House of Commons

Energy and Climate Change Committee

The Future of Marine Renewables in the UK

Eleventh Report of Session 2010–12

Volume I

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The Energy and Climate Change Committee

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Contacts

All correspondence should be addressed to the Clerk of the Energy and Climate Change Committee, House of Commons, 7 Millbank, London SW1P 3JA. The telephone number for general enquiries is 020 7219 2569; the Committee's email address is ecc@parliament.uk

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Wave and tidal stream energy (marine renewables) have the potential to benefit the UK: there is an abundance of resource (potentially enough to supply 20% of current electricity demand); they can provide a more reliable and predictable source of energy than some other types of renewables; they could help cut carbon emissions; and they could provide new jobs and industries. As the current world leader in the development of marine renewables, the UK could also benefit by exporting goods and skills as other markets begin to emerge around the world. The UK should follow the example set by Denmark in the 1980s in establishing a domestic wind power industry. Adopting a similar vision for a marine industry in the UK could help to accelerate development in the sector and to secure benefits for the UK.

Attracting investment will be key to the development of marine renewables technologies. Investors want a stable and consistent policy regime to give them confidence to invest. They also need to have confidence that there is a long-term, viable market for the technology that they are backing. Market signals through revenue support schemes like the Renewables Obligation are one way of providing this. Investors are unwilling to take on excessive risks. Splitting the costs between the private and public sectors may help to reduce risks, as could addressing practical barriers (such as a lack of grid connections).

Marine renewables are part of a much larger landscape of low-carbon energy technologies, which includes nuclear and carbon capture and storage as well as other types of renewables, they could play an important role as part of a low-carbon energy mix in the future. But their very high cost at their present state of development means they are unlikely to make much, if any, contribution before 2020. The priority over the next decade must be to focus on reducing the cost of marine renewables. The Government should clearly set out its expectations of industry in this regard so that progress can be monitored. If cost reductions are delivered successfully, more ambitious plans for the deployment of marine renewables can then be adopted.

Potential obstacles fall into three categories: bureaucratic, financial and practical. Many organisations are involved in providing funding and support to the sector. A more streamlined approach may reduce duplication and inefficiency in funding schemes. The formation of the Low Carbon Innovation Group is a step in the right direction, but we would like to see further action to simplify the funding landscape. We also hope that the Department will minimise bureaucracy for applicants to the £20m fund that is available for testing arrays, potentially by developing a joint pre-qualification process with the £18m fund that is available from the Scottish Government.

The proposal to increase revenue support to five Renewables Obligation Certificates (ROCs) per MWh has been widely welcomed by the industry and it will encourage investors. However, there is still a great deal of uncertainty about the level of revenue support that will be provided beyond 2017 and how levels are likely to change over time. The Department must provide clarity on these matters as soon as possible. It must also consider how to prevent costs to consumers beyond 2017 from becoming excessive.

Practical obstacles include access to grid connections, the planning and consenting

process and accessing a suitably skilled workforce. It is important to address these issues now to ensure that the development of the sector is not blocked in the future. Gaining acceptance from members of the public is also important .

Although it is still early days for marine renewables, the potential longer-term benefits associated with developing a thriving wave and tidal industry in the UK are significant. An overly cautious approach may allow other countries to steal the UK's lead. It is vital that DECC continues to support the development of these technologies so that the UK can retain its leadership position.

1 Introduction

1. The seas and oceans represent a large potential source of renewable energy but, unlike wind turbines and solar panels, technologies that can achieve the Holy grail and "turn sea water into electricity" are still in their infancy[1]. If captured effectively, the energy contained in waves and the flow of the tides could provide a clean and reliable source of electricity. With the largest wave and tidal resource in Europe, the UK could gain substantial benefits from marine renewables.

2. The UK is currently the world leader in the development of wave and tidal stream technologies.[2] Of the eight full-scale prototype devices installed worldwide, seven are in the UK.[3] This success is the result of a number of factors: an abundant natural resource, a long history of academic research on wave and tidal power, world-class testing facilities and a strong skills base in other maritime industries.[4]

3. Our inquiry was prompted by DECC's decision to close the £50m Marine Renewables Deployment Fund and to replace it with a £20m innovation fund but it has not been limited to it. We have also examined the opportunities for the UK in developing wave and tidal energy and assessed the effectiveness of the Government's broader policy measures in this area.

4. In this report, we use the phrase "tidal energy" to refer to tidal stream energy (unless otherwise stated). While we recognise that tidal range technologies (such as tidal barrages and tidal lagoons) could also make a significant contribution to the UK's energy system, we have not looked in detail at this family of technologies. This is because this group of technologies is more mature (La Rance tidal barrage in France has been operational since 1966[5]) and therefore faces a very different set of challenges around deployment and support than those faced by nascent technologies such as wave and tidal stream. We refer interested readers to the work of our predecessor committee on Severn Estuary Tidal Power Projects.[6] We use the term "marine renewables" to refer to wave and tidal stream energy only – we have excluded consideration of offshore wind from this inquiry.

5. We received 50 submissions of written evidence and held three oral evidence sessions. A full list of witnesses can be found at the end of this report.[7] We are very grateful to all those who have contributed towards this inquiry. We also visited the European Marine Energy Centre (EMEC) in Orkney, where we met with members of the industry and representatives from the local council.[8] We would like to express

1 with the exception of some tidal range technologies, such as La Rance tidal barrage in France – Ev w16.

2 Tidal *stream* devices use the flow of water due to tides to generate electricity. Tidal *range* devices use the change in height of water due to tides, using principles similar to a hydroelectric dam.

Ev 42, 53, w1, w20, w24, w32, w39, w45, w61, w97, w107; Q 11

3 Ev 82

4 Ev 42, 78, 82, w20, w45, w52, w61, w97, w102

5 Ev w8, w16, w73, w78, w81

6 Energy and Climate Change Committee, Minutes of Evidence, *Severn Estuary Tidal Power Projects*, 14 October 2009, HC 1011-i

7 Page 36

8 See annex 1 – note of visit.

our thanks to all those who took the time to meet us and to impart their first-hand knowledge of the opportunities and challenges in developing wave and tidal energy.

Structure of this report

6. We begin our report in Chapters 2 and 3 by setting out the context of our inquiry, including identifying some of the potential benefits the wave and tidal energy could bring and some of the barriers to investment in this sector. Chapter 4 looks at the Government's overarching strategy and the various institutions that are engaged in developing the marine renewables sector. Chapters 5 and 6 address some of the main barriers to the development of marine energy, including raising sufficient finance (Chapter 5), grid connections, the consenting process, public acceptability, environmental integrity and the skills gap (Chapter 6). Finally, we draw conclusions in Chapter 7.

2 Potential benefits of wave and tidal power

7. One of the aims of our inquiry was to identify the potential benefits that wave and tidal power could bring to the UK. In this section we provide a summary of the potential rewards associated with developing marine renewables.

A large domestic resource

8. The UK has the largest wave and tidal resource in Europe. This is a result of the UK's exposure to Atlantic winds (which boost the wave resource) and the existence of a number of headlands and islands, which concentrate tidal flows.

9. Various attempts have been made to estimate the size of the resource that is available in the UK. Estimations of the practical wave resource range from 40-50TWh per year (for comparison, a total of 381TWh of electricity was generated in the UK in 2010). The practical tidal stream resource has been estimated at 116TWh but a more recent assessment of the practical and economic resource produced a lower figure of 21TWh per year. [9] In total, the Carbon Trust believes that practical and economic sources of wave and tidal power could provide 20% of current UK electricity demand.[10]

10. Although the potential resource is large, it may be years or even decades before the technology is sufficiently advanced to be able to harness significant levels of this energy economically. Potential deployment levels and timescales are discussed in more detail in paragraphs 37-42.

Energy security

11. Marine renewables could benefit energy security by reducing the UK's reliance on imported fuels. Tidal stream has the additional benefit of providing a predictable output that is not dependent on the weather. This could be extremely valuable in a system that also contains intermittent sources of generation, such as wind.[11]

12. Although wave power is driven by the wind there could nevertheless be some energy security benefits associated with this technology too. This is because wave power is less variable from hour-to-hour than wind energy and can be forecast several days in advance. Wave power can also sometimes be out of phase with offshore wind since waves generated in the mid-Atlantic travel more slowly towards the land than the pressure fronts themselves. Finally, there is a good match between the availability of wave energy and seasonal electricity demand.[12]

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9 A practical resource takes technical and physical constraints (such as world heritage sites or shipping lanes) into consideration. Economic resource considers the available energy which can be exploited at a cost considered to be economic.

The Offshore Valuation Group, *The Offshore Valuation: A valuation of the UK's offshore renewable energy resource,* 2010

Carbon Trust, *Accelerating marine energy*, July 2011

DECC and Ofgem, *Statutory Security of Supply report,* November 2011, p 9

10 Ev 82

11 Ev 58, 62, 78, 91, 99, w16, w32, w52, w78, w85, 88, w91, w100, w102

12 Ev 78, 91, w85, w107

Carbon savings

13. Wave and tidal stream are renewable forms of energy and therefore could make a significant contribution towards the UK's long term climate change objectives.[13] DECC told us that "by 2050, for a high deployment scenario of 27GW installed capacity, wave and tidal stream technologies could save 61Mt of CO_2" (for comparison, total emissions from the power sector in 2010 were 156 $MtCO_2e$).[14] The Engineering Institutions told us that this was a reasonable estimate.[15]

Economic benefits

14. The establishment of a new marine energy industry could bring economic benefits for the UK. The Carbon Trust has recently estimated that the global market for marine could be worth £340 billion (in 2050) and that the UK's share of this could be worth £76 billion.[16] The industry estimates that there could be 10,000 direct jobs in 2020 and the Carbon Trust has estimated that there could be as many as 68,000 UK-based jobs by 2050.[17]

15. Many witnesses highlighted the potential for export opportunities in the future. There is increasing interest in marine renewables around the world, with markets beginning to emerge in Canada, USA, Korea and New Zealand (among others). There is scope for supplying physical components of marine devices to these other markets, as well as providing specialist skills and expertise (such as offshore surveying and contracting, and environmental management).[18]

16. We heard numerous pleas to heed the lessons of the UK's experience in developing wind power technology in the 1980s. Although the UK was at one point a leader in terms of research and testing of wind turbines, it failed to establish a domestic wind turbine manufacturing industry and therefore was unable to capture many economic benefits. Denmark, on the other hand, supported its domestic wind power industry through the early adoption of Feed in Tariffs and emerged with almost 40% of the wind turbine market in 2003.[19] The Renewable Energy Association said:

> Denmark is the undisputed leader of the modern wind energy industry and lessons must be learned from this success if the UK is to capitalise on its current stronghold in marine renewable energy. Early political vision in Denmark, including consistent financial support mechanisms and priority grid access, provided security for private investors to develop wind energy on a commercial basis. […] With similar vision and structured political support, the potential of the marine renewables industry could be captured in the UK.[20]

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13 Ev w45, w52, w107

14 Ev 42; DECC, *The Carbon Plan: Delivering our low carbon future*, December 2011 p 69

15 Ev w91

16 Ev 82

17 RenewableUK, *SeaPower: funding the marine energy industry 2011-2015*, March 2011; Carbon Trust, *Accelerating marine energy*, 2011; Q 184

18 Ev 42, 53, 62, 78, 88, 99, w1, w24 ,w29, w32, w39, w45, w58, w49, w81, w83, w85, w97, w100, w102, w107

19 Ev 53, 62, 71, 78, 91, w29, w43, w45, w85, w91, w100, w102,

20 Ev w 85

3 Attracting investment

17. Private sector investment in wave and tidal energy will be crucial to the future of these technologies. According to the Carbon Trust, demonstrating a full-scale prototype at sea costs around £10m-£30m. Deploying the first wave and tidal farms will cost £30m-£100m for each project.[21] Not all technologies can be expected to be successful at the demonstration stage, so there is still a high level of risk attached to investing in the marine renewables sector.

Types of investor

18. Different types of investor have different types of expectation in terms of risk:reward ratios and the timescale over which they would like to see returns. As a result, different types of investor can be expected to invest at different points in the journey from an idea on the drawing board to a fully commercial wave or tidal farm. In general, venture capital and angel investors tend to provide finance earlier in the development process, whereas large corporates and debt investors are more risk averse and prefer to invest only once a technology has been proven to work and there is an assured level of return.

19. To date, most investment in marine devices has been from venture capital and angel investors. However, as the first full-scale, grid-connected prototypes have begun to be tested, investment from large corporates has started to come forward, including investment from both large utilities and Original Equipment Manufacturers (OEMs).[22] We are also aware of one project that has secured bank debt finance.[23]

Increasing investor confidence

20. The wave and tidal sector will only be able to attract investment if the sector compares favourably with other investment options. Witnesses highlighted four key factors that could help tip investors' decisions in favour of the marine renewables sector:

- Policy certainty – investors want stable and consistent policies so that they can plan confidently for the future.[24] Several witnesses highlighted the recent unexpected changes to solar PV feed-in tariffs as an example of how policy changes had created uncertainty, which makes private investment more difficult to secure.[25] Plans to reform the electricity market were seen as an opportunity to create policy certainty.[26]

- Risk sharing – the costs and risks involved with developing wave and tidal technologies are currently too high for private investment to bear alone. Governments can help to reduce the risk by agreeing to take on some of the costs

21 Carbon Trust, *Accelerating marine energy*, July 2011

22 Ev 99, w45, w97, w102, w107, Q 57

23 Ev 62

24 Ev 58 , 67, 71, 78, 88, 103, w29, w39, w83, w85, w91, w102, w119

25 Ev 58, w85, w91, w102

26 Ev w91, w102

involved, for example through the provision of capital grants or infrastructure such as testing sites.[27] This approach has worked successfully in the past for marine renewables; trade body RenewableUK estimated that every £1 spent by the public sector on marine renewables leverages a further £6 of private sector investment.[28]

- Confidence that there will be a future market – investors want to know that there is a long-term, viable market for the technology they are backing.[29] One way governments can provide such a market signal is through a market support mechanism.[30] The Government currently runs the Renewables Obligation (RO) for this purpose, although it is due to be replaced with a Feed-in Tariff in 2017.

- Removal of other barriers – investors want to be sure that there are no other practical or regulatory obstructions to the development of a long-term market. These might include inconsistencies in the planning system, lack of grid connections, lack of manufacturing sites, lack of installation support infrastructures and lack of technology development support.[31]

21. The rest of this report will look at these four aspects in greater detail. The next Chapter, focusing on the Government's overall strategy and policy direction, will investigate the question of whether DECC is providing sufficient policy certainty. Chapter 5 looks at financial support programmes—both "risk sharing" capital grant schemes and revenue support schemes that provide a long-term market signal. Finally, Chapter 6 will explore progress in removing other barriers.

27 Ev 62, 71, 82, w32, w49, w54, w58, w61, w85, w91, w97, w107

28 Ev 53

29 Ev 91, w29 , w32, w52, w61; Q 67 [Mr Stevenson]

30 Ev 67, w29, w61

31 Ev 67, w29, w102

4 Strategy and policy direction

22. In this chapter we explore how wave and tidal energy fit into the broader picture of low-carbon technologies and examine DECC's overall level of ambition and aims for the sector. We also consider how well the various strategic funding organisations that are active in the sector are working together.

Low-carbon technologies

23. The UK has adopted legally binding targets both to reduce emissions of greenhouse gases and to increase the use of renewable energy. The Government has suggested that 40-70GW of new low-carbon electricity capacity will need to be built by 2030, and 100GW or more will be required in 2050.[32]

24. There is a range of low-carbon technologies that could play a part in delivering these long-term goals. These include nuclear, fossil fuel with carbon capture and storage (CCS) and renewables. The Government believes that 30% of electricity generation will need to come from renewable sources by 2020 in order to meet our renewable energy obligations. However, the Government has not specified what the mix should look like in the longer term, stating instead that it "would like to see the three low carbon technologies [nuclear, CCS and renewables] competing on cost in the 2020s to win their share of the market".[33]

25. Some low-carbon technologies are relatively advanced; nuclear power is well established and onshore wind is nearing maturity. Other technologies, such as CCS, are still very much at the experimental stage. Wave and tidal stream energy are also still in the early stages of development. While some marine devices are now being demonstrated at scale, further testing in array formation will be needed before they can start generating electricity in any meaningful quantity.

26. Most witnesses and witnesses agreed that wave and tidal energy was unlikely to make a significant contribution towards the UK's energy system in the near future. The Minister told us that even "with the best will in the world", wave and tidal energy will not contribute significantly to UK electricity generation before 2020. However, he went on to add that "in the 2020s [...] and up to 2050, marine can make a very substantial contribution to our renewables portfolio".[34] Some other witnesses were more cautious about the role wave and tidal energy could play in a future energy mix; the Energy Technologies Institute (ETI) told us that wave and tidal might be considered as a "hedging option" as insurance against failure to deliver other low-carbon technologies such as nuclear and CCS.[35]

27. Since the total amount of funding available to support low-carbon technologies is finite (DECC has a total pot of £200m to spend on low carbon innovation in the current Spending Review period and the Treasury has set a cap on the total amount of subsidy that can be provided through the RO), decisions will inevitably have to be

32 HM Government, *The Carbon Plan: delivering our low carbon future*, December 2011

33 HM Government, *The Carbon Plan: delivering our low carbon future*, December 2011, p 73

34 Q 175 [Mr Barker]

35 Ev 67; Qq 78-79 [Dr Clarke]

made about how to make best use of the available resources. Trade-offs will have to be made between supporting the deployment of those (more mature) technologies that could help to deliver our 2020 renewables target and funding the development of those that are less mature, but could play a significant role over a longer timescale.

28. DECC has so far allocated 10% (£20m) of its Low Carbon Innovation Fund to marine energy and is consulting on increasing the level of support offered through the RO (see chapter 5 for a more in depth discussion of these measures).

29. While we recognise that funding is limited in the current economic climate, we nevertheless feel that the Government's funding for marine renewables represents a modest investment for what is a world leading industry with the potential to bring significant benefits to the UK.

Reducing the cost of wave and tidal energy

30. Because marine renewables are still in the early stages of development, they currently represent an expensive way to generate electricity compared with established forms of generation. The Carbon Trust has suggested that the baseline costs are likely to be in the range of 38-48p/kWh for the first wave farms and 29-33p/kWh for the first tidal farms.[36] This compares with the current cost of 9-10.5p/kWh for onshore wind.[37] It is clear that the costs of marine renewables will need to fall significantly if these technologies are to compete effectively in the market.

31. Cost reductions can be expected to occur naturally as more and more devices are deployed. This happens because larger production volumes bring economies of scale and "learning by doing" helps to improve efficacy and efficiency.[38] However, the Carbon Trust told us that a "continued focus on technology innovation" would help to bring down costs even faster.[39] Amaan Lafayette, E.ON Climate and Renewables, illustrated the point by describing how an innovative engineering solution had eliminated the need to hire very expensive vessels to install particular marine devices, thereby producing a significant saving on the overall cost of the project.[40] Other ways in which cost reductions might be achieved include improvements in manufacturing techniques, device reliability and durability (which reduce the need for maintenance work), anchoring technologies, and the integration of underwater electrical systems.[41]

32. The Energy Technologies Institute (ETI) told us that the marine renewables industry would need to demonstrate the potential to move towards a cost competitive position compared to other low-carbon technologies in the next 5-8 years if it is to retain commercial investor engagement.[42] The Low Carbon Innovation Group (LCIG) (of which DECC is a member) has taken on this challenge and is already

36 Carbon Trust, *Accelerating marine energy*, July 2011

37 Figures for projects started in 2011, assuming 10% discount rate. ARUP, *Review of the generation costs and deployment potential of renewable electricity technologies in the UK,* June 2011, p 286

38 Ev 53, 62, 78, 82, 88, 91, w39, w85, w119

39 Ev 82

40 Q 69 [Mr Lafayette]

41 Ev 62, w8, w54; Q 96 [Dr Clarke]

42 Ev 67

working towards the goal of reducing the cost of marine energy. However, it has not yet stated what rate of cost reduction is needed to demonstrate that marine technologies could eventually be cost competitive.[43]

33. There may be a case for the LCIG to adopt a more specific cost reduction goal. The Technology Strategy Board (TSB) explained that if the Government set out clearly the extent of cost reductions that it expected the industry to achieve over a set timescale, it would be easier to assess the prospects for the sector and to make decisions and funding in the future. For example, if the industry is not able to meet cost reduction targets, this may raise questions about the feasibility of generating electricity in a cost competitive way in the long-term, which in turn would raise questions about the case for public funding.[44] Rob Saunders, TSB said:

> There are two examples of cost-of-energy road maps [the ETI and UK Energy Research Centre roadmap and Carbon Trust Technology Innovation Needs Assessment] that we could use to track our progress as the marine energy sector evolves. The point I was trying to make was that we perhaps ought to do that a little bit more formally so that we know what progress we have made in five or 10 years' time and we are not sitting here again asking the same questions as to whether we should be funding it into the next 30 years, and we can demonstrate the progress that we have made against cost of energy.[45]

34. In its marine energy roadmap, the ETI suggested cost reduction targets of 9-18 p/kWh by 2020 and 7-10p/kWh by 2030 in order to reach a long-term cost competitive target of 5-8p/kWh in 2050.[46]

35. **The Low Carbon Innovation Group is right to focus on reducing the cost of energy, but it should be more specific about the progress it would like to see. Without setting out its expectations clearly, it will be difficult to assess the efficacy of policies and to make decisions on the future funding for the marine energy sector. We recommend that DECC and the LCIG adopt a formal cost of energy target of 14p/kWh by 2020. This will give a clear indication of Government expectations to the industry.**

Deployment targets

36. DECC's Renewable Energy Roadmap suggests that there could be 200-300MW of marine capacity by 2020. This is significantly less than the 1-2GW that was forecast in the previous Government's *Marine Energy Action Plan 2010*.[47] The Minister told us the figure had been revised because the original targets were not "anything close to what was potentially achievable by the industry" and because he wanted a "much more realistic strategy for deployment, implementation and funding".[48]

37. The industry however told us that the Roadmap was "too cautious" and "pessimistic".[49] SSE said "RenewableUK have estimated that this figure [300MW] is

43 Ev 78

44 Ev 78 , Q 114 [Mr Saunders]

45 Q 114

46 Energy Technologies Institute and UK Energy Research Centre, *Marine Energy Technology Roadmap*, October 2010

47 DECC, *UK Renewable Energy Roadmap,* July 2011; HM Government, *Marine Energy Action Plan 2010*

48 Q 175

49 Ev w45, w102; Qq 4, 5

achievable by 2017 and SSE alone expects to be commissioning 200MW projects around 2020".[50]

38. We heard concerns from the industry that a perceived downgrading of ambition from Government could have a negative impact on market confidence about the long-term future of wave and tidal energy in the UK.[51] Some witnesses believed that a firm deployment target would demonstrate commitment to the sector and would boost investor confidence.[52] Dr Wyatt (Carbon Trust) advocated the use of "stretch" targets (that are slightly above what the industry is likely to achieve on a business-as-usual trajectory) to accelerate deployment and boost confidence.[53]

39. However, other witnesses felt that it was too early to set targets given that there was still a great deal of uncertainty about whether the technology would work in practice and whether the current high costs associated with the sector could be brought down.[54] The Minister shared this view and said that there were "too many uncertainties at this stage to set targets that would be credible beyond 2020".[55] Dr Clarke (ETI) advised that deployment targets should only be set once a certain level of cost of energy had been achieved (see paragraph 36 above).[56]

40. As things stand, both the industry and the Department view the 200-300MW figure as a "soft target", which they hope will be exceeded.[57] The Minister said that setting a target for the longer term (beyond 2020) "may be something that we will want to revisit".[58]

41. **We recognise the Department's concerns about introducing a deployment target to soon in the development of the technology. However, we also recognise the value that targets can have in demonstrating political commitment to the sector. A more visionary approach from Government could help to boost confidence and to drive the pace of development of the sector. The Government should not rule out setting an ambitious deployment target for marine renewables in the future and should consider introducing such a target if cost reductions to 2020 remain on track (see paragraph 36).**

Coordination between strategic funding bodies

42. There are currently a large number of organisations involved in funding aspects of marine energy development. These include DECC, the Technology Strategy Board (TSB), the Carbon Trust, the Energy Technologies Institute (ETI), Research Councils, the Scottish Government and Scottish Enterprise.

50 Ev w102

51 Ev w24

52 Q 171 [Mr Callaghan]

53 Q 85

54 Qq 171 [Mr Cook and Mr Huyton], 86

55 Q 180

56 Q 86 [Mr Saunders and Dr Clarke]

57 Qq 8 [Dr Tyler], 60

58 Q 180

43. We heard several complaints that this funding landscape is too crowded and complex and that a better coordinated and more streamlined approach would be preferable.[59] Witnesses from the University of Edinburgh called for a system similar to that used in the USA where all government funding in the energy sector is administered by a single organisation.[60] On the other hand, one of the organisations in question (the TSB) argued in favour of the multi-agency approach, suggesting that there are benefits to be gained from different organisations with different skills focusing on the same overall aim.[61]

44. A key risk associated with an overly complex funding landscape is that money may be wasted. As well as the potential for duplication and overlap between schemes, there are also inefficiencies associated with projects having to apply to multiple schemes and the administrative costs associated with running multiple organisations.[62]

45. The Low Carbon Innovation Group (LCIG) was established to try to improve coordination between strategic funding bodies. The members of the Group (which includes DECC, BIS, TSB, ETI, Carbon Trust and Research Councils UK) believe that it has been successful: a common consensus on the key steps to reducing the costs of marine energy had been built among members, who were now better able to share strategic information and to integrate their plans.[63] There was some evidence that the industry also felt that coordination had improved.[64]

46. However, the current membership of the LCIG excludes one of the UK's major funders of marine renewables: the Scottish Government. There is still a significant risk of duplication and overlap between UK-wide and Scotland-only programmes. This has been demonstrated recently by the announcement of two separate schemes to support the development of marine arrays—DECC's Marine Energy Array Deployment Fund and a new £18m fund to support marine arrays in Scottish Waters announced by the Scottish Government in October 2011.[65]

47. A large proportion of the UK's marine renewable resources are located in Scottish waters. However, the allocation of powers between Westminster and Holyrood is complex. Energy is generally a reserved matter, but the Renewables Obligation in Scotland and responsibility for consent for power stations over 1MW offshore have been executively devolved to Scottish Ministers. However, the rights of ownership of Scotland's territorial seabed are held by the Crown Estate, a public body responsible to the UK Treasury. Surplus revenues (from leases, dues and fees charged to develop areas of the seabed) are passed to the UK Treasury.

48. Officials told us that the Scottish Government was a member of DECC's Marine Energy Programme and had been involved in the development of the Marine Energy

59 Ev w1 , w39, w45, w52, w97, w102, w119

60 Ev w1, w39

61 Ev 78

62 Ev 91, w1; Q 76 [Dr Green]

63 Ev 42, Ev 67, Ev 82

64 Qq 36 [Mr Davidson and Dr Tyler], 76

65 Ev 42, w57

Array Deployment Fund through this forum. [66] Similarly, DECC had been invited to advise on the development of the Scottish Government fund through its Marine Energy Advisory Group.[67]

49. The Minister acknowledged concerns about the complexity of the funding landscape. He told us:

> If you look back over the last 10 years, the landscape has been far too complex and we have begun trying to simplify and harmonise that. Obviously there is a limit to the extent to which you can do that, given that some funding will come from Europe and some funding is going to come from the devolved Administrations, and those are important pieces of the jigsaw. […] I am sure we can continue to do better, not just for marine funding but across the board. I agree that the funding landscape is still too complex.[68]

50. **At a time when resources are limited, it is essential that money is spent wisely and efficiently. The complicated funding landscape for marine renewables creates a risk of overlaps and inefficiencies in the way the programmes are funded. We are pleased that the Minister acknowledged that the funding landscape is too complex and recommend that DECC take steps (beyond the creation of the Low Carbon Innovation Group) to address this problem.**

51. It is clear that—as with other types of renewables—coordination between DECC and the Scottish Government is very important. However, it was beyond the scope of this inquiry to investigate the relationship in detail.

66 The Marine Energy Programme Board draws together stakeholders from across the marine energy sector and is chaired by Greg Barker.

67 Q 187

68 Q 185

5 Financing

52. Marine renewables will require significant levels of investment in order to become commercially viable. Finding ways to meet these costs probably represents the biggest barrier to the development of wave and tidal energy. There are two main types of financial support that can help with this problem: capital support (usually in the forms of grants, low-interest loans or infrastructure investment) and revenue support, which provides a supplement to the income generated from emergent technologies. In this section we investigate the Government's approach in both of these areas.

Capital support

53. As discussed in paragraph 21, the costs and risks associated with wave and tidal energy are currently too big for private investors to shoulder alone. Publicly-funded capital grants towards the costs associated with demonstration projects can help to share the risk between the private and public sectors. This situation is not unique to marine renewables – the Technology Strategy Board (TSB) pointed out that public funding is required for most new energy technologies when they reach the so-called "valley of death" phase of development (where the risks and costs are the greatest).[69]

54. The next step in the development of marine renewables will be to test arrays of devices rather than single prototypes. This will involve a large increase in project costs – from millions of pounds to tens of millions.[70] The Carbon Trust has estimated that 5MW arrays are likely to require investments of £30m-£50m.[71] Marine Current Turbines (MCT) put the costs at £40m-£50m for an 8-10MW tidal array.[72] Industry trade association RenewableUK estimated that in total £40m-£80m of capital support for wave and tidal arrays was needed.[73]

55. To date, there have been many different marine energy grant schemes in the UK, including schemes run by central government and devolved administrations as well as those offered by other funding bodies such as the Energy Technologies Institute (ETI), TSB and Carbon Trust.

56. One of the most high profile schemes was the £50m Marine Renewables Deployment Fund (MRDF), which was established in 2006 by the then Department for Trade and Industry. The scheme was intended to support the demonstration of small arrays of pre-commercial wave and tidal energy devices. However, the scheme did not receive any suitable applications and so was not able to provide any awards for demonstrations.[74] The Department explained to us how this failure came about:

69 Ev 78; The Commons Science and Technology Committee launched its inquiry "Bridging the 'valley of death': improving the commercialisation of research" on 15 December 2011.

70 Ev 53, 62, 88; Q 17

71 Carbon Trust, *Accelerating marine energy*, July 2011

72 Ev 88

73 Ev 53

74 Ev 42

> The scheme was instigated on the basis of discussions with the sector between 2004 and 2006, which asserted that such a support scheme was urgently required to allow the sector to progress to commercialisation. In hindsight the industry claims were premature as developers had found it more difficult to develop, deploy and test prototypes to full-scale than anticipated.[75]

57. In order to help the industry advance to the point at which it was eligible to apply for the MRDF, a new Marine Renewables Proving Fund (MRPF) was introduced. This £22m fund was designed to help the industry to progress to large scale prototype deployment and testing. It provided a total of six grants and all recipients but one have now deployed their devices for testing at EMEC (the remaining device is due to be deployed in 2012).[76] The Tyndall Centre told us that the MRPF had been widely praised in its recent study of stakeholders.[77]

58. In March 2011, the Government ended the MRDF. This was followed by an announcement in June 2011 that up to £20m of its Low Carbon Innovation Fund would be spent on the development of marine devices.[78] This scheme is expected to open in Spring 2012 and will support two projects to test prototypes in array formations. While members of the industry welcomed the decision to provide some support, many also expressed disappointment that the funding was less than half of the value of the now defunct MRDF.[79]

59. In October 2011, Scottish First Minister Alex Salmond announced a new £18m fund to support the deployment of the first commercial marine arrays and the scaling up of the devices currently on test in Scottish Waters. The details of the scheme have not yet been finalised, but the Scottish Government plans to consult directly with industry about the nature of projects that will be supported.[80]

60. The Scottish fund will go some way to making up the funding "shortfall" that is perceived by some members of the industry, although this may be more through luck than design; it is not clear to us whether DECC had any knowledge of the Scottish Government's plans ahead of Mr Salmond's announcement.[81]

61. Dr Edge (RenewableUK) told us that the industry hoped for a "coherent package" made up of DECC's £20m and the Scottish Government's £18m. He said "if there were a joint pre-qualification, there would be a pool of projects to which either set of money could be allocated. You would have a common set of hurdles that projects would then jump over to able to access either set of money".[82] The Department told us that there was co-operation between officials in the development of the two funds (see paragraph 49).

62. We were pleased to hear that officials are working together to try to ensure that the DECC and Scottish Government schemes to support arrays are complementary.

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75 Ev 42

76 Ev 42

77 Ev w83

78 Ev 42

79 Ev 62, w83, w85, w107; Qq 12 [Gordon Edge], 65

80 Ev w57

81 Q 235

82 Qq 12-13

However, we do not know which options are currently being "kicked around".[83] **The £20m funding provided by DECC to underpin a world-leading industry is not large, even when combined with the additional funding provided by the Scottish Government. DECC must ensure maximum value for money and must avoid duplication and overlaps between the schemes. The Department should identify how it will achieve this. We urge DECC to try to keep the industry in mind when discussing options with the Scottish Government and recommend that DECC minimises bureaucracy for applicants, for example through running a joint pre-qualification process.**

63. The combined total of £38m that is available from DECC and the Scottish Government for testing arrays is still some way off the total sum that the industry claims is required to develop wave and tidal energy in the UK.[84] However, it may be possible to access additional funding from other sources.

64. One option is the European New Entrants' Reserve (NER) 300 Fund.[85] The UK has submitted 12 applications to the fund. Of these, seven were for CCS projects, four were for projects on wave or tidal renewables and one for an offshore wind turbine project. Successful applicants will be announced towards the end of 2012.[86]

65. The industry told us that it was "keen for the UK Government to work more proactively with the industry to access European streams of funding […] such as the New Entrants' Reserve 300 programme".[87] Officials from DECC told us that "we are hopeful that if we can we would benefit from both marine and also CCS under the NER300, but it will depend on what comes out of the Commission's due diligence and scrutiny".[88]

66. The industry would also like to see low-cost lending to wave and tidal projects from the Green Investment Bank.[89] The Minister told us that wave and tidal were not within the initial key priority areas for the Bank but that he expected some of the 20% of the portfolio that will be used outside of the priority areas to go to marine renewables.[90] He went on to tell us that large-scale marine renewable funding opportunities were not likely to be available until "later in this decade at least", when commercial scale projects might start to appear.[91]

67. **We welcome the initial support from the Department for accessing other sources of funding such as European NER 300 and Green Investment Bank. As the UK is a leader in the development of wave and tidal energy, DECC should actively promote the potential benefits of marine energy at the European level and maximise the opportunities for UK-based marine renewable projects to benefit from European funding schemes.**

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83 Q 235

84 Ev 53

85 Ev 42, 82, 99, w49

86 Q 202

87 Q12

88 Q 203

89 Ev62, Ev 53

90 Q 204

91 Q 207

Revenue support

68. As discussed in paragraph 31, it is currently more expensive to generate electricity from wave and tidal power than from conventional sources. This means that some form of revenue support is needed to make deployment of marine renewables an economically viable option for energy companies. In time, as technologies mature and generation costs fall, the need for revenue support will reduce. Ultimately, technologies should become fully commercial, at which point support should be removed. Revenue support schemes can provide a "market signal" by giving investors confidence about the level of return they can expect on investments, generally over a timescale of one or more decades.

69. At the moment, revenue support is provided through the Renewables Obligation (RO), which is designed to provide a supplement to renewable energy generators on top of the income they receive for selling electricity to the grid.

70. In England and Wales, wave and tidal stream energy both receive 2 Renewable Obligation Certificates (ROCs) for each unit (MWh) of electricity generated. However, the Scottish RO offers more favourable rates; 5 ROCs per MWh for wave energy and 3 ROCs per MWh for tidal stream. Many witnesses argued that this more generous scheme, combined with the existence of the EMEC testing centre in Orkney, had led to a much greater level of activity north of the boarder than could be found in England and Wales.[92] An overwhelming majority of the responses we received called for DECC to raise the level of support offered in England and Wales to 5 ROCs per MWh for both wave and tidal.[93]

71. In October 2011, DECC published a consultation on proposals to do exactly that. The document suggested that ROCs awarded in England and Wales from 2013-2017 should be increased for both wave and tidal energy to 5 ROCs per MWh.[94] This proposal has been widely welcomed by industry.[95] The consultation closed in January 2012 but at the time of writing, a final decision had not been announced.

72. We note that DECC's proposals did not include any limit on the number of projects that would be able to benefit from the more generous level of support (although there was a limit on the size of each individual project). This was despite the fact that the industry itself had proposed a 300MW limit on the total volume of capacity supported at this level in order to limit the total costs to the consumer.[96] Although witnesses told us that the likelihood of there being considerably more than 300MW of capacity in the water before 2017 was very low, it nevertheless seems strange that DECC does not intend to apply a cap, given the recent difficulties experienced with feed-in tariffs for solar PV.[97]

73. In the longer term, the Government is planning to replace the RO with a Feed-in Tariff with contract for difference (CfD). As a result, the RO will be closed to new entrants from 2017. Witnesses from the industry stressed that clarity about what

92 Ev 58, 91, 103 , w43, w52, w61 , w83, w91

93 Ev 53, 58, 62, 88, 99,103,w24, w32, w45, w58, w61 w85, w97, w100, w111

94 Q 177

95 Q 26

96 Ev 53, Ev 58

97 Qq 32 [Dr Edge], 97 [Mr Saunders, Dr Clarke and Dr Green]

would happen to revenue support beyond 2017 was needed in order to create confidence in a future market for marine energy.[98] Rob Saunders (TSB) said:

> Some continuity in terms of the view forward on revenue support would really help the industry to plan longer term. Without that, there is [a] risk that we do the first arrays, but then there is a hiatus when everybody waits to see what happens with the Contract for Difference, Feed-in Tariff or whatever comes next.[99]

74. The Minister told us that he was not in a position to say what the likely costs of marine energy would be in 2017 and therefore did not know what level of support would be offered beyond 2017.[100] However, he also told us that the Government planned to provide more clarity as plans for electricity market reform were developed. He said "by 2013-14, the industry will have absolute certainty about what the forward long-term funding arrangements will be—well before we come to the end of the ROC regime".[101]

75. **The industry needs clarity about the level of revenue support it can expect to receive beyond 2017 as soon as possible. We welcome the Minister's commitment to provide absolute certainty on this issue by 2013-14. We will monitor whether DECC keeps to this timetable and urge the Department to deliver its decision in 2013 rather than 2014.**

76. The industry expects the high level of support of 5 ROCs/MWh (or equivalent under the CfD regime) to be reduced over time, but it is concerned that there may be a temptation to reduce the level suddenly when the transition from RO to CfD is made in 2017.[102] Dr Tyler (Marine Current Turbines) said:

> If we end up with five ROCs in 2017 and then we fall off a cliff, the five ROCs are pointless. We need to see that continuity and have a strong signal that we will see a continuum off the back of five ROCs. Obviously, we would expect [the level of support] under the EMR to fall with time as we bring costs down. But if there is a cliff edge in that, the investors will all run for cover.[103]

77. **Revenue support should be reduced over time as technologies mature and costs fall. The Government needs to consider carefully how it will implement any changes to the level of revenue support in future, including the rate at which reductions are made and the criteria that are used to determine when reductions are introduced. Government must communicate its intentions on both these points clearly to industry at the same time as it announces the level of support that will be provided beyond 2017. Above all, the Government must avoid a repeat of the situation with solar PV Feed-in Tariffs, where drastic reductions were made at very short notice.**

78. **The Government has proposed increasing the level of support to wave and tidal energy devices that are deployed before 2017. Since very little deployment is expected**

98 Q 59 [Mr Stevenson, Mr Pearson]

99 Q 98

100 Qq 212 – 220

101 Q 220

102 Q 67

103 Q 32

before this date, the overall cost to the consumer will be insignificant. However, looking beyond 2017, the Government will need to balance the interests of consumers against the needs of the industry. The Government should consider capping the total volume of capacity that can benefit from revenue support in any future support regime, perhaps at the level of any deployment target.

6 Other barriers to the development of marine renewables

79. In this section we consider the non-financial barriers to the development of wave and tidal energy that were identified during the course of our inquiry.

Grid

80. The best wave and tidal resources lie in some of the most remote parts of the UK, which tend to be areas with very little access to the high-voltage transmission grid. If marine renewables are ever to make a significant contribution to the UK's energy system, it is clear that investment in grid infrastructure will be needed in order to allow electricity to be transported from wave and tidal generation sites to end consumers.[104]

81. The Government acknowledged that grid availability is a potential barrier to large-scale deployment of marine renewables. However it also pointed out that, although the small scale deployments expected in the next few years will probably connect to the low-voltage distribution network, work was already underway to accommodate higher levels of deployment onto the high-voltage grid in 2020.[105]

82. **The availability of grid connections will be a critical factor in determining the future of wave and tidal power in the UK. We welcome DECC's acknowledgement of this and urge the Department to ensure that investment in new grid connections keeps pace with development of the industry.**

83. The transmission charging regime was also highlighted as a concern. Under the current arrangements, higher charges are levied for generators that are located further from the main centres of demand. This means that wave and tidal generators situated in remote areas like North Scotland will have to pay some of the highest charges for using the national grid (in the case of Orkney, this is compounded by the need to pay an additional charge for a link to the mainland).[106] Witnesses told us that high transmission charges may impede the development of the industry.[107]

84. At the time of taking evidence, the regulator Ofgem was in the process of assessing the current charging regime, to consider whether it is still suitable given the changing nature of the generation mix and the challenges of decarbonising the electricity system.[108] Witnesses to our inquiry were hopeful that the outcome of this review would improve the situation for wave and tidal.[109] On 20 December 2011, Ofgem published its initial findings, which recommended incrementally changing the current approach rather than moving to a "socialised cost" model, where all

104 Ev 53, 58, 62, 67, 82, 85, 88, 91, 99, w1, w8, w24, w35, w39, w45, w49, w52, w54, w58, w61, w73, w78, w83, w85, w91, w97, w100, w107, w111; Q 37

105 Ev 42

106 Ev w122; Q 38

107 Ev 62, 99, w20, w24, w35, w54, w58, w85, w100, w107, w122

108 Qq 117, 129

109 Ev w85, w122; Q 39

generators would pay a uniform charge, regardless of type and location.[110] Ofgem is due to conclude its consultation and make a final recommendation in Spring 2012.[111]

85. A further problem for marine energy is the requirement for generators to underwrite the cost of new grid connections (that is, generators who wish to connect to the transmission system are liable to pay the cost of building the grid connection in the event that their projects to build new power plants are cancelled).[112] E.ON explained:

> One particular hurdle that we have encountered in relation to our activities in the Pentland Firth and Orkney Waters, is the fact that we are required to accept the full liabilities for the cost of building the additional capacity in the event that a generating asset is not connected to the transmission network. Given the nascent and unproven nature of commercial wave and tidal arrays, accepting this level of risk is incredibly challenging for project developers and their investors.[113]

86. Two potential solutions to this problem were proposed. The first was for developers to form consortia and apply collectively for grid connections, which would allow any associated liability to be shared between all of the members rather than being borne by a single company.[114] The second proposal was for Government to take on some or all of the underwriting liability.[115]

87. **Requirements on the industry to underwrite the cost of new grid connections place an excessive burden on individual developers. DECC should use the Marine Energy Programme Board to explore opportunities for establishing consortia that could collectively underwrite new links. If this approach is unsuccessful, DECC may need to consider the case for Government taking on this liability.**

Planning and consenting

88. Many witnesses to the inquiry were concerned that complex and costly licensing processes could hinder the development of marine renewables. To some extent, this is an unknown quantity since no large-scale projects have yet gone through the consenting process and so there is no experience on which to judge the likely speed of the process.[116] The industry is keen for the process to be as streamlined as possible. Several witnesses noted the "one-stop-shop" approach adopted by Marine Scotland and suggested that other UK marine licencing bodies could consider following this example.[117]

110 Ofgem, *Electricity transmission charging: assessment of options for change, Consultation,* 20 December 2011, reference 188/11, Q 120

111 Q 119

112 Ev 58, w29, w35, w54, w83

113 Ev 58

114 Ev w29, w83

115 Ev 58, w83

116 Ev 53, 62, 88, w102

117 Ev w1, w32, w35, w39, w54, w107; Q 73 [Mr Pearson, Mr Lafayette]

Environmental monitoring requirements

89. Wave and tidal energy could be damaging to marine wildlife in UK waters. For example, wildlife could collide with the devices, habitats might be lost or damaged, migration routes could be blocked and construction will result in noise and vibrations, which may have adverse consequences for wildlife.[118] Since the technology is still very novel, there is still a great deal of uncertainty about how likely or severe these impacts will be. In addition, data about marine wildlife in UK waters is far from comprehensive, which means it is difficult to know which locations would be the most sensitive to wave and tidal developments and which might be less affected.[119]

90. Marine licensing authorities have taken different approaches to monitoring requirements in different parts in the UK. In some places a stringent "precautionary" approach has been taken while others have set a more flexible "deploy and monitor" type of requirement.[120] We were not surprised to hear that conservation groups tended to favour the precautionary approach, while some industry groups argued that this was too onerous and could result in significant costs to developers, potentially to the extent that the financial viability of projects was threatened.[121]

91. The RSPB suggested a "middle way" in which particularly sensitive sites were identified "up-front" through a systematic survey of marine wildlife and were then excluded from further development (under the EU Habitats Directive, marine renewables developments should not cause long-term or irreparable damage to existing sites or species of national or international environmental importance). A "deploy and monitor" approach could then be used for developments in other areas. Such a survey could be targeted in the first instance on areas that are of strategic interest to the industry in order to keep costs down.[122] The RSPB argued that this kind of approach would have benefits for the industry because "the locations of important sites for internationally important species will be known, avoiding scenarios where they are found during baseline monitoring, which significantly delayed the London Array offshore windfarm".[123] The industry would also support a "pan-industry" approach to environmental assessments to allow developers to focus on an area in the sea that they could all work on.[124]

92. **The development of wave and tidal energy must not happen at the expense of marine biodiversity. Because of the lack of data about marine wildlife in UK waters, developers may only discover that an area is environmentally sensitive late in the development process, leading to costly changes in plans. Identifying potentially sensitive areas in advance of leasing rounds would avoid this risk and reassure conservation organisations that the deployment of marine renewables will not threaten marine flora and fauna. We recommend that DECC cooperates with the industry and other interested stakeholders to deliver a baseline survey of areas of**

118 Ev 71, w12, w66, w68, w69

119 Ev 103; Q 140

120 EV 42 (DECC)

121 Ev 53, 58, w12 , w14, w66

122 Qq 132, 141, 147

123 Ev 103

124 Qq 28-29, 55, 74

strategic interest, in advance of any further leasing rounds. The Marine Energy Programme Board would provide a good forum for this discussion. In addition, an agreement is needed on the criteria that would be used to determine whether a particular area was too environmentally sensitive to allow development. This could be drawn up by an independent body of expert marine scientists, like the Science Advisory Panel for the Marine Conservation Zones, supported by relevant statutory bodies, such as the Joint Nature Conservation Committee, Natural England and the Marine Management Organisation. This body could also have the power to review whether criteria have been appropriately applied when disputes emerge.

Skills

93. The lack of people following careers in scientific and engineering disciplines in the UK could potentially threaten the successful development of the wave and tidal workforces.[125] We heard that the problem was particularly acute at the Further Education level; EMEC told us "we will have Graduates, Masters and doctors, but we will not have the skilled 'artisan' workforce […]to actually do the job".[126]

94. Some witnesses suggested that skills could be transferred from other existing industries, such as maritime and offshore engineering (that is, offshore oil and gas and offshore wind), consultancy and marine services.[127] Energy infrastructure company Alstom said "it is very important that we capitalise on these existing North Sea skills sets before they disappear".[128] However, the Carbon Trust was sceptical about whether this would solve the problem:

> The UK renewable energy industry faces a general shortage of suitably skilled workers in both technical and commercial disciplines and faces stiff competition for talent with other industries, particularly offshore oil and gas and other major construction sectors. Relying on talent from those sectors or importing labour from abroad will not be sufficient.[129]

95. **We are concerned about the shortage of skilled scientists and engineers in the workforce. The Government must encourage more students into these disciplines now so that they are able to take advantage of the new jobs that could be created through a UK-based wave and tidal industry. We note that students may be more likely to select science and engineering subjects if they felt confident that there would be suitable jobs available once they qualified. The level of confidence that DECC can provide about the future of the wave and tidal industry in the UK may therefore have an impact on education and training choices.**

Public acceptability

96. We have the impression that the industry has not yet given a great deal of consideration to potential public concerns about wave and tidal energy. Although

125 Ev w20, w52, w61, Ev w119; Q 109

126 Ev w20; The BIS Committee launched its inquiry into apprenticeships on 21 December 2011.

127 Ev 58, 67, w24, w29, w39, w45, w61, w85; Qq 110-111

128 Ev w45

129 Ev 82

projects to date may not have experienced much local opposition, the situation may change when commercial-scale projects begin to be deployed.[130]

97. The Tyndall Centre told us that among industry players there is "still a dominance of a sense of the technologies being 'out of sight out of mind' and 'benign'".[131] It is risky to assume that simply because wave and tidal energy is less visually intrusive than other types of energy generation (such as wind and nuclear), it will automatically be more socially acceptable.[132] We heard that "local interpretations of marine energy can differ unexpectedly" from those of developers and that there may be other reasons for objections to marine energy, including its impacts on wildlife and implications for the fishing industry.[133]

98. Involving the public (and other stakeholders) ahead of deployment could identify key public concerns and ensure they are properly addressed in the development of new projects. This may avoid delays to projects further down the line. More engagement would also provide an opportunity to set out the potential benefits associated with marine energy, for example the fact that tidal power is predictable (unlike some other renewable sources of energy) as well as any local economic benefits that may arise.[134]

99. **We recommend that DECC establishes a new working group under the Marine Energy Programme to consider public engagement. Its remit should include identifying best practice and suggesting methods for effective public engagement ahead of any new marine energy projects. It could also collate a list of common concerns expressed by members of the public so that they can be addressed up front in the development of any new project. Public understanding and acceptance of new technologies is important in its own right, but it may also contribute to a smoother, more consensual and therefore quicker planning and consenting process.**

100. During our trip to Orkney, we heard that the Crown Estate had not consulted with the local community before announcing its leasing round for wave and tidal projects in Pentland Firth and Orkney Waters. We were pleased that the Crown Estate acknowledged that "there is probably more that we could have done before and during [the leasing round]" and that it is now taking a more pro-active approach to public engagement ahead of its leasing round in Northern Ireland.[135]

101. As well as giving the public an opportunity to express any concerns, Research Councils UK also suggested that local communities should benefit from the financial rewards of local marine renewables projects, for example by obliging energy companies to share some of the income generated from wave and tidal energy.[136] However, we note that this type of approach can be controversial, since accusations of bribery may arise. The Chancellor has recently announced a "Coastal Communities Fund", which should allow communities in coastal areas to benefit from some of the

130 Ev w1 , w20, w35; Qq 50-52, 104, 106 [Dr Clarke]

131 Ev w83

132 Ev w85, w91

133 Ev 103, w83, w113; Q 106 [Dr Green]

134 Ev 71, w49, w66, w113; The Scottish Affairs Committee launched its inquiry on "The Crown Estate in Scotland" on 6 July 2011.

135 Qq 155 – 158

136 Ev 71

revenue raised by the Crown Estate's marine activities (which would otherwise be paid to the Treasury).

7 Conclusion

102. The UK is clearly leading the world in the development of wave and tidal energy. Indeed, the sense of pride in the UK's achievements in this sector was palpable throughout our inquiry, and rightly so. Marine renewables have the potential to contribute a significant amount of clean electricity to the UK system and could also bring substantial economic benefits. It should therefore be a key priority for the Government to ensure that the UK remains at the cutting edge of technology development and does not allow its lead to slip.

103. Although it is still very early days for marine renewables and it is unlikely that they will make a significant contribution to the UK's energy mix before 2020, the potential longer-term benefits associated with developing a thriving wave and tidal industry in the UK are significant. The Government must not repeat the mistakes that allowed the UK to lose its lead in the development of wind power. An overly cautious approach to developing the sector may allow other less risk-averse countries to steal the UK's lead.

104. The priority must now be to focus on reducing the costs of marine energy to a level that is competitive. Simplifying the plethora of different organisations that provide funding will help minimise bureaucracy for the industry and providing greater certainty about policy plans beyond 2017 will help to boost confidence. The Department has learnt from the experience with the Marine Renewable Deployment Fund and is now engaging much more closely with the industry through the Marine Energy Programme Board. This should ensure that new policies are based on a realistic assessment of what the industry can deliver.

105. While most of the focus to date has been on getting prototype devices in the water, it is important to anticipate other barriers that will need to be overcome as the sector moves closer to commercialisation. As the scale of deployment increases, issues such as grid connections, the consenting process, the need for better data on marine wildlife and public attitudes all have the potential to derail the development of marine renewables. It is reassuring that DECC is already thinking about dealing with some of these obstacles, though in the case of others such as public engagement there is clearly room for improvement. The industry in particular should not assume that marine renewables will automatically enjoy public support simply because they are "out of sight and out of mind".

106. Wave and tidal energy is a sector that shows great promise. The opportunities for deployment of these technologies worldwide are considerable. Although it will be some time before we can reap the full benefits of a fully-fledged marine energy industry, it is vital that DECC continues to support the development of these technologies so that the UK can retain its leadership position. The resource that the Government has put in to underpinning our world lead has not been large, but the potential benefits are great. The UK needs a strong political vision to ensure that we can reap the rewards of a successful marine industry.

Recommendations

Strategy and policy direction

Reducing the cost of wave and tidal energy

1. The Low Carbon Innovation Group is right to focus on reducing the cost of energy, but it should be more specific about the progress it would like to see. Without setting out its expectations clearly, it will be difficult to assess the efficacy of policies and to make decisions on the future funding for the marine energy sector. We recommend that DECC and the LCIG adopt a formal cost of energy target of 14p/kWh by 2020. This will give a clear indication of Government expectations to the industry. (Paragraph 35)

Deployment targets

2. We recognise the Department's concerns about introducing a deployment target to soon in the development of the technology. However, we also recognise the value that targets can have in demonstrating political commitment to the sector. A more visionary approach from Government could help to boost confidence and to drive the pace of development of the sector. The Government should not rule out setting an ambitious deployment target for marine renewables in the future and should consider introducing such a target if cost reductions to 2020 remain on track (see paragraph 36). (Paragraph 41)

Co-ordination between strategic funding bodies

3. At a time when resources are limited, it is essential that money is spent wisely and efficiently. The complicated funding landscape for marine renewables creates a risk of overlaps and inefficiencies in the way the programmes are funded. We are pleased that the Minister acknowledged that the funding landscape is too complex and recommend that DECC take steps (beyond the creation of the Low Carbon Innovation Group) to address this problem. (Paragraph 50)

Financing

Capital support

4. The £20m funding provided by DECC to underpin a world-leading industry is not large, even when combined with the additional funding provided by the Scottish Government. DECC must ensure maximum value for money and must avoid duplication and overlaps between the schemes. The Department should identify how it will achieve this. We urge DECC to try to keep the industry in mind when discussing options with the Scottish Government and recommend that DECC minimises bureaucracy for applicants, for example through running a joint pre-qualification process. (Paragraph 62)

5. We welcome the initial support from the Department for accessing other sources of funding such as European NER 300 and Green Investment Bank. As

the UK is a leader in the development of wave and tidal energy, DECC should actively promote the potential benefits of marine energy at the European level and maximise the opportunities for UK-based marine renewable projects to benefit from European funding schemes. (Paragraph 67)

Revenue support

6. The industry needs clarity about the level of revenue support it can expect to receive beyond 2017 as soon as possible. We welcome the Minister's commitment to provide absolute certainty on this issue by 2013-14. We will monitor whether DECC keeps to this timetable and urge the Department to deliver its decision in 2013 rather than 2014. (Paragraph 75)

7. Revenue support should be reduced over time as technologies mature and costs fall. The Government needs to consider carefully how it will implement any changes to the level of revenue support in future, including the rate at which reductions are made and the criteria that are used to determine when reductions are introduced. Government must communicate its intentions on both these points clearly to industry at the same time as it announces the level of support that will be provided beyond 2017. Above all, the Government must avoid a repeat of the situation with solar PV Feed-in Tariffs, where drastic reductions were made at very short notice. (Paragraph 77)

8. The Government has proposed increasing the level of support to wave and tidal energy devices that are deployed before 2017. Since very little deployment is expected before this date, the overall cost to the consumer will be insignificant. However, looking beyond 2017, the Government will need to balance the interests of consumers against the needs of the industry. The Government should consider capping the total volume of capacity that can benefit from revenue support in any future support regime, perhaps at the level of any deployment target.
(Paragraph 78)

Other barriers to the development of marine renewables

Grid

9. The availability of grid connections will be a critical factor in determining the future of wave and tidal power in the UK. We welcome DECC's acknowledgement of this and urge the Department to ensure that investment in new grid connections keeps pace with development of the industry. (Paragraph 82)

10. Requirements on the industry to underwrite the cost of new grid connections place an excessive burden on individual developers. DECC should use the Marine Energy Programme Board to explore opportunities for establishing consortia that could collectively underwrite new links. If this approach is unsuccessful, DECC may need to consider the case for Government taking on this liability. (Paragraph 87)

Environmental monitoring requirements

11. The development of wave and tidal energy must not happen at the expense of marine biodiversity. Because of the lack of data about marine wildlife in UK waters, developers may only discover that an area is environmentally sensitive late in the development process, leading to costly changes in plans. Identifying potentially sensitive areas in advance of leasing rounds would avoid this risk and reassure conservation organisations that the deployment of marine renewables will not threaten marine flora and fauna. We recommend that DECC cooperates with the industry and other interested stakeholders to deliver a baseline survey of areas of strategic interest, in advance of any further leasing rounds. The Marine Energy Programme Board would provide a good forum for this discussion. In addition, an agreement is needed on the criteria that would be used to determine whether a particular area was too environmentally sensitive to allow development. This could be drawn up by an independent body of expert marine scientists, like the Science Advisory Panel for the Marine Conservation Zones, supported by relevant statutory bodies, such as the Joint Nature Conservation Committee, Natural England and the Marine Management Organisation. This body could also have the power to review whether criteria have been appropriately applied when disputes emerge. (Paragraph 92)

Skills

12. We are concerned about the shortage of skilled scientists and engineers in the workforce. The Government must encourage more students into these disciplines now so that they are able to take advantage of the new jobs that could be created through a UK-based wave and tidal industry. We note that students may be more likely to select science and engineering subjects if they felt confident that there would be suitable jobs available once they qualified. The level of confidence that DECC can provide about the future of the wave and tidal industry in the UK may therefore have an impact on education and training choices. (Paragraph 95)

Public acceptability

13. We recommend that DECC establishes a new working group under the Marine Energy Programme to consider public engagement. Its remit should include identifying best practice and suggesting methods for effective public engagement ahead of any new marine energy projects. It could also collate a list of common concerns expressed by members of the public so that they can be addressed up front in the development of any new project. Public understanding and acceptance of new technologies is important in its own right, but it may also contribute to a smoother, more consensual and therefore quicker planning and consenting process. (Paragraph 99)

Annex 1: Note of the visit to Orkney

In October 2011 we visited Orkney. We met with representatives from the European Marine Energy Centre (EMEC), industry representatives and representatives from the local council. We visited EMEC's wave test site and substation at Billia Croo, the Lyness marine renewables support base and the Hatston Development in Kirkwall. We discussed the experiences to date of developing wave and tidal energy in Orkney and the challenges that the industry is facing .

Participating members:

Mr Tim Yeo (Chair)

Sir Robert Smith Barry Gardiner Albert Owen

Dr Phillip Lee John Robertson

Monday 17 October 2011

Dinner hosted by European Marine Energy Centre with:

Neil Kermode, EMEC; Tony Trayner, Flumill; Chintan Shah, Bluewater; Sue Barr, Openhydro; Andrew Scott, Pelamis Wave Power; John McGlynn, Scotrenewables Tidal Power; Joseph Fison, Atlantis Resources; and Martin McAdam, Aquamarine Power.

Tuesday 18 October 2011

Briefing from Neil Kermode and Eileen Linklater, European Marine Energy Centre

Meetings with:

Andrew Scott, Pelamis Wave Power

Albert Tait, Gavin Barr, Shona Croy, Cllr Ian Johnstone, Cllr Graham Sinclair, Cllr Jim Foubister and Michael Morrison, Orkney Islands Council; Gareth Davis, Aquatera; Jeremy Baster, Consultant; Graham Harrison, Highlands and Islands Enterprise; Adam Payne, Xodus; and Kathy Bichan, Roving Eye Enterprises.

Formal Minutes

Tuesday 7 February 2012

Members present:

Tim Yeo, in the Chair

Ian Lavery	Laura Sandy
Albert Owen	Sir Robert Smith
Christopher Pincher	Dr Alan Whitehead

The following declarations of interest relating to the inquiry was made:

Tuesday 2 November:

Sir Robert Smith declared the following interests: Shareholder in Shell Transport and Trading

Draft Report (*The Future of Marine Renewables in the UK*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 106 read and agreed to.

Annex and Summary agreed to.

Resolved, That the Report be the Eleventh Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Written evidence was ordered to be reported to the House for printing with the report (in addition to that ordered to be reported on 11 October, 15 November and 13 December).

[Adjourned till Tuesday 21 February at 10.00 a.m.

Witnesses

Wednesday 2 November 2011

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Tuesday 22 November 2011

Tuesday 13 December 2011

List of printed written evidence

List of additional written evidence

(published in Volume II on the Committee's website www.parliament.uk/eccpublications)

14	Innovation and Policy Group, University of Edinburgh	Ev w1
15	Parsons Brinckerhoff	Ev w8
16	Whale and Dolphin Conservation Society	Ev w12
17	Seabed User and Developer Group	Ev w14
18	Shawater Ltd	Ev w16
19	The European Marine Energy Centre (EMEC) Limited	Ev w20
20	Atlantis Resources Corporation	Ev w24
21	AMEC Environment & Infrastructure UK Limited	Ev w29
22	Pulse Group Holdings Ltd	Ev w32
23	Highlands and Islands Enterprise	Ev w35
24	Marine Energy Group, University of Edinburgh	Ev w39
25	Trident Energy	Ev w43
26	Alstom	Ev w45
27	Royal Institution of Chartered Surveyors	Ev w49
28	Institute of Marine Engineering, Science and Technology	Ev w 52
29	The Scottish Government, Energy Directorate, Offshore Renewables	Ev w54, Ev w57
30	RWE Npower Renewables Limited	Ev w58
31	Wave Hub	Ev w61
32	Wildlife Trusts	Ev w66
33	Campaign to Protect Rural England	Ev w68
34	Countryside Council for Wales	Ev w69
35	Low Carbon Developers	Ev w73
36	Hales Energy Ltd	Ev w78
37	Peel Energy Limited	Ev w81
38	Tyndall Centre	Ev w83
39	Renewable Energy Association's Ocean Energy Group	Ev w85
40	Engineering the Future Alliance	Ev w91
41	National Renewable Energy Centre NAREC	Ev w97
42	ScottishPower	Ev w100
43	SSE	Ev w102
44	AWS Ocean Energy Ltd	Ev w107
45	Welsh Government	Ev w111
46	Northern Ireland Executive	Ev w113
47	JWG Consulting Ltd	Ev w119
48	Jeremy Baster	Ev w122

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2010–12

First report	Emissions Performance Standards	HC 523 (807)
Second report	UK Deepwater Drilling–Implications of the Gulf of Mexico Oil Spill	HC 450 (882)
Third report	The revised draft National Policy Statements on energy	HC 648
Fourth report	Electricity Market Reform	HC 742 (1448)
Fifth report	Shale Gas	HC 795 (1449)
Sixth report	Ofgem's Retail Market Review	HC 1046 (1544)
Seventh report	A European Supergrid	HC 1040 (1684)
Eighth report	The UK's Energy Supply: Security or Independence?	HC 1065
Ninth report	Solar Power Feed-In Tariffs	HC 1605
Tenth report	The EU Emissions Trading System	HC 1476
First Special Report	Low carbon technologies in a green economy: Government Response to the Committee's Fourth Report of Session 2009-10	HC 455
Second Special Report	Fuel Poverty: Government Response to the Committee's Fifth Report of Session 2009-10	HC 541
Third Special Report	The future of Britain's electricity networks: Government Response to the Committee's Second Report of Session 2009–10	HC 629

Oral evidence

Taken before the Energy and Climate Change Committee

on Wednesday 2 November 2011

Members present:

Mr Tim Yeo (Chair)

Dan Byles	Albert Owen
Barry Gardiner	Laura Sandys
Ian Lavery	Sir Robert Smith
Dr Phillip Lee	

Examination of Witnesses

Witnesses: **Neil Davidson**, Public Affairs Manager, Aquamarine Power, **Dr Gordon Edge**, Director of Policy, RenewableUK, **Chris Rich**, Finance and Investor Relations, Offshore Wave Energy Ltd, and **Dr Andrew Tyler**, CEO, Marine Current Turbines, gave evidence.

Q1 Chair: Good afternoon and welcome to the Committee. Thank you for coming in. Just to set the parameters, we have about 45 minutes with the four of you, if you could time your responses to our questions with that constraint in mind. There are a number of issues we would like to cover. Some of the Committee, including myself, have already been to Orkney to look at the European Marine Energy Centre, so we have some familiarity with what is happening there. It is probably useful to keep that in mind.

I wonder if I could start by asking you to tell us briefly about the companies that you are working for and the devices that you are developing.

Dr Tyler: My name is Andrew Tyler. I am chief executive of Marine Current Turbines. As the name suggests, we are purveyors of fine marine current turbines, and so are very much on the tidal current flow side of things. I took the liberty of bringing a couple of things to illustrate, because a picture does speak 1,000 words, so I will pass these around the Committee, if that is okay. They give an idea of the sort of systems that we are developing.

The photograph is of what we call the SeaGen unit, which is installed in Strangford Lough and has been there since 2008; it has generated just over 2.7 GWh to the grid. Our strategy going forward is to install a number of these devices in small-scale arrays at a couple of sites in the UK, to demonstrate the progression to the next, commercial scale of tidal current energy generation.

Neil Davidson: I am Neil Davidson from Aquamarine Power. We are a wave energy company based in Edinburgh. Our technology is called the Oyster, which is a simple hinged flap that sits in the near-shore area and moves backwards and forwards, generating hydroelectricity in a shore-based station. We were founded in 2005 and we successfully installed our first Oyster device at EMEC in 2009. That operated successfully through two winters, and we are currently installing our Oyster 800 device, at EMEC also, to form part of a three-device array. The Oyster 800 project has been supported by UK and Scottish Government funding. Our plans going forward are to develop small arrays in the UK and overseas. We have a 200 MW lease from the first Crown Estate leasing round and a 40 MW lease off Lewis, and we are looking to develop those concurrently.

Dr Edge: My name is Gordon Edge and I represent RenewableUK. We are the leading trade association for the wind and the wave and tidal sectors. I believe that we represent the large majority of the industry in the UK.

Chris Rich: My name is Chris Rich. I am working with Offshore Wave Energy Ltd, which is an early-stage technology developer. We were awarded a grant from the Technology Strategy Board last year, and we are currently in the process of trying to raise sufficient funding to build a full-scale demonstration device at the WaveHub in Cornwall.

Q2 Chair: The UK is seen as a leader—perhaps the world leader—in this general sphere. Which other countries are trying to catch up? Where is the competition?

Dr Edge: Certainly it depends on where the resources are. For instance, in Canada, they are very interested in tidal—they have somewhere like the Bay of Fundy, and there is a test site there. The west coast of the United States has significant wave resource, and there is some activity there. Places like France are taking tidal much more seriously now, and there is a project with OpenHydro being installed at the minute. As well, there are other wave resources in places like Australia and, until recently, Portugal and Spain, but I think that the economic situation there might have put paid to their ambitions at the moment.

Neil Davidson: We can also put west coast USA on the map; the US Government have put in place more than $50 million into marine hydrokinetic research, which includes wave and tidal.

A few weeks ago, I was in Chile for a marine energy conference; they are quite well advanced and are now looking to introduce a marine energy tariff, which they will put before Congress in the next couple of months. They are potentially pulling in funds from the UK—the International Climate Fund—and from the Inter-American Development Bank to develop some of the first arrays there. Obviously, Chile has tremendous

resource, and they are looking to put a tariff in place in support of marine energy.

Q3 Chair: Given that we have a natural advantage in this country for both tidal and wave—but we are not the only countries—can we attribute the position that we have achieved so far to the actions of the Government or the interests of investors here? What has been the factor that has helped us get into the lead?
Dr Edge: There is a very significant history in this, going right back to the '80s and beyond, when we established a kind of intellectual, academic lead in researching the resource and the technologies for exploiting that resource. So I think, really, we started from there. The Government funding we have had, particularly in the past 10 to 15 years, has been very significant in exploiting that academic lead. Also, the investment in the testing facilities has made a very big difference in allowing us then to go into the sea and really test full scale.

Q4 Barry Gardiner: In 2010, the marine energy action plan suggested that the Government's view was that 1GW to 2 GW of installed capacity could be achieved over the next 10 years—by 2020. The Government's most recent publication, the "Renewable Energy Roadmap", suggested in July this year that, in fact, they thought that that was now only 200 MW to 300 MW of capacity by 2020. Why is that?
Dr Edge: I am not sure why the Government were thinking quite so pessimistically because we do not see any reason why 1,000 MW or thereabouts is not a do-able figure by 2020. Perhaps they were taking a more pessimistic view of how the technology would develop, which is unjustified given the recent access of large OEMs into this space and the ongoing support by large utilities.

Q5 Barry Gardiner: Prior to the report coming out in July, what dialogue did they have with you? What indicators did you give to them about your anticipated amount of installed capacity that they should have drawn such pessimistic conclusions?
Neil Davidson: The marine energy programme board and a number of leading developers, including the people here in this room, provided information on their build-out plans that were certainly more ambitious than the 300 MW indicated by the DECC roadmap. To put it in context, 300 MW is six developers developing a 50 MW project, which most companies here would aspire to be doing within the next four to five years.

Q6 Barry Gardiner: What representations have you made to DECC since July to say politely, "Look, this may be a roadmap to 2015 or 2016, but it's certainly not a roadmap to 2020"?
Neil Davidson: We've got a very good relationship with DECC, which has been extremely supportive of the industry. The interface through the marine energy programme board is very positive because it brings together all the players from technology developers to utilities to financiers to industrialists to present them with a holistic view of industry. The indicator of how quickly and how rapidly the industry will grow from that 300 MW towards 1,000 MW is very much predicated on the level of public sector support that the industry gets in the next five years.

Q7 Barry Gardiner: So is the fact that the Government have downgraded by up to 1,000% their original estimate, which you would have backed, indicative of the lack of trust that they have in your projections or is it indicative of a lack of commitment on their part in terms of the public incentives that they are prepared to put into the programme?
Neil Davidson: You would have to ask the DECC officials, I imagine.

Q8 Barry Gardiner: Oh, I will ask them, but I am asking you at the moment.
Dr Tyler: The way we would look at this is that it is not a hard target and, if we can exceed the target, we will do that and it will demonstrate that we were right. We are very focused on making sure that hurdles and barriers are not put in our way in the short term to get to the next step. If we are successful in the next step, we would expect success to breed success, and there are plenty of opportunities between now and 2020 to be revising targets upwards off the back of the success that we had.

Q9 Barry Gardiner: You should be talking to the Foreign Office, not to DECC, with such a diplomatic response. That is very nice indeed.
Dr Edge: It is the case that those are not hard-targets. They will be revising them on an annual basis. For the next iteration of the roadmap, we will certainly be engaging very strongly with them to ensure that we don't get that kind of message again.

Q10 Barry Gardiner: The Technology Strategy Board suggested that DECC should adopt all that. It sets out how the costs of marine energy are expected to fall over time and to chart the industry's progress against that, as a basis for the future. Is that something that you would welcome?
All Witnesses: Yes.

Q11 Sir Robert Smith: We talked earlier about other parts of the world with wave and tidal resources, although we are very well endowed in the UK. The industry has said that the next two to three years is critical for the development of wave and tidal power. Is it suggesting that, if we don't get it right in the next two to three years, somewhere else will leapfrog us or is it that just the whole industry will be set back globally?
Neil Davidson: My view is that the UK has a global lead in a number of technologies. This is an opportunity for the UK, over the next three to four years, to enable a number of companies to get over the financial hurdle of putting in place the first pre-commercial arrays. If we get to that stage, then there is a global opportunity for UK plc. If we do not take that opportunity, it will be a setback for the industry, and it will depend whether other countries wish to step into that space.

Q12 Sir Robert Smith: At RenewableUK, you have argued that we need approximately £40 million to £80 million in capital support for arrays, plus continued support for prototype testing. How do you react to the Government's idea of £20 million?

Dr Edge: Clearly, it was a disappointment that we did not receive more. We are very happy that the Scottish Government is also coming forward with a similar amount of money, and we are hopeful that that can be seen as a more coherent package between them. Certainly it gives more emphasis to the need to find other sources of funding to come into the sector.

We are very keen for the UK Government to work more proactively with the industry to access European streams of funding in particular, because we believe there are things out there that we can exploit to help the wave and tidal sector here in the UK, such as the new entrants' reserve 300 programme, future calls under frameworks 7 and 8 and the European Commission research and development programme. Those are all areas where we could be supplementing the money that we do have. We are also looking to the green investment bank to come forward with suitable products that will help finance projects for arrays in the water. We are hopeful that we can get some progress on that.

Q13 Sir Robert Smith: What sort of co-ordination would improve the £18 million and the £20 million working together?

Dr Edge: Well, for instance, we are talking about a pre-qualification procedure for the £20 million that DECC has. If there were a joint pre-qualification, there would be a pool of projects to which either set of money could be allocated. You would have a common set of hurdles that projects would then jump over in order to be able to access either set of money.

Neil Davidson: DECC officials are already working very closely with Scottish Government officials with the goals of maximising growth within the industry and leveraging private sector investment. It is an important point to make that every £1 the Government has put into the leading developers to date has leveraged more than £5 in private sector investment. A Government looking for a growth agenda could look at the half-dozen or more leading marine energy companies, which all have utility backing and industrial interest. You could look at that grant money as a particularly good way of incentivising growth within the UK economy over the next five years.

Q14 Sir Robert Smith: Do you agree with the idea of focusing that £20 million on arrays rather than more prototypes?

Dr Edge: Yes, that is a key gap in the funding array of sources out there. There is nothing at that point, and that is where we need to go next.

Q15 Sir Robert Smith: You also wanted continued prototypes. What sort of funding do you think is needed to keep the prototypes coming?

Dr Edge: How much would you need, Chris?

Chris Rich: I am looking for a modest £5 million, but that is a selfish situation. The difficulty over the past 24 months has been that the private sector—venture capital and the private equity houses—has not been a good source of match funding or investment. That has created significant difficulties for businesses such as ourselves. Having said that, we would not have been able to get to the state that we have without Government funding throughout the 10 years of the company's existence.

Dr Edge: It is worth pointing out the need for that continued innovation funding. It is by no means certain that we have found the right technologies to exploit these resources yet. Obviously, the leading technologies are getting to the point where we can find out, but there may be other ones that we still need to look at. Indeed, they might just bring further techniques that improve the leading technologies. It is very much necessary to keep the innovation funding going.

Neil Davidson: Another very useful development is the offshore renewable energy Technology and Innovation Centre, which will come into place to look at pan-industry solutions for things such as installation techniques, power take-off systems, new materials and so on. It will look at cross-industry solutions, which is a very positive development.

Q16 Dr Lee: Building on what Robert has been asking and what Barry said, if the figures are 5:1, as Mr Davidson said, why are you not getting support from Government? Is it because you are lobbying poorly? I hardly get anybody from your industry lobbying me. I get so many solar panel groups that I just get fed up with saying no, to be honest with you. I just wonder whether there is a responsibility for you to put your case more strongly.

Dr Edge: I think you'll find we have been engaging very strongly with officials and Ministers on these subjects. Indeed, getting 10% of the £200 million that DECC had for energy innovation over this Parliament was significant in itself.

Q17 Dr Lee: Some of us have just returned from Orkney. What struck us, and struck me, was the enthusiasm, the complete commitment and total belief that it was going to return big time. One particular individual springs to mind, who thinks he will make his millions out of this. Yet, that does not seem to fit with where you fit in, in the energy mix with DECC at the moment, and I wondered about that disparity.

Dr Tyler: Broadly speaking—and okay, we would always like more money—the Government support that we have been getting has been proportionate to the phase of development that we have been in. The key issue now is that, as we move from devices in the laboratory to putting large devices into the real sea environment and then putting a number of devices into arrays, the requirement for investment goes up by a quantum each time. Instead of the odd million here or £5 million there, it is finding £50 million here and £100 million there, which changes the paradigm when it comes to raising investment.

Q18 Dr Lee: Sure, but has there been a significant increase in technological progress because of the funding you have had in the past 10 years?

Dr Edge: Yes.

Q19 Dr Lee: And if so, in view of the fact that quite a lot of this technology was being talked about in the '70s and '80s, if you had more money you would get more technological progress. Yes?
Dr Tyler: Yes, I suppose that has to be—

Q20 Dr Lee: So, if that is the case and, in view of the fact that we have significant resources—the Severn bore, the tide through Pentland Firth and so on—strategically, it would make more sense for us to be putting more money into this. Yes?
Dr Tyler: It is fair to say that the industry has done astonishing things with relatively small amounts of resource. Certainly, coming from the background that I had come from previously, in defence, it astounds me how much progress has been made from meagre resources. So yes, you are right, you could always put more in. However, when you look at the state of maturity of the business now, it is only in the last three years that we have got to the point where we have viable scale devices. When I say "scale", I mean those that are producing meaningful amounts of electricity that could be commercially viable. It is only in the last three years that devices of that sort of scale have come from a number of different players within the industry and are finding their way into a real sea environment.

Q21 Dr Lee: A final question. Looking at Wikipedia, I see that the first windmill producing electricity was built in Scotland in July 1887. We did not really do very well, did we, in terms of progressing that on in the next century? Are we in danger of doing the same thing with marine?
Neil Davidson: Was that question related to wind?

Q22 Dr Lee: I am just saying that we ended up developing and then we allowed the Danes to make all the money.
Neil Davidson: It is a very interesting comparison.

Q23 Dr Lee: I just wonder whether we are going to do the same with the Canadians.
Neil Davidson: Well, it is interesting, because we did a comparison with the Danish wind industry and what we did differently in the UK. In terms of R and D funding, we put in very similar amounts to Denmark, but what was different about Denmark was that it put in place a very early and very steady market incentive in terms of a market price for energy. You can see that the "hockey stick" of exponential growth in Denmark began earlier. They got an early advantage in that sector because they put in place a market incentive earlier.
That is why it is critical, and why it is terrific, that DECC has proposed putting in place five ROCs for marine energy for wave and tide across the UK. But it is also why it is vitally critical for the industry that the electricity market reform puts in place a suitable strike price for marine energy, because at the moment you are getting industrials and utilities looking at investing in the sector. They can see the picture to 2017, which is, to be honest, when the industry will just be starting, but they cannot see beyond 2017 to what the strike price for marine energy will be. The call from the industry is for the Government to give as early a signal, and as much detail as possible, on the future market price. That will be the big incentive for investment in the industry going forward.

Q24 Chair: So how much funding would you like to see for prototype testing?
Dr Edge: I don't have that number immediately in my head, but it is in the region of tens of millions.

Q25 Chair: Tens of millions? Where should it come from?
Dr Edge: We see a role for EPSRC, the research council, to fund the fundamental research. The TSB should be there making moves on the more fundamental, prototype scale, and more programmes like the marine renewables proving fund or the WATERS fund up in Scotland are the kind of thing we are thinking of.
Dr Tyler: We should also say that having success at early commercial scale will provide the signal to the private investment community, be they utilities, original equipment manufacturers or other investors, to put money into prototype development, seeing that a ready market is starting to grow. That would be the strongest way to get the money for prototype development into the system.
Chair: Sure.

Q26 Albert Owen: If I can move on to renewable obligations, which Mr Davidson mentioned, what is the panel's view on the outcome of the ROC rebanding review?
Dr Edge: The industry is pleased. Five ROCs is what we asked for. There is no overall cap on the amount of megawatts at which they can be received. A 30 MW project cap is something that we can live with. It has been favourably received by the industry.

Q27 Albert Owen: How important is it to attract further investment?
Dr Edge: It is absolutely vital to have a long-term market signal that there will be a pull into the market of a suitable revenue support mechanism.

Q28 Albert Owen: When we were up in the Orkneys, that was the big issue, but by the time we got back here it had been resolved. It was not solely down to us, but it did happen in that time frame. Moving on to marine energy parks, what is your view on the Government's proposals to have a cluster and our own energy park?
Neil Davidson: The point is that all of the UK is a potential marine energy park. To take the example of the Oyster 800 project, which has had UK and Scottish Government funding, the installation vessels came from Fugro Seacore in Falmouth; we manufactured the piles in Arnish, in the Western Isles; the R and D was done at Queen's University Belfast; and the installation was done by an Orkney firm whilst the company is headquartered in Edinburgh. The whole UK is the supply chain for marine energy. More than 90% of our device was sourced within the UK.
I would caution against overly incentivising one area of the UK rather than another, because by our

project's very nature we are using companies from across the UK. One area where marine energy parks might be useful would be in the marine environment, doing pan-industry environmental impact assessments and helping with grid infrastructure and transmission upgrades, which would enable developers to focus on an area in the sea that they could all work on.

Q29 Albert Owen: Are the rest of you broadly in favour of them?
Dr Tyler: I absolutely second that. There are a lot of areas where despite the competition within the industry between device manufacturers, and so on, we are of one voice. If we can achieve more streamlined planning, for example, and if we can achieve grid connectivity into an area, we will all benefit. We would far rather be pooling the resource and the effort together, because eventually we will all benefit. If a marine energy park might be a mechanism to facilitate that, we would be hugely supportive.

Q30 Albert Owen: When we were out and about, the Welsh Government, as you know Dr Tyler, allocated my constituency of Anglesey as an energy island enterprise zone. Enterprise zones are up and running in many parts of England. Do you think that the marine energy parks should have the same incentive as enterprise zones?
Dr Tyler: I would say so. I am impressed with the way the set-up in Anglesey has made things very easy. It has been easy to come to Anglesey and look to develop a project of this nature, more so than it has been in other areas, because they have put that package together. It is not called a marine energy park, but in essence it has many of the same features. I think it is a good model.

Q31 Albert Owen: What about the planning issues?
Dr Edge: That would require going further than the enterprise zone model, in which there is relaxed planning within the zone to develop supply chains. We are talking about resource areas in the sea, which is a different matter. If we could have enhanced grid connection and streamlined planning in those areas, it would be useful, but it is a slightly different model from the enterprise zones.
Chris Rich: The infrastructure picture in terms of the grid and planning is more important than the micro-level of the supply chain. That does not seem to be our biggest problem currently. It is not a business threat; the grid position is.
Albert Owen: Okay, we may come on to that.

Q32 Chair: Is it not the case, however, that the Government can confirm five ROCs in the review because they know perfectly well that the volumes likely to be generated by the industry between now and the end of the period are almost zero? Modest is the word we would use.
Dr Edge: The Government's own analysis says 130 MW in that period, but I would be hopeful that we could do more than that—it is not a huge amount and it would certainly not break the bank.
Dr Tyler: That is why we made the point earlier that what follows in EMR is so vital. If we end up with five ROCs in 2017 and then we fall off a cliff, the five ROCs are pointless. We need to see that continuity and have a strong signal that we will see a continuum off the back of five ROCs. Obviously, we would expect what five ROCs represent under the EMR to fall with time as we bring costs down. But if there is a cliff edge in that, the investors will all run for cover.

Q33 Chair: Yes, I can see that. There is some encouragement to be drawn from what the Government have planned with the ROC regime for other technologies that have been tapering.
Dr Tyler: There is precedent, which is positive.

Q34 Laura Sandys: We have had quite a lot of evidence to say that there is a lack of co-ordination between Government and different agencies, which has been confusing, particularly because many of you are smaller businesses that do not have the capacity to manage all the relationships. I appreciate that the low carbon innovation group is there to help with that co-ordination, and I would like you to comment on that. But also, in light of the comments you have just made, why is DCLG not represented on that group? Obviously, planning is one of your key barriers, yet DCLG does not seem to be a stakeholder in that group.
Dr Edge: Well, DCLG would be responsible for onshore planning.

Q35 Laura Sandys: But with substations and certainly with the offshore wind sector, onshore planning has been a problem.
Dr Edge: That is a fair point, but the offshore stakeholders of the Marine Management Organisation and so on would perhaps be further a part of this. But are those kinds of stakeholders part of the Marine Energy Programme Board?
Neil Davidson: Not that I am aware of.
Dr Edge: The programme board has been useful in bringing more co-ordination to the sector, but perhaps we should recommend that it extends further.

Q36 Laura Sandys: Do you feel that there are too many different organisations? There are the Carbon Trust, ETI, TSB and the research councils, and the green investment bank will come online. Those are complex but layered organisations, possibly with competing—
Neil Davidson: I think the landscape is becoming clearer. There is much improved co-ordination between organisations. The industry has long asked for a continuum of funding so that from the earliest days with developers and all the way through, there are clear gates to go through and different gates to knock on and, potentially, open. TSB and Scottish Enterprise are collaborating at the moment, the offshore technology and innovation centre is very positive and there is much better co-ordination between those organisations.
Dr Tyler: I am very new in the industry, so I have been learning it from first principles for the last three and a half months. I have been pleasantly surprised by how relatively quickly one is able to get one's head around how the different parts work together. It is

quite a small community, which talks very freely among itself.
Laura Sandys: Good.

Q37 Dan Byles: Can I come back to grid connections? We have heard several times from different people that grid connections are a concern to the industry when you start scaling up into larger arrays. What must happen to ensure that we can physically connect what you are putting in the water to the grid?
Neil Davidson: Finance is the number one priority and the grid is number two, planning is probably number three. In terms of the main wave energy sites in Scotland—Orkney and the Western Isles—transmission upgrades are critical. There is a system under which potential developers must apply and underwrite the cost of the transmission upgrade. So the cost of those upgrades is number one—

Q38 Dan Byles: Does that risk limiting access to the larger players and stopping smaller companies that do not have the capacity to do that?
Neil Davidson: They can only build on the back of what has been asked for, so there is a need for large players to put in and put down big requests for grid infrastructure.
The other side of the coin is transmission charging. An awful lot of Government policy is directed towards encouraging more renewables, and often the best renewable resources are at the windiest and most exposed parts of the UK, at the periphery. But transmission charging, which is being looked at by Project TransmiT, charges the highest fees for generation at the periphery of the UK. It seems counter-intuitive that transmission charging is flying in the face of all other Government policy, which is trying to encourage more renewables. We would hope for a positive response from Project TransmiT, which would make for a much more level playing field across the UK in terms of transmission charging for renewables.

Q39 Dan Byles: How optimistic are you that Project TransmiT will produce what you want it to?
Dr Edge: We think it will give us a better result. At RenewableUK, our positioning is that while we are not against location charging as a principle, we feel that the skew of the playing field is way too high. I am hopeful from what I have heard coming out of Ofgem about Project TransmiT that there will be a much lower slope. I am really quite hopeful that we will get a decent result out of that.

Q40 Dan Byles: But if you cannot physically connect because people do not have the power to underwrite the transmission issue, the costs are irrelevant, aren't they? How optimistic are you that there is a solution to the physical problems?
Dr Edge: There are processes in train and we have precedents from some years ago, when there were some renewable energy transmission studies—RETS. That gave Ofgem the permission to allow particularly Scottish and Southern Energy Group and ScottishPower to invest quite heavily in new upgrades. For instance, the Beauly-Denny line was a result of that.

Q41 Dan Byles: They were able to invest without that underwriting in place.
Dr Edge: As long as there is a process to be gone through that says there will be that need. There is now a refresh of the electricity networks strategy group's 2020 vision going on. My understanding is that it includes an allowance for about 1,000 MW of wave and tidal, primarily in the far north of Scotland. That would further enhance the reinforcements—for instance, re-conductoring out to Dounreay, which is a line that already exists. Those kinds of investment would go ahead. I am hopeful that the issue has been seen. As long as Ofgem is continually being held to the fire, hopefully we can get a good result.
Dr Tyler: It is a problem that we share with other renewable energy types. Having organisations such as RenewableUK and the Renewable Energy Association seeing the purview across all renewables is very helpful to us in keeping this very high on the agenda. We have to accept the fact that this is a strategic realignment of a grid that started as a centralised energy generation grid and is now moving to be more federated. That is a big, capital intensive change in the structure of our grid that will take many, many years to physically do. What we need to do is to see that progress and open up the sites we need to get access to. At the moment, we have sites that are effectively disconnected and are unlikely to be connected for some time to come. Those are some of the choicest sites where we wish to develop our wave and tidal projects.

Q42 Dan Byles: Is there a danger that you are just too small, that the effort will go to the large offshore wind farms and that there will not be the incentive to connect to small marine sites?
Dr Edge: This is where the Pentland Firth round has significant power. When you have 1.6 GW of capacity in one lump, it starts being something that the transmission network has to take seriously.

Q43 Dan Byles: Is this an argument in favour of marine energy sparks?
Dr Tyler: Yes. We talked about the grid connection earlier; we would all love to have a very fat cable connecting Pentland and Orkney to the rest of the UK. That would benefit everybody universally.
Neil Davidson: A number of major applications have gone in for grid infrastructure in Orkney and that is triggering the process that will hopefully bring the grid to Orkney for 2016. Similarly, a number of large-scale wind developers have triggered the process for the Western Isles. Hopefully, we are looking at 2015 for that. Things are moving in those regards.

Q44 Dan Byles: Do you think Ofgem are taking this seriously enough?
Dr Edge: Yes.

Q45 Dan Byles: You are happy that they are?
Dr Edge: I would not say happy.
Dan Byles: Satisfied that they might be.

Dr Edge: They are doing more than they used to.
Dr Tyler: But we are talking about large capital sums of money being expended to make this happen. Obviously, one might feel that in the current economic circumstances that they are going to have to attract a lot of financing to get this done.

Q46 Laura Sandys: On the technology side, is there any linkage that you can make with offshore wind farms to in many ways maximise the connection? Are technologies being looked at that we would call micro wave and tidal, which can sit alongside, to utilise that corporate investment?
Dr Edge: I used to get this question a lot, but for some reason not so much now. Where you want to be for offshore wind and where you want to be for wave and tidal are quite different places. Whether it would be worth while trying to exploit the small amounts of wave or tidal that are at offshore wind sites is questionable.
Dr Tyler: But at a generic technology level, yes there is a lot of synergy. We are using a lot of systems, components and supply base, as the offshore wind industry is. If I were to speculate, I might feel that an offshore wind turbine manufacturing facility would be a good place to build tidal turbines.

Q47 Laura Sandys: Because there is a supply chain synergy.
Dr Tyler: Yes.
Neil Davidson: BiFab also does offshore wind jackets.

Q48 Chair: Going back to the grid connection issue, one striking thing on our visit to Orkney was its suitability—sparsely populated and very windy—for onshore wind. Although this inquiry is about marine renewables, nevertheless, in looking at building up capacity, I guess quite a lot of the sites that are suitable for either wave or tidal also have some landmass, which is very windy and not too heavily populated. It is usually the population that resists onshore wind applications anyway. When you are looking at the grid connection cost issue, are you talking to people involved in onshore wind to see whether there is an opportunity for cost-sharing or cost reduction?
Neil Davidson: That is exactly what is happening on the Western Isles.
Dr Tyler: When you are talking about the utilities and the OEMs, it is the same people.
Dr Edge: One of the benefits of representing both wind and wave and tidal is to have that dialogue. It is also important to point out that there are some useful synergies between wind and wave and tidal. We produced a report a couple of years ago that indicated that a mix of 120 TWh of renewable energy, if it was 70% wind and 30% marine, would reduce the amount of balancing power required by 2 GW and 200 million a year. There are some useful benefits there.

Q49 Sir Robert Smith: Dr Tyler, you mentioned the supply chain in passing. As offshore wind is expected to take off, are there going to be constraints for marine renewables—a sort of Cinderella—in terms of cable laying and positioning equipment?
Dr Tyler: That is a possibility but at the moment we are seeing it more as opportunity than threat. We are going to represent relatively low volumes for a while to come. We could probably get cost reduction advantages from the fact that there is a supply chain with the right skills, facilities and so on, and we are not having to create those ourselves. By the time we are getting up to the sort of full production capacities that we aspire to in a decade's time, offshore wind might be coming off the back of the boom, and our timing might be just about perfect.

Q50 Ian Lavery: We all remember the initial outcry when wind power started to be developed on land. It hampered the development of wind power turbines in the UK for some time. It will be interesting to hear whether you have had any local opposition, and what public attitudes have been towards marine renewables, including the test devices that you have been installing in many areas.
Dr Tyler: I can tell you a little about the experience we have had in Strangford Lough in Northern Ireland, where for three years we have had a device in a sensitive site—I showed you pictures of it. It is a Natura 2000 site, so it is very environmentally sensitive; local communities are immediately proximate to where the device is.
The natural instinct when something new like that comes along, particularly in smaller communities, is to be a bit suspicious. We have found that a lot of very close engagement with the local community is vital. For that reason, I sacrificed myself to drink a lot of Guinness in a pub in Glenelg in Scotland the other night, so I could have conversations with the people who live immediately proximate to one of our proposed project sites.
We have had very little opposition, all the while the device has been in there. I would say that if you went and talked to the community which lives round that device today, it is universally supportive. They have seen two things, one expected and one not so. The first thing they have seen is direct income into the local economy, because local people are doing the maintenance and support of the device. It is local companies that are physically getting on the device every day and doing the maintenance. Secondly, although we were not expecting it, it has been a significant tourist draw. Now when you look at the boat trips that are run up and down the lough, one of the things they advertise is a couple of circuits of the tidal turbine. They would say there has been a net benefit to them in having the system there.

Q51 Ian Lavery: Is your experience the same?
Neil Davidson: I was going to make exactly the same point. The crucial difference between wind and marine energy is that the economic benefits of marine energy are closely hefted to where the devices are deployed. For us in Orkney, you probably got the sense that marine energy is very popular. We have looked at our numbers and we have spent more than £2 million locally already directly in the economy and have worked with more than 30 local businesses. A lot of that work with local businesses is around capacity building, HSE training for dive firms and the

installation of Oyster 800. The first Oyster device was installed with jack-up barges from far afield. The Oyster 800 that was deployed this summer was done with two multicat vessels engaged locally. Again, there is a really close relationship between where devices are deployed, operations and maintenance and the communities where they are sited.

Q52 Ian Lavery: Are there any negative comments?
Dr Edge: I saw one objection to an array near Islay, which I think was a misunderstanding rather than anything else. So far the development has not gone far enough for people there to say, "I don't like it" because it is just not happening yet. I would expect at some point to find some negative comment but I do not anticipate it being debilitating.
Dr Tyler: The one area where I think there is concern, and there is still a burden of proof on us, is environmental impact. What we can say is that everything we have put in so far has had a negligible environmental impact, but until you have put more devices of different types in different places, it is difficult to be conclusive on that.

Q53 Ian Lavery: On that issue, do you think that some of the environmental monitoring requirements for some of the equipment are too onerous and possibly too costly?
Dr Tyler: I think it is something we have to be very careful with going forward. It is one thing to have quite onerous environmental monitoring, as we have had, when you are at the prototype stage and you are putting devices in and you want to understand their impact on the environment. But if that becomes an expensive and enduring requirement on a commercially installed field, it will damage the economics very significantly. We are talking—the conversations are very constructive—with the statutory bodies about getting proportionality into both the planning side of the environmental issues and also, in particular, the amount of monitoring that is required post installation.

Q54 Ian Lavery: On a slightly different issue, what impact do you think the Government's coastal communities fund will have on support for or, indeed, opposition to ordinary renewables?
Dr Edge: It can only be helpful to have the ability to bid to support the development of your community from funds that come from the development of the marine resource. So we are very supportive of that issue.
Neil Davidson: On a European scale, there is growing interest not just in the directorate-general for energy but also in DG MARE, which is for maritime affairs and coastal communities, as to the potential economic benefits that marine energy can offer to coastal communities. Again, you can see how we could potentially access European funding for marine energy developments not just from the green energy agenda but from the jobs and the economic benefit of that opportunity.

Q55 Sir Robert Smith: On the environmental impact, is there enough sharing of information between developers and agencies and so on, so that people do not have to reinvent the wheel in terms of understanding environmental TOE?
Dr Tyler: It is early days because there are not an awful lot of scale devices in the water capable of being environmentally monitored, but it is definitely in that category of information and knowledge which is not seen as commercially proprietary and therefore, in principle, I do not think that the developers will have a problem sharing it. We would certainly positively encourage the different agencies to share it because we would see that as the route to reducing our burdens in planning and monitoring.
Dr Edge: Similarly, if you take the analogy with offshore wind, we are keen that the lessons that are learned on all the offshore wind farms are then fed back so that consenting for the next set is not so onerous. We have that example to show to bring into the wave and tidal sector.
Neil Davidson: The UK Government have just brought in the Knowledge Transfer Network, with the principal goal of achieving exactly that: bringing all the players together to share information where that is feasible and possible.
Chair: Thank you very much, and congratulations on keeping your answers short enough to enable us to complete what we wanted to do. We are grateful to you for your time this afternoon.

Examination of Witnesses

Witnesses: **Amaan Lafayette**, Marine Development Manager, E.ON Climate and Renewables, **Dan Pearson**, CEO, MeyGen Ltd, and **Rob Stevenson**, CEO, Tidal Generation Ltd and Vice-president of Rolls-Royce Power Ventures, gave evidence.

Q56 Chair: Good afternoon and welcome to the Committee. I think that you were all present for the previous witnesses. Thank you for coming in. Perhaps I can ask you to start, as we asked the other witnesses to do, by explaining what your companies are doing in the field of wave and tidal energy. I should say that some of us saw the Pelamis in the water in Orkney about three weeks ago.
Amaan Lafayette: Good afternoon. My name is Amaan Lafayette and I am the head of the marine energy team based at E.ON. Our activity is covering both wave and tidal. We are a utility and we are very interested in the marine generation sector. We have been active since 2001. The machine that you referred to—the Pelamis machine that is deployed in Orkney—was one that we purchased from Pelamis Wave Power. We have deployed it at EMEC.
Rob Stevenson: A very good afternoon everybody. My name is Rob Stevenson and I am Vice-president of Power Ventures for Rolls-Royce plc. I am also the

chief executive officer of Tidal Generation Ltd. Tidal Generation Ltd became a wholly owned Rolls-Royce subsidiary in December 2009. Since then we have been quietly working away. We were pleased to announce last week that we had generated our first 100 MWh from our 500 kW test turbine located at EMEC. That is part of the Rolls-Royce energy low carbon strategy.

Dan Pearson: Good afternoon, my name is Dan Pearson and I am the CEO of MeyGen Ltd, a company that was set up dedicated to the development of the Inner Sound tidal site off the Caithness coast in Pentland Firth. It is fair to say that we are the largest project from a megawatt perspective in the Pentland Firth Crown Estate leasing round. Our shareholders are Morgan Stanley, the investment bank, International Power, GDF Suez, as well as the technology developer, Atlantis Resources Corporation, whose device is at the EMEC facility. We are a 12-person team dedicated to developing the project. We are currently going through our EIA and front-end engineering design. Because of our size we are nimble and we are moving quite quickly. We would therefore like to be putting in our consents towards the end of the year for the first phase, which is 86 MW.

Q57 Chair: Good. You are all, directly or indirectly, part of much bigger groups now—serious players. Why do very large companies get interested in what, at the moment, looks like a fringe activity?

Amaan Lafayette: Generally, there is real confidence that there is a significant opportunity for marine generation. In the UK, it could deliver something in the region of 40 TWh a year for wave. It is a little more difficult to do for tidal, and Rob may be able to give you a better view of that, but it could generate somewhere between 20 and 100 TWh a year. There is a broader range on that, but it is a significant generation opportunity. As a utility, it is something that we are very interested in. A number of the benefits have been mentioned previously. We have a renewable portfolio that has onshore and offshore wind and biomass. We are obviously interested in a fantastic indigenous resource in marine renewables and the benefits that would offer in reducing the intermittency issues and that kind of thing. We are particularly interested because of the size of the opportunity, as well as the diversity it adds to the renewables portfolio.

Rob Stevenson: Rolls-Royce believes that the sector has tremendous prospects. You hinted in your early session—DECC have heard me say this many times, so it is not news to them—that the industry has been guilty of overselling itself in previous years. We firmly believe that it is time to calibrate expectations. We have to be quite clear that we have been active in this sector for a good part of three years, and it is extremely challenging. It is challenging both technically and financially. I again urge everyone to calibrate their opinions on where the industry is today. As we stand at EMEC today, our unit is the only one that is generating, so we have a long way to go.

The devices that will be put in the water as part of the £20 million will not resemble what you see going forwards, largely in the way that they connect to the system, so there is much work to do. From a Rolls-Royce perspective, we are a global energy solutions provider. We think this offers worldwide global prospects, but we emphasise to everybody today that there is much work to do. 40% to 50% of the capital costs of an array are nothing to do with the turbine. My point is that we have to get the R and D working across the entire system. That is our drive to achieve.

Dan Pearson: Speaking on behalf of our shareholders, I think that both Morgan Stanley and International Power have been looking into the sector and have been actively participating for about four or five years now. The key thing is that they have seen progression. They have seen positive signals from the Government, and they are obviously seeing the Government acting on that. With the progression from the Crown Estate, which is leasing round now to five ROCs and what have you, it is now gathering momentum. The renewables sector in general is obviously the largest growing sector within the power sector. Being part of tidal, which is hopefully on the cusp of being commercialised—taking Rob's points on board—they certainly want to be a part of that.

Q58 Chair: On the relationship between utilities, equipment manufacturers and financial investors, are they all compatible as partners?

All witnesses: Yes.

Amaan Lafayette: You are talking about the natural partners in the energy space already, so companies such as Rolls-Royce are companies that E.ON UK are used to dealing and working with. Clearly, we work together all the time, and our presence in the marketplace gives the visibility that we, as a utility, are serious about this and that we genuinely feel that there is a marketplace and an opportunity here. That puts a signal out there in the marketplace that shows the original equipment manufacturers that this is a sector that they need to be interested in. We need their participation if we are going to manage some of the inherent risks. Everybody has talked about how difficult it is and how complex the challenge is. Having partners who are used to the energy space and who have the competence and capability to deliver is a key element to de-risking it, so it is a natural partnership and it works. It is a good thing.

Q59 Dr Lee: There have been some claims that the Government's renewable energy roadmap is too cautious in its ambitions for wave and tide. What is your opinion of that?

Rob Stevenson: To go back to my earlier comments, the roadmap is a good piece of work in that, when you write it down on paper, you get a feel for the size of the challenge of delivering it. From a tidal perspective, which I will speak on if you do not mind, the number for marine in the roadmap is roughly, as was referred to, about 300 MW. What we have seen currently is five ROCs, which is very good and we support that and want to talk about it a little bit more, and the £20 million. If we assume one tide and one wave project, that is 30 MW, so you have to multiply that by 10 to achieve the roadmap. The big issue there for us to put on the table now is that there is a huge

danger of a vacuum in a clear indication to us on tariff support.

Five ROCs is excellent. There are some issues with it that I will talk about, but it is a start. As was mentioned in the previous session, we have to get the EMR debate out there, and we have to understand where it is leading us in terms of phased tariff support. We need a phased tariff support line to drive our cost base and to see, basically, if you can create a business. There is a huge danger, now that we have a few megawatts in the water, that will take between now and 2017 while we all sit round and wait for announcements on EMR. In my organisation, Rolls-Royce spends £950 million a year on R and D. The internal competition for R and D is huge and I have to fight for my money. My bosses look very carefully at where they will see their money best spent. My big plea is that we must have the debate—we have had a great debate with DECC over recent times, and we do not want to stop that. We must continue the discussion and get the issues out there. Some of it we will like and some we won't, but at least we will have the debate.

Dan Pearson: I concur with Rob, inasmuch as it looks forward to 2020. Our project is a phased build-out from 2013–14 through to the 2020 mark, but the revenue support in those final three years is not known right now. Therefore, to make a financial decision to build out the larger commercial phase, we are obviously keen to see the EMR adhered to. As long as, I suppose, people hit the time scales for having that debate and Government are clear and transparent, as they have been so far, we look forward to contributing to it.

Amaan Lafayette: Will you go through your question again for me?

Q60 Dr Lee: It is basically about the renewable energy roadmap; do you think it is too cautious on goals for wave and tidal?

Amaan Lafayette: I can understand the perspective from the Department of Energy and Climate Change. There has been active and useful engagement, in which there has been a hard challenge process and it has brought a good consensus across the sector—from utilities, financiers, original equipment manufacturers in the early stage, and technology developers—to come forward with a view of what can be achieved. Obviously, you can expect that there are a lot of differing opinions on that, and DECC has to distil that down into something that it can put down on paper that reflects the opinion of the sector. It is a good piece of work, and it is the right thing from DECC's perspective. It is up to us to try and beat that and go above it.

Q61 Dr Lee: Do you share the calls for greater political leadership? What do you expect? What is not being done that you would like to see?

Amaan Lafayette: I do not think it is as much what they are not doing, because a lot is being done in Government. What I would like to see more of, and you can see it when it works really well, is collaboration between different Departments. There is DECC, BIS, and Scottish Enterprise, and you can see Scottish Enterprise talking now with the TSB. When there is that dialogue, you see that it really starts to leverage the power of government and accelerate things. Through that dialogue with government, and through then forcing an equal dialogue from industry, it has been good to bring together all the opinions, get everybody talking, and get everybody who is required to make a decision in the room so that the messages, questions and answers are consistent, and it happens through a work-through position. What I like to see, and what works very well, is when Government are joined-up and working through all the different Departments that they have.

Q62 Dr Lee: In terms of big projects, you can look at Apollo, man on the moon, spin-offs, $14 for every dollar invested—we have all read the same things. If the Government were to commit to something as big as the Severn bore, do you think that would bring forward technological progress? Where would it make a significant difference to the way in which the industry developed over the next 10 years? Would it be a big project and would everyone want a piece of the action, or do you think that it would be the wrong thing to do at the moment?

Amaan Lafayette: Because my focus is pretty much wave and tidal industry and generation, that is a difficult question for me to answer. I realise its importance, but it is not something that I could answer for you today.

Q63 Dr Lee: It could be tidal, whether it is technology-linked or other.

Rob Stevenson: This is not a direct answer but I would like to say that again, we have to be extremely careful, and I keep using those words, in that tariff support—five ROCs, but it could be 10, if there's nothing deployed. The point was made that as the Government said five ROCs, because five ROCs can be deployed, we have to get the capital—I will rephrase that. We have to get the devices to produce energy reliably and cost-effectively, otherwise it does not matter if it is five, 10 or 20 ROCs. One challenge that we face is that people come to OEMs, because OEMs can offer guarantees. When faced with a five-ROC tariff, you can get nowhere near offering the guarantee that these guys want, because, in essence, my device generates five times more revenue for him than a gas turbine does on land, so the significance of performance at five ROCs is five times more important. That has to be recognised in the work left to be done on ensuring that the devices coming through on generation one can actually deliver, because there will be a danger that we generate generation level one, but there is a bit of a hiccup and we have to go back to generation two. Revenue support is great—we applaud it—but we should not take our eye off the ball in terms of R and D activity.

Dan Pearson: I think from the Apollo 11 juncture and the Severn bore—obviously that is a tidal range issue, but we are obviously on a lower capital intensive project but nonetheless challenging—a key issue for us is the synergistic values you can have between oil and gas and offshore wind, and the kind of skill set that is developed north of the border and across the

southern North sea and the UK generally. The skill set in the UK can certainly be deployed to have the diversification of skills, and obviously vessels and electrical equipment. From our perspective, I think that is one area that we can really focus on, and on which we are focusing, in our engineering and design for what is, essentially, almost an Apollo 11 project.

Q64 Dr Lee: Denmark's success in building a wind industry is often mentioned. I met a famous Norwegian capitalist, who told me that you need to build an industry, and perhaps that is what this is about. On wave and tidal, what can we do more than we are doing? Are we doing enough to create the industry that UK plc can benefit from in terms of exports?

Amaan Lafayette: It is a very challenging area and the costs are high—everybody knows that—so money is particularly important. Of the £200 million that was available, for marine renewables to get access to £20 million is very positive, but it is not the only thing being done at the moment. The offshore renewable energy technology and innovation centres are going through and there is also the work that industry is doing through the ETI, and that is in partnership with Government. Money is being made available, and, yes, more would be useful, but delivery from the sector to match that is also important.

You can see early-stage technology going into the water and you will have the opportunity to go to EMEC and see that people have deployed. There is success there—moving on to the next phase of arrays and proving that the technology can deliver, and then you are into a dialogue, saying, "We've delivered this and it is the right time to talk about more." I think it is clear that it is expensive. In this particular instance, where you are talking about the benefit to UK plc, if we as an industry can, with Government, make the argument for the benefit to UK plc, then we are into another discussion about the right thing for Government to do to secure that opportunity for UK plc.

Now we are talking about the delivery of these first-scale arrays, but if you are talking about a different debate, which is the argument about UK plc, that is a new debate. We can have that too and talk about what is right for Government to do to secure that. If it is accessing more money through Europe or what is happening in Scotland and working collaboratively with the industry, then that is the right thing to do.

Rob Stevenson: I agree entirely; it is about building an industry. At the minute, the industry is focused on the prime mover. We have to open our horizons up, because it is about the installation, the maintenance, the cabling and how we get the power to shore. It is all of those things combined, and as yet, we do not have everybody working on those pieces of the puzzle. Again, I think we need funding, but I think we need targeted funding. People in the room have proved the physics—we can extract energy from the tide or waves. We can do it, but that does not mean that we can build a commercial business, so the next phase has to involve all those people in the puzzle and target precious support—let's be honest, we all realise money is tight—where we can show progress.

Q65 Albert Owen: May I develop a little further this point about Government support? We have been told in evidence that Government support is a make-or-break issue when it comes to attracting corporate investment. Do you agree? On a second issue, Mr Lafayette, you talked about the £20 million that is being provided from the £200 million, and it is easy for a large company such as yours, which has different portfolios, to deal with that, but isn't that amount of money chickenfeed for the marine sector itself, when compared with some of the other renewable sectors?

Amaan Lafayette: I understand the point. I would not use the same words. Yes, renewables power generation is an expensive area in which to deliver projects—everybody is aware of that. Marine renewables are an area where we as a business are learning, and that is the reason for the early involvement. Get involved early, try to understand the dynamics and see whether you can do things cost-effectively—that is why we are involved. We are in learning mode, and as we go on, we begin to understand some of these issues.

Yes, we can make representations to DECC about what we see as the current situation and the likely cost curve associated with it. Through that dialogue and dialogue with Government, we can give clarity on what we think the costs are and how they are going to come down. £20 million right now is good news. The sector requires capital investment for the very intensive capital investment that is required up front. Having that capital is extremely important; getting access to that money, getting machines out there in the water and proving the case puts you into a new discussion about this being the right thing for the UK Government to be doing and the right thing for UK plc. Let's talk about what additional support there is and what is right at that point in time.

Dan Pearson: The £20 million is focused on arrays. On Rob's point, that money will not necessarily focus on the turbine side of things; we will actually focus mainly on the balance of plant, the cabling back to shore and the directional drilling that you will most probably need to do. What we are trying to do is to pull together pieces of proven technology. We are not trying—not right now, at least—to invent new equipment for the balance of plant; we are trying to integrate systems. That can be done. You have a lot of learned companies like ABB, Siemens, Rolls-Royce and GE, for example, which are all interested in the sector and which are all quoting and giving prices to the sector to contribute.

For the first phases, the £20 million will obviously help a lot. You are also seeing other money—not in isolation—coming through from the Scottish Government for similar deployments, which is also very welcome. One of the issues we have mentioned briefly is the European part, and we need to make more effort to access money from there. We need to help lobbying institutions and industry to get into the EU and extract more money from research funds such as the NER300. We need to focus the Government on lobbying the industry through that route as well.

Q66 Albert Owen: Mr Stevenson, is Government support make or break?

Rob Stevenson: The way I see it, if I understood your question right, is that Government capital support in the short term is extremely important to the early developers of the projects, which is why the OEM group supported that position. That is the £20 million. But that is for relatively small demonstration devices, and as discussed, it might only be one for the type.
Albert Owen: Sure. I coupled two questions.
Rob Stevenson: Long term, I see my customers as the utilities. We are not playing in the project development circle, because we stick to our knitting, in that we deal with device development—I leave project development to the utilities. In terms of capital injection for small SEM-type projects that are trying to develop projects to stimulate cash and get some leverage in, I can understand the argument. The argument sort of goes away when you get to larger scale. What these guys will need are the guarantees from us so we can justify the investment.

Q67 Sir Robert Smith: And as you said earlier, a guarantee that the market is going to be at a value that makes the investment looks attractive. The signal from renewables obligation to feed-in tariffs is absolutely essential.
Rob Stevenson: Absolutely essential.
Dan Pearson: It is in everyone's interest to reduce the cost of energy. We are all looking at how we can do that, but essentially we do not want to see a cliff face off the ROC regime suddenly go down from five ROC support to brown energy price parity. We are very encouraged by what the Government are saying and how they are acting, but the quicker we can get EMR to dictate what those others are is best.
Rob Stevenson: It is the lead time. The lead time for the device manufacturers is three years in, so the project developer's spend profile kicks in a lot later than ours. We are having to speculate now to secure a market going forward. What we can't do because of reputation and customers is not deliver stranded assets. I cannot commit to building a 1,020 MW project in 2015, 2016 or whatever if I do not believe there will be a market there in 2017–18, otherwise I will have to support that asset for 25 years—because that is what we do.

Q68 Sir Robert Smith: With £20 million being spent on arrays, do you agree with the other witnesses about prioritising arrays?
Amaan Lafayette: Yes.
Rob Stevenson: I think so. It would become apparent to anybody that, as soon as they put a device in the water, their learning starts there.

Q69 Sir Robert Smith: I must remind the Committee of my interest in the oil and gas industry. Mr Pearson, you mentioned trying to take a lot of the skills. Given that there is a skills shortage in the oil and gas industry and there is the offshore wind as well with a similar environmental skills sense, do you think that you have the financial backing to compete for those skills?
Dan Pearson: We have been encouraged by a lot of initiatives that are going on in universities, for example. Near to us in Thurso, the University of the Highlands and Islands has basically set up courses—it recognises the skills gap—to encourage the operations and maintenance side mainly, once the projects are built. The manufacturing sites are able to make turbines and pull turbines together, and the foundations and the steel work that would be required. If you look at a lot of the fabrication locations in Scotland, England and Wales, they can cope with that. It is perfectly within their capabilities. It is more what happens afterwards and how you operate and maintain the projects and the skills there which are in short supply.
The installation side is the key element, and trying to reduce costs of the installation is one of the biggest factors in our cost model. Currently, we are factoring costs incurred from DP3 vessels—massive oil and gas vessels that can hold station in tidal flows. The day rates can vary from about £80,000 through to £200,000 per day depending on the spot market for oil and gas. You are competing almost with the oil and gas market in that regard. A lot of research and activity is going on at the moment to be able to focus on how to maintain that capability of being able to hold station, but also being able to reduce costs.
Rob Stevenson: The answer is that you have to engineer it out.
Dan Pearson: Exactly.
Rob Stevenson: It's got to go.
Amaan Lafayette: I agree that Dan is right. It is a good challenge point that sometimes you are competing for resource and, if you are competing with oil and gas, they have much deeper pockets and they can pay bigger fees so it is very competitive. But that pushes and forces innovation. With the technology that we are working with, they were struggling with that to begin with so they engineered away from that solution and went from using anchor handlers and very expensive vessels that were over £50,000 a day down to a vessel that is now £2,500 to £3,000 a day. That is a vessel that we at E.ON have shared between our offshore wind activity and the delivery of this particular machine into operation. You can see that as the innovation kicks in and as you work towards it, you can engineer out certain solutions and bring in things. You are then using a vessel that is a work-class vessel for an offshore wind farm. When it was finished there, it came to us and was doing work for the deployment of a wave machine.

Q70 Sir Robert Smith: Some of the Pelamis machines had their engineering done in Stonehaven from subsea oil.
Amaan Lafayette: That's right. They have leveraged a lot of their skills and the expertise that exists in that marketplace already to do some of the welding that requires certain offshore-level codes that those places can do. So there are some benefits.

Q71 Ian Lavery: The majority of the supply chain for marine renewables is based here in the UK. A percentage of the supply chain, however, is currently based outside the UK. Can you give us any information on what those components are and where they come from?

Rob Stevenson: The truth about the marine supply chain is that there isn't a lot there at the moment. We review what we can put through our internal supply chain and what we have to go external for. We are also talking to people with a lot of synergies in the wind industry about how we can integrate into their supply chain.

Tidal devices are very heavy—140 tonnes for a turbine—so you want to be making it close to where you install it. It goes back to the question, "Where are we going to install volume?" Everybody who picks up the phone to talk to me wants to know where I'm going to build my factory. That is the first question they get to very quickly. Our serious answer is that we don't know yet. It will depend where the volume is, but certainly for the heavier parts, you have to build them close to where you are going to do your installation.

In terms of percentage, we have a 500 kW device in the water, and we are currently building a 1 MW. I would say that the 1 MW is 99% UK, but it is not a production machine. Obviously the big question that is coming is, "How much is this stuff going to cost?" We are going to have to look very hard at the supply chain to deliver quite a lot of those savings.

It's early days yet, but the prospect for the UK is huge. We believe that there is 10 GW of deep-water tidal resource in the UK, out of a world resource of about 23 or 24 GW. We are probably close to 50% in the UK.

Q72 Ian Lavery: What do you think it will take to encourage those in the supply chain outside the UK, or just new manufacturers, to set up in the UK?

Rob Stevenson: It is easy to answer—I keep repeating myself—that it is confidence in the ability to deliver volume. Is there a market there? If there is a market, we will get a supply chain. We will have no trouble with that; we will get it UK-based. It is back to the EMR question and tariff confidence. Will there be a market post-2017? That is what everybody needs to know.

It has to be said, and I will say it in this forum, that the current taskforce on wind is to reduce the cost of wind to £100 per MW by 2020. Getting tidal to that point will take a lot of work, part of which is the supply chain and the incentives being offered to the wind industry. We need to look at tidal as a genesis industry, but above all, we need to get the R and D in place at this early stage, otherwise you spend your money twice. If you are going to engineer costs out of a product, you have to do it on day one. If you do it on day three, it costs you five times as much.

Amaan Lafayette: The delivery of single units in places such as the European Marine Energy Centre has created a lot of interest in the sector. As Rob has mentioned, the sector has done a very good job of talking itself up, so there is interest from people who are looking to diversify and to see whether there is an opportunity. There is often a feeling that the sector is perhaps the next wind industry, so there are lots of places that have become involved in the marine renewable sector and we need to encourage that. Looking at things such as the offshore renewable technology and innovation centre, which has been proposed by the Technology Strategy Board and is on its way through, a key component of that will be to energise the supply chain and to bring them in. There are ongoing things and activities that will start to do that, but it really is about the visibility of projects, and those projects coming through at scale, that will excite people, energise them and bring them in. Rob is right that because the technology is large—generation-scale equipment—it needs to be delivered very close to the point of generation. There is a massive opportunity because the resource in the UK is so fantastic.

Dan Pearson: We are quite encouraged by the number of calls we get from supply chain and large manufacturing centres. There are a lot of ports and steel manufacturing that can do the work. Most of the turbines so far have been built in the north-east, by Rolls-Royce in Bristol and what have you. You have seen it demonstrated; it can be done. We are also encouraged by agencies such as the Highlands and Islands Enterprise and other RDAs who are almost working on our behalf trying to organise the supply chain in the background. We are working closely with them to try to make sure it is done in a fair and orderly way instead of sporadically, which we are trying to avoid. I think there is great potential.

Rob Stevenson: Small projects are one thing, but volume is different.

Amaan Lafayette: I am seeing the interest from the supply chain to get the sector to the place where there is volume. They are engaging now to try to understand what it will take to get to volume, for the balance and plant side of things, which means all the electrical infrastructure and all the switchgearing cabling, and that kind of thing, as well as the actual components themselves, and people who are adept at steel manufacture and others who are good at assembly, and all the rest of those kinds of things. Pelamis are a great example of that. They had a lot delivered in that factory in Leith in Scotland. They did really well at that and so there is an opportunity for that. I visited the manufacturing facility up in the north-east, which is SMD, where the Atlantis machine was being delivered. There is a lot of work for a number of the turbines and wave energy machines that have been delivered in the UK through the supply chain that exists here already. They are energised to do more but the visibility of scale will do more.

Q73 Chair: There are some environmental impacts from both wave and tidal energy. I believe that in the four different jurisdictions in the UK there are different agencies involved in licensing and so on. They may adopt a different approach. Does it make a big difference to you whether they adopt a precautionary approach or a deploy and monitor approach? Is that a factor in your challenges?

Dan Pearson: From our perspective in Scotland, what we have seen first hand is that a top-down approach is being applied by the Government to try to streamline as much as possible the process for deploy and monitor. We encourage that. We think it is a great move. There are just some things that you cannot theoretically guess without putting turbines in an array in the water. So we are working very closely with Marine Scotland, Scottish Natural Heritage and a few

other key departments to make sure that we live up to the obligations they put to us. In respect of other jurisdictions such as Wales and England, it is tough for me to comment because of my lack of exposure.

Rob Stevenson: We are not acting as project developers so we are not actively involved in the side where we provide information to the developers. We just encourage consistency because it helps all the way down the chain.

Amaan Lafayette: Our current engagement with Marine Scotland is good. They are moving more towards the deploy and monitor approach. That is extremely positive. I think that the trials that all of us are deploying will provide information. We are doing research and development work with a number of partners in Scotland—EMEC is one and some of the other educational establishments in the area—to extract information from that trial and make it available to Marine Scotland so that they can start to build their experiences too. We are working in partnership. Deploy and monitor is extremely important. The dialogue is very important as well. They have guidance out at the moment and that is useful. As soon as the information that we as a sector can provide them with allows that guidance to move from just being guidance to being what is required, it will be very helpful. But in making the move from its just being guidance to being, "This is the process and this is the procedure", we need to make sure that we do not damage the opportunity to deliver in the future by being overly cautious and putting in place some things that are particularly expensive or difficult to achieve. We are at the point when we are precedent-setting, so we need to be very careful. That is the message.

Q74 Chair: To the extent that data are being collected by the monitoring process, is that information now shared?

Amaan Lafayette: In designing any R and D programmes where we will be trying to get environmental data, we have tried to engage with Marine Scotland, to let them know what our plans are and allow them to offer advice and guidance on what they would like to see as part of that process. Therefore, the information that we gather and recover will be relevant and valuable to Marine Scotland. That is the approach that we are trying to take at the moment. That is one of the things about the sector that is very good; people are working collaboratively. We are working collaboratively with ScottishPower Renewables and with Aquamarine Power, as well as with Pelamis Wave Power and the local educational establishments, to try to deliver some of that work.

Dan Pearson: As a developer, and as a first mover in the industry it is an area where you spend a lot of money on. It is the price you pay. We do not want to hide any of the information that we get, because it is for the benefit of the industry that we are finding it. I am encouraged to see that everyone else is playing the same game. There is no real protectionism around it.

Chair: Good. That concludes our questions, so thank you very much for coming in.

Tuesday 22 November 2011

Members present:

Mr Tim Yeo (Chair)

Dr Phillip Lee
Albert Owen
Christopher Pincher
John Robertson
Sir Robert Smith

Examination of Witnesses

Witnesses: **Dr Stephen Wyatt**, Carbon Trust, **Dr Jason Green**, Research Councils UK, **Rob Saunders**, Technology Strategy Board, and **Dr David Clarke**, Energy Technologies Institute, gave evidence.

Q75 Chair: Good morning. Thank you for coming in. Sorry we are running slightly behind time. We are quite tight for time this morning, if you could bear that in mind in assessing the length of your responses. Perhaps we can kick off. We know who you are and you know who we are, so we will dispense with any more detailed introductions, but would you like just to tell us briefly how each of your organisations is supporting wave and tidal energy development?

Dr Clarke: David Clarke, Chief Executive of the ETI. We do strategic analysis and modelling of the UK energy system across heat, power, transport and infrastructure, and then, where we see an opportunity, we invest in major engineering and technology projects that will help us on the pathway towards delivering some of that overall system design.

In the marine piece, we do exactly those two things. We carry out analysis in the UK. We can see where marine is likely to fit into the UK system in the future and the value of that, and we will talk about that perhaps, and then we invest in major projects, and we have currently got around £21 million of marine energy projects across tidal and wave in development and demonstration, so it is technology development and technology demonstration. They are running at the moment, and we have about another £20 million of projects in contracting right now. They are fairly big projects. The smallest one is very small; it is about £1.5 million. The biggest one is £15 million.

Rob Saunders: Hello, I am Rob Saunders, and I lead on offshore renewables at the Technology Strategy Board. The Technology Strategy Board is the nation's innovation agency. We are an NDPB sponsored by BIS, and our goal is to accelerate economic growth by stimulating and supporting business-led innovation. We operate across a number of sectors, of which energy is one, and we view marine energy as a priority. Since 2007, we have provided grants to fund a number of projects that total about £22 million. We have supported cost reduction in marine devices, and we have supported underpinning technologies, in particular to help to develop the technologies that go around the devices as well, in a couple of calls last year especially.

Dr Green: Morning. My name is Jason Green and I am the Head of the Research Councils' Energy Programme. The Energy Programme covers the remit of five Research Councils, and part of our remit is marine and tidal. We have a current portfolio of around £550 million of projects, and around £20 million of those are in marine and tidal research. We support early stage research and postgraduate training.

Dr Wyatt: I am Stephen Wyatt. I head up an area called technology acceleration at the Carbon Trust, which is about commercialising promising low-carbon technologies. We have been active in wave and tidal energy since 2003, and we offer a joined-up range of support from backing early-stage promising technologies through business incubation and technology verification, support and grants through to full-scale prototype support, most recently through the MRPF programme that saw £22 million to six concepts.

Q76 Chair: Okay, that is helpful. Can you throw some light on how you ensure that this is co-ordinated? You are all members of the Low Carbon Innovation Group, but that does not include the Scottish Government or Highlands and Islands Enterprise. Can you avoid duplication and can you co-ordinate effectively, given you are all working in somewhat overlapping fields?

Dr Green: I say that yes we can. The Low Carbon Innovation Group has the Research Councils, TSB, ETI, BIS and DECC represented and also the Carbon Trust, and really within the landscape that moves through the TRL levels—the Technology Readiness Levels—we all have certain areas where we predominantly fund, but then, as you would expect, things would overlap. For example, early-stage research will then move on to early-stage demonstrations, where we will link together.

The Low Carbon Innovation Group at a recent meeting has rebranded as the Low Carbon Innovation Co-ordination Group, and that is what we are there for. We are there to co-ordinate research across the sector, in marine and tidal, for example. We meet every six to eight weeks at an operational level where we share information and plan strategy, twice a year at CEO level, and then once a year where we will look at forward planning and sign off with Ministers. That is how we co-ordinate across the sector.

Dr Wyatt: I could perhaps add to that by saying the co-ordination works on two levels, first considering which technology challenges the group are focusing on, in what areas, but also the mode of intervention, if you like, so the style of unlocking and breaking down those technology barriers. Those two things are what are discussed at the group meetings, and we make sure that our activity is co-ordinated accordingly.

Q77 Sir Robert Smith: In that co-ordination, though, given that so much of the potential renewable resource is in Scotland, do you have any links to the Scottish Government or Highlands and Islands Enterprise for co-ordinating?

Dr Wyatt: I can probably start on that one. At a Carbon Trust level, yes, absolutely. It is ingrained in EMEC in terms of a board member, but also we have officers in Scotland and a strong working relationship with both organisations. From our perspective, we are able to feed that into the group meetings to make sure we stay co-ordinated.

Rob Saunders: From a Technology Strategy Board point of view, we are working very closely with Scottish Enterprise on our marine portfolio at the moment and we are expecting to co-fund our future call in 2012 with Scottish Enterprise. At a working group level, it is very closely aligned, and even within the LCIG at working group level, they are involved. I think we are well aligned with Scotland at the moment.

Dr Clarke: Similarly, we work directly with most of the major Scottish groups, whether that is the technology providers, Scottish Enterprise, Department for Energy and Climate Change in Scotland and the test sign groups. On the whole, it is pretty well co-ordinated with them, albeit—at this stage, anyway—not directly through the LCIG explicitly.

Dr Green: DECC now has an actual specific resource to manage LCIG as the secretariat, and it is in discussion with the Scottish Government to bring them in as a full core member of LCIG.

Q78 Sir Robert Smith: On the Government's £200 million innovation budget, how do you feel about the way in which they have split it between the different low-carbon technologies? Do you think they have got it about right—anyone?

Rob Saunders: From our perspective, we see the marine energy industry at the moment as characterised by being one of great potential, but one of also quite high uncertainty at the moment—in particular, the uncertainty of the future cost of energy from wave and tidal devices—so we feel that it needs to be supported until we have better certainty about its future cost. We feel that it is a good part of the portfolio approach of the Government at the moment and, therefore, that it is right that it should be funded as part of the £200 million. When you look at the level, at the £20 million that has been proposed for this, verses the £30 million for offshore wind innovation, which will be a much bigger market. It is probably about the right level.

Dr Clarke: If we look at the modelling work we do at ETI, which is very rigorous—it has been very heavily peer-reviewed by international groups—if you look at what we see through that, looking out to 2050, we see the key challenges for the UK in the energy space across that whole spectrum of heat, power, transport and infrastructure, CCS, nuclear, bio-energy, energy efficiency. Those are your top four, and will explain why. Those are the things that have the greatest option value. That is, if we don't do them between now and 2050, those are the ones where there is the greatest cost increase as a consequence, because we have to do something else that is more expensive, and we are always searching for the lowest-cost solution.

After those four, if you have any challenge or any problem in delivering those four effectively, we see offshore wind as the next major item, and that is all about cost reduction, clearly. Just below that, you start to then find the marine renewables, the marine energy systems. I think that is absolutely right, what was just said from the Technology Strategy Board, which is, if you look in that context, where Government would be best placed to put innovation money is in those lower areas, where the technology needs to be developed and, to an extent, risk taken out before the commercial market would be prepared to look at it.

Dr Green: I think we are all in agreement on that.

Q79 Sir Robert Smith: On that ETI analysis, because it is less optimistic than some of the other witnesses we have had, what has driven that caution?

Dr Clarke: All the modelling work we do is searching for the lowest-cost design for a future UK energy system across our transport and infrastructure, and I stress that piece because the system integration—how does heat play out versus power generation? Can we use waste heat from power stations effectively, for instance?—is crucial. One reason why we may come out with a slightly different answer from some other views is because we are looking across the entire system, not just power, for a start.

The second piece is to say that we look very hard, as I have said, for the lowest-cost solution. In terms of looking out to 2050, you find two things drive your design options. One is time, in terms of development time for technology and the asset life of particular systems once they are deployed, whether that is offshore wind or marine or coal-fired power plant or whatever it is. Time is crucial. The other piece is risk, and all the work we do suggests very clearly that, on marine, unless we can demonstrate a pathway to reducing the cost quite aggressively, which means over the next five to eight years, then the chances are that the market is likely to start to build other technologies as alternatives, because they will feel more assurance in those and more opportunity for return. Basically, the message, as we see it, is that there is a five to eight year window to demonstrate the opportunity. We don't have to get right to the bottom but we need the opportunity to significantly reduce costs on marine, and if we can't in that period, the chances are the market will build other assets that will have very long lives—20 or 25 years—that will take us out towards 2050.

Q80 Sir Robert Smith: From the ETI perspective, if it is fall-back technology, should we be letting other countries develop it and import it rather than—

Dr Clarke: The question that I would raise—I think it is for the manufacturers and the technology developers probably to answer this question—is, where is the opportunity for development, and is another country going to develop it first in the timescale that we are talking about? We have some of the best resources in the world; we have got some of the best technology development companies already. If we don't do it here, will it get done somewhere

else? I don't know, but that is the question I would be asking the developers around the world.

Rob Saunders: From our perspective, coming from the point of view of the businesses, we completely agree with the ETI's analysis for the UK energy system, but there are opportunities for UK business outside of the UK energy system as well, and it may be that some countries won't be able to do CCS or choose not to do nuclear, and we will have wave and tidal resources that they will want to take advantage of in the future. There are opportunities for export if they can get the cost of energy down to a reasonable level where it becomes viable in an export market as well.

Sir Robert Smith: Given the sites we have, it is worth our trying to develop the technology here, because it is—

Rob Saunders: Yes, we have the sites, but we have the research and we have the capability in the UK at the moment, so it seems like we are best placed to make those cost of energy reductions that need to happen.

Dr Clarke: Can I comment very quickly on the point made earlier? You say our views are perhaps more conservative than some of the others. I would go back to what I said. If the industry can demonstrate significant cost reduction, and in the event that we have any problems in delivering at scale those other things of CCS, bio-energy and nuclear energy efficiency, we almost certainly will need marine in the UK.

Q81 Sir Robert Smith: Yes, so it is worth it. I have just one final thing. Given that tidal is very predictable, should that be the one that we are aiming at more than wave?

Dr Wyatt: We probably talked about it a little bit. If you consider the UK's resource, we have more wave than we do tidal. It is probably true to say that tidal is perhaps more certain than wave in terms of the technology situation at the moment, but as a longer-term play, wave has a lot going for it. Some of our work around cost reduction indicates that because of the global potential to roll out wave energy technology, it may well be that the cost for wave ultimately comes down to a level that is perhaps below tidal.

Sir Robert Smith: Thanks very much.

Q82 Christopher Pincher: Can I just pick up a point Dr Clarke made? You said that in order for marine to be truly marketable—let us put it in those terms—then costs need to be aggressively reduced over the next seven to eight years, but even if they are reduced, the Carbon Trust has done some analysis to suggest that tidal and wave technology will still be 3p to 6p per kWh more expensive than offshore wind, for example. Is that a significant difference, and do you anticipate that that extra cost is either going to be picked up by the companies in terms of reduced profits, or will it be passed on to the consumer, or do you expect the taxpayer will have to pick up that difference?

Dr Clarke: It depends on the time frame that you are on. If you are looking at the very long term, you can see the potential for tidal. As Stephen just said, with wave, partly because of the global market scale, you can see the potential for it to become cost competitive with other forms of generation by 2050. In the nearer term—2020 or 2030—I think those numbers feel about right, from my point of view, but clearly you would need some form of financial incentive to persuade the developers to invest at that level. You are talking about long-term sustained support to make that happen, but clearly at a reducing level through time.

Q83 Dr Lee: The 2020 target on sourcing 15% of energy from renewables is a bit soon for marine. Would adopting one for 2030 now help with technology development in marine?

Dr Wyatt: In terms of timing, it is obviously still very uncertain. We are still at the proving stage for the industry. We are still demonstrating an understanding of exactly what we can achieve in terms of power performance and cost reduction. Our analysis suggests that there is the potential to get wave and tidal energy by 2020 to the point that offshore wind is now—that is, the point where it is possible to deploy in large scale—so that is the ultimate position where we consider we can get to, and that will be around 2020, 2025.

Q84 Dr Lee: Again, if there were a more explicit target for marine energy deployment, would that help with market confidence and investment?

Dr Wyatt: If there were a specific target for marine renewables?

Dr Lee: Yes.

Dr Wyatt: Absolutely, yes.

Q85 Dr Lee: What should that target be?

Dr Wyatt: It is very hard to say at this stage. I would say that good targets are ones that are stretch targets and slightly above what the industry is likely to achieve, but I think any target would give certainty to the industry, which can only help the investment case for the industry.

Q86 Dr Lee: Are there any disadvantages for having these targets, do you think?

Rob Saunders: Maybe I could comment. We need to be slightly careful with targets, because the main aim of the first arrays we deploy are to learn rather than to deploy huge amounts. We need to make sure that we are deploying at a rate that is suitable for that learning, rather than trying to deploy too fast too soon. Maybe setting very ambitious targets now, before we have deployed a single array, can get in the way of our learning process. If you deploy a 100 MW array and you find a problem, you have a lot of things to fix in very difficult conditions. There is probably a staged targeting process where we make some learning targets and then some full deployment targets in a few years' time, once we have learnt a bit from our first array deployment.

Dr Clarke: I support that quite strongly because, at the end of the day, a target around level of deployment is one story. It is all about cost. Why is the market going to bother chasing that target if it can deploy something else that is cheaper and that it can get a

greater return on? From my point of view, you can have a deployment target, but ahead of that, taking a staged target view, I would be saying, "I want a cost target and I want to see it demonstrated." If you can hit that, then you can start to set deployment targets, if you wanted to, which would have a big incentive effect by having already demonstrated a path that is going to take you down a cost-effective deployment opportunity route.

Dr Lee: So ultimately it comes down to the technology paying?

Dr Clarke: Yes.

Q87 Dr Lee: That is what I have just said to the previous panel. Is there anything more we could be doing in this area? I am quite a big supporter of marine. I think it is something that Britain could lead on, and we have missed the boat with all the others, it seems. Is there anything more that you would say that we could be doing in order that, come 2030, say, marine energy is a viable technology for us to export from this country?

Dr Wyatt: I suppose the target point is that anything that gives clarity over the ultimate size of the market is important to inform investment decisions, and ultimately, if there is a recognition that there will be Government support in the longer term, and there is talk of a vision where significant proportions of the industry can be delivered, then that gives certainty around investment. I absolutely agree with the point that cost is key, of course, and this is not going to happen if the economics don't stack up.

Q88 Dr Lee: Okay. I have one final question, and this is the difficulty of coming in, the electoral cycles and the politics of this. I am getting a bit of grief, and I am sure others are, about the feed-in tariffs and reducing on solar. Personally, I don't want to make any more solar power billionaires in China, so I am quite happy to not be subsidising an industry that we don't make any money out of. Should we perhaps take a more strategic view and say, "Right, we are removing all the subsidies from everything, except that area where we may make money for UK plc over the next 20, 30 years"?

Dr Clarke: That is a fair point, and it is very important to look at the subsidy effect in the round—what is the total economic effect?—which we possibly haven't done previously. You are quite right in the sense that this is an opportunity for the UK, and taking the point that was raised about wave earlier, the market for wave in the big sense is probably outside the UK in terms of the resource availability, so there is a real export opportunity in this for UK engineering companies.

Dr Lee: So the answer is yes. We seem to be chasing targets on CO_2 emissions and things that we are not going to meet and, in a sort of a futile attempt to meet them, we are subsidising technology and industry that is based outside this country, so not only are we paying it twice over, we are not going to get anything in return, other than feeling good about ourselves every time we look at Bangladesh. I wonder whether strategically we would just be able to say, "Right, forget all of this. We are going to subsidise something that may give us an economic return," and you are saying, "Possibly, yes."

Dr Clarke: I am saying subsidise things that are going to give you the best overall economic return for the country, which has to include a manufacturing base and export opportunities from the UK.

Dr Lee: Good. Thanks.

Q89 John Robertson: Obviously everything depends on how much money you have got. We have had people who have given evidence to us, and they would like to see a co-ordination between DECC's £20 million innovation funding and the Scottish Government's recently announced £18 million. Do you think it is feasible, and if it is, how do you think it would work in practice?

Rob Saunders: I will kick off. I am certainly not entirely clear what the detail of the Scottish funding is, other than it is for marine arrays. As a concept, absolutely it will be great to join those funds up and to ensure that they are dealt with in some consistent manner in terms of the technologies or the companies that can access them. Clearly, Scotland will want to see some additionality to their funding over what would come from central Government anyway, but it would be a good thing to connect those up, yes.

Q90 John Robertson: Can I maybe add something? Maybe this will help. According to the notes I have here, it says that the £18 million from the Scottish Government was to support marine energy commercialisation, whereas the £20 million is for innovation. Is that different? It strikes me that commercialisation comes after innovation.

Dr Green: They will overlap in some way. They should complement each other, ideally. DECC is currently working with the UK Marine Energy Programme, its finance working group, and the Scottish sector is involved in that as well, so they are discussing both axes, the £18 million and the £20 million and how they complement each other, but as far as how that works in practice, that is still open for discussion.

Q91 John Robertson: So should we have a sort of English and Wales equivalent for the commercialisation part? Would that help?

Dr Wyatt: I think it is true to say that there are several challenges to get to the first array stage. Innovation challenges still need to be solved, so the £20 million that provides capital support to physically build an array out is one thing. There will be additional R and D and innovation that is required to make sure that you are in the position to do that, and so there is perhaps an argument to, I suppose, de-risk the £20 million DECC innovation money for first-array deployment up front. I can see there is some mileage in doing that.

Q92 John Robertson: Having thought about it a bit more, I am looking at the fact that one is innovating and they will do all the hard R and D work, and then the other one cashes in and takes them all up to Scotland. I don't have a problem with that, of course, but I would think there might be some workers in

some companies in England who might be a bit upset if, once something has been invented, it is developed somewhere else. We have had this problem, of course, as we have said already, where the idea starts here and it is taken up somewhere else, and other people make the money on it. Do we have a problem with that, that we really do have to look at our innovation, look at our development and keep it in house?

Rob Saunders: Given the stage of the industry, commercialisation inherently has to include innovation because, as Steve has said, deploying these first arrays will involve a huge amount of innovation and doing things for the first time. The DECC funding is at a very late innovation stage, so it is almost on the boundaries of innovation and commercialisation anyway, because it is a demonstration stage, so I suspect they are probably going to be compatible.

Q93 John Robertson: Should we set really strong criteria lines governing this money that we are giving out?

Rob Saunders: That is being done certainly on the DECC money by the Marine Energy Programme Board at the moment. It is working very closely with industry to set those criteria.

Q94 Sir Robert Smith: The Carbon Trust recommended that we maybe take the same approach as offshore wind in terms of trying to get collaborative research on reducing costs where there may be a common R and D. Do any of the organisations have plans to implement such a programme?

Dr Wyatt: I can perhaps discuss the thinking behind that suggestion, and that is that we look at the industry and it is reaching the stage where there are a number of utilities which are committed to developing the first generation of farms, if you like. They will have a number of common challenges and barriers. We also have to remember that we are at an earlier stage here, so the level of innovation in IP creation is going to be higher than for offshore wind, so that has to be managed, and that is often one of the barriers to collaborative working.

Sir Robert Smith: But you can still see an advantage in unique—

Dr Wyatt: Yes, I do, and I think there are two flavours of it. One is to get engineers, OEMs and technology developers collaborating around a common challenge, and the other one is to get utilities as the end market to collaborate and try to pull through solutions, and there is space for both of those things to happen in this industry right now.

Q95 Sir Robert Smith: Are any of you funding anything in that?

Rob Saunders: We are in the process of developing something that we hope will take the best elements of a true joint innovation programme and integrate that into one of our collaborative R and D competitions. As I think I mentioned earlier, we are working with Scottish Enterprise and the Research Councils to co-fund a competition that will, exactly as Steve mentioned, target the common challenges to first array deployment. We are just in the final stages of developing that at the moment. We have been working with a cross-industry group, including the utilities and the OEMs, to develop the themes or the challenges that we are trying to solve, and we want to make sure that we continue that collaborative working by making sure that there is regular dissemination events as the projects progress.

Dr Clarke: ETI is more focused on taking the outputs from some of those projects than integrating those into full system demonstration.

Q96 Sir Robert Smith: Another thing the Carbon Trust has come forward with is—I suppose it is fairly obvious—tidal, installation and the structure are where the greatest potential is for cost reductions, and for wave it is operation and maintenance. Is that something you all agree with?

Dr Wyatt: Just to elaborate on that a little bit, I think, with tidal, we understand the physics, so it is possible to predict to a certain degree what your energy generation is likely to be from a tidal device and, therefore, the challenge is more and more around cost reduction in the capital sense; that is, get that structure in at a lower cost and ultimately use less materials. For wave, we are still in the phase where we are truly trying to understand the interaction with waves and ultimately how much power we are going to generate, so for wave it is a question of operations and maintenance, but it is also one of control and making sure we improve our energy yield from our wave energy converters.

Dr Clarke: It may sound like a kind of fiddling detail, but in addition to those points, particularly around tidal but wave as well, all machines to date have been single devices in the water. They have been designed to be connected to the electricity grid with a single piece of wire, so point to point. We don't yet have a technology demonstrated for underwater integration of the electrical systems. At the moment, if we put out 30 devices in the water, they will be designed to have 30 wires going back to the shore. There is a piece about how we integrate those effectively from an electricity point of view, particularly given the cost of electricity infrastructure and so on at the moment. That is the other important cost piece for the future, but I agree, the installation piece is absolutely key at the moment. That is the next hurdle we are going to hit.

The offshore wind industry handled that by putting a surface-piercing platform in with a substation on it. Nobody is particularly worried about one extra platform in an offshore wind array, because there are potentially 100 turbines or whatever already piercing the surface. In this case, if everything is subsurface for tidal particularly, we may have a challenge about putting in a surface-piercing substation or whatever, so it most probably will have to be underwater. Again, that technology is just not quite ready at the cost this industry can afford. Oil and gas have it, but they pay a high price for it.

Q97 Chair: The Government is proposing to offer five ROCs now for wave and tidal energy, and that is based on a fairly cautious assessment of how much this is going to contribute. I have the impression that parts of the industry are much more optimistic about

the size of the contribution. If the industry turn out to be right and the Government are wrong—and perhaps not for the first time—is there a danger we get another situation as we did with solar recently, where take-up vastly exceeds expectations and, therefore, we can't afford to do this?

Rob Saunders: I suppose there is a possibility, but we are talking about a fairly short timescale in the life of the ROCs now. There are plenty of other barriers other than finance that will limit how much deployment gets done by 2016–17, so even if the industry is right, it might be right by a small amount. I don't think we see gigawatts of this stuff going in by 2016.

Dr Clarke: If you go back to my last comment, there are an awful lot of technological barriers still to be overcome and, while we may be able to get equipment in the water, there are then some other issues such as grid connection, onshore and planning concepts and environmental permitting and all these kind of things for sites, all of which take considerable time. Yes, there is a risk. Does it appear unacceptable? I would have thought not.

Dr Green: It is very unlikely that you will have a repeat of the solar.

Q98 Chair: Fine, okay. Looking ahead, as ROCs are going to be replaced by feed-in tariffs relatively soon, do you have any views about what the Government should decide for the level of support going beyond 2017?

Rob Saunders: I know there is lots of nervousness in the industry about what happens post-RO, so they are incredibly happy that they have five ROCs at the moment, but especially some of the big players, it is great to see some of the big OEMs getting involved in the sector like Rolls-Royce and Siemens, who are all kind of buying into device developers but I know that they are there for the 100 MW arrays, the gigawatt scale deployment, not for the first 5 MW. But at the moment, that is all they can see in terms of revenue support. Some continuity in terms of the view forward on revenue support would really help the industry to plan longer term. Without that, there is kind of a risk that we do the first arrays, but then there is a hiatus when everybody waits to see what happens with the contract for difference, feed-in tariff or whatever comes next. Some idea of what is going to come next I think is really important, even if it is an estimate of return rate, given a cost of energy of X or something along those lines, would help the industry.

Dr Wyatt: Just to add, while it is difficult to predict what costs are likely to be or indeed what rate of return will be proportionate to the risk that the developers are taking, building on Rob's point, clarity on how that will be determined now or in the near future would be helpful to the industry, if not being able to anchor a particular figure at this stage.

Q99 John Robertson: The Select Committee visited Orkney and had a look at the innovations that they are doing up there, and we noticed that TSB is currently in the process of establishing an Offshore Renewable Technology and Innovation Centre. Can you tell us a bit more detail about it and specifically how it will contribute towards wave and tidal technologies?

Rob Saunders: Yes. So the Offshore Renewable Energy Technology Innovation Centre was announced in May as the third Technology and Innovation Centre in a series of probably six initially—high-value manufacturing and cell therapies were the first two. Since then, we have been running an open competition for the leadership of that TIC and development of it into an operating entity, and we are coming to the end of that process now. We are expecting bids in at the end of this week, and we hope to announce the winner of that competition, the people that will lead that Technology and Innovation Centre, around the end of the year sometime and have the actual centre operating middle of next year.

The aim of Technology and Innovation Centres in general is to be a strategic long-term investment that will help generate growth in the UK by filling critical gaps in the innovative landscape. The idea is that they will stimulate innovation and growth, that they will anchor high-value development in the UK and that they will build bridges between our world-leading research and industry, and that means companies large and small in particular who are keen to grow. It will be a physical location bringing together the multiple capabilities of the UK. We hope that it will also have global reach and impact. It will interact with the other European centres operating in this area and it will be able to sell the UK research base and its broader capabilities on that front.

Specifically, the offshore renewable energy one we see as being a single front door for business to be able to access the best research, to be able to build a critical mass of activity in wave and tidal and offshore wind—so it covers offshore wind as well as wave and tidal—that companies should be able to access expertise on a systems level, but also a few very deep expertise areas.

Q100 John Robertson: This allows small companies to get involved that normally wouldn't be able to afford to. How does that work?

Rob Saunders: Yes. One thing that we will ensure is that SMEs have a route to access the best facilities and testing facilities around the country, so if you are an SME with a great potential tidal device, we hope the TIC will offer you support and access to some of the facilities that might be in the universities or in Orkney, for example, or at Narec or at Wave Hub, some of the great facilities that we have in the UK that can help to develop this.

Q101 John Robertson: The Government were talking about "parks" as in plural, so they see this as the start and they want to grow. Is there a danger that we may have an overlap in technologies and research that could have been, shall I say, better harnessed in one area rather than split into different parts?

Rob Saunders: Are you referring to the Marine Energy Parks?

John Robertson: Yes.

Rob Saunders: Yes. I think these are separate things. The Technology and Innovation Centre will be a national body. My understanding of the Marine Energy Parks is that these are more likely to be local clusters based in particular geographies—I know the

South West is leading the thinking on marine energy parks—and that these will be co-ordinating areas for local industry as well as research, potentially with better planning regulation or Enterprise Zone status. I don't know what the plans are for that, but that would be a good ambition for them, I think. We certainly see there being a lot of interaction between the TICs and Marine Energy Parks, but I don't think those are going to overlap in a very heavy way. We would see that the TIC could provide the Marine Energy Parks with access to the best research, which may not be in their geographical area.

Q102 John Robertson: But they will share, working on the theory that one park could have an invention of great magnitude that would help the other five?
Rob Saunders: Indeed.
John Robertson: Would that be shared among them or would the person that has developed it own it?
Rob Saunders: The person who develops it will own the IP. I am sure—
John Robertson: But are they committed to have to share it?
Rob Saunders: The Technology and Innovation Centre will, I am sure, be wanting to make sure that the best ideas are shared and are used and commercialised in the best possible way, and that may not be in that individual Marine Energy Park, should a number of these spring up. So yes, the information sharing will be a key role of the TIC.

Q103 Chair: It is quite common for new energy developments to attract local opposition. Have any of you encountered that and, if so, have you done any research on why the public have concerns about either tidal or wave energy?
Dr Green: The Research Councils have looked into this, and they have carried out some public understanding research on perceptions around marine energy. I think marine energy has the environmental issues associated with it, which DECC have looked at quite closely, and also, in the communities where things are based, they have tried to work alongside communities, looking at marine energy and where the first arrays have been, and deployed the first tests to look at the public acceptability in this area.

Q104 Chair: What are the outcomes of that? Are the attitudes similar to those towards wind turbines, for example?
Dr Green: I think that they found that the attitudes are more positive where the actual community feels it has buy-in and some stake in what is being undertaken. They are looking at developing some tests at the moment, some case studies in marine energy. Because of the amount of deployment has been so low to date, there has not been a wide opportunity to do this. In offshore wind, for example, they have had areas where communities have owned maybe a number of the wind turbines that have been deployed, and the public acceptability has been looked at there and it has been much better than where that has not taken place. NERC started an initiative in April that is going to look at that with marine as part of the Research Councils' Energy Programme, so that will be studied.

Q105 Chair: Looking at good practice, I believe the RCUK have mentioned the Islay Energy Trust as a good example.
Dr Green: Yes.
Chair: What were the lessons out of that, or indeed any others?
Dr Green: I think they feel the same way, as having community involvement is important, and that is the vital thing that has come forward from the Research Councils' Energy Programme studies in this area.
Chair: All right.

Q106 Sir Robert Smith: Where is it at in terms of the development? Everything has an impact on its environment where you put it. Where are we at with concerns about the kind of environmental impacts that tidal and wave could have?
Dr Green: There are two impacts. There are studies, for example, involving the Marine Animal Centre in Oban that are looking at the impacts that it has on the marine life, so that is one part of it, and then also for local communities for deploying the arrays and the associated infrastructure and how that impacts. It is really a two-pronged approach that is being looked at and is planned more widely.
Dr Clarke: If you look at certainly one of our major programmes on tidal turbine deployment, where we are putting a 1 MW machine up at EMEC in the Orkneys, then a major part of that project is a £15 million project, of which about £5 million is going purely into environmental assessment and environmental monitoring. We have been assessing the site for the last 18 months in terms of mammal life, water flows and so on and then, once the turbines go in, we will be carrying on that assessment for a period of up to two years. That project is very much about trying to acquire some of that local environmental data, including the effect on marine mammals and so on.
Then we are also looking at perhaps a more macro level, which is what, from a modelling point of view around the UK in terms of tidal flows, is likely to be the overall impact on flow of water right around the UK and the west coast in particular if we put in very large quantities of tidal developments? It is not insignificant. The north coast of Scotland is not too dramatic, but you can imagine the Irish Sea, where you have got relatively constrained in and out, could be slightly more important. Yes, it is fair to say there is quite a lot of work going into this at the moment, but from my point of view, we are focusing on what I would call the technological end of environmental performance and environmental assessment. The public acceptability piece is exactly as has been said. In local communities, with community engagement, it tends to be very strongly supported, on the whole, from what we see certainly.
Dr Green: There is a lot of work going on with the fisheries sector as well, because they have concerns about the impact that marine will have on the fishing grounds around the coastline, so there is work going

on with them on public acceptability and the actual impact that that will have in the marine habitat.

Dr Wyatt: It is probably worth saying that the type of macro effect that David was saying was referring to where we start to influence the nature of the tide is related to very, very large levels of deployment, so it is not a problem that we are staring down the barrel of, as it were, and it is something that can be understood and managed. It is not a showstopper in that sense.

Sir Robert Smith: It is not a problem we aspire to.

Dr Wyatt: Indeed.

Dr Clarke: It would be another problem to have to handle seriously, but we are getting the tools ready in case the industry can go that fast.

Dr Wyatt: On the environmental point, the industry has adopted an approach to deploy and monitor, and it has been very mature in its approach to that. The first device has gone in the water. The MCT device in Strangford Lough has been a case study in many examples where very, very rigorous environmental monitoring has been undertaken and that data has been disseminated.

Q107 Christopher Pincher: The Technology and Innovation Centre concept clearly provides an excellent opportunity to provide a centre of excellence, but that can only surely be successful if you have the right engineers, scientists and technologists to fill the roles in those centres and in the marine parks you described. Some respondents in this inquiry have said that there is a skills gap in the UK with respect to marine technology. Do you think that is the case, and if you do, what do you think are the specific gap areas?

Dr Green: That is something that we have recently recognised. The Research Councils funded a number of doctoral training centres that will train scientists and engineers across the energy sector, and one of the areas that we hadn't managed to fund was in marine energy, so recently we have established an industrial doctorate centre working with ETI, which will provide quite a large number of doctorally trained students in the future.

Q108 Christopher Pincher: So that is in higher education?

Dr Green: That is in higher education.

Q109 Christopher Pincher: What about in further education? In further education, EMEC has suggested that there is a gap in the further education set of skills.

Dr Green: That is probably a consequence of stem subjects being unpopular in schools and people then not going on to take up science-based degrees, so I don't think that is specific just to marine energy. If people train as engineers at university or in further education take science subjects, they can then move on to be trained at a Masters or Doctoral level in the courses that are applicable to working in wave and tidal.

Q110 Christopher Pincher: In terms of the elapsed time to build these skills and have these PhD-grade doctors ready versus the aggressive timescale that you need to drive down costs and build this industry, is there a mismatch there? Do you think we are going to have to import people?

Dr Green: I don't think we are going to have to import people, but I think there are already examples of people, for example, that have been trained in oil and gas that are using their transferrable skills to move and work in marine. A lot of people have trained in oil and gas through Cranfield University in the past, and a number of those are now moving to work with industry on these early-stage deployments. I think we have the skills within the UK at the moment where they can transfer across and then, through the new doctoral training, we will have people for the future.

Q111 Christopher Pincher: Is there sufficient encouragement to transfer those skills from oil and gas into marine, do you think, enough to make it attractive?

Dr Green: Yes, there are, and it is certainly something that the Research Councils would encourage and provide funding for if it was required for people. We call it discipline hopping, so retraining in certain areas. We would support that.

Dr Clarke: I would say there is real evidence that it is starting. Let's put it that way. It is interesting, if you look at what is happening up at EMEC, for instance, in terms of device development and device testing up there. Three years ago, there wouldn't have been a great degree of oil and gas skills involvement. It was mostly what I would call local guys in local boats, whereas we are now seeing, because of the scale of activity up there and the sophistication of what people are trying to do and in terms of trying to drive costs down, people using much more sophisticated vessels, some of which are coming in from the oil and gas industry, that the oil and gas guys are having to meet them halfway in terms of the technology and the cost, which has been to reskill their people to operate in a slightly different way. Certainly, I would say, on an average month on Orkney, you see it happening, yes.

Q112 Christopher Pincher: This just passed through my mind. It may be wholly off-beam, but given that shale gas has become a much more interesting concept of late, does shale present another alternative and attractive opportunity for those individuals in oil and gas, and that may discourage them from moving into the marine renewable field?

Dr Clarke: If you are looking over the next 10 to 15 years, we need a lot of engineers. Let us just put it that way. Part of what we try to do is to train as many as we can through our projects, as well as through things like the Industrial Doctorate Centre. Will there be competition for these guys? Yes, there will, and it will be a global competition. It won't just be a UK competition. We have to fight to get these guys in.

Q113 Christopher Pincher: So I am in the wrong job?

Dr Clarke: Depends what your background is.

Dr Green: It is definitely an area to move into and, certainly in wave and tidal, the UK research base is world-leading. We had an international review of the whole energy programme and it came out as being

world-leading, so the research is there to train the people and to get out and deploy marine and tidal and to get a UK lead in that area. There is the potential there.

Rob Saunders: With the key skills of offshore engineering, essentially I think the UK is second to none, and it is often said that we know our seabed better than any country in the world. Yes, it is a matter of trying to transfer some of those skills into the marine energy industry, and there are challenges to it, largely in the kind of cost structures and cost of oil and gas versus marine energy at the moment, but as David said, it is starting to happen and we are seeing it happen.

Dr Clarke: There is maybe an anecdotal-type comment though, just to say, from the point of view of exciting young people to go into this industry, if you want an engineering challenge, if you can convey this to people, this is about as difficult as it gets. It might not look it, but purely from an engineering and science point of view, this is pretty much it. If you can do this, you can crack virtually anything, because it is a combination of difficult materials and a difficult environment. It is quite literally a hostile and dangerous environment. If you can engineer a system that will go into there and operate reliably at low cost and so on, this is pretty difficult to put in the hardware. If you want an exciting challenge for young engineers, this is good.

Dr Wyatt: If you also look at the profile of deployment for offshore wind and think about the skills that are going to be required to meet that deployment level and then look at when the deployment for wave and tidal is likely to happen, you begin to see that a lot of the skills that will be needed at the peak time for insulation and fabrication around offshore wind could be redeployed as well as that peak comes down, because it has met with another one from wave and tidal.

Q114 Chair: Just finally, on the TSB idea about having a roadmap to show how the costs are going to fall, are there specifics in mind already for how those cost reduction targets could be set up?

Rob Saunders: Acknowledging the cost of energy is the critical thing, and across all the public funders it is the critical thing, irrespective of our overall aims. There are already roadmaps developed. I see David is holding one in his hand. The ETI and UKERC developed a marine energy roadmap earlier last year that sets out against deployment what the cost of energy might be or perhaps some targets that we should aim at. I know that the technology and innovation needs assessment—that has been done by the Carbon Trust—has a similar kind of cost reduction curve against time, which ends up at pretty much the same place. There are two examples of cost-of-energy road maps that we could use to track our progress as the marine energy sector evolves. The point I was trying to make was that we perhaps ought to do that a little bit more formally so that we know what progress we have made in five or 10 years' time and we are not sitting here again asking the same questions as to whether we should be funding it into the next 30 years, and we can demonstrate the progress that we have made against cost of energy.

Q115 Chair: Those are public documents, are they?

Dr Clarke: The ETI UKERC roadmap is a public document, published October 2010 last year.

Rob Saunders: The technology and innovation needs assessment has yet to be published, but should be published shortly.

Q116 Chair: Would you like to let us to have sight of that? We will not publish our report for a little while yet.

Rob Saunders: Yes. It is not my document to give, but I am sure that the LCIG can give you a summary of that.

Chair: If it is restricted, you can let us know, but it would be useful for us to have sight of it. Okay, thank you very much for coming in. That has been a useful session. Thank you.

Tuesday 13 December 2011

Members present:

Mr Tim Yeo (Chair)

Dan Byles	Christopher Pincher
Ian Lavery	Sir Robert Smith
Dr Phillip Lee	Dr Alan Whitehead
Albert Owen	

Examination of Witnesses

Witnesses: **Hannah Nixon**, Ofgem, **Stuart Cook**, Ofgem, **Harry Huyton**, RSPB, and **John Callaghan**, The Crown Estate, gave evidence.

Q117 Chair: Good morning. Thank you for arriving early, enabling us to start a few minutes ahead of time. As you represent rather different organisations, some of the questions will clearly be directed at individuals, or at least individual organisations, and others may be more general, but do feel free to respond to any of the things that we raise, any of you. We know who you are, so we do not need to have any formal introductions.
Could I kick off with the issue of grid charges, which the industry have said are one of the biggest barriers to the development of marine energy in the UK, and ask Ofgem to what extent you are considering wave and tidal energy in your review of transmission charges?
Hannah Nixon: We kicked off Project TransmiT about a year ago. We started with a call for evidence, and that call for evidence highlighted two issues that marine generators are particularly concerned about. One was connections and one was charging, and in fact they highlighted both as equally important. On the charging side, we have in place a regime that was very much designed for a generation mix where we had relatively few generators and those were mainly large-scale. That is clearly not the generation mix we have today, so TransmiT is about standing back and saying, "Do we need to update that methodology to take into account the new realities of the generation mix?" Throughout that review, we have explicitly incorporated consideration of both wave and tidal generation and they are fully incorporated in our modelling.

Q118 Chair: You are going to make a recommendation early next year?
Hannah Nixon: We are planning on putting a consultation document out before Christmas, consulting on the options for the way forward and then concluding in the early spring next year.

Q119 Chair: How do you balance up the different factors when you are trying to reach these sorts of conclusions? Obviously, there is a question about consumer prices; there is progress towards low emissions, and general economic effects. Do you have a method of assessing the importance to attach to each of those?
Hannah Nixon: Yes, we do. It is a good question. We are committed at Ofgem to facilitating the achievement of the environmental goals in terms of low carbon and renewables, and in doing so making sure that we maintain safe and reliable services for consumers and ensure value for money to consumers today and in the future. What we are doing in TransmiT is we have a detailed model of the different generators; it is a half-hourly model that goes out 20 years. We then assess how individual generators would respond to different charging regimes. All the models are calibrated to give the same level of renewable and low carbon output, so we can compare them directly, and we assess the total cost of delivery, delivering the low carbon economy under each model. We also assess what that would mean for security of supply as well.
Stuart Cook: I think it is worth adding that the process that has been run is a very open and inclusive one. There have been a lot of stakeholder meetings and all participants have had a chance to comment on the results.

Q120 Chair: Could you share with us some of the ways in which that modelling works? Is it possible to do that?
Hannah Nixon: Yes. We are looking at two key alternatives to the existing charging regime. One is a socialised or a postalised approach, whereby all generators would pay exactly the same charge regardless of where they are located in the system. The other alternative is looking to improve the cost reflective nature of the regime. By "cost reflective", we do not just mean taking into account location; we also mean taking into account network technology and the type of generator. Those are the two broad alternatives. What the model does is see how generators would respond to those different transmission charge signals; it then looks at how generators would come on to and off the system by type of generator in each region and what that would imply for the renewables target, the low carbon target, and total cost to consumers and security of supply.

Q121 Chair: Have you made an assumption about what the likely capacity for the wave and tidal energy sector will be in the UK?
Hannah Nixon: Yes, we have. We have used the information that has been published by DECC and the industry, and also the input that our stakeholders have provided to us in our technical working group. We have assumptions for the capital costs, which are based on publicly available information. We have

assumptions on the maximum build rate per year and also on learning rates.

Q122 Sir Robert Smith: Currently, new connections to the grid require the user to underwrite the cost of that new grid connection, but you are consulting on changes to the user commitment arrangements. Could you outline what those changes might be?
Hannah Nixon: Yes. As I mentioned at the beginning, one of the key issues that marine generators mentioned was the amount of security they have to post against new connection assets. We have encouraged National Grid to lead some work with the industry on assessing what the appropriate level of security is for generators, particularly small generators, to post against new connection assets. They have recently tabled a proposal—it came into us at the end of November and we are assessing it now—that we take a risk-based approach to the amount of security that needs to be posted. That would significantly reduce the amount of security that small generators in particular would need to post.
The proposal is that, pre-consenting, the generator would post around 40% of the existing liability; post-consenting that would drop to 10%. That would result in a huge reduction in the amount that the small generators need to post. We need to go away and assess that and make sure it provides the appropriate balance between the need to get renewables on to the system and the need to protect consumers against bearing the cost of stranded assets.

Q123 Sir Robert Smith: You are also consulting on the possibility of wider works being borne jointly by the generator and the consumer?
Hannah Nixon: There are two aspects to TransmiT. One is about connection arrangements and how much the generator has to securitize up front, which is the industry process I just outlined. The other question is to what extent wider works are socialised across all generators and consumers, which has been picked up through our charging arrangements. One of the models that we are looking at there is a fully socialised approach where all generators would pay the same charge.

Q124 Sir Robert Smith: Would there be any consideration of the local works being also socialised because of the security of supply benefits of marine versus more intermittent generating?
Hannah Nixon: We have looked at that model and it is one of the models that we are actively considering, yes.

Q125 Sir Robert Smith: Even for the local works?
Hannah Nixon: Even for the local works, yes.

Q126 Sir Robert Smith: When do you think there will be an answer on that?
Hannah Nixon: As I mentioned, we intend to consult on the way forward on charging before Christmas, and then to firm up the direction of travel in early spring.

Q127 Sir Robert Smith: Have there been any examples where the Government have underwritten transmission costs?
Stuart Cook: I am not aware of any specifically, no.

Q128 Sir Robert Smith: Finally, Scottish and Southern Energy Power Distribution has launched a consultation on building a new connection between Orkney and the mainland. Is this likely to be affected by the changes or will it be under the current system?
Hannah Nixon: The purpose of the Orkney proposals is to make sure that the network does not stand in the way to new renewables connecting in Orkney. That is a two-phase approach, as I understand it. Will it be impacted by the charges? To the extent that any change in the regime means that there is less security required by generators and/or it reduces charges to generators on Orkney, then we would expect that generation to come forward more rapidly, and therefore it would be easier to make a near-term case for that link.

Q129 Albert Owen: Still with Ofgem on grid connections, it seems that the wave and tidal energy companies are likely to have a double whammy in that they have high admission charges and commitments to liabilities. To what extent have you considered this?
Hannah Nixon: This is absolutely at the heart of Project TransmiT. Under the proposals that National Grid have tabled on user commitments, marine generators and all small generators would benefit significantly if we were to approve those. On the charging side, at the moment the regime does not take into account the variable nature of some generators, including marine. Both of the alternatives we are looking at would take into account the variable nature of those types of technology. If we were to go down that route, that would benefit generators in Scotland and the north of England, but we would actually see higher charges for generators in the south.
Stuart Cook: It is precisely because of those types of challenges that we launched Project TransmiT as an attempt to understand and drive that forward.

Q130 Albert Owen: With TransmiT, obviously, it is spring you intend to bring this out. Have you heard concerns from potential generators that this is an issue? Are you looking at that specifically?
Hannah Nixon: Yes. It was directly in response to concerns raised by generators that we launched TransmiT a year ago. As soon as we got the powers to launch code reviews ourselves we launched Project TransmiT. We then went out straightaway with a call for evidence and, as I mentioned, people came back with concerns both on the connection side and the charging side, and that is true of the marine generators in particular.

Q131 Ian Lavery: Mr Huyton, the RSPB have been particularly critical of the way in which the offshore Strategic Environmental Assessment was carried out in both England and Wales. This has now been completed. In your view, are there any outstanding problems? If there are, can they be rectified, or do you

believe that things have gone too far—it is a little bit too late?

Harry Huyton: Thank you. Our criticisms of the SEA process in England and Wales were that it was not spatially defined, unlike the parallel SEA in Scotland. It was so broad and shallow that it did not provide the direction for the industry in terms of where these technologies would be most appropriate spatially. As you say, the SEA is done. What do we do next? Our view is that we need a push behind survey, deploy and monitor around the UK waters: i.e. we need to invest in bird and marine mammals sites in those areas where wave and tidal are most likely to be deployed, so that in the future we are in a position to be able to filter out those most sensitive sites and ensure that they are deployed in the most appropriate area from the outset.

Q132 Ian Lavery: In relation to the environmental monitoring, there are basically two hugely different approaches being taken by different marine planning authorities. One is a deploy and monitor approach and the other one is a precautionary approach. What are your views on those two?

Harry Huyton: I am probably not going to surprise you by saying there is probably a middle way to this. If you were asking me that question in a perfect world where we already had a thorough understanding of marine biodiversity in our waters, then we would be feeling a lot more relaxed about deploy and monitor because you would be able to filter out all the most sensitive sites; but, given that we have an imperfect and partial understanding of where wildlife is in the seas, I do not think deploy and monitor is appropriate for now. That is why we are talking about survey, then deploy and monitor, so that you can filter out those sites.

There are instances where deploy and monitor might be appropriate. To give an example, in the Sound of Islay where ScottishPower Renewables have been awarded their lease for a tidal stream array, and that is effectively a deploy and monitor approach, we welcomed that because there is good baseline data for that area and we know that that area does not have areas of significant biodiversity interest. For now, because we have imperfect knowledge of biodiversity, deploy and monitor is not appropriate as a general rule, but it might be in certain instances.

Q133 Ian Lavery: Mr Callaghan, the Crown Estate is planning a second marine energy leasing round in Northern Ireland. I am wondering why this new area, and why there was not a continuation of the approach in Orkney.

John Callaghan: We look at the resources the UK has in wave and tidal energy all around the UK. In Northern Ireland we see potential for perhaps 200 MW to 300 MW of tidal developments. Over the last couple of years we have been working very closely with the Department of Enterprise, Trade and Investment in Northern Ireland to understand those resources. DETI itself has done a Strategic Environmental Assessment and provided regional location guidance, and we see the logical next step as offering leases in and around Northern Irish waters. We are also going to do that for offshore wind as well as tidal.

Q134 Ian Lavery: At what point will the Crown Estate consider further leasing in and around Orkney? Will that happen?

John Callaghan: Yes, we think it will happen. We are certainly conscious that there is a high degree of local interest in further development around Orkney. It is fair to say that for the time being the industry is also interested in other areas. Since we concluded the Pentland Firth leasing round, if anything, the industry has been interested in sites off the Western Isles and off Shetland and we have leased about a dozen sites in other places.

We need to be conscious of two risk factors with regard to further leasing in the Pentland Firth area. One is potential risks to the existing 11 projects: we do not want progress in development of those projects to be delayed. Due to the current state of the science, around resource effects and cumulative environmental impacts, that is something to bear in mind. The second thing is we want to avoid precluding large-scale commercial development in future. The Pentland Firth area has some of the best resources in the UK. We think it is important that the industry is able to develop those at real scale when it is ready to do so.

Q135 Ian Lavery: Do you have plans for leasing rounds in England and Wales?

John Callaghan: We are doing some work at the moment to work out key resource areas, strategic areas, all around the UK that have potential for large-scale development in future. Informed by that, we are planning to run a consultation with the industry next year to ask developers where they would like to see developments going forward and that will influence our leasing approach.

Q136 Albert Owen: On that point, I am not sure of the role of the Crown Estate. You say developers approach you, but have you done an independent mapping exercise where you think the potential is?

John Callaghan: Both, actually. Developers do approach us very frequently to express their interest in sites in various places. We are doing a study at the moment to try to understand better where are the best locations all around UK waters for large-scale wave and tidal project development. We will be publishing that next March.

Q137 Albert Owen: As the Crown Estate, basically your priority is to gather money in, isn't it? How do you work with developers and how do you decide which area has the best potential?

John Callaghan: I suppose there are two things we do. We do lease sites and, under the Crown Estate Act, we are obliged to take a commercial interest when we do that leasing. We also actively support development, so we make investments to try to accelerate and de-risk the development process. I suppose we are receptive to industry views where developers see the best sites and the best chances for development. Currently, we also work very closely with DECC and the devolved Administrations, understanding their

interests, for example, in relation to economic development. Of course the Scottish Government sees a lot of potential in economic development through development of the wave and tidal industry.

Q138 Chair: Just for clarification, to whom do you feel most accountable? Is it the Treasury? Is it DECC? Is it the devolved Administrations? When you are sitting there working out what to do next, who do you think is going to be the person who takes the most close interest in you?
John Callaghan: I guess we have to balance a range of interests on the side of both Government and the industry and other stakeholders, such as the RSPB. As I say, we are very receptive to what the industry wants to do. We work very much with the Government in understanding national policies to develop renewables, but also with local interests around economic development and other areas, so essentially we have to balance a set of interests

Q139 Chair: Which Minister could call you into account if you did not do it right?
John Callaghan: I guess we work most closely with DECC in relation to energy policy as it affects renewables, and wave and tidal in particular, so Greg Barker.

Q140 Dr Whitehead: Can we turn to the suggestion that there should be a further marine wildlife survey? Mr Huyton, you suggested that. What are the particular things that you would want to look for in that, over and above what has already happened in the Strategic Environmental Assessments and the Environmental Impact Assessments that already go into the consent process? Are there new areas that you consider are not researched and, if so, what are they?
Harry Huyton: From our perspective, the key criterion to getting these schemes in the right place is avoiding areas at sea that are important for vulnerable sea birds and vulnerable marine mammals. At the moment our data for those species—for birds—is largely based on a survey that was conducted and funded by the oil and gas industry throughout the 1980s and 1990s, but it was only of certain parts of our waters. For example, it was done from ferries and you can see we have very good data from some ferry lines but beyond that nothing. There are large data gaps that need to be filled and, effectively, those data gaps are baseline monitoring of those species that are vulnerable to wave and tidal power—as well as other marine developments; this is of interest to all energy operations in our seas—so that we can fill that baseline data and direct development into the right places.

Q141 Dr Whitehead: Essentially you are saying that the information we have is, first, area specific, and secondly, not in depth in terms of understanding marine interactions. Is that right?
Harry Huyton: That is absolutely correct, yes. In an ideal world we would have a co-ordinated partnership with industry, Government and other interested bodies to get the full baseline data that we need, but it takes time to deliver that. There are examples of a more strategic approach. My colleague here from the Crown Estate was talking about Pentland Firth and Orkney waters. Marine Scotland are doing aerial surveys of those waters at the moment to identify and filter out the most sensitive parts of those waters, which I think is a good approach that we could easily replicate, i.e. focus on those areas of most strategic importance to the industry and make sure we get the baseline data.

Q142 Dr Whitehead: I presume there is a difference between saying certain areas are less sensitive than others and saying, "We don't know too much about how the whole thing works, so we need to do a first principles study of whether there are unacceptable effects on marine mammals in general from noise, vibration and so on." Which way do you tend to go on this suggestion?
Harry Huyton: There are two issues here. One is your baseline data, which is what I have been talking about today; That is about directing developments into the right place. The other is understanding how wave and tidal schemes interact with marine wildlife. For that, the critical way of improving our understanding is making sure that all the developers set up monitoring—so we are talking about survey, deploy and monitor—to look at interaction with the marine wildlife and their turbines. The key challenge is getting that data into the public arena. If you look at what has happened with offshore wind, although we have had monitoring for a lot of the round 1 and round 2 sites, and Cefas recently published a review of what that tells us, little data has been made public, and it was not harmonised so the data was incompatible and we know very little about how that interacts with wildlife. All of that monitoring has not furthered our understanding of this industry. That means that we can't relax, which is what we would like to do. We would like to know that certain species are not affected by offshore wind in this particular example and we can therefore relax about their interaction in future developments. That is where we would like to be with tidal and wave, but for that to happen the monitoring has to be made public and it has to happen. Again, there were instances with round 1 and round 2 where the monitoring that was part of the licence did not actually happen. That will be the challenge for this industry and how we overcome it. There is a potential model for collaborative research called COWRIE from round 1 and 2 offshore wind. It stumbled because of commercial confidentiality of data, but that kind of partnership and the kind of common requirements on licensing for wave and tidal so that monitoring is compatible might be able to make sure that in five years' time we understand how these things interact with wildlife.

Q143 Dr Whitehead: Who would be responsible for this?
Harry Huyton: The monitoring requirements are put on the licences issued by the MMO in England and Marine Scotland in Scotland.
John Callaghan: May I add to that point just briefly? The Crown Estate is working with DECC to create a data and knowledge exchange network, including for

environmental data, to encourage sharing and support research into environmental effects.

Q144 Dr Whitehead: What would this cost and over what period? Who would foot the bill for the sort of survey you are suggesting and what would the bill be?
Harry Huyton: There are a number of different things. First of all, some of this monitoring already happens and the first challenge is making sure it goes into the public arena. That is free. The bigger baseline surveys do, of course, have costs. I am not in a position to give you a quote, but JNCC, Marine Scotland and MMO should be able to give that data.

Q145 Dr Whitehead: Are you making the assumption that this is for waters other than marine conservation zones, or are you suggesting that, in principle, marine conservation zones would fit in with development of wave and tidal energy, subject to this sort of survey?
Harry Huyton: Marine conservation zones need to happen to give further certainty and spatial guidance for the industry, but in themselves they will not lead to the kind of monitoring we are talking about.

Q146 Sir Robert Smith: Can I just ask how it compares with the data sharing for the oil and gas industry in terms of the public availability of the data that they acquire?
Harry Huyton: That is quite interesting. We might be able to come back with an answer on that. I would have to consult colleagues who are involved in the oil and gas sectors.

Q147 Sir Robert Smith: I just wonder if there are any lessons learnt, because obviously there has been huge activity out there where data has been gathered and has been shared.
Harry Huyton: Absolutely. I think the one big strategic survey that we did have, which was called the *European Seabirds at Sea* survey that was done annually by the JNCC—it is the one I have referred to—does have big data gaps, but it was done for the oil and gas industry effectively and it was paid for by the oil and gas industry. That does at least give us an example of what can be done, and it helped the whole industry because it was pooling resource and information.

Q148 Dr Lee: Allow me just to broaden out to the RSPB's view of energy in general. What is the RSPB's position on the Severn Bore projects that have been proposed?
Harry Huyton: The Severn tidal power?
Dr Lee: Yes, harnessing the Severn Bore, what is the RSPB's position on it?
Harry Huyton: Sorry, it is the Severn power or the Severn tidal power?
Dr Lee: The Severn tidal power, the Severn Bore, harnessing it: what is the RSPB's position on that?
Harry Huyton: We are supportive in principle of a tidal power scheme in the Severn if it can be done within existing environmental legislation. We are aware that there is currently interest from a private developer on the Severn, and we are already working with them closely on what they need to do if they are going to overcome the environmental challenges in the Severn. Of course, some of the initial proposals did have hugely detrimental impacts. We think they could be managed and reduced—we hope they can be—and we are working with others on that.

Q149 Dr Lee: In making that judgment, does the RSPB have a view on the ideal energy generation form, and if not, why not?
Harry Huyton: We are supportive of all renewable energy technologies where they can be deployed within the environmental legislation that we have.
Dr Lee: That is not my question.
Harry Huyton: We are not going to pick a favoured, I mean—

Q150 Dr Lee: Why not?
Harry Huyton: Because we know that we need all of the renewable energy technologies that we have available to deliver to their maximum sustainable potential. We know that we need wave, we know that we need tidal, we know that we need on and offshore wind, and that is why we support all those technologies. I do not think it would make sense for me to back one of those over another.
Dr Lee: Yes, but if you are coming out against something, it is easy to be against; it is very difficult to be for.
Harry Huyton: We frequently come out for—

Q151 Dr Lee: In view of the fact that electricity demand in this country is going to go up quite significantly in the next few decades, and the RSPB is undeniably a powerful force in terms of lobbying with the size of its membership, it would be nice, if you were against the Severn Bore development because of the environmental impact, that you could come up with an idea of how we would switch on the lights.
Harry Huyton: We have publicly supported onshore wind. We have publicly supported a number of offshore wind proposals, including the Thames Array, for example. As I said, we have publicly supported some of the most recent tidal stream applications on the Severn. We have spent our own money helping to develop alternative technologies that could be deployed. During the Severn tidal power feasibility project we commissioned one of the engineering consultancies to look at the tidal reef, for example, and how that might be deployed in the Severn. I absolutely agree that, as an NGO that is objecting to some technologies, we have to be taking a positive position on others. I hope that we are doing that and—

Q152 Dr Lee: Is there an acceptance within the RSPB that there is going to have to be compromise at some point if we are to mitigate CO_2 emissions? It strikes me that offshore wind is going to cause problems, but by the same token if we allow our carbon emissions to go up you are going to get climate change that is going to change migration patterns, there will be species that will not withstand that changing climate, et cetera. Whichever way we turn, there is going to be an impact upon bird life. I am

suggesting that it might be—I don't know—that we have to suck it up in the Severn, so to speak, in order to mitigate damage elsewhere.

Harry Huyton: I hope that we can exploit the Severn but in a sustainable way. The lens that we look at all of this through is absolutely—as you suggest—that climate change is the biggest long-term threat to wildlife. That is why we absolutely have to deliver on renewables. I think we are taking compromises across the line. We publicly supported these, and do not forget we have taken an awful lot of stick from our own constituency for doing that. We have lost a lot of members for doing that. It is tough; we are walking a really hard line here. What I would say at the moment is we do not think it is a simple trade-off. We do not think it is, "Meet your renewables target but don't meet your biodiversity target." We think you can do both, and that is the aim of the contribution we have tried to give this Committee on marine renewables and on other energy policy.

Q153 Chair: One of the factors in reaching renewables targets is the availability of incentives to address the fact that some of them are much less economic than others. Given there is now a lot of interest in the fact that the amount of money available for FITs is capped, it sounds a tiny bit of a cop-out to say the RSPB supports all these because in the end there is a limited amount of resource available for incentives. Some of them are clearly much more expensive than others. Are you going to reach a conclusion at some point, do you think, organisationally, that in order to get to the renewables target we have to focus on some of the ones that may offer better value than others?

Harry Huyton: Yes, but we interpret value as cost to the consumer as well as environmental impact, which of course has a cost to the overall country. A few weeks ago we did publish, along with our European partners, a review entitled *In Harmony with Nature* of how we believe we can meet the 2020 targets in Europe. That includes a risk assessment of each technology and their potential impacts for wildlife, and categorises technologies into high, medium and low risk in terms of their environmental impact.

Of course, we would advocate lower-risk technologies receiving greater support. We have always said that we think the renewables obligation and feed-in tariffs should be banded so that they reflect sustainability. I think that is as far as we can go on that, but if others believe that it would be more useful for an organisation like ourselves to take a stronger line on which technologies should and should not receive support, I think that is something we should probably consider.

Q154 Christopher Pincher: Mr Callaghan, it is clear from what you said that the Crown Estate is very keen to develop areas like the Pentland Firth and the Orkney waters. You said that you deal with developers and you ask them which are good sites, and you also talk to DECC and you talk to the Scottish Executive. What you did not say was whether you talk with local communities. Of course, their engagement is very important to obtain buy-in or to identify the concerns that they have. I wonder if you could tell us what sort of community engagement you would normally undertake.

John Callaghan: Yes, certainly. To look at the Pentland Firth first, just a couple of weeks ago, and also this time last year, we ran a series of public events, inviting the public to come along and find out about the projects being developed, and to meet some of our team and other public bodies that are supporting development and, of course, the developers that are leading the projects. We had about 700 people come to events over four days last year. This year we ran a couple of evening talks. We had about 100 people come to those events in Thurso and Kirkwall to get an update on progress. We are very keen to hear local views, to facilitate a discussion between local stakeholders and folks who are representing organisations such as RSPB locally, but also members of the public as well.

We are conscious of two issues in particular that are coming to the surface with the Pentland Firth projects. One relates to impact on fisheries, so we are trying to facilitate a discussion with local fisheries groups and the local fisheries industry; and secondly, visual impact. We are aware that some parties in Orkney have concerns, particularly about the west coast of Orkney mainland and how projects may affect views from that coastline. We are keen to engage with local communities to understand those concerns and to also encourage developers to work with local stakeholders.

Q155 Christopher Pincher: When the Committee went up to Orkney earlier this year they heard from representatives of the local council group suggesting that there had been no engagement at all, so there is clearly a disconnect between some people who say they hear nothing from the Crown Estate and your saying that you engage with local people—hundreds of people turn up to the public events that you organise and learn about your proposals. Why do you think there is that disconnect?

John Callaghan: We probably could have done more before and during the leasing round competition. To a certain extent we were limited, due to competition law considerations. For example, we could not disclose parties involved in the leasing round or the sites they were looking at because that was a commercial competition. Certainly since completion of the leasing round, we have been very active in trying to work with local stakeholders and get that—

Q156 Christopher Pincher: But that is after the fact, isn't it, rather than before and during?

John Callaghan: Yes, and I would accept that there is probably more that we could have done before and during.

Q157 Christopher Pincher: Given you accept there was more you could do and you are undertaking the same sort of leasing round in Northern Ireland, what more do you plan to do there?

John Callaghan: Earlier this year, ahead of the leasing round, we ran a consultation to invite views on where we should lease projects and also how we should give development rights. We had around two

dozen responses to that consultation exercise, which we called a design discussion.
Christopher Pincher: Two dozen?
John Callaghan: Yes. Prior to that DETI, in running the Strategic Environmental Assessment and forming regional location guidance, gained views from a wide variety of stakeholders looking at different aspects of development, including environmental aspects and impacts on other sea users. So in Northern Ireland there has been a fair degree of consultation already, some run by DETI, some run by us, but no doubt there is a need for further work with local stakeholders as we go forward.

Q158 Christopher Pincher: What impact has that further consultation had? Are you changing or revising your plans to persuade the community that your plans are appropriate and desirable?
John Callaghan: I think it has helped us balance interests, which I mentioned earlier we needed to do, and find the right balance in Northern Ireland. For example, for tidal projects we know there is interest in both small technology demonstration projects and some larger scale schemes, such as those that are being developed in the Pentland Firth. We need to see how both sorts of projects can be accommodated and also think about the best places for those different sorts of projects.

Q159 Christopher Pincher: What has the community feedback been so far?
John Callaghan: There has not been a great deal of community feedback to us. We are aware of one concern related to fisheries in one of the areas we are considering leasing, but beyond that there has not been a great deal of feedback.

Q160 Christopher Pincher: Why do you think that is? Is it because people do not know about the proposals, or because people are not too concerned about them?
John Callaghan: I imagine that awareness will increase once we start the leasing round, and certainly when we award sites people will be able to see where we have awarded development rights. I suppose the key thing to bear in mind, though, is that when we give development rights, which we call agreements for lease, they are only rights to survey and start to plan developments. They are not actually leases. The statutory consents process will happen afterwards and doubtless will include a great deal of consultation, some led by the development companies themselves with local stakeholders in the run-up to them making consent applications, which will be determined by the Northern Ireland Environment Agency with input from various others in Northern Ireland.

Q161 Christopher Pincher: Can I ask you about the Coastal Community Fund that the Chancellor announced in July? As I understand it, the revenues will be raised by the Crown Estate's marine renewable proposals and the outcomes of those, and 50% of those revenues will be put back into good local causes. How much do you estimate will be raised?
John Callaghan: As you say, the fund is based on the surplus revenue that is attributable to the marine estate, which is one part of the Crown Estate. My understanding is that when the scheme starts in April next year there will be a total of £23.7 million available.

Q162 Christopher Pincher: Is that more or less than you expect? What sort of figure were you hoping for?
John Callaghan: It is based on a formula of half the surplus revenue of the marine estate. That figure is based on the surplus revenue.

Q163 Christopher Pincher: The more you develop the bigger that fund is going to be, surely?
John Callaghan: That is right.

Q164 Christopher Pincher: So you have an incentive to develop as much as possible?
John Callaghan: That is right, and in obtaining grants from the scheme, we and the Treasury hope that local communities will benefit from that.

Q165 Christopher Pincher: What is your view of that fund? Is that going to prove valuable? Are you in favour of it?
John Callaghan: Yes, we are certainly very supportive. I should say that it is a Treasury fund and it is not administered by the Crown Estate—in fact we understand that the Big Lottery Fund is going to manage it going forward—but we are certainly supportive of the spirit and principles of the fund, and what it is trying to set out to achieve.

Q166 Christopher Pincher: You say it is a Treasury fund, not a Crown Estate fund, but will you have any say in how the funding is allocated?
John Callaghan: No.

Q167 Christopher Pincher: Do you think you should?
John Callaghan: No, I think we are content for the Treasury to administer it with the Big Lottery Fund.

Q168 Christopher Pincher: Will you have any role in identifying which communities should benefit from the fund?
John Callaghan: We will not, but my understanding is that it will be distributed across the four countries of the UK, making an additional distinction in Scotland between the Highlands and Islands and the rest of Scotland. The pot of funds available to each region will depend on the scale of activities the Crown Estate is developing in the marine estate locally. There is a formula but we will not be involved beyond that.

Q169 Christopher Pincher: Essentially, your role is to develop as much of the estate as possible to fill that pot as much as possible. Then it is for the lottery fund and for the Treasury to decide how that money should be allocated.
John Callaghan: That is correct.

Q170 Chair: We were told by the industry that the consenting process is more streamlined in Scotland than in England. Could it be improved in England?
John Callaghan: Sorry, is that a question to me?
Chair: Yes.
John Callaghan: I would say that overall there is not that much experience to date. While we have leased sites for 33 projects, only a handful have yet obtained consents or are actually operating in the water. The majority of sites are in Scottish waters and Marine Scotland and other parts of the Scottish Government have been very active in supporting their development. It is probably the case that the equivalents to Marine Scotland around the rest of the UK could learn from the experience that Marine Scotland has gained, but I suppose they have not seen the volume of projects coming forward to consent yet that Marine Scotland has.

Q171 Chair: Could I ask you all more generally whether you think it would be appropriate for DECC to adopt a deployment target for wave and tidal energy?
John Callaghan: I can comment on that. Certainly, what we would see as valuable is DECC and other parts of Government maintaining a clear long-term commitment to the emerging industry. I suppose the longevity and the durability of that commitment is material to investors. It may be that through setting a target, investor confidence could be increased, but I suppose there are other ways that that clear long-term commitment could be demonstrated.
Chair: Anybody else?
Stuart Cook: The observation I would make is that we are at a very early stage in a potentially new industry and there are a lot of uncertainties around the way in which the technology would unfold in the future, and hence trying to fix a view on what the level might be is a relatively difficult exercise for anybody to try.
Harry Huyton: I agree it is difficult. I guess where the uncertainty lies is what happens post-2017, because we have a cap on the 5 ROCs per MWh subsidy up to 2017 and then what will happen beyond then with the Contracts for Difference? The value of a longer-term target would be that it provides certainty for the industry in that transition period.

Q172 Sir Robert Smith: Do you think that, rather than having a target, just ending that uncertainty would allow investors to then work out how best to respond?
Harry Huyton: That might be appropriate—I would ask investors that. As others have said, a target is difficult in that a target could just as well limit ambition as drive ambition if you set it incorrectly, so yes, that could be a prioritisation.
John Callaghan: In the previous sessions you have heard from developers talking about what happens in the gap between the renewables obligation closing and feed-in tariffs coming in under and the electricity market reform. Certainly, we understand that developers and investors are looking at this as a long-term opportunity, so that gap is important. For the Government to provide a signal as to what might come out of EMR for wave and tidal is also important.

Q173 Chair: Given how many organisations there are involved in the process of delivering marine renewables, not just the Government ones but lots of other ones as well, is the co-ordination satisfactory at the moment? You have DECC, the Scottish Executive, the Carbon Trust, the ETI, the TSB, and so on and so forth.
Stuart Cook: I think it is difficult. We play a part in that overall exercise, so I think as far as the role that we play there is an awful lot of co-ordination between Ofgem, the Department, the companies and the local communities, but that is one part of the picture.
John Callaghan: I suppose the risk associated with lack of co-ordination is certainly something we are very conscious of. To come back to the Pentland Firth and Orkney waters, we are working very closely with the Scottish Government, Marine Scotland, Highlands and Islands Enterprise and the local councils and others to co-ordinate activities between ourselves, but also think about how collectively we can deliver things working with the private sector.

Q174 Chair: Finally, could I just ask Ofgem: when Project TransmiT is completed could you share with us the numbers about the assumptions you have made on the modelling process? Is that possible to do in due course?
Hannah Nixon: Yes. We have been committed to running a fully open and transparent process on TransmiT. As I say, we have had a technical working group who have developed the inputs to that modelling. We have had a number of stakeholder engagements. We have published all the assumptions behind our modelling. We have had working group sessions where we have taken the stakeholders through the modelling in detail, so we are happy to make all of that available.
Chair: Thank you. We have some more witnesses just about to start, so thank you all very much for coming in.

Examination of Witnesses

Witnesses: **Greg Barker MP**, Minister of State, DECC, **Duarte Figueira**, Head, Offshore Renewables, DECC, and **Trevor Raggatt**, Deputy Head, Offshore Renewables Unit, DECC, gave evidence.

Q175 Chair: Thank you for coming in. I am sure there is plenty going on in your lives. Your officials have given us most of the answers but there are one or two tricky questions they thought they would reserve for you.

Could I start off by raising what appears to be a mismatch between what the industry thinks it can deliver from marine renewables and what is in the renewable energy roadmap? Why do you think there is a difference there?

Greg Barker: Would it be useful, before I launch into the nitty-gritty, just to give the Committee a brief overview of what it is that we are actually trying to do and maybe the context of our ambition?

Chair: By all means, yes.

Greg Barker: When the Coalition came to Government last year there were some very ambitious targets for marine. There were some large pots of money for marine. What is clear is that there was a total absence of delivery: neither were the targets anything close to what was potentially achievable by the industry, nor did they in any way reflect the actual progress that there had been on the ground.

Basically, what I wanted to do was drive progress on the ground, which meant having a much more realistic strategy for deployment, implementation and funding. Also, we had to have an approach that took more into account than simply carbon abatement, particularly in relation to our 2020 target. Part of the reason for the lack of progress on the ground was that, at DECC, the wider context in which marine operated was very much the imperative of meeting our 2020 renewables targets. With the best will in the world, marine is not going to make a material contribution to meeting that very ambitious target. However, in the 2020s, and indeed in the 2030s and up to 2050, marine can make a very substantial contribution to our renewables portfolio. What is more, marine offers the UK a unique entry point into a global renewables market, in that the UK really is a global leader in this particular technology and there is a huge industrial potential that was not being reflected in the focus on marine.

What I have endeavoured to do is drive forward the realistic deliverable deployment on the ground by working much more closely with the industry and being much more mindful of what we can help deliver at an industrial level, even if this is a longer timeframe than perhaps we have been used to in the past. If we do not start, we will never deliver that future potential. In terms of the roadmap you are right, Chair. The UK renewables roadmap quotes 200 to 300 MW by 2020, when the 2010 Marine Energy Action Plan suggested 1 to 2 GW. Some people have interpreted this as representing in some way a lack of ambition or a rowing back. The fact of the matter is the 200 to 300 MW by 2020 by no means represents a cap on our ambition. Instead, it is meant be a realistic most up-to-date projection, based on independent consultants' reports of what is actually in the pipeline and what is potentially deliverable. We are going to continue to monitor that, however, and if there is the opportunity to upgrade that realistic forecast we will certainly do so. I would be disappointed if the efforts we are making to drive progress in the sector do not result in an upgrade of the potential.

The fact is that in May 2010, when we came into office, despite the high targets and the high numbers for potential funding, there were only 2 MW of marine energy devices deployed globally and almost all of that was in the UK. We are starting from an incredibly low base of actual deployment—effectively from a standing start—so we are trying to go from 2 MW to 200 to 300 MW. Certainly everyone that we talk to in the industry thinks this more realistic approach is going to actually deliver, and obviously it is delivery that is going to be the benchmark of success.

Q176 Chair: That is helpful. There might be circumstances in which that realistic estimate might be raised in due course?

Greg Barker: Absolutely.

Q177 Chair: Have you envisaged what those circumstances could be?

Greg Barker: Success for our policy. We want to under-promise and over-deliver. That is the new ethos that we are trying to drive right across DECC, rather than have these targets that are totally out of kilter with what will be delivered on the ground. I hope that the introduction of marine energy parks—for which there is huge appetite and potential, both in the far north of Scotland and the Orkneys and in the south-west, and which are now coming together—will drive progress. I hope the greater strategic direction that we are giving to the industry by the formation of the Marine Energy Programme Board, which I chair, will help to galvanise industry and to inform policy, to ensure that we stay much more closely aligned between Government policy, Government expectation, Government targets and Government funding, and what can be delivered on the ground.

I also hope that expanding the UK's marine testing infrastructure, by investing in EMEC, Narec and Wave Hub, will help. I also hope that if we are successful in prioritising the UK's bid for EU NER300 funding, this will be additional support into the marine sector; and that the impact of the £20 million, which we announced in the summer, to support the demonstration of marine energy arrays will be much quicker and much more effectively deployed than previous attempts to get money into the sector have been.

Finally, we think that the announcement that we are consulting on 5 ROCs for wave and tidal stream technologies from 1 April 2013 is what the industry has been asking for for years. We listened very closely and I think that the 5 ROC signal will be very powerful, but I do not want to raise expectations so that they run ahead of what we can deliver on the ground. It is all about delivery.

Q178 Chair: We will come back to the 5 ROCs a bit later on. DECC is a member of the Low Carbon

Innovation Group, which has adopted a goal of reducing the cost of energy in the marine sector. Do you have a figure in mind that you think would be acceptable for the costs in 2020?

Greg Barker: The costs in 2020? Perhaps one of my officials can answer.

Duarte Figueira: The renewable energy roadmap set out in the relevant chapter at the front the range of potential costs in 2020, which range from £160 to £340 per MWh. Of course, the long term ambition for the sector, in order to enable deployment to happen, must be that we get costs further down below that. The problem we have at the moment is that, because there has been so little deployment, there is very little idea about costs. When we published the Arup report in the summer, which set out a range of costs for marine renewables, it had quite a wide range for high, low and medium costs. It was based upon very little real data and therefore projections up to 2020. We do not have projections for costs at the moment because there has been so little real deployment. We have projections of costs up to 2020. The long term ambition must be to make the sector less reliant on subsidy funding from the RO and the EMR FITs.

Q179 Chair: Are you saying it is too early to be very specific about what the figures would be?

Duarte Figueira: Yes. In the report that they published as an independent study for us, Arup specifically said that there was enormous uncertainty about cost projections. It does depend upon whether or not there is scale deployment and what effect that will have on costs. It also depends on the costs of deployment and whether we can get those down through technology innovation and through reducing non-financial barriers.

Q180 Chair: I understand the point about the realistic projection. Do you think it would be helpful if we had a deployment target for wave and tidal?

Greg Barker: We have a target effectively, which is 200 to 300 MW but, as I say, it clearly is just a beginning. I think there are too many uncertainties at this stage to set targets that would be credible beyond 2020, but as we start to make real progress on the ground and the industry starts to mature and gets more kit in the water, it may be something that we will want to revisit. Simply putting into documents targets that have been plucked out of thin air is not particularly helpful. It can give a false sense of progress or ambition.

Q181 Albert Owen: Minister, can I take you back to what you said about how you do not think marine energy will make a material difference to carbon abatements on the scale that the industry and jobs—

Greg Barker: Before 2020. I think it may have a big difference post-2020.

Q182 Albert Owen: I realise that, but you do not have any deployment targets because it is underdeveloped, so you are not in a position to say what you are going to do post-2020, either. Can I say—and this is quite a topical question but it has been around for a long time—have you considered the barrage? When we talk about barrages, have you talked about Bristol Channel and that kind of thing? Some estimates say that that could produce 5% of the country's energy resources. Is that something that the private sector is looking at now and has that been put into the roadmap?

Greg Barker: That is not in the roadmap. It is certainly not in the consideration of the marine strategy as things stand, but you are absolutely right, Mr Owen: that would be a game changer. It is something that we remain interested in. As you know, we have undertaken recent studies, which concluded that a public sector funded proposition running to north of £30 billion is not something that we think is currently feasible, but we have by no means closed our minds to that in the future. However, the private sector is still actively pursuing that and we are very supportive of private sector propositions. There are a range of technologies, and it is not a one monolithic technological proposition. The private sector is actively looking at that and I am aware of at least one major project that is currently being evaluated, and we are waiting for more details of that. It is something that I have by no means ruled out, but I am afraid I do not have anything more than that to say at this stage.

Q183 Albert Owen: On the jobs aspect, you said it is a very important industry. I think it is unfair to say that nothing happened prior to May 2010. We have been up to Orkney and we have seen some of the schemes, the European scheme up there, the European Centre, which has been producing and it is a world leader in many ways.

Greg Barker: I do not want to be disparaging of the last Government—

Albert Owen: You sounded it in your opening remarks.

Greg Barker: I suppose I am little bit disparaging because the reality is that we got two to three—

Q184 Albert Owen: When I raised the issue only last year with the Secretary of State for Energy, and asked him about development in marine, he was saying, "Oh yes, it is underdeveloped. Wind is actually a technology that is proven so that is why we are supporting it." You have had a change of policy in recent months on that. Returning to the jobs aspect in the roadmap, can you tell us how many jobs you envisage in the UK in the marine industry?

Greg Barker: I think it would be difficult to give you a very precise figure, but I was really surprised. When I took over the chairmanship of the Low Carbon Innovation Group, which I jointly chair with David Willetts, one of the first questions I asked of that group, which brings together a number of the large strategic funding bodies, was: what was the impact on jobs and growth of the specific projects that we were sponsoring? One of the officials looked at me with rather glazed eyes and said, "I am afraid I can't tell you that, Minister." I said, "Why ever not?" He said, "Well, no one has ever asked that question before" in the context of—

Albert Owen: Now I am asking you.

Greg Barker: I can tell you that we are now much more focused. The Carbon Trust and Renewable UK

estimate that between 16,000 to 19,000 jobs could be created in the UK by 2040. Personally, I think it could be significantly more than that. I do not have any learned studies to back that up; I just feel, given the potential technological advantage, that that figure tends to look at the UK deployment, but the fact of the matter is that the UK, albeit in a very nascent industry, is still seen as a global leader. We know Korea and Japan are looking at these technologies. They look to us, but they are also looking to develop their own capabilities elsewhere around the world. I think this could be an industry that not only services the potential that we have in our own coastline, but becomes a global export industry. That is very hard to quantify but intuitively, politically I think it is much more.

What we are seeing that I think is exciting is the entry of larger companies with stronger process engineering skills, like Rolls Royce, who are able to offer a path to a scaleable manufacturing proposition into this market. Before, it was dominated by incredibly innovative, very bright, exciting young VC players, but they hit the buffers when it came to scaling up. The skill set that you have in terms of innovating, taking things out of a laboratory or taking a proposition out of an idea is one thing, but scaling up to large deployment is quite another, and I think those process engineering skills, which are typically in relatively few large manufacturers who could do this, are key to unlocking it.

Q185 Sir Robert Smith: Perhaps one of the keys to unlocking is to make it clearer how the funding all fits together. It has been put to us that in the US they have the Department of Energy basically handling the funding of energy investment, whereas in the UK there are at least six different organisations administering marine energy funding. Is there any scope for making it more streamlined and efficient?

Greg Barker: I totally agree with you. If you look back over the last 10 years, the landscape has been far too complex and we have begun trying to simplify and harmonise that. Obviously there is a limit to the extent to which you can do that, given that some funding will come from Europe and some funding is going to come from the devolved Administrations, and those are important pieces of the jigsaw. Certainly, through the funding we have at our own disposal or have an influence on, we are trying to create a much greater sense of purpose. That is why we have the Low Carbon Innovation Group, which is directly tasked with trying to bring some sense to that. I am sure we can continue to do better, not just for marine funding but across the board. I agree that the funding landscape is still too complex.

Q186 Sir Robert Smith: You mentioned that division between Scotland and the UK, so DECC's fund is £20 million and the Scottish Government has an £18 million fund. Do you think more could be done to co-ordinate those two funds?

Greg Barker: The Low Carbon Innovation Group is a lot more than DECC's £20 million, but that bit which is dedicated to marine is £20 million. I have £18 million from the Scottish Government as the comparable amount.

Sir Robert Smith: £18 million, yes.

Greg Barker: Obviously, we also have the Energy Technology Institute allocating £21 million and we are waiting for the Technology Strategy Board, which is a partnership between the private sector and the public sector, so it is not totally Government.

Q187 Sir Robert Smith: But the £20 million and the £18 million are both aimed at promoting arrays, so we wondered if there was a way of co-ordinating those two so you have £38 million?

Trevor Raggatt: A lot of co-ordination is already going ahead. The Scottish Government has been closely involved, along with the other devolved Administrations, in the Marine Energy Programme and the Programme Board, which the Minister chairs, which helped to feed into the creation of our £20 million Marine Energy Array Deployment Fund. An announcement was made earlier in the autumn by the Scottish Government. They are planning to get advice on the design of their own fund from their Marine Energy Advisory Group, which is convening again this Thursday. We have been invited as DECC to be a part of that process, to ensure that the learning we have already received from our own design of our fund can be brought into that to make sure that the two funds align as closely as possible. As of yet, it is too early to say whether they will align as effectively parallel, very similar schemes, or if the Scottish Government will choose to use different types of instrument to create a complementary scheme, but certainly we are going to be working closely with the Scottish Government to make sure that happens.

Q188 Sir Robert Smith: Would a joint pre-qualification process be something that might come out of it?

Trevor Raggatt: It is too early to say. It would depend on the form of the different schemes. We are already working to put together the form of our scheme, which we hope to announce in the New Year. It would all depend on the precise instruments that the Scottish Government would choose to use, whether they go for a grant scheme or some sort of investment model. It is just too early to say right now.

Q189 Sir Robert Smith: On the Low Carbon Innovation Group, how formal is the relationship with the Scottish Government and Scottish Enterprise, or could it be more formal?

Greg Barker: We could certainly liaise more closely with them. We have a good working relationship at an official level and, despite the politics of this, on the ground there is a strong shared analysis.

Trevor Raggatt: My understanding is it is not an area that we lead in, but the Scottish Government are being invited to be much more closely involved in meetings of the group, so they have an active input in the actual workings of the group in terms of co-ordination.

Duarte Figueira: It is worth emphasising that the Marine Energy Programme Board has a very close relationship across the devolved Administrations, all of which play a part in its activities. Indeed, the

second meeting was in Scotland where we discussed how we could work more closely together.

Greg Barker: We held that meeting in Edinburgh in the summer, and the Scottish Environment Minister was invited to attend. We had a very good session in Scotland and obviously the potential for a second Marine energy park between Caithness and Orkney is very great and there is a lot of momentum now biting at the heels of the southwest.

Q190 Dr Lee: A couple of questions on strategy. The £20 million, how did you arrive at that figure, in view of the fact that that is relatively modest when compared with the £2 billion a year in nuclear decommissioning? There is still £1 billion of DECC spending there. How was it arrived at to say £20 million for that but £1 billion for CCS? Is there a strategy as to why it is such a modest sum?

Greg Barker: We have a roadmap in terms of what is going to deliver what, in terms of our overall Carbon Abatement Strategy to reduce our emissions by 80% by 2050. Technology is assessed for its potential. The £20 million comes out of our innovation budget; it is a significant chunk of that innovation budget, in terms of innovation for CCS as opposed to other support for CCS. I am not aware of any other—my officials will correct me—but I think that is the largest, single spend on any technology from the innovation budget, per se. Is that right?

Duarte Figueira: We have announced £20 million for marine and we have announced £30 million for offshore wind.

Trevor Raggatt: In terms of the process that was undertaken to determine the level of funding for the marine fund, the Low Carbon Innovation Budget is overseen by a board, which operates within DECC, and there was a process undertaken and led by our Chief Scientific Adviser, David MacKay, to look at the various ways in which the innovation funding could be spent and to allocate priorities between that. The outcome of that process was £20 million for the Marine Energy Array Demonstration Fund. That was based on a lot of work we had done with the sector through the Marine Energy Programme and through the Finance Working Group, looking at the realistic levels of deployment that were likely in the period that is covered by this Spending Review period.

In terms of the number of projects likely to come forward at a small array scale, we felt that the £20 million budget was appropriate, alongside in particular our hopes that the UK would be successful in funding at least one marine project of a similar scale from the EU NER300 project programme. Of course, now that we have the Scottish money alongside that, that may allow us to do more, but we looked very carefully at what was able to be spent within the timescales that were available to us.

Greg Barker: The key barrier for the industry has not been the resource available; it has actually been the ability to deploy or spend it. The previous Government had the Marine Renewable Deployment Fund, which was £50 million of which only £2 million was spent during the five years that that operated. In the four or five years that that was up and running, it only managed to get £2 million of the £50 million out of the door.

Q191 Dr Lee: But they have been successful, with about £5 of private money for every £1 of state money. That is pretty good leverage for a technology scheme. It is the private sector who is interested in this. I guess my point is, if there is that level of interest, is there a danger that other countries will get ahead of the curve?

Greg Barker: Unlike other technologies, there are very real constraints on just how quickly you can deploy these technologies. These are our big engineering solutions. For example, there is no comparison to, say, the way in which you can scale up the solar industry. This is something that is very capital equipment intensive. I would say, look at the £2 million deployed with the MRDF over the last five or six years. If we can get £20 million deployed in the next few years that would be a tenfold increase in that particular funding stream.

Q192 Dr Lee: Specifically, why are we so religiously adhering to the 25% state aid cap?

Trevor Raggatt: It is something we are looking into at the moment. The fund will come under the research and development guidelines and the innovation phase, which array deployment occupies, is very close to market. We see this as being the last step before moving on to commercial scale and deployment and commercialisation. Because it is very close to market. the state aid rules require a lower aid intensity rate. Within the guidelines that is set at 25% for that type of innovation.

Q193 Dr Lee: That is for the EU?

Trevor Raggatt: For the EU. However, we have become aware of a recent scheme that was approved for Sweden for a 10 MW array.

Q194 Dr Lee: Yes. That is what I was going to go on to. It is more like 40%

Trevor Raggatt: It looks like that, yes, around about 40%. So we are looking to see if we can get sight of that approval to see what argumentation was put in place to allow that higher rate of aid intensity.

Q195 Dr Lee: The quote that I have here is: "It is compatible with the EU framework for state aid for research development innovation. It will currently bring immature green energy technology closer to the market without unduly distorting competition. In view of the limited expected market share of the aid beneficiary, the presence of several competing European projects and the expected growth of the markets concerned".

Trevor Raggatt: Yes. It is something that we were looking at very interestedly, because the way that the Commission approves state aid is very much based on precedent, and the fact they have set this precedent in the case of the Swedish scheme potentially allows us more flexibility. However, the way the DG Competition assess state aid is a very complex process.

We will also be looking to ask the Commission to allow us to not only give the MEAD fund, the £20 million fund, but also allow the enhanced level of ROC for the electricity generated out of the devices, alongside that grant funding. It may be that in Sweden there is no equivalent feed-in tariff or support system. It is something we are certainly going to explore with the Commission now that we have seen they have been comfortable in approving that sort of grant fund level, but a lot of the devil will be in the detail and it will be dealt with in the discussions over the coming few months.

Q196 Dr Lee: Is the feed-in tariff for marine after 2017 under discussion?

Greg Barker: It is not just under discussion, but it has been actively proposed under the Electricity Market Reform Proposals. We see a feed-in tariff in the form of a contract for difference as being something that could be transformational in terms of pulling through marine technology. The challenge is to have them in a position to be able to take advantage of that sort of financial incentive, because obviously they would only be paid for the electricity they are able to produce and guaranteed a price for it under the contract for difference. They need to be in a position to be able to produce it.

Q197 Dr Whitehead: In terms of the Marine Renewables Deployment Fund and its not great deployment, do you think there is a comparison to be made with what you have mentioned—the more or less standing start we have as far as marine renewable deployment is concerned—in terms of future projections? What happened in that period as far as the difference between marine renewables development, which had limited funding but was substantially deployed, and the Marine Renewables Deployment Fund, which was not used because the industry was not at the deployment phase point? Do you think your projections are accurate there?

Greg Barker: Dr Whitehead, you have accurately identified that part of the problem is that the vaulting ambition for the sector has in some way got in the way of actual progress, by underestimating the practical difficulties of getting from the standing start. We all want to leap ahead and concentrate on the broad sunlit uplands—if you can have uplands in the marine technologies—and talk about the 2020s and the 2030s, saying it is going to be a global industry, a world beater, and it is going to provide a huge degree of our electricity. All of that is true but, as politicians, we need to realise that there is a lot of work that needs to be done before we can start getting to that.

The industry shares our ambition, and what we need to do is not focus on painting the big canvas. The march from 2 MW to 100 MW is probably going to be the hardest bit of all. Once you get to 100 MW you are really then in take-off land. The 5 ROC incentive with a 30 MW project cap, in England we are unlimited in the number of projects we can have, but realistically we are not going to be inundated with projects. It is really tough to get this complex engineered equipment into the sea and get it working at scale. We have all sorts of interesting things but the difference between interesting proposition and deployment on that sort of scale is immense, and it is in the foothills that the battle is going to be won.

Trevor Raggatt: It is also worth remembering that the technology landscape now is fundamentally different from where we were back in 2004, 2005 when the MRDF was first being created. We have already said that in hindsight we realise the projections of the industry on how fast it would progress were rather overoptimistic, to say the least. Back in 2004, 2005 there were no megawatt scale devices being demonstrated. I think the first Pelamis was sort of being rolled out. Since 2009 SeaGen went in—the first megawatt scale tidal turbine in Strangford Lough—then in the last couple of years the Marine Renewables Proving Fund has brought along six devices, across both wave and tidal, with the last two due to go in at EMEC in the early part of next year. So we are now in a position within the sector where we see real credible megawatt scale technologies going into the water, which gives us a good launch pad for array deployment over the next few years.

In terms of the analysis that went into the creation of the fund, again we had much more access to real data. In the Finance Working Group of the Marine Energy Programme, I have to pay real credit to the sector and the way they co-operated with us in providing us with the evidence base on which we could do some really credible planning. We were given access to commercially confidential deployment plans that different technology developers and utilities and project developers have, to give us a really good view of the rollout that they see for the technology over the next five or 10 years. That gives us a lot more confidence now that the spending that we have allocated within the MEAD fund, which is allocated towards the second two years of the current Spending Review, matches where the most credible project development is going to be. We are, I hope, quietly confident but still keeping a close eye on making sure that the sector moves forward.

Duarte Figueira: To add to that, I think we are also in a different place in terms of the infrastructure we have in place to help deliver that. You visited EMEC, I understand, but we also have Wave Hub, as well as the Narec facilities, which provide drive train and testing facilities. We have a position where the industry can develop through an infrastructure that is in place, plus through the chairmanship of the Minister, we have the Marine Energy Programme Board, which brings together all the various parties in a way that is much more consistent and much more co-ordinated.

Greg Barker: I would not underestimate the extent to which we now have a very aggressive industrial policy. In the past, Ministers' policy priorities have been elsewhere. They have been quite generous with the potential funding under the previous Government, but it has been very much a matter of, "Here is some money, go away and get on with it. Let us know how you get on." We do not have the luxury of unlimited funding now, but what we do have is a much greater commitment to bringing all the different pieces on the chessboard together in a much more coherent way. The creation of the Marine Energy Programme Board

brings together all the stakeholders in one place, so there is a much greater sense of co-ownership of policy. They have managed to create marine energy parks that will bring clustering and a focus of economic development, the industrial potential, the training, the skills, and economic innovation opportunities all together in one physical place, on a hub and spoke basis. This is crystallising the opportunities. We have to do more with less in this current environment, is the honest answer. We have to make our budgets work, but I think just bringing that additional focus and having an ambitious industrial policy that is hands-on, really is paying dividends.

Q198 Christopher Pincher: I am clear on what you want to achieve with the Marine Energy Programme Board, but I am not still clear about the total amount of public money that is available to be spent. You and your officials have described how the LCIF funding order was arrived at—the £20 million—and you have mentioned the £18 million coming from the Scottish Executive. I think you also said you are waiting on £21 million. What is the total amount of public money available to support these initiatives?
Greg Barker: As you said, Mr Pincher, there is £20 million from DECC under the auspices of the Low Carbon Innovation Group, £21 million from the Energy Technologies Institute, £18 million now from the Scottish Government, and we are waiting for confirmation on the Technology Strategy Board's piece. Then, the most important thing is the pull through you will get in terms of mobilising private sector finance that will come as a result of the 5 ROCs that are being offered up to a 30 MW cap. That piece of funding has the potential to offer the greatest leverage from private sector finance. On top of that, we also have the potential for the EU funding. I cannot give you a precise figure because we are still waiting confirmation of those numbers.

Q199 Christopher Pincher: It is north of £59 million, plus private sector investment, is it not?
Greg Barker: Absolutely. I do not have the figure off the top of my head. There must be a value attached to the 5 ROCs proposition, which would be hundreds of millions, if not more than that, over the lifetime of the programme.
Duarte Figueira: We made an assessment when we did the calculation for the 5 ROCs. We did not just rely on the modelling that was done for us by Arup and by Pöyry, but used the industry, as Trevor said, to help us provide a realistic deployment pipeline that would come through, which formed the underpinning for the 5 ROCs consultation. Over the period of the lifetime of the ROCs, that was 160 MW, that came to £1.5 billion.
Greg Barker: That is a £1.5 billion pot that is available just for starters for the industry and it could be significantly more than that, so that is quite a carrot.

Q200 Christopher Pincher: We will talk about ROCs some more in a moment, but quite a lot of money is available. What was the industry's response? When the MRDF was scrapped, I think there was rather a damp response. What are you doing to engage and energise the industry? What do you propose?
Greg Barker: I think in your earlier hearing, Amaan Lafayette from E.ON told you that a lot is being done in Government. I have to say they are absolutely right. Overall, the response from industry, particularly articulated through the Programme Board as I have said, has been very positive. The response to the 5 ROC announcement was very positive indeed. This has been a long-time ask from industry.

Q201 Christopher Pincher: Can we just talk a little bit about the European dimension? I know you have touched on this already, but there are pots of money available in Europe. There is the NER300 fund, but I think there are 12 UK applications to the fund, four of which are for wave and tidal renewable projects. There is also the FP7, offering €50 billion worth—it is currently denominated in euros—of potential funding. What sort of support is the Government giving to industry to access those funding streams?
Greg Barker: You are absolutely right, Mr Pincher, there is a lot of money potentially available within the EU. DECC has been leading a lobbying effort with the European Commission that has secured support for the Ocean Energy Technology Demonstration under the EU's Framework Programme 7, energy work programme for 2012, and we expect it to continue into the 2013 work programme. We are lobbying the Commission with the sector and other member states for marine energy to be included in the EU's strategic energy technology plan—the SET plan, as it is known—which could open doors to new funding. Also, alongside the EU Ocean Energy Association, with some of our potential key European partners in this area, like Denmark, France, Portugal, Ireland, Spain, we launched the *EU Position Paper on Marine Energy* at last month's Energy Council Meeting. The paper underlined the importance of marine energy to the EU as a whole, and it was a statement of our collective willingness to work together as a strategic partnership to build a European marine energy industry with an emphasis on jobs for growth. In addition to that EU work, which we are very much leading, there are other policy initiatives, such as the marine energy work stream that is coming out of the British/Irish Council to promote support for EU marine energy.
The actual sums are difficult to quantify at the moment, but we are putting a lot of effort into trying to get the same attention focus and support at the EU level for this sector as there has been for others.

Q202 Christopher Pincher: The European Investment Bank will be making its grants, I think at the end of this year—on 31 December. How likely is it that our four applications will be successful?
Trevor Raggatt: In terms of the NER300?
Christopher Pincher: Yes.
Trevor Raggatt: The process is actually that the EIB are doing due diligence for the European Commission, and we understand the latest from the Commission is that the EIB is due to report to them sometime around February next year. That will produce a ranked list of all member state projects in terms of their value for

money. Member states will then be asked to comment on which of their own projects they would support going forward to the final stage of consideration by the European Union, and then the successful applicants will be announced towards the end of 2012.

Q203 Christopher Pincher: I see. So we have seven CCS projects, four for wave and tidal, and one for offshore wind. If you had to prioritise them what would you prioritise?
Trevor Raggatt: That will all be dependent on which come up within the ranking, but also on the overall value for money that they return to the UK. Under the process the UK should be guaranteed one project, and up to three. If there is only one project, there will be a hard decision to be made on the return that the projects make to the UK, but we are hopeful that if we can we would benefit from both marine and also CCS under the NER300, but it will depend on what comes out of the Commission's due diligence and scrutiny.

Q204 Christopher Pincher: You can be certain we are backing this, and I am batting very hard for all marine. Do you envisage the Green Investment Bank lending to marine renewable projects, or do you have a different set of priorities for any investment the GIB might make into renewable technology?
Greg Barker: No, I think the GIB could be an important supporter of the sector as the sector begins to mature. It is not one of the key priorities for the Green Investment Bank, as stated, but in terms of the amounts of money that realistically we would be thinking of attracting, it would be entirely sensible and feasible for the GIB to allocate part of the 20% of its portfolio that can be used outside the priority sectors that have been given by the Secretary of State for BIS. I would expect that to be the case. Obviously it is up to the bank to make individual investment decisions and for the board to allocate those, but it is early days. The bank will not be in the business of giving grants or subsidy; it is more likely to be in the business of leading the market proposition, so stepping in at the point where it is coming to market, but where it needs to accelerate and scale up investment ahead of where the market would be at a given time.

Q205 Christopher Pincher: Does that not advantage wind over marine technologies? It affects the change more.
Greg Barker: It does not advantage. The fact of the matter is that wind is at a much later stage of development—much further along the deployment curve. Costs are much lower and have come down, so it is a totally different proposition. In the near term, particularly in the current decade, wind is going to see a much greater level of commercial deployment and will take a very substantial chunk of the burden of helping us meet our renewable targets by 2020. That is not our expectation of marine at this stage of its development. It is really into the 2020s that marine comes into its own.

Q206 Christopher Pincher: Is it not the case that the cost has come down partly because of the subsidy? The GIB should therefore not look at marine renewables as somehow more costly, because wind has a state cost associated with it anyway.
Greg Barker: Absolutely, but they are not in the same position so I would not expect the Green Investment Bank to look at wind and marine as an either/or situation. They are at totally different stages of their industrial development. It is entirely feasible, given that we are establishing in the Green Investment Bank a permanent financial institution, to envisage a big draw on the Green Investment Bank to support the deployment of offshore wind, particularly in the current decade; but as you get into the 2020s, the pull from the offshore wind, which will start to mature, will be significantly less. It is at exactly that point that the marine industry will be scaling up, so timing-wise it works rather well. There is a certain degree of impatience in that everyone is expecting the Green Investment Bank to do everything immediately, rather than seeing it in the context of a permanent institution that is going to be a constant part of the renewables landscape in perpetuity.

Q207 Christopher Pincher: When do you expect the GIB to be able to fund marine renewable projects? In 2015? 2016? After that?
Greg Barker: I do not have a formal view on that, but I think the large-scale opportunities will be later in this decade at least. There will not be a large commercial proposition for them to scale until we have deployed the first arrays, so we have to get the projects that are in the pipeline up and running first. I do not rule out at all some focused, targeted early support, but to be comparable to what we anticipate for the offshore wind industry, where it may be supporting bond issues, for example—bond issues that are going to be multi-hundred-million pound offers into the market, and the Green Investment Bank could be coming in to take a strategic slice of that—we are not really going to be in that scale of development for quite some time. However, we fully intend to get there.

Q208 Albert Owen: You mentioned ROCs a couple of times to other colleagues here, and it was very much welcome. When we were up in Orkney, we spoke to developers and members of the industry and certainly they were pushing for it. We had only been back a week and you announced that it was going ahead, so perhaps we had some influence in that role but we will not take the credit. There is no proposed cap on the number of projects. Why not?
Greg Barker: We have been realistic about the likely number of projects coming through, and if we achieve all of those we will be doing well. I would like to achieve more than that, but that has not been the nature of the industry. As I said, this is a very engineering, capital-intensive industry that cannot just spring up by importing kit.

Q209 Albert Owen: But you put a cap on at 30 MW. Why did you decide to do that as opposed to capping the number of projects?
Greg Barker: Because what we want to see is the maximum use across a range of technologies; we do

not want to see just one technology deploying at scale. We looked at this, and if we had thought there was a dangerous likelihood of a runaway train in marine, in the way that we have seen in the last three months in solar, then we would have considered that. I do not think we need to, and there is no need to put a cap on when it is not necessary and to take an arbitrary figure.

Q210 Albert Owen: You have got one cap.
Greg Barker: We have a cap on the project—30 MW.
Albert Owen: Exactly.
Greg Barker: That has broad support from the industry. We discussed this with the Marine Energy Programme Board, and they were also very much of the view—not unanimously, but certainly it was a strong view—that they wanted to see a range of technologies competing for funding. As you can imagine, we spoke at length with the Treasury about this and, given the fairly good sight that we have of the project pipeline, we did not feel that a cap was necessary.

Q211 Albert Owen: One thing the industry has talked about to raise confidence is continuity. They are not sure what the level of support is going to be post-2017. Why 2017? You said it is underdeveloped, and we are not sure how it will develop. Are you confident in your analogy about the uplands? Are you certain that by 2017 the industry, in your opinion, will be mature enough to stand on its own two feet? Is it going to go the Green Investment Bank? Are there other forms? Why 2017?
Greg Barker: No. That is when the ROC programme extends to. We expect that by 2017 new projects coming on stream will be funded by the contract for difference feed-in tariff.

Q212 Albert Owen: Will that be equally as attractive as 5 ROCs?
Greg Barker: I hope it will not need to be. I hope the industry's costs will have started to come down by then. Obviously 5 ROCs is not a long-term sustainable proposition. It is a big push to get the industry going and to encourage costs to come down, so if we were still having to offer 5 ROCs in 2017, that would not be a huge sign of success.

Q213 Albert Owen: But you do not know.
Greg Barker: We do not know.

Q214 Albert Owen: The industry does not know.
Greg Barker: No.

Q215 Albert Owen: But it wants to know.
Greg Barker: We would all like to know, but we do not have—

Q216 Albert Owen: No, hang on, I asked the question: what is the likely support going to be in 2017, and you said the contract for difference. What does that mean in cash terms?
Greg Barker: We do not know. What are the likely costs? Can you tell me what the costs are in 2017?

Q217 Albert Owen: No, I am not the Minister and I do not make these policies.
Greg Barker: No, but I do not know. We can only offer support—

Q218 Albert Owen: You are critical of the previous Government for not knowing and for going blindly into this thing, but you say yourself you do not know because it is under development, and I accept that. But the industry wants to know, because it is slow developing, what kind of arrangements are going to be made available post-2017. I think that is fair under any road map.
Greg Barker: They will know well before 2017. The fact of the matter is we are—

Q219 Albert Owen: Can you say roughly when? "Before 2017" is not really a considered answer.
Greg Barker: I mean significantly before—2013–14.

Q220 Albert Owen: In 2013–14, there will be a review of ROCs? Or will that be the next phase?
Greg Barker: No, ROCs will be coming to an end in 2017. Next year, we will legislate for the most profound reform of the electricity markets since privatisation with our electricity market reform programme, and that will be contained in the Energy Bill. We are going through a process of consultation, and we have published a White Paper. There is a lot more to it than just marine; that is one of the pieces on the board. The industry as a whole—not just marine—want certainty, and any change creates a hiatus, but we believe that getting on to a higher trajectory of ambition and on to a more effective funding mechanism and support system for the industry will be worth that hiatus, which is unavoidable at the stage when you migrate from one system to another. By 2013–14, the industry will have absolute certainty about what the forward long-term funding arrangements will be—well before we come to the end of the ROC regime. We are not in a position now, in 2011, to say either what the costs will be or what the funding will be.

Q221 Albert Owen: So you are confident that by 2013–14 the industry will be aware of the rates of return?
Greg Barker: Yes, that is right.

Q222 Albert Owen: That is the answer I am looking for. You do not expect a massive rush for ROCs in 2017 because the other scheme you indicated was not attractive?
Greg Barker: Correct.
Duarte Figueira: Of course what we have done, by creating a transition process, is enabled the industry to make a one-off choice between feed-in tariffs and the ROCs up to 2017, so the industry will have the security of the ROC regime until 2017.

Q223 Albert Owen: Many people in solar thought that as well.
Greg Barker: No, they were not being offered the choice.

Q224 Albert Owen: The industry said that next year there would have been a review; they were expecting that to happen.
Greg Barker: No. They were not expecting to have a choice between funding mechanisms. What my colleague was saying is that there will be a window under which marine developers will have a choice whether to take ROCs for the lifetime of their scheme or whether to go with the contract for difference, and there will be a phased-in approach, so it is a double—

Q225 Dr Whitehead: After 2017 or up to 2017?
Greg Barker: Up to 2017. I guess from 2014 to 2017 there will be a window when you have both schemes available as we are in transition.

Q226 Dr Whitehead: CFD will phase in, what, 2015?
Greg Barker: 2014.

Q227 Dr Whitehead: Okay, but we will only know about it in 2013.
Greg Barker: We know the perils of setting rates of return for technologies. Eighteen months in advance, as witnessed by the solar FIT, to try and anticipate what the cost base would be and then accurately set the correct rate of tariff this far out would just be impossible.

Q228 Albert Owen: Sorry, the difference with FITs is this is long-term development—we all acknowledge that—and they want some certainty. You have said that in 2013–2014 they would have the new rates and they will have a choice of whether to stay with ROCs in 2017.
Greg Barker: You can only set the rate when you know the costs, and we do not.
Albert Owen: I will leave it at that.

Q229 Sir Robert Smith: You will only know the cost when you have a fair idea of roughly what the ballpark is of the costs?
Greg Barker: Yes. The reason we are bringing in contract for difference is to deliver that transparency, certainty and longevity that the industry needs, and that is what the hallmark of our policy process is to deliver with greater certainty to industry.

Q230 Ian Lavery: One of the major barriers to development of wave and tidal energy is new grid connections and obviously the lack of grid connections. It is a particular problem for smaller generators—the requirement to underwrite the cost of the new connections is extremely problematic. Will the Government, now or in the future, consider providing some sort of support in this area, possibly by taking on some risk in the construction of new grid connections?
Greg Barker: Certainly, Mr Lavery, I agree that this is a big issue and it is one that we take very seriously. We think the policies are in place now to ensure grid connections are delivered on time, and under the new enduring connect and manage regime, five tidal projects have already had their connection dates brought forward by an average of six years. As for marine energy being given sufficient priority in the grid build out, it is obviously for network transmission owners to propose the scale, location and timing of new network investment, based on information such as each individual project's timescale. The vast majority of marine generation projects planned so far would connect to the Scottish Hydro Electric Transmission network in northern Scotland, which has submitted publicly available plans to Ofgem for network development 2013–2021, which include the network potentially required to accommodate marine energy.

Q231 Ian Lavery: Ofgem is currently reviewing the charging system as part of the Project TransmiT. It is critical that Ofgem give specific focus and consideration to the long-term climate targets and potential for economic opportunities, and that they work on grid connections, as I have just mentioned, and charges. Are you confident that this will be the case?
Greg Barker: Obviously there is Project TransmiT, Ofgem's independent review of transmission charging, which takes in a greater work stream.
Duarte Figueira: Just in terms of transmission charging, obviously Project TransmiT is due to report quite shortly. They will be looking at whether carrying out this independent review of transmission charging will be suitable for delivering not just the renewable energy but all the low carbon energy that is required, as well as preserving security of supply. What we need to do now is to await the outcome of Project TransmiT, as well as the outcome of the work Ofgem are doing on grid liabilities and user commitments. We must wait to see what comes out of it in terms of providing renewable projects with the transmission charging regime and a grid liability regime that they think is appropriate. It is then, after the regulatory process has wound its way, for Government to have a look at that. Both these exercises are nearing completion, and in both cases we need to see the outcome before we take the matter forward.

Q232 Ian Lavery: Can you give an update on the work of the Electricity Network Strategy Group's vision for the future, in particular when the report will be published and to what extent wave and tidal energy might feature in the report itself?
Duarte Figueira: For those Members who are perhaps not as familiar with it, the ENSG process was carried out originally in 2009 and brought together all the various parties that were involved in electricity transmission planning; it also took in the transmission operators, to give an analysis of what would be the requirements of the grid for 2020, not just in terms of onshore but also reinforcing the onshore grid for offshore transmission coming ashore. That work is being renewed at the moment—being carried out again. The members of that group, which is chaired by DECC and Ofgem, include the transmission operators, which will give an assessment of what they think needs to be done to the transmission system to reinforce it, to make sure that the renewable energy can connect to the main centres of population.

As a result of that, a lot of the information that will be looked at by the ENSG2 process will be the same information that the transmission companies are providing to Ofgem for the next regulatory review. What we will see is a single picture through ENSG2, which is due to come out early next year, which will provide a picture of what reinforcement of the transmission network needs to happen. That is in train and it is due to report early next year. It is a joint DECC/Ofgem project and it will give a picture of what is required for all technologies.
In the case of marine, as has already been said, a lot of the connections in the next few years will be done under the SHETL transmission operator in northern Scotland. A lot of those are already in the plans that have been submitted to Ofgem. They include various options on how to connect other marine projects that are being developed in Scotland in particular. All that has been taken into account in the process that is going on at the moment.

Q233 Chair: In the past, the NAO criticised DECC for not monitoring all the renewables, including funding provided by other Departments and devolved Administrations. You actually provided this information in your written evidence to us. Does that mean you are now collecting it on a regular basis and monitoring it?
Trevor Raggatt: Monitoring and appraisal is written into all of DECC's funding plans at a basic level. I referred to the Innovation Programme Board earlier. When they approve projects and schemes to go forward it is necessary to prepare a number of business cases, and part of that business case includes a formal monitoring plan. So all of the processes that we have in place will be monitored using the various Treasury guidance on that, and that will feed back into the understanding of how those have operated both from an ongoing but also at the end of the schemes.

Q234 Chair: Does that process mean you have eliminated risk of overlap between different funding sources doing things that are duplicating?
Trevor Raggatt: I wouldn't say "eliminated", but again, this is very closely related to the work that the Low Carbon Innovation Co-ordination Group is doing. One of the focuses of that group, across all technologies, is to ensure that where there are different funding streams operating in similar policy or technology areas, that those are complimentary rather than competitive. I think a good example of that is DECC's Marine Renewables Proving Fund, which was launched in 2009, again to push prototype development through to a point where array deployment could begin.
Alongside that, about six months after the Proving Fund was launched, the Technology Strategy Board launched a couple of calls for research into marine energy. They specifically designed those to be complimentary to the Proving Fund, so that the work that was going on under the Proving Fund could effectively act as a foundation or a test bed for the further work aimed at cost reduction through technology development and through operations, and so forth, under the TSB. So that would sit completely alongside the work of the Proving Fund but not overlap. I think the work that the Low Carbon Innovation Co-ordination Group is doing has been very helpful in ensuring that we don't have overlaps but we have complementary things working alongside of each other.

Q235 Chair: In relation to the Scottish Government, when you are announcing support for schemes and they are announcing it, do you have specific discussion in advance before that takes place?
Trevor Raggatt: It is difficult to give a clear answer to that because under the devolution settlement the Scottish Government has its own powers and it also has its own political imperatives. What I would say is that officials work very closely together and are in close discussions about all the sorts of options that may be being kicked around, or may be being worked up at any point in time. We do try to link very closely what we are doing and again ensure it is complementary. I think a good example of that is that the Scottish Government announced their £18 million fund and they also asked us to co-operate in the design of that fund, in the way they had been co-operating through the Programme Board on the design of our £20 million fund. It is a different situation and not one that I as a civil servant can comment on in terms of how the political imperatives work with each other, but at an official level we certainly try to ensure everything is as joined up as possible.

Q236 Chair: In relation to the £20 million low carbon innovation funding, how are you going to measure success?
Trevor Raggatt: Spending to profile, particularly given the lessons learned from the MRDF, will be one. It should be pointed out that this is ultimately a late stage innovation programme, so it falls within R&D, and there are uncertainties and technology risks amongst any of these sorts of projects. I think there will be a range of measures as we go forward—simple procedural ones, like meeting project milestones and spending to planned budget schedules as we go on, which will allow us to ensure that things stay on track; as well as meeting the overall objectives of the scheme—getting arrays deployed, which then operate and act as a stepping stone for further commercial deployment. Then, in the longer term, we will be looking back at how successful in hindsight the scheme was, and how quickly the commercialisation and the early commercial deployment of the sector are accelerated. Monitoring and appraisal is an ongoing and a long term process, so there will be a number of measures that are very short term, procedural and ongoing, but there will also be a number of measures such as getting the devices in the water and then the knock-on effects on a much longer term basis.
Chair: We have more or less come to the end our time. Thank you very much indeed for coming in again. We look forward to seeing you again before long.

Written evidence

Memorandum submitted by the Department of Energy and Climate Change

DECC RESPONSE TO THE ENERGY AND CLIMATE CHANGE SELECT COMMITTEE INQUIRY ON FUTURE OF MARINE RENEWABLES IN THE UK

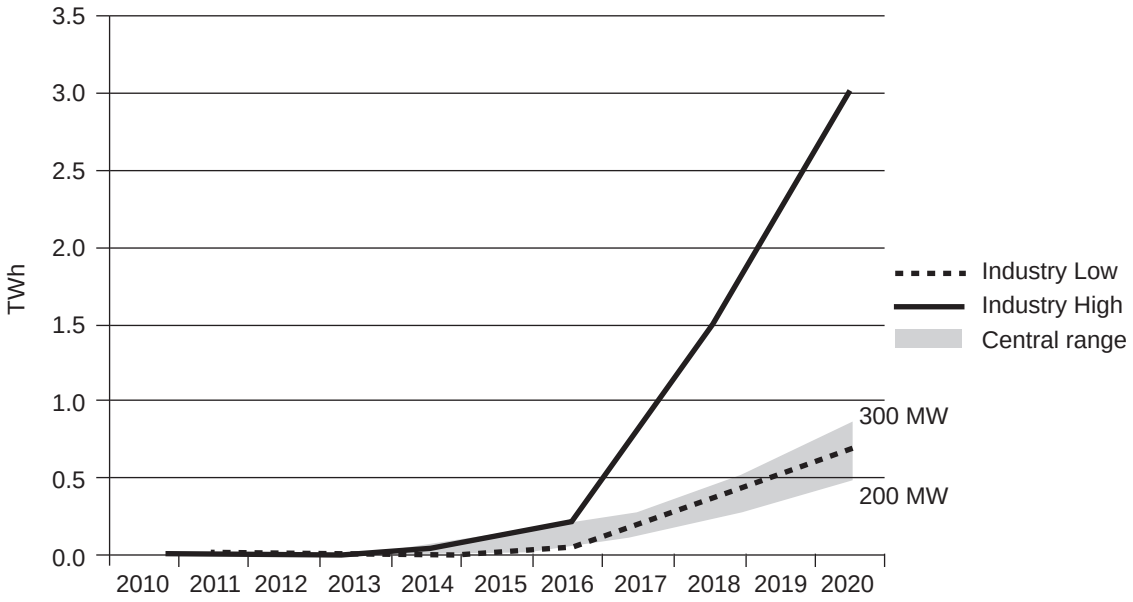
Introduction

Wave and tidal stream energy technologies are at an early stage of development with only a few megawatt scale devices currently being tested. The development of these devices has been assisted by Government funding but commercial scale demonstration and deployment is yet to begin. As such, marine energy is likely to only make a modest contribution to our energy mix to 2020 but it is a technology which provides an option for bulk renewable energy generation as part of our energy mix to 2030 and 2050.

The UK Renewable Energy Roadmap[1] published by the Department of Energy and Climate Change (DECC) in July 2011 estimates that, in "central range" modelling, small pre-commercial wave and tidal stream array demonstrations will be carried out between 2013 and 2015. Commercial scale deployment will then increase through the second half of the decade, reaching in the order of 200–300MW by 2020. The figure below, extracted from the Roadmap, gives an indication of the range of potential deployment for marine energy in the UK to 2020.

Figure 17

DEPLOYMENT POTENTIAL TO 2020 FOR MARINE ENERGY



A variety of sources suggest there is a wide range of possible deployment levels beyond 2020.[2] The levels of deployment forecast in these studies are dependent on a range of factors. These include the success of the marine technology development in reducing cost, the economics of the alternatives and the assumptions made on the sector's ability to overcome potential financial, technical and other barriers to deployment. DECC 2050 Pathways analysis suggests that deployment could range from a negligible level (in a worst case scenario) up to, at the higher end of the range, around 27 GW by 2050.[3]

The Government recognises the potential of marine energy and is committed to harnessing the benefits which a successful marine renewables sector could bring to the UK. This commitment is acknowledged by marine energy being an explicit part of the Coalition Agreement which states: "We will introduce measures to encourage marine energy".

The UK is recognised as the world leader in the research, development and deployment of wave and tidal stream technologies. The world's two largest tidal turbines are deployed in the UK: the 1.2MW SeaGen turbine in Strangford Lough, N. Ireland and the 1MW Atlantis AK1000 turbine at the European Marine Energy Centre (EMEC) in Orkney. Similarly, two of the world's most advanced wave energy devices (Pelamis and

[1] UK Renewable Energy Roadmap, DECC, July 2011, URN 11D/698. http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/re_roadmap/re_roadmap.aspx

[2] DECC 2050 Pathways, 2010: 0–27GW (Scenarios 1–3, Scenario 4 not included); PIRC/Offshore Valuation Report, 2010: 4–35GW; DECC/Scottish Government, Cost of and financial support for wave, tidal stream and tidal range generation in the UK (Ernst & Young/Black & Veatch), 2010: 8.9–43.1GW; Unpublished DECC analysis, 2011: 027GW.

[3] 2050 Pathways Analysis, DECC, July 2010, URN10D/764.

Aquamarine's Oyster) are currently deployed in the UK, at EMEC. Further deployments of both wave and tidal pre-commercial prototypes are scheduled over the next 12 months.

With its indigenous academic and technical expertise and unique testing infrastructure the UK is seen as an attractive location for overseas device developers to develop their technology. As a result of this, of our excellent marine energy resources and of Government support for the sector, many of these leading overseas device developers have offices in the UK.

However, the marine energy sector is currently reaching a critical stage of development. The challenge for the sector is to move from a research and development focus towards, initially, demonstration of small arrays (in the range of 5–10MW) and subsequently commercial scale deployment in the period to 2020. As part of this process, the sector will need to prove that its technology will operate on a commercial basis in arrays and demonstrate that it can reduce costs of generation sufficiently to make the technology cost effective in the longer term (with respect to other forms of renewable generation).

Analysis carried out for DECC[4] suggests considerable variation in the levelised cost of energy (LCoE) from marine technologies, ranging from £162 to £340 per MWh in 2020. This reflects cost differences between the individual technologies considered, uncertainties about anticipated levels of learning and of global deployment, and technology risk. Capital costs are expected to fall as projects move from prototype stage to commercial scale deployment, but the scale of the decrease is hard to predict and will depend, for example, on the intensity of the marine resource exploited.

DECC (along with other public sector partners) is working to put in place a number of policies and instruments which will facilitate the process of array demonstration and commercialisation and secure the development of the sector in the UK. This includes support for innovation and demonstration of devices, revenue support under market-based instruments and the acceleration of supply chain growth through the development of Marine Energy Parks. This work is coordinated by the UK Marine Energy Programme Board, which is chaired by Greg Barker, Minister of State for Energy and Climate Change.

As agreed with the Select Committee, this paper only considers wave and tidal stream technologies. It does not cover tidal range energy or other forms of marine energy, which are not relevant for mass deployment in the UK such as ocean thermal energy conversion or salinity gradient technology.

The Benefits of Marine Energy

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

Carbon abatement potential: Successfully developing the marine energy sector will provide the UK with an additional solution with which to combat climate change and limit CO_2 emissions. There are significant uncertainties but under deployment projections of 2.6GW installed capacity in 2030, wave and tidal stream could provide carbon abatement benefits of 17Mt of CO_2 valued at £490 million to 2030 (real, discounted with central projections for the EU-ETS carbon price). By 2050, for a high deployment scenario of 27GW installed capacity, wave and tidal stream technologies could save 61Mt of CO_2 valued at £1.1bn to the UK economy (real, discounted).[5]

Diversity of generation, security of supply and grid balancing: The successful development of marine energy could help ensure a more diverse portfolio of generation technologies. This could increase the UK's security of supply and reduce over-reliance on one type of technology or fuel. Due to their limited contribution to renewable electricity to 2020, marine energy technologies will only contribute to the energy mix in the longer term.

The development of the sector could also provide benefits for grid balancing. For instance tidal energy intermittency is predictable and, with the phasing of the tides around the coastline, could form part of the energy system's baseload to provide bulk electricity to the grid, unlike offshore wind. In addition wave energy is much more predictable over longer periods than wind giving more scope for short-term planning of grid usage. A diversified renewables mix with marine energy as well as wind intermittent generation will likely reduce the need for back-up and reserve capacity, and hence lead to fuel and CO_2 savings. This was supported by the conclusions of a report commissioned from Redpoint by Renewable UK (then BWEA).[6]

Economic and financial benefits: The UK is at the forefront of marine energy with UK companies having a significant marine design and engineering experience and already a sizable share of device developers and patents. In 2008–09, the UK market size for wave and tidal was £78 million, while UK employment in the sector was approximately 600 people.[7]

[4] Analysis referenced by Arup and Ernst & Young, which is summarised in section 2.2 of the UK Renewable Energy Roadmap.

[5] DECC internal analysis.

[6] The benefits of marine technologies within a diversified renewables mix—A report for the British Wind Energy Association by Redpoint Energy Limited, 2009. http://www.bwea.com/pdf/marine/Redpoint_Report.pdf

[7] Low Carbon and Environmental Goods and Services: an industry analysis—Update for 2008/09, Innovas 10, March 2010, URN 10/795.

The successful development of the marine energy sector could lead to a substantial marine energy generation industry in the UK but also a substantial supply chain, a large proportion of which could be based in the UK if the country's technological lead is maintained. This would result in an attractive environment for both domestic and inward investment in manufacturing facilities as well as the potential for UK export to international markets. Development of the domestic facilities will also provide significant opportunity for exports of both technology and knowledge.

The Carbon Trust[8] suggest that, if the sector succeeds in achieving substantial levels of deployment, there is the potential for up to 16,000 jobs arising from the wave industry alone by 2040s with 25% supporting UK exports. Other estimates indicate a potential for around 14,000–19,000[9, 10] direct marine industry jobs, but excluding the supply chain.

The role of Government: The UK is ideally placed to capitalise on the marine energy potential described above. Whilst the industry is not expected to make a strong contribution to the 2020 renewables target, Government support is assisting the industry to establish the basis for commercial scale deployment in the period to 2020. This would enable the technology to contribute to the energy mix carbon reduction targets and economy in the 2020s and beyond.

Innovation Funding And Other Support

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

The wave and tidal stream sector is still at an early stage of development with a few wave and tidal prototypes having been deployed at, or approaching, megawatt scale. Significant development and demonstration of the current technologies will be needed before the sector begins commercial scale deployment. The risks entailed in bringing forward marine technologies are being addressed by Government largely though innovation funding. In addition, once commercial scale deployment of devices commences this will be supported through Government market support mechanisms allowing the sector to reduce costs of generation and move through to commercialisation.

The development of marine energy prototypes carries a very high technology risk, demonstrated by the slow progress of the sector towards testing of full-scale devices. This, coupled with the large cost of developing such prototypes, has made it difficult for prototype developers—mostly SME start-ups some years away from achieving any commercial return—to raise the necessary capital to support development. Indeed, a study by Kreab & Gavin Anderson for DECC[11] showed that the financial markets have perceived the marine energy sector as inherently risky.

It is only recently, with the development of promising near-megawatt scale devices, that major industrial players have begun to invest in the sector. Whilst larger investors are taking more interest, financial modelling carried out by DECC has shown that the first demonstration arrays (ranging in size from 5–10MW) will require both grant and market instrument support to generate the internal rates of return which will be necessary to justify investment from funding partners such as utilities and large industrial organisations.[12] This has been corroborated by commercial information provided by both technology and project developers.

Up to this point the Government has targeted innovation support largely towards the development of large-scale prototype devices. Following the success of the Marine Renewables Proving Fund (MRPF, see below), DECC's focus is now shifting towards the demonstration of a small number of marine technologies through the deployment of small commercial-scale arrays. Government support at this stage of development is needed as, although arrays are the next crucial step towards wider commercial scale deployment, they are viewed as high risk by investors due to their uncertain success rates and considerable cost.

In addition, where demonstration projects are successful, further innovation will often be required, so that the reliability, performance and durability of devices can be improved, before companies can move to commercial scale deployment. Other public funding bodies (eg within the Low Carbon Innovation Group or the Devolved Administrations) will be best placed to address funding gaps for such issues.

Once the sector has entered a commercial scale deployment phase (likely to be in the latter half of this decade) we do not see a strong rationale for continuing grant support to the sector for technology development other than targeted innovation support aimed at cost reduction. Commercial scale deployment of energy devices is more effectively supported under the framework of market incentives which DECC has in place, namely the Renewables Obligation (RO) and, beyond 2017, the outcomes of the Electricity Market Reform.

Coordination of Government Innovation Policy: Given the current constraint on public spending, it is crucial that Government support for marine innovation is well coordinated to focus support in a most effective manner to the sector's need. The Low Carbon Innovation Group (LCIG), which brings together the key organisations

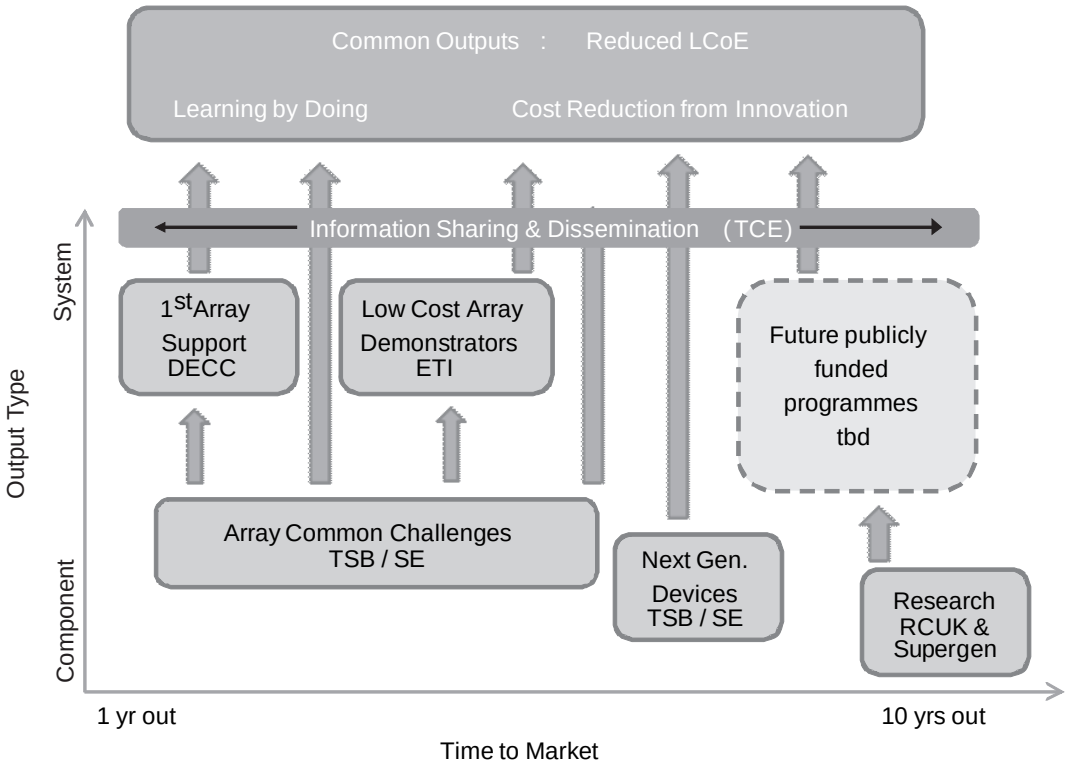
[8] Focus for Success—A new approach to commercialising low carbon technologies, Carbon Trust, 2009.
[9] Offshore Valuation—a valuation of the UK's offshore renewable energy resource, 2010.
[10] Channelling the Energy—A Way Forward for the UK Wave and Tidal Industry Towards 2020, Renewable UK, October 2010.
[11] DECC Wave & Tidal—Investor Survey, Kreab & Gavin Anderson, February 2010.
[12] Cost of and financial support for wave, tidal stream and tidal range generation in the UK—a report for DECC and the Scottish Government, Ernst & Young and Black & Veatch, September 2010.

that use either in whole or in part public funds to invest in low carbon innovation, ensures such a focused, co-ordinated approach to the delivery of UK Government's support.

The core members of the LCIG are: the Technology Strategy Board (TSB), the Energy Technologies Institute (ETI), the Carbon Trust, DECC, Department of Business Innovation & Skills (BIS) and the Research Councils. Each member has a specific remit and brings a unique perspective and skill set to the area. Greg Barker (DECC) and David Willetts (BIS) co-chair the LCIG Steering Board.

Over the last year, one of the key activities for the LCIG has been the development of Technology Innovation Needs Assessments (TINAs). Currently focusing on nine low carbon technologies, including marine energy, the TINAs will provide detailed analysis of the key innovation needs in each technology, an assessment of the likely impact and value of those innovations and an assessment of the need for UK government support in addressing those needs. Key findings from the TINAs are expected to be published in late 2011 or early 2012.

The work to date on the marine TINA together with other sources of evidence and insight have been used by the members of the LCIG in developing plans for a coordinated portfolio of support to innovation in marine energy that together will help address the range of innovation challenges the sector faces. Details of future schemes are still under development but the expected relationship between the planned key marine innovation programmes from LCIG members is summarised in the diagram below.[13]



Overview of Uk Government Policies for Marine Energy

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

Government support for the marine energy has been largely aimed at supporting each stage of the technology development of the sector. A summary of Government support for marine energy is detailed below. This has largely been aimed towards the development of prototype devices—from design through tank testing to full-scale prototype development.

To underpin innovation, the Government, Devolved Administrations and regional authorities have provided support to the UK's marine testing facilities. A package of funding from DECC and BIS totalling £28 million supported the expansion of EMEC in Orkney, the National Renewable Energy Centre (NaREC) in Northumberland and Wave Hub in Cornwall. This has led to the UK possessing a unique device testing, development and demonstration offer which has acted as a draw to overseas device developers.

UK Marine Energy Programme: In January 2011 the Department established the UK Marine Energy Programme. A Marine Energy Programme Board has been created to oversee the development of the Programme and advise Ministers on what actions the Programme should address to advance the industry. The Board is chaired by Greg Barker, Minister of State for Energy and Climate Change, and comprises energy

[13] Developed by TSB in partnership with LCIG.

utilities, industrial companies, technology developers, financiers as well as Government. DECC has worked closely with the Board and its financial working group which have provided evidence to underpin the Department's RO Banding Review. They have also assisted in DECC reaching a decision on the allocation of the innovation funding of up to £20 million for marine energy and will provide advice over the coming months to assist detailed design of the scheme.

Marine Energy Parks: At the first meeting of the Marine Energy Programme Board in January 2011 Greg Barker issued a challenge to the marine energy sector to come forward with plans to develop Marine Energy Parks which would help drive forward the commercialisation of marine energy. The development of marine energy parks throughout the UK will encourage the clustering of activities with the aim of bringing together R&D capabilities, manufacturing, marine energy infrastructure, environmental expertise and other activities to drive the marine sector forward to commercialisation and encourage the development of its supply chain.

Key South West stakeholders are developing proposals to establish the UK's first such park. This public/private partnership aims to mobilise the resources and expertise of the South West and provide strong industry leadership, to attract investment and encourage the growth of a global marine energy industry based in the UK. This model, which will need to be truly sustainable and build on the strengths of the region, could form the basis for other regions looking to establish their own Park. Should any device deployment be associated with plans to create a Marine Energy Park, these would be taken forward through the existing mechanisms which exist for seabed leasing (eg through The Crown Estate) and marine planning and licensing (eg through the Marine Management Organisation and IPC).

Summary of Innovation support initiatives: The Government has provided considerable support to research and development in the wave and tidal sector in recent years. This has led to a significant number of wave and tidal energy devices being pulled through the development process to a point where they are being tested at megawatt scale. It has also led to the UK's unique innovation testing infrastructure thus putting the UK in the position of world leading player in the development, testing and deployment of marine energy.

Innovation support has been provided through a number of channels (see annex A for details). These include:

- The Research Councils' on-going marine energy programmes across EPSRC and NERC and through the Supergen marine programme.
- The TSB's on-going funding for marine projects from which many of the leading device developers have already benefitted, allowing them to bring early-stage devices to pre-commercialisation prototypes stage.
- The ETI's existing marine programmes covering, among other, resource modelling and deployment technologies.
- The Carbon Trust's Marine Energy Accelerator Programme and Applied Research Programme.
- The former Regional Development Agencies and the Devolved Administrations.

In addition, DECC has had a number of funded schemes which were devised to complement and enhance commitment from the members of the LCIG and other bodies such as the Devolved Administrations.

- The £50 million Marine Renewables Deployment Fund (MRDF) was originally set up under the DTI. It aimed to support, through a combination of capital grants and revenue support, the construction and operation of early-stage commercial scale wave and tidal stream projects using technologies that had completed their initial R&D phase. The scheme which opened in 2006 did not receive any suitable applications. The next section highlights the lessons learnt from the MRDF.
- The £22 million Marine Renewables Proving Fund (MRPF), created in 2009, provided grant funding for the testing and demonstration of pre-commercial wave and tidal stream devices. The MRPF has driven forward the development of six of the leading wave and tidal devices, four of which have already been deployed at the EMEC with the remaining two due to be deployed in the next year. The success of the MRPF has paved the way for the sector to begin demonstration of small arrays of devices in the coming three to four years.
- In June up to £20 million marine innovation funding was announced, which, subject to value for money assessment, will facilitate demonstration projects over the next four years. Although details of the scheme remain to be defined, we anticipate it will be based on a competitive process which will aim to support the demonstration of up to two 5–10 MW marine energy arrays. The first small arrays will be critical to accelerating the learning-by-doing elements of cost reduction across the industry, while demonstrating that marine energy can be successfully generated at scale. This programme is expected to be launched in 2012 with the majority of funding available in years 2013–14 to 2014–15.

In addition to UK funding we expect the sector to be supported by European funding from the EU Framework 7 Programme and, potentially, the EU New Entrants' Reserve Fund 300 (NER300) to which DECC recently submitted one wave and three tidal stream array projects for consideration.

These activities have all been designed to complement each other and together they add up to broad and coherent UK government backed support for Marine Energy which should help the sector achieve its potential.

Market support and investment initiatives: The Government has put in place the following market support and investment mechanisms, which have the potential to support the commercial scale deployment of marine energy:

- Renewable Obligations (RO): Under the RO, marine energy technologies receive an enhanced level of support. The Government is currently undertaking a Banding Review to consider the levels of support provided under the RO for all renewable energy technologies, including marine, for the period 2013–17. The Government intends to publish its consultation shortly and announce its decision on banding levels as soon as possible after the consultation ends. The new bands for marine will come into effect on 1 April 2013, subject to Parliamentary and State Aid approval.
- Electricity Market Reform (EMR): "Planning our electric future: a White Paper for secure, affordable and low-carbon electricity" published in July 2011 includes proposals for a new system of long-term contracts in the form of Feed-in Tariffs with Contracts for Difference (FiT CfD), providing clear, stable and predictable revenue streams for investors in low-carbon electricity generation. To provide flexibility, once the FiT CfD is introduced and until 31 March 2017, new renewable generation will have a one-off choice between the RO and FiT CfD. The RO will close to new accreditations on 31 March 2017. No generation will be able to accredit under the RO from that date.
- The Green Investment Bank (GIB) which is currently being developed by Government will play a vital role in addressing market failures, unlocking significant new private investment into green infrastructure projects. Ministers will set the GIB's strategic priorities in due course, to ensure that the Bank remains an effective instrument of green policy. The GIB will be an enduring institution, seeing an acceptable level of return on investment. In time, therefore, commercial scale marine energy deployments could benefit from the GIB investment.

Regulatory initiatives: Last year, the Crown Estate (TCE) announced the successful bidders for the world's first commercial scale wave and tidal leasing round, for eleven sites in Scotland's Pentland Firth and Orkney waters. The 1.6 GW (600 MW from wave and 1000MW from tidal stream) proposed by the developers, could, if developed to full capacity, meet the electricity needs of up to three quarters of a million homes. The Crown Estate is expected to launch a leasing round for Northern Ireland waters later this year.

DECC recently completed the Offshore Energy Strategic Environmental Assessment (OE SEA) for wave and tidal energy in English and Welsh waters[14]. DECC's post-consultation report on the assessment should be published on the SEA website shortly. The SEA for English and Welsh waters will complement the existing work on SEAs for Scotland, Northern Ireland and the Severn estuary. This should open up suitable sites across the UK for consideration for potential deployment of marine energy devices.

These two developments have been key in allowing the sector to begin planning future commercial scale deployment.

Case Study

The role of coordinated Government initiative in pulling projects through to commercialisation

An example of how these complementary initiatives have best been used to achieve success is the Marine Current Turbines' 1.2MW SeaGen tidal turbine. SeaGen, the first full-scale commercial scale tidal energy device to be deployed anywhere in the world, was initially developed with support from the TSB research programme and from the Carbon Trust's Marine Energy Accelerator programme. Successive support from DECC's MRPF, complementary TSB support and the RO have allowed SeaGen to move from unproven prototype to a grid-connected device supplying electricity to Northern Ireland since December 2008.

Lessons Learned from Prior Government Funding of Marine Energy

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

In developing policies and funding instruments to support marine energy the Government has actively sought to include the lessons learned through appraisal and monitoring of previous policy initiatives. Close working with the sector through initiatives such as the Marine Energy Action Plan and the UK Marine Energy Programme has given the government access to data which has allowed us to target our limited resources to address demonstrable market failures and innovation need, in a manner in which it will have the most positive effect.

The development of the MRPF provides a good example of this approach. The fund was created in response to the failure of the sector to access the MRDF (see case study below). When additional innovation funding became available to DECC in 2009, the lessons learned from the MRDF strongly informed the design of the

[14] http://www.offshore-sea.org.uk/site/index.php

MRPF, specifically to address the failure of the sector to progress to large scale prototype deployment and testing. The design of the MRPF also reflected a need to focus limited government support towards the leading devices in the sector so as to maximise progress towards array deployment.

The closer targeting of the objectives of the MRPF on leading devices and specific market failures allowed more effective coordination of the fund with other support measures. For example the support provided to developers under the MRPF was underpinned by further investment in the UK's wave and tidal energy testing facilities and by complementary research calls from TSB, totalling £12 million. The scheme provided six grants with all but one of the recipients due to have deployed their devices for testing this year. The remaining device is due for testing in Orkney next year.

One of the lessons learnt from the MRPF was the benefit of having a "technical services team" of independent experts "mentoring" the projects alongside the Carbon Trust programme managers. Although this added to the apparent programme management costs of the scheme, this was highlighted as a success by several participants as it ensured better delivery against the scheme's objectives, increased reliability of the devices and maximised the value obtained from the projects. We will consider whether a similar approach would be beneficial for future grant funding schemes.

On the basis of the work undertaken under the MRPF we now estimate that several device developers should be in a position to commence deployment of small pre-commercial arrays in the period from 2013 to 2015. This was taken into account in DECC's decision to allocate up to £20 million of its innovation budget to a new scheme which, subject to value for money consideration, will support the demonstration of small pre-commercial wave and tidal arrays. We plan to use the Finance Working Group of the UK Marine Energy Programme Board to provide sector input into the design of the new scheme in the autumn. In doing so we will look to incorporate the lessons learned from the MRDF and the operation of the MRPF.

The Department is also working closely with colleagues in the EU to support the inclusion of wave and tidal energy within EU energy and R&D initiatives. We will continue to use our links with organisations such as Renewable UK, the European Ocean Energy Association, the British Irish Council and the International Energy Agency Ocean Energy Systems Implementing Agreement to promote the UK marine energy sector internationally, to collaborate and to learn lessons from international activities in the sector.

Case Study

Lessons learned from the MRDF

Government funding for wave and tidal energy has largely mirrored the development path of the sector. The exception was the £50 million MRDF, launched in 2006 to support the demonstration of small arrays of pre-commercial wave and tidal energy devices. The scheme was instigated on the basis of discussions with the sector between 2004 and 2006, which asserted that such a support scheme was urgently required to allow the sector to progress to commercialisation. In hindsight the industry claims were premature as developers have found it more difficult to develop, deploy and test prototypes to full-scale than anticipated.

The Department repeatedly faced criticism from the sector that the MRDF entry criteria were too strict and should be relaxed to allow technologies to be able to take advantage of the fund. However, there would have been significant risks with a relaxation of the entry criteria—to both the public purse and to the sector alike. Devices would have been deployed prematurely, leading to a high risk of (catastrophic) project failure. This could have severely undermined investor confidence across the sector (making finance raising for technology and project development even more difficult), risked failure of those companies undertaking premature MRDF projects and wasted public money.

The Renewables Advisory Board (RAB) report on the scheme,[15] concluded that the MRDF was a basically sound scheme and its lack of uptake was not related to its design but to the delays in technology developers progressing devices to a pre-commercial level. DECC addressed the sector's need for funding to develop and prove their large scale prototypes through the MRPF.

Non-Financial Barriers

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

The main non-financial barriers affecting the development and deployment of wave and tidal technologies are centred around planning and consenting requirements, knowledge sharing, grid connection and the development of an established supply chain.

Planning & Consenting: It is clearly necessary to ensure that deployment of marine energy does not cause unacceptable effects on the marine environment. However, the data available on the environmental effects of wave and tidal technologies are limited as individual devices have only recently started to be deployed.

Because of this lack of data a number of different approaches have been adopted by different regulatory authorities for deployments to date. In some cases a more precautionary approach to granting consent and environmental monitoring and mitigation measures has been taken. In others a more flexible "deploy and

[15] Marine renewables: current status and implications for R&D funding and the Marine Renewables Deployment Fund, Renewables Advisory Board, January 2008, URN 08/566.

monitor" approach has been used for the limited levels of deployment to date (largely single test devices). Where a more precautionary approach has been taken the cost of surveys, analysis and reporting are not insignificant to developers. The data being gathered in these surveys are potentially of great value to Government and regulatory authorities and to the industry as a whole. However, these data are not always being shared because of its commercial value and the cost of obtaining it. In response to the current difficulty in data management the Marine Management Organisation (MMO) are currently building up an evidence base for marine planning including gathering socio-economic and environmental information. Having one organisation collate and manage the data will ensure standardisation and consistency. The MMO are working with industry to ensure as much information as possible is shared with Government and regulatory authorities.

The implementation of the Marine Strategy Framework Directive and marine conservation legislation, specifically for Marine Protected Areas, may also have an effect on the deployment of wave and tidal technology (ranging from potentially restricting deployment in specific areas to requiring additional environmental mitigation and monitoring, with associated cost implications). DECC and DEFRA are working together to achieve the right balance between conservation objectives and deployment of offshore renewables.

The Marine and Coastal Access Act 2009 established a framework to manage our seas better and included the introduction of marine planning and a new streamlined licensing system. Marine planning has been introduced to ensure the sustainable development of our seas. It will provide greater certainty for developers, allowing growth, whilst reducing burdens on industry and ensuring cumulative effects of development are within eco-system limits. It will also ensure greater integration with terrestrial planning. The MMO commenced planning in April 2011 in the East inshore and offshore areas between Flamborough Head to Felixstowe. Once a marine plan is in place all licensing decisions must be made in accordance with the plan therefore ensuring decisions are made in a sustainable manner. The new licensing system was introduced on 6 April and the MMO are working with industry to ensure clarity on how these processes fit together.

To consider these and related issues, the UK Marine Energy Programme has set up two working groups covering Planning & Consenting and Knowledge Sharing. These groups will consider measures to ensure an appropriate balance can be struck between protection of the marine environment and the production of marine renewable energy and how to broaden access to data of value across the sector.

The Planning & Consenting working group is led by the MMO and Marine Scotland through their Offshore Renewable Energy Licensing Group (that is also looking at offshore wind). The working group will, among other things, take an overview of licensing and permitting processes associated with deployment of wave and tidal deployment, examine regulatory processes and particularly, identify and propose solutions to issues that affect efficient and timely licensing. The first meetings of the group are expected to take place over the autumn.

The Knowledge Sharing working group is being led by the Crown Estate, working with Renewable UK and other interested parties. The group will explore ideas and discuss the possible creation of a network for knowledge development, based on collaboration and sharing. The first meeting of the working group is scheduled for mid-September

Both working groups will feed back to the Marine Energy Programme Board.

Grid availability: There are currently a number of grid connected marine energy devices operating in the UK. Because these are single devices or relatively small installations (eg EMEC and Wave Hub) connection has been via the distribution network. The next phase of deployment for the sector being small pre-commercial arrays of devices (in the range of 5–10MW) and these will also in all likelihood be connected into the distribution network. It will not be until the sector begins the deployment of much larger commercial-scale array deployments in the latter half of the decade that grid availability and capacity is likely to become a consideration (albeit that project developers will need to factor timing of any needed grid enhancement into their developing business plans at a much earlier stage).

Work is already underway to put in place the changes needed to the grid which may be required to accommodate the general increase in offshore renewable generation expected by 2020. This includes the need for timely and potentially significant investment in the grid, both to bring electricity ashore and to strengthen the onshore transmission network. Given the geographical distribution of marine energy resource the longer term needs of the sector are being included in network company considerations for accommodating the offshore renewables sector.

Further information on offshore grid developments is contained in the Renewable Energy Roadmap[16] (pages 54–56). Electricity transmission network company Business Plans for the period 2013–21 have been submitted to Ofgem. Further information is available at:
http://www.ofgem.gov.uk/Networks/Trans/PriceControls/RIIO-T1/Pages/RIIO-T1.aspx

[16] http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/2167-uk-renewable-energy-roadmap.pdf

Supply Chain Development

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

The Government's planned development of Marine Energy Parks will assist in promoting the development of the UK's supply chain for marine energy. However, that supply chain is still at a very early stage of development as the sector has not yet progressed beyond the manufacturing of single prototypes or pre-commercial devices. It is difficult at this stage to know if the current suppliers for prototypes will end up forming a significant part of the supply chain once manufacturing is scaled up for commercial scale production or whether components and services will be sourced elsewhere. The oil & gas, maritime and offshore wind supply chains are ideally suited to diversify and seek opportunities in the wave and tidal sector because of the synergies between the sectors, particularly in areas such as drive trains, sub components, installation & maintenance vessels and cabling.

By providing the appropriate framework both in terms of regulation and financial support the Government aims to encourage investment and deployment of marine energy technology in the UK to help embed a home based supply chain industry, maintain the UK's lead in the sector and benefit from the potentially substantial export opportunities in the sector once it expands into overseas markets. Confidence in the wave & tidal sector will also build confidence in the supply chain sector and encourage it to invest in innovation and gearing up for commercial scale production.

DECC is working with The Crown Estate and the industry Trade Associations to stimulate a UK supply chain by highlighting the opportunities in the offshore renewables sector through initiative such as: seminars/ workshops, publishing supply chain directories and booklets.

Summary

The Government and Devolved Administrations have provided significant levels of support to developing the wave and tidal stream energy sector in the UK. To date this has largely been directed towards research and development activities aimed at developing successful megawatt-scale prototype devices. This, including the Department's recent £22 million Marine Renewables Proving Fund, has allowed the sector to bring forward a number of promising devices to the point where several are now ready for pre-commercial demonstration in small arrays (5–10MW) over the coming three to four years. This is the precursor to commercial-scale deployment of devices in the second half of the decade which will pave the way for the commercialisation of the sector.

To support the commercial-sale deployment the Government is providing long term support through market-based instruments such as the Renewables Obligation and the outcomes of the Electricity Market Reform process.

In conjunction with this the Government is working with the sector and other key stakeholders, principally through the UK Marine Energy Programme, to address financial and non-financial barriers to the development of a commercial market for marine energy in the longer term.

September 2011

Annex A

EXAMPLE OF RECENT AND FUTURE INNOVATION INITIATIVES BY LCIG MEMBERS

— The Research Councils concentrate on funding projects in the early stages of development. They have recently invested £7.7 million to push marine technology from initial concept through to deployment, including the marine energy Supergen programme. A further £2.4 million budget focuses on the environmental benefits and risks of up-scaling marine renewable energy.

— The Technology Strategy Board focuses on bringing early stage project to a pre-commercialisation prototype stage and many of the leading device developers have already benefitted from TSB funding. Their on-going funding for marine projects (£12 million announced in 2010) supports underpinning technology development, cost reduction and improved performance through innovation. The TSB are in the process of establishing a Technology and Innovation Centre (TIC) in offshore renewable energy, including marine energy. This aims to establish a critical mass of activity in accelerating the commercialisation of new concepts and research, and will be one of a new network of elite centres. The centre is planned to start mid 2012, and will have core funding of its own, but will also competitively tender for public money through competitive funding and private contracts. The TSB and Scottish Enterprise plan a joint programme targeting technical barriers to initial array deployment. This programme, developed in partnership with the industry will develop solutions to common challenges across the industry, such as cabling and electrical infrastructure, installation methods and corrosion/fouling issues. In addition, there is likely to be a "next generation device" programme which will help to bring on individual devices that can step-change the cost of energy in the longer term.

— The Energy Technologies Institute's unique partnership between international industrial companies and the UK Government aims to bridge the gulf between laboratory proven technologies and full-scale commercially tested systems. ETI has launched a range of calls supporting marine energy. Existing programmes cover resource modelling and deployment technologies. Two key further projects are planned to fund tidal and wave array design developments that target whole system levelised cost of energy (LCoE) reduction.

— The Carbon Trust has just reported on its Marine Energy Accelerator Programme first phase following their delivery of the MRPF which helped many of the devices now leading the way to develop their technologies. Through the £3.5 million Programme, the Carbon Trust, working with the industry and developers to progress key component technologies, has set out clear pathways to achieve the future cost of energy reduction needed to make marine technologies competitive with other forms of renewable generation. The Carbon Trust also fund a number of wave and tidal projects under its Applied Research Programme.

Annex B

SUMMARY OF GOVERNMENT FUNDING MARINE FOR MARINE ENERGY[17]

As requested by the Select Committee, this annex summarises the funding which the Government and Devolved Administrations have allocated to development of marine energy over the last 5 years.

DECC Funding

Marine Renewable Proving Fund (MRPF)—Total: £19.5 million to date (Six leading technologies supported)

Marine Renewables Deployment Fund (MRDF)

Below is the funding allocated through the MRDF (Marine Renewable Deployment Fund) for wave and tidal energy performance and standards protocols, contribution towards the construction of the wave & tidal testing facility at EMEC, Wave & Tidal environmental research and a contribution towards the Sustainable Development Commission's Tidal Study.

Contractor	*Description*	*Total*
Hartley Anderson Ltd	W&T environmental research	**£960,000**
EMEC Infrastructure phase 2	EMEC tidal facility (incl extension)	**£934,000**
EMEC Infrastructure phase 1	EMEC wave facility,	**£197,000**
Sustainable Development Commission	SDC Tidal Study	**£132,000**
EMEC Ltd	Draft Performance Measurement Standard for Tidal Stream Devices	**£34,000**
Edinburgh University	Wave energy device performance assessment protocol.	**£25,000**
Edinburgh University	Tidal current device performance assessment protocol.	**£22,000**
EMEC Ltd	Rewrite of Wave Performance Testing Standard	**£11,000**
Total		**£2,315,000**

In addition the management costs of the MRDF totalled £460k (over the life of the scheme, 2005–11). This breaks down into a number of different activities. Overall management charges and tasks related to the demonstration scheme: £205k (this includes the development and promotion of the scheme, evaluating applications and dealing with developer enquiries). Environmental and Related Research: £175k. Advice underpinning policy development: £80k

EMEC phase 3 Infrastructure improvements (2009–10 to 2010–11) for three additional grid connect berths and construction of a four berth non-grid connected nursery site—**Total: £8 million.**

BIS Funding (mostly through the dual-key BIS/DECC Low Carbon Innovation Fund)

Wave Hub—construction of the wave array testing facility:	**Total £9.5 million**
Nautilus—marine drive-train test rig at NaREC:	**Total £10 million**
Hayle Harbour—infrastructure to facilitate marine energy business park: (NB this funding was from the RDA):	**Total £4.5 million**
Plymouth Marine Building—including wave tank: (£0.5 million contribution from the RDA)	**Total £4 million**

[17] Figures based on the latest available data from the specific funding bodies.

RESEARCH COUNCIL FUNDING

Supergen Marine programme for generic research

Supergen Marine Phase 1 2003–07	**Total: £2.6 million**
Supergen Marine Phase 2 2007–11	**Total: £5 million**

TSB FUNDING

TSB has funded 23 projects in the past five years (since 2006/7) in marine renewables, **totalling £20.7 million** of grant allocation, £11.6 million of which has been claimed to date. In addition, there is one project yet to start, comprising a further £1.1 million of grant.

CARBON TRUST FUNDING

Marine Energy Challenge[18]	**Total: £3 million**
Marine Energy Accelerator	**Total: £2.3 million**
Applied research/incubation/Entrepreneur Fast Track[19]	**Total: £2.6 million**

ENERGY TECHNOLOGIES INSTITUTE FUNDING

Total expected "funding" overall (public and private)—**Total marine 2008–17 as at 31/08/11 per the plan £32 million (£16 million public and £16 million private).**

Total funding from the public sector on the marine projects:

(i) to date: **£2 million**; and

(ii) currently committed going forward: **£10 million public funding as per values contracted/ announced.**

Specific breakdown for expenditure at EMEC. **Spend to date £0.3 million total (£0.15 million public & £0.15 million private) and contracted £1.5 million total (£0.75 million public & £0.75 million private).**

NORTHERN IRISH ASSEMBLY FUNDING

Total: £400k—expenditure incurred has been for offshore renewables and not specifically marine. This has been in relation to the Strategic Environmental Assessment, Habitat Regulations Assessment and other related environmental/locational studies.

SCOTTISH GOVERNMENT FUNDING

Wave and Tidal Energy Support scheme (WATES)

£2.5 million—support related to on and offshore infrastructure work (moorings, substations) at the European Marine Energy Centre in Orkney (EMEC).

£7.3 million—grants to wave and tidal technology companies.

Wave and Tidal Energy: Research Development and Demonstration Support (WATERS): Budget £13 million. Approximately **£130,000 disbursed by SE to date**.

Support to the European Marine Energy Centre (EMEC): £5.9 million at Orkney over the last five years.

Saltire Prize:

The £10 million Saltire Prize will be awarded to the consortium that best demonstrates commercially viable wave or tidal stream energy in Scottish waters by achieving a minimum electrical output of 100 GWh over a continuous two year period.

WELSH ASSEMBLY GOVERNMENT FUNDING

Marine Renewable Energy Strategic Framework (MRESF)—£0.9 million: Study to analyse the available practical wave and tidal resource in Welsh territorial waters. The project included research into key data gaps to help with the data confidence levels.

Low Carbon Research Institute Marine Programme (LCRI Marine)—£7 million (2010–13) Marine LCRI has been funded from the Welsh European Funding Office (WEFO) to undertake significant multidisciplinary, pan-Wales research through the Wales Low Carbon Research Institute (LCRI). The £7 million LCRI Marine Consortium aims to enable, support and help build a sustainable marine energy sector in Wales. Programme of applied R&D.

[18] NB The Marine Energy Challenge was the precursor to the Carbon Trust Marine Energy Accelerator. This ran from 2004–06 so a proportion of this funding will have fallen outside the last five years.

[19] NB These schemes have run from 2002 to2011 so a proportion of this funding will also have fallen outside the last five years.

Deltastream Project—£7 million: Direct funding via the ERDF through the Welsh Government towards environmental research, modelling and manufacture of the Deltastream 1.2MW full scale tidal demonstrator. Two awards: £600k in 2009 and £6.4 million in 2011.

Sustainable Expansion of the Applied Coastal and Marine Sectors (Seacams)—£12.6 million (2010–13): Funded via ERDF through the Welsh Government, SEACAMS offers businesses with interests in the marine sector access to the research, expertise and knowledge base of universities in Wales. (This funding is not restricted to marine energy.)

Marine Energy Infrastructure Study—£0.1 million: Forthcoming study appraising marine energy infrastructure requirements to support the development of the marine energy industry and device deployment in Wales.

Additional submission from the Department of Energy and Climate Change

Renewables Obligation Consultation

On 20 October, the UK Government launched its public "Consultation on proposals for the level of banded support under the Renewables Obligation for the period 2013–17" for England and Wales. (see http://www.decc.gov.uk/en/content/cms/consultations/cons_ro_review/cons_ro_review.aspx)

The Government is proposing to introduce five Renewable Obligation Certificates per megawatt hour (ROCs/MWh) for wave and tidal stream energy, up to a 30MW project cap for deployment in the period to 2017. This is an increase from the current banding level of 2 ROCs/MWh. The proposed level of support will help stimulate much needed investment into the sector. The new bands will come into effect on 1 April 2013.

The overall reaction from the marine energy sector has been very positive with some commenting that the five ROCs is the clear signal that investors need to encourage them to enter the sector.

Strategic Environmental Assessment

DECC published its Post Consultation Report for the Offshore Energy SEA2 Environmental Report on 11 October 2011. It can be found at http://www.offshore-sea.org.uk/site/scripts/news_article.php?newsID=46

In light of the final recommendations set out in the post-consultation report , the Department concluded that there are no overriding environmental considerations to prevent the leasing of wave and tidal energy technologies provided appropriate measures are implemented that prevent, reduce and offset significant adverse impacts on the environment and other users of the sea.

The OESEA2 complements the existing work on SEAs for Scotland and Northern Ireland and opens up suitable sites around the UK for consideration for potential deployment of marine energy devices.

November 2011

Memorandum submitted by RenewableUK and Scottish Renewables

Executive Summary

The United Kingdom has a global lead in the marine renewables market, drawing on an extensive skills base, developed supply chain and some of the best wave and tidal resources in the world. However, domination of this potentially global industry is an opportunity which needs to be secured and decisive action is needed to cement the UK's position and maintain its lead over other nations developing interests in the sector.

The marine energy sector is a good example of the UK leading world innovation and it is vital that the commercial benefits are retained. Policy to date has brought forward the first pre-commercial devices and the current challenge is in advancing the industry to commercial scale, via the deployment of the first arrays. This path has been well trodden by other renewable technologies, bringing substantial economic benefits, but marine energy needs key support to grow in the medium term. The industry is at a critical stage and government support is crucial to building a thriving industry. Thus the Government needs to consider two both capital support and revenue support.

The announcement of £20 million of funding through the Department of Energy and Climate Change (DECC) Low Carbon Innovation Fund was welcomed by industry, yet it is less than half the funding previously offered through the Marine Renewables Deployment Fund (MRDF). Experience has shown that for every public sector £1 spent leverages £6 of private investment. In this sense too Government capital support is essential to develop the industry through helping access to private finance.

The new funding should be sufficient to attract enough private funds for one or potentially two 8–10MW arrays to be deployed by 2015. However that level of deployment would not create a large enough market to secure the level of competition required to drive down costs and stimulate further innovation. In addition it would risk manufacturers basing themselves overseas, thus depriving the UK of the opportunity to establish a world leading industrial base in marine energy.

RenewableUK's early work has established the need for approximately £120–130 million of seed corn funding to stimulate a sufficiently robust UK market. While we believe that a higher allocation of DECC's innovation funding would be justified, we believe that the bulk of this should come from alternative sources of Government backed capital, chiefly the Green Investment Bank (GIB). We believe that the GIB may offer the chance to plug any potential gap in funding beyond 2015 by providing a line of specially targeted financial products at smaller higher risk investments such as marine energy,

Consistent and sustainable revenue support is critical to the development of the industry. It is vital that the economics of marine renewable energy continue to attract investment and five ROCs at a 300MW cap is an essential element of the package needed to support the sector. Equally, consistency is required through the period of the current Comprehensive Spending Review and into the Electricity Market Reform period. Without this sustained revenue support, there is a chance that the industry will fail to attract further investment and take advantage of the generous support the UK Government has provided until this point.

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

— deliver continued targeted innovation and cost reduction funding;
— ensure a long term, consistent and sustainable revenue support package;
— encourage involvement of utilities and project management teams, which improve; investor confidence; and
— apply lessons learnt in offshore wind such as enhancing the transmission grid to keep pace with technology development.

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

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

1.1 The UK's substantial wave and tidal resources (25% of Europe's tidal and 10% of Europe's wave potential) present an opportunity to build a world leading industry, with significant benefits to the nation in terms of reducing carbon emissions and furthering economic development. In particular, a thriving marine energy industry would offer the potential to capitalise on the UK's significant global lead in marine energy technologies, utilising our existing supply chains and revitalising the wealth of its maritime legacy.

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

— 4.5GW by 2030 and up to 60GW by 2050 (Carbon Trust, 2011).
— Cost parity with nuclear and onshore wind by as early as 2025 (Carbon Trust, 2011).
— 10,000 jobs and revenues of nearly £4 billion per year by 2020 (RenewableUK, 2010).
— 68,000 jobs and £76 billion revenue to the UK economy by 2050 (Carbon Trust, 2011).

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

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

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

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

2.2 According to a presentation made to DECC's Marine Energy Programme Board, developers Aquamarine Power, Atlantis Resources Corporation, Pelamis Wave Power and Marine Current Turbines have received collectively a total of £33 million public funding over the last 10 years which as in turn leveraged private sector investment of £189 million.

2.3 Without this support, it would have been extremely challenging for these firms to reach the point they have. For example, MCT has used its £9 million of public funding to leverage approximately £31 million from

the private sector. This investment has enabled MCT to develop its tidal turbine technology to the stage that the company is generally acknowledged as world leader in this field with a commercial scale demonstration unit operational for over three years and a detailed plan developed to move forward into commercial production.

2.4 The DECC-led Marine Renewables Deployment Fund (MRDF) failed to support early projects as the selection criteria used in the process were not appropriate for the scale of the industry at the time. This is a mistake that should be learnt from and not repeated.

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

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

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

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

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

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

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

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

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

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

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

4.2 The influx of Original Equipment Manufacturers (OEMs) into the industry over the last two years is a very positive development and a sign that the industry is maturing to the point that major industrials are viewing it as an investment opportunity. Investment in specific projects indicates that they have successfully carried out due diligence and are likely to attract further interest. However, OEMs cannot be expected to close

the funding gap on their own and capital support through the current CSR period is vital to developing the industry.

4.3 The UK Government's commitment to the sector now needs to continue in a different guise as commercial scale projects are developed. There is a rich variety of technologies available now, with most either completing or entering their demonstration phases. The fittest of these will survive but will need to be able to move seamlessly into commercial scale projects if those companies are to survive.

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

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

4.5 It is important to point out that this support is only needed to start the sector. Once development gets underway we expect costs to reduce due to economies of scale, advanced manufacturing techniques and risk premiums reduction.

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

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

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

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

5.2 Technical issues (installation and deployment):

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

5.2.2 The marine environment is amongst the most inhospitable on Earth and all parties need to plan for the hostile conditions experienced. It would be beneficial if more suitable testing locations were developed, or current test centres expanded, to ensure projects can attain the required level of durability. EMEC, Narec and Wavehub have pivotal roles to play here and have advanced projects along the path to commercialisation.

5.3 Grid:

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

5.3.2 Action is required on two fronts:

- Transmission upgrades to ensure the capacity is put in place by 2015–16—particularly in the Pentland Firth and Western Isles.
- Transmission charging which ensures a fair transmission charging regime which does not penalise generators on the periphery of the UK.

5.4 Consenting:

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

5.4.2 The planning system procedures need to be efficient, transparent and easily understandable. Dialogue need to be set up to ensure that renewables can coexist with other marine users, such as the shipping and fishing industries. Public understanding of the issues needs to be enhanced as the expansion of the renewables industry needs support at both local and national levels. It

would be beneficial to the industry if Marine Scotland and Scottish Natural Heritage policy is aligned with UK and Scottish renewables targets.

5.4.3 Further clarity from the Crown Estate on future site releases for wave and tidal energy would also be helpful to support the strategic planning of test and development centres, and we look forward to their consultation on this subject later in the year. The completion of an SEA of English and Welsh waters, coupled with a clear indication from The Crown Estate on how they plan to develop the UK coastline over a number of rounds will, in our view, assist this strategic planning process.

5.4.4 Marine Conservation Zones, Marine Protected Areas and Benthic Zones can be affected and the interactions with wildlife need to be better understood so that environmental risks can be mitigated. Regulators are being put under increasing pressure by the European Commission to ensure that sites designated in the Habitats Directive are properly protected. This could mean that the required level of environmental assessment and post construction monitoring work increases to such a level that it significantly impacts the financial viability of projects. However, scientific evidence indicates that the environmental impact has been minimal and it is to be hoped this will streamline the planning process.

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

6.1 Much of the existing supply chain is in the UK and Aquamarine Power states that more than 90% of the supply chain for its Oyster 800 device was within the UK, while Marine Current Turbines notes that 75% was sourced from UK suppliers and Atlantis Resources Corporation conclude that 77% of the spend on ther AR1000 was with UK suppliers. Some specialist components cannot currently be sourced within the UK and this represents an opportunity to support supply chain development here. The UK has significant design capabilities and all the design for MCT's SeaGen device was carried out in the UK.

6.2 Companies involved in the early UK projects will be far better positioned to win future work here, and to export abroad, therefore a premium should be attached to early initiatives. Given the nature of the technology, it will always be the case that significant amounts of expenditure will be incurred where the devices are deployed. Assembly and testing, commissioning and operation and maintenance will always be local to the turbine site. Structures will often be more economic to manufacture locally thus avoiding transportation costs.

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

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

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

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

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

7.2 The Marine Energy Park approach consists of clustering assets in a particular area, which has been shown to create efficiencies in other sectors. However, there is a danger that regionalizing assets to this extent could fragment the industry as regions are pitted against one another for potentially lucrative contracts. As all other UK government policies are implemented on a national basis, it is vital that the government takes on a coordinating role and ensures that value in the supply chain is retained and developed across the UK.

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

7.4 The costs of the first commercial scale tidal array are estimated to be in the region of £40–80 million for a 5–10MW deployment of up to 10 devices. Capital support of at least 20–25%, together with five ROCs for each MWh of generation and low coat debt, potentially from the GIB, are conditions precedent to attracting the balance of private sector investment.

7.5 Although five ROCs implies high generating costs, there is robust evidence that can confirm the costs will fall to competitive levels given the usual economies of scale and learning curve effects that follow the

"roll out" of a few reasonable sized projects. It is worth noting that typical project size is small enough to ensure that ROC costs remain small but that the ROC benefits will ultimately be very high if they can kick off a major new industry.

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

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

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

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

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

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

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

September 2011

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Memorandum submitted by E.ON

— The UK has extensive energy resources offshore, including marine energy. If the UK is able to develop and optimise use of these resources, while also preserving the marine environment, they could provide a valuable contribution toward meeting the UK Government's aims of delivering secure, affordable and low carbon energy.

— Marine technologies, such as wave and tidal, remain in the early stages of development and need to be deployed through commercial scale projects in order to be successful. E.ON, like many developers, is evaluating a number of specific projects. We have been investing in the commercialisation of marine technologies since 2001 and were the first energy company to deploy a commercial wave device in UK waters in 2010.

— Wave and tidal deployment at full commercial scale presents a number of challenges given the relatively immature nature of these technologies. This includes the ability to manage the risks and costs of R&D and securing early investment from the capital markets, which is required for commercial deployment. In addition to this, developing a strong supply chain infrastructure within the UK and securing consents with relatively limited information remain obstacles for this fledgling sector to overcome. In light of these challenges we believe that it is unlikely that wave and tidal technologies will be commercially viable at a large scale before 2020, especially given the high costs and long lead times for construction.

— We hope that some of these challenges can be overcome through industry and Government collaboration. Effort should be focused on reducing project and product development risk, as well as stimulating cost reduction. Without this, wave and tidal generation will lose momentum and will not catch up with wind and other established low carbon technologies, which could result in a missed opportunity for the UK, both in terms of creating an industrial marine capability and in terms of exploitation of a potentially valuable energy resource.

— We urge the Government to continue to support the development of wave and tidal technologies and believe that if a revenue support level of five ROCs (or equivalent) were provided for both wave and tidal technologies, with a 300 MW limit on the total volume of capacity supported at this level, this would drive both cost reduction in this sector, and support the roll-out of the proposed Marine Energy Park concept of geographically clustering marine energy sector capabilities in other areas of the UK.

Q1. *What are the potential benefits that marine renewables could bring to the UK and should Government be supporting the development of these particular technologies?*

1. By encouraging innovation in the marine renewables sector through wave and tidal technologies, a useful contribution could be made towards meeting the UK's energy and climate change goals. However, enabling this potential contribution to be realised will require improvements in the reliability of wave and tidal technologies coupled with reductions in the costs associated with construction and deployment. Furthermore, it is worth noting that the National Renewable Energy Action Plan includes investment in 1.3 GW of wave and tidal stream technologies by 2020, which is likely to be very stretching, given current low levels of deployment (around 2 MW).[20]

2. The Committee on Climate Change[21] has reinforced the view that UK has significant potential for wave, tidal stream and tidal range generation. They consider the practical potential for wave energy to be 40 TWh/year and tidal range exploitation around the UK (including the Severn) is also estimated at around 40 TWh/year. Unlocking this potential will require the creation of a sustained partnership between Government and industry. As such the Committee on Climate Change has concluded there is merit in the UK supporting demonstration and deployment of marine technologies, based on:

— their assessment of costs which suggests that, by 2040, tidal stream and possibly wave could offer a cost-effective alternative to offshore wind;

— Pöyry's intermittency analysis which suggests that marine energy could usefully add diversity to the generation mix; and

— the Committee's 2010 innovation review which found that the UK has an important role to play in developing marine technologies for both domestic and global markets.

3. We support the Committee on Climate Change view that further support should be provided through the ROC regime or under the new electricity market arrangements. Further R&D funding should also be considered in the context of the next spending review, given the early stage of marine technologies.

Q2. *How effective have existing Government policies and initiatives on marine renewables been in supporting the development and deployment of these technologies?*

4. The previous Marine Renewables Proving Fund (MRPF) was a step in the right direction. It was managed systematically and swiftly and as a result six projects have now been "fast-tracked". However, it was understood to be a one-off fund and continued support is necessary in the short to medium term to nurture this sector and take it to commercialisation. We believe that future support should focus on reducing risk and stimulating cost reduction.

5. We welcome the Government's continued commitment to the marine energy sector, with £20 million of new money being allocated. However, we feel that a mix of solutions is needed in order to support the continued development and deployment of wave and tidal technologies. This mix is likely to need to include Government led revenue and capital support, private equity support and project sponsor equity.

6. We recognise that industry must also have a role. This is why we believe that it is essential that technology developers should begin to work more closely with major industrial companies in order to generate a momentum which will move the sector towards consolidation of design, as seen in the wind industry with

[20] DECC (2010) UK National Renewable Energy Action Plan (NREAP).
[21] Committee on Climate Change—The Renewable Energy Review May 2011

three bladed turbines. The Government could have an important role to play in motivating this group to engage more closely and partner with technology manufacturers, perhaps through tax based incentives accessible as a result of partnering (subject to compliance with EU State Aid rules).

7. The Crown Estate's leasing round for the world's first commercial wave and tidal arrays, across ten sites in Scotland's Pentland Firth and Orkney waters, has had a positive impact through stimulating the industry and promoting the UK internationally. This leasing round was made possible following the completion of a Strategic Environmental Assessment (SEA) for Scottish waters. We urge Government to ensure that a SEA for English and Welsh waters is completed in as short a timeframe as possible in order to enable additional UK based opportunities to be opened up. Furthermore, an update on when Government expect to complete the SEA2 in England would be welcomed by industry.

8. We welcomed the introduction of the Marine and Coastal Access Act 2009, which was in part designed to streamline the offshore planning regime. The introduction of the Marine Management Organisation (MMO) and the implementation of a new marine planning system, if administered correctly, have the potential to avoid delays which can be very costly to developers.

9. The ROC mechanism provides bankable support, which encourages investment in UK energy projects. The favourable ROC regime in Scotland which awards five ROCs to wave technologies and three ROCs to tidal has stimulated a high level of activity north of the border and, coupled with the presence of the European Marine Energy Centre (EMEC), Scotland is already viewed as an emerging world centre of excellence for marine energy.

10. In order to ensure that the rest of the UK does not fall behind, parity should be established with the Scottish ROC regime, which may move towards five ROCs for both wave and tidal technologies, given that the technologies require similar levels of support. Therefore, we call on Government to apply a level of five ROCs for both wave and tidal technologies with a 300 MW limit on the total volume of capacity supported at this level to cap total support costs. This level of support would be key to driving further cost reduction, maintaining investor confidence, and would support the roll-out of the proposed Marine Energy Park concept of geographically clustering marine energy sector capabilities in other areas of the UK. Once the new contract for difference based regime for supporting new low carbon generation is introduced as part of UK electricity market reform, equivalent levels of support should be provided through this mechanism.

Q3. *What lessons can be learnt from experiences within the UK and from other countries to date in supporting the development and deployment of marine renewables?*

Long term stable framework

11. It is essential that a long term view can be taken by technology companies, and their partners, where there is confidence in both the consistency and longevity of the framework for operating in the UK. Where there is inconsistency or unexpected changes in levels of support (as seen with the FiT review's impact on the UK solar industry), confidence may be eroded in the sector which slows both development and growth.

Adapting to change

12. The ability of funding bodies to change and adapt to the needs of an emerging sector as their situation changes is critical. However, it is not just the responsibility of funding bodies to adapt to the needs of an emerging sector, there also needs to be open and honest two-way communication. An example of where this approach could have been better executed is the case of the Marine Renewables Deployment Fund (MRDF).

13. Following industry consultation the MRDF was intended to provide capital support for commercial scale arrays. However, much of this funding went unspent as the sector was not able to adequately meet the requirements that had been set. Therefore, a key lesson for the sector is the need to be realistic about what is achievable and over what timeframe.

Lessons from Danish wind industry development

14. There are important lessons to be learnt by comparing the development of the UK and Danish wind energy industries including the need for a long-term position on support, which thereafter needs to be consistently applied to provide a market push at the early prototype stage and complemented by a revenue pull.

15. A number of these lessons have been learnt for offshore wind in the UK, notably by providing a large long term market opportunity through Round 3, the ability for investors to earn a fair return commensurate with the risks, and funding to upgrade logistical assets (eg ports) to attract tier one manufacturers to the UK. The same measured approach should be adopted by the UK Government with the marine sector in order to ensure we can take the lead and develop a sustainable industry.

Q4. *Is publicly provided innovation funding necessary for the development of marine technologies and if so, why?*

16. If the UK economy is to extract real value from this sector, the Government needs to continue to demonstrate a clear commitment to supporting the early stages of its growth in order to foster investor confidence in its long term industrial significance.

17. Continued capital support is needed to ensure a healthy market of competitive technology options if the investment risk is to be spread across an appropriate portfolio.

Q5. *What non-financial barriers are there to the development of marine renewables?*

The lack of a UK wide Strategic Environmental Assessment (SEA)

18. Further clarity from The Crown Estate on future site releases for wave and tidal energy would help support the strategic planning of test and development centres, and we look forward to their consultation on this subject later in the year. The completion of an SEA of English and Welsh waters, coupled with a clear indication from The Crown Estate on how they plan to develop the UK coastline over a number of rounds will, in our view, assist this strategic planning process.

Access to Grid Connections

19. The grid transmission infrastructure must receive adequate investment to connect regions with high resource potential. It is important that Ofgem and other key stakeholders support strategic investment in the grid where the potential for projects being deployed is high.

20. One particular hurdle that we have encountered in relation to our activities in the Pentland Firth and Orkney Waters, is the fact that we are required to accept the full liabilities for the cost of building the additional capacity in the event that a generating asset is not connected to the transmission network. Given the nascent and unproven nature of commercial wave and tidal arrays, accepting this level of risk is incredibly challenging for project developers and their investors. Therefore, we would flag this as a critical area where perhaps creative risk sharing initiatives could be employed which may involve Government playing a role. There may also be a role for Active Grid Management solutions here which may represent a relevant area for Ofgem's Low Carbon Network Fund to fund projects which could reduce the need for full capacity upgrades.

Planning and Consenting

21. Environmental monitoring of early stage projects presents a hurdle to developers that may discourage investment decisions and thus growth of the sector. The 2010 joint Government and Industry Marine Energy Action Plan (MEAP) identified a number of ways in which the disproportionate cost burden associated with the precautionary principle can be avoided. There is a need to develop the sector whilst understanding the practical effects of marine energy devices on the environment. This can best be achieved through a "deploy and monitor" approach.

22. Government should apply appropriate and co-ordinated requirements that do not demand unnecessary continued monitoring if initial results demonstrate a negligible environmental impact. Proactive early engagement from developers and utilities coupled with openness from statutory consultees is critical.

23. The absence of comprehensive life-cycle data concerning the environmental impact of wave and tidal technologies makes judging risks more uncertain for executive agencies such as Marine Scotland and the MMO. In light of this we feel that it is important that such agencies take a measured approach in weighing up evidence and managing uncertainty around knowledge gaps. Nonetheless, we welcome the MEAP recommendation to form a UK-wide strategic coordination group to develop a planning and consenting roadmap for all types of marine renewables. We believe that such a group is vital in order to ensure consistency and proportionality.

The need for a more integrated approach to utilisation of port infrastructure

24. With the support of both the UK and Scottish Governments, the UK boasts some of the best test facilities in the world, namely EMEC, NaRec and Wave Hub. To truly maximise the UK's potential, a more tightly co-ordinated approach to deploying and using infrastructure is required, taking into account the characteristics of a particular environment. For a marine energy industry to flourish, there should be more focus on upgrading key port and harbour facilities specifically to benefit renewable energy scheme deployment. This includes both marine energy and offshore wind. We welcome the announcement in the 2010 spending review that up to £60 million would be available for the establishment of offshore wind manufacturing at ports in assisted areas of England.

25. We also welcome the MEAP recommendation for Government, Devolved Administrations and other relevant stakeholders in the sector that they should capitalise on opportunities for marine energy by learning from and building on synergies related to the skills and supply chain for offshore wind. There is an important role here for the recently established Marine Energy Programme Board (MEPB), chaired by the Minister of

State for Climate Change, to draw together cross sector expertise to identify both risks and opportunities and act as a Government/industry partnership.

Q6. *To what extent is the supply chain for marine renewables based in the UK and how does Government policy affect the development of these industries?*

26. Participants in the marine energy supply chain have begun to cluster around areas of rich marine energy resource and testing facilities in the UK.

27. However, the area where there is currently the greatest concentration of supply chain participants is in the Orkney Islands. This is driven by the presence of EMEC, an attractive revenue incentive regime (ie multiple ROCs for marine energy) and a completed Strategic Environmental Assessment and Licensing round.

28. This outcome illustrates the key ingredients which can foster the clustering of the marine energy supply chain in the UK:

— proximity to accessible marine energy resource;
— attractive level of revenue support (with long term certainty);
— SEA completed and licenses made available; and
— world class testing sites and academic institutions operating nearby.

Q7. *What approach should Government take to supporting marine renewables in the future?*

29. There are three key funding challenges that exist in the UK's support framework, which relate to the stages of industry development as outlined in RenewableUK's October 2010 report: *Channelling the Energy—A Way Forward for the UK Wave & Tidal Industry Towards 2020.* A stable financial framework which provides parity across Great Britain from a ROC level perspective, underpinned by the following mixture of capital and revenue support could contribute to ensuring that the UK remains ahead of the rest of the world. This requires a coordinated approach across Government (DECC, BIS and HMT) to establish a unified vision for the future of the marine energy sector in the UK and closely co-ordinate policy action. E.ON would advocate the following approach to supporting marine renewables in the future:

30. **Provide continued capital support for first and next generation prototypes**. At the current stage of marine industry development, the greatest need is for capital grants that create a market push. Capital support is vital as devices require continued support through the R&D stage; particularly when devices are ready for open ocean deployment, at which point capital needs to rise rapidly. At this point the initial risk exposure is high, and therefore developers require capital support to de-risk investment in technology development. Whilst the capital support recently announced by the Government is welcome, it will need to be sustained in the medium term as the sector moves towards technology consolidation, as experienced previously in the wind energy industry.

31. **Blending both capital and revenue support to enable the first wave/tidal farms.** At this stage both a technology push and market pull are required. The availability of revenue incentives will play an important part in making these first arrays economically viable. However, because electricity production from the first arrays will be unpredictable, making revenue incentives alone insufficient, capital grants will also still be required to help reduce the amount of developer capital at risk. Continued Government support will help to make marine projects more attractive investments and comparable with other renewable energy generation options.

32. **Sustained level of revenue support to provide confidence in second farms and beyond.** By this point we would anticipate the sector to be mature enough to work on a market pull alone and projects could start to move towards attracting debt finance. In turn this will deliver associated cost reductions that would reduce the level of revenue support required. We would like to see a revenue support review at this point. With this integrated support package the UK will be able to build a successful, well developed and sustainable marine sector, for both domestic use and export.

September 2011

Memorandum submitted by Aquamarine Power

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

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

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

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

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

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

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

Executive Summary

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

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

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

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

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

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

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

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

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

- 4.5GW by 2030 and up to 60GW by 2050 (Carbon Trust, 2011).
- Cost parity with nuclear and onshore wind by as early as 2025 (Carbon Trust, 2011).
- 10,000 jobs and revenues of nearly £4 billion per year by 2020 (RenewableUK, 2010).
- 68,000 jobs and £76 billion revenue to the UK economy by 2050 (Carbon Trust, 2011).

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

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

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

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

2.2 Aquamarine Power, Atlantis Resources Corporation, Pelamis Wave Power and Marine Current Turbines have received collectively a total of £33 million public funding over the last 10 years which has in turn leveraged private sector investment of £189 million.

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

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

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

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

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

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

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

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

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

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

— Maximum use of existing expertise and synergies.
— Support for infrastructure development such as ports.

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

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

4.2 The UK Government's commitment to the sector now needs to continue in a different guise as commercial scale projects are developed. There is a rich variety of technologies available now with most of the serious ones either completing or entering their demonstration phases. The fittest of these will survive but will need to be able to move seamlessly into commercial scale projects if those companies are to survive.

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

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

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

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

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

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

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

5.2 Technical issues (installation and deployment):

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

5.3 Grid:

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

5.3.2 Action is required on two fronts:

— Transmission upgrades to ensure the capacity is put in place by 2015/16—particularly in the Pentland Firth and Western Isles.
— Transmission charging which ensures a fair transmission charging regime which does not penalise generators on the periphery of the UK.

5.4 Consenting:

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

5.4.2 The planning system procedures need to be efficient, transparent and easily understandable. Dialogue need to be set up to ensure that renewables can coexist with other marine users, such as the shipping

and fishing industries. Public understanding of the issues need to be enhanced as the expansion of the renewables industry needs support at both local and national levels. It would be beneficial to the industry if Marine Scotland and Scottish Natural Heritage policy is aligned with UK and Scottish renewables targets Clarity is still to be delivered by Marine Scotland on the operation of its Survey, Deploy and Monitor policy.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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September 2011

Memorandum submitted by Energy Technologies Institute

SUMMARY

1. The Energy Technologies Institute's (ETI) modelling of future UK energy system options consistently highlights marine as a potential part of future UK electricity generation base alongside major contributions from fossil fuels with Carbon Capture and Storage (CCS), bioenergy, nuclear and wind.

2. In the context of (3) and (4) below, marine energy can be seen as important for the UK but not the highest priority or lowest risk development for establishing the country's future energy system. It is however an important part of potential "hedging options" to ensure the UK has a balanced portfolio of fuel and electricity sources available to ensure delivery of sustainable, secure and affordable energy for consumers.

3. Tidal stream energy appears as a significantly more important development than wave energy and occurs in around 75% of potential 2050 system design options identified through ETI's "ESME" modelling. ESME focuses on identifying the lowest cost options for the UK's energy system out to 2050 and the likelihood of deployment of specific technologies. Wave energy appears in less than 50% of potential system options.

4. ETI assessment of UK energy system options for 2050 estimates the additional system costs to the UK of not introducing marine energy systems (wave and tidal) as between £0.1 billion and £0.4 billion per year by 2050 (in money of 2010). The equivalent "option value" for nuclear energy is £5–10 billion per year and for CCS over £60 billion per year. Nuclear and CCS appear in over 98% of system design options.

5. In the event that a constraint develops in the take-up of other generating sources such as nuclear, biomass or onshore wind then the "hedging option" of marine energy will become more important.

6. Achieving cost competitiveness with other generation systems will be critical if marine energy is to be available as anything more than a "niche deployment" in the UK. To sustain commercial investor engagement the marine energy industry must demonstrate in the next five to eight years the potential to move towards a cost competitive position compared to other low carbon energy sources—particularly offshore wind.

7. Intervention is needed to support immediate activity to demonstrate cost reduction approaches for installation, deployment and through-life maintenance of arrays of devices. ETI is currently developing new projects to enable cost reduction on array installation and through-life operation. ETI has already invested over £21 million in marine energy development and demonstration projects.

8. Until significant cost reduction has been demonstrated on arrays the industry will not be able to deliver electricity which is competitive to alternatives without some form of subsidy. Continued medium to long-term support through the ROC system (or similar) will be essential to incentivise and reassure project developers, financiers and engineering developers who will have other investment options.

9. As well as incentives for electricity delivery the Government must send continued signals of assurance, favourability and long-term consistency of policy towards the sector to ensure major industrial groups will commit continuing support and business engagement.

10. These signals must address all critical elements of the technology, supply-base and project deployment value chain. The development of the Offshore Renewables Technology Innovation Centre (TIC) is an important part of this to encourage technology investment in the UK whilst a "premium" level of ROCs (higher than today) for Marine Energy is likely to be necessary to demonstrate commitment and accelerate initial project developments.

Context

11. Marine energy systems offer the potential for production of electricity from a fuel source (tidal stream or wave) which is "free" although intermittent and only partially predictable. Tidal energy can be considered a more valuable market commodity than wave since tidal flows are generally very predictable (months, years in advance) whereas wave is only predictable to any degree of accuracy a few hours ahead of real time. The UK has some of the largest marine energy resources in the world, particularly off North Scotland and the South-West of England and Wales.

12. The skills for developing, manufacturing, installing and supporting marine energy devices, systems and installations are largely available within the UK's existing marine and offshore industries however delivering these skills through safe practices using cost effective assets (boats, ports etc) is critical if marine energy is to deliver electricity which is cost competitive with other sources.

13. The UK has a significant capability base in marine energy which is being exploited on a global basis. Until recently the industry has been largely dominated by UK SME groups. There are however, now a number of device developers and deployment specialists from mainland Europe and North America entering the UK market coupled with a growing range of multi-national equipment supply groups acquiring UK SME capabilities. This is an important development in ensuring effective scale-up of capability and reflects a degree of increasing industry confidence, however, the majority of these groups are entering the market on the basis of the ability to attract government support for technology development. There is very limited wholly private financing of technology developments and demonstrations.

14. The ETI carries out modelling and analysis of the UK energy system to allow identification of key challenges and potential solutions to meeting the UK 2020 and 2050 targets at the lowest cost to the UK. Where there is additionality the ETI then invests in major engineering and technology demonstration projects which address these challenges with the aim of reducing risk—both in technology and in supply-chain development—for subsequent commercial investors.

15. The ETI's UK energy systems modelling focuses on establishing the most cost effective options for the UK. The ETI's system modelling toolset ("ESME") has been assessed alongside other tools available to HMG and shown to provide a unique viewpoint for presenting system level choices, uncertainties and eventual economics, together with analysis of the required supply chains. Tidal stream, wave and tidal range (barrages) are included in ETI's modelling.

Potential Contribution of Marine Energy to Delivering UK Energy Goals

16. The ETI's modelling of future UK energy system options consistently highlights marine as a potential part of future UK electricity generation base alongside major contributions from fossil fuels with Carbon Capture and Storage (CCS), bioenergy, nuclear and wind (onshore and offshore). Tidal stream energy systems appear as a significantly more important development than wave energy systems and occur in around 75% of potential 2050 system design options identified through ETI's ESME modelling. Wave energy appears in less than 50% of the potential system options.

17. ETI assessment of UK energy system options for 2050 estimates the likely additional system costs to the UK of not introducing marine energy systems (wave and tidal) is between £0.1 billion and £0.4 billion per year by 2050 (in money of 2010). This is termed the "option value". For comparison the equivalent option value for nuclear energy generation is of the order of £5–10 billion and for Carbon Capture and Storage over £60 billion.

18. The likely level of marine energy capacity deployed in 2050 appears to be between 5GW and 10GW nominal capacity, depending on the ability to establish early cost competitiveness (in the cost of electricity delivered to the grid) compared to alternatives such as offshore wind.

19. Achieving cost competitiveness with other generation systems will be critical if marine energy is to be taken up as anything more than a "niche development" in the UK. The ETI has worked extensively with the UK offshore renewables industry and trade associations to develop a robust view on the targets the industry must address to make a significant impact in the UK energy market. These targets have been documented and published in the "ETI/UKERC Marine Energy Technology Roadmap" published in November 2010.

20. The ETI/UKERC Marine Energy Technology Roadmap sets a 2050 target for the Levelised Cost of Energy (LCoE) from Marine of 5–8p/kWh. This would be competitive with anticipated costs for offshore wind.

21. Without intervention from outside the industry the Levelised Cost of Energy (LCoE) for tidal stream is expected to be in the range of 6–13p/kWh by 2050 and higher for wave energy. This wide range indicates the degree of uncertainty in how the industry might develop. At these levels marine energy is unlikely to be viewed as a competitive electricity source and the industry will not be viable without significant, long term subsidy.

Effectiveness of Interventions to Date

22. Government support to date has been effective at enabling the establishment of a number of UK power conversion device developers (tidal stream and wave). Most of these groups are SMEs. The challenge for these companies now is two-fold:

(a) demonstrating reliability, efficiency and cost effectiveness on their particular machines and;

(b) establishing adequate business development and scale-up capability to allow them to provide effective delivery and support to longer term array development and system deployment projects.

23. The steady engagement of major private sector utilities and engineering manufacturers with many of the UK's leading (SME) device developers suggests there is confidence in the embryonic technology and these groups have the capabilities to ensure that both of the challenges above are addressed effectively. On this basis there appears to be a limited case for continued Government support for device development. The critical issue now is ensuring a strong focus on array deployment, demonstration and cost reduction.

24. The Low Carbon Innovation Group under the leadership of DECC and BIS is proving to be a valuable vehicle for sharing strategic information and developing opportunities for communication and integration of investment plans and policy development by a number of groups linked to the public sector. ETI was a founding member of the LCIG along with the Carbon Trust and Technology Strategy Board. ETI's ESME modelling system is being used by the LCIG to inform technology investments across a number of areas including marine energy.

Required Action

25. The next five to eight years will be a critical phase in development of the marine energy industry. If the industry cannot demonstrate in this period the potential to move towards a cost competitive position then it is unlikely to progress against competition from other low carbon sources—other than as a niche solution in very specific geographic locations where either alternatives are not practical or there are local economic and social development reasons for subsidies. In either case affordability will be challenging for consumers and government.

26. Intervention is needed to support immediate activity to demonstrate cost reduction approaches for installation, deployment and through-life maintenance of arrays of devices. Without near-term improvements in these areas potential array project finance support from the investment markets is likely to reduce as increasing commitments are made towards alternatives such as wind projects (offshore and onshore) which will be perceived to offer lower risk on returns. It is critical that strong focus is created on array deployment, demonstration and cost reduction.

27. ETI is currently developing new projects to enable cost reduction on array installation and through-life operation for both tidal stream and wave. ETI has already invested £21 million in Marine Energy system and sub-system development and demonstration projects.

28. The marine energy industry remains immature and the extent to which major industrial groups will commit continued support will be dependent on perceived assurity, favourability and long-term consistency of Government policy towards the sector.

29. Until significant cost reduction has been demonstrated on arrays the industry will not be able to deliver electricity which is competitive to alternatives without some form of subsidy. Continued medium to long-term support through the ROC system (or similar) will thus be essential to incentivise project/array developers, financiers and engineering developers who will have other investment options. A "premium" level of ROCs (higher than today) for Marine Energy is likely to be necessary to demonstrate commitment and accelerate initial project developments.

30. In parallel with ensuring consistent long-term policy ("demand and return") signals are sent to industry it is important that the relevant national issues of appropriate grid connections, manufacturing sites, installation support infrastructures and technology development support (science base and test facilities) are considered and appropriate solutions committed ahead of need. This will be a key element in both ensuring early development of the industry and ensuring that economic value is captured in the UK rather than being allowed to transfer into other countries.

31. The ongoing development of the Offshore Renewables TIC (Technology Innovation Centre) by the Technology Strategy Board is an important part of ensuring the UK engineering, technology and science base is seen as a significant benefit to major engineering, manufacturing and product support companies who will be considering global industrial development options—both on whether to invest in Marine Energy and whether to then invest in the UK or elsewhere.

32. Ongoing support for skills and capability development will be important. This can build effectively on the wide range of programmes and centres being developed to support the offshore wind industry. For instance, the recently launched £6.5 million Industrial Doctorate Centre in Offshore Renewables being funded by the ETI at the Universities of Edinburgh, Strathclyde and Exeter will deliver training which will aid in creating future leaders in both the Marine and Offshore Wind industries.

Context and Background on ETI

33. The ETI has two modes of operation—(1) modelling and analysis of the UK energy system to allow identification of key challenges and potential solutions to meeting the UK 2020 and 2050 targets at the lowest cost to the UK, and (2) investing in major engineering and technology demonstration projects which address these challenges with the aim of de-risking solutions—both in technology and in supply-chain development—for subsequent commercial investors.

34. ETI has six industry members (BP, Caterpillar, E.ON, EDF, Rolls-Royce and Shell) who offer complementary capabilities in the energy area. Their financial support (£5 million per annum each), skills, business capabilities and market access routes are made available to the Government through the ETI partnership structure. HMG (through BIS) provides matching support to industry member financial contributions. ETI invests in projects as a commercial entity, it is not a grant awarding body.

35. ETI's in-house strategic modelling capability has been developed with the strong involvement of the UK industrial base (not just ETI Members). The ETI capability addresses the full UK energy system and centres on first developing robust, shared understanding of critical issues for the UK in reaching 2020 and 2050 energy targets.

36. Having identified the key engineering and technology barriers associated with achieving the 2020 and 2050 goals the ETI then establishes projects to demonstrate potential solutions to these challenges. This approach forms a key part of demonstrating the industrial capabilities needed to meet the UK's future needs, incentivising industry by informing them of the potential business opportunities and creating the embryonic supply-chain and skills to deliver solutions for the UK.

37. To date the ETI has invested in over £128 million of projects to benefit the UK. £21 million of these are targeted at Marine Energy systems. ETI is currently developing further projects targeted at reducing the cost and risk in deployment of future arrays of tidal and wave devices.

38. Uniquely, the ETI's energy system modelling focuses on identifying the lowest cost solutions to the UK and provides an assessment of the option value of key technologies in the 2050 energy system (ie; answering the question "what is the cost to the UK of NOT implementing a specific technology?"). The primary modelling tool is a bespoke toolset developed by the ETI and termed "ESME".

39. ETI modelling was used by DECC in support of its 2050 pathway work and also supported the Committee on Climate Change (CCC) development of the fourth Carbon budget proposals and the recent CCC Renewables Review. The ongoing "Technology Innovation Needs Analysis" activity on marine led by DECC is also using inputs from the ETI ESME system. The ETI modelling systems have been successfully peer reviewed by an international review team led by Imperial College.

September 2011

Memorandum from Research Councils UK

1. Research Councils UK (RCUK) is a strategic partnership set up to champion research supported by the seven UK Research Councils. RCUK was established in 2002 to enable the Councils to work together more effectively to enhance the overall impact and effectiveness of their research, training and innovation activities, contributing to the delivery of the Government's objectives for science and innovation. Further details are available at www.rcuk.ac.uk.

2. This evidence is submitted by RCUK and represents its independent views. It does not include, or necessarily reflect the views of the Knowledge and Innovation Group in the Department for Business, Innovation and Skills (BIS). The submission is made on behalf of the following Councils:

— Engineering and Physical Sciences Research Council (EPSRC).

— Natural Environment Research Council (NERC).

Executive Summary

3. The EPSRC led RCUK Energy Programme aims to position the UK to meet its energy and environmental targets and policy goals by investing in world-class research and postgraduate training. The RCUK Energy Programme supports a substantial portfolio of activities, bringing together researchers from many disciplines to tackle the research challenges involved in developing and exploiting energy technologies and understanding their environmental, economic and social impact. In this submission marine renewable energy refers to wave and tidal energy as per the Inquiry announcement and does not include offshore wind or bioenergy. Marine renewable energy research that is supported as part of this balanced portfolio can be found in Table 2, Annex two at the end of this document.

4. According to the offshore valuation report[22] marine renewables have the potential for contributing up to 192TWh of electricity to the UK grid, and could support between 5,000 and 26,000 jobs depending on the level of deployment. Whilst the cost of marine renewables is currently high, 2050 levelised costs are predicted to be between 8 pence and 12 pence per KWh. The research supported by the research councils is focused at tackling the fundamental scientific challenges that need to be overcome in order to meet these cost reduction targets.

5. The Research Councils currently support £17 million of ongoing research in marine renewable energy. Our research portfolio includes most marine renewable energy technologies, covering the environmental, engineering, economic and policy aspects of the technologies. The exploitation of the research we support is important and the Research Councils work closely with the Energy Technologies Institute, the Technology Strategy Board, Government and industry to coordinate the support for fundamental research through to development and application. Marine renewable energy is supported through the EPSRC SUPERGEN programme (since 2003), through the UK Energy Research Centre (UKERC) portfolio, and through the NERC Knowledge Exchange Marine Renewable Energy programme set up in 2011 to support the translation and uptake of research relevant to marine renewables.

6. An important objective of the RCUK Energy Programme is to develop and maintain high level skills through support for postgraduate training. The provision of this skills base is key to the future economic viability of the marine renewable energy and the demand for qualified marine engineers is high. The Research Councils all support studentships in marine renewable energy. In August 2011, EPSRC and the Energy Technologies Institute announced a new £6.5 million Industrial Doctorate Centre in offshore energy to develop the next generation of research and industry leaders in this area.

7. Supporting evidence for this submission was taken from the reports listed in Annex 3.

Introduction

8. The Research Councils play a key role in supporting the fundamental science that underpins energy research that will position the UK to most effectively develop and exploit technology advances. By its nature the technical and scientific challenges addressed through fundamental research will have an impact on the economics and sustainability of renewable energy.

9. The contributions of science to the development of marine renewables include:

— Understanding the energy resource that is available and that can be realistically extracted.

— Providing monitoring capability both for the impacts of deployment and mechanisms for mitigation and de-risking new technologies

— Mechanical and electrical engineering provide understanding of the design of devices and how power can be taken on-shore.

— Underpinning fundamental science leading to new and potentially transformative designs and technologies.

— Providing knowledge on wave and tidal conditions, as well as the surrounding environment, to enable the most effective deployment of devices.

[22] http://www.offshorevaluation.org/downloads/offshore_valuation_full.pdf

— Providing knowledge of the behaviour of individual devices and of arrays.

— Environmental science to consider the whole system when developing and deploying renewables (for eg optimising marine space use to accommodate fisheries, transport and other industrial activities as well as the deployment of renewable devices).

— Issues affecting regulation and consenting for deployment, including impacts of noise (for eg from pile driving) and other potentially negative impacts.

10. Historically the Research Councils have concentrated their funding in marine renewables through the EPSRC SUPERGEN Marine programme[23] and NERC research centres.[24] SUPERGEN has been running since 2003, has received over £8 millions of support and has led to advances in resource modelling, electricity take-off from devices and arrays, device control and engineering, moorings, the environment impact of marine renewable energy extraction and the economics of marine energy. The NERC National Oceanography Centre in Liverpool (NOCL) has extensive experience researching the potential impact of renewable energy structures on the marine environment. Early work included assessments of the power available to various tidal power schemes proposed for the Bristol Channel and current work is looking at the potential for the Eastern Irish Sea. Other relevant work[25,26,27] at NERC research centres has been has been funded via the Oceans 2025 programme.[28]

11. Support for marine renewables in recent years has been both focused, to coordinate the science research, and broadened to include aspects of policy, environmental impacts and arrays. In addition to this, investment in mid-scale test facilities has been made to address identified gaps in the research capability.

12. Significant Research Council activities in marine renewables include:

— A newly supported £3 million SUPERGEN Marine Hub which will coordinate university-led research in marine renewable energy whilst engaging closely with industry and other stakeholders. This will include the successful proposals from a recently closed £3 million call for underpinning challenges in Marine renewable energy.

— NERC/Defra joint Marine Renewable Energy Research Programme:[29] This programme works with the technological development of wave and tidal energy, using existing facilities and industry data, to predict the cumulative environmental interactions which result from deploying "wet renewables". Projects arising from this programme are focussed on understanding the environmental benefits and risks of up-scaling marine renewable energy schemes on the quality of marine bio-resources and biophysical dynamics of open coasts

— The NERC Marine Renewable Energy Knowledge Exchange Programme (MRE KEP),[30] will catalyse the development of stronger partnerships between the academic, public and private sectors; provide the private and public sectors with access to potential suppliers of the most up-to-date academic research in this field; facilitate public, private and academic sectors in integrating policy, business and research needs and support the private and public sectors in delivering a sustainable future for marine renewable energy. The MRE KEP is working in partnership with the Offshore Renewable Research Steering Group (ORRSG), a cross department group managed by the Marine Management Organisation and involving Defra, DECC and The Crown Estate among others.

— Resource and sea bed mapping: this survey work provides information to organisations planning offshore renewable energy projects and to guide policy and planning decisions for future site leasing rounds eg the NERC National Oceanographic Centre worked with the Met Office, ABP-MER and Garrad Hassan to map the UK's wind, wave and tidal resources in the widely acclaimed Atlas of UK Marine Renewable Energy commissioned by BERR;[31] the NERC supported British Geological Survey is developing seabed geology maps to underpin the assessment of our marine resources and provide an important part of the framework for marine planning.[32]

— A new £6 million combined wave and current test facility, supported by EPSRC has been commissioned at the University of Edinburgh that will model both wave and tidal devices and arrays at ~1/16 scale in conditions that model the most severe environments that will be encountered during deployment off UK shores. This facility will complement a facility being constructed at the University of Plymouth which will model the environmental impact of devices and small arrays at similar scales.

— A new EPSRC-ETI £7 million Industrial Doctoral Centre in Offshore Renewables will supply 50 doctoral students into the marine sector over the next eight years equipped with broad industrial experience and a good understanding of the marine sector.

[23] http://www.supergen-marine.org.uk/drupal/
[24] http://noc.ac.uk/; http://www.pml.ac.uk/
[25] http://www.pol.ac.uk/coin/
[26] http://www.pol.ac.uk/home/research/theme6/wp61.php
[27] http://www.mba.ac.uk/simslab/res_mpa.html
[28] http://www.oceans2025.org/
[29] http://www.nerc.ac.uk/research/programmes/mre/
[30] http://www.nerc.ac.uk/using/keprog/mre.asp
[31] http://www.renewables-atlas.info/
[32] http://www.bgs.ac.uk/research/marineAndCoastal_gm.html

13. A table of the annual expenditure by the research councils on marine energy and a comprehensive list of current research projects can be seen in Annex 2.

Q1. *What are the potential benefits that marine renewable could bring to the UK and should Government be supporting the development of these technologies?*

14. As stated in the inquiry notification the Carbon Trust[33] estimate that 15–20% of UK electricity could be generated by marine renewables. Although this represents a much smaller resource than offshore wind it is more regular and dependable, especially tidal energy. As such marine renewables have a role in moderating the intermittency issues of wind.

15. The location of the UK means that about 10% of global available marine renewable energy is located within the UK's coastal waters, with the Pentland Firth having one of the largest flows of water globally and the river Severn having the second largest tidal range of any river globally. This positions the UK well to develop wave and tidal power using its resources, to deploy these approaches in other markets in the future.[34]

16. The UK is currently one of the leading countries in developing marine renewables. This technology lead is built on a strong scientific, maritime and offshore engineering capability supported by world-class environmental science. In addition to the potential for contributing to energy self sufficiency, this sector has major potential to stimulate supply chains and manufacturing in the UK, with associated employment benefits. According to a recent paper by the Carbon Trust, the global market for offshore energy, including offshore wind, could be worth up to £460 billion in the period 2010—2050. They consider that the UK could capture around 22% of the global market, with a gross contribution of £15 billion to UK GDP over the period and the generation of over 68,000 UK jobs by 2050.[35] The offshore valuation report puts the WET marine renewable energy renewables as having the potential to contribute up to 192TWh of electricity to the UK grid, and could support between 5,000 and 26,000 jobs depending on the level of deployment.

Q2. *How effective have existing Government policies and initiatives on marine renewables been in supporting the development and deployment of these technologies?*

17. UK government support via the Research Councils has been critical to supporting the underpinning research base that has given the UK a global lead in this technology. The Research Councils have supported fundamental research into devices, arrays, policy, electricity grid connections, moorings and more recently into environmental issues. This research has helped define the Energy Technologies Institute marine renewable energy programme and is being increasingly used by industry to guide their development efforts in Technology Strategy Board supported programmes.

18. Also, the Research Council supported UK Energy Research Centre (UKERC) Marine Energy Technology Roadmap provides a comprehensive list of government initiatives in recent years (see page 9 of road map).[36] These initiatives are bringing marine energy technologies to deployment more quickly by linking the underpinning research base to device development and deployment and by sharing the risk that the small device developer companies face.

Q3. *What lessons can be learnt from experiences within the UK and from other countries to date in supporting the development and deployment of marine renewables?*

19. Early adoption and investment can lead to a rapid capture of the market, as seen in the Danish wind energy industry and the German solar energy industry. The approach in Germany and Denmark to offshore wind has been much more proactive than in the UK—especially with respect to the policy and research landscapes; in both Denmark and Germany the research science community were engaged early in technology development and environmental issues and strategic research programmes set up to support development and deployment. This has given them a strong market position in the wind energy sector.[37]

20. The UK needs to continue to support marine renewable energy research, including both the technology itself and the environmental and socio-economic consequences of deployment. Indeed, the environmental and socio-economic consequences of marine energy development need to be addressed in advance of deployment, rather than post deployment as with wind energy, both to address public concerns over their impact and ensure marine space is developed sustainably.

21. This whole systems understanding is critical for confidence in the investor decision making processes, regulatory, planning and consenting requirements and is essential in order to allow the industry to globalise and reduce lead times to deployment. This can only be delivered in collaborative programmes between the Research Councils, industry and government.

[33] http://www.carbontrust.co.uk/SiteCollectionDocuments/Various/Emerging%20technologies/Technology%20Directory/Marine/Other%20topics/ECI%20variability_uk_marine_energy_resources.pdf

[34] http://www.bwea.com/marine/atlas.html

[35] http://www.carbontrust.co.uk/news/news/press-centre/2011/Documents/110503-marine-green-growth.pdf

[36] http://ukerc.rl.ac.uk/Roadmaps/Marine/Tech_roadmap_summary%20HJMWMM.pdf

[37] http://www.aquamarinepower.com/sites/resources/Reports/2654/The%20Danish%20wind%20industry%201980%20-%202010%20-%20Lessons%20for%20the%20British%20marine%20energy%20industry.pdf

Q4. *Is publicly provided innovation funding necessary for the development of marine technologies and if so, why?*

22. Marine renewable energy is a developing industry that is dominated by small companies with insufficient resources to develop the industry and technology without risk sharing. Carefully targeted public support at the early stages can reduce the risk and give the larger companies confidence that the sector is worth investing in. Much of the capital that will be invested in marine renewables deployment is from global funds. For this to be invested in the UK, de-risking of both the technologies and issues related to their deployment is required. Furthermore, a stable and predictable regulatory environment, which is informed by research linked to the innovation is necessary. With the UK's strong knowledge base, there is the potential to be ahead of other nations provided that sufficient funding is deployed to address these issues.

23. The current strategy across the funding organisations is to develop a mixed portfolio of research and development activity. The Research Councils are responsible for the underpinning scientific understanding of the marine environment, the mechanical and hydrodynamic properties of devices (at the generic level) and the socio-economics of marine energy. This fundamental understanding is supporting development research supported by the Technology Strategy Board and the Energy Technologies Institute.

Q5. *What non-financial barriers are there to the development of marine renewables?*

24. Public attitudes to marine renewable energy development in the UK are generally less negative[38] than to onshore wind and nuclear. However, there are regional differences and resistance to development in some areas has the potential to stall deployment. A key to changing this landscape is to oblige energy companies to find means to include communities which effectively host projects in the financial rewards of renewable energy generation eg as per Fintry Development Trust[39] and Islay Energy Trust.[40]

25. Conflict with other sectoral interests, such as fishing, navigation and recreational activities has led to major problems in some areas. The NERC MRE KEP is in the process of addressing these issues directly through initiatives to bring sectors together and facilitate the necessary research to ensure public understanding of the issues and appropriate decision making by regulators.

26. Other barriers that are already being addressed through Research Council activities include:

- The creation of an Industrial Doctoral Centre by the Research Councils and the Energy Technologies Institute to address capacity issues that the sector may face in the coming years.
- Mid range test facilities for repeatable tidal system studies, and combined wave and current test facilities for both wave and tidal studies were identified as a capability gap in the UKERC roadmap.[41] These issues have been resolved with the support of an environmental test facility at Plymouth (not funded by Research Councils) and the all water test facility being constructed at Edinburgh that is being funded by the Research Councils.

Q6. *To what extent is the supply chain for marine renewables based in the UK and how does Government policy affect the development of these industries?*

27. The industry is very immature, as such, the supply chain is still developing; this is the case globally. However, infrastructure decisions are being made in the UK for the offshore wind industry and these should also benefit the marine energy industry eg the offshore North Sea electricity grid. In addition, the UK has a strong offshore engineering industry and a manufacturing base that should be capable of meeting the necessary deployment schedule as long as there is industry confidence in the future of the technologies.

28. Business investment relies on a long-term stable fiscal and regulatory context in which businesses can operate. This is the primary requirement for the sector. Government can also encourage businesses operating in other sectors to transfer their skills to the marine renewables sector.

Q7. *What approach should Government take to supporting marine renewables in the future?*

29. For this sector to grow and flourish, it is essential that government continues to support the necessary fundamental research that industry is unlikely to fund, especially so for novel and transformative research. It is also essential that flexible funding is available which allows industry and government to engage the best of UK science in collaborative fundamental and applied research to support the development of the sector. Continued and joined up investment in engineering, environmental and socio-economic research will be needed over the next ten years to bring the potential of this sector to fruition.

[38] http://geography.exeter.ac.uk/beyond_nimbyism/deliverables/bn_wp1_4.pdf
[39] http://www.fintrydt.org.uk/
[40] http://islayenergytrust. wordpress.com/tidal-energy-project/
[41] http://ukerc.rl.ac.uk/Roadmaps/Marine/Tech_roadmap_summary%20HJMWMM.pdf

30. The Research Councils will continue to support the underpinning research needed to help move marine renewable energy technology to deployment in co-ordination with the TSB and ETI. Recent activities to define the research challenges include:

- A scoping workshop involving the academic community and industry to identify the underpinning research challenges facing marine energy. The outputs of this workshop provided the basis of a £3 million call that will support research from 2012 as an addition to the recently EPSRC funded SUPERGEN Marine Hub.
- NERC MRE KEP has collaborated with stakeholders from regulatory, policy and industry organisations to map the environmental research necessary to support UK government and EU 2020 targets for marine energy deployment (includes offshore wind). This has resulted in the identification of more than 100 high level generic environmental research issues that need to be addressed to support development of the sector; ranging from high priority basic science to meet existing legal requirements through to the very fundamental need to understand whole system consequences of technology deployment in the marine system
- Working with ORRSG to provide a collaborative forum for dialogue with relevant stakeholders and policy makers, and co-ordination and dissemination of research and evidence on the impacts of offshore wind, wave and tidal technologies.

Q8. *Are there any other issues relating to the future of marine renewables in the UK that you think the committee should be aware of?*

None

September 2011

Annex 1

CASE STUDIES

The case studies below illustrate how fundamental research can benefit the marine renewables sector.

Tidal Turbines

The SeaGen tidal turbine at Strangford Lough, Northern Ireland, was the first turbine in the world built on a commercially viable scale. Research Council supported research has helped demonstrate environmental compatibility, a crucial hurdle for the acceptability of the technology, particularly for a highly environmentally sensitive location, and should help fast track the roll out of the technology within the UK. Carbon emissions to the value of £35–70 million pa by 2020 could be saved should 500–1000 turbines be deployed. A lead in this sector could open up the marine renewables market to UK industry with the sector predicted to be worth £150 million to £1 billion pa in the UK by 2050.[42]

Aquamarine Power

The world's first near-shore wave power system, developed from research funded by the RCUK Energy Programme,[43] began supplying power to the National Grid for homes in Orkney and beyond in December 2009. The Oyster, developed by Edinburgh based Aquamarine Power, has no gearbox, generator or electrical components in the water. Instead, it transfers the sea's energy to the shore for electricity generation on dry land. This cuts costs, reduces environmental risk and makes Oyster easier to maintain and more reliable. The company's latest development, the Oyster 800, was unveiled in July 2011 for installation in Orkney this year.[44]

Test Facilities

The UKERC 2010 marine energy roadmap identified a capability gap in test facilities capable of modelling devices and arrays at intermediate scale in both waves and currents and noted that this was a priority in the technical strategy. These issues have been addressed by the support of two new test facilities; the PRIMaRE facility at Plymouth University supported by SWRDA that will be able to model devices and small arrays and their impact on coastal conditions; and the UKMER facility at Edinburgh University that will model devices and arrays in multidirectional wave and tidal flow conditions at high relative energies. These facilities should be fully functional by late 2012 early 2013 and will give the UK a strong lead in understanding how devices function in deep water conditions and what their impact will be on the wider coastal environment.

Environmental Impact Assessment Software

PRIMER is a software package developed out of NERC funded research at the Plymouth Marine Laboratory and operated through a spin-out company PRIMER-E. It enables users to perform complex analysis of environmental datasets and has been used to inform the Environmental Impact Assessments of offshore wind

[42] http://www.nerc.ac.uk/using/casestudies/documents/developing-marine-energy.pdf
[43] http://www.rcukenergy.org.uk/impact/new-technology-will-harness-the-power-of-the-sea.html
[44] http://www.aquamarinepower.com/news/aquamarine-powers-next-generation-oyster-800-unveiled-by-first-minister/

farms. PRIMER was used to conduct assessments for eight of the 17 sites granted permission as part of the second round of leasing by the Crown Estate. Taking into account average energy consumption, these eight offshore wind turbines could potentially generate enough electricity for 1.75 million UK households per year once fully operational. Taking an approximate average household spend on electricity of £1,000 per year, this equates to £1.75 billion in household electricity expenditure each year. PRIMER is one of the leading industry standard packages for marine community and biodiversity research. Before PRIMER, it was not possible to analyse such complex data sets, so the effects of many marine activities were unknown.

UKERC Energy & Environment Phase II

Plymouth Marine Laboratory is currently working on this project to develop strategies for marine and land based energy production and GHG mitigation technologies which limit environmental impacts whilst safeguarding or even restoring ecosystem services. A methods toolbox which integrates socio-economic valuation of ecosystem goods and services into technology evaluation will be developed and applied. This will allow a holistic assessment of the impact of energy production and GHG mitigation technologies on the UK carbon footprint.

Evaluation of Antifouling Systems for Tidal and Wave Devices—ReDapt

Plymouth Marine Laboratory and PML Applications Ltd (PML's wholly owned trading subsidiary) are working on this project funded by the Energy Technologies Institute. The aim of this project is to develop a protocol for selection of anti-fouling systems (AFS) for tidal and wave energy devices, given the operational requirements of the sector to meet the 2020 target of 2GW installed capacity. Tidal and wave device developers are being subjected to a barrage of marketing literature from different coatings producers, and at present have no independently verified, objective and scientifically robust information to differentiate between the products on offer.

Annex 2

PORTFOLIO OF SUPPORTED RESEARCH

Table 1

ANNUAL EXPENDITURE ON MARINE RENEWABLE ENERGY RESEARCH BY THE RESEARCH COUNCILS

1998–99	*1999–2000*	*2000–01*	*2001–02*	*2002–03*	*2003–04*	*2004–05*
157,000	175,000	300,599	605,693	616,694	830,226	995,253

2005–06	*2006–07*	*2007–08*	*2008–09*	*2009–10*	*2010–11*
1,026,178	633,228	1,015,251	3,117,340	1,855,608	8,039,507*

Note: In late 2010 several large projects were funded by the research councils that will significantly increase the annual expenditure on Marine energy in future years. These new projects are highlighted in blue in table 2.

2010–2011 numbers include a one off payment to support the construction of a test facility at Edinburgh University/

Table 2

LIST OF CURRENT RESEARCH PROJECTS IN MARINE RENEWABLE ENERGY SUPPORTED BY THE RESEARCH COUNCILS (AS OF 30 JULY 2011)

Reference Number	*Grant Title*	*Holding Institution*	*Grant Holder*	*Grant Value*
EP/E040136/1	SUPERGEN Marine	University of Edinburgh	Wallace, Professor R	£5,453,302.33
EP/F030975/1	THE HYDRODYNAMICS OF A DISTENSIBLE WAVE ENERGY CONVERTER	University of Southampton	Chaplin, Professor JR	£430,172.58
EP/H012745/1	Design of Wave and Current Generators for Stable Wave Generation in Multidirectional Combined Wave Current tanks	University of Edinburgh	Bryden, Professor I	£990,292.80
EP/H044078/1	A Teaching Resource for Sustainable Power Generation	University of Bristol	Pavier, Professor MJ	£17,496.02
EP/I001239/1	Partnership for Public Engagement: Facts about Wave and Tidal Energy	University of Edinburgh	Ingram, Professor DM	£19,997.68
EP/I027912/1	United Kingdom Centre for Marine Energy Research	University of Edinburgh	Wallace, Professor R	£2,931,243.22
EP/I02932X/1	United Kingdom Centre for Marine Energy Research: The all UK waters, combined, current and wave test facility.	University of Edinburgh	Bryden, Professor I	£6,000,061.00
TS/I001743/1#	Fully Submerged Evolution of SeaGen for Exposed Open Deep Water Locations	University of Edinburgh	Bryden, Professor I	£97,651.23

Reference Number	*Grant Title*	*Holding Institution*	*Grant Holder*	*Grant Value*
TS/I002030/1#	Assessment of novel WEC with rubber-air-water interface; performance validation, optimization and demonstration of associated cost benefits	University of Strathclyde	Day, Dr A. H.	£145,868.81
TS/I002162/1#	Fully Submerged Evolution of SeaGen for Exposed Open Deep Water Locations	Queen's University of Belfast	Elsaesser, Dr B	£145,637.14
EP/J500847/1	Industrial Doctoral Centre for Offshore Renewable Energy (IDCORE)‡	University of Edinburgh	Ingram, Professor DM	£6,499,212.00
NE/J004332/1	Flow, Water column & Benthic Ecology 4D (FLOWBEC)	National Oceanography Centre Liverpool	Bell, Dr P	£852,432.00
NE/J004251/1	Understanding How Marine Renewable Device Operations Influence Fine Scale Habitat Use and Behaviour of Marine Vertebrates (RESPONSE)	University of St Andrews	Thompson, Dr D	£804,971.00
NE/J004227/1	Optimising Array Form for Energy Extraction and Environmental Benefit (EBAO)	University of Edinburgh	Bryden, Professor I	£1,074,631.00
NE/H009299/1	Great Race Eddies and Turbulence	Scottish Association for Marine Science	Dale, Dr AC	£390,565.00
NE/I015094/1	Wave Hub Baseline Study	Plymouth Marine Laboratory	Torres, Dr RJ	£48,147.00
NE/G524387/1	Impact of Offshore Wind Farm Sub-sea Cable B-fields on Important Crustacean Species	Newcastle University	Bentley, Professor MG	£70,590.00

*** Project yet to start*

 # collaborative with the Technology Strategy board

‡ Co-funded with ETI

NB the above table does not include information on the NERC Marine Renewable Knowledge Exchange Programme as it does not fund research

Annex 3

SUPPORTING EVIDENCE

— Marine SUPERGEN Phase I final report, Phase II achievement report, and annual reports.[45]

— Marine Energy Technology Innovation Needs Assessment.[46]

— UKERC/ETI Marine Energy Technology Roadmap 2010.[47]

— UKERC Marine Renewable Energy Technology Roadmap 2008.[48]

— HM Government Marine Energy Action Plan 2010.[49]

— Offshore Valuation: A Valuation of the UK's offshore renewable energy resource.[50]

— Industry, regulator and policy priorities for environmental research as identified by NERC programmes in marine renewable energy 2010.

— Developing Marine Energy: De-Risking the Growth of Tidal Energy, DTZ economic impact analysis 2010.[51]

— Cost of and financial support for wave, tidal stream and tidal range generation in the UK, Ernst and young and Black and Veatch report 2010.[52]

[45] Available on request from the SUPERGEN consortium.
[46] Available on request from the Low Carbon Innovation Group
[47] http://ukerc.rl.ac.uk/Roadmaps/Marine/ETI_UKERC_Roadmap_2010.pdf
[48] http://ukerc.rl.ac.uk/Roadmaps/Marine/Tech_roadmap_summary%20HJMWMM.pdf
[49] http://www.decc.gov.uk/publications/basket.aspx?FilePath=What+we+do%5cUK+energy+supply%5cEnergy+mix%5cRenewable+energy%5cexplained%5cwave_tidal%5c1_20100317102353_e_%40%40_MarineActionPlan.pdf&filetype=4#basket
[50] http://www.offshorevaluation.org/downloads/offshore_valuation_full.pdf
[51] http://www.nerc.ac.uk/using/casestudies/documents/developing-marine-energy.pdf
[52] http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Renewable%20energy/explained/wave_tidal/798-cost-of-and-finacial-support-for-wave-tidal-strea.pdf

Memorandum submitted by the Technology Strategy Board

1. The Technology Strategy Board is a business-led organisation with a leadership role to stimulate technology development and innovation for the benefit of UK business in the areas which offer the greatest potential for boosting UK growth. The organisation operates across Government and advises on polices which relate to technology, innovation and knowledge transfer. The Technology Strategy Board is the prime channel through which the Government incentivises business-led technology innovation.

2. Energy generation and supply is one of the main priorities of the Technology Strategy Board. Within that broad heading the focus is on supporting UK business R&D and innovation in areas which include offshore wind, wave and tidal. The Technology Strategy Board has invested over £22 million over the last five years in wave and tidal R&D projects and has a current portfolio of projects in excess of £40 million, with business providing 50% of the funding.

3. We consider that the UK has excellent strengths in marine renewables and that it is an area where the Government needs to use all of its levers to support the sector to ensure the UK maintains a world leading position.

4. We make the following points in response to the specific questions raised by the Committee.

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

5. To set the potential benefits in context, it is important to consider the UK's natural resource in marine renewables. The UK has a very significant wave and tidal resource and the scale of this resource means that wave and tidal power could play a significant role in the future electricity system of the UK, and as much as 27GW of peak capacity might be installed off UK coasts in the next 40 years, according to the Government's renewable energy roadmap published this year. This can have significant positive effects for the UK in a number of ways:

5.1 *Economic Growth*: wave and tidal energy have the potential to create significant industries around them in the UK. Recent research by the Carbon Trust predicts that a global market of £48 billion could be generated in the period to 2050, or £3.7bn/yr by 2050, and that the UK could capture a significant part of that market, especially beyond 2030, much of which is likely to be export. The UK's lead in this area is worth continuing to support and promote in order to give industry in the UK a head start in developing devices, supply chains, construction, installation and maintenance solutions for a future market.

5.2 *Decarbonisation of the electricity system*: according to the Committee on Climate Change (CCC), in order to meet EU and UK targets on decarbonisation of the energy system, it is anticipated that the electricity system will need to be largely decarbonised by 2030, in order to allow for the more difficult decarbonisation of transport and heat to run on a slower path while maintaining overall energy emissions levels against targets. In addition, the electrical system will need to supply more power than ever before with increasing electrification of heating and transport, this being the only long term way of decarbonising these elements of the energy system. With this context in mind, it is thought that marine power could supply 10–15% of total demand in 2050, according to the Carbon Trust, not a large overall proportion of the electricity needs of the UK, but potentially a significant one in its role in diversifying supply and reducing intermittency.

5.3 *Diversity of Supply*: while offshore wind will provide the bulk of the extra renewable generation, there is good reason to build a more diverse mix for the future. Firstly, more diversity of generation will help to minimise the variability of renewable energy generation. Tidal power for example is highly predictable and can be planned into the network easily. Wave power is driven by winds, but produces power out of phase with offshore wind by a significant time in most areas, since waves generated in mid Atlantic for example travel slower towards land than the pressure fronts themselves. The costs of intermittency of renewables are thought to be about 1p/kWh for relatively high levels of penetration according to the CCC, but these will be minimised by a diverse mix of renewable energy generation.

5.4 *Balancing costs and benefits*: public discourse currently focuses on cost rather than the relationship of cost and benefit. To judge whether government should support marine energy, both must be considered. The potential benefits of marine energy to the UK lie as much in export potential and domestic job creation as in carbon avoidance and renewable energy targets. The UK is likely to lead the way in deploying the first arrays, and will build a domestic industry around these deployments. Assuming that cost performance improves as thought possible, overseas markets are likely to emerge in the next decades, with the global market likely to double the UK market by 2030, and be about four times the UK market by 2050. It is critical to establish domestic capability in the UK now in order to reap the benefit in future decades.

5.5 *Cost uncertainty*: There is a high level of uncertainty over future cost performance of marine energy. Current forecasts and targets predict a challenging but possible trajectory to full competitiveness by 2050 with the ETI and UKERC roadmap for the industry setting a 5–9p/kWh target for levellised cost of energy. Wave and tidal energy are more likely to become competitive as

deployment is scaled up and at the same time, we see offshore wind being forced further from the coast, conventional generation experiencing higher carbon costs and the impact of tightening emissions standards. However, the uncertainty over the cost of marine energy is very high, and the future costs of other generating technologies against which it will be compared also have relatively high uncertainty (eg nuclear, offshore wind, CCS). It is recommended (in line with the CCC) that public funding is needed as a minimum to get to a point where this uncertainty is reduced enough to see whether the potential benefits of marine energy can be realised on a large scale.

6. We believe the Government should be supporting the marine energy industry because the potential benefits outweigh the likely costs. We believe that it needs regular review over the next decade to check that this assumption remains correct as the future costs of wave and tidal power in relation to other low carbon generation options becomes clearer. It is however important to consider not only the issues of decarbonisation of the electricity system and diversity of supply, but equally the economic growth that the UK marine renewable sector can deliver though global market opportunities.

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

7. The UK has a clear leading position in marine renewables, and this is down to multiple factors; a very fortunate scale of natural resource; historical research strength; and, a favourable policy regime. It may be argued that the research strength in the UK has emerged because of the natural resource around it, the enthusiasm of a few pioneers, and positive funding over decades. More recently broader support mechanisms have been in place to help pull through research into industrial reality.

8. The Renewable Obligation Certificate scheme has enabled the emerging industry to see the longer term revenue from marine energy, and has recently encouraged larger industrials such as Voith, Alstom and Rolls Royce to enter the market. These companies bring great value to an emerging industry, but will only move into a sector once future revenues are relatively certain. Uncertainties in the revenue support continue to slow investment in the industry. The level of ROC support to 2017, both in banding and total availability, and the level of support under the FiT post 2017 are currently creating a discontinuity in future revenue for technology and project developers.

9. While research has historically been strong in marine energy in the UK, the market has only recently become ready for the technology. While prototype wave devices were being developed in the 70s in Edinburgh, the perceived need for these technologies came and went with the oil crises of the 70s and 80s, but was never sustained for long enough for the technology developers to make progress beyond lab testing. It has only been with the advent of carbon targets and legislation to encourage renewables that marine power has made progress. This history demonstrates that new emergent technologies cannot thrive under varying market conditions, and that policy, when used advantageously, can create a steady market.

10. Public sector funding of marine energy technology development has come from a variety of sources. The Technology Strategy Board has funded 23 projects in the last five years, totalling £22.7 million of grant allocation with this funding matched by the participating businesses. Most of the leading device developers including Atlantis, Pelamis, Aquamarine, TGL and MCT have received Technology Strategy Board funding. DECC, Carbon Trust, ETI and RCUK have been the other main funders of device development. More recently, the Technology Strategy Board projects have focussed on underpinning technologies across the whole system, for example a pioneering foundation drilling technique recently demonstrated by Bauer Renewables Ltd, while the Carbon Trust marine energy accelerator has also taken a system wide approach. The ETI and DECC are now clearly focussed on reducing the costs and accelerating the deployment of first arrays respectively. This move of funding from device development and testing to deployment of individual devices, to system wide costs and lastly to array deployment has worked well in supporting the industry as it moves through the expensive journey from concept to commercialisation. We believe that public sector funding now is more aligned than ever in marine energy (see paragraph 19 for more details).

11. The Marine Energy Development Fund was a DECC fund that was planned to take deployment on to the next stage and is perhaps the only programme that was not successful in allocating funds after the industry failed to meet the criteria for funding within the spending review period. This discontinuity was very unfortunate and caused by financial phasing limitations in government combined with overselling of timelines by the industry. Better alignment will be needed in future to ensure this is avoided.

12. The development of world-leading test centres has been critical for the industry. The scale testing facilities in numerous universities and research establishments combine with Narec, EMEC and Wavehub to provide a clear testing route to get from lab to ocean. Public funding has been essential in setting up all of these facilities.

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

13. The UK leads the global marine energy industry, but Canada, USA, South Korea, Portugal, Spain, Norway and Ireland, Australia and New Zealand all have active programmes in marine energy. The UK lead comes as a result of the alignment of resource, research and testing strength, policy and relative market

certainty, all of which are needed to maximise progress to commercialisation. It might be argued that none of the other countries involved have such good alignment of these four factors.

14. Parallels have been drawn between the marine energy industry today and the wind industry in the UK in the 1980s. At that stage the UK held a good lead in research and testing of wind turbines, but the policy support was not continued, and that lead in research was not turned into an industrial manufacturing industry. Instead, Denmark in particular supported their domestic wind power industry and emerged with almost 40% of the wind turbine market in 2003. One of the keys to success in Denmark was early adoption of Feed in Tariffs and capital support to its domestic market, as well as streamlining of planning legislation. These policies built a thriving domestic based industry which then was able to expand to service the emerging export market.

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

15. Public funding is required for most new energy technologies, and marine is no exception. The investment size is enormous, and the timescales involved in getting from concept to commercial scale is very long. For example, it is estimated that it might take £30 million and 10 years to develop a wave or tidal device from lab scale to the point where it is producing steady revenue. This creates a high risk investment that most venture capital steers clear of, creating the investment "valley of death". Research funding at lab scale is relatively small but is sufficient to develop and test initial concepts at very small scale. As testing scales up, the development costs rapidly rise as model size increases, testing protocols become more complex and project management complexity rises, yet the risk for investors is not significantly reduced until large scale testing, when risk is reduced enough for investors to be able to see a clear route to commercialisation. This has been seen in marine energy for the first time recently with investments by Rolls Royce in TGL, Alstom in AWS, and JP Morgan in Meygen, all of whom are in the latter stages of scale-up. The technology developers behind the devices in these companies have needed public support until this point.

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

16. Barriers to be considered are:

- Licensing, consenting and planning requirements.
- Environmental unknowns in interactions of marine technology and the marine environment.
- Supply of skilled workforce and resource availability. Location of resources vs. demand and the capability of the grid to transmit power to where it is needed.

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

17. At present, the supply chain for the marine industry is largely localised in the UK, but this is dependent on the sector of the industry as set out below:

- *Device*: For UK devices, which make up about half the global total, the supply chain is largely UK based at the moment. Blades are supplied from the UK by composites specialists. Power Take-off is usually part of the inherent IP of the technology developers, and supply is often a mix of bespoke design with standard components eg generators, with many of the components bought in from abroad. Nacelle/body construction and assembly is again, normally localised at this stage of the industry's development. Companies like BiFab near Edinburgh provide service in this area, and because these devices are significantly smaller than wind turbine nacelles, some of the limitations of UK supply chain in manufacturing large castings for example are not so problematic.
- *Electrical Infrastructure*: Largely based abroad through companies like Siemens who have expertise and experience in supplying power electronics, transformers, switchgear. Cabling companies such as JDR have a presence in the UK but compete with Norwegian and other mainland European companies.
- *Foundations & Moorings*: Largely localised to date, but very early in standardisation and development of fixation systems for marine energy. UK expertise in offshore engineering provides strength here.
- *Installation*: Largely localised, with hubs of operation emerging around Orkney, and around the South West of England. UK's maritime and offshore engineering history is a big benefit in this sector.
- *Operation & Maintenance*: As for installation, but very early in the development of the O&M process at this point in time. It is expected that the UK will have the skills and the advantage of proximity to early UK devices to develop methods and practices ahead of other countries.

18. Policy can maintain a UK based supply chain in the following ways:

- Ensure that the positive market for marine energy is maintained. As with the Danish wind power example, with strong market pull, the industrial base follows.

— Be clear about where the UK has strengths and build on these to protect them. In this case, offshore engineering, installation, operation and management are likely to be the bedrock of supply chain for the UK.

— Use innovation to insulate the supply chain by keeping one step ahead of the competition. Part of the Technology Strategy Board's focus in the coming years is likely to target the emergence of an innovative supply chain in the UK.

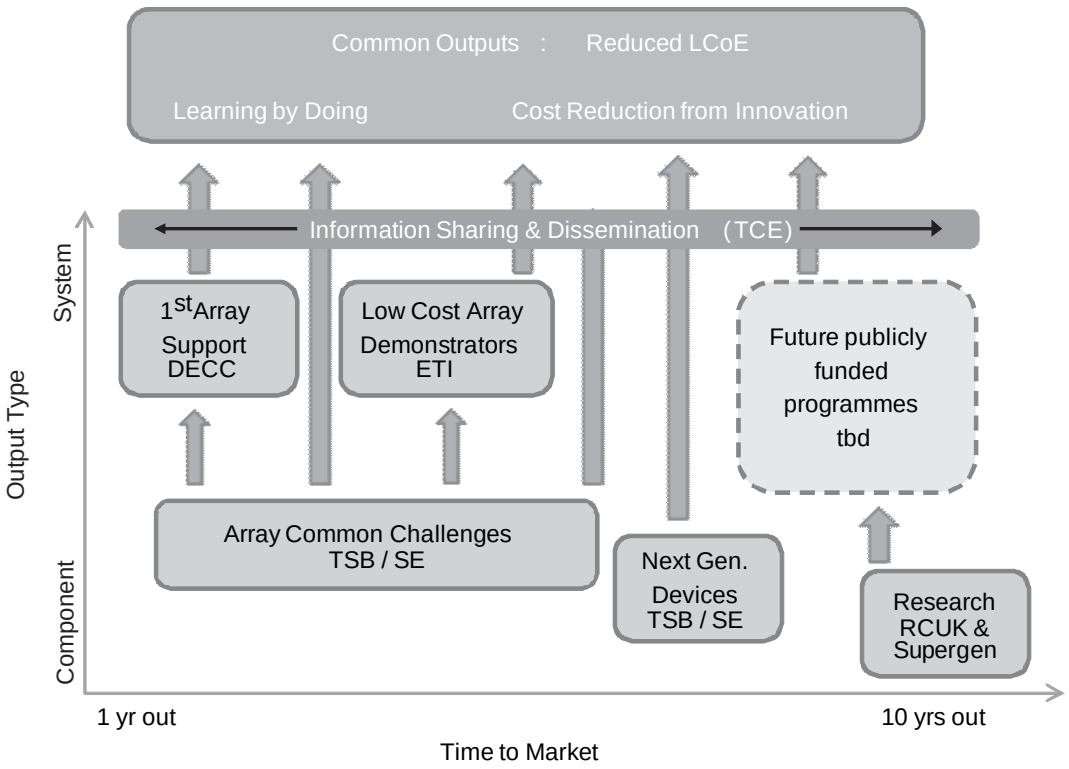
— Encourage local/regional hubs of activity, such as those emerging in the South West and around Orkney. The idea of Marine Energy Parks is good for building local industrial capability and focussing on building supply chains to support marine renewables in particular regions.

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

19. Public funding must be made to work together towards a common goal. The different departments and bodies involved all have different individual goals, but currently, all have a common goal in driving down the levellised cost of energy (LCoE), since this is the main determinant of the future success of the industry. All the main funders meet together in the Low Carbon Innovation Group (LCIG), and recent discussion at that working group has led to the Technology Strategy Board leading an alignment proposal summarised in fig 1 below. This shows how all the public funding expected in marine energy over the next few years lines up to deliver the common goal of LCoE reductions through the acceleration of array deployment, and "learning by doing", and technology innovation targeting system costs.

Figure 1

MARINE ENERGY PUBLIC FUNDING ALIGNMENT



20. Each programme has individual aims (for example the Technology Strategy Board and Scottish Enterprise (SE) will be keen to ensure UK business benefits from their programmes, while ETI will need to see value for its members), but all also have the common aim of cost of energy reduction. The Technology Strategy Board programme will provide building blocks for the DECC and ETI programmes, while breaking immediate barriers to deployment.

21. We believe that as long as it is well aligned, this multi-agency approach strengthens the landscape by bringing different skills and focus to the same overall aim, in a way that a single agency would not be able to do. In order to maximise alignment, and ensure the industry and funding landscape move together, excellent information sharing between the industry and funding bodies will be essential.

22. The Technology & Innovation Centre in Offshore Renewable Energy that is being established by the Technology Strategy Board (as one of a number of elite centres in the UK) is not located on fig1 at present since the application process is still open and its role still under development with stakeholders. But this new organisation will help provide an essential bridge between academia and industry and play an important role in information sharing in the future.

23. Policy should be maintained over an appropriate timescale. There is some concern that policy changes and spending review periods may get in the way for an industry that needs to operate over decade timescales. The failure of MRDF to provide funding is an example of government spending timescales matching industry's timescales poorly. The more long term certainty in policy, the better the private sector can plan and the faster industry can progress.

24. In return for long term certainty, the industry must be able to demonstrate the progress it is making in reducing their LCoE. It is recommended that a roadmap of cost vs. time is adopted by the LCIG as a whole, and that this is used as a criterion against which a regular review is carried out with the marine industry. Progress against this roadmap can then be used to make rational decisions about future funding levels. The LCIG is the best forum to coordinate this review process.

Conclusion

25. The UK currently has a leading position in the development of wave and tidal devices. There is now the opportunity to capitalise on this and on the investments already made in wave and tidal, but to do so the UK needs to continue to provide well aligned public funding at appropriate levels, set clear LCoE targets against which progress can be reviewed and set a longer term policy environment which is supportive of the development of the wave and tidal industry in the UK. By enabling continued innovation and reducing the future uncertainties associated with the industry, the UK will be able to fully reap the potential benefits through decarbonisation of the electricity system and economic growth.

September 2011

Memorandum submitted by the Carbon Trust

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

1. Yes, we believe the UK Government should be supporting the development of marine energy technologies and projects in the UK. The Carbon Trust has been supporting wave and tidal-stream technology since 2003 and has a unique understanding of the technical and financial challenges the industry faces.

2. We also have a unique understanding of the industry's potential in terms of renewable energy generation capacity: our assessment shows that some 70 TWh could practically and economically be generated from wave and tidal stream energy in the future (about 20% of current UK electricity demand), around 20 TWh per year from tidal and around 50 TWh from wave.

3. The UK is a world leader in these technologies and is well placed to remain at the forefront of technology innovation. We believe that if the industry is supported the UK could capture around 22% of the global market for these technologies. We estimate the total addressable market for marine energy at £340 billion, which suggests the UK could enjoy a market share worth £76 billion. (Reference: Carbon Trust Green Growth Paper published 2011, and *Accelerating Marine Energy* (2011)).

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

4. The combination of a strong academic research base, high levels of resource and relatively good support from government have combined to make the UK world the leader in both wave and tidal stream technology. Of the eight full-scale prototype devices that will be installed worldwide by the end of 2011, seven are in the UK and the majority of the companies that developed them are UK-based. Equally, a large proportion of the earlier-stage technology development companies are also in the UK.

5. The industry has now gained considerable momentum, thanks largely to the DECC-funded £22.5 million Marine Renewables Proving Fund which funded six of the eight full-scale prototypes. This scheme has proved that marine energy generators can be installed and function at full scale. UK Government support has been vital to this success, and has underpinned the sector for several years—there is probably no device development company operating at any scale in the UK that has not received support of some kind.

6. Government support needs to be appropriate for the stage of technology development. The support ranges from grant funding for academic research, through innovation funding for component and early-stage technology development, to capital and infrastructure support for deployment of full-scale devices. The Carbon Trust has been the key body in the delivery of this support in the UK: we have managed the Marine Energy Challenge, the Marine Energy Accelerator and most recently the Marine Renewables Proving Fund, and we are a founding funder of the European Marine Energy Centre in Orkney. Support to date has consisted mostly of capital support (mostly grants), and has been most successful where the funding body had a good understanding of the industry and where support is targeted at particular goals. The MRPF and MEA are good examples at different scales, as is the provision of infrastructure at EMEC.

7. Companies are now looking to develop their first multi megawatt arrays in UK waters. Early arrays will require a combination of capital and revenue support although in due course arrays will be funded entirely

from revenues (with a ROC multiplier or Feed In Tariff to build the business case over and above wholesale price of energy). Getting the right balance of revenue and capital support for large scale projects is vital; long term clarity over the level of support is equally important to allow developers to raise private sector finance for their business plans.

8. It is also important to continue to innovate within the industry, and the focus at all times should remain on reducing the levelised cost of wave and tidal energy. We believe further innovation funding is required: to bring forward the next generation of devices with the potential for step change cost of energy, and to reduce costs of components, assembly, installation and operation of the existing front-runner devices. This thinking is developed in depth in *Accelerating Marine Energy*, which we published in July 2011.

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

9. Successful marine energy technology programmes have tended to be focussed on specific goals. This may not always suit all participants in the industry (for example numerous marine energy companies were too early-stage to participate in the MRPF), but it allows the programmes to be outcome-led which in turn leads to viable milestones and tangible results with demonstrable progress in the sector. Making additional technical expertise available to programme participants has also proved vital in the MRPF. This scheme put a "technical service team" in place to assist projects with the new challenges of scaling up to full scale prototype devices, bringing a comprehensive set of engineering and project management expertise to the supported projects.

10. Other lessons the Carbon Trust has learnt from its marine energy engagement include:

- The MRPF has shown that supply chain pinch points will develop in a complex technology, even for early-stage demonstration projects, and measures to address this need to be considered early on.
- Investment will be required at all stages of technology development in order to develop a domestic industry. The UK's strong position in marine energy reflects this.

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

11. Yes, we believe it is. We explain our thinking in depth in *Accelerating Marine Energy* (July 2011), but in brief, marine energy will be too expensive to deploy at any meaningful scale if focussed innovation does not continue to drive down costs, and due to the risk/cost tradeoff of the marine sector, this innovation will not happen without public funding support. We believe continued innovation with a focus on cost of energy reduction is required alongside demonstration funding of the leading devices. Early-stage innovation will deliver the next generation of wave and tidal devices (these are necessary for tidal, to cope with the technical challenges of high-resource areas, and desirable for wave to reduce costs).

12. We also believe that de-risking innovation activity is crucial for the delivery of the first arrays. These farms are likely to be supported by a combination of the European Commission's NER300 mechanism and the £20 million announced by DECC for array-funding to 2020.

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

13. The ultimate barrier limiting the deployment of wave and tidal arrays is the availability of capital due to the high level of technical and project risk currently associated with marine installations. These barriers, and the steps needed to address them, are addressed in detail in our *Accelerating Marine Energy* report.

14. Other non-financial barriers which impact the marine sector include: uncertainty on availability of grid capacity at shore (particularly at the Pentland Firth and off the Western Isles); consenting requirements; inflexibility of leasing arrangements for small-scale projects; and potentially bottlenecks in the availability of offshore vessels and some device components.

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

15. While the supply chain for most devices installed to date is based in the UK these devices are small-production run prototypes. To a large extent it remains to be seen whether the supply chain will or will not be UK-based.

16. That said, a relatively high proportion of the value of marine energy projects is in installation and assembly, both operations that are likely to take place near the final project site. Given the size and quality of the UK resource, a large proportion of total marine energy expenditure is likely to remain in the UK. And, of course, government support for marine technology development will increase the proportion of components or operations delivered from the UK. This is particularly true for high-value components: we believe certain simple components will eventually be manufactured at the location of least cost, but innovation support will increase the likelihood that technically complex components such as control-systems, hydraulics, bearings and marine-specific PTOs and electronics will be developed and manufactured in the UK. Similarly, by continuing to lead the world in the deployment of early prototypes and first arrays, the UK can develop the capability for marine deployment and operations and export this capability globally (it is of note that the UK's offshore oil

and gas operations capability is now exported globally; in contrast, the offshore wind sector currently brings its installation capabilities from overseas due to the lack of an indigenous supply chain).

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

17. With capital support for first arrays, it is crucial to recognise that technology developers need external help in de-risking the delivery of these projects. There are fundamental challenges that need to be addressed now in order for the government to have confidence that first-array support can be utilised in the 2013–2015.

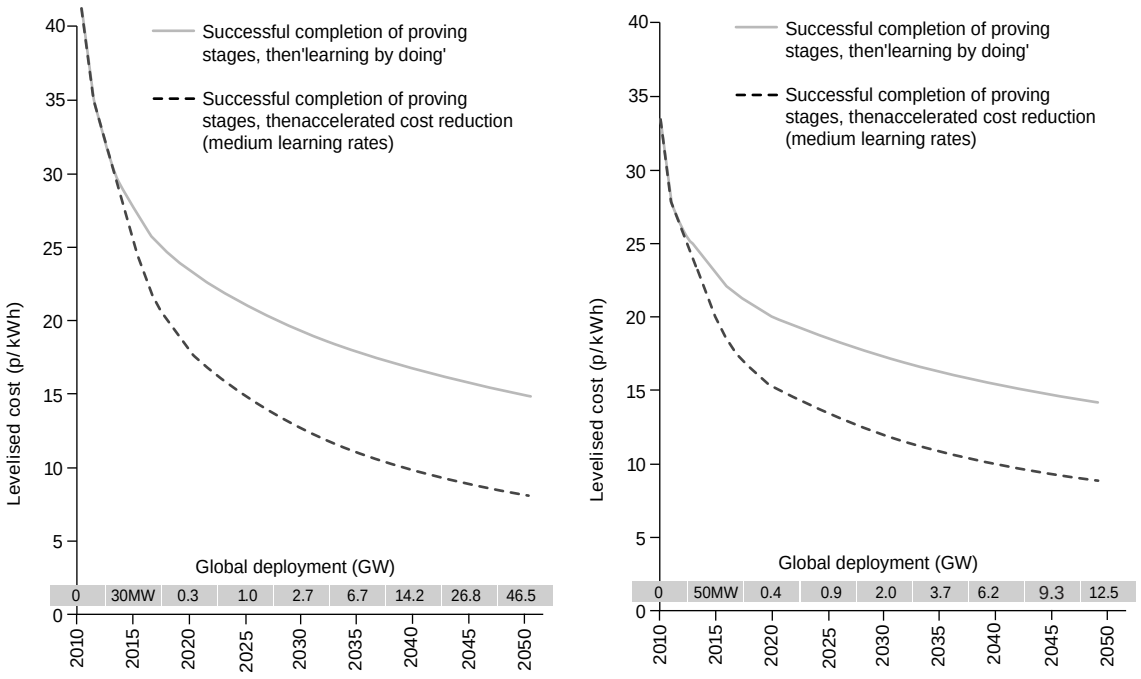
18. The assessment of technologies suitable for funding is key to success and for ensuring value for money from public funding. The best concepts should be identified and funded, which requires specialist skills and capability. This was achieved in the MRPF, and a similar process should be deployed at the later stages of industry development.

19. Our experience suggests that the delivery body for the capital support should have significant experience of marine energy projects. Understanding of the project risks and technical issues is vital for designing a suitable assessment framework for selection of participants and then for putting suitable milestones in place. Understanding of the numerous issues facing installation of marine projects is also vital for management of the operational changes and contingencies that will inevitably be part of any large-scale funding programme.

20. As stated earlier, we also believe that a continued focus on technology innovation is vital to achieve an acceptable cost of energy within a reasonable time-frame. Cost of energy reductions will come through "simple" learning-by-doing as volume and scale increase, but we believe the cost reduction curve needs to be steepened beyond that achievable through simple learning and scale effects alone. Our thinking on learning rates is developed in some depth in *Accelerating Marine Energy*, but the graphic below gives a summary of the potential pathways for cost of energy from marine energy with and without innovation support.

Figures 23a and 23b

DEPLOYMENT POTENTIAL TO 2020 FOR MARINE ENERGY



Note: Two proving stages exist, one at full-scale prototype, and one at first array stage.

21. Alongside capital support for projects we feel that a programme aimed at promoting non-competitive R&D by industry participants would help to significantly accelerate technology improvement in marine energy. A consortium-based R&D programme could be based on the Carbon Trust's DECC-funded Offshore Wind Accelerator model, which draws in funding and expertise from eight of the leading utilities with Round 3 Offshore Wind licences, and could deliver value-for-money technology innovation through leveraging public funds with industry funding (the Offshore Wind Accelerator delivers £2 of industry funding for every £1 of DECC funding). A consortium-based approach to delivering innovation would work with project developers and supply chain companies involved in R&D work to address specific technical and cost problems identified as the principal barriers to preventing the cost-effective deployment of the first commercial arrays.

22. We believe there is still scope for early-stage devices to offer a step-change reduction in cost of energy. An innovation programme funding the development of these devices (this might include innovative device-agnostic installation/deployment concepts) will ensure that future or "second generation" devices are developed

in the UK rather than elsewhere. The "nursery berths" currently being installed at EMEC would be a good target-point for this sort of early-stage innovation.

23. Finally, we believe that the work being undertaken within the Low Carbon Innovation Group (LCIG, comprising DECC, BIS, Technology Strategy Board, Energy Technologies Institute, Carbon Trust and EPSRC) to ensure a coherent and coordinated approach is taken to supporting innovation in the marine sector is vital in ensuring value for money. Through LCIG, the development of a Technology Innovation Needs Assessment has allowed a consensus to be built around the key steps to accelerating the reduction of costs of marine energy, and we believe that an LCIG-wide approach to this challenge is vital to the success of the sector.

September 2011

Memorandum submitted by Offshore Wave Energy Ltd

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

The UK oceans are particularly rich in ocean wave energy, exploitable resources being estimated as 50TWh per year or 13% of current UK demand, This is two and a half times the estimated exploitable tidal stream energy [CARCON TRUST JULY 2011"ACCELERATING MARINE ENERGY"].

Wave energy is complementary to offshore wind in that waves, originating from a distant weather system, can be present when there is little wind at a particular location. Wave power therefore needs to be developed in order to provide a balance in the offshore network of renewable power sources and to provide a risk-mitigation opportunity to offshore wind developers. In a wider perspective, the more diverse sources of energy are, the less the effects of variation in resources, so the more types of RE generation (Solar, Wind, Marine, Biomass etc) the more reliable the supply will become. This is also true for diverse locations as the resource often varies regionally, so it is important to have many sources in as many locations as possible. The upshot of this will be to increase the penetration of renewables and the quantity of energy that can be supplied to the nation.

OWEL WEC's can be deployed in flotillas away from shipping lanes in many sites off the UK coasts with the maximum output from the energetic oceans off the west coast . This dispersed generation has security benefits in that overall supply from these sources cannot easily be disrupted and remains in the UK's control.

In economic terms, there are synergies between offshore wave and wind devices in that they can be co-sited to share infrastructure including power cabling to the shore and management/maintenance economies. Large, mature-stage, multi-megawatt, OWEL wave energy converters (WECs) have the potential for sharing physical platforms with wind turbines.

The development and construction of OWEL WECs brings together many UK sources of marine expertise and operational facilities, such as consultancies, manufacturing and servicing. (See also the answer to question 5, below).

A strong UK capability in the development of wave energy devices brings opportunities for export in the form of complete systems or in the sale of licenses for local construction. However, this opportunity depends on the existence of strong intellectual property to protect the WEC designs. The unique OWEL technology is fully protected by international patents, but this is not the case with many other systems such as point absorbers, attenuators and oscillating water columns, where the basic operating principle has no such protection.

Where protection is weak, the market is open to late-comers from abroad who may manufacture similar devices to those developed over many years in the UK through the expenditure of blood, sweat and tears (and money). The late entry of GE into the market for horizontal axis wind turbines with similar designs to those developed by the Danes, is an example of this process and demonstrates that concepts have to be exploited early or others will reap the benefits.

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

OWEL has received four stages of support, without which the present state of development could not have been achieved.

At an early stage, a small SMART grant helped to fund a "proof of concept" investigation. This was conducted at Southampton and Gosport by the Qinetiq organisation and comprised both tank-testing and mathematical modelling. It predicted multi-megawatt performance from a full-scale device.

Later, a grant from the Carbon Trust enabled 1:4 scale tank-testing at the NaREC facility in Blyth supported by computational fluid dynamics (CFD) modelling at the University of Bristol. This proved the scalability of the concept.

At a third stage, support from the South West Regional Development Agency (SWRDA) allowed further design and tank-testing work to improve the efficiency of the wave to air pressure energy conversion. This led to refined and highly promising estimates of the commercial viability of the OWEL system.

The current development programme is leading to the construction and testing of a seagoing demonstrator at the Wave-hub facility. It is supported by a grant from the Technology Strategy Board.

The first two of the above tranches of support were vital for proving the technical effectiveness of the OWEL WEC. The third concentrated on efficiency issues and concluded with predictions of viable commercial operation for the WEC. The fourth has allowed progress towards a near full-scale demonstration of the potential of the OWEL design under seagoing conditions. This will lead directly to the design, construction and deployment of the first, commercial WECs. The first three tranches of support proved highly effective in confirming the technical viability of the OWEL concept. The fourth is expected to be equally effective in confirming its commercial viability.

The OWEL project was not sufficiently advanced to be eligible for the Government's MRDF or MRPF schemes. It is interesting to note that of the wave energy technologies that currently have demonstration devices in ocean conditions ALL of these benefitted from the MRPF funding and indeed the absence of such funding at the present time is a significant problem for emerging technologies such as OWEL in terms of the timescales in moving these to "market" and to Commercial-scale levels of operation. Facilities to assist in the ACCELERATION of the technologies are urgently required.

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

In the OWEL experience, although we have been successful in being awarded Government grants, there have been gaps between the funded periods which have caused some difficulties and delays. This lack of a coherent technology acceleration strategy is a major impediment to growth.

It has to be remembered that a company developing a wave energy device generates neither profit nor cash-flow until the first commercial device is sold or licensed. There are many years between the first conception of a device and the first sale. The long time-scale and market uncertainties are such that private investment is difficult to find. This, in turn, makes it difficult for a development company such as OWEL to continue development, or even survive, when there are long periods between grants, and the absence of a technology strategy. There is a problem inherent in the concept of "matched-funding" which is an effective condition of certain grant/subsidy awards, because there is a genuine difficulty in the present market to obtain such funding. This is in part the result of difficult economic conditions (at a world or macro level) and also the experience of the investors who became involved in marine energy devices in 2008–9 against a more optimistic outlook. Certain of those businesses have expended considerable sums of government and private investment with little tangible progress. This experience points towards the consideration of more active involvement by government (or government funded bodies such as Carbon Trust and Narec) in projects where funding/grant assistance is treated as a part of the technology acceleration process which involves:

- Definition of detailed milestones and achievement of these defined targets to permit access through "Gates" to next level of funding/support (see note on Technology readiness levels (TRLs) below).
- Use of existing expertise within organisations such as CT/Narec/(other approved technical bodies) to supervise/manage projects and carry-out due-diligence reviews.
- Potential for government to share in upside of projects through defined repayment plans/profit participation.
- More creative and coherent approach to funding opportunities and engagement of private sector (see below).

In the case of OWEL, it would have helped to maintain the momentum of R&D if our Carbon Trust funding had followed closely on the successful "proof of concept" study, and if the SWRDA funding had followed closely on the Carbon Trust funding. In the event, commitments by partner companies and by academic institutions allowed R&D effort to continue during unfunded periods although at a lower level than would have been desirable. Current progress and route to market in inhibited by difficulties in securing investment/matched-funding in the difficult market conditions.

It is clear to us that a level playing field needs to be created in order that the correct devices receive funding. Definitions of rated power and methodologies for calculating important metrics (such as annual power output) should be used. The European Marine Energy Centre (EMEC http://www.emec.org.uk/) testing documents would be excellent for this purpose, and should become the standard for testing across Europe, and the world.

It is also important for the concept of matched-funding to be (re)appraised . It seems inconsistent that as a part of the TSB awards in July 2010 grant monies were provided on similar terms to private ("start-up") companies and mature companies including a company whose shares are quoted on the US stock-exchange. We are not suggesting that projects which assist the UK economy (in medium and longer term) should not receive support, but it would appear that such support might be in terms of deferred-project-loans rather than outright grants and the less mature businesses have access to "capital or quasi-capital" funding.

NOTE ON GATES AND TECHNOLOGY READINESS LEVELS.

The staged provision of support is an efficient way of encouraging the innovation that has been necessary in the emerging technology for extracting energy from ocean waves. In the OWEL case, the funding has comprised four stages, with, at the end of each, a rigorous assessment of the results obtained leading to an informed decision as to whether or not investment for the next stage was justified.

At the first stage, the investment was small but the risk was relatively high. At subsequent stages, our understanding of the techno-economic factors was greater, the risk of proceeding was therefore decreased, and it was reasonable to make an increased investment. The risk of making a large investment in an ultimately non-commercial product was thus minimised.

OWEL would be glad to submit to a formal review process in order to qualify for future funding. Such a process could be based on Technology Readiness Levels (TRLs). Nasa defines nine of these, starting with the concept, progressing via various levels of testing through to a commercial machine.

Formal assessments could be made between TRLs 3&4 when moving from a desk based study to scale modelling (which represents a step change in funding) and between TRLs 6&7 when moving from a model to a large scale demonstrator (another step change in funding), and then again when moving to eight which is a full scale demonstrator.

These assessments could initially focus on efficiency, and later on they could focus on the likely cost of energy (COE). Standardising these reviews would give the funding bodies an excellent insight into the comparative performance of the various machines, and the tests themselves could (should) be based on EMECs test protocols for small scale and large scale devices.

Assessments should be carried out by competent, but impartial, experts who all work within one governing organisation (to ensure continuity.

This approach is detailed in: Guidelines for the Development & Testing of Wave Energy Systems IEA-OES June 2010 www.iea-oceans.org/_fich/6/Report_02–2.1(a).pdf.

OWEL has followed this process internally and it has been highly productive in our experience, although the often prolonged delays between the successful completion of one stage and the start of the next were undesirable and not easy to deal with. The fact that OWEL had to interact with a different funding team at each of the four stages may have exacerbated the delays.

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

The OWEL experience is that publicly provided innovation funding is necessary for the development of wave energy devices. The main reason, as noted in the previous section, is because of the very long lead-time between first concept for a wave energy converter and the deployment of the first commercial device.

The time between initial investment and the first return on capital is likely to be between five and 10 years, which is too long for most private financiers to consider. We believe it is the case that no—developer of wave energy converters has yet made a profit, although many have been in business for over 10 years.

It is certainly the OWEL experience that development work to date could not possibly have proceeded without Government support. However, the nearer we come to a commercial project, the shorter the lead-time and the greater the probability of receiving private investment.

Please refer to comments made above regarding the urgent need for continuity of finance along the lines of the MRPF, and for a more developed an coherent technology acceleration strategy.

A more creative approach to investment opportunities is also required .Many of the ideas put forward by the Green Investment Bank(“GIB”) would appear to offer the kind of solution required, although it is appreciated that these will take some time to develop/roll-out. We see no reason however why certain of the proposals cannot be fast-tracked ahead of the formal GIB launch or as a part of a staggered launch. These might include:

- Issued of Green Investment Bonds to institutions/public and advance of funds to approved bodies (CT/Narec/TSB) to manage due-diligence and Investment process and monitoring.
- Underwriting a proportion of investment risk.
- Tax relief for defined projects. The government increased the tax relief for EIS investment schemes in the 2011 budget to 30% and also restricted reliefs to those businesses receiving a significant proportion of their income from FITS or similar subsidies. These moves are welcomed but the government should consider increasing the tax reliefs available for certain defined “high-risk Cleantech “projects which would include marine energy to 50%. This would provide a measure of risk-mitigation which, if combined with availability of development/research funding such as the MRPF could pride a coherent technology acceleration path and a partial solution to the “funding-gap”. This when combined with the issue of Green Investment Bonds could provide a real and substantive acceleration of the route to market of Marine Energy businesses and provide real and tangible benefits to UK employment and the economy.

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

Wave devices are very diverse, with different machines suitable for deployment in different zones (on-shore, near-shore and off-shore). This diversity is good for the generation of ideas in an industry that hasn't yet settled on particular designs for the three zones. It does make it difficult for investors and policy makers to decide on which device is a good prospect, and this it another reason to introduce the staged development process described above.

There is considerable uncertainty over governmental support, both in the development stages, and further down the line in easing companies into a commercial state. The recent announcement of the withdrawal of ROCs wasn't accompanied by details of the support that will be available after 2017.

The grid is likely to be a barrier in the coming years with strengthening required in most areas close to the large marine resources.

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

It is the OWEL experience that almost all our funding has been spent using UK suppliers.

This includes such items as the construction of a Perspex model for tank-testing at the Southampton test-tank, and conduct of the "proof of concept" study by the Qinetiq organisation at Gosport.

A 15 metre steel test-tank model was constructed by a Newcastle fabricator and conduct of the proof of scaling study by the NaREC organisation at Blyth.

Supporting studies were carried out at the Universities of Bristol and Southampton.

The only exception has been the construction and testing of a polycarbonate model at HMRC, cork which has a test tank capable of a greater variety of sea-states than any currently available in the UK.

At the present stage, OWEL has been joined by UK partners:

- IT Power (project management and engineering design).
- Gifford (structural design in concrete).
- A&P Falmouth (structural design in steel and construction techniques).
- NaREC (electrical systems and control, grid interface).
- NPL (instrumentation and performance monitoring).
- Mojo (mooring systems, deployment and commissioning).
- University of Plymouth (control, safety and performance optimisation).
- DNV (certification).

For partners A&P and NPL, working with OWEL provides an opportunity to enter the renewable energy sector.

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

See also our detailed comments above.

- Staged provision of support (Based on TRLs, and administered centrally).
- Certainty over log term government support (define support after ROCs, and introduce a development fund for early stage developers).
- Creative approach to project funding (GIB loans and reduced reliance on matched funding)
- Re-introduce schemes like the MRPF/MRDF to fill the demonstrator funding gaps.

September 2011

Memorandum submitted by Marine Current Turbine Ltd

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

1. The UK has one of the largest marine renewable energy resources in the world. While estimates vary, MCT alone has identified sites in the UK with the potential to deliver 3,000MW of installed tidal stream capacity. Current Company projections shows in excess of 200MW of capacity being installed by the end of 2020 providing a small but significant contribution to the governments announced renewable energy targets. With wind energy essential to meeting the 2020 goals, investing now to exploit our marine resources will make major contributions towards 2030 goals and beyond.

2. Tidal renewable energy has the specific advantage that it is predictable. In the necessary mix of renewable technologies, this brings an added advantage to utility customers seeking efficient and balanced energy to the grid.

3. As well as the obvious contribution to the UK's renewable energy targets, the UK has managed—with Government support—to build the worlds most innovative and advanced industry. With tidal resource present in many countries around the world, this represents major export potential for the UK and will add a new sector to British manufacturing industry.

How effective have existing Government policies and initiatives on Marine Current Turbines Ltd renewables been in supporting the development and deployment of these technologies?

4. By and large the Government has supported the sector well thus far as it has progressed through its development phase. This support in turn has attracted significant private sector investment into the market. Over the past 10 years for example, MCT has attracted over £40 million of investment of which approximately £31 million has been private sector and £9 million from the public sector. This investment has enabled MCT to develop its tidal turbine technology to the stage that the company is generally acknowledged as world leader in this field with a commercial scale demonstration unit operational for over three years and a detailed plan developed to move forward into commercial production.

5. We are now entering a crucial phase where the industry needs to make the notoriously difficult transition from development and demonstration, to full commercial scale operation. This path is well trodden by renewable energy technologies, but ocean energy needs this key support right now. If the transition cannot be made in the next two-three years, there is every likelihood that much of the good work Government has done in positively positioning the UK marine industry will be undone as companies fail to be able to exploit their developments.

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

6. Fundamentally the lesson is to have stable and consistent policies that give the private sector the confidence to invest. The sector is risky enough for investors during the technology development phase without the policy ground shifting underneath ones feet. It has taken MCT over 10 years to reach the point where it now has a product ready for the market and the consistency of government support over this period has been essential. Moreover the projects that are needed to allow the technology to be deployed on the increasing scale necessary to bring down costs, in common with virtually all large scale power generation projects have a multi-decade life expectancy. This therefore needs long-term and consistent government support.

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

7. At this stage, yes absolutely. But the UK Government's commitment to the sector now needs to continue in a different guise as commercial scale projects are developed. There is no need for major new investments in technology development. There is a rich variety of technologies available now with most of the serious ones either completing (MCT) or entering their demonstration phases. The fittest of these will survive but will need to be able to move seamlessly into commercial scale projects if those companies are to survive.

8. Government policy during this next phase needs to focus on commercial scale projects. These require a different scale of investment from the private sector—10s of millions instead of millions. Government support for the revenue from these projects is essential initially while the economies of scale and learning are achieved. And for the very early projects a level of capital investment support will also be required to soften the risk profile for private sector investors. It is very clear from MCT's discussions with project investors that Government support will make or break their corporate investment decisions.

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

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

10. Planning

Planning could prove to be one of the most significant constraints to development. At present the signs are positive for the consenting of projects and the regulators and statutory consulters seem keen to work with developers and get projects consented.

However, so far only single devices and one project have been consented and it is only when larger array projects for longer term durations start going through the consenting process that we will know the full extent of this as a constraint. The nature of tidal sites are that they coincide with areas used regularly by marine mammals as well as having other environmental sensitivities, hence there are often designations that need to be considered as part of the environmental assessment process.

Regulators are being put under increasing pressure by the European Commission to ensure that sites designated in the Habitats Directive are properly protected. This could mean that the required level of environmental assessment work increases, or the level of post construction monitoring required is at such a

level that it significantly impacts the financial viability of projects. Or some projects may struggle to get consent at all.

However the scientific evidence so far, at least with MCT's own technology, is that the environmental impact has been minimal and it is to be hoped this will inform future decisions and thereby help the planning process.

11. Grid connection

Although grid connection is not considered to be a significant constraint on some of the sites being looked at by MCT, such as the Anglesey Skerries, in general the capacity of the transmission network to accommodate additional large scale generation is going to be a significant issue.

The nature of many of the sites identified as being suitable for tidal projects is that they are often in remote locations where the transmission network is weak. In terms of timescales for development this is one of the key constraints with reinforcements to the network around key areas such as the Pentland Firth planned for 2016 at the earliest.

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

12. Over 75%, by value, of the SeaGen turbine in Strangford Lough was sourced from UK suppliers. Given the nature of the technology, it will always be the case that significant amounts of expenditure will be incurred where the tidal turbines are deployed. Assembly and test, commissioning and operation and maintenance will always be local to the turbine site. Structures will often be more economic to manufacture locally thus avoiding transportation costs. All of the design work for the SeaGen turbine was carried out in the UK.

13. The next challenge will be to attract the supply chain that can deliver multiple turbine units to the cost and quality that customers will demand and for this to take place the supply chain must believe that a market of a significant size will develop. The supply chain will be looking at the level of subsidies that will be put in place to stimulate the deployment of the first farms of tidal turbines and react accordingly. Suppliers will not scale up and make the investments required to produce significant quantities of tidal turbines unless they are sure a market will develop.

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

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

15. MCT has estimated the cost of the first commercial scale tidal array to be in the region of £40–50 million for an eight-10MW deployment of four-five turbines. A capital grant of at least 20–25% together with five ROC's for each MWh of generation are conditions precedent to attracting the balance of private sector investment.

16. Although five ROCs implies high generating costs, there is robust evidence that can confirm the costs will fall to competitive levels given the usual economies of scale and learning curve effects that follow the "roll out" of a few reasonable sized projects. It is also worth noting that the initial projects which need this support are sufficiently small to ensure that the initial ROC costs will remain relatively very small in the context of the UK renewable energy market but that the ROC benefits will ultimately be very high if they can kick off a major new industry.

17. It is anticipated that revenue support will be required for some time to come (as it has been with other renewable sources). However, in time this can be progressively reduced. Capital support is likely to be required for the first few arrays but should rapidly be replaced by private sector funding as costs come down, risks reduce, and overall confidence in the sector grows. It is envisaged that key financial players such as the Green Investment Bank will be able to make significant contributions beyond 2015 and broaden the pool of investors for large scale tidal projects.

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

18. Time is absolutely of the essence. It is no exaggeration to say that the future of this sector is likely to be determined in the next two-three years. Unless the industry can establish a couple of commercial scale tidal array projects, it is very difficult to see how companies will be able to sustain investment. Provided that the revenue support and capital support mechanisms are activated in the next few months and strictly focused on technologies that are at proven maturity, this is eminently achievable.

September 2011

Memorandum submitted by The Crown Estate

SUMMARY OF THE CROWN ESTATE'S REMIT AND RESPONSIBILITIES, AND CURRENT WAVE AND TIDAL ACTIVITIES

1. The Crown Estate manages an estate worth £7.0 billion, which contains extensive marine assets including over half of the UK's foreshore and the vast majority of the seabed out to the 12 nautical mile territorial limit. Under The Crown Estate Act 1961, The Crown Estate's permission, in the form of a lease or licence, is required for the placement of structures or cables on the seabed. In addition to this, by virtue of the Energy Act 2004 and Energy Act 2008 it has the rights vested in it for the development of renewable energy within the Renewable Energy Zone out to 200nm; and for development of natural gas and carbon dioxide storage out to the UK Continental Shelf.

2. In carrying out its duties, under the core values of commercialism, integrity and stewardship, The Crown Estate is concerned to deliver the maximum renewable energy potential of the marine estate, in line with government policy. The Crown Estate is working with the grain of government to develop this new energy mix through several programmes of work including wave and tidal, offshore wind, CO_2 storage and natural gas storage. The Crown Estate's revenue surplus is paid to HM Treasury on an annual basis, such that the nation secures the benefit of the UK seabed being utilised for commercial purposes.

3. The Crown Estate has undertaken and continues to operate leasing activities for marine renewables. Figures 1 and 2 show projects that are currently in agreements for lease or lease. Most developments are currently focused in the Pentland Firth and Orkney waters, in which area The Crown Estate ran the first major leasing round between 2008 and 2010. This led to eleven projects with 1.6 GW potential capacity—the largest planned development of wave and tidal stream energy worldwide. One of the key objectives of the Pentland Firth and Orkney Waters leasing round was to kick-start the industry by creating a greater market pull from utilities and other developers. Lease structures have been designed so as to incentivise and facilitate delivery.

4. The Crown Estate has already awarded development rights for projects elsewhere in Scottish waters, and around the UK. We are continuing to lease demonstration projects (up to 10 MW capacity, around UK territorial waters) and projects in connection with the Scottish Government's Saltire Prize (up to 30MW capacity, Scottish territorial waters), with six-monthly application windows. We are also preparing to run a tidal (and offshore wind) leasing round in waters off Northern Ireland.

5. The Crown Estate is actively assisting the marine renewables sector, working closely with DECC, the Devolved Administrations and the other parts of government on key challenges facing development. This includes the need to attract greater capital to technology development and manage high costs and technology risks in initial projects. The Crown Estate is investing over £5 million in Enabling Actions to accelerate and de-risk the Pentland Firth and Orkney waters projects, and undertaking other initiatives to support industry development more widely. This includes an initiative in collaboration with DECC to create a Knowledge Network for marine renewables.

6. The Crown Estate's unique perspective on the UK offshore energy sector and programmes outlined above allows us to comment on the future of marine renewables.

Figure 1

TABLE OF PROJECTS WITH AGREEMENT FOR LEASE OR LEASE (SEPTEMBER 2011)

Type and location		*Potential capacity (MW)*	*Developers*
Pentland Firth and Orkney waters			
Wave	Brough Head	200	Aquamarine Power Limited & SSE Renewables Holdings (UK) Limited
	Costa Head	200	SSE Renewables Developments (UK) Limited
	Farr Point	50	Pelamis Wave Power Limited
	Marwick Head	50	ScottishPower Renewables UK Limited
	West Orkney Middle South	50	E.ON Climate & Renewables UK Limited
	West Orkney South	50	E.ON Climate & Renewables UK Limited
Tidal stream	Brough Ness	100	Marine Current Turbines Limited
	Cantick Head	200	SSE Renewables Holdings (UK) Limited & OpenHydro Site Development Limited
	Inner Sound	400	Atlantis Resources Corporation Pte Limited, Intenational Power Marine Developments Limited, Morgan Stanley Capital Group Incorporated
	Ness of Duncansby	100	ScotishPower Renweables UK Limited
	Westray South	200	SSE Renewables Developments Limited

Type and location		*Potential capacity (MW)*	*Developers*
Other Scottish Sites			
Wave	Aegir, Shetland	10	Pelamis Wave Power Limited and Vattenfall AB
	Galson	10	Aquamarine Power Limited
	Moray Firth	N/A*	Ocean Power Technologies Limited
	North West Lewis	30	Aquamarine Power Limited
Tidal Stream	Kyle Rhea	8	Marine Current Turbines Limited
	Sound of Islay	10	ScottishPower Renewables (UK) Limited
Other UK Sites			
Tidal Stream	England, Humber	0.5	Neptune Renewable Energy Limited
	Wales, Ramsey Sound	1.2	Tidal Energy Limited
	Northern Ireland, Strangford Lough	1.2	Marine Current Turbines Limited

Note: This is not a complete list of UK wave and tidal energy schemes. The Crown Estate has also leased areas of seabed for the test and demonstration facilities EMEC, around the Orkney Isles, and Wave Hub, off Cornwall. In addition, developers have publicised other projects. Some are existing assets where there is no contract between the developer and The Crown Estate (eg because the site is not part of The Crown Estate) while others are potential schemes which could in future be the subject of Crown Estate contracts.

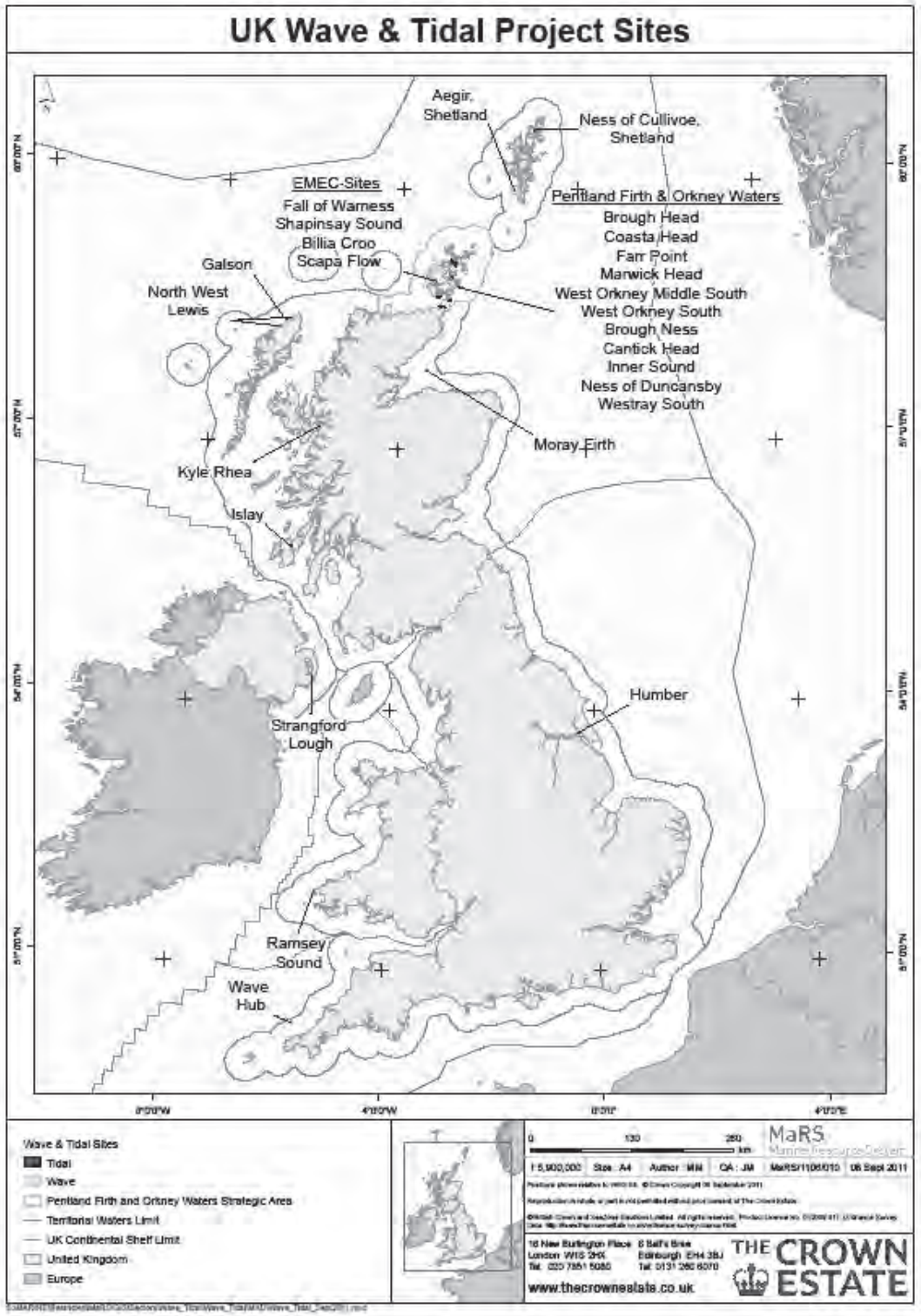
*Sea trials only; not planned to be grid connected

Source: The Crown Estate. Note: This list is correct as of September 2011. The Crown Estate is continuing to lease further sites and readers are advised to visit our website[53] for updates.

[53] www.thecrownestate.co.uk/wave-tidal

Figure 2

MAP OF PROJECTS WITH AGREEMENT FOR LEASE OR LEASE (SEPTEMBER 2011)



Source: The Crown Estate. Note: See notes to table in Figure 1.

RESPONSE TO CONSULTATION QUESTIONS

Q1. *What are the potential benefits that marine renewables could bring to the UK and should Government be supporting the development of these particular technologies?*

7. Wave energy and tidal energy have the potential to provide significant quantities of clean, carbon free electricity for the UK, due to the significant wave and tidal resources around the UK's coasts. The Carbon Trust suggests that there is a technical wave and tidal resource of 79 TWh, which could meet 15–20% of national electricity demand (Carbon Trust, 2006).

8. The pace and extent to which this resource is exploited is uncertain, largely due to the fact that the generation technologies to exploit are still under development, and development in earnest (with significant industry interest) began only last decade. Consequently, scenario development is challenging, but for reference here are some indicators:

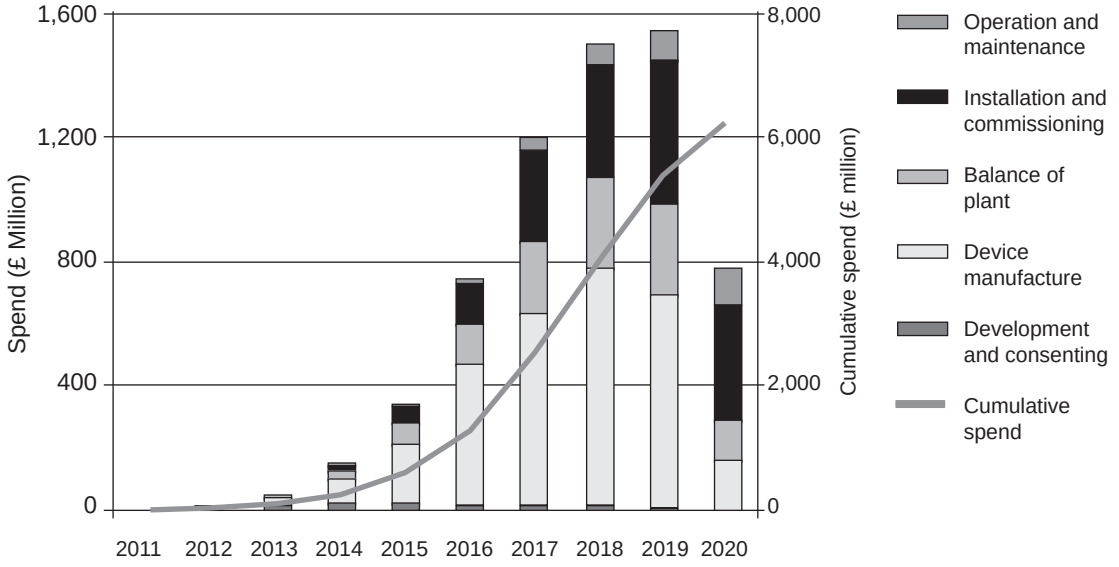
- RenewableUK (2011) suggests developer appetite to deploy 2.17GW of capacity by 2020.
- UKERC/ETI (2010) suggest deployment of 1–2GW by 2020 and 6–12GW by 2030.
- DECC (2011) indicate a lower figure of 200–300MW by 2020, followed by significant deployment in the 2020s to reach 27GW by 2030.

9. The deployment of wave and tidal energy capacity could benefit the UK in the following ways:

- **Security of supply—** The deployment of marine renewable capacity will improve the security of supply in the UK by reducing reliance on imported fossil fuels.
- **Decarbonisation**—DECC (2010) has indicated that renewables could make a significant contribution to achieving the UK's 2050 carbon reduction target under the 2008 Climate Change Act, by displacing the use of fossil fuels. The Committee on Climate Change has suggested that in order to achieve the 2050 target, the power sector will need to be largely decarbonised by 2030; and that renewables, nuclear and CCS technologies are central to the achievement of this aim.
- **Balancing the variability of wind**—It is often thought that increasing the penetration of wind into the UK energy supply mix may be problematic due to its variability, and will require additional capacity to be kept in reserve. However, it has been argued (for example by Sinden, 2005; and BWEA, 2009) that wave and tidal power can balance against the variability of wind, as there is a relatively low correlation between the power output patterns of wind and marine energy, and a relatively strong relationship between seasonal wave power output and electricity demand. This could mean there is in a reduced requirement for backup capacity when wind, wave and tidal are combined.
- **Supply chain benefits**—The development and deployment of wave and tidal devices in UK waters has the potential to create economic benefits, across the value chain from research to long-term operation and maintenance. In May 2011, The Crown Estate published a report indicating the potential costs and associated supply chain opportunities of developing and constructing the Pentland Firth and Orkney Waters projects. The report described a range of challenging technological, environmental, planning, economic and financial factors that will have to be overcome in order to progress these projects. £100 million could be spent on development and consenting activities for these projects by the middle of the 2010s. If statutory consents and investment are secured, and the projects progress through to installation and commissioning, then this would require £6 billion+ of capital expenditure towards the end of the decade (not including expenditure related to grid and other infrastructure upgrades) should the projects be built out completely. The forecasted pattern of expenditure is summarised in Figure 2 below:

Figure 3

FORECAST EXPENDITURE ON PENTLAND FIRTH AND ORKNEY WATERS PROJECTS



Source: BVG Associates for The Crown Estate.

In addition to meeting domestic demand, there is potential for UK-based suppliers to export marine renewable goods and services globally; particularly if the UK can maintain its lead on technology development (as explored further in response to Question 4 below). We are engaging with the emerging supply chain as part of our supply chain events, held in various places including Scotland and Northern Ireland in the past year. This is helping to ensure that companies with the potential to enter the industry are aware of the opportunities—a programme of work we will continue to undertake.

10. Overall, this provides a strong case for government to support marine renewables.

Q2. *How effective have existing Government policies and initiatives on marine renewables been in supporting the development and deployment of these technologies?*

11. Government support for technology development has been significant in value[54] and very effective in helping make wave and tidal stream technologies make the transition from academic research to industrial development by start-up companies, and test and demonstrate full-scale prototype devices in the sea. This is evidenced by the progression of a number of companies, eg Pelamis Wave Power (formerly Ocean Power Delivery) and Marine Current Turbines. UK government bodies[55] have collectively provided more support than that of any other country. As a consequence of this funding and the private investment it has catalysed, the UK has a global lead in marine renewables generation device design and testing.

12. However, government support for the industry to progress beyond this stage, towards full industrial design and manufacturing of generation devices, plus commercial project installation and operation, has been less successful to date. For example, the Marine Renewables Deployment Fund (MRDF), a scheme designed to support initial arrays of devices, was effectively unsubscribed, and the scheme's design not fully re-evaluated when it became clear that the support on offer was not that which was essentially needed by the industry at the time, (although a sister scheme, the Marine Renewables Proving Fund, was successful in supporting the necessary prototype manufacturing and testing).

13. For a number of years, the industry has called for a long-term signal to attract the type and scale of investment necessary to progress further. A considerable amount of equity is needed to further develop technologies, and due to high initial technology risks, capital for early projects is also likely to be largely in the form of equity. For the industry to move further, it needs to have a clear sight of how technology and project investments will yield returns. For other renewables technologies (particularly renewable electricity technologies), this has and is being achieved through revenue support. Unfortunately, it is only presently in Scotland that banding of the Renewables Obligation for wave and tidal energy was undertaken in such a way that support levels were commensurate with project costs and risks; for the rest of the UK, the support has been too low. This is evidenced by industry behaviour; the vast majority of project development interest is in Scottish waters (see Figure 2).

[54] UKERC (2010) estimates that £152 million of UK public funding has been invested into marine energy since 1990.

[55] Including centrally from the DTI and DECC, Devolved Administrations and publicly-funded bodies such as the Carbon Trust, Energy Technologies Institute, Technology Strategy Board and others.

Q3. *What lessons can be learnt from experiences within the UK and from other countries to date in supporting the development and deployment of marine renewables?*

14. Concerning government support, the following insights may be suggested on reflection of the industry's progress in the UK last decade:

— The visibility and consistency of government support for marine renewables is a key determinant of investment decisions, and therefore a key driver of the rate of growth. Where support has been more visible (particularly in Scotland, with support from the First Minister), progress has been made faster.

— As one amongst several types of low carbon generation to supply the UK's future electricity needs, support for wave and tidal needs to fit in to wider and sometimes existing government policies and mechanisms (eg the Renewables Obligation). But the support must nevertheless meet the needs of marine renewables specifically, otherwise it will be ineffective (eg ROC band outside Scotland).

— It is advisable to think systematically about how growth of the sector can be stimulated, to avoid situations where support of one kind is given but despite this, critical barriers hold back progress. For example, several years elapsed between test facilities (grid connections and data infrastructure) at the European Marine Energy Centre at Orkney became ready to use, and companies actually had prototype machines ready to use them; investment in the prototypes lagged investment in the infrastructure, and one without the other left the system incomplete.

15. In parallel, lessons learned in the industry include the following:

— Marine renewables technology development is capital intensive; and the amount of capital necessary to successfully develop wave and tidal energy technologies, and the time necessary for development, is not necessarily a good fit with standard venture capital business models. While venture capital has had a positive effect in further development, investor perceptions are not entirely positive due to commercial requirements not being met, irrespective of technical progress.

— Non-financial barriers, such as obtaining site consents, may present significant unexpected hurdles, on top of the engineering challenges inherent in technology development—and these hurdles may significantly delay development or make it more expensive—again despite success in technical progress. An example is the Marine Current Turbines SeaGen prototype at Strangford Lough. Such hurdles may be beyond the influence of any single company, and require coordination between the industry and multiple government bodies to resolve.

16. While the experience of other countries is relevant, the fact that the majority of recent work has been undertaken in the UK means there are fewer insights to reference. It is worth mentioning, however, that while the UK has significant indigenous wave and tidal resources, so do numerous other countries and there is clear potential for the industry to grow more internationally in future. Indeed, some companies (eg tidal technology developer OpenHydro) are already working across multiple jurisdictions.

Q4. *Is publicly provided innovation funding necessary for the development of marine technologies and if so, why?*

17. Publicly provided funding for innovation (for research, development and demonstration) has been necessary in the past. It has been significant in value and effective, as described above in the answer to question two. The case for publically provided innovation funding has to date been made based on the following market failures facing the marine renewables industry:

— **Externalities**—The current energy market and wholesale energy price does not reflect the true environmental and social cost of carbon (ie a negative externality). Measures such as the Renewables Obligation and EU Emissions Trading Scheme go some way towards penalising high carbon forms of energy and rewarding low carbon forms of energy; but not far enough to reflect the full costs of carbon. Consequently there has been an insufficient incentive to invest in low carbon forms of energy. Addressing these externalities in improved fashion partly motivates Electricity Market Reform and the Carbon Price Floor.

— **Risk appetite and capital availability**—Linked to the above, there are significant risks associated with technology development which many types of investor are unwilling to bear (for example the lack of evidence of viability). Some forms of private equity are not well-suited to funding research and development activity as returns from R&D activity are too distant and uncertain, or funds are insufficient to deliver the amount of investment required. See the comment about venture capital funding for marine renewables technology development under question three.

— **The scale and duration of investment required**—The capital intensive nature of development and time required for testing and demonstration (influenced by factors such as weather windows for installation) makes private investment challenging. This has implications for the scale and duration of public support. As a benchmark, it is estimated that Denmark spent £1 billion over 10 years bringing onshore wind from demonstration to full-scale deployment (BWEA, 2009); in return, however, it now enjoys an export market worth several £ billion per year[56] (Aquamarine Power, 2010).

— **Knowledge spillovers**—While intellectual property in generation technologies can be protected through patents, an accompanying range of knowledge and experience (eg installation methodologies) may not be protectable in practice, and information will flow to the wider sectors (competitors) or economy (eg through the supply chain or movement of personnel). The limit to what can be protected may cause investment to be lacking in some areas. Public funding, which often requires results to be published, may be necessary to meet the funding shortfall.

18. Today, some of these factors appear different to industry participants than they did several years ago. There have been significant steps forward in technology development, with technologies having developed more of a track record (eg Voith Hydro Wavegen LIMPET OWC plant now been operated for a decade). Capital availability for technology development is increasing due to the trend of recent years for large industrial equipment manufacturers to enter the market (for example Voith Hydro and Alstom, each of which has both wave and tidal technology programmes). However, from a project development perspective, technology risks appear high compared to other, more mature technologies. These factors mean the industry's needs are shifting from a requirement for early stage innovation funding, towards a requirement for project-level demonstration funding. Yet in considering support, it is also important to recognise that:

— The quantity and rate of investment which the private sector brings to marine renewables will be a reflection of the perceived market opportunity (ability to make sales).

— Investment decisions will also be affected by events elsewhere in the energy industry and wider economy; a clear constraint at present is the disrupted state of global markets.

Q5. *What non-financial barriers are there to the development of marine renewables?*

19. Wave and tidal energy face a number of barriers to development, some of which are common to other forms of renewable energy. They include:

— **Uncertainty of environmental impacts**, and uncertainty caused by a lack of data on the environmental impact of marine energy devices; plus interaction with other sea users (eg shipping and military activities). This is a developing picture as further installations are made and their effects are monitored.

— **Consenting**, including clarity of data/information requirements and the processes to manage project applications. This has changed in recent years due to the Marine and Coastal Access Act and other legislation, and the creation of new organisations including the Marine Management Organisation and Marine Scotland.

— **Grid access**, given the geographical mismatch between areas of high wave and tidal energy and distribution/transmission network capacity to connect new generation. This is an evolving picture, partly due to grid upgrade plans and regulatory changes associated with offshore and onshore wind.

20. Supply chain capacity is sometimes cited as a barrier, but whilst this is true in other parts of the renewables industry (including offshore wind); it is not yet a major concern for marine renewables. Activities to manufacture and sell generation devices, plus work to design, install and operate generation projects, have not yet reached a scale where there is insufficient capacity; rather, it is a question of competition for interest with other business opportunities.

21. Previous experience in development of other energy technologies suggests that, while it is necessary to devote some attention to non-financial barriers, strong motives to overcome them are likely to occur only when there is a real commercial pull for projects. As such, while undoubtedly important, the barriers can be considered secondary to the issues of financial support discussed earlier; without this support, strong motives will not be present.

Q6. *To what extent is the supply chain for marine renewables based in the UK and how does Government policy affect the development of these industries?*

22. Given that marine renewables is an emerging industry, the supply chain is embryonic on a global scale. The UK is leading development, with more technology companies active and projects being developed here than any other country in the world. The UK is well positioned for further industrial growth, given the country's strengths in related sectors such as offshore oil and gas and offshore wind.

[56] The Danish export market for wind turbines was worth over £4.8 billion (€5.7 billion) in 2008. With a 20% share of the global market, the Danish wind industry employs 28,000 workers and contributes £1.2 billion (€1.5 billion) in Gross Value Added (GVA) to the national economy each year.

23. Historic experience, including the renewables industry (eg wind energy in Denmark), points to the importance of a strong domestic market at first for a country to develop a leading export position in future. There is no doubt that the extent of the UK's wave and tidal resources are sufficiently large to underpin this market, and The Crown Estate's activities in leasing sites to access these resources are helping it to grow.

24. A number of studies have been undertaken on the marine energy supply chain. For example, BIS (2011) estimated that there were 550 people employed in wave and tidal in 2009–10. Sgurr Energy & IPA (2009) considered the likely expenditure pattern and supply chain associated with future Scottish marine renewable energy projects. Based on a survey of supply chain companies, the study concluded that 53% of capital expenditure would be retained in Scotland, and a further 30% in the rest of the UK, with only 17% relating to imports; suggesting an expectation of a strong indigenous supply chain in the future.

Q7. *What approach should Government take to supporting marine renewables in the future?*

25. We would make the following recommendations about future government support for marine renewables:

26. The government should make a clear long term commitment to the marine renewables industry—creating greater certainty for developers, investors and manufacturers.

27. Financial support which is truly commensurate with the costs/risks to the industry and appropriate to the industry's needs at the time; but crucially also with foresight of how incentives today will drive investment for the future. At present there is a need for financial support to ensure the roll-out of initial arrays, but there also needs to be a commitment now to an appropriate level of support for full-scale commercial developments in the medium to long term. This is particularly important in view of the significant investments required in technology development and manufacturing.

28. There are clear interdependencies between the level of government ambition and support for a given technology; the degree of commitment and investment by industry; the level of cost reduction achieved; and the level of support required through revenue support mechanisms such as the Renewables Obligation or Feed-in Tariff. A climate of strong government support and commitment is a catalyst to industry investment, which as capacity is built out, is also likely to lead to significant cost reductions[57] (due to economies of scale and learning). As and when such cost reductions are achieved, the need for government support will diminish. The implication is that development could be significantly aided by a commitment now to provide support in such ways and for a period of time that helps puts wave and tidal energy on a path to becoming cost competitive (reaching cost parity) with other forms of energy.

29. At present, there are clear opportunities to design and implement financial support measures that are commensurate with cost/risks, which drive investment for the future and help put marine renewables on a cost competitive path. These opportunities include:

- The Renewables Obligation Banding Review, which is considering revenue support levels for the whole of the UK that would support projects in the period before feed-in tariffs are introduced.
- Electricity Market Reform, with the introduction of new feed-in tariffs.
- The Green Investment Bank.

Q8. *Are there any other issues relating to the future of marine renewables in the UK that you think the Committee should be aware of?*

30. We have no further comments to add.

September 2011

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Memorandum submitted by MeyGen

(I) About MeyGen Ltd

MeyGen Limited is a joint venture between Morgan Stanley (45%), independent power generator International Power GDF SUEZ (45%) and tidal technology provider Atlantis Resources Corporation (10%), formed to develop the Inner Sound tidal site allocated through The Crown Estate Pentland Firth and Orkney Waters leasing programme.

MeyGen is solely dedicated to the engineering, development, and execution of a tidal energy project with an in-house team of specialists. All three shareholders have previous experience within the tidal energy sector and the consortium has the expertise, financial strength, commitment and ability to develop the Inner Sound project in a manner that provides the marine energy industry with a benchmark that will assist in taking it from its current nascent stage to commercial reality.

The Inner Sound project is the largest tidal stream energy project in the world, and is considered by many as the "Crown Jewel" site in the Pentland Firth, with tidal flows that offer some of the best commercial potential in Europe. The project has been developed over past four years by a dedicated UK team, with financial backing from Meygen's shareholders.

MeyGen's first milestone is to install a 20MW array as a proof of commercial concept and ultimately build out 398MW of capacity.

(II) Summary

- The growing marine energy industry is strongly represented by a range of Government working groups (eg Marine Energy Programme Board) trade associations (eg European Ocean Energy Association, Renewable UK, Scottish Renewables) and industry collaborations (eg The Crown Estates Developers Forum). A number of reports have been written which examine the opportunities and threats to the industry as well as attempting to quantify the scale of the potential market and the barriers to making this market commercially viable.
- We welcome the enquiry by the Energy & Climate Change Committee into the *Future of Marine Renewables in the UK* and believe that it is well timed to consolidate and enhance the debate ahead of key policy decisions such as RO Banding due this year and the beginning of next year.
- Strong political leadership and commitment, as demonstrated by a robust policy framework, is an essential "green light" for private sector investors to continue their commitment to the sector. The continuation of these clear, positive market signals should ensure significant capital will continue to be drawn into the sector.
- We do not intend to reiterate elements of the debate that have been made historically but instead focus on specific policy measures and decisions which the UK government might consider appropriate to take in the short term. If implemented, we believe these will have a materially positive impact on the ability of the utilities and OEM's of marine technology equipment to deliver the first commercial proof-of-concept projects, building on the earlier successes of prototype testing and development. By making the transition from prototype to commercial proof of concept, the industry will have achieved a key milestone, comparable to that which the offshore wind sector achieved in the 1990's which led directly to that sector's successes today. These specific recommendations are:
  - Provide 5 ROCs/MWh for marine renewable projects across the UK.
  - With respect to the New Entrants Reserve fund (NER300), provide Member State guarantee to European Investment Bank in the event of a successful UK marine energy project.
  - Ensure pre construction allocation of £20 million Low Carbon Innovation funding to projects of the right size to serve as representative proof of commercial concept (minimum 5 units).
  - Provide clear mandate to the Green Investment Bank (GIB) in relation to marine projects in line with Coalition Agreement commitment.
  - Explore tax relief for activities relating to marine energy project delivery.

(III) Detailed Answers to the Inquiry Questions

Question 1: *What are the potential benefits that marine renewable could bring to the UK and should Government be supporting the development of these particular technologies?*

1. The UK has established a technology lead in this sector with facilities at the European Marine Energy Centre (EMEC), the National Renewable Energy Centre (NaREC) and Wavehub that are capable of supporting

global marine project pipelines in the same way as the Danish and German wind sector now supports offshore wind assets.

2. The UK has a national asset which, if appropriately exploited, could materially reduce the need for reliance on energy imports. The tidal energy sector specifically could deliver 5–10% of UK electricity demand from a reliable, predictable and domestic source which is decoupled from fossil fuel price.

3. The sector could draw inward investment and long term economic benefits to peripheral regions of UK through ongoing operations & maintenance facilities and professional services.

4. The sector has a number of distinctive characteristics which enable it to compliment other renewable sources in the generation mix and ensure maximum penetration of renewable electricity. Tidal stream energy in particular:

5. Is close to shore (thereby minimising offshore infrastructure costs):

(a) has a compact footprint (thereby limiting the areas of seabed that are used for development);

(b) has high energy density (thereby limiting the quantities of raw materials used in production); and

(c) is reliable and predictable (thereby creating a range of commercial and technical benefits).

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

6. We recognise and appreciate the many years of support that successive governments have given to the marine renewable energy sector. We welcome the Coalition's commitment to "introduce measures to encourage marine energy" [1] and we were encouraged by Minister of State Greg Barker's speech to the Renewable UK Wave and Tidal Conference [2] where he reiterated that the "development of the sector is explicitly written into the fabric of the Coalition Agreement". Strong political leadership and commitment, as demonstrated by a robust policy framework, is an essential "green light" for private sector investors to continue their commitment to the sector. The continuation of these clear, positive market signals should ensure significant capital will continue to be drawn into the sector.

7. Early public sector funding for EMEC established a facility which has reduced prototyping costs and schedules through the provision of power off-take infrastructure, background planning permission and implementation services.

8. Funding from TSB, Carbon Trust and ETI has leveraged private sector investment in prototypes and produced scalable proof of concept units suitable for investment and mass production by large OEM's.

9. Renewable energy and CO_2 reduction targets have guaranteed a future market across all renewable technologies, although there remains lack of clarity about the size of the role Government expects marine energy to play. There is also a risk that too little ambition for the sector will not provide the longer term certainty that today's significant investments require.

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

10. The UK is currently at the forefront of marine renewable development and therefore other countries are looking to learn from our experiences and incorporate these into their marine energy programmes.

11. A close parallel to the likely growth of the marine renewable sector is the offshore wind sector (of which the UK has the largest installed capacity in the world) and a study of its heritage will serve to highlight the key steps that a successful UK based marine energy industry is likely to require.

12. Today's leading offshore wind technology suppliers have charted a similar course with each securing early multi turbine demonstration projects (eg Vindeby, Utgrunden, Beatrice, Tunø Knob) supported by Government capital grants[3] , a medium term project pipeline (eg North Hoyle, Nysted), and backed up by longer term market pull (eg Round 2/3). With this track record and background, investments are currently being made for UK based manufacturing facilities catering for Round 3.

13. Offshore wind has enjoyed a stable support mechanism and Government has been responsive to rising cost bases over time by increasing the ROC banding. This approach has led to the successful deployment of over 1000MW capacity.

14. The UK offshore Oil and Gas industry has strong parallels with the pioneering of innovative technology and engineering achievements that continue to this day from which both equipment and intellectual "know how" is exported on a massive scale around the world. The knowledge base that the UK has accumulated in both this sector and offshore wind can only enhance the development of the marine renewables sector as it looks to make the next step into commercialization.

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

15. The industry is now delivering on previous years' developments: the lessons learned through unit monitoring and the demonstration of multiple deployment methods are now being built into the design of future deployments. With political support, technology tests, sites, grid connections and planning work, nearly all the pieces are now in place for a proof of commercial concept: the final piece is to bridge the technology gap from single unit test to multiple unit deployment.

16. However, without proven reliability, availability or performance it is difficult to quantify the risks of pilot projects to the level that is required for many conventional investment processes. Therefore public innovation funding is essential as match funding to reduce the amount of "at-risk" equity investment and increase the probability of marine renewable projects securing capital from investors.

17. We welcome funding announcements from the EU (NER300) and UK Government (Low Carbon Innovation Fund). Up-front funding helps to mitigate the one off First of a Kind (FOAK) costs that are inevitable as new products & processes are designed from the bottom up.

Question 5: *What non-financial barriers are there to the development of marine renewable?*

18. *Grid.* It is well understood that the timing of planned upgrades and cost of access to the transmission system has been a constraint to renewable energy development in peripheral areas of the UK, particularly with grid capacity not being available in some cases until beyond the 2020 horizon. We are encouraged that this issue is being addressed through NGETs "connect and manage", Ofgem's Project Transmit and DECC's Transmission Charge Adjustment consultation (under Section 185 of the Energy Act 2004). We await the proposals on the following issues:

(a) Transmission charging remains high in peripheral areas where marine renewable energy development is taking place, when in other areas generation receives a payment for being connected.

(b) Efficient coordination of upgrade programmes carried out by the network owners as a result of applications made and the interaction with the OFTO tendering periods. This is required to maximise the early delivery of capacity and minimise the underwriting exposure to individual projects.

19. *Planning.* Good progress has been made on Marine Spatial Planning and monitoring guidance in areas where marine renewable development is taking place. The establishment of the MMO and Marine Scotland means there are now dedicated organisations responsible for marine planning. The industry would benefit from clarity on the likely pre- and post-construction planning conditions and monitoring requirements that will be needed for early marine renewable developments and especially any circumstances under which shutdowns are being considered as a mitigant.

20. Technology testing. Project investors require "hours on the clock" testing prior to being able to sanction large capital costs for arrays. Good progress is being made with EMEC but technology companies and development companies alike need to see that there is a future market in order to be able to bolster these crucial early single unit technology years.

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

21. The UK has a strong heritage in Oil and Gas fabrication, retrofitting and servicing, which means that there are a number of existing yards capable of manufacturing the key components of marine energy systems, for example foundations.

22. Due to the compactness of marine energy systems in comparison with offshore wind, fewer modifications should be required to yards to accommodate the units.

23. There are likely to be a number of factors which mean the assembly, test, load out and O&M facilities may be located in close proximity to project sites within the UK. This would mean locally based repair & maintenance crews, operations and support personnel would be required. These facilities would greatly assist the development of remote communities such as those in the North of Scotland who are currently witnessing a downturn in young population retention (brain drain) due to the lack of opportunity in the region. It is strongly believed that skills and job generation in such an exciting sector will help rectify this.

24. To date, all marine renewable energy equipment has been fabricated/manufactured in the UK. The supply chain is prepared to meet the challenge of scaling up on the basis that the support mechanisms are in place to demonstrate a future market.

Question 7: *What approach should Government take to supporting marine renewables in the future?*

25. The industry stands at a critical juncture where short term and specific Government action will greatly reduce the risk that the momentum which has been built up over the past few years is lost. Specific measures are:

26. Provide 5ROC/MWh across the UK for marine renewables. As funds are only allocated on commissioning of plant, the RO can be seen to reward success and does not create a liability for UK Government during the development phase.

27. NER300:

(a) The European Investment Bank has indicated that NER300 funding can be supplied at pre-construction stage if underwritten by Member States. Should UK Government agree to provide this underwriting (as DECC are considering for CCS projects [4]), this would greatly de-risk projects.

(b) The Government has submitted 7 CCS projects and 4 marine renewable projects under NER300, but will only get support for a maximum of 3 projects. In this competitive landscape we welcome DECC's undertaking "priority is being given to the ocean category as a reflection of national priority" in the NER300 programme[5]

28. Low Carbon Innovation Fund

(a) Projects should be of sufficient scale to act as meaningful commercial proof of concepts (minimum 5 units)

(b) Funding should be disbursed as a pre-construction CAPEX

(c) Clear permission should be given to allow fund to combine with other funds up to the EU State Aid limits, and no artificial restraints should be imposed.

(d) Projects should remain eligible for enhanced ROCs in whichever jurisdiction they are located

29. Other measures:

(a) Provide clear mandate to GIB in relation to marine projects in line with Coalition Agreement commitment to introduce measures to support marine energy

(b) Consider tax relief for activities associated with marine energy development.

30. The Industry needs clear signals to justify continued investment therefore continuity and stability through RO to EMR transition is essential. The Industry needs to understand a range of specifics arising from EMR such as the level of FIT for marine renewable, eligibility of tidal energy for capacity payments and route to market under FIT CFD and how this will affect investment decisions.

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

31. It is essential that several commercial proof of concept or demonstrator arrays are established in the next 2–3 years and we believe Government policy and support should focus on this goal. Experience from the offshore wind industry shows that these projects act as a springboard for the medium term 50–100MW projects. The industry has managed to develop from an embryonic technology innovation "experiment" to an industry that has major institutional investors on the cusp of investing substantial funds in order to develop the market. The opportunity to convert this periphery interest from external funding is now upon us.

32. The industry should not be categorized purely as a way to assist reduces CO_2 targets by 2020. There is significant potential for development into a significant growth and export industry for UK plc over the next 10–20 years. The industry requires the government to continue its faith in the industry and build upon the knowledge and expertise that has already been developed.

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September 2011

Memorandum submitted by RSPB

Summary

1.1 The RSPB strongly supports continued expansion of the tidal stream and wave industries because of the significant role they could play in delivering low carbon energy and positioning the UK as a global leader in green growth. Significantly increased efforts are needed, however, to understand and mitigate the potential impacts this will have on marine biodiversity. Failure to do so will result in adverse environmental impacts, and public concern over these impacts, becoming a major barrier to further deployment. We recommend:

(i) Support for tidal stream and wave power is increased to the same level as currently received in Scotland (5/ROCs/MWh) in England, Wales and Northern Ireland. Ideally this should not be capped, but if a 2017 cap is introduced it should not be less than 300MW.

(ii) Tidal range may be capable of delivering significant amounts of energy. However, the evidence shows that existing commercial technologies are not capable of harnessing this without causing major environmental impacts. Support should therefore focus on the research, development and demonstration of low-impact tidal range technologies.

(iii) Urgent action is taken to designate an ecologically coherent network of marine protected areas, ensuring proper protection of marine wildlife from energy development and other offshore activities, and reducing uncertainty for the marine renewables industry.

(iv) DECC, Defra and the marine energy industry collaborate to develop a coherent and comprehensive survey programme for marine wildlife.

(v) Public R&D investment focuses on technological innovation to reduce the environmental impacts of tidal and wave power, and a collaborative industry-stakeholder-government partnership is established to monitor the impact of marine renewables on the environment and share data.

(vi) National-level infrastructure assessments are made in each UK country to assess port infrastructure requirements and to develop a strategic approach that will minimise overall requirement and the overall impact on the natural environment.

The RSPB and Marine Renewables

2.1 Climate change is already affecting birds and wildlife in the UK and globally, and it threatens to drive future biodiversity loss unless urgent action is taken to reduce emissions and keep the world within "safe" levels of climate change. One study published in *Nature* indicates that climate change could cause up to 35% of species to be committed to extinction by 2050.[58] The RSPB therefore strongly supports the UK's greenhouse gas reduction targets and recognises the critical role that renewable energy, including tidal stream and wave power, will play in delivering them as part of a wider package that prioritises energy savings.

2.2 The huge amount of new infrastructure needed to decarbonise our energy supply can, however, have a detrimental impact on wildlife in the UK if poorly located and/or designed, whether at sea or on land. The Government has committed to reversing biodiversity decline by 2020. We believe, therefore, that Government has a duty to ensure these targets are met with minimal environmental impact.

2.3 The RSPB engages with individual applications for renewable and other energy infrastructure across the UK, advising developers how they can minimise the impact of their developments. Where the environmental impacts of a proposed scheme are likely to be unacceptable, we will object, but our preference is to work with renewable energy developers to address and mitigate any impact. This has meant that since 1990 we have placed sustained objections on only 5.9% of wind farm applications that we have engaged with.

Tidal Stream and Wave Power

2.4 The RSPB works closely with the tidal power industry across the UK. The industry is at an important stage as preferred designs and approaches have yet to emerge, and there is therefore an opportunity to ensure that minimising impacts is a priority for the industry from the outset. For example, we worked with Marine Current Turbines on their tidal stream installation on Strangford Lough, advising on the monitoring regime required to evaluate its impact on wildlife, and we recently welcomed Scottish Power Renewables' announcement that they will build a 10 turbine array in the Sound of Islay and will implement a comprehensive monitoring programme.

2.5 Our key concern is the potential impacts on the UK's internationally important breeding seabird populations, notably Manx shearwater, northern gannet, great skua and lesser black-backed gull, for which the UK has particular responsibility given the high proportion of their breeding populations that we host. We have therefore conducted a review of potential impacts of wave and tidal stream energy on seabirds, which will be published in due course. Given the paucity of literature in this area, the review is based on an ecological approach, making inferences about likely impacts based on what we know about seabird ecology. A short summary of potential impacts based on this review is available on request.

[58] Thomas et al. (2004) *Extinction risk from climate change* Nature 427 pp.145–148

Tidal Range

2.6 The RSPB has been closely engaged with the Severn Tidal Power Feasibility Study (STPFS), and was on the Steering Group for the SEA. Whilst we objected to the barrage proposals, which would have had an irreversible and detrimental impact on the geomorphology of the estuary with consequential effects on the unique and internationally important biodiversity in the estuary and on flood risk, we were open to innovative means of sustainably exploiting the energy resource in the Severn. We consistently called for greater resources and effort to be put behind developing these options, and asked that acceptable environmental impact be considered a priority for the feasibility study. Whilst we welcomed the Severn Embryonic Technologies stream of the study, it was under-resourced and formed only a small part of the overall study (£0.5 million). As a result, the £20 million STPFS ultimately delivered recommendations that were unworkable because of their excessive costs, due in part to their enormous environmental impacts.

2.7 We note that the Mersey barrage proposal by Peel Holdings followed a similar trajectory to that of the STPFS, with plans now shelved because of costs and opposition on the grounds of environmental impact. Whilst the RSPB supports the sustainable exploitation of tidal range power in principle, we conclude from these experiences that:

- It is extremely difficult if not impossible for a conventional shore-to-shore high head barrage to be built without detrimental impacts on biodiversity and on the hydrology and geomorphology of an estuary, and therefore to comply with environmental legislation.
- Innovative technologies may allow tidal range to be exploited sustainably, but further R&D is required to develop and commercialise them. We believe this should be the focus of the industry and any future Government intervention.

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

3.1 The UK's tidal stream and wave resources offer a significant source of low carbon, renewable energy. If deployed with care and sited correctly, we believe this resource can be exploited without unacceptable impact on the marine environment, and therefore strongly support public intervention to research, develop and deploy these technologies sustainably. In the absence of proactive measures to mitigate impacts, however, marine renewables risk having significant detrimental impact on seabirds and marine mammals in particular, and that this would result in significant public concern and opposition to further deployment.

3.2 Provided measures to achieve sustainable solutions are in place, we believe that Government should increase support for tidal stream and tidal power in England, Wales and Northern Ireland to the level of support received in Scotland. (5ROC/MWh). The higher support available in Scotland, along with clear political commitment and initiatives such as the Saltire prize, has led to Scotland becoming a global leader in this new industry. Furthermore, the 2017 cap should be set at no less than 300MW to ensure growth is sustained and investor confidence.

3.3 The UK's tidal range resource is considerably more difficult to exploit without causing major alterations to estuarine geomorphology, resulting in unacceptable damage to wildlife and flood risk, and at an acceptable financial cost. We believe that future support should be smarter, and targeted at low impact technologies, and consideration should be given to what combination of R&D investment and ROC support is needed to develop and commercialise lower-impact tidal range technologies. This should be coupled with a removal of ROC support for shore-to-shore high head barrage schemes, which would send a clear signal to potential developers that impacts of such magnitude are unacceptable, and that rewards will be reaped by those who innovate lower impact approaches.

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

4.1 There are a number of examples of good spatial planning at sea as a means of facilitating deployment of marine renewables and reducing conflict with the natural environment from which England could learn.

4.2 The Scottish Government has introduced spatial planning for wave and tidal power through the Strategic Environmental Assessment process, which was carried out for wave and tidal development off the north and west coasts in 2007, and also identified and supported the European Marine Energy Centre (EMEC) site in Orkney for testing new technologies. This process established a clear direction of travel for the industry and ensured environmental impacts were considered and mitigated from the outset. The Scottish Government has commenced a new strategic planning exercise for wave and tidal development in all Scottish waters out to 200nm in consultation with the industry and stakeholders, including the RSPB. We believe that a similar approach would be extremely useful in other countries, and note that the parallel SEA (OESEA2) in England and Wales was not spatial for these technologies and therefore failed to deliver such clarity.

4.3 In Northern Ireland, the Department of Enterprise, Trade and Investment (DETI) commissioned a strategic action plan for the development of offshore wind and marine renewable energy, with an accompanying Strategic Environmental Assessment. This spatially identified areas within Northern Irish waters that may be suitable for marine renewable energy, although there was a limit on the amount of environmental data available.

4.4 The Welsh Government commissioned a Marine Renewable Energy Strategic Framework (completed 2011), which was a spatial exercise aimed at mapping the available tidal stream and wave resource in Welsh territorial waters. This work incorporated marine conservation features, and recommended methodologies for impacts on mobile species, including seabirds

4.5 The Netherlands has developed a marine spatial plan to facilitate the deployment of renewables and other economic activities at sea. This has involved a strategic approach to the identification of Marine Protected Areas alongside other uses (including offshore wind and aggregates extraction) through the development of the Spatial Plan for the Dutch North Sea. In addition, a single Appropriate Assessment methodology has been agreed, which is now required to be used in all offshore windfarm cases, and to be delivered by a single contractor across all proposed sites to ensure quality of assessment and proper consideration of in-combination impacts. This approach—when compared to that in England—has the potential to better protect marine biodiversity and to reduce risk and uncertainty for developers.

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

5.1 We believe that public funding for the development of marine technologies is essential given the early stage of development of this industry, and its potential to deliver low carbon, renewable energy. Public funding should, however, be aimed at reducing impacts on wildlife and the environment. Private funding for innovation tends to focus on economic considerations, such as efficiency, reliability, and costs, whereas the benefits of reducing impacts on wildlife are less tangible to the developer. This is in spite of the fact that costs of impact have a significant bearing on the economics of individual projects. As an example, the STPFS found that a Cardiff-Weston barrage would significantly heighten flood risk to local homes, businesses and industry, with mitigation costs of £672 million to £2,015 million.

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

6.1 The environment and the need to protect marine wildlife have been considered by some parts of the renewable energy industry as a barrier to deployment. The RSPB believes that marine renewables can be delivered at scale and pace in harmony with the environment, provided that the right policy framework is in place. Critical to this is reducing uncertainty for developers in the marine environment by fully designating marine protected areas including the marine Natura 2000 network, and introducing a comprehensive and transparent marine biodiversity survey in UK waters. The absence of such measures has been seen to be a major source of uncertainty and risk in the deployment of, and investment in, offshore wind.

6.2 It has been suggested by some that the Habitats Directive may present a barrier to large-scale renewables deployment, particularly in relation to tidal range technologies. The RSPB strongly rejects this assertion. The EU Birds and Habitats Directives provide a clear and robust legal framework for achieving sustainable development—a conclusion shared by the Sustainable Development Commission (SDC) in their authoritative report, *Turning the Tide.*[59] In the vast majority of cases, consideration of environmental impacts at the earliest stages in marine renewable technology design and site selection should ensure that effects on Natura 2000 sites can be avoided and/or mitigated. This is with the caveat, however, that the failure to identify and deliver a complete Natura 2000 network at sea has made this more difficult for both developers and regulators. Where avoidance and mitigation is not possible, the Habitats Directive does not preclude development. Instead, it requires that this development only be permitted where there are no less-damaging alternative means of delivering the public interest, where there are reasons of imperative overriding public interest why the development should proceed, and where adequate compensation has been secured.

6.3 For tidal range, we acknowledge that even the least damaging alternative may have adverse effects on the integrity of one of more Natura 2000 sites. However, we believe that it should be possible to limit any damage, such that it can be addressed through mitigation and/or (where appropriate) compensation.

Designation of a coherent marine protected area network

6.4 Defra's recent report, *Charting Progress 2*,[60] shows the UK's seas are increasingly coming under pressure and suffering damage. Seabirds and other marine wildlife are in continued decline. The offshore renewable energy industry can either exacerbate the situation or be a catalyst for the solution: an ecologically coherent marine protected area network that includes sites for seabirds. As well as being an environmental imperative, designation is a legal requirement under national and European legislation. Furthermore, rapid designation accompanied by the surveying required to identify new protected areas is key to giving developers the information they need to avoid impacts and any associated costs and delays. This means developers face uncertainty over whether a site to which they have acquired development rights may be designated in the future, either because of known biodiversity interest or because of findings from pre-construction monitoring.

6.5 As well as a protected area network, better marine spatial planning could further facilitate and accelerate renewable energy deployment. This involves identification of suitable areas for marine developments and activities, allowing possible conflicts to be identified and addressed at the earliest possible stage, and effectively front-loading the process through which developers must go.

[59] Sustainable Development Commission, 2007. *Turning the Tide: Tidal Power in the UK*
[60] http://chartingprogress.defra.gov.uk/

A systematic marine wildlife survey

6.6 Impacts on seabirds and the marine environment caused by renewables and other economic activities at sea can be minimised by financing a comprehensive and systematic survey of marine wildlife. The data collected will have the added value of supporting being useful for wind leasing assessments, and allowing shorter pre-construction monitoring following site allocation. It would also reduce risk, as the locations of important sites for internationally important species will be known, avoiding scenarios where they are found during baseline monitoring, which significantly delayed the London Array offshore windfarm.

6.7 We believe that DECC, Defra and the offshore energy industry to should collaborate in the delivery of such a programme, which would aim to deliver a Geographic Information System atlas of bird and marine mammal distribution and abundance, significantly reducing risk and uncertainty for the industry, and providing an extremely useful component of a constraints assessment for offshore energy. The programme needs to include:

(i) Comprehensive baseline seabird data collection in potential development zones, using a combination of aerial and ship-based surveys, as best suits local conditions, using recommended methods.

(ii) A systematic survey to plug gaps in spatial and temporal coverage of existing data and provide updated contextual information for UK Continental Shelf waters.

(iii) Further research into foraging ranges and areas used by priority species relevant to each development zone for marine renewables, making use of developing technology such as GPS data loggers and habitat suitability modelling.

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

7.1 The RSPB believes that Government needs to take a strategic approach to marine renewables, spatially planning for future deployment in order to minimise the industry's impact on wildlife by avoiding the most sensitive and vulnerable sites. This needs to be informed by a systematic survey of marine wildlife, funded by Defra, DECC, the Scottish Executive, and the marine energy industry (6.6, 6.7). In addition, R&D investment into marine renewables should be targeted at innovation that will yield lower environmental impact technologies.

7.2 Support for tidal and wave power should be increased in England, Wales and Northern Ireland, whilst support for tidal range should be aimed at bringing innovative, low-impact technologies forward (3.2, 3.3)

7.3 In addition to surveys and spatial planning, considerable research effort and data sharing will be required as the wave and tidal sectors develop. This requires collaboration between government, industry and NGOs. COWRIE, which was established by the Crown Estate to carry out research into the impacts of offshore wind, provides a good model for such a partnership that could be emulated for wave and tidal stream power.

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

8.1 Marine renewables need considerable infrastructure in and around port sites to manufacture, supply and service installations. This demand for port facilities is in addition to rapidly growing demand from the offshore wind industry. It is important to recognise, however, that this could put pressure on the UK's coasts and estuaries, which are extremely valuable areas for birds and other wildlife. DECC has identified 27 port locations in the UK that may be suitable for development to service the offshore wind industry, and presumably these sites will also be candidates for servicing the wider marine renewables industry. We estimate that 21 of these are in or adjacent to Natura 2000 sites.

8.2 Strategic consideration of supply chain needs is critical to ensure construction, assembly and maintenance capability is in place, and environmental impacts are minimised. The Scottish Government's national Renewables Infrastructure Plan has been useful in identifying the capabilities of existing sites in Scotland—although it would have been much improved if it had also more fully considered environmental constraints and identified which sites should be priorities for development to assist the sustainable development of the industry. The RSPB believes that UK countries should positively plan for onshore infrastructure for the marine renewables industry through developing spatial infrastructure plans, similar to that developed by the Scottish Government.

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