development spending, primary material used, skills required, and estimate of job creation (if available). The analysis considered the potential scenarios (low, medium and high) set out in this Road Map. A capital cost learning curve was adopted, based on the **indicative figures** of a 12.5% learning rate and a capital cost of £3m/MW in 2014. MEG is considering the need to commission a second supply chain study, to further analyse opportunities.

Report's Key Findings

The Economic Prize

The report analysed the average projected costs for a 50 MW project up to the construction phase. It projected that 53% of expenditure on such a project in Scottish waters would be retained in Scotland, with a further 30% retained in the UK, 16% in the EU and the remainder elsewhere globally. MEG believes that the retained Scottish proportion could rise significantly, if subject to proactive stimulation over time. The report highlighted that notable areas of significant expenditure where the contribution from the Scottish supply chain is expected to be relatively low include: mechanical plant (e.g. hydraulics, turbines); electrical plant (e.g. generators, switchgear); cables, umbilicals and communications, grid connection; and installation vessels.

On this basis, the report concluded that reaching 1GW of marine renewable energy by 2020 will result in significant expenditure of around **£2.4bn**. It is anticipated that even without direct stimulation of the Scottish supply chain that **£1.3bn** of this expenditure

would be retained in Scotland. Development on this scale could provide **2,600 direct Scottish jobs** with **5,000** jobs overall in the EU. Should developments accelerate at the pace to which MEG aspires, i.e. the 'high' scenario of 2GW by 2020, overall expenditure could rise to **£4.7bn** with a potential **£2.5bn** being spent within Scotland. **10,000 direct jobs** would be created with more than half of those direct jobs, **5,300**, retained in Scotland.

In addition to these estimates of direct jobs it can be assumed that an additional number of indirect but related jobs will also be supported. For instance, the new report primarily analysed capital expenditure rather than including research/development activity or operations and maintenance. Both these subsectors will provide an additional number of long-term skilled and potentially high value jobs for the Scottish workforce. In an initial analysis, Scottish Enterprise has estimated that the 1GW by 2020 scenario could be associated with roughly **12,500 gross jobs**, if indirect and induced jobs are taken into account.

Additionally, the Report looked at the Scottish domestic market only. A key objective of establishing a strong domestic market and industry is to provide the springboard required to secure and supply the export market. Job creation for the export market could be many times the numbers presented above. It is of course difficult to forecast the growth of other marine energy markets in Europe and beyond. However, the opportunity is considerable and represents the real economic prize for securing the early stages of the industry – Denmark now exports around 99% of its wind energy manufacturing capacity, worth an annual £2.4 bn to their balance of trade.

It is recommended that to follow on from the above analysis for the Scottish domestic market, MEG should extend this work to estimate export opportunities and associated economic activity.

Given the new study's parameters, focusing on direct jobs in the domestic market, its figures complement the job projections from the MEG (2004) report[21]. From the study it is clear that the marine renewables industry has a strong contribution to make to Scotland's economy - both up to 2020 and to an even greater extent beyond this.

Jobs and Skills Profiles

Developers, where possible, will be looking to source expertise and services locally to support their projects. The following areas of work have been identified as having strong local employment opportunities for the Scottish workforce: permitting/consenting, vessel hire, divers and ROV surveys, environmental and geotechnical monitoring, maritime operations consultancy, fabrication and final assembly, cable installation, operations and maintenance as well as port facilities.

Whilst the Report concludes that 53% of overall capital expenditure will be retained within Scotland, the challenge for the Scottish Government, Scottish Development International and the Enterprise agencies will be to increase this figure by strategically targeting activities currently being taken forward outside of Scotland which could be located within Scotland. MEG believes there is no reason why Scotland's industrial base and capability could not be extended to increase its share of the supply chain to 75% or more. **It is recommended that MEG commission a further study to assess the potential for increasing Scotland's share of the supply chain.**

Scotland already has an experienced offshore industry supporting the oil and gas sector. MEG appreciates that there are vital skills within the oil and gas sector which could be translated to the marine renewables industry, particularly in the coming years as

[21] MEG (2004) "Harnessing Scotland's Marine Energy Potential" – predicted 7000 jobs from marine energy, related to 1.3GW of deployment by 2020 and a preliminary estimate of the export opportunity

projects start deploying in Scotland's seas, to ensure early deployment success. Lessons learned from the offshore wind and other marine sectors (such as fisheries, shipping etc) will also be of value to project developers working in the offshore environment.

Despite the existing level of offshore skills within Scotland's workforce, MEG believes that demand from the emerging marine and offshore wind renewable industries will create a heavy demand on the available workforce. A strategic approach is required to the transfer of existing skills and development of new skills across Scotland's workforce, not only in terms of working in an offshore environment but also for engineering and technical support during the development, design and construction of planned projects. Operations support staff will be needed post-deployment to operate and maintain the projects.

Recommendations

Infrastructure

MEG recognises and welcomes the positive work taking place under the National Renewables Infrastructure Project. In order to further stimulate infrastructure investment for marine renewables in Scotland, MEG recommends that:

- **MEG** should feed into the spatial framework being drawn up by Scottish Enterprise and HIE on port and port-side land infrastructure for marine renewables;
- Following identification of the key National Renewables Infrastructure Projects, **SCOTTISH ENTERPRISE AND HIE** should **swiftly announce its plans** for taking forward the development of the identified projects;
- **EMEC** to consider **expanding its infrastructure to include so-called "pre-EMEC" testing sites** in more sheltered areas for the testing of early stage prototypes.

Supply Chain

Following the outcome of MEG's Supply Chain report, MEG recommends:

- In response to the conclusion of their work on Scotland's supply chain companies, **SCOTTISH ENTERPRISE AND HIE** to actively promote the supply chain opportunities within the marine renewables sector to the companies with services relevant to the sector.
- **SCOTTISH DEVELOPMENT INTERNATIONAL** to identify gaps in the supply chain where inward investment opportunities could be pursued to increase Scotland's share of the marine renewables supply chain;
- **MEG** to engage with the Skills Development Scotland Renewables group to identify the key skills required to progress their projects.
- **MEG** to consider commissioning a second stage MEG Supply Chain study.

PLANNING

Context

OpenHydro device at EMEC © OpenHydro

MEG convened a Planning Sub-Group to develop key recommendations on the planning and consents systems governing marine energy developments in Scotland. MEG believes that the quality and efficiency of Scotland's onshore and offshore licensing and consents system will be critical to developing a successful marine energy industry.

The UK Marine and Coastal Access Bill and the Marine (Scotland) Bill are currently going through their respective Parliamentary processes. Both make provisions for improved planning, simplified regulation and strengthened protection in the marine environment.

MEG welcomes Marine Scotland's current pledge to introduce a one-stop-shop for marine energy offshore consents and for its commitment to reach a decision within nine months, where practicable.

MEG supports the work of the Marine Energy Spatial Planning Group (MESPG), which is piloting and prioritising four workstreams on wave, tidal stream and

offshore wind energy, with the goal of limiting uncertainty for the sectors given the tight timescales involved in delivering significant developments by 2020, and to pilot approaches for their sustainable development .

MESPG's four theme work programme is as follows:

- **Theme 1: Planning and Locational Guidance** – including the production of an Interim Marine Spatial Plan for the Pentland Firth/Orkney Waters Strategic Leasing Area to guide developers and regulators.
- **Theme 2: Consents and Licensing** – including the production of Guidance on the Simplification of Marine Renewable Development Applications, incorporating guidance on EIA and Appropriate Assessment processes.
- **Theme 3: Environmental Research and Data** – A number of strategic environmental research projects, including work on monitoring protocols for marine renewables.
- **Theme 4: Regional Initiatives** – the promotion of regional marine renewables initiatives. MESPG is currently working with the Pentland Firth Co-ordination Committee, the Western Isles Development Trust and Scottish Enterprise in Dumfries and Galloway.

MESPG has established the Marine Strategic Studies Forum (MSSF) to provide key feedback on studies affecting marine stakeholders, including those commissioned by MESPG. The Group meets quarterly and comprises representatives from environment, fishing, shipping and renewables interests.

Recommendations

MEG recognises and welcomes the positive work of MESPG. In order to further reduce planning risk for marine renewables in Scotland, MEG recommends that:

Theme 1

- The Interim Marine Spatial Plan for the Pentland Firth/Orkney Waters Strategic Area is **drafted in a flexible way** that allows for evolution of the Plan to incorporate new data from monitoring and technology deployment experience and acknowledges that some developers' initial plans will be moving forward in advance of the drafting of this Plan**.** The Plan should also be clear that it is non-Statutory until it is replaced by a Statutory Plan under new marine legislation.
- **SCOTTISH & UK PARLIAMENTS** should ensure that the UK Marine and Coastal Access Bill and the Marine (Scotland) Bill create mechanisms which will **ensure consistency between marine spatial plans and onshore plans**, in terms of content and also in terms of plan production/revision timetables.
- **MARINE PLANNING AUTHORITIES** should **prioritise marine spatial planning in key development areas, in advance of leasing or regional initiatives** outside of the Pentland Firth/Orkney Waters Strategic Area. Key development areas are currently being identified by MESPG, through a survey of developers.

Theme 2

- **MARINE SCOTLAND** should ensure that the current strengths and speed of the consents and licensing procedure **are not lost** in developing new streamlined procedures. New streamlined procedures **should be available by the end of 2009,** with further streamlining subsequently resulting from proposed Marine Bill changes. Projects which have applied for consents/licences through the current procedure should be dealt with under this procedure.

- **REGULATORS** of the marine renewables industry **must adopt a 'Deploy and Monitor' strategy**. Consents & licences should be handled in a pragmatic way which allows initial developments to progress, in order to collect information on environmental interactions of devices. This should be reflected in the monitoring protocols being commissioned by SNH, to be published by the end of 2009. Monitoring and data collection requirements placed on developers should be proportionate to the environmental risk posed by the development. For marine energy, there is a lack of data on this risk given the novelty of developments, but also because of a lack of strategic baseline data. These issues should be reflected in the cost burden placed on the private sector, especially those involved in the initial deployment of marine renewable projects.

Theme 3

- **SCOTTISH RENEWABLES** should advise MESPG on an industry view of proportionate costs for monitoring.

Marine Legislation

- **SCOTTISH & UK PARLIAMENTS** should ensure that both the UK Marine and Coastal Access Bill and the Marine (Scotland) Bill should be **explicit and clear on devolved responsibilities** for planning, consents and licensing and marine conservation in the Renewable Energy Zone.
- Noting that the 'State of Scotland's Seas' Report concluded that Scotland's seas are generally 'clean, safe, healthy and biologically diverse'[22] **THE SCOTTISH & UK PARLIAMENTS** should ensure that marine renewables development is facilitated by the UK Marine and Coastal Access Bill and the Marine (Scotland) Bill, in order to ensure that climate change mitigation is given high priority in policy.

[22] Scottish Government (2008) 'Scotland's Seas: Towards Understanding Their State' http://www.scotland.gov.uk/Publications/2008/04/03093608/0

- **THE SCOTTISH & UK PARLIAMENTS** should seek to ensure the UK Marine and Coastal Access Bill and the Marine (Scotland) Bill facilitate an 'ecologically coherent network' of marine protected areas (MPAs), by requiring a strategic approach to any MPA designation, to ensure the network is complementary with the growth of a sustainable marine energy industry.
- It is of **critical importance** that **THE SCOTTISH & UK GOVERNMENTS** ensure **all regional and regulatory bodies tasked with implementing functions of the Bills must be fully resourced.** MEG fully supports SNH's recent decision to fund recruitment of an offshore renewables team.

Other

- **THE MARINE RENEWABLES INDUSTRY should prioritise early engagement with all key marine stakeholders.**

Europe

Context

The European Commission is strongly promoting the development of renewable energy technologies for the purposes of mitigating climate change and securing economic benefit. Through its Directive[23] 2009/28/EC it has set itself the challenging and world-leading target of having 20% of Europe's energy demand met by renewables by 2020. MEG is confident that the marine renewables industry in Scotland will contribute to this 2020 target whilst the continued growth of the sector across Europe will see the marine renewables sector make a significant contribution to Europe's renewable energy mix post-2020.

However, marine energy technologies are perceived by the European Commission as being too far from commercial realisation to be of significance in the short to medium term, and as a result do not strongly feature in the European Strategic Energy Technology Plan. This perception has meant that European funding for energy is largely directed towards other low-carbon technologies – this is demonstrated by the fact that, while marine renewables have been supported to a limited extent by the 7th Framework Programme, they have not featured strongly in recent Work Plans.

Recommendations

MEG recommends that the Scottish industry and Scottish public organisations work to raise the profile of marine renewables within Europe. Specifically, MEG recommends:

[23] Directive 2009/28/EC *'On the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC'* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

- **THE SCOTTISH EUROPEAN GREEN ENERGY CENTRE (SEGEC)** should **work closely with EU-OEA and Scottish industry in building links for the marine energy sector within the European Commission**. The marine sector should ensure that the Commission has full awareness of its potential for growth, the barriers to its growth and solutions to these barriers.
- **MEG** should **present its Road Map to the European Commission and to a wider European audience**, through events in Brussels and press for inclusion of marine energy under EU support mechanisms.
- **THE EUROPEAN COMMISSION** should **recognise the potential of marine energy**, particularly in the medium to long term, **through funding further R&D and demonstration projects**. This could be through, for instance, FP7 and the New Entrants Reserve Fund.
- **THE SCOTTISH GOVERNMENT** should use its lead on the British-Irish Council (BIC) marine energy workstream to **work closely with BIC administrations on wider promotion of the marine energy sector.**
- **MEG, SEGEC and the SCOTTISH GOVERNMENT** should give consideration to **a strategic alliance with other European regions to drive forward a European roadmap** and identify practical actions for collaborative working.
- **MEG/SEGEC** should work with **DECC to ensure that marine energy is included in the next Energy Technology Perspectives Report from the International Energy Authority (IEA)**, to be published in 2010
- **MEG, SEGEC and the EUROPEAN COMMISSION** should consider **how EU funding mechanisms in the next funding period (2014-20) can be adapted** to ensure the most effective support for the large scale development of marine renewable technologies.

CONCLUSIONS AND NEXT STEPS

Large scale deployment of marine energy technology in Scottish waters by 2020 is possible, but requires fast and concerted action by all players, coupled with a strong leadership role for the public sector.

Limpet device on Islay © Voith Hydro Wavegen

A 'Critical Path' for the marine energy industry, detailing crucial actions for the next 24 months of the Scottish sector's development has been summarised in the Scottish Government Renewables Action Plan[24]. MEG will seek to build on this, and promote action to tackle barriers to growth of the Scottish marine energy industry. As its first task after the publication of the Road Map, MEG will seek to present its recommendations to Ministers and the other relevant parties identified within this document. MEG will then continue to take forward actions within its Work Programme. MEG should undertake a review of progress on the recommendations in this Report in Summer 2012.

[24] Scottish Government (2009) Renewables Action Plan http://www.scotland.gov.uk/Publications/2009/07/06095830/0

ANNEX 1

FREDS MARINE ENERGY GROUP: REMIT
01.04.09

Vision
The FREDS Marine Energy Group 2009 will work towards the following vision:

"To accelerate delivery of the world's leading marine energy industry that will provide a substantial contribution to the sustainable economy and environment of Scotland."

Working Methods
The full MEG will meet monthly, until its work programme is complete. Sub-groups will be formed to undertake specific detailed pieces of work. These sub-groups may rise and fall as required. The MEG will continue to consider means for covering the cost of any detailed work it deems necessary for its work programme.

The MEG has a formal working relationship with the Marine Energy Spatial Planning Group as the other key Group operating in this area. Phil Gilmour will act as the formal link to the latter Group on MEG. The MEG will also have strong links through its members to the following Groups:

- Core FREDS Group
- Offshore Wind Delivery Board
- Energy Networks Strategy Group
- SRF Marine Work Group
- BWEA Marine Strategy Group
- REA Ocean Energy Group
- Energy Technology Partnership
- Saltire Prize Team
- Renewables Advisory Board
- Department for Energy and Climate Change
- Treasury

'Road Map'

The MEG will draft and accept a Scottish Marine Renewables '*Road Map'*[25]. The MEG may need to commission a variety of studies in order to inform the '*Road Map'.* The '*Road Map'* will be completed by Summer 2009. The FREDS MEG Project Plan will be used to manage the delivery of the *'Road Map´* and associated workstreams. Associated workstreams may be considered on topics such as grid, finance, supply chain, planning and consents.

The MEG will liaise with the MESPG to ensure that the '*Road Map'* can also act as a framework for the work by the latter group.

In addition, the MEG will have a role in the promotion of the Scottish marine energy industry, and communications on industry issues with other stakeholders.

Actions

After agreeing the Scottish Marine Renewables '*Road Map'*, the FREDS MEG will take forward specific actions to enable the achievement of the aims laid out in the '*Road Map'*. These are laid out in the FREDS MEG Project Plan.

Wherever appropriate, FREDS MEG should work with MESPG and other individuals/organisations.

[25] Name of document to be revised

ANNEX 2

FREDS MARINE ENERGY GROUP: MEMBERSHIP
01.07.09

Responsibility on MEG	Name	Organisation
Co-chair; link to ENSG, FREDS and Offshore Wind Delivery Board	Lynne Vallance	Scottish Government
Co-chair; link to Wave Energy Technology Developers Forum and Renewable Core Skills Group	Sian McGrath	Aquamarine Power
Secretary	Morna Cannon	Scottish Renewables/Scottish Government
	Robin Burnett	Airtricity *[from June 2009]*
	Gareth Davies	Aquatera
	Graham Bibby	AWS Ocean Energy
	Tom Mallows	The Crown Estate
	Neil Kermode	EMEC
	Audrey MacIver/Elain Cameron	Highlands & Islands Enterprise
	Robin McGregor	Lunar Energy/Christie Griffith
	Duncan Burt	National Grid
	Richard Yemm	Pelamis Wave Power
Link to BWEA Marine Strategy Group	Alan Mortimer	ScottishPower Renewables
	Mike Barlow	Scottish & Southern Energy
	Paul Neilson	Scottish & Southern Energy
	Paul O'Brien	Scottish Development International

	Brian Nixon	Scottish Enterprise
	Karen Fraser	Scottish Government
Link to MESPG	Phil Gilmour	Scottish Government
	Alistair Birnie	Subsea UK
	Robin Wallace/Henry Jeffrey	University of Edinburgh
	Matthew Seed	Wavegen

ANNEX 3

Existing road map work taken into account by MEG:

- UKERC Marine (Wave and Tidal Current) Renewable Energy Technology Roadmap (UK Energy Research Centre) [26]
- Marine Energy Road Mapping for Scotland (Aquatera Ltd)
- Marine Energy - Path to Power (BWEA)
- Future Marine Energy (The Carbon Trust)

[26] It should be noted that the UKERC road mapping work is being continued at an international level, with the IEA's Ocean Energy Group currently considering a proposal for an international marine energy technology road map

ANNEX 4

Summary of Existing 2020 Aims

Source	Capacity (GW)	Location	Notes
Future Marine Energy. The Carbon Trust. (2006)	3 GW	UK	Installed
Path to Power. BWEA (2006)	3 GW	UK	Installed
Harnessing Scotland's Marine Energy Potential. FREDS Marine Energy Group (2004)	1.3	Scotland	Installed
Strategic Objective. Scottish Renewables Forum (2008)	1.3	Scotland	Consented by 2017
Marine Energy Road Mapping for Scotland. Aquaret (2008)	1	Pentland Firth	Operational in 2020
UKERC Marine Renewable Energy Technology Roadmap. UKERC (2008)	2	UK	Installed capacity. Estimated breakdown for Scotland – 1GW.
Saltire Prize. Scottish Government	<0.030	Scotland	Installed by 2017
The Crown Estate – Pentland Firth Strategic Area	0.7	Pentland Firth	Installed

ISBN 978 0 7559 9083 2 (web only publication)