



# House of Commons

## Energy and Climate Change Committee

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# A Severn Barrage?

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## Second Report of Session 2013–14

### *Volume I*

*Volume I: Report, together with formal minutes, oral and written evidence*

*Additional written evidence is contained in Volume II, available on the Committee website at [www.parliament.uk/ecc](http://www.parliament.uk/ecc)*

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## The Energy and Climate Change Committee

The Energy and Climate Change Committee is appointed by the House of Commons to examine the expenditure, administration, and policy of the Department of Energy and Climate Change and associated public bodies.

### Current membership

Mr Tim Yeo MP (*Conservative, South Suffolk*) (Chair)  
Dan Byles MP (*Conservative, North Warwickshire*)  
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John Robertson MP (*Labour, Glasgow North West*)  
Sir Robert Smith MP (*Liberal Democrat, West Aberdeenshire and Kincardine*)  
Dr Alan Whitehead MP (*Labour, Southampton Test*)

The following members were also members of the committee during the Parliament:

Gemma Doyle MP (*Labour/Co-operative, West Dunbartonshire*)  
Tom Greatrex MP (*Labour, Rutherglen and Hamilton West*)  
Laura Sandys MP (*Conservative, South Thanet*)

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The Committee is one of the departmental select committees, the powers of which are set out in House of Commons Standing Orders, principally in SO No 152. These are available on the internet via [www.parliament.uk](http://www.parliament.uk).

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The Reports and evidence of the Committee are published by The Stationery Office by Order of the House. All publications of the Committee (including press notices) are on the internet at [www.parliament.uk/ecc](http://www.parliament.uk/ecc). A list of Reports of the Committee in the present Parliament is at the back of this volume.

The Report of the Committee, the formal minutes relating to that report, oral evidence taken and some or all written evidence are available in a printed volume. Additional written evidence may be published on the internet only.

### Committee staff

The current staff of the Committee are Sarah Hartwell-Naguib (Clerk), Liz Bolton (Second Clerk), Jenny Bird (Senior Committee Specialist), Tom Leveridge (Committee Specialist), Luanne Middleton (Inquiry Manager), Shane Pathmanathan (Senior Committee Assistant), Jonathan Olivier Wright (Committee Assistant), Joe Strawson (Committee Support Assistant), and Nick Davies (Media Officer).

### 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](mailto:ecc@parliament.uk)

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## Summary

Following reports that a private consortium had met with the Prime Minister to discuss a new proposal for a tidal barrage in the Severn Estuary, the Committee launched an inquiry to examine the proposal in more detail and to encourage transparency and public debate. It had been suggested the scheme could meet 5% of the UK's electricity needs from an indigenous renewable source. The proposal from Hafren Power Ltd is for an 18km fixed tidal barrage between Brea in England and Lavernock Point in Wales. It would have 1,026 Very-Low-Head (VLH) bi-directional turbines, generating approximately 16.5 TWh/year on both ebb and flood tides.

The inquiry generated a high level of public interest, but many witnesses were concerned about the lack of detailed, publicly-available information about the project. The lack of robust supporting evidence led to a sense of mistrust on the part of some stakeholders, made worse by the uncertainties surrounding a possible Hybrid Bill. Closer engagement with stakeholders from the outset and a more open approach was needed from the developers of such a huge and unprecedented scheme.

Although construction of the barrage would be privately financed, Government support would be required for approximately thirty years through Contracts for Difference (CfD) or a similar mechanism. The strike price required by Hafren Power is unknown, but the ability of the project to compete with other low-carbon forms of energy is in doubt. A high strike price risks swamping the Levy Control Framework (LCF), while a strike price below £100/MWh appears unlikely to ensure the project's economic viability.

Hafren Power have failed to overcome the serious environmental concerns that have been raised. Further research, data and modelling are needed before environmental impacts can be determined with any certainty – in particular regarding fluvial flood risk, intertidal habitats and impact to fish. The need for compensatory habitat on an unprecedented scale casts doubt on whether the project could achieve compliance with the EU Habitats Directive.

Construction of such a large-scale barrage would inevitably create jobs but could also lead to job losses in local businesses and in particular the ports industry. An independent assessment of the overall net employment impact is needed.

While a tidal barrage could offer decarbonisation and energy security benefits, the Hafren Power project in its current form has not demonstrated sufficient value as a low-carbon energy source to override regional and environmental concerns. Alternative pathways exist to meeting our 2050 carbon targets.

Alternative options for exploiting Severn tidal resources also exist. Stronger public governance of these resources would offer the opportunity to develop alternative technologies and strengthen the evidence base before building a large-scale facility.

# 1 Introduction

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1. The UK possesses significant wave and tidal resources. A recent report by the Crown Estate suggested that the theoretical potential of UK wave and tidal resources was up to 118 GW (Gigawatts) of generating capacity.<sup>1</sup> Current UK electricity power plant capacity is approximately 89 GW (based on 2011 figures).<sup>2</sup> The Crown Estate's theoretical estimate for the generating capacity of tidal range technologies is 59 GW. Of this, 45 GW could be provided by tidal barrages while tidal lagoons could account for 14 GW.<sup>3</sup> The Severn estuary alone could provide up to 5% of the UK's current electricity generation from an indigenous renewable source, offering decarbonisation and security of supply benefits in addition to significant potential for national and local employment.<sup>4</sup>

2. Proposals for harnessing the tidal power of the Severn estuary, which has the second highest tidal range in the world, have been extensively studied since the early 19<sup>th</sup> century.<sup>5</sup> The most comprehensive study undertaken to date by Government is DECC's Severn Tidal Power Feasibility Study (STPFS), which concluded in 2010.<sup>6</sup> The study carried out a cost-benefit analysis of five short-listed tidal power schemes for the Severn estuary, examining a variety of tidal technologies including barrages, lagoons and fences.<sup>7</sup> Of these schemes, the Cardiff-Weston tidal barrage was identified as offering best value for money, although it was also found to be the most environmentally damaging of the schemes put forward. At the time, the Government did not see a strategic case for public investment in a Severn tidal power scheme, although it did not preclude a privately-financed scheme coming forward.<sup>8</sup>

## Context of the inquiry

3. In August 2012, press reports stated that David Cameron had ordered the Secretary of State for Energy and Climate Change Edward Davey and Minister of Government Policy at the Cabinet Office Oliver Letwin to look in detail at new proposals from the consortium Corlan Hafren for a privately financed tidal barrage scheme in the Severn, which claimed to mitigate impacts on the estuary's wildlife habitats.<sup>9</sup> At the time of launching our inquiry

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1 The Crown Estate, UK Wave and Tidal Key Resource Areas Project, October 2012

2 DECC, Digest of UK Energy Statistics 2012

3 Tidal range technologies use the change in water height brought about by tides, using principles similar to a hydroelectric dam. Tidal barrages are built across an estuary or waterway; tidal lagoons are impounded areas of water across one part of a coastline.

4 DECC, *Severn Tidal Power Feasibility Study, Conclusions and Summary Report*, October 2010; See also Ev 69, Ev 107, Ev 153;

5 <http://www.environment-agency.gov.uk/homeandleisure/recreation/31439.aspx>

6 DECC, *Severn Tidal Power Feasibility Study, Conclusions and Summary Report*, October 2010

7 These structures all make use of tidal range: barrages are built across an estuary or waterway; tidal lagoons are impounded areas of water across one part of a coastline, and tidal fences deploy an array of tidal turbines on a fixed structure using both tidal stream and tidal range to generate electricity.

8 Ev 69

9 The Independent, No 10 asks Ministers: Can we now support £30 bn barrage?, 19 August 2012, [www.independent.co.uk/environment](http://www.independent.co.uk/environment)

there were no details of the new proposals in the public domain. The Consortium, which has since dissolved and reformed as Hafren Power Ltd, submitted written evidence outlining its new proposals in more detail. This evidence is published on our website.<sup>10</sup>

4. The purpose of our inquiry was, in light of the attention given to the Hafren Power proposal by the Prime Minister and the Secretary of State for Energy and Climate Change, to examine the Hafren Power proposal in the context of current UK energy policy. The UK needs to ensure the security of its future energy supply while meeting its decarbonisation targets and keeping energy prices as low as possible. In recent reports we have identified challenges in getting new nuclear power stations up and running, and demonstrated that the scale of recoverable shale gas reserves is as yet unknown and the benefits of shale gas development may take some time to realise.<sup>11</sup> The Hafren Power proposal for a Severn barrage, which could potentially meet 5% of the UK's energy needs from a renewable source, clearly warranted investigation.

5. Hafren Power's proposal is for an 18km fixed tidal barrage between Brean in England and Lavernock Point in Wales. The barrage would consist of 1,026 Very-Low-Head (VLH) bi-directional turbines, generating approximately 16.5 TWh/year on both ebb and flood tides.<sup>12</sup> It is this ebb-flood nature of the barrage, which allows for a closer replication of the natural tide, together with a turbine design which Hafren Power suggested will optimise "fish-friendly" characteristics, which together constitute the primary differences to the 2010 Cardiff-Weston proposal and which form the basis for claims about environmental mitigation.

6. Hafren Power claimed that the £25 billion required to fund the project would come entirely from private sources. In practice however, Government support would be required over a 30-year period through Contracts for Difference (CfD) or a similar mechanism.<sup>13</sup>

## Our inquiry

7. We received 93 submissions of written evidence, and, in addition, 14 submissions of supplementary written evidence. We held three public oral evidence sessions and one private oral evidence hearing. We are grateful to all those who provided written and oral evidence. In addition, the Parliamentary Office for Science and Technology (POST) produced a useful note on tidal barrages we have drawn upon in our assessment of environmental impacts.<sup>14</sup>

8. In March 2013, we received, in confidence, a business case from Hafren Power. On occasion, Committees receive papers in confidence to assist in deliberations. This recognises the fact that there may be relevant material that is not appropriate for

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10 Ev 153

11 Energy and Climate Change Committee, Sixth Report of Session 2012–13, *Building New Nuclear: the Challenges Ahead*, HC 117 and Seventh Report of Session 2012–13, *The Impact of Shale Gas on Energy Markets*, HC 785

12 An ebb-flood barrage generates on both the incoming and outgoing tides and water is not temporarily held back on the outgoing tide as in the case of an ebb-only barrage. This is likely to allow for a closer replication of natural tidal flows.

13 Q 197; Qq 139-140

14 *Environmental Impact of Tidal Barrages*, Draft provisional POSTnote 435, Parliamentary Office of Science and Technology, June 2013

publication. We accepted the business case on a confidential basis and will therefore not publish it. However, we urged the Consortium to make as much of this information public as possible, and believed that this could be done without serious breaches of commercial confidence. Hafren Power has since published a redacted version of the business case on its website.<sup>15</sup>

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15 Hafren Power Severn Barrage business case, Issue B, 10 May 2013, [www.hafrenpower.com](http://www.hafrenpower.com)



## 2 Transparency and public consultation

9. A project on the scale of Hafren Power's proposed barrage will need public support in order to succeed. The Consortium's proposals have generated a great deal of controversy and public interest, but a lack of information and a perceived lack of transparency have marred stakeholder relations and led to public opposition. This section explores Hafren Power's approach to public engagement and considers what constitutes due process for large-scale infrastructure projects in the pre-consent and planning phases.

### A lack of publicly-available information

10. Following our call for evidence, many respondents criticised the lack of detailed, publicly-available information on the project upon which to comment. We received correspondence from a number of groups expressing concern in this regard, including letters from The Bristol Port Company and Associated British Ports objecting to the call for comment on proposals which they said Hafren Power had itself has described as "inchoate".<sup>16</sup> This concern was reflected almost unanimously in the written evidence we received, in which respondents pointed out that it was difficult to draw firm conclusions regarding potential impacts without in-depth knowledge of the project.<sup>17</sup> The lack of detailed information has provoked public hostility toward the scheme. Hafren should have adopted a more open approach from the start. The Angling Trust summarised its position as follows:

Our principal message to the Committee is that the proposals must be worked up into much more detail before any firm view can even begin to be formed about the costs and benefits of this scheme. In addition, rigorous, independent, peer-reviewed assessments must be carried out to calculate the impacts of the proposals.<sup>18</sup>

11. During oral evidence, Kate Jennings (Head of Site Conservation Policy, RSPB) stated that there was "no detailed information on the Hafren Power proposals from which to dispute their assessment".<sup>19</sup> Simon Bird (Chief Executive, The Bristol Port Company) reported first hearing of the project in summer 2012, and expressed concern that "there is no detail there on some of the assertions that have been made."<sup>20</sup> In response to such criticisms, Anthony Pryor (Chief Executive, Hafren Power Ltd) has since suggested that our inquiry has exposed the project prematurely to detailed external criticism, prompting questions that the company is not able to answer at this stage of the project's development. However, we note that Hafren Power only questioned the inquiry when it became exposed to public criticism.

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16 Letter to Chair Tim Yeo from Simon Bird (Bristol Port Company) and Matthew Kennerley (Associated British Ports), 7 November 2012

17 Ev 69, Ev w5, Ev w37, Ev w48, Ev w66, Ev 83, Ev 84, Ev 91, Ev w78, Ev w87, Ev w89, Ev w100, Ev 119, Ev 143, Ev 183, Ev w134, Ev w151, Ev w153, Ev w156

18 Ev 183

19 Q 55

20 Q 87

12. DECC agreed that there was a need for further information. Minister of State at the Department of Energy and Climate Change, Rt Hon Gregory Barker MP stated in oral evidence that Government is unable to make a decision on the project without “much greater detail”, and “most importantly, evidence that the project is affordable and represents good value to electricity consumers”<sup>21</sup>. Recently, the Secretary of State for Energy and Climate Change, Rt Hon Ed Davey MP reiterated this message at the Liberal Democrat Conference in Cardiff.<sup>22</sup> Hafren Power, in addition to its original evidence submission, has now provided the Committee with supplementary evidence as well as a copy of its confidential business case. We have published all material where possible and encouraged the Consortium to publish its business case. The Consortium has indicated however that further data will not become available until the Government has shown in-principle support for the project. Thus, a ‘Catch-22’ situation has arisen whereby Hafren Power’s delivery partners and investors require evidence of Government support before developing proposals further, which Government will not provide until more details are known.

13. The Corlan Hafren/Hafren Power Consortium proposal received attention from Downing Street and was drawn to the attention of the Department of Energy and Climate Change, prompting our scrutiny of the matter. In fact, our inquiry has stimulated open public debate and input from a wide range of stakeholders (something which the Liaison Committee has concluded is an important function of scrutiny committees).<sup>23</sup> We have gathered and published a wide range of evidence on the topic and this will in itself promote better informed consideration of the issues. Hafren Power may believe that our inquiry has subjected its proposal to premature scrutiny, but if it hopes that Government will make an in-principle policy decision on the proposal, it must recognise that detailed scrutiny is not just entirely appropriate but also essential.

## Need for robust and credible evidence

14. The Committee’s evidence sessions demonstrated the strength of feeling generated by Hafren Power’s proposals. Industry and environmental stakeholders expressed almost unanimous opposition to the project. Representatives of the National Trust, the Angling Trust, the RSPB and the Wildfowl and Wetlands Trust articulated serious concerns regarding environmental impacts, while the ports industry, represented by The Bristol Port Company and Associated British Ports, were opposed on commercial grounds.<sup>24</sup> In particular, concerns have centred around certain claims made by Hafren Power which have not been independently verified. Martin Salter (National Campaigns Coordinator, the Angling Trust) described claims about the “fish-friendly” characteristics of Hafren’s turbines as “guff” and “spin”, reflecting a sense of distrust toward the Consortium on the part of some environmental groups.<sup>25</sup> The Wildfowl and Wetlands Trust identified several

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21 Q 341

22 Wales Online, Energy Secretary questions Severn Barrage scheme at Welsh Lib Dem conference in Cardiff, April 2013, [www.walesonline.co.uk/news](http://www.walesonline.co.uk/news)

23 Liaison Committee, Second Report, 2012–13, *Select committee effectiveness, resources and powers*, HC 697, paragraph 9.

24 Qq 87-107

25 Q 58

terms used in the marketing of the proposed Hafren barrage scheme which it described as “confusing and misleading”, such as the implication that the barrage could be considered a “saviour for wildlife” in protecting against sea level rises.<sup>26</sup>

15. We note that the following claims made by Hafren require further substantiating evidence or independent review (these points are explored in more depth in subsequent chapters):

- evidence of the “fish-friendliness” of the proposed turbines for a range of fish species and sizes, and how “the objective of 100% survival of all species of fish transiting the barrage”<sup>27</sup> might be achieved;
- the notion that the barrage will result in “improved habitats” and “increased biological productivity”<sup>28</sup>
- the claim that the barrage will cause only “minimal delays to shipping” and “minimum inconvenience;”<sup>29</sup>
- the suggestion that pumping<sup>30</sup> or topographic raising could be an effective way to mitigate wildlife impacts;<sup>31</sup>
- claims that the barrage will be able to operate with a strike price under Contracts for Difference “below offshore wind”,<sup>32</sup> and
- the reported employment benefit of the barrage, said to provide in excess of 50,000 direct and indirect jobs.<sup>33</sup>

**16. Robust and credible evidence is fundamental to building trust and reassuring key stakeholders, particularly for an unprecedented and huge project such as the proposed Hafren Power barrage. We support the calls for further evidence and technical detail of the proposal in order to arrive at an informed decision. We recommend that such evidence is placed in the public domain as soon as possible if stakeholder confidence is to be established and in order to promote maximum transparency.**

**17. We further recommend that Government makes clear to Hafren Power that no further consideration will be given to their proposal until and unless the additional information requested has been provided.**

## Engagement with stakeholders

18. We received written evidence from six local councils, four of whom emphasised the need for consultation and engagement with local communities.<sup>34</sup> Sedgemoor District

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26 Ev 119

27 Ev 153

28 As above

29 As above

30 “Pumping” refers use of mechanical pumps to artificially water levels.

31 Q 220; SEV70

32 Q 133

33 Ev 153

Council suggested that the “lack of any timetable or formal process” for the Hafren scheme had caused “misgivings” amongst local communities.<sup>35</sup> Written evidence from Cardiff Council recommended that “all affected communities of the barrage are consulted widely” and emphasised the need for “strong and cooperative communications from the outset.”<sup>36</sup> In oral evidence Andrew Shirley (Chief Surveyor, the Country Land and Business Association) underlined the pitfalls for landowners who may face compulsory purchase orders:

The landowner will not be able to choose when he has his land acquired, or what land he has acquired. What is for certain under the present system and even the systems proposed under HS2 [High Speed Two rail network], is that the landowner will get the minimum amount that can possibly be given to him as a result of the scheme. The uplift is minimal and, no, I have not met one person over my [...]25 years of professional experience, who feels that he has been anywhere near compensated for any compulsory purchase across his land. That is where we stand.<sup>37</sup>

19. It is therefore clear that any barrage developer needs to engage closely with stakeholders from the outset, in order to ensure public acceptability and support. It will also be important to ensure that the interests of both Welsh and English stakeholders are fairly represented, recognising the key role of the National Assembly for Wales and the Welsh Assembly Government in discussions relating to the Severn resource. Local councils, residents and landowners should form a priority for public consultation due to the significant land-change and impacts on local businesses which any barrage scheme would entail.

## Legislative routes

20. The Minister told us in oral evidence that Hafren Power’s barrage project could potentially proceed either as a Hybrid Bill<sup>38</sup> or through an application for a Nationally Significant Infrastructure Project (NSIP) under the 2008 Planning Act.<sup>39</sup> This latter route ensures public consultation through a clearly mapped formal process, which the Minister set out in a letter to the Committee.<sup>40</sup> This letter also identifies that the consultation approach under a Hybrid Bill is less clear, since “the consultation processes that might lead to a Hybrid Bill are not prescribed in detail by legislation to the same degree.” As a result, DECC “cannot, therefore, be specific on consultation”, although the Minister assured us

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34 Vale of Glamorgan Council (Ev w27), Gloucestershire County Council (Ev w22), Kingston Seymour Parish Council (Ev w25), North Somerset Council (Ev w131), Sedgemoor District Council (Ev w132), Cardiff Council (Ev w156)

35 Ev w132

36 Ev w156

37 Q 248

38 A hybrid bill has characteristics of both a public bill and a private bill. Although of general interest, the content of the bill would significantly affect the interests of certain individuals or organisations. Bills brought in by the Government (or a backbencher) which propose to undertake works of national importance, but in a local area, have usually been hybrid. Such bills are introduced only rarely, the last occasion being the Crossrail Bill introduced in 2004. A hybrid bill relating to the High Speed 2 rail network system is expected to be introduced in this parliamentary session.

39 Q 348

40 Ev 73

that consultation would occur in line with the same underlying principles of the Planning Act.<sup>41</sup>

21. Hafren Power stated that it expects the barrage to be fully operational within eleven years, and partially operational in nine years.<sup>42</sup> When questioned as to whether this timescale factored in legislative or planning consent processes, Gregory Shenkman (Chairman, Hafren Power Ltd) responded in the affirmative.<sup>43</sup> Rt Hon Peter Hain MP, who sits on Hafren Power's Expert Panel, has suggested that time could be made for a Hybrid Bill in the current Parliament, potentially as early as 2013.<sup>44</sup> However, the Minister stated that this was "not at all" realistic:

We don't even have the beginnings of the information to take a decision as to whether or not that would be necessary. To talk of there being a Bill before 2015 would require some transformational level of information, in order for us to give up Government legislative time, which would be very squeezed, as well as all the political time and effort that would need to go into pursuing what is a very substantial project alongside [...] an extremely packed DECC agenda.<sup>45</sup>

A Hybrid Bill process is likely to be lengthy: the last Hybrid Bill, relating to the Crossrail railway system, took four years to receive Royal Assent.<sup>46</sup> This leads us to question Hafren Power's suggestion that "the next period of about two and a half years" will be sufficient to secure a Hybrid Bill.<sup>47</sup>

**22. We consider Hafren Power's expected timetable for the passage of a Hybrid Bill completely unrealistic. We note that the Hybrid Bill route does not offer an open and fully accountable process for stakeholders and affected parties. An application via the Planning Act 2008 may provide a more suitable legislative vehicle for a barrage project. Clearer guidelines on due process, expected timescale and the information required by Government under different legislative routes, and particularly under a Hybrid Bill, would be helpful for both stakeholders and developers.**

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41 Ev 73

42 Ev 153

43 Q 200

44 Wales online, "Severn Barrage plans 'could be put through Parliament next year'", 26 October 2012, [www.walesonline.co.uk/news](http://www.walesonline.co.uk/news)

45 Q 347

46 Crossrail Act 2008

47 Q 197

### 3 Costs and value for money

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23. This section explores the economics of Hafren Power's barrage scheme, including the cost of energy and level of Government support required; the affordability of barrage electricity compared to other low-carbon sources; the potential impact on the Levy Control Framework, and the financing of the barrage.

#### Cost of Energy

24. Comparative costs of different energy sources can be established by calculating *levelised cost of energy* (LCoE) which illustrates the average cost per MWh (Megawatt hour) of electricity generated over the lifetime of a power plant. Hafren Power claimed that the LCoE for its barrage will be £48/MWh over the lifetime of the plant.<sup>48</sup> Hafren Power's written evidence suggested a figure of approximately £160/MWh for the first 30 years (its business case refers to an initial price "in the range between offshore wind and nuclear") which would fall to £20/MWh for the remaining 90 years of the barrage's lifetime.<sup>49</sup>

25. Written evidence from Engineering the Future pointed out that the figures currently being discussed are "substantially less than historic estimates for Severn Barrage designs". The submission went on to state:

We are not at this stage convinced that the capital cost reductions are sufficient to support a generation cost of £160/MWh for the first 30 years of the scheme, especially when the full range of total capital costs including financing costs are taken into account.<sup>50</sup>

Concerns about the cost of the project have been raised by other stakeholders. RWE npower pointed out that, according to DECC analysis, the cost of energy for a Cardiff-Weston barrage at a 10% cost of capital would be £312/MWh, noting that "unless the new proposals are a significant capex reduction from the previous estimates this does suggest that such a strike price may be difficult to justify for consumer affordability".<sup>51</sup> Analysis from engineering consultancy Parsons Brinckerhoff suggested a cost of energy of £200/MWh for a project of similar scale and cost to the Hafren scheme.<sup>52</sup> Engineering consultancy Halcrow (now part of CH2M HILL), a former member of the Corlan Hafren Consortium with a six year involvement in the project, reported cost of energy estimates of between £150-£350/MWh for a tidal barrage in the Severn.<sup>53</sup>

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48 Ev 153

49 Ev 153; Hafren Power Severn Barrage business case, Issue B, 10 May 2013, [www.hafrenpower.com](http://www.hafrenpower.com)

50 Ev 107a

51 Ev w66

52 Ev w5

53 Ev w61



26. When questioned by the Committee on the disparities between these estimates, Anthony Pryor (Hafren Power Ltd), stated that he did “not recognise the £350 per MWh from the meetings we used to have in Corlan Hafren, some 18 months ago.”<sup>54</sup>

27. DECC’s own estimates suggest a LCoE for tidal range projects of between £214-£353/MWh (2012 prices) – see Table 1 (p14). It is possible however, when looking at the business case for a barrage, to take into account the minimum 120-year lifespan that a tidal facility claimed to offer. This lifespan compares favourably to other low-carbon energy sources: the lifecycle of a nuclear plant may span 60 years, while off-shore wind farms are expected to last 20 to 30 years. DECC’s levelised cost estimates assume a 40 year “financial lifetime” for tidal range projects, despite acknowledging a “120 year design life”, which suggests that levelised costs are calculated over the shorter period.<sup>55</sup> Based on the standard discount rate of 10% used in DECC cost estimates, additional income or costs accrued after the 40-year “financial lifetime” would be discounted down to a minimal amount: by way of illustration, using a 10% discount rate, £100 in income or costs in 80 years’ time will be considered to be worth £0.05 now.<sup>56</sup> Such analysis may lead to a less favourable assessment of projects with a long lifecycle compared to those which have a lifecycle of 40 years or less, since additional generation after the 40-year period may not be taken into account. Regen SW and South West Marine Energy Park stated that “One of the drawbacks of the LCoE analysis under Green Book rules is the limited timeframe in which projects are considered.”<sup>57</sup>

***28. We recommend that Government ensure that levelised cost of energy analysis reflects a fair appraisal of long-term cost and power generation, which takes into account the full lifecycle of marine energy projects.***

## Contract for Difference (CfD) support

29. The Government is planning to introduce Contracts for Difference (CfDs) as a way of supporting investment in low-carbon electricity generation. CfDs are contracts that provide long-term electricity price stability to developers and investors in low-carbon generation. Generators will receive the price they achieve in the electricity market plus a “top up” from the market price to an agreed level (the “strike price”). This “top up” will be paid for by consumers. Where the market price is above the agreed level, the generator would be required to pay back and thus ensure value for money and greater price stability for consumers. Agreements about the level at which the strike price is set will be based (in part) on the levelised cost of energy for the technology in question.<sup>58</sup> Like nuclear power stations, it is likely that a strike price for a barrage project would be set through a process of direct negotiation with DECC (the strike prices for other renewables will be based on evidence and analysis from the System Operator, National Grid).

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54 Q 176

55 ARUP/DECC, Review of the generation costs and deployment potential of renewable electricity technologies in the UK, October 2011

56 A discount rate is used to convert future costs or benefits to present values.

57 Ev 91a

58 Levelised cost of energy refers to the average cost per MWh (Megawatt hour) of electricity generated over the lifetime of a power plant

### Value for money compared to other low-carbon sources

30. Since CfDs will be paid for by consumers, value for money is an important consideration when the Government is deciding whether or not to allocate CfDs to a particular project. DECC's own calculations suggest that a tidal barrage is likely to be considerably more expensive than other forms of low-carbon energy, and would therefore require a much higher strike price (see Table 1, p14). These calculations suggest that a tidal range project would not provide value for money compared to other low-carbon sources of energy.

Table 1

#### Levelised cost estimates of selected low carbon sources, projects starting in 2018

£/MWh in 2012 prices

|                        | Central | Low | High |
|------------------------|---------|-----|------|
| Nuclear                | 81      | 72  | 93   |
| Wind                   |         |     |      |
| Onshore >5 MW E&W      | 104     | 85  | 125  |
| Onshore >5 MW UK       | 93      | 78  | 111  |
| Offshore R2            | 118     | 104 | 134  |
| Offshore R3            | 134     | 117 | 156  |
| Dedicated biomass      |         |     |      |
| >50MW                  | 122     | 106 | 165  |
| <50MW                  | 117     | 82  | 160  |
| Co-firing Conventional | 92      | 78  | 108  |
| Solar 250-5000kW       | 169     | 145 | 203  |
| Tidal range            | 285     | 214 | 353  |

Note: Tidal range figures converted from 2010 prices and assume a start date of 2020-2030

Sources: Electricity Generation Costs, DECC (October 2012)

Review of the generation costs and deployment potential of renewable electricity technologies in the UK, ARUP/DECC (October 2011)

31. Hafren Power told us the barrage would need an initial period of price support—through a CfD—lasting 30 years, in order to provide a commercial return.<sup>59</sup> The precise strike price which the company would require is unknown, although Hafren Power is seeking a contract duration of 30 years, whereas other renewables such as wind are likely to receive price support for only 15 years.

32. The total amount of funding available through the Contract for Difference mechanism is capped under the Levy Control Framework (LCF). If one project were to receive a sustained level of price support at a high level over many years it would absorb a disproportionate amount of the available funding, and prevent development and investment in other low-carbon energy sources. Several stakeholders expressed concern in this regard and the problem was acknowledged by the Minister in oral evidence to the Committee.<sup>60</sup> DECC maintained that “any CfD funding would need to be value for money

59 Hafren Power Severn Barrage business case, Issue B, 10 May 2013, [www.hafrenpower.com](http://www.hafrenpower.com)

60 Ev w66, Ev w140, Ev 91a ; Q 360



and considered against support for other low-carbon technologies in the context of the Levy Control Framework”, while RWE npower argued that a “spread of investment in proven technologies” could represent a lower risk and lower cost option for the UK.<sup>61</sup> Regen SW and South West Marine Energy Park pointed out that unlike many other low-carbon technologies, the barrage, as a fixed, one-off structure, offers little opportunity for incremental cost reduction and technology innovation over time.<sup>62</sup>

33. As Engineering the Future highlighted, the barrage project currently offers “limited scope, if any, for competitive tendering” since Hafren Power Ltd are the only developers currently proposing a tidal barrage on this scale.<sup>63</sup> The strike price would be the subject of private negotiations between Government and the company, as in the case of new nuclear. As noted by the Minister, the absence of the “driver of competition” does make it more difficult to achieve an acceptable strike price.<sup>64</sup> At the time of writing, negotiations regarding the strike price for a nuclear power plant at Hinkley Point C between EDF and the Government are ongoing, and draft strike prices for other technologies have yet to be published by DECC. The uncertainty regarding Hafren Power’s proposed strike price makes it difficult for the Committee to assess with any confidence whether or not the project represents value for money in comparison with other low-carbon sources.

34. **We believe that the strike price for the barrage would have to be considerably higher than the £100/MWh which Hafren Power have “in mind”.<sup>65</sup> Furthermore, the company say they would require this price to be guaranteed for 30 years, twice as long as an offshore wind project. It is unsatisfactory that such wide-ranging figures have been cited regarding the level of Government support required for a barrage. As a minimum, the strike price for barrage-generated electricity should not be higher than that for offshore wind, which is expected to be around £100/MWh by 2020. While the use of novel turbines and updated design may indeed provide savings in barrage construction, it is very unlikely that the Hafren project will be financially viable with a strike price at this level. If a higher strike price was offered, it would risk swamping the Levy Control Framework to the detriment of other low-carbon technologies. Claims by Hafren Power of long-term affordability are too distant and uncertain a prospect to overcome more immediate economic, environmental and local concerns.**

### ***Flood risk benefits and the strike price***

35. Hafren Power argued that the barrage may offer significant flood risk benefits. The Consortium estimated savings in flood defences due to reduced flood risk and damage at between £2bn to £8.5bn (although these figures have yet to be verified by Defra), with potential protection for 90,000 properties and 500 km<sup>2</sup> of land due to greater control of tides and water flow.<sup>66</sup> However, witnesses contested this assessment (see Chapter 4 for a more detailed discussion of flood impacts). Ed Mitchell (Environment Agency) noted that

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61 Ev 69; Ev w66

62 Ev 91a

63 Ev 107

64 Q 362

65 Ev 153

66 Ev 153

“A barrage across the Severn has potentially both positive and negative implications for flood defence” but is “probably cost neutral”.<sup>67</sup>

36. It was initially suggested by the company that such savings should be taken into account through a “*net strike price*” which reflected these benefits.<sup>68</sup> In his evidence, Anthony Pryor (Hafren Power) explained that the company had in fact changed its position in response to our comments setting out the difficulties in offsetting savings in Government spending against the cost of consumer-funded CfDs.<sup>69</sup> Hafren Power reported that they are now able to “justify the project on gross strike price”.<sup>70</sup> The discussion suggested however that the company still expects flood risk benefits to have some bearing on the strike price negotiations.<sup>71</sup> The Minister conceded that taking into consideration such benefits would present “very real practical difficulties”, but did not rule out their playing a part in negotiations.<sup>72</sup>

**37. We do not believe that potential collateral benefits should be factored into any strike price negotiations. In the case of the Hafren scheme, significant uncertainty remains regarding whether such savings would in fact be made, and there is a lack of consensus regarding the impact of a barrage on flooding. The support available via Contracts for Difference comes directly from consumers via their energy bills. Any flood defence savings made as a result of projects supported will not accrue to bill payers but to the Exchequer. We recommend that the savings from any potential reductions in Government spending are disregarded when negotiating strike price.**

## Financing the barrage

38. Hafren Power stated that the £25 billion investment required to fund construction of the barrage would come from a series of sovereign wealth funds, including global infrastructure and pension funds.<sup>73</sup> We recognise that such a substantial sum of private-sector investment has the potential to bring significant benefits in terms of UK industry, jobs and growth (See Chapter 5). Hafren Power asserts that 80% of the investment would remain in the UK through use of British manufacturing, workforce and supply chain wherever possible, with wider economic benefits arising from an influx of money to the local economy.<sup>74</sup> Rupert Armstrong Evans (Evans Engineering and Power Ltd) raised concerns regarding this method of finance:

It is not going too far to say that, first of all, morally, you cannot take a piece of Wales and England and sell it off to a foreign multinational company. They have admitted themselves just now that they want to develop the project and sell it on. You cannot sell a piece of the UK. I think there is enough interest and good will out there in the

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67 Q 280

68 See Ev 153 and Financial Times, *Severn barrage backers seek investors*, December 17 2012

69 Q 186; Q 3

70 Q 186

71 Qq 179-186

72 Q 361

73 Q 203

74 Ev 153

British public to be able to float a green bond so everybody can take part in this project [...] <sup>75</sup>

**While we do not share these concerns regarding foreign investment, and indeed welcome investment in renewable projects from private sources, all efforts should be made to ensure maximum UK content if the project is taken forward.**

39. A more pressing concern is the cost of private finance: E.ON points out that private sector discount rates would need to be applied to the project, while investors would need to be “prepared to commit very large capital sums for some years without seeing a return.”<sup>76</sup> Although Hafren Power is confident that it can access the necessary finance, attracting very large sums of money from long-term investors may prove challenging – particularly in the light of press reports which question the financial reliability of some of the company’s backers.<sup>77</sup> The discount rate applied will also have an impact on cost assessments. Hafren Power explained that “the rate that we use is the rate that we expect sovereign wealth funds to be able to raise debt and equity for in the market”.<sup>78</sup> However Regen SW and South West Marine Energy Park cautioned against the use of a discount rate lower than 10% in calculating barrage costs, which they suggested is unlikely to present accurate future costs of finance.<sup>79</sup> Regen SW and South West Marine Energy Park pointed out that 100% private finance would be expensive, advocating instead “a co- financed model, and/or underwritten by UK government”<sup>80</sup>. The consultancy suggested an alternative finance model:

One model to use for long-term energy projects such as tidal range (Lagoons or Barrages) is a DBFOT finance model (Design Build Finance Operate Transfer). This works on the basis that the Government owns the asset and invite[s] tenders for a 30 year concession to design, build, finance, operate the asset over 30 years before it is handed back to the public sector at the end of the concession period [...] <sup>81</sup>

40. Hafren Power have stated that they would be willing to consider other forms of Government support, for example through Renewable Obligation Certificates (ROCs). The company stated that it would require up to 2 ROCs/MWh in order to provide a return for investors<sup>82</sup>. However, ROCs will begin to be phased out in 2017 to be replaced by CfDs and therefore do not present a viable alternative.

**41. The Committee notes that the current mechanisms to support large renewable projects are limited in scope, and that support under CfDs will be limited by the Levy Control Framework. While private finance offers a welcome boost to infrastructure investment, particularly during the economic downturn, projects will inevitably need**

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<sup>75</sup> Q258, 30 January

<sup>76</sup> Ev w140

<sup>77</sup> Q 197; BBC, Severn barrage: Two project founders were declared bankrupt in past, 11 April 2013, news.bbc.co.uk

<sup>78</sup> Q 164

<sup>79</sup> Ev 91a and Q 164

<sup>80</sup> Ev 91

<sup>81</sup> Ev 91a

<sup>82</sup> Information from HP business case

to provide an attractive return to investors and the future cost of such finance remains uncertain. We are not convinced that Hafren will be able to raise the funds needed for their project as easily and cheaply as they claim.

42. Hafren Power's proposals will require massive support under the Contract for Difference (CfD) mechanism and for a much longer period than alternative low-carbon technologies. Currently it is unclear whether the company's proposal would be eligible for such support since it has yet to prove value for money compared with other low-carbon sources. Until the company is able to provide stronger evidence of interest from investors and of the basis for its claimed costings, the economic viability of the project will be in doubt.

## 4 Environmental impacts and mitigation

43. While it is clear that a tidal barrage will have a significant effect on the environment, the scale of specific impacts is difficult to determine. This section will examine some of the key environmental aspects of the Hafren Power proposal, including: flood risk issues; loss of intertidal habitat; international comparator sites; impact on fish and birds; compliance with EU environmental legislation, and mitigation measures.

### Flood impacts

44. Assessments regarding the impact of a barrage on flood risk vary. Two types of flooding are relevant: fluvial flooding risk (flooding from rivers) and tidal or coastal flood risk. Hafren Power asserted that the barrage would offer protection against coastal flooding and storm surges, offering protection to 90,000 properties over an area of 500km<sup>2</sup>.<sup>83</sup> Engineering the Future agreed that flood risk due to storm surges would be reduced due to control of basin water level, while modelling by Professor Falconer (Expert Panel, Hafren Power Ltd and Professor of Water Management, University of Cardiff) suggested that the area around Bridgwater would experience “a small reduction of the water level” and that overall, “the mean water level [...] will stay the same.”<sup>84</sup> The Natural Environment Research Council (NERC) noted that “In general, it is anticipated that they [barrages] will mitigate sea flood risk (particularly storm surges) by providing a physical barrier that prevents seawater ingress”<sup>85</sup>, although Ed Mitchell (Environment Agency) pointed out that such tidal surges are “very rare”.<sup>86</sup>

45. There is evidence to suggest that a barrage would offer some protection against flooding caused by sea level rise; in addition, research undertaken by Professor Falconer (currently unpublished) suggested that the “far-field effects”<sup>87</sup> of a barrage would be negligible.<sup>88</sup> However, fluvial flood risk is an area of concern for a number of stakeholders.<sup>89</sup> NERC outlined some of the potential complications of a barrage:

For example, flood risk may be increased as a result of saltmarsh erosion, the restriction of river outfalls by the longer high water stand, and the possible siltation of outfalls as a result of hydrodynamic changes. Flood risk, freshwater supplies and local land use patterns may also be affected by changes to the water table and groundwater flow.<sup>90</sup>

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83 Ev 153

84 Ev 107; Qq 148, 156

85 Ev w103

86 Q 281

87 In this context, “far-field effects” refer to effects on water levels beyond the Bristol channel.

88 Ev w5, Ev w61, Ev w66, Ev 107, Ev w103, Ev w134, Ev w158; Zhou, J., Pan, S. And Falconer, R.A., 2013, Effects of Open Boundary Location on the Far-Field Hydrodynamic Impact of a Severn barrage (in draft), Cardiff University

89 Ev w26, Ev w43, Ev 143, Ev 115, Ev w103

90 Ev w103

According to Professor Falconer, under the Hafren Power barrage scheme low tide would be raised by 3m.<sup>91</sup> Dr Richard Creswell (Environment Agency) explained that this was a “major concern” since it might restrict river outfalls and water drainage and hence lead to increased flooding from rivers:

“It is the 3 metres at the lower end with which we have the greatest concern because of the freeboard for getting water out of rivers. Certainly, around the Severn Estuary one of the biggest problems is land drainage.”<sup>92</sup>

46. Overall, there is a lack of consensus regarding how flooding might be affected by the Hafren Power scheme or indeed any barrage. NERC highlighted the “apparent contradictions” when discussing barrage impacts due to a “lack of empirical evidence”.<sup>93</sup> Regen SW and South West Marine Energy Park claimed that the impacts of an ebb-flood barrage on flooding are as yet unknown, stating that “Much more modelling and research is required to fully understand the hydrodynamic impacts of this technology.”<sup>94</sup> The impact on flood risk is likely to be mixed, as reflected in Ed Mitchell’s assessment (Environment Agency) that a barrage “has potentially both positive and negative implications for flood defence” and is therefore “probably cost neutral” (i.e. it would neither increase nor reduce costs from flood defence and damage).<sup>95</sup>

## Loss of intertidal habitat

47. According to Professor Falconer, the Hafren Power barrage scheme would reduce tidal range in the Severn from its current range of 0m to 14m to one of 3m to 12m.<sup>96</sup> Low tide would therefore be raised by 3m, as noted previously, and high tide would be reduced by 2m. The overall reduction in tidal range would lead to a reduction in intertidal habitats of salt marsh and mudflats, with a resultant impact on bird populations dependent on these areas for feeding grounds. Kate Jennings (RSPB) suggested a barrage would have “significant adverse effects on the populations of 30 species” with potential “serious effects on a total of 96 European protected sites for birds”.<sup>97</sup> The Countryside Council for Wales illustrated how changes to the estuary’s morphology could further affect habitats by altering conditions in the estuary:

“Decreased flows and flow speeds incurred by a barrage would reduce the suspended sediment concentration within the impounded area and downstream leading to further changes in the estuary extent and composition of intertidal and subtidal habitat features of the Severn Estuary”<sup>98</sup>

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91 Q 147

92 Q 284

93 Ev w103

94 Ev 91

95 Q 280

96 Q 147

97 Q 57

98 Ev w70

48. DECC's Severn Tidal Power Feasibility Study estimated that a Cardiff-Weston barrage would cause loss of 40-50% of intertidal habitat (baseline figure).<sup>99</sup> Hafren Power stated that its new ebb-flood design would lead to 60% less habitat loss, which equates to 49km<sup>2</sup> or 4900 hectares of lost habitat;<sup>100</sup> our understanding is that this is equivalent to approximately 16% loss of overall intertidal habitat.<sup>101</sup> Kate Jennings (RSPB) suggested that there were additional, ongoing complications after the initial impact:

You would expect the estuary to evolve, to try to change its shape in response to barrage construction over time, which would result in on-going erosion and loss of intertidal habitat. That is significant because of what it means in terms of the intertidal habitat, the loss of that habitat and the features it supports, like the internationally important populations of birds.<sup>102</sup>

49. Many witnesses agreed that there was a lack of up-to-date baseline data for the estuary from which to gauge potential impacts.<sup>103</sup> HR Wallingford noted that while expertise has advanced, there is an "absence of robust and long-term basic data for the estuary" and recommended "A comprehensive bathymetric survey of the entire estuary"<sup>104</sup>. The recent POST note on environmental impacts of barrages pointed out that "studies of habitat response are limited to conceptual models only", with available models diverging in their assessment of long-term impacts to habitat.<sup>105</sup> Dr Simon Pryor (Natural Environment Director, National Trust) highlighted the risk of unintended consequences:

First principles, if you look at the Severn estuary, it is a huge, very complex, very dynamic ecosystem and the hydrology, the geomorphology, the ecology are all very much interdependent, and if we intervene in a very major and quite heavy-handed way, we can expect unintended consequences.<sup>106</sup>

**50. We conclude that the environmental impacts of the Hafren Power barrage, as currently presented to us, are very considerable and that there is a high risk of unintended and possibly damaging consequences. We also conclude that Hafren Power has not presented sufficient credible evidence relating to estuary morphology, impacts to habitats and upstream fluvial flood risk. Further data, research and modelling will be required before impacts in these areas can be assessed with any degree of certainty.**

## International comparator sites

51. Suggested comparators for environmental impacts include the following sites:

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99 DECC, *Severn Tidal Power Feasibility Study, Conclusions and Summary Report*, October 2010

100 Ev 153; Ev 153a describes how the "60% less" figure was arrived at;

101  $[49\text{km}^2]/\text{total intertidal habitat } (310\text{km}^2)] \times 100 = 16\%$  habitat loss rounded to nearest percent. Figure for total intertidal habitat rounded to nearest km<sup>2</sup> and taken from DECC, Severn Tidal Power Sea Environmental Report, May 2010

102 Q 52

103 Ev w32, Ev w61, Ev w64, Ev w70, Ev w103, Ev 143, Ev 189

104 Ev w32

105 *Environmental Impact of Tidal Barrages*, Draft provisional POSTnote 435, Parliamentary Office of Science and Technology, June 2013

106 Q52



- EDF's tidal barrage facility at La Rance;
- the Annapolis Royal Tidal Barrage in Canada, an ebb-only scheme intended as a pilot for a proposed larger facility in the Bay of Fundy, and
- the Eastern Scheldt Storm Surge Barrier in the Netherlands.

52. While Hafren Power cited the La Rance scheme as evidence of the potential for improved biodiversity with a barrage in place,<sup>107</sup> assessment of environmental impacts is hampered by a lack of any baseline data prior to the construction of the barrage. In addition, we have received evidence arguing that La Rance is not an appropriate comparator for the Severn since it is “a rocky river valley” unlike the sediment-rich Severn estuary.<sup>108</sup> Problems experienced at the Annapolis Royal site in the Bay of Fundy include “fish mortality, erosion problems downstream and the health of the river upstream”. Professor Graham Daborn and Natasha Barker Bradshaw reported that tidal causeways across tributaries in the area have led to “rapid, unpredictable consequences and no foreseeable return to a state of dynamic equilibrium.”<sup>109</sup> However, Hafren Power has drawn attention to studies which illustrate the complexity of the flows in the area which limit its comparability with the Severn.<sup>110</sup> Erosion issues have also been experienced at the Eastern Scheldt site, as Kate Jennings (RSPB) explained:

Experience in the Eastern Scheldt, where they built a storm surge barrier in the 1980s—this is the site that the Severn Tidal Power Feasibility Study identified as the best comparator for a Severn Barrage—is they have found that 30-odd years after construction that estuary shows absolutely no sign of reaching a new equilibrium, so it is still attempting to change its shape and its morphology in response to the construction of the barrier. It is still losing intertidal habitat. They think it will go on losing habitat for at least a century, so the idea that the Severn will reach any rapid equilibrium of any kind—clearer water, muddier water or whatever—does not seem realistic based on the evidence.<sup>111</sup>

53. However, once again comparisons with the Severn are constrained due to differences in the type and source of the sediment at each site. As NERC pointed out, “only limited information is available from existing power plants [barrages], and there appear to be no examples of coherent, comprehensive monitoring.”<sup>112</sup> **We therefore conclude that the usefulness of international comparator sites is limited as a result of differences in estuary characteristics and scheme designs.**

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107 Ev 153

108 Ev w41, Ev w48, Ev w70, Ev 91, Ev w78, Ev 107, SEV 54, Ev 115, Ev 122, Ev w114, Ev w134; Q 60

109 Ev w114

110 See Ev 175, reference to Aretxabaleta et al., Model Simulations of the Bay of Fundy Gyre

111 Q 60

112 Ev w103



## Impact on fish

54. The Severn estuary is an important habitat for many species of fish. Martin Salter (Angling Trust) described the species composition of the estuary:

In terms of fish, there are 83 species of fish recorded in the Severn estuary. It is an incredibly dynamic habitat, both for migratory fish and freshwater fish upstream of the intertidal zone and obviously as a nursery area for bass and many other important sea fish. There are five Annex II species. These are the highly protected species under the Habitats Directive. They are the twait shads, the lamprey and the salmon. There are 11 BAP protected species. That is the UK Biodiversity Action Plan. That includes high-value species like sea trout as well as a whole range of sea species.<sup>113</sup>

55. The presence of turbines across the estuary poses a number of concerns, in particular to migratory fish. Consequences include: death or injury when passing through turbines as a result of blade strikes; disorientation caused by pressure changes and noise, and delayed or terminated migration due to physical barriers.<sup>114</sup> For the Cardiff-Weston barrage studied under the Severn Tidal Power Feasibility Study, local extinctions and population collapses were predicted for designated fish including Atlantic salmon and twaite shad, with the possible loss of the latter as a breeding species in the UK.<sup>115</sup>

### “Fish-friendly” turbines?

56. Hafren Power’s stated aim is to “accomplish zero mortality for fish passage through its turbines” through the use of a new, bi-directional Very-Low-Head (VLH) turbine design. The Hafren turbine would operate at a tip speed of 9m/s, which is below the “limit of negligible fish mortality” suggested by Oak Ridge National Laboratory research, as published by Idaho National Laboratory.<sup>116</sup> However, most trials of turbine related fish mortality have been carried out using small-sized salmon, a notoriously robust species.<sup>117</sup> These trials do not encompass the diversity of fish, invertebrates and crustaceans found in estuaries. In addition, estimates of fish mortality are based on fish making a single pass through a turbine: fish living in an estuary may make multiple passes in a day, increasing their risk of mortality.<sup>118</sup> Hafren Power also drew attention to the “fully operational VLH turbine” developed to prototype by French company MJ2 Technologies on which “full-scale field tests using live European eels” have been carried out which indicate a 100% survival rate.<sup>119</sup> While such initial results are encouraging, further research will need to be carried out with different fish species and sizes, in addition to upstream studies, before firm conclusions can be drawn. As yet, no prototype of the Hafren turbine has been built and

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<sup>113</sup> Q 57

<sup>114</sup> *Environmental Impact of Tidal Barrages*, Draft provisional POSTnote 435, Parliamentary Office of Science and Technology, June 2013

<sup>115</sup> DECC, *Severn Tidal Power Feasibility Study, Conclusions and Summary Report*, October 2010

<sup>116</sup> Ev 153a

<sup>117</sup> *Environmental Impact of Tidal Barrages*, Draft provisional POSTnote 435, Parliamentary Office of Science and Technology, June 2013

<sup>118</sup> *Environmental Impact of Tidal Barrages*, Draft provisional POSTnote 435, Parliamentary Office of Science and Technology, June 2013

<sup>119</sup> Ev 153a, See also MJ2 Technologies website: [www.vlh-turbine.com](http://www.vlh-turbine.com)

tested. “Indirect impacts”, such as sub-lethal injuries and predation, may constitute a significant source of overall mortality but there has been little research in this area.<sup>120</sup>

57. Regarding Hafren Power’s proposed VLH turbine, Ed Mitchell (Environment Agency) stated that “it is difficult to envisage how that could be fish friendly”<sup>121</sup>. **We note that the Environment Agency claims that it is “not aware of any turbine designs which would allow the safe, repeated passage of fish through a barrage at the scale proposed.”**<sup>122</sup> While claims that a barrage would lead to very extensive fish mortality may be exaggerated, existing figures of low level fish mortality tend to derive from a single species and do not encompass the diversity of species found in estuaries. Studies have largely focused on only direct mortality. However initial studies on indirect mortality suggest it may constitute a significant source of overall mortality. Field testing a prototype in an estuary on a range of fish species and sizes will need to be carried out before the claimed “fish-friendliness” of Hafren Power’s proposed turbine can be determined.

## Compliance with EU legislation

58. Hafren Power acknowledges in its evidence that the barrage project would need to comply with the following legislation:<sup>123</sup>

- Water Framework Directive<sup>124</sup>
- The Floods Directive<sup>125</sup>
- The Habitats Directive<sup>126</sup>
- The Birds Directive<sup>127</sup>
- The Environmental Impact Assessment Directive<sup>128</sup>

59. The Habitats and Birds Directives are likely to be the most challenging legislative requirements for the Hafren Power project to meet, due to the significant impact a barrage would have on a number of Annex I and II species of wild flora and fauna, protected by law under the Directives. The Severn estuary is designated as a UK Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC) under the EU Habitats Directive, recognising its extensive intertidal mud flats and importance for migrating birds.<sup>129</sup> Its international importance for wildlife is also recognised through its designation as a Special Protection Area (SPA) under the Birds Directive and a Ramsar site.<sup>130</sup> Under the Habitats

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<sup>120</sup> *Environmental Impact of Tidal Barrages*, Draft provisional POSTnote 435, Parliamentary Office of Science and Technology, June 2013

<sup>121</sup> Q 291

<sup>122</sup> Ev 115

<sup>123</sup> Ev 153

<sup>124</sup> Directive 2000/60/EC

<sup>125</sup> Directive 2007/60/EC

<sup>126</sup> Directive 92/43/EEC

<sup>127</sup> Directive 2009/147/EC

<sup>128</sup> Directive 2011/92/EU

<sup>129</sup> Directive 92/43/EEC

<sup>130</sup> Ramsar sites are wetlands of international importance, designated under the Ramsar Convention.

Directive, the Severn region forms part of “Natura 2000”, an EU-wide network of SACs and SPAs established to assure the long-term survival of Europe's most valuable and threatened species and habitats.<sup>131</sup>

60. Representatives of the RSPB and the Angling Trust stated they would support the Hafren Power barrage project if it were able to comply with European Directives.<sup>132</sup> The Sustainable Development Commission's 2007 report “Turning the Tide: Tidal Power in the UK” recommended that “any proposal for a Severn barrage must fully comply with the Directives and adhere rigorously to the process they set out.”<sup>133</sup>

## EU process under the Habitats Directive

61. As a project affecting a Natura 2000 site, the barrage would trigger an “appropriate assessment” under EU law to determine whether there were adverse environmental impacts. Alan Seatter (European Commission) indicated that “a base line of data in relation to the objectives for conserving that site” would be used in order to “inform public authorities as to what kind of impacts might happen and what you would need to do to address those”.<sup>134</sup> If the barrage were found to have an adverse effect on the integrity of the site, the project could only go ahead via the derogation process under Article 6(4) of the Habitats Directive. That process requires that the following three sequential tests are met:

- There must be no feasible alternative solutions to the plan or project which are less damaging to the affected European site(s);
- There must be “imperative reasons of overriding public interest” (IROPI) for the plan or project to proceed, and
- All necessary compensatory measures must be secured to ensure that the overall coherence of the network of European sites is protected.<sup>135</sup>

## Feasible alternative solutions?

62. Chapter 7 examines alternatives to a fixed barrage in more detail. In terms of the legislative requirements of the Directive, alternatives must be “financially, legally and technically feasible” to be acceptable, and must “deliver the overall objective of the original proposal.”<sup>136</sup> It is clear that alternatives to the barrage do not deliver energy on the same scale as the barrage (16.5 TWh/year), although the Minister has suggested that alternatives do exist:

If there were no alternative to the barrage that would enable us to meet our 2050 target, then I think the question that you pose would be at its most acute, i.e. unless

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131 For more information see ‘Natura 2000’ section: <http://ec.europa.eu/environment/nature/>

132 Q 81

133 Sustainable Development Commission, Turning the Tide: Tidal Power in the UK, October 2007

134 Q 307

135 DEFRA, *Habitats and Wild Birds Directives: Guidance on the application of Article 6(4)*, December 2012

136 DEFRA, *Habitats and Wild Birds Directives: Guidance on the application of Article 6(4)*, December 2012

we went down the road of the barrage Britain would miss its 2050 target, but I am not aware that anyone is seriously saying that is the case.<sup>137</sup>

63. Guidance from the Department for Environment, Food and Rural Affairs (Defra) states that the relevant competent authority would need to “use its judgment to decide what is reasonable in each case” when considering alternatives.<sup>138</sup> In oral evidence, Mr Seatter drew attention to how discussions about alternatives could lead to a change in the project’s design in order to mitigate impacts: “It is difficult to find an example where there isn’t a discussion involving project design that then changes during the course of a process.”<sup>139</sup>

### ***Imperative Reasons of Overriding Public Interest (IROPI)***

64. Alan Seatter (European Commission) indicated that a barrage scheme could pass the IROPI test as a renewable infrastructure project. Mr Seatter stated that the “elected people” – as opposed to the European Commission – would be responsible for balancing climate change and environmental considerations: “You cannot say in one case it is more important than another, but clearly the fight against climate change in a major project is a question of great public interest.”<sup>140</sup> The Minister indicated that such considerations would be weighed in the context of “our 2050 commitments”, noting that the barrage “is not deemed as yet to be an essential element of a successful 2050 package”.<sup>141</sup>

### **Clarity in application of the EU Habitats Directive**

65. Alan Seatter confirmed in evidence that a project on this scale was “completely unprecedented” in the Commission’s experience of projects subject to the Habitats Directive.<sup>142</sup> This underlines the uncertainty identified by DECC during the Severn Tidal Power Feasibility Study as to how the regulatory framework of EU Directives might apply to a large-scale barrage.<sup>143</sup> Mr Seatter also characterised the Habitats Directive as “a directive that is implemented by member states in the way that they feel best meets their own requirements and the requirements of the directive”, which clearly indicates that the onus is on the UK Government to judge compliance with European legislation, and indeed suggests some leeway in the way it is applied.<sup>144</sup> Several further points of uncertainty regarding the Habitats Directive were also explored in questioning:

- the distinction between “like-for-like” and “equal value” compensatory habitat,<sup>145</sup>
- the possibility of providing compensatory habitat outside the member state, currently unprecedented,<sup>146</sup> (see also next section) and

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137 Ev 153; Q 377

138 DEFRA, *Habitats and Wild Birds Directives: Guidance on the application of Article 6(4)*, December 2012

139 Q 324

140 Qq 327-328

141 Q 377

142 Q 311

143 DECC, *Severn Tidal Power Feasibility Study, Conclusions and Summary Report*, October 2010

144 Q 314, 28 February

145 Qq 330,333

- if the Commission is called upon to review a decision, what considerations inform the Commission's view on whether the benefits of a particular project outweigh environmental harm caused.<sup>147</sup>

66. Research from Bournemouth University drew attention to the “legal paradox” underpinning the Severn barrage and other large-scale renewable energy infrastructure projects where there is “a damaging impact to the environment caused by development designed to mitigate the damaging impact to the environment”.<sup>148</sup> This research suggested that the principle of IROPI (‘Imperative Reasons of Overriding Public Interest’) could be applied to all climate change mitigation development, potentially opening the door to all manner of environmentally damaging projects and overriding the statutory protections of Habitats Directive. In response to our enquiries on this issue, Alan Seatter (European Commission) confirmed that IROPI could potentially be applied to all developments which involve climate change mitigation, but assured us that “such projects could not be given the green light regardless of their impacts.” The question of public interest would need to be considered:

What is expected here is that the importance of the public interest is weighed against the severity of the impact on the site. Is the public interest truly overriding? If so, the Member State must then show that it has taken all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected and inform the Commission of these measures.<sup>149</sup>

**67. Before giving further consideration to the project, the Government should establish greater clarity in the terms and application of the Habitats Directive to major renewable infrastructure projects, in particular regarding the derogation process and principle of ‘Imperative Reasons of Overriding Public Interest’ (IROPI).**

### ***Compensatory measures and mitigation***

68. Hafren Power proposed a number of mitigation measures to offset adverse environmental impacts, based on “the operation of the barrage and the optimisation of the turbine design.” The company suggested that the use of a “fish-friendly” VLH turbine together with an ebb-flood mode of generation which “more closely emulate[s] the natural tidal flows” would reduce environmental impacts. The Consortium also stated that “screening technologies” based on fish behaviour, use of fish ladders and fish passes could help prevent or reduce the passage of fish through turbines.<sup>150</sup> However, the overall efficacy of such measures has not been determined, with potentially “contradictory effects on different species” and “limited research on marine species.”<sup>151</sup> As noted previously, the environmental impacts of a new bi-directional VLH turbine have yet to be fully modelled.

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146 Q 315

147 Qq 337-339

148 Ginige TA, Thornton A, Ball F, *The Severn Tidal Barrage Project: A Legal Paradox?*, Journal of Water Law 21:66-77 Article number 2 2011

149 Ev 192

150 Ev 153

151 *Environmental Impact of Tidal Barrages*, Draft provisional POSTnote 435, Parliamentary Office of Science and Technology, June 2013

69. The EU Habitats Directive requires provision of compensatory habitat to replace that which is lost. European Commission guidance states that any compensation must “fully offset any loss or damage to the site” and must be “feasible and operational” within a specified timescale. The guidance also states that ratios for compensatory habitat “should be generally well above 1:1” unless habitat is known to be 100% effective.<sup>152</sup> Alan Seatter (European Commission) confirmed that compensation “should be in place before the project is completed” and that Member States are responsible for deciding on the adequacy of compensation provided.<sup>153</sup> Hafren Power suggested that marine construction techniques such as topographic raising could be used to “increase foraging space for wading birds” and provide additional mudflat and saltmarsh habitat.<sup>154</sup> Engineering the Future explained:

To mitigate the loss of inter-tidal habitat, material dredged from beneath the caissons and from the shipping channels could be used to raise the bed of the estuary in selected places replacing some of the bird feeding habitat that would become submerged.<sup>155</sup>

70. However, extensive areas of compensatory habitat would need to be created. Hafren Power estimated that 49 km<sup>2</sup> (4900 hectares) of habitat would be lost as a result of the barrage, which at a 2:1 ratio would require the implementation of 9800 hectares of compensatory habitat. Even with the “up to £1 bn [billion]”<sup>156</sup> that Hafren Power is prepared to invest in the creation of alternative habitats, provision of compensation on this scale remains a great challenge and could prove a lengthy process. As part of the Severn estuary flood risk management strategy, Environment Agency proposals to create 400 hectares of compensatory intertidal habitat were reported to have taken “eight years in the negotiations.”<sup>157</sup>

71. Creating fish habitat, as opposed to intertidal habitat, could present particular difficulties. Mike Evans (Environment Agency) outlined some of the challenges:

Of course the other difficulty then is that with salmon they are loyal to their natal rivers. They do return to the same river to spawn, so there is a particular challenge there. We have poor understanding of shad, which only spawn in four rivers in the United Kingdom at present, three of which would potentially be upstream of the Severn barrage. We don’t quite know what makes a shad prefer those three rivers to similar adjacent rivers, which they do run into but don’t successfully spawn in.<sup>158</sup>

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152 EC Guidance Document, *The implementation of Habitats and Birds Directives in estuaries and coastal zones*, January 2011

153 Q 331-332

154 See Ev 153: “Marine construction works: These can provide additional or improved intertidal mudflats and saltmarsh habitat for wintering birds upstream of the barrage. For example, topographic raising to increase foraging space for wading birds which, in combination with habitat enhancement, can improve quality of feeding, ameliorating the loss of habitat. Salt marsh creation is also beneficial to support wildlife and offset habitat loss.”

155 Ev 107

156 Ev 153

157 Q 302

158 Q 299



This will be particularly challenging if a barrage necessitates “creation or restoration of 25% of the salmon habitat in England and Wales” as was suggested by Kate Jennings (RSPB).<sup>159</sup>

72. Anthony Pryor (Hafren Power) suggested that a barrage project could follow a similar process to HS2 [the High Speed Two rail network]:

If I may just mention the parallel example of HS2. The Minister for Transport stood up at least 12 months ago and said, “We will have a hybrid Bill approach to this project”. They put a project team in place. I do not think they had even settled the line of the railway track when she said that. So there was not much data out at that time. It is exactly the same process for major projects of this nature.<sup>160</sup>

However, a barrage project is unprecedented in the UK and, as we have highlighted, the environmental impacts are uncertain. In the case of HS2 Phase 1,<sup>161</sup> an Appraisal of Sustainability (AoS), including a Habitats Regulation Assessment, was prepared as a “starting point” for the full Environmental Impact Assessment (EIA); the resultant Environmental Statement will be presented alongside the Hybrid Bill when it is introduced to Parliament.<sup>162</sup> The objective of the AoS was to “determine the extent to which HS2 reflects and promotes sustainable development through the integration of environmental, social and economic considerations.”<sup>163</sup> The AoS consultation process concluded prior to the announcement of Government support for the project.<sup>164</sup> Tidal Lagoon Power Ltd have submitted an Environmental Impact Assessment scoping report to the Planning Inspectorate in relation to their proposed tidal lagoon in Swansea Bay; this is to help identify the scope of a formal EIA.<sup>165</sup> An EIA scoping report for the barrage would help to provide greater certainty regarding potential environmental impacts and compensatory habitat requirement.

**73. Serious questions remain about the effectiveness and feasibility of providing compensatory habitat on the scale required for the proposed Hafren Power barrage scheme. While optimisation of barrage design and operation offer possibilities for mitigation, the requirements of the EU Habitats Directive are a significant challenge. We note that smaller scale projects may face fewer obstacles in achieving compliance with European legislation.**

**74. We appreciate the financial outlay implied in, for example, developing a full Environmental Impact Assessment of the proposed project. But it is clear that such a large-scale, high risk and high cost project cannot go ahead in a designated area without**

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159 Q 59

160 Q 195

161 Phase 1 refers to the proposed London to West Midlands route;

162 Booz & Co. (UK) Ltd and Temple Group Ltd, HS2 London to the West Midlands Appraisal of Sustainability, Main Report Volume 1, February 2011 and Appendix 4 – Associated Assessment Reports

163 Booz & Co. (UK) Ltd and Temple Group Ltd, HS2 London to the West Midlands Appraisal of Sustainability, Main Report Volume 1, February 2011

164 HC Deb, 10 January 2012, col 23

165 Infrastructure planning portal, Proposed Tidal Lagoon Development in Swansea Bay, South Wales, Environmental Impact Scoping Report, October 2012, <http://infrastructure.planningportal.gov.uk>

**supporting evidence and assessments in place. Without such evidence the project will not achieve political and public acceptability.**



## 5 Socio-economic impacts

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75. The Hafren Power barrage project has the potential to offer significant employment benefits on both a local and national scale, potentially creating thousands of jobs and providing a much-needed economic boost to the surrounding areas. However there are also adverse impacts to be considered, in particular to ports and fishing industries. This section looks at the socio-economic implications in more detail.

### Jobs, industry and growth

76. One of the primary benefits of the proposed barrage scheme is the potential for job creation on a grand scale. Hafren Power estimated that its barrage will directly generate 20,700 jobs, supplemented by a further 30,000 indirect and induced jobs. The Consortium pledges that 80% of the £25 billion barrage investment will remain in the UK. This is to be achieved by building components locally and establishing two manufacturing plants either side of the barrage to supply the 1,026 turbines. Upon completion of barrage construction, Hafren Power estimated that the barrage will sustain approximately 1,000 permanent jobs.<sup>166</sup> The company anticipated increased trade for ports and aggregates industries bringing in construction materials, with added potential for water sports and tourism due to the more clement and clearer waters created by the barrage. In oral evidence, Rt Hon Peter Hain MP, claimed the project would “leave a legacy of jobs for local ports, for commercial and marine and leisure activity”.<sup>167</sup> Mr Hain went on to emphasise the transformational nature of the project, in particular for the steelmaking and ports industries in Port Talbot and the surrounding area.<sup>168</sup> Evidence from Tata Steel highlighted the project’s need for steel products and services, which could be provided by “indigenous suppliers.”<sup>169</sup>

77. Martin Mansfield (General Secretary, Wales TUC) also underlined the need for economic growth in the region: “[...] we believe that major infrastructure investment like this is absolutely required in order to provide the economic stimulus that we need to take us out of the economic crisis we are in, particularly in South Wales.”<sup>170</sup> Andy Richards (Wales Secretary, Unite the Union) drew attention to the level of unemployment in Wales, particularly amongst young people, and the “significant opportunity it [the project] creates for real economic and social regeneration in Wales.”<sup>171</sup> NERC outlined the wider benefits for UK industry:

A successful project to extract energy from the Severn estuary, through application of UK research science and engineering capabilities, could potentially kick start global interest in exploiting tidal range resource. This would allow the UK to export innovative design products, advice and services derived from the Severn experience

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<sup>166</sup> Ev 153

<sup>167</sup> Qq 14-16

<sup>168</sup> Q 16

<sup>169</sup> Ev w35

<sup>170</sup> Q 10

<sup>171</sup> Q 23

via our international research, consultancy and engineering sectors. This would include technology for energy extraction, as well as electrical infrastructure, flood protection, mitigation of natural heritage assets etc.<sup>172</sup>

78. Engineering the Future agreed that the barrage would generate international interest, with the unique Very-Low-Head turbine design boosting UK engineering and low-carbon industries.<sup>173</sup> Speaking about the export potential of the barrage, Professor Tim Broyd claimed that “We potentially have an opportunity to get the world market in this and to retain it for a while.”<sup>174</sup> Others were more hesitant about the export potential, given the limited number of sites with the necessary tidal range to operate a barrage facility.<sup>175</sup> Regarding turbine production, Hafren Power stated that manufacturers have shown “agreement in principle” to build turbine plants in Port Talbot and Bristol, although “negotiations have not reached the point of detailed commitment.”<sup>176</sup>

**79. The Hafren Power barrage scheme could offer significant benefits for the UK in terms of jobs and growth, with the potential to reinvigorate the local economy. A tidal barrage on this scale would highlight the UK’s engineering capabilities in the construction of large-scale renewable projects.**

## Adverse impacts to local industries

### *Impacts to the ports industry: water levels*

80. Countering the picture of economic regeneration are the adverse economic impacts which may result. The ports industry in particular has expressed strong opposition to the Hafren Power proposal on the grounds that its business would be severely compromised and possibly forced to close if a barrage were to go ahead.<sup>177</sup> The key impact identified by Simon Bird (The Bristol Port Company) would be the loss of approximately two metres of depth of water upstream of the barrage. Shallower waters would restrict the port’s capacity for deep-sea vessels, which along with delays to shipping caused by the introduction of locks on the barrage could cause “erosion in terms of our [the ports’] overall competitiveness”.<sup>178</sup> Mr Bird explained how a 2m or greater loss of water depth would affect trade:

From a Bristol Port perspective, we are one of the UK’s national deep sea ports. We handle some of the largest vessels coming into the UK; 60% of our trade is in vessels of greater than 70,000 tonnes deadweight, which come with arrival draught of greater than 13 metres. Losing that amount of water off the tide will mean that those vessels

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172 Ev w103

173 Ev 107

174 Q 124

175 Ev w41, Ev w61, Ev w66, Ev 91, Ev 143

176 Ev 153a

177 Ev 122

178 Q 87 [Matthew Kennerley, Associated British Ports]

will typically only get in on 20% of the tides throughout the year; on 80% of the tides large vessels will be unable to come into the port with that loss of high water. The loss of high water is probably a killer for us.<sup>179</sup>

81. Witnesses also raised concerns that the proposed barrage would jeopardise £1.2 billion worth of investment in infrastructure for which planning permission has been granted: a £600m Deep Sea Container Terminal and two biomass power stations.<sup>180</sup> According to The Bristol Port Company, these investments depend upon the Port's ability to accommodate deep-draught ships, handle cargo efficiently and benefit from excellent inland infrastructure links – qualities which Hafren Power's proposed barrage may adversely affect.<sup>181</sup> Rail freight which relies on rail freight flows to and from Bristol Port also requires that the port remain fully operational.<sup>182</sup>

### **Pumping**

82. Hafren Power have suggested that tides could be raised through pumping, which the company claim would improve access to existing docks.<sup>183</sup> However, analysis commissioned by Bristol Port suggests that to raise tide levels by 1m on a spring tide, 600,000,000m<sup>3</sup> would need to be pumped, equivalent to each turbine pumping 100,000 tonnes of water per hour over a six hour period.<sup>184</sup> To date Hafren Power have not produced evidence regarding technical capability of the turbines or the commercial viability of operating the barrage in pumping mode.

### **Operation of locks**

83. Hafren Power has stated that locks will be introduced on the barrage “to allow all current shipping movements.”<sup>185</sup> While Hafren Power has pledged to cover the expenses involved in operating and maintaining the locks proposed, with no charge for transit, the introduction of new locks poses other problems.<sup>186</sup> Matthew Kennerley (ABP Port Director South Wales, Associated British Ports) explained how a small change in freight costs, caused by delays or difficulties transiting locks, could cause trade to move elsewhere. An additional set of locks could cause “a convergence of a large number of large vessels” in the ports, which could increase delays and freight rate:

Not only that, you have vessels trying to get out of the impound at the same time, so huge concerns there from a ship owner's perspective. You have the risk of an extra lock, which they do not like doing. You have extra tug interaction; again, something that they try to avoid. You have the time of transit, and I question whether 40 minutes is really realistic, certainly in the case of some of the larger vessels. You have

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179 Q 87

180 Ev 122b

181 Ev 122

182 Ev w12

183 Q 229

184 Ev 122d

185 Ev 153

186 Q 242

the issue of risk of having to put a vessel through the lock and the potential delays that are associated with a possible queuing arrangement. All of that in future, when somebody is pricing a cargo to come into South Wales, will be priced into the freight rate.<sup>187</sup>

84. Hafren Power have yet to provide details of the design and dimensions of the proposed locks, although Anthony Pryor (Hafren Power) informed us that they would be designed by engineering firm Arup.<sup>188</sup> The Bristol Port Company highlighted further questions which remain unanswered:

Crucially, HP have not explained how they will guarantee in perpetuity the operation and maintenance of the locks and their approaches; the provision of pilotage and vessel traffic services; and the management of commercial priorities for access to the locks by multiple vessels all requiring passage through the locks on the same tide.<sup>189</sup>

### *Siltation and dredging*

85. Siltation caused by a barrage may result in the need for extensive maintenance dredging. As the barrage will slow water flow in the impounded area, suspended sediment is likely to drop out of the water and accumulate on the sea bed leading to shallower waters and potential difficulties for ship navigation. Moreover this may not occur proportionally: reduced water velocity leads to a faster reduced rate of suspended sediment and potential siltation. Simon Bird (The Bristol Port Company) stated that the port operates “24/7 dredging”<sup>190</sup> to keep lock entrances clear. Hafren Power acknowledged the problem of siltation, but believe that the location of turbines “spread across the breadth of the estuary” would allow for a slower velocity through the turbines and “more uniform” settling out of siltation due to “more uniform velocity distribution across the estuary”.<sup>191</sup> Witnesses noted that there is a lack of up-to-date information relating to estuary dynamics<sup>192</sup> and Hafren Power “has not yet undertaken its own detailed computational morphological modelling of the estuary.”<sup>193</sup> Due to the lack of published information on sedimentation patterns under the new barrage scheme there is no way to predict how siltation might affect the ports: this is a significant issue which Hafren Power has yet to address.

**86. Hafren Power has failed to reassure the ports industry that its business would continue to be viable with a barrage in place. Serious questions remain in regard to the barrage’s impact on water levels, shipping times, freight costs and siltation. These will need to be fully addressed before impacts to the ports can be accurately evaluated.**

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187 Q 87

188 Q242

189 Ev 122a

190 Q 87

191 Ev 153a

192 Ev w32, Ev w61, Ev w64, Ev w70, Ev w103, Ev 143, Ev 189

193 Ev 153a

### **Marine aggregates industry**

87. The marine aggregates industry could benefit in the short term by the demand for high volumes of sand needed to provide both the construction aggregate and fill associated with a barrage project. But concerns were expressed from the aggregates industry that the proposed barrage would constrain access to licensed reserves and landing sites. In addition, the current reserve permitted in the existing licensed area would not be sufficient, and therefore either new licences would be needed in the Bristol Channel region or permitted offtakes would need to be increased substantially. The British Marine Aggregate Producers Associate pointed out that this is a lengthy process of “3 years as an absolute minimum”<sup>194</sup>.

### **Fishing and tourism industry**

88. Operators of fisheries and tourist attractions in the area may suffer adverse impacts as a result of the barrage due to impacts on fish stocks and catch. The Angling Trust feared the further degradation of fish stocks and the resultant impact on the angling economy, which it described as a “vitally important part of the social and economic fabric of communities along rivers throughout the Severn basin and along the coastline”<sup>195</sup>. The DECC Severn Tidal Power Feasibility Study estimated the value of commercial and recreational fisheries at more than £28m; charter boat annual turnover was valued at approximately £1m.<sup>196</sup> Tourism to the region may also be affected: Dr Pryor (National Trust) expressed concern regarding the impact on “a really valuable expanse of open space, fresh air and places to experience nature that is accessible to an awful lot of people”.<sup>197</sup> The potential impact on the Severn bore could also affect tourism in the area.<sup>198</sup>

### **Overall employment impact**

89. As mentioned previously, Hafren Power estimated that a total of 50,000 direct and indirect jobs would be created by the construction of the barrage, with “a private-sector stimulus, including multiplier effect, of around £70bn” for the UK economy.<sup>199</sup> These figures for economic benefit have not been independently verified. Job losses in local industries should be factored in to provide a robust assessment of the regional net impact. DECC figures are broad-ranging, suggesting that if the Bristol Port Deep Sea Container Terminal were to go ahead, Gross Value Added (GVA) could range from +£5.9 billion to -£1.5 billion, with a central estimate for job creation post construction of – 80 (meaning overall loss of 80 jobs).<sup>200</sup> While the Minister conceded that such vast ranges reduced the usefulness of the figures, they do illustrate the complexity of calculating the socio-

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194 Ev w17

195 Ev 183

196 DECC, *Severn Tidal Power Feasibility Study, Conclusions and Summary Report*, October 2010; Ev 69

197 Q 61

198 A bore is a naturally occurring tidal wave which forms as the rising tide forces a large volume of water through a narrowing river channel with a rising river bed.

199 Ev 153

200 Ev 69

economic impact accurately.<sup>201</sup> The Minister also pointed out that Hafren Power's assessment appeared optimistic:

We have not seen the details behind the Hafren Power figure. They have not been made available to us. So we can't comment in detail, but they do seem very high. They certainly don't compare to our feasibility study estimate or to the number of jobs we would expect from a similar generation capacity for, say, nuclear energy.<sup>202</sup>

90. DECC's assessment suggested that a barrage would result in job losses whereas Hafren Power thought that the overall employment impact of its project would be positive. *We therefore recommend that any claims about job creation and economic benefit should be independently verified, particularly with reference to the costs being borne by energy users, with adverse impacts to existing industries factored in to calculations in order to provide a robust assessment of net regional economic impact.* The employment benefit of a barrage scheme is likely to centre around temporary jobs during construction. The number of high-quality, permanent jobs created by the proposals will be ultimately more significant.

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201 Q 369

202 Q 370

## 6 Decarbonisation and energy security benefits

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91. It is widely agreed that a tidal barrage in the Severn estuary has the potential to generate 5% of UK electricity from a clean, indigenous and renewable source.<sup>203</sup> The energy security and decarbonisation benefits would be considerable. This sections explores such benefits in more depth and investigates how local and environmental concerns should be weighed against national energy and climate change objectives.

### Energy security

92. Hafren Power emphasised the ability of the barrage to contribute to UK energy security by diversifying the energy mix and reducing reliance on imported energy. Hafren Power's barrage would produce 5% of UK electricity, a figure recognised by DECC<sup>204</sup> and Engineering the Future,<sup>205</sup> generating 16.5 TWh/year.<sup>206</sup> Generating on both ebb and flow tides would enable the tidal barrage to generate for a period of 15.25 hours per day.<sup>207</sup> Ian Gardner (Director, UKMEA Board, Arup) claimed the Hafren Power barrage has "a very strong point of applicability and relevance in a diverse UK market".<sup>208</sup> Engineering the Future outlined the energy security advantages:

The scheme would add much-needed diversity to the UK's renewable energy portfolio. Given the barrage's generation characteristics, it could complement nuclear and wind and reduce the reliance on imported gas, providing the UK with flexibility for the future.<sup>209</sup>

On the other hand, the Energy Technologies Institute noted that alternative low-carbon energy sources exist which could prove more economical:

A Severn Barrage could provide an important element of secure energy supply, but there are many alternative ways to meet the same objective. To decide which is the most attractive option requires a detailed consideration of the net contribution of each scheme, their capital and lifetime costs, the economic benefits they may offer and how each of them might contribute to the UK energy system.<sup>210</sup>

93. The barrage has the potential to strengthen the UK energy portfolio - an increasingly urgent objective as the margin between supply and demand narrows following the closure of old plant. However, Hafren Power's barrage would not be fully operational until 2025 at

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203 Ev 69, Ev 107, Ev 153; See also DECC, *Severn Tidal Power Feasibility Study, Conclusions and Summary Report*, October 2010

204 Ev 69

205 Q 113

206 Ev 153

207 Ev 153

208 Q 168

209 Ev 107

210 Ev w85



the earliest and will not help address the more imminent energy gap caused by the closure of coal-fired plant over the next few years.

### “Variable base load power”

94. The predictability of tidal energy, described as “totally reliable”<sup>211</sup> by Professor Broyd (Engineering the Future), has advantages over intermittent sources of low-carbon energy such as wind and solar. Hafren Power suggests that tidal energy will provide the system operator with “variable base load power”, which the company suggested will help the grid operator to balance supply and demand.<sup>212</sup> Accommodating this tidal power is possible in principle, as illustrated by the findings of a National Grid study.<sup>213</sup> On the other hand, there are some drawbacks to tidal power relating to timing and variability:

The amount of power that would be generated could be calculated for any period in the future. However, the timing of energy production would vary with the tides and the amount of power generated would vary significantly between spring and neap tides. Even though there are engineering possibilities to hold back and control water flow through impoundments, there would be some days every month when electricity was produced at times when ordinarily demand would be very low.<sup>214</sup>

95. Electricity storage may offer possible solutions for this in the long-term. However the technology is currently immature and moreover there is an inevitable loss of energy with storage. In the immediate future, smart grids and appliances may therefore offer a more effective way of utilising off-peak generation through demand management.<sup>215</sup> Interconnection with other countries could also help to balance supply with demand. **We accept that the a tidal barrage scheme in the Severn estuary could provide a reliable and predictable low-carbon electricity supply, which could bring benefits for energy security. Technological innovations such as smart grids, interconnection and electricity storage could help to overcome the challenges associated with tidal energy.**

## Climate Change Benefits

### Carbon savings

96. Hafren Power stated that the barrage will offer carbon savings of 7.1 Mt CO<sub>2</sub> per year compared to fossil fuel generation, achieving carbon neutrality after the first 2.1 years of operation.<sup>216</sup> However, DECC pointed out that the carbon savings will depend on the type of electricity generation the barrage displaces: for example, by the time the barrage project comes on-stream, DECC will not be commissioning unabated coal plant. The Department calculated that a Cardiff-Weston barrage, if replacing generation from coal with CCS,

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211 Q 114

212 Ev 153

213 National Grid, Feasibility Study for Connection of Severn Tidal Generation for Department of Energy and Climate Change, Final Report, September 2009

214 Ev 107

215 Q 114

216 Ev 153



would lead to an estimated 219 Mt CO<sub>2</sub> savings during its operations, equivalent to 1.8 Mt CO<sub>2</sub> per year. DECC estimates for the carbon payback period of a Severn tidal barrage range from -0.8 years to 7 years, reflecting uncertainties regarding potential benefits and risks.<sup>217</sup> A lifecycle assessment of the Cardiff-Weston design carried out by the University of Bath suggested that “carbon intensity of the Severn barrage is small in comparison to the National Grid mix” and, notably, the barrage operation stage rather than the construction stage was found to be the most carbon intense due to associated environmental impacts.<sup>218</sup> **We note the disparities in these carbon savings assessments and the need to take into account a carbon payback period. Carbon reduction offered by a barrage would nonetheless be considerable.**

### ***Contribution to climate change targets***

97. The 2009 EU Renewable Energy Directive sets a target for the UK to meet 15% of all energy needs from renewable sources by 2020.<sup>219</sup> Although Hafren Power’s barrage would not be fully operational until 2025, the Consortium claim that the EU “will look favourably on schemes under construction.”<sup>220</sup> The company conceded to the Committee that this was based on an “understanding” of the process, as opposed to explicit confirmation from EU institutions. However, the barrage would be able to contribute to the UK’s legally binding 2050 target to reduce carbon emissions by 80% on 1990 levels, as set out in the Climate Change Act 2008. In addition, the barrage is likely to be able to offer some measure of protection against potential storm surges or other events related to climate change.

### ***Weighing up the arguments***

98. Arguments relating to nationally significant issues such as energy security and climate change benefits must be weighed against local and environmental concerns. Our oral evidence sessions drew attention to the importance of striking the right balance.<sup>221</sup> Andy Richards (Unite the Union) suggested that the barrage project should not be prevented from going ahead due to “parochial future business interests”.<sup>222</sup> However, there is clearly a need to ensure that energy and climate change solutions are “environmentally acceptable, sensible and sustainable”.<sup>223</sup> The Minister balanced the arguments as follows:

If there were no alternative to the barrage that would enable us to meet our 2050 target, then I think the question that you pose would be at its most acute, i.e. unless we went down the road of the barrage Britain would miss its 2050 target, but I am not aware that anyone is seriously saying that is the case. It is not in our 2050 road

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217 Ev 69. The carbon payback period refers to the number of years it would take for a barrage to pay back the carbon debt of its construction and operation.

218 Ev w50

219 Directive 2009/28/EC

220 Ev 153

221 Q 109

222 Q 51

223 Q 52 [Martin Spray]

map. It is not deemed as yet to be an essential element of a successful 2050 package and, therefore, I think, weighing it up, there are better arguments.<sup>224</sup>

**99. We conclude that the Hafren Power project in its current form has not demonstrated sufficient value as a low-carbon energy source to override regional and environmental concerns. We agree with the Minister that, at present, the barrage is not vital to meeting our 2050 carbon targets, for which alternative pathways exist. On the basis of the evidence available, we further conclude that the same or similar policy objectives could be delivered through less environmentally damaging means and possibly at lower cost.**

## 7 Barrage technology and alternatives

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100. In this section, we consider Hafren Power's Very-Low-Head, bi-directional turbine design and examine the strengths and weakness of a fixed barrage structure with reference to international comparator sites. We also look at alternative approaches and proposals for harnessing the Severn resource, with some analysis of comparative socio-economic and environmental considerations. Finally, we look at approaches to the management of Bristol Channel's marine resources and Government's role in stimulating growth in the sector.

### The Hafren Power barrage design

#### *Very-Low-Head turbines*

101. Hafren Power proposed to use a Very-Low-Head turbine design deploying two sets of contra-rotating blades, separated by a gap of 1.5m, which would spin simultaneously. Generation would be bi-directional; in other words, generating on both the ebb and flood tides. Hafren Power has indicated that they are considering purchase of the Intellectual Property Rights (IPR) for the Rolls-Royce/Atkins concept design produced for the Severn Tidal Power Feasibility Study.<sup>225</sup> Hafren Power stated that French company MJ2 Technologies have produced a fully operational VLH turbine, albeit on a smaller scale than the proposed Hafren turbine.<sup>226</sup> Regen SW and South West Marine Energy Park stated that such a turbine would be "of significant benefit" to the marine industry with the potential to "be applied across a range of projects in the UK and abroad".<sup>227</sup> Notwithstanding the further R&D required, it is promising to hear of progress in the development of the VLH turbine.

102. On the other hand, it is clear that engineering challenges remain and that the Hafren Power turbine is still some way off technological readiness. Commercial deployment of the turbine may be a more distant prospect, as Regen SW and South West Marine Energy Park outlined:

However, even if the physical technology development could be accelerated, the commercialisation of the technology would still require several years of demonstration and deployment to reach the stage where the turbine can be "bankable" – i.e. backed by a manufacturing capability, performance guarantee and warranty (as well as environmentally proven) which investors will require before investing in large scale projects. We have seen the same in offshore wind, wave and tidal energy – and this is why it is almost impossible to imagine a scenario whereby a credible new turbine technology would first be deployed as a critical component in a £25 billion project.<sup>228</sup>

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225 Ev 153a ; Atkins/Rolls Royce, Severn Embryonic Technologies Scheme, Concept Design for a Very-Low-Head Dual Generation Tidal Scheme for the Severn Estuary, February 2010

226 See [www.vlh-turbine.com](http://www.vlh-turbine.com) for further details of the MJ2 design

227 Ev 84a

228 Ev 107a

103. Vincent de Laleu (EDF Energy) confirmed that a 100% reversible turbine remained “a technical challenge” that would require “many years to develop”.<sup>229</sup> **Although Hafren Power has assured the Committee that it has included time for turbine testing and development in the project timescale, we doubt that the two years proposed will allow sufficient time for production of a novel turbine as well as the necessary independent verification and trials.**

### *A fixed barrage*

104. A fixed barrage which spans the length of the estuary is expected to maximise energy yield, due to the large area of water that it will impound. Professor Broyd (Engineering the Future) described the barrage option, compared to alternatives such as tidal lagoons and fences analysed during the Severn Tidal Power Feasibility Study, as “head and shoulders above the rest for any return on investment at all”.<sup>230</sup> Hafren Power argued that the impounding an area of water of more than 500km<sup>2</sup> behind a relatively short impoundment wall (18km) is a highly efficient way of extracting maximum energy from the tidal range.<sup>231</sup> By contrast, lagoons would require a long perimeter wall to impound a relatively small area. Hafren Power claims that the proposed Swansea Bay Lagoon would only be able to provide one fortieth of the energy of the barrage.<sup>232</sup> The “Stepping Stones” lagoon proposed by Parsons Brinckerhoff and Black & Veatch<sup>233</sup> would have a lower annual energy yield than the barrage (1.2 TWh/year), although capital costs are also much lower at £1.7billion.<sup>234</sup>

105. Nonetheless, a large fixed barrage structure, while arguably having the greatest generating capacity, also has its disadvantages. Specialist consultants HR Wallingford highlighted the construction risk involved in such a project:

To our knowledge, the construction process for a tidal power scheme, and in particular during the latter phases where the degree of constriction is high, of a tidal power scheme of this scale has not been the subject of serious study in the last 20 years or more. The major hydraulic forces during this operation therefore remain a risk area for any developer of such a scheme.<sup>235</sup>

106. Rupert Evans (Evans Engineering and Power Ltd) described the conventional barrage as an “elephant”, due to the inability to modify or “future-proof” the structure. Mr Evans suggested that in contrast a tidal reef or fence structure would offer more flexibility and scope to adapt to technological advances or environmental concerns.<sup>236</sup> Friends of the Earth supported the need for “a degree of flexibility in deployment of infrastructure in the

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229 Q 273

230 Q 108

231 Ev 153a

232 As above

233 See Ev w5 and Ev w78

234 Ev 91a

235 Ev w32

236 Q 259

Severn”, while some stakeholders maintained that barraging the estuary can never be acceptable due to damaging impacts on ports and wildlife, especially migratory fish.<sup>237</sup>

## Tidal power facilities worldwide

107. Significant examples of tidal power facilities in operation worldwide include:

- The 240 MW EDF tidal barrage facility at La Rance, currently the largest of its kind in Europe
- The 254 MW tidal barrage in the Sihwa Lake in South Korea<sup>238</sup>
- The 18MW Annapolis Royal Tidal Barrage in Canada, an ebb-only scheme designed as a pilot for a proposed larger facility in the Bay of Fundy which was not built due to environmental concerns<sup>239</sup>

108. As discussed in Chapter 4, these international sites do not necessarily provide useful environmental comparisons, however they do illustrate the feasibility of barrage technology. The bulb turbines at La Rance are “still performing well” almost fifty years after construction of the plant.<sup>240</sup> Although Vincent de Laleu (EDF Energy) was unwilling to disclose the precise cost of energy generated, it is widely acknowledged that the facility provides low-cost electricity.<sup>241</sup> In addition to the Sihwa Lake facility in South Korea, proposals have been submitted to build a larger 1.3 GW facility at Incheon Bay, although this project and further tidal projects in South Korea are reportedly on hold.<sup>242</sup> The Canadian experience offers less cause for optimism: problems associated with fish mortality, erosion and the upstream river have led to a decision not to develop further barrage schemes in the Bay of Fundy.<sup>243</sup> EDF Energy also points out that sites with the suitable tidal range conditions are “rare”, which suggests that export potential for barrage technology is limited.<sup>244</sup>

## An alternative approach?

109. Much of our written evidence drew attention to alternative technologies for harnessing the Severn’s energy resources. Stakeholders argue that a smaller-scale, more incremental approach would allow tidal power technologies to be fully developed and tested, and environmental impacts assessed, before large-scale projects were attempted.<sup>245</sup>

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237 Ev w41; Ev 122, Ev 143, Ev w134, Ev w151, Ev w153

238 Ev w103

239 Ev w114

240 Ev 187

241 Q 270; Ev w61, Ev w5, SEV 68

242 Save International, Tidal Power in South Korea, Update for early 2013, [www.saveinternational.org/saveinaction](http://www.saveinternational.org/saveinaction)

243 Ev w114

244 Ev 187

245 Supporters of this approach included RSPB, Friends of the Earth, The Wildlife and Wetlands Trust, Professor Graham Daborn and Natasha Barker Bradshaw, Bristol Port Company, Black & Veatch, Parsons Brinkerhoff, Regen SW and South West Marine Energy Park, and the a coalition of NGOs (See Ev w151)

Black & Veatch and Parsons Brinckerhoff set out the arguments for a “step by step approach”:

Rather than considering development of one of the largest tidal power schemes in the UK as the first step, we believe a more incremental approach would be more attractive to investors, reduce the blight effect on ports, create and sustain construction and operational jobs in the UK tidal power sector as well as allowing valuable operational evidence to inform development of subsequent larger tidal power projects.<sup>246</sup>

The Renewable Energy Association (REA) also expressed concerns about the “financial and environmental risks” of a large-scale barrage and advocated building a small barrage to begin with, “to assess the costs and monitor the environmental impact”.<sup>247</sup>

110. The Regen SW and South West Marine Energy Park discussion paper, “Bristol Channel Energy – A Balanced Technology Approach”, outlined an alternative vision for marine energy in the Severn. It claimed that a combination of tidal, wave and wind technologies could provide up to 14 GW of low-carbon electricity, obviating the need for a “single mega-project which has major economic and environmental impacts”.<sup>248</sup> The paper also suggested that the focus on a single, “potentially divisive” barrage project is damaging for the marine industry and instead recommends “a more inclusive discussion”.<sup>249</sup> Johnny Gowdy (Regen SW) explained in oral evidence that the “basis of the approach was to look holistically at all the potential energy sources in the Bristol Channel Area” and to “look to develop technologies as they became more mature and as they became more cost-effective.”<sup>250</sup> Tidal resource modelling undertaken by the Energy Technologies Institute suggested that “the energy yield from a single large-scale Severn barrage could be achieved with a lower level of interaction and impacts through a combination of tidal energy extraction at a number of smaller, different sites.”<sup>251</sup>

## Other tidal power proposals

111. Proposals for tidal power facilities which have been presented to the Committee include:

- A 600 MW tidal lagoon known as ‘Stepping Stones’ put forward by Parsons Brinckerhoff and Black & Veatch<sup>252</sup>. This would be a smaller scale project and is intended to embody a “step-by-step” approach which could potentially lead to larger projects. It would have a capital cost of £1.7 billion.<sup>253</sup>

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<sup>246</sup> Ev w78 and Ev w5

<sup>247</sup> Ev w111

<sup>248</sup> Ev 91

<sup>249</sup> Regen SW and South West Marine Energy Park and in conjunction with stakeholders, Bristol Channel Energy: A Balanced Technology Approach, November 2012

<sup>250</sup> Q 252

<sup>251</sup> Ev w85

<sup>252</sup> See Ev w5 and Ev w78

<sup>253</sup> Ev w5

- Rupert Armstrong Evans (Evans Engineering and Power Ltd) outlined his proposal for a low-impact 6GW tidal ‘reef’ between Aberthaw in South Wales and Minehead in Somerset.
- Tidal Lagoon Power Ltd have submitted a scoping report to the Planning Inspectorate for a 250-350 MW tidal lagoon in Swansea Bay with an estimated annual output of 400,000 MWh/year.<sup>254</sup> The company vision is to generate up to 10 GW of energy from a series of lagoons which exploit the tidal range of UK waters.<sup>255</sup> DECC officials met with the company in March 2013 to discuss the project.<sup>256</sup>

### *Socio-economic and environmental impacts of alternatives*

112. The socio-economic benefits of alternative proposals will need to be robustly assessed in the same way as the Hafren Power scheme. The Committee has been presented with little data about the impacts of alternative schemes. However, some advantages have been suggested in relation to the deployment of tidal lagoons:

- Land-connected lagoons are located away from navigation channels, and therefore are unlikely to impact on the operations of Severnside ports.<sup>257</sup>
- A lagoon design would be unlikely to impede the development of other marine technologies in the region.<sup>258</sup> The Regen SW and South West Marine Energy Park discussion paper suggested that a fixed barrage would “impact on downstream flow and hence tidal stream generation potential”,<sup>259</sup> although Hafren Power maintain that the barrage is compatible with other technologies.<sup>260</sup>
- Environmental impact is thought to be less since lagoons would not affect tides and water flow to the same extent and would not obstruct downstream and upstream migration of fish.
- A smaller-scale lagoon design may be more likely to gain support from a broad range of stakeholders, while still offering potential for employment benefit and energy generation. Parsons Brinckerhoff claim their “stepping stones” lagoon offers “the potential for 4,000 direct jobs, of which 50% or more could be local”. The Severn Tidal Power Group suggest that “the merits of developing such a scheme should be carefully considered”.<sup>261</sup>

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254 <http://infrastructure.planningportal.gov.uk/projects/wales/tidal-lagoon-swanea-bay/>

255 Ev w147

256 Q 385

257 Ev w78

258 Ev w78

259 Regen SW and South West Marine Energy Park and in conjunction with stakeholders, Bristol Channel Energy: A Balanced Technology Approach, November 2012

260 Q 143

261 Ev w109



113. However, as CH2M HILL observed, some of the projects put forward remain in the early conceptual stages of development, and “do not present a sound business case”. The firm argued that “A traditional barrage with tried and tested bulb turbine technology could be implemented relatively quickly and would provide the high degree of confidence that will be necessary to attract investors.”<sup>262</sup> Hafren Power also suggested that tidal lagoons are “untried and unproven and would have similar impacts on ecology and wildlife to a barrage, which would need to be addressed”.<sup>263</sup> The costs of marine technologies are currently high: at the time of writing wave and tidal stream technologies received five Renewable Obligation Certificates per MWh, equivalent to an approximate strike price of £200/MWh. Tidal lagoon and tidal barrage developers currently receive 2 ROCs/MWh, though this is set to reduce over the next four years.<sup>264</sup> The Energy Technologies Institute recommended that “a detailed consideration of the net contribution of each scheme, their capital and lifetime costs” is undertaken to assess relative economic benefits.

**114. We conclude that a more incremental approach using alternative technologies (such as tidal lagoons) may have the potential to provide a lower-risk, lower-impact option than the Hafren Power barrage scheme. Whether these alternatives offer better value for money is far from clear at this stage. Any alternative proposals to the Hafren Power scheme would need to demonstrate the same robust evidence about the costs, environmental and socio-economic impacts which we require for the Hafren Power scheme. *We recommend consideration is given to first developing a smaller scale tidal project, in order to build a stronger evidence base for assessing impacts, risks and costs before proceeding with any larger scale scheme. The Government should take this into consideration before approving the development of projects in the Severn estuary.***

## Future of tidal industry and Severn resource management

115. This inquiry has demonstrated the scale of public interest in the considerable potential of Severn marine resources, but the debate has to some extent suffered because it has been focussed so much on the merits or otherwise of the Hafren Power barrage scheme. Recent discussions at the Sustainable Severn Conference organised by Regen SW, RSPB and The Bristol Port Company suggested that stronger public governance of the marine resources in the Severn was needed.<sup>265</sup> This could be achieved through:

- a clear policy and planning framework for the development of projects with a proactive approach from Government and public bodies;
- a fair and open forum for stakeholder debate with an appointed representative body for Welsh and English interests, and
- a “spatial plan” of Severn resources for energy developers which takes into account technology compatibility, socio-economic and environmental concerns.<sup>266</sup>

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262 Ev w61

263 Ev 153a

264 Department of Energy and Climate Change, Calculating Renewable Obligation Certificates (ROCs), Renewables Obligation (RO) banding, [www.gov.uk](http://www.gov.uk)

265 For further information see: [www.sustainablesevern.co.uk](http://www.sustainablesevern.co.uk)

266 [www.sustainablesevern.co.uk/event-reports/](http://www.sustainablesevern.co.uk/event-reports/)

116. We conclude that the Government should continue to examine the energy generating potential of the Severn region in the event of Hafren Power's proposed barrage scheme not going ahead. *We therefore recommend that the Government consider how a more proactive approach to Severn resource management could stimulate growth in the marine renewables industry and drive forward tidal projects in the region.*

## 8 Conclusions

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117. The evidence presented to us in this inquiry leaves the case for the Hafren Power barrage proposal unproven. Hafren Power has yet to provide robust and independently verified evidence of the economic, environmental and technological viability of the project. The overall socio-economic impact of the scheme remains uncertain. In its current form Hafren Power's proposal fails to address environmental and commercial concerns in enough detail to allay the concerns of stakeholders and the wider public. Crucially, Hafren Power has failed to demonstrate that the project could offer value for money for the consumer in line with other low-carbon energy sources such as nuclear and off-shore wind.

118. Nonetheless, the Government should remain open to considering any marine project in the Severn which is able to comply with the requirements of the relevant EU and UK legislation — including a potential barrage scheme. A project that would deliver renewable energy on the scale that Hafren Power's proposal aspires to, could be the knight in shining armour that the UK energy mix needs. Harnessing the energy of the Severn would offer significant decarbonisation and energy security benefits. However far more detail and evidence about Hafren Power's proposal is required before an informed decision can be made. In its present form, with a very wide range of uncertainties remaining, we do not recommend its approval. Smaller-scale projects may face fewer legislative barriers, while still contributing to energy and climate change objectives and to the development of the marine renewables industry.

# Recommendations

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## Transparency and public consultation

1. Robust and credible evidence is fundamental to building trust and reassuring key stakeholders, particularly for an unprecedented and huge project such as the proposed Hafren Power barrage. We support the calls for further evidence and technical detail of the proposal in order to arrive at an informed decision. *We recommend that such evidence is placed in the public domain as soon as possible if stakeholder confidence is to be established and in order to promote maximum transparency.* (Paragraph 16)
2. *We further recommend that Government makes clear to Hafren Power that no further consideration will be given to their proposal until and unless the additional information requested has been provided.* (Paragraph 17)
3. We consider Hafren Power's expected timetable for the passage of a Hybrid Bill completely unrealistic. We note that the Hybrid Bill route does not offer an open and fully accountable process for stakeholders and affected parties. An application via the Planning Act 2008 may provide a more suitable legislative vehicle for a barrage project. Clearer guidelines on due process, expected timescale and the information required by Government under different legislative routes, and particularly under a Hybrid Bill, would be helpful for both stakeholders and developers. (Paragraph 22)

## Costs and value for money

4. *We recommend that Government ensure that levelised cost of energy analysis reflects a fair appraisal of long-term cost and power generation, which takes into account the full lifecycle of marine energy projects.* (Paragraph 28)
5. We believe that the strike price for the barrage would have to be considerably higher than the £100/MWh which Hafren Power have "in mind". Furthermore, the company say they would require this price to be guaranteed for 30 years, twice as long as an offshore wind project. It is unsatisfactory that such wide-ranging figures have been cited regarding the level of Government support required for a barrage. As a minimum, the strike price for barrage-generated electricity should not be higher than that for offshore wind, which is expected to be around £100/MWh by 2020. While the use of novel turbines and updated design may indeed provide savings in barrage construction, it is very unlikely that the Hafren project will be financially viable with a strike price at this level. If a higher strike price was offered, it would risk swamping the Levy Control Framework to the detriment of other low-carbon technologies. Claims by Hafren Power of long-term affordability are too distant and uncertain a prospect to overcome more immediate economic, environmental and local concerns. (Paragraph 34)
6. We do not believe that potential collateral benefits should be factored into any strike price negotiations. In the case of the Hafren scheme, significant uncertainty remains regarding whether such savings would in fact be made, and there is a lack of

consensus regarding the impact of a barrage on flooding. The support available via Contracts for Difference comes directly from consumers via their energy bills. Any flood defence savings made as a result of projects supported will not accrue to bill payers but to the Exchequer. *We recommend that the savings from any potential reductions in Government spending are disregarded when negotiating strike price.* (Paragraph 37)

7. While we do not share these concerns regarding foreign investment, and indeed welcome investment in renewable projects from private sources, all efforts should be made to ensure maximum UK content if the project is taken forward. (Paragraph 38)
8. The Committee notes that the current mechanisms to support large renewable projects are limited in scope, and that support under CfDs will be limited by the Levy Control Framework. While private finance offers a welcome boost to infrastructure investment, particularly during the economic downturn, projects will inevitably need to provide an attractive return to investors and the future cost of such finance remains uncertain. We are not convinced that Hafren will be able to raise the funds needed for their project as easily and cheaply as they claim. (Paragraph 41)
9. Hafren Power's proposals will require massive support under the Contract for Difference (CfD) mechanism and for a much longer period than alternative low-carbon technologies. Currently it is unclear whether the company's proposal would be eligible for such support since it has yet to prove value for money compared with other low-carbon sources. Until the company is able to provide stronger evidence of interest from investors and of the basis for its claimed costings, the economic viability of the project will be in doubt. (Paragraph 42)

## Environmental impacts and mitigation

10. We conclude that the environmental impacts of the Hafren Power barrage, as currently presented to us, are very considerable and that there is a high risk of unintended and possibly damaging consequences. We also conclude that Hafren Power has not presented sufficient credible evidence relating to estuary morphology, impacts to habitats and upstream fluvial flood risk. Further data, research and modelling will be required before impacts in these areas can be assessed with any degree of certainty. (Paragraph 50)
11. We therefore conclude that the usefulness of international comparator sites is limited as a result of differences in estuary characteristics and scheme designs. (Paragraph 53)
12. We note that the Environment Agency claims that it is "not aware of any turbine designs which would allow the safe, repeated passage of fish through a barrage at the scale proposed." While claims that a barrage would lead to very extensive fish mortality may be exaggerated, existing figures of low level fish mortality tend to derive from a single species and do not encompass the diversity of species found in estuaries. Studies have largely focused on only direct mortality. However initial studies on indirect mortality suggest it may constitute a significant source of overall mortality. Field testing a prototype in an estuary on a range of fish species and sizes

will need to be carried out before the claimed “fish-friendliness” of Hafren Power’s proposed turbine can be determined. (Paragraph 57)

13. Before giving further consideration to the project, the Government should establish greater clarity in the terms and application of the Habitats Directive to major renewable infrastructure projects, in particular regarding the derogation process and principle of ‘Imperative Reasons of Overriding Public Interest’ (IROPI). (Paragraph 67)
14. Serious questions remain about the effectiveness and feasibility of providing compensatory habitat on the scale required for the proposed Hafren Power barrage scheme. While optimisation of barrage design and operation offer possibilities for mitigation, the requirements of the EU Habitats Directive are a significant challenge. We note that smaller scale projects may face fewer obstacles in achieving compliance with European legislation. (Paragraph 73)
15. We appreciate the financial outlay implied in, for example, developing a full Environmental Impact Assessment of the proposed project. But it is clear that such a large-scale, high risk and high cost project cannot go ahead in a designated area without supporting evidence and assessments in place. Without such evidence the project will not achieve political and public acceptability. (Paragraph 74)

### Socio-economic impacts

16. The Hafren Power barrage scheme could offer significant benefits for the UK in terms of jobs and growth, with the potential to reinvigorate the local economy. A tidal barrage on this scale would highlight the UK’s engineering capabilities in the construction of large-scale renewable projects. (Paragraph 79)
17. Hafren Power has failed to reassure the ports industry that its business would continue to be viable with a barrage in place. Serious questions remain in regard to the barrage’s impact on water levels, shipping times, freight costs and siltation. These will need to be fully addressed before impacts to the ports can be accurately evaluated. (Paragraph 86)
18. *We therefore recommend that any claims about job creation and economic benefit should be independently verified, particularly with reference to the costs being borne by energy users, with adverse impacts to existing industries factored in to calculations in order to provide a robust assessment of net regional economic impact.* The employment benefit of a barrage scheme is likely to centre around temporary jobs during construction. The number of high-quality, permanent jobs created by the proposals will be ultimately more significant. (Paragraph 90)

### Decarbonisation and energy security benefits

19. We accept that the a tidal barrage scheme in the Severn estuary could provide a reliable and predictable low-carbon electricity supply, which could bring benefits for energy security. Technological innovations such as smart grids, interconnection and

electricity storage could help to overcome the challenges associated with tidal energy. (Paragraph 95)

20. We note the disparities in these carbon savings assessments and the need to take into account a carbon payback period. Carbon reduction offered by a barrage would nonetheless be considerable. (Paragraph 96)
21. We conclude that the Hafren Power project in its current form has not demonstrated sufficient value as a low-carbon energy source to override regional and environmental concerns. We agree with the Minister that, at present, the barrage is not vital to meeting our 2050 carbon targets, for which alternative pathways exist. On the basis of the evidence available, we further conclude that the same or similar policy objectives could be delivered through less environmentally damaging means and possibly at lower cost. (Paragraph 99)

### Barrage technology and alternatives

22. Although Hafren Power has assured the Committee that it has included time for turbine testing and development in the project timescale, we doubt that the two years proposed will allow sufficient time for production of a novel turbine as well as the necessary independent verification and trials. (Paragraph 103)
23. We conclude that a more incremental approach using alternative technologies (such as tidal lagoons) may have the potential to provide a lower-risk, lower-impact option than the Hafren Power barrage scheme. Whether these alternatives offer better value for money is far from clear at this stage. Any alternative proposals to the Hafren Power scheme would need to demonstrate the same robust evidence about the costs, environmental and socio-economic impacts which we require for the Hafren Power scheme. *We recommend consideration is given to first developing a smaller scale tidal project, in order to build a stronger evidence base for assessing impacts, risks and costs before proceeding with any larger scale scheme. The Government should take this into consideration before approving the development of projects in the Severn estuary.* (Paragraph 114)
24. We conclude that the Government should continue to examine the energy generating potential of the Severn region in the event of Hafren Power's proposed barrage scheme not going ahead. *We therefore recommend that the Government consider how a more proactive approach to Severn resource management could stimulate growth in the marine renewables industry and drive forward tidal projects in the region.* (Paragraph 116)



# Formal Minutes

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**Tuesday 21 May 2013**

Members present:

Mr Tim Yeo, in the Chair

Barry Gardiner  
Ian Lavery  
Peter Lilley  
Albert Owen

John Robertson  
Sir Robert Smith  
Dr Alan Whitehead

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

Albert Owen declared a non-pecuniary interest as a member of the All Party Parliamentary Group on the Severn barrage.

Sir Robert Smith declared interests, as listed in the Register of Members' Interests, in the oil and gas industry, in particular a shareholding in Shell transport and Trading (oil integrated).

Mr Tim Yeo declared interests, as listed in the Register of Members' Interests, including as Director of ITI Energy Limited (unremunerated), suppliers of gasification equipment; Director AFC Energy; company developing alkaline fuel cell technology; Non-Executive Director, Groupe Eurotunnel SA; and Chairman of TMO Renewables Limited. Shareholdings in Anacol Holdings Ltd.; AFC Energy (share option); Eco City Vehicles plc.) and Groupe Eurotunnel SA.

Draft Report (*A Severn Barrage?*), proposed by the Chair, brought up and read.

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

Paragraphs 1 to 118 read and agreed to.

Summary agreed to.

*Resolved*, That the Report be the Second 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 for publishing on 4, 11 and 18 December 2012, 10, 16, 23 and 30 January and 26 March).

[Adjourned till Tuesday 21 May at 2.00 pm]

## Witnesses

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### Tuesday 10 January 2013

Page

**Rt Hon Peter Hain MP**, British Labour Party, **Martin Mansfield**, Wales TUC General Secretary and **Andy Richards**, Wales Secretary, Unite the Union in Wales and President, Wales TUC

Ev 1

**Martin Spray CBE**, Chief Executive, Wildfowl & Wetlands Trust, **Kate Jennings**, Head of Site Conservation Policy, Royal Society for the Protection of Birds, **Dr Simon Pryor**, Natural Environment Director, National Trust and **Martin Salter**, National Campaigns Co-ordinator, The Angling Trust

Ev 9

**Simon Bird**, Chief Executive, Bristol Port Company, **Matthew Kennerley**, Associated British Ports Port Director, South Wales and **Professor Tim Broyd**, Engineering the Future

Ev 18

### Wednesday 30 January 2013

**Gregory Shenkman**, Chairman, Hafren Power Ltd, **Anthony Pryor CBE**, Chief Executive, Hafren Power Ltd, **Ian Gardner**, Director, UKMEA Board, Arup, **Professor Roger A Falconer**, Expert Panel, Hafren Power and CH2M HILL-Halcrow Professor of Water Management, Cardiff University and **Andre Karihaloo**, Head of Operations, Hafren Power

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**Andrew Shirley**, Chief Surveyor, the Country Land and Business Association, **Johnny Gowdy**, Programme Director, Regen SW, **Rupert Armstrong Evans**, Proprietor, Evans Engineering and Power Company Ltd and **Vincent de Laleu**, Offshore and Marine Engineering, EDF Energy

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### Thursday 28 February 2013

**Ed Mitchell**, Director of Environment and Business, Environment Agency, **Dr Richard Cresswell MBE**, Director South West, Environment Agency and **Mike Evans**, Strategic Environmental Planning Manager, Environment Agency

Ev 51

**Alan Seatter**, Deputy Director-General, DG Environment, European Commission

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**Gregory Barker MP**, Minister of State, DECC, **Trevor Raggatt**, Head of Small Scale and Emerging Renewables and **Barbara Garnier Schofield**, Head - Marine Energy and Tidal Range

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The following written evidence has been reported to the House, but to save printing costs has not been printed and copies have been placed in the House of Commons Library, where they may be inspected by Members. Other copies are in the Parliamentary Archives ([www.parliament.uk/archives](http://www.parliament.uk/archives)), and are available to the public for inspection. Requests for inspection should be addressed to The Parliamentary Archives, Houses of Parliament, London SW1A 0PW (tel. 020 7219 3074; email [archives@parliament.uk](mailto:archives@parliament.uk)). Opening hours are from 9.30 am to 5.00 pm on Mondays to Fridays.

Bristol Port Company Supplementary  
Hafren Power Supplementary

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# Oral evidence

## Taken before the Energy and Climate Change Committee on Thursday 10 January 2013

Members present:

Mr Tim Yeo (Chair)

Dan Byles  
Barry Gardiner  
Ian Lavery  
Dr Phillip Lee  
Albert Owen

Christopher Pincher  
John Robertson  
Sir Robert Smith  
Dr Alan Whitehead

### Examination of Witnesses

*Witnesses:* **Rt Hon Peter Hain**, MP for Neath, British Labour Party, **Martin Mansfield**, Wales TUC General Secretary, and **Andy Richards**, Wales Secretary, Unite the Union in Wales, and President, Wales TUC, gave evidence.

**Q1 Chair:** Good morning. We have a very tight timetable, as you know; we have scheduled 30 minutes for this session. We have two other groups of witnesses. This is an inquiry in which there is enormous interest, so I think that itself reinforces the justification for conducting it.

Welcome to our first session. I should draw the attention of the Committee to my entries in the Register of Members' Interests, and in that context, perhaps, Peter, I might ask if you want to do the same thing.

**Mr Hain:** Happy to do so. I have been working with Hafren Power, the company concerned with this. I have had a longstanding interest in the Severn estuary from when I was Secretary of State, but I have no commercial relationship with it at all.

**Q2 Chair:** Fine. I just wanted to get that clear. I would like to start on the question of costs, which seems, to me, absolutely central. The evidence we have had from the company suggests that a figure of £170 per kilowatt hour would be required. As you know, that is very substantially higher than almost any other renewable energy source under consideration as a potential substantial contributor to our energy needs. Why do you think we should be considering something that looks so much more expensive?

**Mr Hain:** When I went to see the Secretary of State for Energy about this, and the company came with me, it was very clear that this was not going to be an issue, but Hafren Power made it clear that their financial plans mean that they are not asking for anything more than offshore wind gets. In fact, if you look at the net cost, it will be substantially less, as you can see from their evidence that they provided to you, because of the flood protection savings to the nation. This is the one renewable energy project that will see considerable savings on flood protection, and that needs to be netted off, I think, in the overall bill. I am not sure about that figure, Chairman. When we have engaged with DECC, it is very clear this is not going to be obstacle, although there is a commercial negotiation to happen.

**Q3 Chair:** It is not really possible to net off savings of public expenditure against the costs of contracts for difference, because that cost falls directly on electricity consumers, and there will be no way of reimbursing them for a high price paid for a particular electricity source, even if it did deliver savings in some part of public spending.

**Mr Hain:** I understand that, and the company welcomes contracts for difference as being a better deal for the consumer. All I am saying is, if you are looking at this project in the round and its considerable benefits, which, no doubt, we will get to, from my point of view, to look at the massive savings, running to billions, in flood protection for the nation as a whole, even though you cannot net it off in quite the way that might have been supposed—you are right about that—nevertheless, you have to look at it in the round.

**Q4 Chair:** When the company comes to see us, which I think it is doing in about two or three weeks' time, it will confirm that it would be happy with the strike price, which is the same as the one granted—we do not yet know what it is; we have a rough idea—for offshore wind?

**Mr Hain:** Yes. They are not asking for anything more or less than offshore wind, and there will be, in the end, a negotiation to be had around this. I do not see this as being a problem at all, frankly.

**Q5 Barry Gardiner:** Why did they put the price of £170 into their figures? Why is it out there in the public domain?

**Mr Hain:** Because this is a public evidence session.

**Barry Gardiner:** If in fact they are only asking for whatever it is that offshore wind is getting, then why don't they say that publicly in the documents? Why do they have a figure of £170 in there in the first place?

**Mr Hain:** I think you should ask the company about that.

**Barry Gardiner:** Yes, we will.

**Mr Hain:** From my point of view, I am very clear that the company is not asking for anything more than



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offshore wind is getting, and indeed, as I say, because of the flood protection benefits, it will actually be less.

**Q6 Chair:** The company has said in a letter itself that its proposals are, at this stage, inchoate. They are not prepared to clarify them until they have agreement in principle from the Government that the Government will support the project. Do you think that is a reasonable approach?

**Mr Hain:** This is early stages, Chairman. I have only been involved in this myself for the last six months or so, and the company is very much in its early planning. This is a huge project, with massive benefits to the nation, and I think it is right that it is approaching it step-by-step, and your evidence session is an opportunity to test some of those matters, but this is a stage-by-stage approach.

**Q7 Chair:** But it is quite difficult—is it not?—for Ministers, or indeed for this Committee, to say in principle whether this is a good project if the details of it are not even clear from the evidence supplied by the company.

**Mr Hain:** I think the evidence is very clear. I think they have laid it out in a great deal of detail. This Committee has the benefit of having more detail on their plans than has ever been given before, and, as I say, you will have the opportunity to question them in detail, as you are doing so to me, and then we can move forward. But I hope we can get on to the benefits of this project, because they are massive, for the United Kingdom as a whole, and for South Wales and the South West of England in particular.

**Q8 Dan Byles:** I am very interested in the idea that you can say they are only asking for what offshore wind wants, yet, at the same time, we have been told that the initial contract for difference price they expect to be £170 per megawatt hour, filtering through to much lower costs further down the line, to a jam tomorrow of £20 per megawatt hour. What you are saying is simply not true. The figures the company has given us are significantly higher than the current figures that we are looking at for offshore wind.

**Mr Hain:** All I can say is that when I was in the meeting with the Secretary of State for Energy, with the company, it was made absolutely clear—and this is the position I have always understood from the company. It is a separate operation; I am a Member of Parliament supporting, passionately, a project that I think is in the interests of the country and the interests of renewable energy and the interests of tackling climate change, and it has enormous infrastructure and investment opportunities. It was made clear in that meeting that they are not asking for anything more than offshore wind, and in fact probably less.

**Q9 Dan Byles:** It is all very well saying that there are great benefits to the nation. That may well be true, but—

**Mr Hain:** I am talking about the strike price. They are not asking for anything more than offshore wind.

**Dan Byles:** I think we are going to have to explore that with the company, perhaps, when they come in

front of us. That is not the impression that we have been given from the paperwork we have been shown.

**Q10 Chair:** Could I bring the TUC to the discussion? Would you like to tell us about your meetings with the company, and what your expectations are from all this?

**Martin Mansfield:** Certainly. The Wales TUC obviously is a constituent part of the UK TUC, but we have devolved responsibility for matters specific to Wales. Our interest is to ensure that any development of tidal energy on the Severn has maximum impact on particularly the Welsh, and the South West, workforce and economy, and we believe that major infrastructure investment like this is absolutely required in order to provide the economic stimulus that we need to take us out of the economic crisis we are in, particularly in South Wales. That is the interest that we take.

We have been really careful not to associate ourselves strongly with one company or one proposal. What we do is ask what has the most benefit for the Welsh workforce, for the Welsh economy? We can see, from the public pronouncements of the company, from the information received via Peter Hain, and from checking that information informally with the company, that there are certainly potential serious benefits for the Welsh economy and the Welsh workforce from this proposal. If there was another proposal with the same benefits or greater, we would be equally as supportive. If several proposals could be shown to have the same impact, we would be supportive of them, so we do not take a commercial interest or support a particular commercial proposal. What we do want to see is that this proposal, which we can see has major benefits, is not precluded from going forward because other potential proposals are there.

**Q11 Chair:** Peter, we will give you a chance to talk about the benefits in a moment. Just before we do that, on the legislative requirements, this is going to require a hybrid Bill, presumably. What are the public and private interests that that is going to have to reconcile?

**Mr Hain:** First of all, it will need a hybrid Bill because there are public interests, obviously planning issues, estuary issues, wildlife issues and so on, and there is also the actual commercial operation of operating a gigantic power station, so a hybrid Bill is the only really serious and appropriate vehicle. But there will be considerable opportunity—and I think some of the evidence that you have received is wrong in this respect—for all interested parties with a direct interest in this to be able to give evidence at both the petitioning period and also of course during the Committee stage, when there is a formal process there in which petitions can be made, evidence given, and that being considered by the Committee.

**Q12 Chair:** How long will that take?

**Mr Hain:** It depends on the Government. If the Government gives business time for it, and this cannot proceed unless the Government is prepared to make time for it in Parliament, I think it will take around a year or so.

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**Q13 Chair:** What does the company plan by way of public consultation, given the scale of the project?

**Mr Hain:** They have already set up a regional committee, as they have explained to you in their evidence, and they have been engaging in regular meetings in both South Wales and the South West of England, and engaging in regular consultations with, for example, Sedgemoor Council and others involved, but, as I say, this is very early stages.

The other major consultation we have had, which I think has been referred to in evidence from the wildlife groups concerned to you, is a meeting with all of them in which they made their concerns and criticisms clear, and we have committed, I personally have committed and the company has committed, to engage with them—the Angling Trust, the RSPB and other key groups—to make sure that their concerns are at least addressed to the maximum possible extent. A number of other issues arise under that, which maybe you can question me about.

**Q14 Barry Gardiner:** Peter, I am sorry. I jumped down your throat earlier, so let me be nice to you now.

**Mr Hain:** I don't mind what you do, Barry.

**Barry Gardiner:** Just set out for us, if you will, what you see as the key benefits of this scheme.

**Mr Hain:** First of all, it will generate fully 5% of the UK's electricity needs. That is massive. It is the equivalent of three or four nuclear reactors and over 3,000 wind turbines. There is nothing like it on the horizon for renewable energy generation. It produces, after the initial consumer support period of whatever it is, 25 to 30 years, in line with all renewable energy, electricity 50% to 75% cheaper than coal, gas, wind or nuclear. For its lifespan, which is 120 years or more, it is a massive win for the UK. In addition, of course, it is huge in investment terms—£25 billion at least of investment—with an overall stimulus through the multiplier impact of around £70 billion, and 80% of that, the company has indicated, will be spent in the UK, which is not the case for other renewable energy—for example, wind most of which is spent abroad. It will create 50,000 jobs over a nine-year period, and it will leave a legacy of jobs for local ports, for commercial and marine and leisure activity, and a more benign sea environment in what will be 570 square kilometres of a sea lake that will go up and down on the upstream side of the barrage, so there are massive opportunities.

In addition, for jobs, from the point of view of my part of the world as a local MP, the caissons, the concrete structures, these giant edifices will be built and assembled at Port Talbot, which is a deepwater port, and then they will leave a legacy for ultra-large container ships, for probably the largest such port in the north-west of Europe. There are massive economic, renewable energy, climate change and every other sort of benefit, and then of course the flood protection issues are considerable. Indeed, 90,000 properties and 500 square kilometres will be protected from flooding. As I think the evidence has shown, there was a storm surge in 2010 that narrowly missed the Severn estuary. When it hit France, it caused \$1.3 billion in damages. It will protect Bristol

and Newport, Weston and the surrounding areas from those kinds of storm surges.

**Q15 Barry Gardiner:** Can I just take you back to the jobs issue? Of course, the 2010 study spoke of a figure of only 120 net jobs that would be created through the barrage scheme. You have given us the Hafren figure of 50,000. Without going into the detailed plans and considering all that Hafren has put down on this, how confident are you that that disparity does not exist between the 120 net jobs and the figure that you gave us of 50,000?

**Mr Hain:** What was previously considered in those figures, which you have fairly referred to, is an entirely different project. This is a project the like of which I have not seen, in looking at this for over 10 years as a Minister and as an MP. It operates on ebb and flow, which is much more wildlife-friendly, for example. It emulates the natural tidal flow of the Severn. It also is using different types of turbines, newly designed turbines that are being developed, which are much more fish-friendly than the old ones were, operate at a lower velocity: low-head turbines.

**Barry Gardiner:** Yes, but I am talking about the jobs.

**Mr Hain:** Yes. What I mean is, for all of those reasons, the jobs flow from the particular project and the way it is configured, and that was not on the table when the last studies that you refer to were done.

**Q16 Barry Gardiner:** We have had quite a bit of evidence from those in the South West, that the feeling is that their businesses and communities will not benefit in the way that you have outlined that you feel people will in Port Talbot and in your part of the world. Is it the case that there is going to be a divide here, that the economic benefits will well be in South Wales but not actually in the South West?

**Mr Hain:** No, it is not. It may well be that South Wales benefits a little more, because we have the steelmaking capacity at Tata Steel in Port Talbot. The port that is ideal for it is a deepwater port, the place in which the caissons will be assembled and so on. But as I think Hafren's evidence has made clear and that all the consultations that have so far gone on and will go on are underlining, there will be massive potential benefits for turbine manufacture and assembly, for Bristol Port to take part in the shipping of millions and millions of tonnes of aggregates, and this is an 18-kilometre structure. It is huge. Whether it is Bristol Port or whether it is Newport or Cardiff, the surrounding ports upstream will all have an enormous amount of work over the nine-year construction period. Then, after that, you will have this much more benign—what I describe as a sea lake, quite different from the fearsome current of the Severn at the moment, which will also afford opportunities for new business activity, leisure activity, marine activity, which just simply is not feasible at the present time.

**Q17 John Robertson:** Peter, I know you do not know the technical aspects of the job, but you mentioned there nine years and 50,000 jobs. Is that from the start of construction until the end of construction?

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**Mr Hain:** Yes. I think the company has estimated that 20,000 jobs will be directly involved in the construction and 30,000 in manufacturing and supplying of services and other goods associated with that—the multiplier effect.

**Q18 John Robertson:** Yes, and you talked about a year to get through planning. As you can see from today how popular this is, the planning stage is not going to be very easy, and you are probably underestimating the amount of time it will take.

**Mr Hain:** Quite possibly. Quite possibly, but I am simply saying what roughly it could take. What is really important with this, and of course it is generating controversy and a great deal of interest—anything that seeks change on this scale is bound to do so, and I do not resent that or in any way or sense say that it is not legitimate. It is legitimate for Bristol Port to put its point of view. It is legitimate for the Angling Trust and the RSPB to put their concerns, and then what matters is your Committee and the actual process of the hybrid Bill and the surrounding political process, particularly involving the Government, whose support is needed—not Treasury support, but other support—then this thing will come out in the round.

**Q19 John Robertson:** Do you have any idea how much this whole project will cost?

**Mr Hain:** The company says it will cost around £25 billion, and they have also said no Treasury money is required. That is very different from previous projects. The last one that I had any involvement with and was put to the Government required £600 million, I think, of Treasury money, which is out of the question, and why should that be given for a private power station, in any case? The costings have been laid out. It is of massive benefit to the British economy at a time when that is needed.

**Q20 John Robertson:** I accept what you are saying, in that respect. My problem with all this is the amount of time it will take from start to finish, plus obviously the cost, no matter who is paying for it, will be great. You have said this is new technology in the case of the turbines. How much testing has gone on in this new technology? Any new form of energy that I know always overruns when it starts to get put into operation.

**Mr Hain:** The sooner we can get the green light from the Government in principle to support the project, also to provide parliamentary time for it—those are the main things that are needed; as I say, no Treasury support is needed—then we can get on with it. It may be that some of this takes a bit longer to get right. For example, one of the things that the company has offered, and I am certainly very keen on ensuring that this happens, is that the wildlife groups are involved in the testing of the turbine technology to check that its claims to be fish-friendly do stand up, so that there is an open-door approach in that respect. This may take a little more time, but in the meantime, the clock is ticking on climate change. The clock is ticking on our ability to meet our legal renewable energy

obligations as a country, and the clock is ticking on the creation of thousands of jobs.

**Q21 John Robertson:** Yes. There is no doubt there are a lot of questions that the company is going to have to answer. I wonder if I could ask the TUC something. You are not exactly all singing from the same hymn sheet when it comes to trade unions on this subject, are you?

**Martin Mansfield:** I think there has been some concern raised, particularly in the media, about potential impact on Bristol Port jobs. We were concerned, as a trade union, from previous proposals that there was a provable impact, potentially, on jobs in Bristol Port, and that is why we were not so vociferous in support of previous barrage proposals. We understand from the company and from the published information that those concerns could be put to rest by this proposal. I understand the Unite the Union branch at Bristol Port provided evidence. Obviously, Unite is also represented here, Unite Wales as part of the Wales TUC, and as part of our evidence to this Committee. What we certainly want to see is the best potential impact from any investment on future jobs and future investment, while maintaining the protection of existing shipping and existing jobs in Bristol Port. It is very important to us that the company explicitly shows that the impact on Bristol jobs will not be negative.

**Q22 John Robertson:** You will appreciate that someone like myself—who is a trade unionist, and I do worry about the jobs side of it—my great fear is that while this will take many years to come to fruition, the knock-on effect it will have into the economy of the area, which will be disruptive. No matter what you say, it will be disruptive. Have you looked into that? Have you done an assessment of what kind of problems it could cause, and how you are going to help the people at the other end, shall we say, and up the Bristol Channel a bit more, to keep employment?

**Martin Mansfield:** What we have said in our evidence to the Committee is that we seek to have robust, evidence-based decision making. We want to see full public consultation. We are not necessarily, as I said, supporting one proposal over another, and we would expect any proposal to prove the net impact of its proposals on jobs, but also on future sustainable jobs, supply chains and UK procurement, and that is why we are very supportive of this proposal. The idea that you ensure that 80 %-odd of your investment has direct impact on UK jobs within South West England, Wales or wider in the UK, and also there is future legacy, particularly for Port Talbot dock and for potential manufacturing. Of course, we have recently only lost 600 jobs at Tata Steel in Port Talbot. We are very keen to ensure that steelmaking remains a feature of South Wales, and this would assist that.

**Q23 John Robertson:** My last question is on the 50,000 jobs, which sounds to me to be incredible. Then, knowing as I do—I am chair of the nuclear energy group in Parliament and how we can create 9,000 jobs to go to nuclear power stations—I cannot

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for the life of me work out how you can have 50,000 jobs for this. I just do not. They must be including the guy who sweeps the street. It just does not seem credible.

**Martin Mansfield:** They are taking the multiplier effects from previous investments, but we are not here to support what the company is proposing. We are here to say, "Please do not allow this proposal—"

**John Robertson:** We appreciate you are there to answer questions, and I am trying to help you.

**Martin Mansfield:** Yes, and we are keen to have that public consultation, that public involvement. What we do not want to see is this proposal not being able to go forward because it is being bogged down in why we can't do something significant, rather than why we should.

**Chair:** Mr Richards, did you want to come in on that last point?

**Andy Richards:** I have to say that from the Wales TUC point of view, and certainly the Unite the Union in Wales point of view, we have looked at these proposals in view of the significant opportunity it creates for real economic and social regeneration in Wales. As the General Secretary, Martin Mansfield, has pointed out there, the previous proposals by the previous groups certainly did give us some cause for concern, and gave cause for concerns among our union members working in Avonmouth docks. These proposals, we are content, allay those fears. It is on that basis that we are supporting them.

**Mr Hain:** Could I just add briefly, if I may, Chairman, that on the jobs front, I think it would be to the benefit of everybody if the initial exploratory conversations that are taking place, I understand, between the company and Bristol Port executives were extended, and that there is a win-win here for Bristol Port, for Port Talbot, for everybody concerned, if people get involved in a proper discussion, commercial negotiation, if that is necessary, rather than firing off shots from the sidelines? I do not think that is in the interests of Bristol, and certainly not in the interests of this whole project, which is of enormous benefit in every possible way to the UK and the South West and South Wales.

**Andy Richards:** Could I also say that as the general council lead on manufacturing, all of the companies that I am dealing with across Wales are quoting the huge, costly energy costs at the moment as being an inhibitor towards inward investment projects. It really is a major issue among companies in Wales. As I say, we have to plan for the future. That is the way that Wales TUC is looking at it. This would form part of a balanced energy policy that we have, which includes nuclear, coal and other technologies.

**Q24 Sir Robert Smith:** Peter, you mentioned about the ports and the balanced argument. Have you yourself looked at the concerns about how the locks would impede the flow of traffic up the river, and how the location of the potential deepwater port might not fit in with the infrastructure afterwards?

**Mr Hain:** Do you mean for Bristol, that is?

**Sir Robert Smith:** Yes.

**Mr Hain:** I have seen Bristol's evidence. There would be minimum delay to shipping because the locks

would be operating. There is already a delay to shipping up the estuary because ships have to wait to move upstream for the appropriate tide. It is not like this is just an open sea that you can come in and out of the port as you like, as it were. I do not understand, and I am open to persuasion, being a reasonable person, why there is this degree of criticism from the Bristol area, because shipping will not be affected. It will pass through without any charge. In many other respects, there will be extra job opportunities for Bristol Port of the kind that I have already described. This can be a win-win for all the ports. I do not think it is sensible to frame this debate in terms of Bristol Port versus Port Talbot Port. That is not very helpful to either port. What we need to do is get the maximum benefit for both. The benefit for Port Talbot is huge obviously; the benefit for Bristol will be considerable as well.

**Q25 Albert Owen:** Can I remind the Committee of my membership of the All-Party Group on the Severn Barrage? Can I ask the TUC from a Welsh perspective what lobbying they have done of the Welsh Government and what is the Welsh Government's view on this, because although energy is a reserve matter here in Westminster, economic development is a devolved issue? Are they supportive of it and are they supportive for the similar reasons to what you have said today?

**Martin Mansfield:** We are members of the Welsh Government's Council for Economic Renewal. We raise all these economic strategic matters through that. That is chaired by the First Minister with the full involvement of the Economic Minister and involves the CBI and others. That is the forum we use to discuss these matters. We have talked in strategic terms about the need for renewable energy as part of a mixed energy, including nuclear, and we particularly talked about the need for any non-devolved investment so the Welsh arm of that would be co-ordinated by Welsh Government so that we can ensure the maximum impact does occur. So we do get those knock-on benefits from the major investment there is.

**Q26 Albert Owen:** Are you aware if the Welsh Government have made representations at all to the UK Government on this issue?

**Martin Mansfield:** We believe there has been supportive representation, but obviously it is a non-devolved matter.

**Q27 Albert Owen:** The other question I have for Peter. You mentioned other potential benefits—flood defences, for instance. Have you considered—as many in the past and as a Minister in the past—road links between South Wales and the South West of England? Do you think this could be part of the mix and make a stronger case for it because you will be more aware than anybody about the problems of the Severn Bridge and various other crossings?

**Mr Hain:** The Severn Tunnel?

**Albert Owen:** The Severn Tunnel, yes.

**Mr Hain:** The company has made clear that if there is any desire on the part of Government either for a

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road link or a rail link or both, the construction would allow for that.

**Q28 Albert Owen:** But who would drive that? That is the important part. Is it going to be the UK Government or is it going to be part of a plan for Wales that will improve the socio-economic benefits of that area?

**Mr Hain:** It would have to involve the South West of England and South Wales being part of that. But the company, rightly in my view, said, "Look, the Severn Barrage itself is enough of a project to undertake on its own," and as you can see from the interest in this issue it is controversial and there are criticisms of it. Those need to be aired and the outcomes resolved. To take on then the whole argument over a rail link and a road link, but if the Government said, "We would want the construction to take place in such a way that allowed for that in the future," which personally I think is sensible if Network Rail wanted to take that option, the Severn Tunnel obviously is an old tunnel, as the only rail access directly to South Wales then that should be in the frame. Similarly, a road link would as well.

Chairman, I know we are running out of time, I am happy to answer questions as long as you want me to, is it possible to just address briefly the wildlife issues that I know you are interested in or are we going over the timeframe?

**Chair:** I will let the session run on a bit longer because it is quite valuable for us what we are doing at the moment.

**Q29 Albert Owen:** Just to finish on that. Will the TUC be making representations on transport issues?

**Martin Mansfield:** We certainly support improved transport links between England and Wales. Our major priority has always been the major commercial economic links east-west rather than links north-south within Wales because we see the economic benefit of that. We think it would be a wasted opportunity if there is major construction going ahead without the UK Government working with the Welsh Government to improve transport links.

**Q30 Barry Gardiner:** Peter, the Natura 2000 designation means that site had to be designated on scientific evidence and one can only undesignate by going to Europe and providing alternative provision. The original barrage was going to lose 45% of the mudflats and salt marshes that were available to birds. The new proposal is only for 60% less than that but that is still 27% of a loss of habitat, so what interests me is what work has the company or has any group done on providing the alternative habitat that would be necessary to designate to be able to get this taken out of Natura 2000?

**Mr Hain:** That clearly will be necessary and you are quite right to raise it, not so much as an objection but as a necessary part of moving forward on this and there have already been discussions of a preliminary kind with the RSPB on the kind of habitat compensation that could be available and the company said, I think, that £1 billion has been allocated in its financial plan towards creating a compensatory

habitat. So that is a very significant investment. Again, as another example why this particular project by Hafren Power is completely different from previous ones that are seen as civil engineering projects alone and a power station project, Hafren Power said you have to address the ecological issues from the outset.

**Q31 Barry Gardiner:** If you do not get it de-designated, you cannot do it?

**Mr Hain:** Of course, in terms of complying with the European directives and so on, but also in terms of addressing the real concerns that wildlife groups have. If I could just make this point—the configuration of the turbines and operating on ebb and flow, which is very different from the past projects, with the latest bidirectional turbine technology that is being developed as well, does mean that the Severn estuary tide is much better simulated than ever before.

I just also want to make this point. The coastal management plan has forecast a loss of habitat, around 10% to 20%, over the coming decades from this area as a result of global changes. That is going to happen anyway. This is not a choice between the status quo and the scenario post-barrage. The status quo is changing all the time. There has been a catastrophic decline in the iconic Dunlin wading bird, for example, as a result of all sorts of issues, including global warming. So the issue is how to make sure that this is as wildlife friendly as possible.

**Q32 Barry Gardiner:** Yes, I have no doubt that Hafren wish to make it wildlife friendly. That is not the issue that I am trying to probe here. The real issue, it seems to me, goes back to John's question about timescale because given that it is designated, given that it has to be undesignated and given that that process has to go through Europe, it means that you have to be sure on that point first before you can proceed. We all know that getting something undesignated in Europe is a very difficult and time-consuming business. Therefore, I wonder sort of timescales you factored in to the project and what additional costs may therefore be added to the project as a result of that?

**Mr Hain:** The £1 billion the company have allocated in broad terms indicates a serious commitment to address them. That is a massive chunk of money. They are well aware, as I am of course, that you have to comply with the directive and that will take the normal time that it takes in Europe. But these things can go in parallel; it is not a question of one step at a time. You need to move these things along in parallel.

**Q33 Barry Gardiner:** It is right, though, that there is nowhere else that Natura 2000 has been undesignated, has there? We are trailblazing here in a sense.

**Mr Hain:** Possibly, but again, I am sure the European Commission and others in Brussels will take a view that the renewal energy benefits of this, the climate change benefits of this are so significant that this has to be looked at in a particular way.

**Q34 Barry Gardiner:** Within the light of Natura 2000 that is not possible, one cannot do an

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environmental offset in that way. You cannot look at the wider social costs.

**Mr Hain:** But you can do it more urgently.

**Barry Gardiner:** It has to be done on a scientific basis and that is why you have to identify the alternative.

**Mr Hain:** Of course.

**Q35 Dr Whitehead:** Peter, bearing in mind that you have already emphasised the bidirectional nature of the turbines and the compatibility of those turbines to work on an ebb and flow basis, unlike the previous proposals that were discussed by Government in 2010, why is there a need for a barrage at all?

**Mr Hain:** Because it is the most efficient way of harnessing the massive power—the second largest, I think, tidal rise and fall in the world—of the Severn estuary.

**Q36 Dr Whitehead:** The turbine technology described is essentially tidal stream technology and is not water retention technology. The previous barrage arrangements were that water would be retained upstream by a barrage. That would then be released in a controlled way for the turbines to drive 50% of the time. The advantage of the proposals that you are suggesting now are that the turbines are bidirectional and therefore do not require water retention, and therefore do not require a barrage.

**Mr Hain:** They do require a barrage.

**Q37 Dr Whitehead:** They require maybe a tidal reef or emplacements or islands for such turbines but they do not, as far as I can see, require a continuous barrage in order to operate. Am I completely mistaken in that?

**Mr Hain:** It really depends whether you want to harness the power of the Severn estuary to its full potential or not. The Severn Barrage, everybody agrees, is the only way of harnessing that full potential. Through a reef or lagoons, or even scattering marine current turbines around the sea bed, or even wave power—which is not really appropriate in this setting—you do not get anything like the amount of power that you get from a barrage. There will be 1,026 of these bidirectional turbines.

**Q38 Dr Whitehead:** Yes, I understand that, but is the proposal therefore to retain water?

**Mr Hain:** I am sorry; you are trumping me on your expertise here, Alan. The tide will flow in and the turbines will turn and then there is an element when the tide is almost frozen and then it comes back out again.

**Dr Whitehead:** That is what happens to the tides anyway.

**Mr Hain:** Exactly.

**Dr Whitehead:** So you do not need a barrage in that case, do you?

**Mr Hain:** You cannot harness it; you cannot create this giant sea lake that goes up and down upstream of the barrage and you cannot get that power by just scattering—I do not know in what way you would otherwise get anything like a fraction of the power.

**Q39 Dr Whitehead:** This is particularly aimed at the context of a number of the environmental industry issues. If, for example, you had an incomplete barrage, which enables you to emplace your turbines in the way that you have described but was not a fully holding barrage across the whole of the Severn then in terms of sea lanes to ports, for example, in terms of estuary tide and ebb and flow, the impacts will be very different than is being suggested for a full barrage. Therefore, the question of discussion on the impacts on the environment and impacts on industry would take a very different colour. Has Hafren considered this, do you know?

**Mr Hain:** I think they have considered all these options. Indeed, they discuss it in the evidence they have given to you, and explain why the alternative technology is maybe appropriate for elsewhere around our coasts—wave power, tidal streams and so on, for example. But if you want to harness the full power of the Severn, and this is the issue, there is only one way of doing that and that is the Severn Barrage. If you want to go for lagoons, they will perhaps produce a third of the power of the Severn Barrage. They will also, by the way, be very obstructive. Lagoons are no easy answer to this. The alternative technology produces tiny fractions, reefs and fences and the rest of it, as well as having considerable disbenefits in their own right. This is the only way of getting that full tidal power.

**Q40 Dr Whitehead:** So the starting point of the Hafren proposal is that you have a full barrage and you then look, as Barry has mentioned, at the potential environmental mitigation that follows from that?

**Mr Hain:** You design it in; you do not just treat it as any other business item.

**Q41 Dr Whitehead:** For example, you have locks at either end. While I take the point that the Severn is unlike Southampton—there is not 24-hour operation in terms of tide—but nevertheless, among other things, the suggestion from the port authorities is that that would even so impede very substantially the traffic of vessels to and from the port.

**Mr Hain:** I do not recognise that reality at all, but my advice to the port in the friendliest terms would be to speak to Hafren Power and establish a proper agreement to make sure that your concerns are met. There is absolutely no reason why they cannot be.

**Q42 Dan Byles:** Peter, you said everybody agrees that the only way to maximise the potential is through a barrage, but in fact the discussion paper *Bristol Channel Energy: A Balanced Technology Approach* that has been put forward by Regen South West, with the support of the Bristol City Council, has said that the barrage will produce 8 GW but that an alternative balanced multi-technology approach including a combination of tidal wave and wind technology could produce double the amount—14 GW of energy.

**Mr Hain:** I do not recognise that comparison at all. The company has put forward clear reasons why the Severn Barrage is the only way of harnessing its full potential. If you want to bring wind into it, well that

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is apples and pears—isn't it?—you are not comparing like with like.

**Q43 Dan Byles:** It is about maximising the potential to generate clean energy from the resource available in that area.

**Mr Hain:** I am in favour of wind turbines where they are appropriately sited, but I think what we are talking about here is do we harness this fantastic power, natural energy—and also make our energy supply much more secure, Chairman, and not so dependent on fossil fuels and foreign imports of energy—and bring over the longer term the price of energy in respect as delivered by the barrage massively lower than anything we are capable of producing at the present time.

**Q44 Dan Byles:** Do you think it would make sense for the Government before perhaps giving a go ahead for the barrage to conduct a full cost benefit analysis of all the options for utilising the resources in the region? That the danger is going ahead with one project like the barrage that is so big is that it would obviously shut down other potential options. I know that you have said you think this is the best of all the options, but I am not convinced that has been fully explored yet.

**Mr Hain:** Dan, I think this has been studied to death. There has been the Sustainability Commission, there have been assessments by the Government and elsewhere, we can carry on researching to our heart's content for decades to come; meanwhile we are not meeting our climate change objectives; meanwhile we are not anywhere near achieving our renewable energy capacity. This island is blessed with natural renewable energy in abundance and we are simply not harnessing it. So my view is we have to think big, act big and grasp this opportunity, which is why I am so passionate about it. To forego it by just getting bogged down in endless assessments that are not, in the end, going to enable you to duck the decision is a mistaken approach, it seems to me.

**Q45 Christopher Pincher:** Can I just come back to the environmental and wildlife assessment? I think we all recognise that Hafren would want to make the barrage environmentally and wildlife friendly, but as a member of the All-Party Group for Angling I am a little bit sceptical about that, and I wonder if you are also sceptical of Hafren's assertion that the turbines will result in 100% survival rate for all types of fish. Do you think that claim is correct?

**Mr Hain:** This has to be tested and you are right to be sceptical.

**Q46 Christopher Pincher:** Would you be sceptical of such a claim that 100% of all fish types would survive the barrage? No fish will be hurt in the building of this barrage and its operation.

**Mr Hain:** I can't be certain about that. Of course I can't, and I am not sure that Hafren have made that set in concrete as well. What they said—

**Q47 Christopher Pincher:** We will certainly test their evidence later.

**Mr Hain:** Yes, I am sure you will, and quite rightly so. But what we said to the Angling Trust for example in the initial meeting that we held in October is, "You come and advise us on what it needs to do." To be fair their position has not been, "No, never" to this project, they approach it—without putting words in their mouth, as they explained to me—from a critical sceptical standpoint waiting to be convinced in return for which the company is saying, and I am saying, "Let's work with you to make sure that this is as fish-friendly as possible and then you make a decision in the end as to whether, bearing in mind the enormous advantages in terms of renewable energy, tackling climate change and any effect on the wildlife what the overall balance is." I think the overall balance will be this is a project that should go ahead.

**Q48 Sir Robert Smith:** I think we have covered mostly what I wanted to ask about. Just to go back and reinforce, if you had a more incremental approach with reefs and lower impact technology obviously you would have less mitigation to worry about. You would not possibly get the same amount of power out of the system, but you would still be making a contribution from the system without having the same impact on the environment that the other impacts?

**Mr Hain:** If you are saying you are going to harness a fraction of the power that the barrage will provide, then if that is your objective, go for another technology. My point is this is natural power that in the long term will produce incredibly cheap electricity for the UK, which is an important advantage, and has many other benefits of flood protection, a more benign environment for other activity and so on.

**Q49 Sir Robert Smith:** There is debate on the flood protection because obviously the impact downstream of the barrage could be worse as a result of it acting as a barrier to a surge.

**Mr Hain:** I have not seen anything that convinces me that that will be the case, but, no doubt, you will test that argument later on in your deliberations. On the contrary, I think there are considerable flood protection advantages from the barrage and they have also said—and they mention this in their evidence—that in addition to the flood protection that the barrage itself will provide they are prepared to build as part of the cost of the whole scheme the Bridgwater bund that will protect the Somerset levels. That is like a mini barrage alongside. That is of great benefit as well. The Somerset levels are very vulnerable.

**Q50 Dr Lee:** In 2005, I was a candidate in Blaenau Gwent and I remember looking at the remains of the Ebbw Vale Steelworks, which was closed in 1978, and I thought to myself, "Well, nothing has come back." I just wonder whether Welsh public opinion in terms of this barrage, in terms of jobs, in terms of heavy industry, the sort of jobs that the Welsh people I met down there wanted to have, for their sons to have and their grandsons to have, is fully behind this, particularly in the environmental sense that has been alluded to, because ultimately when it comes to it that is key—isn't it?—that the public opinion is behind.

**Mr Hain:** Yes.



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**Dr Lee:** I would suspect it probably is because of my experience of accruing my 816 votes in 2005.

**Mr Hain:** For which you deserve a medal, I might add.

**Dr Lee:** But it is a serious point that you see the scars of heavy industry having collapsed in Wales over two or three decades and something needs to replace it, and I wonder what part this plays and to what extent you have engaged the public on it for that reason.

**Mr Hain:** My colleagues will perhaps add to this but I have found almost universal support across Wales for this project and a great deal of excitement in it because it will provide highly skilled, well-paid jobs, over the nine plus years of construction and beyond. So in that sense there is a great deal of excitement. Public opinion is not universally in favour. Friends of the Earth Cymru have expressed opposition, for example, but overall I think there is massive support for it and I think there is a lot of interest and support in South West England as well.

**Q51 Ian Lavery:** You are obviously very much in favour of this—

**Mr Hain:** You got that impression, did you?

**Ian Lavery:** £34 billion project but there seems to be a lot of resistance, in fact it could be described as hostility, towards such a project, even looking at some of the faces behind you. Every time one of you says something there has been a different view expressed on people's faces—quite amusing, to be honest with you. Mr Pincher mentioned the fact that you must give a guarantee, for example, that there cannot be one fish killed during the whole process. If that is the case, this is unlikely to happen. Why is there this hostility? Why is there this resistance from people perhaps on both sides of the barrage?

**Mr Hain:** I was involved in the anti-apartheid struggle, I had a lot of hostility in that, I can tell you. In my experience, when you are trying to do something major and transformative—because this is a transformative project economically,

environmentally, in renewable energy terms, in tackling climate change—of course you get reservations. People do not like change. People are entitled to question the project. Wildlife groups are entitled to put their point of view. They are important concerns and their concerns have to be met and any undesirable impacts mitigated to the greatest possible extent, as I said earlier. Then you make a decision on it. I have made mine, and I hope the Government will back it as well.

**Andy Richards:** What is not humorous is the level of unemployment in Wales, particularly youth unemployment. That is not humorous at all; there is no joy you can find in that. Your question was posed as to what level of public support there would be. Our indications are that there would be significant public support for this project, not just in the construction phase but also the spin-off phases into the manufacture and supply chain and so on for the provision of the jobs. If we can get past the scaremongering and the useless detail that this project has been surrounded by—as Martin has pointed out, there may be other projects—and deal with what are the actual benefits, deal with the facts of it, I hope that the opposition that is being voiced isn't being voiced based on parochial future business interests because if it is that there are no drawbacks on this, if there are no ill effects upon the Port of Avonmouth, if there are no ill effects upon the wildlife, what is the opposition based on? It is very interesting. But from our point of view, as a Wales TUC, as trade unionists—and, by the way, as parents that want to see young people have something better than we had—we are supporting this particular project, the proposals we have on the table at the moment, Chair.

**Chair:** Thank you very much. I might just confirm that I also fought a seat in South Wales in 1974. Amazingly, there was a recount, but I did come second. The recount was to save my deposit. Thank you very much for coming in. It has been a very useful session.

### Examination of Witnesses

*Witnesses:* **Martin Spray CBE**, Chief Executive, Wildfowl & Wetlands Trust, **Kate Jennings**, Head of Site Conservation Policy, Royal Society for the Protection of Birds, **Dr Simon Pryor**, Natural Environment Director, National Trust, and **Martin Salter**, National Campaigns Co-ordinator, The Angling Trust, gave evidence.

**Q52 Chair:** Thank you very much for waiting. We are now about half an hour over time, so I will try and be more disciplined in this section, but thank you very much for giving evidence today. Can I start by asking if you would just like to tell the Committee what you think the likely effect of a shore-to-shore barrage would be on the estuary and the surrounding area? Kate, did you want to say something to start with? We had a request from you to have a very brief introduction.

**Kate Jennings:** Thank you, Mr Chairman. It was just an opportunity to introduce ourselves as four NGOs, three of whom have had some engagement to date with Hafren Power and their supporters, and as such have had an opportunity to consider our concerns and

those have been provided as a briefing to the Committee, so you can see our shared viewpoint as well as hear the representations from the individual organisations. So that is the Angling Trust, the Wildfowl & Wetlands Trust and the RSPB. We are joined today by National Trust, who prior to today have not had a chance to engage.

**Chair:** Fine, okay.

**Kate Jennings:** Should I move on to your question?

**Chair:** If you would.

**Kate Jennings:** So in terms of impact on the estuary of barrage construction, I think the place to start is with the geomorphology, as to what it will do to the shape and sediment of the estuary. The changes would be fundamental. The habitat loss would be substantial

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as has already been described, and I think it is significant to note that habitat loss at the point of construction—the 27% to which Barry Gardiner referred—would, based on the evidence from good comparator sites, be likely to be a small proportion of the problem. You would expect the estuary to evolve, to try to change its shape in response to barrage construction over time, which would result in ongoing erosion and loss of intertidal habitat. That is significant because of what it means in terms of the intertidal habitat, the loss of that habitat and the features it supports, like the internationally important populations of birds. It is also very significant in terms of the implications for flood risk and, as I am sure the Committee is aware, the Severn Tidal Power Feasibility Study, when it looked at a barrage, demonstrated a net increase in flood risk associated with barrage construction from Cardiff to Weston rather than a decrease. There is a thing about storm surges and there is also a thing about fluvial flooding and erosion of flood defences, and that is all related to geomorphology.

**Martin Salter:** Can I come in on that, Chairman, from the Angling Trust point of view? Some 25% of the salmonoid habitat in England and Wales is contained in the Severn catchment. The salmon and sea trout fishery alone in two of the tributaries of the Severn, the Wye and the Usk, is worth £10 million to the Welsh economy. When people start talking about jobs, they should remember there are a lot of businesses that are dependent on angling tourism, bed and breakfast, tackle sales. One of the largest community organisations in Merthyr Tydfil is the local angling club, who have serious concerns about the Severn Barrage and its impact on recreational fishing in particular. When people start talking about jobs and impacts on the economy, there is a serious downside to these proposals because, as we will draw out later and have put in our evidence, the existence of the Severn Barrage, as constructed using old technology and non-fish-friendly turbines, threatens to completely wipe out the migratory fish runs on the Severn in any sustainable manner.

**Dr Pryor:** Just to pick up on the thread that was being discussed earlier about the claims that are being made. On first reading—we are new to engage with this—there are very appealing looking claims and predictions, but we don't have the evidence, we don't have a lot of substantiation there, so I am afraid we stand back from it and approach it from the point of view of first principles and experience. First principles, if you look at the Severn estuary, it is a huge, very complex, very dynamic ecosystem and the hydrology, the geomorphology, the ecology are all very much interdependent, and if we intervene in a very major and quite heavy-handed way, we can expect unintended consequences. I think all the evidence I have seen, and I am not alone here, leaves us not really convinced we know enough to predict with accuracy what will happen.

Turning to our experience, the National Trust manages a lot of fluvial and coastline management. So often things don't turn out how you expect and a very minor intervention can lead to unintended consequences. Changes are quite far distant as well, and the far field

effects have been raised. I think we don't know enough to contest the claims at this stage, there is not enough information there but we do have enough experience to know to be very wary, particularly around the value of compensatory habitats.

**Martin Spray:** Chairman, can I add to that on behalf of the Wildfowl & Wetlands Trust whose iconic headquarters has been on the banks of the Severn at Slimbridge since 1946. It was put there by Peter Scott because of the unique nature of that entire estuary system and Severn system, and that is recognised globally, not only in Europe. The point I would like to make is I think we are facing a lot of the problems that we are here in the UK and around the world because we have gone about things wrongly in the past and we have disrespected the natural environment on which we fundamentally depend. This represents such a massive investment and such a massive change to this estuary that I think we do need far greater information. We have to get a little cleverer about how we address the environment. There is no doubt in my mind about the potential for energy generation in the Severn—absolutely no doubt at all. It is quite clear, it is the second highest tidal range in the world, but I think we have to come up with very environmentally acceptable, sensible and sustainable solutions.

**Q53 John Robertson:** I hear what you are saying and I don't disagree with a lot of the things that have been said, but, let's be honest, I have heard the exact same thing about climate change and all the things you are talking about could already be included in a presentation that you have done prior to anybody even talking about the Severn. Is that not true?

**Martin Salter:** Can I make a point on that, John? We are natural supporters of renewable energy. You are not looking at a bunch of half-crazed climate change sceptics here. We are in favour of green solutions, for goodness sake, but what we are saying is it has to be balanced against environmental considerations because this is an incredibly important habitat, both for wildlife and for activities upon which jobs depend.

**Q54 John Robertson:** With respect, Martin, and I know you have sat on this side asking the questions, but I hear what is being said and suddenly I hear stalling coming in to try to hold things up, "More information required. We don't have enough of this; we don't have enough of that." It is being used by people who just, in effect, don't like change. Is that not a fact?

**Martin Spray:** Not in our case it isn't, no. I would argue that, yes, we do have to solve the climate change issue. We do need more renewable energy generation without any doubt at all, but I don't think we should do that by, at the same time, causing ourselves even more problems by disrupting the natural environment further. We should be looking for much more sustainable and sensible solutions.

**Martin Salter:** John, you have tempted me here. Kate, myself and a lot of the same organisations that are part of this coalition, are part of the joint paper that we put towards you, are part of the Thames Tunnel Now Coalition—a £4.4 billion project to clean up the Thames, which is a massive civil engineering project.

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We are on the side of infrastructure investment where it benefits the environment.

**John Robertson:** I am only putting the other side of this.

**Q55 Chair:** Returning to the question of storm surges and flooding upstream where Hafren have claimed that there will be actual benefits, I get the impression from what you have said you dispute their assessment.

**Kate Jennings:** We currently have no detailed information on the Hafren Power proposals from which to dispute their assessment, so all we can base our evidence on is the findings of the Severn Tidal Power Feasibility Study. What that found was that of course building a wall across the estuary will provide protection against a storm surge, and that is one sort of flooding and that would be a benefit. There are other forms of flood risk. One of the two significant ones here is fluvial flood risk, and managing that relies on the ability to get water out of the Severn. That is largely reliant on gravity outfalls, so holding water back behind a barrage will compromise that and you will have tide-locked drainage at times. We don't know how much because we don't have the details of the proposal.

The other issue is about the robustness of the flood defences. As I described, based on experience in places like the Bay of Fundy in Canada and the Eastern Scheldt in the Netherlands, we would expect to see an on-going loss of intertidal habitat following construction of a barrage. Loss of intertidal in front of defences exposes the defences to wave action throughout the tidal cycle and the Environment Agency estimated, as part of the Severn Tidal Power Feasibility Study, that that would result in not only increased flood risk but also substantially increased flood risk costs to maintain existing defences. The conclusion from the Severn Tidal Power Feasibility Study was that when you added all those bits together the net effect was an increase in flood risk upstream rather than a decrease.

**Q56 Chair:** How about the Somerset levels? They say they might build an additional bund or something to protect the Somerset levels.

**Kate Jennings:** To be honest, it is too early to make any comment about that at all because until and unless we understand the impacts of the main barrage and what that would look like and how that would affect existing flood defences, I don't feel it is really appropriate to comment.

**Q57 Ian Lavery:** For the record, what sort of impact do you think such a barrage will have on the wildlife habitat in the estuary and in particular the birds and the fish?

**Martin Spray:** A lot of the birds are migratory in the winter and they come there because of the exposed mudflats and saltmarsh that is along that river system. That contains a lot of invertebrates that feed the birds. If we are going to be losing 27% of that and probably less exposure for less time, it is going to affect the invertebrates and therefore it is going to affect those birds. It is going to change the system. It is very hard to say by how much or in what way at the moment

because a lot more research needs to be done on that one.

**Kate Jennings:** We can get an idea of scale from the Severn Tidal Power Feasibility Study, which for birds identified significant adverse effects on the populations of 30 species, that this would constitute an adverse effect on at least five special protection areas, so European sites, not just the Severn but another five, and potentially would have serious effects on a total of 96 European protected sites for birds. That was looking in the UK only, not at other sites elsewhere on the flyway. So in particular the impacts on bird populations extend far beyond the Severn itself because of the migratory nature of many of those birds.

**Martin Salter:** In terms of fish, there are 83 species of fish recorded in the Severn estuary. It is an incredibly dynamic habitat, both for migratory fish and freshwater fish upstream of the intertidal zone and obviously as a nursery area for bass and many other important sea fish. There are five Annex II species. These are the highly protected species under the Habitats Directive. They are the twait shads, the lamprey and the salmon. There are 11 BAP protected species. That is the UK Biodiversity Action Plan. That includes high-value species like sea trout as well as a whole range of sea species. Potentially the barrage could be devastating. Peter talked as if it was a good thing that the turbines would be operating 24/7. That is 24/7 fish mincing. At least with the previous proposals there was some respite for fish seeking to migrate. I am sure we will come on to questions later about turbine technology and the rest of it, so I won't spend time on that now, but the impact could be absolutely devastating on the commercial fishery, on the recreational fishery and on highly protected habitat.

**Q58 Ian Lavery:** Martin, would you like to say a little bit more about the mortality rates and the behaviour of fish because of the turbines being present in the barrage?

**Martin Salter:** Certainly. Can I first say that if you don't want to listen to us—and I am sure you do—look at the Environment Agency, the body charged with providing environmental advice? This was almost alluded to in Chris' response. The Environment Agency have said and put on the record that Hafren Power have claimed to the media that the scheme is fish-friendly. The Environment Agency say, "We have many years of experience, employ some of the leading experts in this area and are not aware of any turbine designs which would allow the safe repeated passage of fish through a barrage on the scale proposed." Frankly, claims that these turbines are fish-friendly are absolute guff, they really are. The study that Hafren Power refer to is an Idaho study that talked about salmon smolts going downstream. Fish migrate both ways. Turbines of a speed above 6 to 7 metres per second, that is tip speed, are lethal to migrating fish. The Hafren Power proposal is for a turbine tip speed of 9 metres per second. How on earth can they come in front of a Select Committee or make the press statements that we saw yesterday and claim

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that these are fish-friendly turbines? They are simply not.

Ian, you asked about some of the specifics of what happens to fish when they go through a turbine. One of the biggest problems, of course, is you get a disorientation. These stocks of salmon and sea trout in particular are genetically unique. They return after a year or two at sea to the rivers of their birth. If the flow patterns have been altered radically in those rivers they quite often will not run the river at all and if they don't run the river they don't spawn and you start to see a wipe-out of that genetically unique population. That is the first thing.

Coming through the turbines themselves, there is obviously the strike, the fish mincing, which can be pretty serious. There is rapid pressure flux where you get a pressure flux between high and low pressure blades. That affects particularly larval fish, particularly small fish. It can destroy their swim bladders and basically kill them. There is a thing called cavitation that forms vapour pockets of low pressure that, again, can have really serious impacts on small fish.

On top of that you have issues like a lack of gradation in salinity, so the fish literally hit salt water very quickly as a result of the build-up behind the barrage. That can cause confusion and in some places cause mortality. You have sedimentation build-up. You are not talking about a clean estuary. Hafren Power compare La Rance barrier—a totally fictitious comparison, totally different tidal flows, totally different water. Anyone who has driven over the Severn bridge will see tens of millions of tonnes of sediment moving down that estuary. At a high spring tide, it can be as high as 10 million. We are estimating the Severn estuary this year is going to move something like 100 million tonnes of sediment. Not only is that going to deposit in the Bristol Channel, possibly on vital spawning areas, but it creates a very turbid and murky environment. How on earth are fish supposed to negotiate turbines, or even find where the fish passages are, in an environment like that?

This is a very serious proposal that could have a devastating impact on Britain's most popular participatory sport. The idea that there is overwhelming support for this for a sport like mine, which has something like 3 million participants, that generates £3.5 billion for the economy, is worth 37,000 jobs, is a factor that has to be built into any assessment of these proposals. Frankly, a lot of the arguments that have been put forward by Hafren Power are nothing more than spin.

**Q59 Ian Lavery:** What about the loss of the intertidal mudflats and the salt marshes? We touched on it before, and I think you were all present with the first panel. What level of compensatory habitat would be required to make up for the loss of that? I think Peter Hain mentioned something in the region of £1 billion. I am not sure what he actually meant by it.

**Kate Jennings:** Hafren Power have put on the record that they have £1 billion available as a compensation budget. For us, the issue is that the legal requirement is the provision of like-for-like habitat, so you should replace the thing that you have lost, and compensation

ratios are normally higher than one-to-one. When you make a new habitat, which is what you would need to do, there are a whole bunch of things—there is uncertainty about how well it will work, there are time lags for habitat to develop to something of value. If you are talking about a compensatory area, that would be at least as large as the area of habitat lost. Until we have some detail on this barrage proposal, we don't know what it is that we would be compensating for because we don't have any assessment of the scale of impact. We keep talking to you about the Severn Tidal Power Feasibility Study impact assessment because that is all we have to go on at the present time. So until and unless we know what that requirement looks like, it is very hard to know if any given budget or any given package of proposals would be adequate. I think an important point to make is that in compensatory terms provision of intertidal habitat, habitat for birds, is theoretically possible. Whether or not it is practically deliverable is a whole other thing. The fish again here is the massive issue, because this requirement applies to fish, too. Given the likely scale of impact on the fish, we are talking about creation or restoration of 25% of the salmon habitat in England and Wales—

**Martin Salter:** It has never been done in the world.

**Kate Jennings:** It is hard to imagine how that is achievable.

**Q60 Ian Lavery:** Hafren Power claim that the calmer waters of the barrage would increase wildlife diversity due to the decreased turbidity, greater light penetration and dissolved oxygen levels. I am not sure if you agree with that, but in any event are there any potential benefits to the wildlife habitat of such a barrage?

**Kate Jennings:** There are a few points to make here. In nature conservation terms, what is important about the estuary is its unique characteristics and the habitat and species that it supports. From a moral but also a legal point of view the focus has to be on the impacts on those. What comes after is a separate issue. That said, we are concerned because those claims that are made are unsubstantiated. There are two specific things to say about that. Those assertions are largely based on evidence, and I use that term loosely, from the La Rance Barrage in the south of France. This is a very small barrage built in the 1960s in an estuary that is a flooded ria, so it is a rocky river valley. It is not a sediment-rich estuary; it is a very different kettle of fish, if you will excuse the pun, from the Severn estuary. Not only is it a completely different system, when that barrage was constructed they used coffer dams, so they entirely separated estuary from sea for three whole years while they built the thing, so the original ecosystem was destroyed before the barrage was ever built. There was no pre-construction monitoring, so we don't have an ecological baseline, and post-construction monitoring of this barrage, built in the 1960s, began in the 1980s, so there is no evidence of what the scale of impact was at La Rance. We don't know what the ecosystem was like before. Things like some of the fish-friendly claims again come from La Rance where, as far as I am aware and having discussed this with the EDF manager of the La

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Rance Barrage at La Rance, there is not any evidence of what happens to the fish in the turbines at that barrage. There is concern that those assertions are based on that experience.

The final thing to say is that assumes that the estuary reaches a new equilibrium; that having constructed the barrage it kind of settles down. Experience in the Eastern Scheldt, where they built a storm surge barrier in the 1980s—this is the site that the Severn Tidal Power Feasibility Study identified as the best comparator for a Severn Barrage—is they have found that 30-odd years after construction that estuary shows absolutely no sign of reaching a new equilibrium, so it is still attempting to change its shape and its morphology in response to the construction of the barrier. It is still losing intertidal habitat. They think it will go on losing habitat for at least a century, so the idea that the Severn will reach any rapid equilibrium of any kind—clearer water, muddier water or whatever—does not seem realistic based on the evidence.

**Q61 Albert Owen:** I wanted to pursue a couple of issues with the National Trust. What do you think the effect of this proposal would be on the coast, the countryside and heritage sites? Have you done any assessment on that?

**Dr Pryor:** Yes, we have certainly given it considerable thought. It is quite easy from a distance to think about the Severn estuary as an expanse of mudflats, industrial development and perhaps struggling seaside resorts, but the majority of the landscape and seascape there is essentially a very natural system and a really valuable expanse of open space, fresh air and places to experience nature that is accessible to an awful lot of people. It is highly visible and the barrage will carve right across the estuary and that will be seen from the Mendips and from many other protected landscapes—Exmoor, Quantocks, the All Wales Coast Path, the extension of the South Wales Coast Path. It is going to completely change the atmosphere and the experience from those places.

If I can zoom in on one property we own on behalf of the nation at Brean Down. I went there for the first time last summer and it is an unreal, unexpected and quite a magical experience. There is a rocky promontory sticking right out into the estuary. You suddenly find yourself walking on the most wonderful calcareous grassland with an amazing display of wildflowers. You have peregrines in the air above you and you walk right out into the estuary. We call it one of the natural piers and it is just like the Victorian pier experience. You suddenly get an immersion of the estuary and a different perspective on the coastline. Add to that several miles of sandy beach there, with all the seaside amusements you could want, and it is not surprising that a third of a million people a year go to this tiny place, Brean Down. That is the precise landfall, as far as we can see, for the southern end of the barrage.

**Q62 Albert Owen:** Did you, as an organisation, have similar objections against the Cardiff Bay Barrage and have you been able to do assessments there on your membership of how many people from that area are

members and go there? I remember a similar argument against the Cardiff Bay Barrage on heritage and sites that would be damaged and yet it has regenerated that area and there are probably as many members of the National Trust that work and live there and benefit from the surrounding area.

**Dr Pryor:** I can't give you detail of what happened in the past, I am afraid, but I would say we are very strong on investment in renewable technology. We have over a hundred schemes under way. We are investing millions, if not tens of millions of pounds, in renewable energy generation.

**Q63 Albert Owen:** Would you, as an organisation, support any of those in the Severn estuary?

**Dr Pryor:** We would. We would be very interested in pursuing and exploring the detail of a range of the other technologies and we felt the Regen South West document that was mentioned earlier set out this range. We are actually exploring them ourselves. We are installing a marine heat source pump at Plas Newydd. Far from being NIMBYs, we do want to construct renewable energy generation in our backyard. We would be very keen to—

**Albert Owen:** Marine turbines?

**Dr Pryor:** Absolutely. We are very keen to work with partners, very keen to do it ourselves. I think the problem is that one single solution of one huge barrage we fear is putting all the eggs in one basket and sacrificing a very important bit of recreational space for a lot of people.

**Q64 Albert Owen:** Is that universal as far as other schemes? I know we are coming on to technology.

**Kate Jennings:** I think it is shared. Just coming back to your Cardiff Bay Barrage point, the RSPB was another organisation that opposed that scheme. We were unconvinced by some of the arguments used, such as that the birds would go elsewhere, and had concerns about the compensatory habitat. Provided we manage that habitat, it is brilliant habitat. It is bad compensation. It does not replace what was lost and research after that scheme has shown that birds that used that area died. They did not go anywhere else; they died. I think it is useful to get that on the record. In terms of the other technologies, we are absolutely committed to the deployment of renewable energy as part of attempts to decarbonise the economy. I guess one of our concerns around the current proposal is it seems to be such a high-risk option from every point of view, from an investor point of view, from a flood risk point of view, from an environmental point of view. We feel that an option that maximises energy output, while minimising all those other risks as a way of starting a process of looking at how much energy we can get out of the Severn, in line with the approach advocated by the South West Regen report, is absolutely the way to go. You were asking about individual organisational commitment. Certainly, the RSPB has had dialogue with one of the technologies—the Severn Embryonic Technology Scheme looked at under the Tidal Power Feasibility Study—to see if we could host some of their prototypes. There is a very active commitment in the organisations here.

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**Martin Spray:** Can I add to that, Chairman? As a citizen with a vested interest in UK plc, I think there are great opportunities here for us to become real world leaders and develop technologies that we can export and sell across the world, which are also going to help solve a more global issue. It can present an extraordinary opportunity to the UK.

**Q65 Dr Lee:** It is pretty evident that you are not in favour of this proposal. Yesterday, I met with David MacKay and a few others about the 2050 calculator that is on the DECC website with regard to working out how we are going to generate our energy in the future, how we are going to save and how we are going to meet all of our decarbonisation targets. Clearly, you are against this proposal, so do you go to your organisations, which have big memberships, particularly the RSPB, and say, "Okay, we are going to be against this." But the reality is that when we looked at the calculator, the take-home message yesterday was that we have to build some nuclear reactors. That was the take-home message from looking at that calculator. I could not see any other way. You could argue how many but certainly at least 10, maybe 20. Two or three of the nuclear reactor sites are in the Severn estuary area. Are your organisations in favour of nuclear power? If they are not in favour of this, I would say you are going to have to be in favour of something, because realistically we are going to have to generate our energy in some form or other. It strikes me that nuclear is an interesting one because of the fact that there are currently three sites, I think, on the Severn. We possibly would need more. Would you be supportive of there being more, or do you think your membership would also say, "Not in my backyard?"

**Martin Salter:** Certainly not from the Angling Trust point of view. I am given to understand there are angling clubs in nuclear power plants. From my own point of view, Phillip, I did the hairy lefty thing many years ago and was opposing nuclear power. I did a complete volte-face, along with John and the others I think. Nuclear power provides a safe form of energy and the technology has moved on it to enable it to be a lot safer than it was. I think that is the point with this. The thing that unites almost every submission that you have had, certainly from this coalition, is our clear recognition of the potential of the Severn estuary. As Martin said, it is the second largest tidal range in the world. What we object to—and this is coming back to the point that Alan was teasing out of Peter Hain—is this is old technology, this is failed technology that didn't work in La Rance; it is causing all sorts of problems in the Bay of Fundy and at the Eastern Scheldt. This is turning a river estuary that is supposed to be there into a pond and claiming that it is environmentally friendly. I am sorry, this does not add up, but there are a lot of other technologies that are emerging that will have the potential to harness that power. They will cause disruption but not on this scale.

**Chair:** Martin, you are a witness at this one and not—  
**Martin Salter:** Yes, sorry. I was answering the question.

**Q66 Albert Owen:** But I would like to know from other members of the panel—I am sure Phillip would as well—what technology they do support. I think that is a legitimate line of questioning.

**Chair:** Martin, you are no longer a hairy lefty; you are in favour of nuclear power?

**Martin Salter:** Yes.

**Q67 Albert Owen:** You know my constituency. I have nuclear power, marine turbines potential and wind turbines, and I get the same groups objecting against all three technologies, and that is quite frustrating. That is what we are trying to tease out of you as a panel. You are united against this, but what are you in favour of?

**Martin Salter:** We love offshore wind farms, as fishermen.

**Q68 Albert Owen:** Do you? Not all fishermen do. That is an interesting point because I get more objections from the fishing community on offshore wind development than any other group.

**Martin Salter:** Commercial.

**Albert Owen:** Well, they are fishermen. Would you like to tell us?

**Martin Spray:** On the subject of membership, I think probably every organisation will recognise you are going to get mixed views in your membership on any issue of any controversy. I think that is very healthy and it is up to the organisation to lead. We are faced with some very tricky problems. This is the reason for this meeting here today.

**Q69 Chair:** Are you in favour or against nuclear power?

**Martin Spray:** What I am saying is we would not see that as a long-term solution.

**Chair:** So you are not in favour of nuclear power?

**Martin Spray:** But it is fair to say that from a carbon point of view in maybe the short term it might be something that we have to do. That would be my answer, so it is a reluctance, let's put it that way.

**Q70 Dr Lee:** I think that is unrealistic, with respect. RSPB?

**Kate Jennings:** I think it is fair to say this is an issue that, looking at the calculator and the other information currently available, is under review. There are some things that we are clearly in favour of. For example, we have no problem with a lot of onshore wind provision where appropriately sited. It surprises many to know that the RSPB only object to 7% of wind farm proposals in which we engage, which is in turn a small proportion of the total. But we recognise this is a massively challenging area. We are working very closely with the offshore wind industry, and we know that some of allocations of areas for offshore wind development and the absence of information about what is out there in terms of all kinds of sensitivities, environmental, good connections, all kinds of things, cause complexities there. We recognise the pinch and I think it is fair to say that, while this is a deeply contentious issue among members of all organisations like ours, we have to keep our positions on those under review.

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**Dr Lee:** I would encourage you to find a policy soon, I really would.

**Dr Pryor:** The National Trust's position is to try to solve our own challenges ourselves, in the sense that we have a large land holding with 700 miles of coastline, so we are very actively exploiting and developing opportunities within the full range such as onshore wind at the micro scale. We have objected to some offshore wind, but we would not object if it was in the right place and if it was genuinely offshore. We believe hydro offers great potential and we have active schemes being developed there. PV panels on our buildings, on our land, tidal stream flow, wave, marine heat source; we are exploring and investing in all of those. We are doing all of those at our own properties, which are highly sensitive, and we are doing them in ways that can be accommodated within that constraint, so working within the environmental capacity and trying to get positive outcomes from that and in ways that people appreciate and enjoy them. We believe that by pursuing a whole range of those options—just the argument used for Regen South West—we can achieve the level of renewable generation that we need.

**Q71 Chair:** But specifically on the question about nuclear power, because Dr Lee is quite right, if you look at the calculator, if you say no to the barrage, you are all against that, you are going to have some other very big contributor. If there is a nuclear power station proposed on land adjacent to the National Trust land will you say yes or no?

**Dr Pryor:** We have expressed concerns before about that, about specific extensions to nuclear power plants.

**Chair:** The problem for us is that we have to look at the evidence, and the evidence is quite clear that an awful lot of low-carbon electricity generation is needed very urgently indeed. If the NGOs, for the best of reasons—we respect your views and the difficulty you have with membership, just like we have with constituents—all line up against almost every suggestion—we find you are opposing some onshore wind, you are opposing some offshore wind, you don't like a solar farm, you don't like nuclear power, you don't like the Severn Barrage—there is not a hope in hell we can get anywhere near the targets to which you have all signed up.

**Q72 Dr Whitehead:** To some extent on that line, although we could have discussions on nuclear I guess, the proposals that are put forward as they stand at the moment talk about calmer, clearer waters and impact on tourism being very positive. How do you assess that in terms of things such as wetlands and attraction for tourism as it stands at the moment? What is the sort of balance that you would see there?

**Martin Spray:** I can only speak from the point of view of Slimbridge, which has been there since 1946 and has attracted millions of visitors over the years. We get about a quarter of million a year there. A lot of those people come to see the very special birdlife that exists because of the nature of the Severn. Again, there will be an impact. It is difficult to say exactly to what extent that would be at this time. That is just one

example, because we happen to run that one. I can't necessarily speak on behalf of others.

**Q73 Dr Whitehead:** At the risk of appearing to be advocating a particular solution, presumably solutions that did not impound substantial amounts of water or altered tidal flows significantly would preserve that habitat, in your view?

**Martin Spray:** Yes. If it has less impact on the natural environment of the estuary then of course it is going to be beneficial, but I don't want to talk just about Slimbridge. It is the whole of the Severn system that is vitally important.

**Q74 Dr Whitehead:** Martin, in your presentation you came close to sounding as if any marine current turbine or tidal flow turbine would be the end of the fish population. Is that your position?

**Martin Salter:** No, I don't think that is fair, Alan. I gave specific data about tip speed on turbines, and what is being put forward as fish-friendly by Hafren Power is a tip speed that has been proven by peer-reviewed scientific evidence to be fatal to fish. But I do think there is huge potential for things like tidal reefs and for marine turbines.

**Q75 Dr Whitehead:** So can we be clear, you are not advocating the end of the marine current turbine industry in the UK?

**Martin Salter:** No. I would like the statement that they are fish-friendly to become true.

**Q76 Dr Whitehead:** Is it the case, for example, with the salmon migration that it is not random across the Severn estuary?

**Martin Salter:** No. There are very distinct patterns of migration across the estuary. We know very little about it, but if you mess about with it, you dump sediment in different places, you can disorientate a genetically unique population so it does not run the river.

**Dr Whitehead:** Salmon going up the Usk, for example, they are going to the north of the—

**Martin Salter:** That is correct.

**Dr Whitehead:** Not in the middle, for example?

**Martin Salter:** No. They all have different migratory patterns for the different catchments, yes.

**Kate Jennings:** I think it is fair to say that the NGOs—certainly those who have had the chance to engage in this so far—are not naïve enough to think that you can extract tidal power from an estuary without having an impact, and our position is not that we are opposed to any project that would have an impact. We are opposed to a project that would have an impact on the scale that we suspect the Hafren Power development would. What we have said is a key test for Hafren Power, or for any other proponent of a barrage, is if you can bring impact within the realms of what is practically compensatable to preserve the integrity of the fish populations, of the habitat, we think that is an absolute key test for acceptability.

**Martin Spray:** Can I give you an example of this? We have been very involved with offshore wind farm planning proposals and helping through our research



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there to make sure that they are going to be sited in the place that is the most environmentally acceptable from the point of view of seabird populations and migratory species. Again, it is looking imaginatively, sensibly and scientifically at the issue and coming up with the right solution.

**Q77 Dr Whitehead:** What I am trying to tease out a little is what exactly it is that you are finally and irreconcilably opposed to. Is it any form of power generation across the Severn that has any impact on habitat? Is it a barrage that impounds water on one side and perhaps irrevocably changes the habitat, particularly in terms of silt, on the far side? Is it a partial barrage that has a different onflow to some extent? Is it tidal lagoons that change the habitat locally? What is your tipping point in opposition?

**Kate Jennings:** I think that is quite hard to define simply because there are so many uncertainties about what a structure in this system would do and the uncertainties about the ecological baselines, so how do fish move through the Estuary. I think that means at one extreme we can say that we are deeply sceptical that any shore-to-shore barrage can proceed in a manner that would be acceptable. What we favour is the approach advocated by South West Regen, where you start with a smaller scale development seen as part of an incremental process, because if you start with something that is big enough to be meaningful in energy generation terms but that limits environmental risk, that is a better place to start. Also, we would see a fundamental prerequisite for that kind of development being a requirement on it that it provides a test facility for other technologies, so that we can work out how much further we can go.

**Q78 Dr Whitehead:** For example, one particular tidal reef proposal for not a full barrage suggests that not only would it not be a full barrage but it actually would be located further out in the channel, which would have benefits as far as sediment is concerned, for example, but of course it would have different landings. Presumably the argument that Dr Pryor put forward about the particular landing that there is on the present proposal for the barrage would be replicated by the view from Minehead, for example.

**Dr Pryor:** Yes. Brean Down happens to be SSSI and so on, but I think there is a wider point there. If we invest in a diversity of technologies, initially at a small scale, it gives greater opportunity to refine, to iterate, to improve, to reduce their impacts, to improve their efficiency. I think it is just that very simple concept of investing in one huge barrage, one huge fixed set of technology, compared with the scope to explore half a dozen different solutions, each of which can be developed and improved, and find the one that is fitting and working best across different places in the estuary, exploiting the full potential, but also a great potential for replicating those and extending them. As I say, from the Trust's point of view we would love to see technology developed and applied in the Bristol Channel that we could then extend and apply elsewhere around the coast.

**Martin Salter:** Can I respond to the challenge you have set us, Alan, which is what would inform our

support? We have signed up to the same things that you have signed up to as parliamentarians, the Water Framework Directive, the Habitats Directive, the Ramsar Convention, the Natura 2000 sites. Every single piece of legal advice, every single piece of assessment says that this scheme, as currently configured on the basis of what we know about it, drives a coach and horses through those important environmental protections that this Parliament has signed up to, that the previous Government signed up to, the current Government has signed up to. It is not going to be possible to provide a compensatory habitat under the Habitats Directive. It is not going to be possible to comply with the Water Framework Directive. What is proposed at the moment is a lawyers' charter.

**Q79 Barry Gardiner:** That is a perfect cue in really, because that is exactly what I wanted to talk about. I think you have given a very comprehensive explanation, if I can put it this way, of your biodiversity concerns. What I want to focus your attention on now, though, is much more the legal process of how one goes about complying with the Habitats Directive. There is a four-stage process here, isn't there? If you want to do anything on a Natura 2000 site you have to show that you can mitigate your impact, first of all, and if you cannot mitigate you then have three further points of compliance. One is that there is no alternative that is less damaging, and I would like your comments on that. Two is that it is of imperative reasons of overriding public interest. The third is that compensatory measures can be taken to ensure that the conservation site is protected.

Now, you have talked about the impact on wildlife. You have talked about the impact on the fish species, on the bird species, and other species. Of course, it talks about "the site". It is not just a wildlife directive. It is a habitat directive. Therefore, there seems to me a very fundamental question here, which is that given that everybody acknowledges that the reason this is such an amazing site for renewable energy, which I support and would wish to see go ahead, the reason for that is that it is a unique site. In fact, it is the second largest range in the world. How is it possible to protect the habitat? How is it possible to protect the site? Those are the questions that I would like you to address; those issues about how one would comply with those different stages of annulling the Habitat Directive and moving forward to the point of compensatory measures.

**Kate Jennings:** I think the way you have asked the question nicely illustrates the complexity of doing that in this case. I should say to start with that the purpose of the Habitat Directive is not to stop development; it is to ensure that wherever possible development is compatible with the wildlife interest. There are cases of development in the UK, which have passed in some cases fairly smoothly through the tests you have outlined.

In this case, it is very challenging. As you say, the first test is whether or not there will be an adverse effect on the integrity of the site; whether it will be damaged seriously in the long term. The onus is to mitigate, to avoid or reduce those effects wherever

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possible. That can be done through design and through siting. Obviously, in this case, a full barrage shore to shore resulting in the kind of scale of intertidal habitat loss, there is no way you can mitigate that.

Then, an adverse effect on a site, there are the three tests that you described. We know there are alternative technologies; we know that they are at varying stages of development compared to the more conventional technologies that Hafren Power described, but the test would be whether there are less damaging alternatives to the full barrage and that would seem a challenging test. I should point out these tests are sequential as well, so you have to get through each one to get to the next.

Imperative reasons of overriding public interest looks at whether, if there are no less damaging alternatives, the development should nonetheless proceed. Were proposals to come forward that were the least damaging alternative, then the contribution to decarbonising the economy of a significant renewable energy development might well pass that test.

**Q80 Barry Gardiner:** It seems to me that is the test that is passable, if any of them are.

**Kate Jennings:** Yes, exactly. The final test is: can compensation be secured to ensure the integrity of the Natura network? That is the point at which you acknowledge damage to the site, because it cannot be avoided. The development can only be consented if that compensation can be secured. I think in our discussion already about the scale of intertidal habitats that we are talking about, some of the fish issues, the question of whether or not you could secure adequate compensation if you had made it through the other tests is uncertain and unlikely.

**Martin Salter:** On the fish point of view, no one has ever successfully tried to recreate salmon and sea trout migratory fish habitat on this scale. *Salmon Fishing in the Yemen*, Barry, was a work of fiction and I think Hafren Power proposals should be considered as such.

**Q81 Barry Gardiner:** Thank you for that. Let us now move into the hypothetical. We have done that before as well with "What would you do if they built a nuclear power plant in your back yard?", but let us do it this way. If this project were deemed to comply with EU legislation, one of the criticisms that you have made of it is that you have not seen adequate workings and details. If it were deemed to comply with EU legislation, following all the EIAs and everything Europe would go through on this, would you support it?

**Martin Salter:** Yes, speaking from the Angling Trust's point of view. We believe that the legislation that is currently in force actually provides adequate protection. It gives us the bar that proposals have to meet. It is against that bar that this has to be tested; not against my opinion, their opinion, our collective opinion, but the bar that this Parliament has signed up to. I am very satisfied with the integrity and rigorous nature of that bar.

**Kate Jennings:** We share our view with the findings of the Sustainable Development Commission when they looked at potentials for a Severn barrage and they said that the Habitat Directive test, which we have just

discussed, should be seen as a litmus test for sustainable development and we would support that wholeheartedly. If a development passes those tests, following robust and rigorous assessment, then it should proceed. As we have said, we are deeply sceptical that this one could do that.

**Martin Spray:** I think, given the challenges we face, it would be irresponsible not to go down that line actually.

**Barry Gardiner:** Dr Pryor, slightly different.

**Dr Pryor:** Exactly, but proudly so, because our remit, indeed our statutory purpose, goes beyond that. It is for the preservation of places of historic interest and natural beauty for the enjoyment of the nation in perpetuity. While we would absolutely support and require that test, we would also have an eye to the impact on that development in terms of people's enjoyment of this amazing natural ecosystem there.

**Q82 Barry Gardiner:** Let us cut to the quick here. Are there things that you believe Hafren Power could do that would make this acceptable in your eyes?

**Dr Pryor:** Potentially, yes, I think.

**Q83 Barry Gardiner:** Have you set out what those criteria are?

**Dr Pryor:** No.

**Barry Gardiner:** Why not and when will you?

**Dr Pryor:** It is curious when one of our concerns is about the process. We only saw the detail as the result of the evidence presented to the Committee. We are absolutely not agreed that we are going to oppose this. We have just said we are expressing strong concerns. A barrage could work. We would rather explore it in the light or in the context of all the other marine renewables that have potential there, but we have certainly not ruled out a barrage.

**Barry Gardiner:** Thank you.

**Martin Salter:** Can I just say, we have submitted last night a key concerns paper, key challenges for Hafren Power, which has gone to the chairman and I think has been circulated to you, Kate put it in? That represents the collective view of five people with six key points in there, challenges that need to be met.

**Q84 Barry Gardiner:** Would you please outline for the Committee precisely what those are?

**Kate Jennings:** Okay.

**Chair:** Briefly; we are very much over time.

**Kate Jennings:** Okay. The first is a full assessment of the nature and scale of the environmental impact of the proposal. That needs to be subject to peer review. That will mean two things. It means developing understanding of some of the baseline things like, "How do fish move through the estuary?" and also detail on things like turbine design, which to date as far as we are aware are not decided or available. In order to achieve that full impact assessment, we need the technologies to have been developed and adequately tested, and they need to be tested in conditions which reflect those found in the Severn.

Environmental impacts must, as already described, as a minimum be demonstrated to be within the realms of what it is practically possible to compensate for on a like-for-like basis. It must be demonstrated that

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those measures can be secured and can be delivered in advance of loss. That is a point that you touched on earlier. An impact on jobs, land drainage, flood risk, along with the cost of compensatory measures, will need to be factored into an analysis of the economic viability of the project as a whole.

**Q85 Barry Gardiner:** Can you just clarify one final point and that is that this must be like-for-like and it cannot be equal value? Any of the arguments that we heard earlier about, “Well, it would have these other beneficial effects” are absolutely null and void, not in terms of general consideration, but in terms of overturning the directive.

**Kate Jennings:** Yes, so the Commission’s guidance and case law on this point is entirely clear. The wording of the directive talks about the integrity of the network. As part of the Severn Tidal Power Feasibility Study, this issue of equal value was looked into and there was a fairly clear conclusion that that was unworkable and would indeed contravene the requirements of the directive.

**Barry Gardiner:** Thank you.

**Q86 Sir Robert Smith:** We have already explored in quite a lot detail the potential of alternative proposals for the estuary and also the impact of other proposals in other parts of the world. I just wondered though from the Wildfowl & Wetlands Trust, you mentioned hosting a visit by South Korean Government to look at turbine proposals.

**Martin Spray:** Yes, it is a guy from the Prime Minister’s office in South Korea who was with us for two years and was looking at comparisons, because we are two nations that are obviously very interested in tidal power generation. I would argue that the Koreans have probably been more aggressive about their developments than we have in the past, but one interesting outcome of that is that the Korean Government has recently looked at five major schemes and have rejected four of them on the basis of environmental grounds. That was certainly a change of direction from the Korean Government.

**Chair:** That is very helpful. Thank you all very much indeed.

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#### Examination of Witnesses

*Witnesses:* **Simon Bird**, Chief Executive, Bristol Port Company, **Matthew Kennerley**, Associated British Ports Port Director, South Wales, and **Professor Tim Broyd**, Engineering the Future, gave evidence.

**Q87 Chair:** Good morning. I am sorry you have had to wait a bit, but I am sure you will appreciate that we wanted to explore some of the issues and they may have been of interest to you as well. Thank you for coming in. Could I begin by asking how you think a barrage would affect navigation to and from the Bristol port and the ports in South Wales that take in the estuary?

**Simon Bird:** Thank you, Chair. If I may start that—Simon Bird, the Chief Executive of Bristol Port—could I just go back to something that Peter Hain said at the beginning of taking evidence where he talked about consultation with us in the port? I first became aware of the revised Hafren proposals in a meeting with the Chief Executive of North Somerset council, who told me he had been invited to a meeting with Hafren with Elizabeth Haywood, Peter Hain’s wife, back in the summer. There seemed to be a flurry of press statements picked up by the media in South Wales and, indeed, South West England that alerted us that there was something coming up on the radar so to speak.

We had a meeting with the then Chief Executive of Hafren Power in mid-September, which Elizabeth Haywood attended. At that meeting, they could give us no details; they had no details and were at the very early stages of the proposal. Two months later, she wrote to me, which is the letter we submitted with the evidence, and used the word that the project was still inchoate, as you described earlier, again with no detail. That is as recently as mid-November.

We are pleased that this Committee is looking at this as a project. We are pleased the evidence has come forward, but all we are able to look at is what Hafren has submitted to this Committee as way of

background to the proposal. Again, as you heard from other people, that evidence is very flimsy in detail. There is no detail there on some of the assertions that have been made. To answer the specific question you raised, if we look at Severn Tidal Power, which again has been referred to as where a lot of detailed evidence has been, the key impact upon us, Bristol Port—and Matt will talk for himself—is the loss of depth of water upstream from the barrage. Severn Tidal Power identified that we could be losing potentially two metres of water, a metre off high water and a metre in terms of increased sedimentation as the erosion and the siltation, again as you heard from earlier people, builds up around the estuary. In looking at some of the data that Hafren Power has pushed out with its ebb and flow turbines, that actually could be increased. As the high tide level is reduced by an additional metre, that could be a much higher figure than two, perhaps approaching three metres, of loss of water upstream of the barrage.

From a Bristol Port perspective, we are one of the UK’s national deep sea ports. We handle some of the largest vessels coming into the UK; 60% of our trade is in vessels of greater than 70,000 tonnes deadweight, which come with arrival draught of greater than 13 metres. Losing that amount of water off the tide will mean that those vessels will typically only get in on 20% of the tides throughout the year; on 80% of the tides large vessels will be unable to come into the port with that loss of high water. The loss of high water is probably a killer for us.

On the increased siltation, we heard again from our colleagues earlier that the estuary is very dynamic. It has a lot of suspended sediment in it. You take the energy out of the estuary, where does the sediment

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reappear? So little work has been done on that. We, as a port, operate 24/7 dredging. We use contract dredging to help us keep our lock entrances clear. We move typically five metres of mud outside our lock entrance. The geomorphology of the estuary means that we and others do not fully understand it, but certainly the evidence under Severn Tidal Power would show loss of depth of water and increased sediment will affect the navigation and entrance of vessels coming into Bristol Port.

**Matthew Kennerley:** I can add to Simon's concerns. What Simon has talked about is obviously a concern for South Wales. Just going back to his first point, yet again lack of consultation and real detail about the project and its effects is something that needs to be addressed. The water depth is an issue for both Cardiff and Newport, which are ports upstream of the barrage and would be contained within that water area. Our ports there, while not handling the same sized vessels that Bristol handles, are very much associated with business that heads off into the Midlands and other parts of the UK's manufacturing base, as well as local traffic.

Just to highlight the concern here, cargo will move from ports for a very small change in overall shipping costs, freight costs. The sort of things that we are talking about here affect the freight rate because you cannot load as much cargo on in order to access a particular depth of water. As the freight rate goes up, then other ports around the UK become more competitive to handle that particular business and we will see a steady loss of trade to the likes of Liverpool or the Tees or wherever else that is not constrained by this type of facility. That is the nub of it in terms of the economic balance in terms of the way the cargo is moved.

Loss of water is a key one. The other thing that can affect the overall cost of the vessel journey is obviously the transit through the locks. At the moment, vessels arriving into the Severn to go to Newport, Cardiff and Bristol can make their own transits up there. There was a comment that this is a tidal movement. Yes, of course it is a tidal movement. When you have 14.5 metres of range, those movements have to be carefully planned, particularly for the deep-draughted vessels around arrival times, and so on. What we have at the moment is those vessels can go concurrently with each other. Our concern is that, with another set of locks to go through, you are going to end up with a convergence of a number of large vessels in the case of Bristol, and a range of vessels from 40,000 deadweight down to 2,000 or 3,000 deadweight in the ports that I am responsible for.

Not only that, you have vessels trying to get out of the impound at the same time, so huge concerns there from a ship owner's perspective. You have the risk of an extra lock, which they do not like doing. You have extra tug interaction; again, something that they try to avoid. You have the time of transit, and I question whether 40 minutes is really realistic, certainly in the case of some of the larger vessels. You have the issue of risk of having to put a vessel through the lock and the potential delays that are associated with a possible queuing arrangement. All of that in future, when

somebody is pricing a cargo to come into South Wales, will be priced into the freight rate.

So again, you are getting erosion in terms of our overall competitiveness, so very serious concerns in terms of immediate access. We also have very serious concerns in terms of the other navigational issues, as Simon has already touched upon, dredging, which are already governed by detailed legislation and powers, and licencing regime. There is a potential for channels to be silted that currently we do not have any licences to dredge. Again, there are further environmental questions about those types of activities.

All in all, a major concrete obstruction in the middle of the River Severn is going to have major consequences for any ports upstream of that.

**Q88 Chair:** In the light of what you say, are there any measures that could be taken to enable business as usual for your ports to continue if the barrage was built? If there are, what would they be?

**Simon Bird:** As Matt has said, the suggestion that locks in the barrage downstream of the port could be put in to enable vessels to come and go to the port, we have seen no details of that from Hafren. We saw under Severn Tidal Power some dimensions of lock sizes. They were two very large locks. Yes, you could put locks in there. As Matt has said, the increase in terms of the tug costs, pilotage costs, dredging costs—because there will be silt build-up there—who will manage the to and fro of the vessels, who will set the commercial priorities? At the end of the day, at the present time, vessels come up. They turn left to Matt or right to me. Never the twain shall meet so to speak. Someone has to manage that.

Mr Hain said this morning all that will be free. We noted that. On a 120 year barrage, that is a lot of money. It is not just the lock entrances, but the approach channels would need to be deepened. If we are losing that amount of water behind the barrage, we would have to have the approach channels and indeed the locks, entrance to our locks and ABP locks lowered in order to continue to handle the vessels we handle. Whether that is practical or not to do all that and continue with the business we currently have, I do not know.

**Matthew Kennerley:** On behalf of the South Wales ports, I would say we have looked at in the past widening and deepening our locks in order to be able to compete with ports like Bristol. When you actually get down into the detail of this, setting aside the costs, we estimated it could be—this was work that was done probably 10 years ago—£100 million to widen Newport lock. You have to think about the constraints that you are working with on the ground and the fact that, to do a project like that, you are going to have to close the port for maybe one or two years. In that time, you can say goodbye to probably most of your customers. Then trying to get them back is an impossibility. The concept of trying to modify what we have, I have, again, very strong reservations about and we are dealing with old structures in a lot of these ports as well. Newport lock entrance was opened in 1909 or something like that, so we are dealing with structures that we do not sometimes have a full history on and in a regime where things were done very

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differently than they perhaps are now. Again, there is a huge amount of risk in undertaking any types of those activities.

**Professor Tim Broyd:** If I may add please just a couple of sentences of clarification, I am here representing Engineering the Future, which is an alliance of the major UK engineering institutions and professional bodies, led by the Royal Academy of Engineering. We have no stance for or against the Severn barrage. What we do have a concern in is that decisions, and particularly decisions of a national significance, are informed by the best possible engineering advice at the time.

With that in mind, I think that my two colleagues on the witness bench have very valid concerns that need to be treated very seriously. Just a couple of points on that: it is a shame there was such a mass exodus just before the engineers came up, as it were.

**Chair:** We are on public record. Do not worry.

**Professor Tim Broyd:** It usually happens halfway through when I am speaking, but not before. There were comparisons made earlier with the Eastern Scheldt. I think it is potentially a total red herring. I visited the Eastern Scheldt when it was part way through construction during my own PhD in the mid to late '70s. That was designed and developed using such modelling techniques that were available in the late '60s and early '70s. Just imagine, if you are old enough, what sort of car you were driving at that time and how that compares with today, and so on. The world has changed. Our ability to understand and forecast things is substantially better now, but it is not easy.

Some work has been done. A lot more work needs to be done on the detailed modelling of the Severn estuary and particularly in areas close to major shipping movements. Two particular areas need to be, I think, followed through much more than they have been before. One is just the basic topography of the estuary, if you like the 3D shape of the estuary bed. The modelling work that has been done to date has been based on putting together bits of information and guessing the rest. The second thing is that much more work is needed on the nature of sediments and the sediment movements. Now, the evidence suggests at the moment that the vast majority of sediment in the Severn estuary is held in suspension by high water current speeds and that there is a strong possibility that a lot of this will drop out if behind the barrage speeds get lower.

That in itself will not lead to much greater accretion or erosion. What will have a much more fundamental difference, or potentially, is where the morphology, where the sediments in the estuary end up, and to do that, a much better understanding of the current, the status quo at the moment, and the physical structures of sediments, is needed.

**Q89 Chair:** Just put this in the context of the wider economy of South Wales and the South West. What effects do you think this is likely to have? Is there a sort of blight effect that there is a danger even before the go-ahead was given for this project, that might have some effect on your businesses?

**Simon Bird:** Well, that is without doubt. Bristol Port employs 500 people directly against Severn Tidal Power. The Welsh Assembly Government did the economic work on that and said that we generate direct employment for 7,500 people. We are a national deep sea port supplying cargoes that go from Bristol right up to the North-East of England, Scotland, and all parts of the UK. Talk of a barrage is unhelpful.

Typically, our business is long term. I am sure it is the case with Matt as well. We have long-term leases, long-term agreements with people, which could be 10 or 20 years plus. When they come up to be renewed, they will look again at the economic case. They look at the points that Matt has made in terms of the changing freight rate, the changing costs of getting cargo in or getting cargo out of Bristol, which will affect the economics of whether the project goes ahead or the commercial terms are renewed. You know from our evidence we have a deep sea container terminal that was fully consented by the Government two years ago that will bring further deep sea container capacity into the UK on the west coast where it is required. That economic case and that business case, which were approved by the Government, were done without a barrage being in front of it. The depth of water we had at Avonmouth and the design we had there means that the largest container ships can come up unimpeded on 90% of the tides. They are not queuing waiting for the tide to get to the top. They can come up and go. It is a very important part of the economics of that container movement.

**Q90 John Robertson:** If that would retain the 7,500 jobs if there is no barrage built, would there be a growth in jobs anyway? Have you calculated what the difference would be in terms of job creation?

**Simon Bird:** We have not done that work at the moment. Perhaps we or the LEP in the South West should be doing. Certainly, Bristol is an area of growth. Again, it is a matter of fact that it is one of the regions that is growing substantially with distribution, with national companies setting up in the Bristol area and in the Severnside area adjacent to the Avonmouth Port, there is a lot of new investment down there with companies setting up warehousing, distribution and adding value to those products before they go out into the country.

**Q91 Barry Gardiner:** Professor Broyd, the studies that you are talking about of both the profiling of the bottom and also the sedimentation flows and what would be likely to happen, over what period of time would such a study need to take place in your opinion to be reliable and the basis for future prediction?

**Professor Broyd:** There is a difference in time and effort obviously. So, if you are looking at the basic—

**Barry Gardiner:** Yes, but there are also climatic changes that you would have to account for, and the seasonal changes that one would have to account for.

**Professor Broyd:** Yes. My guess is that a period of two to three years might be necessary.

**Barry Gardiner:** Thank you.

**Professor Broyd:** It is not six months, and it should not take 10 years.

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**Q92 Barry Gardiner:** Indeed. That is what I imagined, but I just wanted to get it on the record. Mr Kennerley, you have spoken about the depth of draught and the problems, the very real commercial problems that that would create for the port. This is a question jointly to you, in effect: what would the possibility be, what would the feasibility be of gouging the bottom of the river such as to allow the ULCCs that currently access the port to continue to do so? I take all the points you have made about bottlenecks and increased costs of tugs and so on, but I just wanted to address that specific issue around draught.

**Matthew Kennerley:** Well, it is possible to dredge channels and I am not completely familiar with the geomorphology of those particular routes at the moment. There is not any channel dredging currently taking place in the Severn estuary in terms of the common channels that are used by vessels. Most of the dredging that is done is around the port entrances and the very close port approaches where channels are maintained in order to enable that access. So, channel dredging is feasible but on the scale of what might be required, you wonder how practical that is and how cost-effective that would be. I do not have an answer for you in terms of what that would be.

**Q93 Barry Gardiner:** But some sort of feasibility work on that would need to be done to accommodate some of those questions.

**Matthew Kennerley:** It would definitely need to be done to understand that dynamic, and particularly in relation to the big vessel access going up to Bristol as well as the handy-sized ships going to Newport. But I think the big issue there is, while you may get access and be able to dredge and what have you, you still have the problem of adapting the port entrances to accommodate that draught with a lower high water, which is a huge engineering undertaking in itself.

**Q94 Albert Owen:** Mr Kennerley, you are responsible for Swansea and Port Talbot as well.

**Matthew Kennerley:** That is right, yes.

**Q95 Albert Owen:** You have heard the earlier evidence session. Do you recognise the advantages that could come to the port of Port Talbot, in particular, but also Swansea?

**Matthew Kennerley:** In terms of business displacement, and I am talking about the on-going business, there is a greater risk that the on-going displacement does not feed into ports further west. It is more likely to feed into ports further north and north-east that are also competing for transit business through into the Midlands and the other major centres of conurbation.

**Q96 Albert Owen:** Particularly during the construction period?

**Matthew Kennerley:** During the construction period, there is no doubt about it. The ports that I am responsible for, bearing in mind their proximity and their access, would benefit from a construction of this type.

**Albert Owen:** Sure.

**Matthew Kennerley:** There is no denying that. That is something that we would very much welcome. I am responsible for running five successful ports at the moment, and what I am more concerned about is that we are running five successful ports in 20 years' time and that we do not have, once we have this barrage in place, a constant bleed of business then following that.

**Q97 Albert Owen:** No, I appreciate that and you are looking specifically at this point.

**Matthew Kennerley:** Can I make one more point? There has been reference to Port Talbot, and I just want to make the point here that the reference to Port Talbot in the first session, I understand, is not the existing Port Talbot harbour. It is the creation of a new harbour three or four times bigger than Port Talbot to the west of Port Talbot.

**Albert Owen:** But close to Port Talbot?

**Matthew Kennerley:** So just for clarity there and make sure everybody understands that.

**Q98 Albert Owen:** Yes, within the region is mainly what I am talking about, and what I am saying is if there is going to be an expansion of offshore wind and various other renewables associated, the ports are going to have a bonus in the United Kingdom.

**Matthew Kennerley:** Yes, absolutely.

**Albert Owen:** This project could bring advantages to the region of South Wales through some of their ports, whether they be new facilities or existing facilities.

**Matthew Kennerley:** It could do, yes. I cannot deny that at all and we are already engaged, I have to say, from a port perspective, in some of these other technologies, and we are already talking about what opportunities there might be—for example, feeding into the Atlantic Array Offshore Wind Farm that has been gathering pace and going through its preliminary planning process now. We believe that our facilities can play a major role in helping to achieve those renewable objectives and we are very much attuned to that. But at the same time we need to think about the longer-term prospects, as well as the impact on jobs that could come through a longer-term erosion of business.

**Q99 Albert Owen:** I understand that. Do you see advantages for the renewable sector and offshore wind in particular and the barrage of the integrated transport system to the ports as well?

**Matthew Kennerley:** Yes, absolutely. They are obviously nodes of interchange with good connectivity, rail access. We have the marine access and good access to roads. So, yes, we recognise all those advantages. But I think it is also worth saying that ports are not just interchanges. We are now very much integrated into primary, secondary and value-added manufacturing processes, and they are recognised both by the Welsh Government and the UK Government generally, in the National Ports Policy statement that came out last year, as being key elements to the strategy of driving growth and investment. We have a much broader role to play in the economy, rather than just being transit points. Hence the figures that you see in the report here that

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demonstrate the number of jobs and economic impact that those ports are responsible for.

**Simon Bird:** Could I just make a point on Port Talbot?

**Albert Owen:** Yes.

**Simon Bird:** Peter Hain talked about the caissons being manufactured in Port Talbot. The Severn Tidal Power Study looked at that and I think it said that there would be lack of capacity in Port Talbot to manufacture all the caissons that are required. In fact, there would be leakage, about 76%, away from the region because the region could not absorb it. Peter Hain's assertion about the deep sea container terminal, I think Matt would agree with me even though we are competitors, Port Talbot being 80 miles west of Bristol, it may have deep water but the economics of moving cargo—a container in this case—from a load port on a vessel through the port to the point of where the container is devanned, Port Talbot will not stand up economically for the shipping lines to back that.

**Albert Owen:** What will not stand up, the current facility?

**Simon Bird:** Port Talbot as a location for a deep sea container terminal. We spent four years in Bristol going through the application process and getting approval. We understand the market very well. As a geographical location, I really do not think for Port Talbot the economics will stack up.

**Q100 Albert Owen:** But if it was to go ahead—let us just say that scenario was to go ahead—and Port Talbot is not, where would the manufacturing take place? It would probably be on continental Europe and just floated in.

**Simon Bird:** It could well be yes.

**Q101 Albert Owen:** So, would it not be an advantage to develop the ports around South Wales?

**Simon Bird:** Well, that is South Wales and not me.

**Albert Owen:** No, I will ask you both. You wanted to intervene in this discussion, so I am going to ask you some questions.

**Simon Bird:** No, I am very happy to. Let us look at what ports do.

**Albert Owen:** I know what ports do. I have worked in one and I live in one.

**Simon Bird:** Ports play a role in terms of logistics and economics. So we are meeting an economic need. We are moving cargoes to where they are needed or we are exporting cargoes from where they have been manufactured. So the costs are very clear.

**Q102 Albert Owen:** I understand, but my question to your colleague and competitor was, and to you, that if it does not get done in the South Wales region and this project was to go ahead, it could get done in Europe and they would be floated in, and rather than manufacturing jobs, they would just be assembly jobs. So there is a case to looking at the manufacturing in this country.

**Simon Bird:** But it has not been, has it? That detail is needed.

**Q103 Albert Owen:** No. That is why £60 million was given a few years ago to develop the UK ports, because we were losing to continental ports and to

ports around the world. So you cannot have it both ways. You cannot say, "We want to invest in ports," but then say, "Yes, well it is not good enough because it is down the road from me."

**Simon Bird:** I am not familiar with the £60 million. We did not receive any.

**Albert Owen:** No, there was £60 million given by Government to ports as a missing link to help with offshore development.

**Matthew Kennerley:** It was through investment for manufacturing in ports rather than actual port developments, but, yes, I do take the point. Clearly, if this thing were to go ahead, then obviously as commercial organisations, we want to benefit from that. I also recognise your point about legacy values as well, but I do agree with Simon that I do not think the proposed development of a deep sea container terminal in that part of the world is going to be something that is particularly marketable. But there might be other legacy uses that could come from such a development, there is no denying that.

**Albert Owen:** Thank you.

**Q104 Sir Robert Smith:** I think all the questions I had have been dealt with, but just for the record, you are saying any of the impact in the short term of the work for the barrage, from your point of view, would not compensate for the disruption and the loss in the long term?

**Matthew Kennerley:** That would need to form part of the overall consideration, yes. That is the concern that we lose the long-term jobs and the current jobs and this point about blight and the process—

**Sir Robert Smith:** The long-term nature of contracts.

**Matthew Kennerley:** Yes, but we are dealing with business now. As Simon mentioned earlier, we are looking into some 20 or 25-year contracts that require significant investment and, therefore, that duration to amortise those investments. The decisions we are making now are reaching that far ahead and with a threat of possible disruption to what those vessel capabilities are, then some of these opportunities may not come to fruition.

**Simon Bird:** There has been a port in Bristol since Roman times. Avonmouth was built in 1890. Portbury was built in the late '70s, early '80s. By then, our deep sea container terminal will come on stream at the right time. As vessels get larger, you need to build bigger facilities to handle those. So we have been around an awfully long time. Being involved in the construction of a barrage that has a finite time. At the end of that period, the workers building that will disappear. No, it is not attractive. Being involved in the supply of aggregate that would—possibly the barrage coming on—that would kill our larger ship business, no it is not attractive.

**Professor Broyd:** May I just make a comment on this, on some of this and not wishing to antagonise the two gentlemen on my right? But increasingly in the UK we are understanding that you cannot look at any one aspect of infrastructure without looking at the system around it; that infrastructure is and needs to be considered as a system of systems. This is pretty much why Infrastructure UK was set up a couple of years ago, to look at the five main economic areas of



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infrastructure—energy, transport, waste, water and ICT. Now, some of these, the topics here and in earlier parts of the session, where there were questions about the potential for transport links across a barrage, more recently here the question of whether Port Talbot is in the right place or whatever, I think arguably those sorts of things have a national significance that need to be considered nationally and you cannot really talk about extending a port facility without looking at transport links and other types of links around it.

**Q105 Sir Robert Smith:** Presumably, if you are doing transport links across the barrage, you are altering the shipping movements through the barrage because you cannot drive across a barrage at the same time as a ship is coming through.

**Professor Broyd:** You can make arrangements for that, certainly. You can one way or another.

**Q106 Chair:** As you have just mentioned national considerations, while we obviously understand and will take account of the regional effects here and, of course, the effects on individual businesses that you are robustly defending, to the extent that displacement simply took place to another part of the UK, whether that is further north or further east in terms of trade, from a national point of view that is a more neutral consideration. This project is so large, it has to be viewed, to some extent, on its national impact. If we concluded that this offered good value in terms of a substantial low carbon energy source and a degree of diversification, if we were satisfied that although there might be an adverse effect on certain individual businesses or even regions but nationally there would be no overall loss, that would obviously be a consideration that we would have to take into account.

**Simon Bird:** You see in our evidence the fact we are making a point: we are a national port. The cargoes we handle are being handled and distributed nationally whether it is coal, aviation fuel, animal feed, cars, whatever. The business that is displaced from my port I do not think will go to another UK port. These are very large vessels having very large bulk cargoes and we and Immingham—another ABP port in the North East—are the only ports capable of handling that size of vessel. So yes, Immingham could if it had the capacity. It is very busy now. I think we would see a lot of leakage to the continent and it would come back in smaller ships to east coast ports.

**Matthew Kennerley:** Delivering less value into the economic picture.

**Q107 Dr Whitehead:** Could I just briefly clarify that in terms of the cost-benefit to ports of what would happen with a full barrage? If you had a partial barrage that did not fundamentally interfere with the routes to your ports, firstly, is it in your understanding that such a thing is possible, and secondly, were that to be the case, would that change your view on the advantages of having the manufacturing and assembly associated with that partial barrage located in and around your facilities?

**Simon Bird:** We are not against Bristol Port looking at ways to harness the power in the Severn estuary and the Severn Tidal Power project threw up a number

of options, including a Severn Cardiff-Weston barrage. But there are other schemes that have been referred to by Regen South West earlier today. There are a number of schemes that are out there that are perhaps at the same stage or further advanced in terms of the technology that we have heard about this morning on ebb and flow. But I understand your specific question on a particular barrage across the estuary. The issue that will concern us, one would have a potential funnel effect on the tide and current going through a much smaller area would need to be assessed for its impact on ship handling and ship manoeuvrability. Could you still have those very largest vessels coming in, depending on where the gap was in the estuary? Of course, whatever you do in the estuary, in terms of taking energy out, you will alter the geomorphology, so there will be another issue of sediment and silt build-up that will drive an issue in terms of dredging. We are open to look at schemes that fundamentally do not kill our business. There are other schemes out there that need to be developed alongside this Hafren one.

**Q108 Albert Owen:** I have a series of engineering questions that are quite technical for me to even ask but I am sure they are going to take some time to answer. But they are important at this stage and you touched on some of them earlier on. Do you feel that the barrage, as proposed in the project that we are talking about, from an engineering perspective, is probably the best that will maximise the most electricity and therefore be in the national interest for producing the most renewable source from that particular area?

**Professor Broyd:** I prefer to answer a question that is not about maximisation of electricity but optimisation of the scheme, if I can put it that way. I was a member of the expert panel used by DECC a couple of years or so ago to assess five different schemes, and there were three barrage schemes and two tidal lagoon schemes. We also looked briefly at reefs and tidal fences. Of those, the only one—and it was pretty much head and shoulders above the rest for any return on investment at all—was the barrage along the line, the type of line that Hafren are suggesting. Other schemes were less viable. They certainly produced less power. But of course a barrage itself, and again harking back to what has been said earlier today, does not prevent other types of renewable energy being tapped within the regions. Wind power and tidal power and heat source, heat pump power are perfectly mutually compatible. In fact, there is a synergy between them, almost certainly given the way that the high voltage grid in the region would have to be modified anyway.

**Q109 Albert Owen:** I do want to stick with how much electricity is generated, if I may, and from a technical side. You are saying that a barrage would be the better one because of intermittency of the other schemes? Is that one of the reasons?

**Professor Broyd:** No, just because for the other barrage schemes addressed generally the vastly reduced power output was vastly reduced

**Simon Bird:** At a lower cost.

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**Professor Broyd:** Yes, but the multiplier was different as well, so it is not just the same percentage benefit.

**Q110 Dr Whitehead:** Could I just clarify on that particular point? I believe, as you say, the study of 2010 looked at five proposals and at that point, tidal reef, tidal fences, as you say, were not worked up but were looked at by the study briefly and, indeed, did not feature in the final report to any great extent.

**Professor Broyd:** Correct.

**Q111 Dr Whitehead:** So, would it be fair to say that you did not look at those?

**Professor Broyd:** Not with the same rigour, no. I would also say that we did not examine there the potential for a very low head turbine system as is being proposed now because—

**Dr Whitehead:** Two-directional turbines?

**Professor Broyd:** Yes, we were looking at bulb turbines and mainly a generating—

**Q112 Dr Whitehead:** One of the items of evidence put forward to us in writing suggests that, admittedly a different location, a non-complete barrage could produce more power than is proposed by the present Hafren suggestions. Did that come out at all in your discussions?

**Professor Broyd:** No. I could not comment on that because I have not seen it. To be honest, it is a bit like—if I were to lower, to get to a point of frivolity or flippancy, but when you buy a computer, there is always going to be a more powerful one coming out in a couple of years' time, but how long do you delay and when is it worth it?

**Q113 Albert Owen:** Can I just ask again, the scheme as we know it could produce 5% of the energy needs of the United Kingdom? Do you recognise that figure?

**Professor Broyd:** Yes, I do.

**Q114 Albert Owen:** Okay. So how would that be integrated into the existing energy system? How do you see the modelling; how do you see that happening?

**Professor Broyd:** The thing about tidal power is that it is totally reliable. It is driven by the moon, or 90% by the moon and 10% by the sun. It is driven by gravity. It is always going to be there as long as the moon is there. So there is a totally reliable, totally forecastable driver to it. It wanders around the day a bit though because a tidal period is 12 hours 25 minutes or whatever, so one day is nearly an hour later than the previous day and that can lead to generation in what are currently quite inconvenient time periods. No one really wants that much energy at three in the morning, apart from my sons who are out wherever they are. I think the main thing I would suggest here is that you do not look at how it might be used now, but you look how it might be used in 10 to 15 years' time, where we ought to be able to treat our grids a lot smarter. We are almost certainly going to have a significantly larger number of electric vehicles, and so on, which will need charging overnight and we would increasingly get the potential and the capacity for even domestic white goods to time themselves when power

is available and cheap rather than when, at the moment, we want to switch them on.

**Q115 Albert Owen:** What about the practicality of storage?

**Professor Broyd:** Practicality of storage, there are a number of schemes in their infancy. At the moment I think the best option would be—if we really were getting more base load power than you wanted—just to stop the barrage generating. Let the turbines free wheel.

**Albert Owen:** Yes, but 10 or 15 years ahead.

**Professor Broyd:** 10 or 15 years ahead, I still think that managing the—

**Albert Owen:** Okay, 30 years ahead when we all have electric cars.

**Professor Broyd:** No, managing demand is always going to be the best way because you get significant losses with storage.

**Q116 Albert Owen:** Then final point, you heard the views of the other panels of witnesses that we had with regards to flood and the possible advantages and, in some cases, disadvantages. What is your view, as an engineer, on that?

**Professor Broyd:** My view as an engineer is I do not understand it. To my mind a barrage will give more or less full protection for areas within the barrage and something that is a bit counter intuitive, a measure of protection for about 10 kilometres down either bank outside the barrage and that is because of the dynamics of the estuary and the movement. The area of land—and of course you will not get any wave or large roller type wave flooding in.

**Q117 Albert Owen:** So you have not done any modelling on this yourself?

**Professor Broyd:** Not myself.

**Albert Owen:** No, but you have seen it?

**Professor Broyd:** I have seen it. The guy who has done a lot of this modelling and his team, Professor Roger Falconer at Cardiff University, I have known and intermittently worked with for over 35 years. He has the best centre in the UK and it is world-reputed. The area of land roughly defended by a barrage would be about equivalent to the Isle of Man. It is about 500 square kilometres.

**Q118 Albert Owen:** What impact would that have on sea levels?

**Professor Broyd:** I beg your pardon, sorry?

**Albert Owen:** The climate change would happen naturally anyway so you would look to build—

**Professor Broyd:** Yes, the indications are perhaps that there are three-quarters of a metre added of sea water rise, sea level rise by the end of the next century, so the barrage will have an ameliorative effect on that, certainly upstream and, to a measure, downstream as well.

**Albert Owen:** Thank you very much for that. I understood all your answers by the way.

**Q119 John Robertson:** Professor, one of your colleagues, Professor Lovelock, many years ago said, "I can only tell you about the science; I couldn't tell

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you about anything else". So would that be a fair assessment of your contribution here?

**Professor Broyd:** I do not know. I am not sure I can tell you about the science. Ask me and I will see. I promise not to talk beyond my levels of competence.

**Q120 John Robertson:** Well, that would likely be well beyond mine. Do not worry about that. We heard a lot about wildlife and you just answered my colleague's question there, but are there any engineering interventions available today, or even within the short-term future, that might be able to help with the mitigation of the impact on wildlife?

**Professor Broyd:** The simplest, and it is not simple, would be a question using the material dredged from beneath the caissons and shipping channels or whatever to create compensatory inter-tidal ground.

**Q121 John Robertson:** We talked about the EDF La Rance facility and how things have moved on since then.

**Professor Broyd:** The only lesson that can be learnt from La Rance in this context is that the turbines and the power generation system used are extremely reliable. La Rance has been going now for 50 years. As far as I understand it, it has never had a major refit, let alone a replacement of kit and the EDF people who run it are extremely happy with it.

**Q122 John Robertson:** That is quite interesting. Hafren Power claim that their new turbine design is low risk, minimal pressure changes in turbulence, aiming for 100% survival of all species of fish and so on. From the knowledge that you have of this kind of turbine, does this turbine they have meet the same?

**Professor Broyd:** I cannot comment. I have not seen details really. The one thing I can comment on perhaps is a suggestion made by someone along the group before us here, that you can quite often get cavitation in turbines. That is really small areas of vacuum that have formed and then explode suddenly. I doubt that would happen at all. If you get that happening, then you are going to put the integrity of the machinery seriously at risk.

**Q123 John Robertson:** So your knowledge of what they call a very low head contoured rotating turbine design, do we need more information on this?

**Professor Broyd:** Yes, I think these need to be independently verified and tested at an appropriate time, quite possibly or probably including some small-scale trials. That means either full-scale turbines in a small-scale—but not across the Severn, or smaller 1:5 or whatever scales.

**Q124 John Robertson:** My last question is basically, and this is really looking into the future, and that is a project like this could be seen in larger scale or even slightly smaller scale throughout the world. Do you think there is an export demand there?

**Professor Broyd:** Potentially, all right. The way I look at it is this, tidal power barrages are in their infancy across the world. There are, however, already an increasing number of flood defence barrages and the two can certainly be combined. Now, we know that

the world demand for power and, in particular, electrical power is going to increase significantly over the next few decades; partly this is because of the increase in world population and partly it is because of the quite natural and understandable desire of people in what I guess we used to call the developing world to better themselves, if I can say that without being patronising or prejudicial. We know there is also likely to be a significant attraction in seeking new power sources that are clean, reliable and would help mitigate climate change impact, so combined, perhaps, with flood defences. I think there are likely to be increasing opportunities, and however fanciful, I would say that in the 1950s and early 1960s the UK led the world in the civil use of nuclear power generation and we totally lost it. We potentially have an opportunity to get the world market in this and to retain it for a while.

**Q125 John Robertson:** Can I ask one question? It is a question I wanted to ask in connection with one my colleague asked. Albert asked about the integration into the network. How much do you think it would cost for the barrage to be connected up to the National Grid? Do you think there would be a lot of work to be done?

**Professor Broyd:** The National Grid, they reckon, is between £2 billion and £2.5 billion. As I understand it, the way that is handled commercially at the moment is that that cost is taken by National Grid up to the point where a scheme is being built but if the scheme is never finished, then there is a requirement for the developer to pay back to Grid their costs, so there is a need for some sort of insurance or surety there.

**John Robertson:** Okay.

**Q126 Barry Gardiner:** Professor Broyd, I did not understand your remark about cavitation. Can you just elaborate on that?

**Professor Broyd:** Well, only that if a piece of machinery is—I don't know—do you suffer cavitation? I will say suffer cavitation.

**Barry Gardiner:** Ships propellers suffer cavitation all the time.

**Professor Broyd:** Then sooner or later, they are going to create damage. There will be damage. There will be pit-holing within the metalwork, and so on. So it is certainly not good practice to have a piece of machinery operating in an environment in which cavitation will occur.

**Q127 Barry Gardiner:** I thought you said that you did not think that they would be subject to cavitation.

**Professor Broyd:** That is why I do not think they will be subject to cavitation. It will be off design limits. Sorry, can I put it a better way?

**Barry Gardiner:** Sorry, I may just be being very dense here.

**Professor Broyd:** Okay. Let us try another approach. The turbine equipment almost certainly will be designed so that there is no cavitation within its normal operating regime. So if you get cavitation, then it is a failure in design or it is being operated significantly out of design intent. I think it is a red herring, not a fish.

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**Q128 Barry Gardiner:** So can you comment then on the propensity of the proposed turbines to suffer cavitation? Are you able to comment, professionally, on the propensity of the turbines to suffer cavitation?

**Professor Broyd:** As a matter of principle, turbines are designed not to suffer cavitation. So if it is happening, something has gone wrong.

**Chair:** We have probably reached the end of this unless there is anything else you wanted to say. We are grateful to you for coming in and this has been a useful session for us, but we have quite a lot more work to do.

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**Wednesday 30 January 2013**

Members present:

Mr Tim Yeo (Chair)

Barry Gardiner  
Ian Lavery  
Mr Peter Lilley  
Albert Owen

Christopher Pincher  
John Robertson  
Sir Robert Smith  
Dr Alan Whitehead

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**Examination of Witnesses**

*Witnesses:* **Gregory Shenkman**, Chairman, Hafren Power Ltd, **Anthony Pryor CBE**, Chief Executive, Hafren Power Ltd, **Ian Gardner**, Director, UKMEA Board, Arup, **Professor Roger A Falconer**, Expert Panel, Hafren Power and CH2M HILL-Halcrow Professor of Water Management, Cardiff University and **Andre Karihaloo**, Head of Operations, Hafren Power, gave evidence.

**Q129 Chair:** Good morning. Welcome to the Committee. I am sorry we are running a few minutes late, but I am sure we can cover all the ground we want to. Thank you for coming in. I believe you have asked to make a short opening statement.

**Gregory Shenkman:** Yes, Chairman.

**Q130 Chair:** I simply make the point that the sympathy of the Committee tends to diminish rapidly if this goes on for more than three minutes.

**Gregory Shenkman:** Thank you, Chairman. Thank you very much for allowing us to bring such a large team. Before I give the opening statement, would it be worthwhile for me, perhaps, to introduce the people here very briefly?

**Chair:** Yes.

**Gregory Shenkman:** My name is Gregory Shenkman. I am the Chairman of Hafren Power. My background, I am a 38-year financier, investment banking mainly, Rothschild, Kleinwort Benson, other firms. My last serious job was running Asia for Rothschild, and I have a long background in fundraising, capital markets, mergers and acquisitions and so on. On my right is Tony Pryor. He is a seasoned engineer and manager. He was the Chairman of Halcrow for five years, which was sold to CH2M HILL earlier this year. Before that, he was a Chief Executive Officer of Devonport Royal Dockyard. Before that, the COO of Kellogg Brown. We have Ian Gardner. He is a director of Arup, the consulting engineers and designers. He has worked on many big engineering projects, particularly design, consent, delivery. He is an expert in handling projects. He has worked on projects like HS1, HS2, St Pancras Station and Crossrail. On my right is Professor Roger Falconer. We are very lucky and grateful to Roger for coming today. He has recently had some pretty serious neurosurgery and this is his first day's work since he completed it. He is Professor of Water Management and Director of the Hydro-environmental Research Centre at Cardiff University. He is probably the leading expert on the Severn Estuary when it comes to anywhere, really—when it comes to tides, floods and siltation. On my left is Andre Karihaloo. He is a brilliant young man we are lucky to have with us. He runs our economic and planning area and his background is in fund management, which he left because he felt a very strong calling to work in the field of renewable energy.

Chairman, Committee Members, we believe that with the barrage we are bringing the right idea at the right time. We are facing a national energy crisis in that over the next 10 years, we are going to lose 20% to 25% of the national generating capacity. We also face 2020 renewable obligations that require us to create 15% of our energy by 2020 from renewable sources. That translates into 31% of electricity. The number today for renewables and electricity is only 9%. Therefore, it is clear that a large chunk of the new generation, which will be built in coming years, is going to be renewable. The only question is what is the mix? We believe that tidal energy, as the barrage will produce, will strengthen and enrich the current mix. The barrage will produce 5% of the UK's electricity need and fulfil 16% of the 2020 target. The barrage electricity will be secure, clean, predictable and reliable. The life of the barrage will be at least 120 years, although in fact probably much longer. The barrage will have three main characteristics. First of all, it will produce very cheap electricity over the lifetime of the barrage, much cheaper than any other form of generation. Second, the electricity we produce will be completely green after a two and a half year payback period. We will save 7.1 million tonnes of CO<sub>2</sub> every year compared to burning fossil fuels, and just to put it in context, this is equal to around 5% of the total CO<sub>2</sub> emissions of all UK households in 2011. The third characteristic is that the barrage will represent a long-term defence against tidal flooding and storm surges, which are becoming more regular. In a world of rapid climate change and rising sea levels, the Severn Estuary is particularly vulnerable and we will protect 500 square kilometres of land and 90,000 properties.

At the hearing on 10 January, which we attended, the environmental NGOs raised a number of concerns that we regard as entirely legitimate, and we share them. Indeed, from the outset, the barrage that we are proposing has been conceived and designed around the environmental concerns. We have already engaged with the NGOs and will continue to do so, and we will find optimal solutions for their concerns. However, I must say that many of the objections raised, both at the 10 January hearing and in the written submissions, were complaints about a project, which we are not. They were complaints about a scheme that will be ebb only with a small number of turbines and involving

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damming. We propose none of these things. Our proposal is very different. It is more efficient and much, much more environmentally friendly. Thank you.

**Q131 Chair:** Thank you. If you are frustrated by the fact that people have criticised schemes that are not precisely the one you are promoting, that may be partly because the details of your own scheme have remained quite obscure to a lot of outsiders so far. But part of the purpose of this inquiry is to try to shed some more light on those areas. To start with, can you confirm what we were told by Peter Hain in our earlier session that the strike price that you will be seeking for the CfD for energy from the barrage will be in line with that awarded to offshore wind?

**Gregory Shenkman:** Peter has expressed his view. Our expectation is that we will be seeking a strike price that is below offshore wind. As you will expect, the strike price is a matter of negotiation between Hafren Power and the Government, and we are not terribly keen to discuss that today specifically. But we are seeking a price that will make the project viable within DECC's levy control framework. We expect that the strike price we will be able to negotiate will fall below offshore wind, and we hope close to, or perhaps at, the sort of strike price that nuclear power is currently negotiating.

I know I am talking about numbers that are not out there in the public domain. We all have our ideas—I am sure you gentlemen and ladies do as well—as to what they might be. We have had our thoughts about it, but we believe we can be in that zone. If we are in that zone, we believe that from an economic point of view, within this levy control framework, our project is viable.

**Q132 Chair:** We also recognise that these figures are not yet public, but the one for nuclear may become public sooner than the rest. We are assured by EDF that they are not seeking a strike price up around £140. I think the magical figure they will not want to exceed is £100. Are you saying that you would be able to proceed, financially, with a viable scheme, without any public support other than a strike price at that level?

**Gregory Shenkman:** I cannot say that, Chairman, no. As I say, we cannot discuss the strike price today. We must negotiate that with the Government. I think if we start giving an indication today, the whole process will be convoluted.

**Q133 Chair:** Let me put it the other way round. This Committee has a particular concern that the money available under the levy control framework is used in the most cost-effective way. If there are technologies that deliver the same savings in terms of carbon emissions at much lower cost, it will become very hard to justify recommending a commitment of the scale and length that you are seeking.

**Gregory Shenkman:** Yes, we understand that. I repeat that we are confident that we will come in below offshore wind, which is a very large component of the expected renewable generation. At the moment, there

is no tidal energy out there at all. When the barrage is built, we would be able to fulfil 16% of the 2020 target. If our strike price falls in the range between nuclear and offshore wind, then we should be able to fit into that framework and bring the cost down as compared to offshore wind.

**Q134 Mr Lilley:** Are you talking about the strike price now or the strike price in 2020 for offshore wind?

**Gregory Shenkman:** I think we are talking about the strike price as it will be decided for the 2020. That is correct, isn't it?

**Andre Karihaloo:** It depends on the financial close that we are looking at.

**Gregory Shenkman:** 2020?

**Andre Karihaloo:** No, the financial close on the scheme would be 2015–16. The financial close is how they determine the strike price.

**Q135 Barry Gardiner:** Mr Shenkman, you are talking about a net strike price, are you not?

**Gregory Shenkman:** We would be very happy to discuss a net strike price. We believe because we bring the benefits of flood defence—

**Barry Gardiner:** Let us just clarify it rather than extemporise it.

**Gregory Shenkman:** Sorry, yes.

**Q136 Barry Gardiner:** You are talking about a net strike price that would fall within that range.

**Gregory Shenkman:** We are talking about a gross strike price now. I am talking about a gross strike price.

**Q137 Chair:** We read reports that your costs could be as much as £200 or £250 per MWh.

**Barry Gardiner:** DECC says £312.

**Gregory Shenkman:** I am afraid we would not agree with that.

**Q138 Barry Gardiner:** Recently it was reported that the difference between your net and your gross strike price was accounted for by the fact that you had taken into account, when you were talking about net strike price, the flooding mitigation. This does not form any part of your net strike price figure?

**Gregory Shenkman:** No, it does not. We are talking to you today entirely about a gross strike price. For reasons you will understand, we would like the idea of a net strike price because we think we are actually bringing something to the party, as well as taking consumer support for 30 years. But we will bring flood defence and that will be savings, and from the point of view of cost to the nation, there will be a benefit as well. We are not discussing that this morning. We will be urging you—and I do urge you—that the benefits should be taken into account as well as the cost.

**Q139 Chair:** That is a very helpful clarification of the terms that we are discussing. Are you going to seek a CfD for 30 years?

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**Gregory Shenkman:** If that is the way the Government would like to arrange things, yes we would. We will work with ROCs or CfDs. CfDs are what we are actually expecting. I think other renewables obtain 30-year consumer support and we would hope to do that as well.

**Q140 Chair:** If it turns out that alternatives for renewable technologies only receive a 15-year CfD, is that acceptable to you?

**Gregory Shenkman:** We would have to consider that. Thirty years is what we have based all our thinking around at this time. There is a very important consideration, which is that at the moment we believe—although we are not entirely sure—that the tendency, at DECC for example, is to look at things over 30-year cycles, perhaps because wind is imputed to have a 30-year lifetime. We say the barrage will last a minimum of 120 years. It will probably last for 200 years or 250 years, or longer. The absolute minimum is 120 years.

If you are going to look at a generating asset you should look at the cost over its lifetime, and after the 30 years of support. There are three stages to the barrage. The first stage is a stage of nine years of construction and commissioning, during which £25 billion or so will be poured into the economy. There will be a lot of jobs, a lot of activity, all coming from the private sector, all private investment. After that, we are hoping for a 30-year period of consumer support. After that there will be a minimum period of 90 years with no consumer support, when we believe we will be generating electricity at approximately £20 per MWh. For comparison today, I think that the cheapest and dirtiest method of generation, burning fossil fuels, costs about £40 per MWh. By the time we get to that period, we think we are going to be about 75% cheaper than all other forms of generation. That is for at least 90 years, perhaps for 190 years. If you look at it over just the 90-year period, and put the 90 years and the 30-year support period together, you get a concept of levelised cost, which is the way we think you should compare the cost of generating assets. The levelised cost, over its 120-year life, of electricity from the barrage, is £48 per MWh. For nuclear, assuming it has a 60-year life—if one can assume that—the cost is approximately £80; £88 I think it is. For offshore wind, assuming a 30-year life, the cost with current technology is £190, with an ambition to bring it down to £100 by 2020. On a levelised cost basis, looking at the generating asset over the life of the generating asset, we think we bring cheap electricity.

**Chair:** In my view, there is a lot of jam tomorrow in that. What we have to be concerned about is how we get best value for the limited resources available under the levy control framework in the next 10 to 15 years.

**Q141 Sir Robert Smith:** I remind the Committee of my entries in the Register of Members' Interests to do with the oil and gas industry, and, in particular, a shareholding in Shell.

In your opening remarks, you said that you would be contributing to the 2020 target, but just now you said

it would take nine years to construct and build, so how would it contribute to the 2020 target?

**Gregory Shenkman:** That is a reasonable question. We believe that the EU will be prepared to take into account, when looking at the target, projects that are under construction.

**Q142 Sir Robert Smith:** Obviously, there is a lot of energy resource within the Severn Estuary. In your assessment, have you worked out what other potential uses of the Severn Estuary to produce energy would be sterilised by your project, and the net effect that would have on its contribution?

**Gregory Shenkman:** Andre, would you like to answer that?

**Andre Karihaloo:** I think you are talking about whether we would use up a portion of the levy control framework.

**Q143 Sir Robert Smith:** No, more that the physical existence of the barrier means that other options would be ruled out.

**Andre Karihaloo:** Absolutely. The Regen SW scheme presents a very interesting holistic view of energy extraction from the Bristol Channel. They said that we could extract 14.5 GW from the channel, but part of that was a barrage, part of it was embryonic wave technology, part of it was tidal stream and part of it offshore wind. All of those things are compatible with our barrage; we should and we could do all of them. The fact is that the money exists now to do this barrage and the money will exist at some point in the future to do the others. Given that we are facing an energy crisis—by 2025 we are going to have a 60 TWh electricity gap between supply and demand in the market—we need large-scale, low-carbon projects to help offset that, because where is this electricity going to come from? We would not want to face the situation of blackouts in the United Kingdom. We should do all those things. All of those things are compatible, but the money exists for this now.

**Q144 Sir Robert Smith:** They can't all be compatible once you have built the barrage.

**Andre Karihaloo:** For instance, wave is completely compatible. It is all about efficiency. You need to put each one of these technologies in the most efficient place. Tidal stream belongs with fast velocity currents. Barrages belong where you have high tidal ranges. Wave is great out in the Irish Sea—that is where it belongs. Yes, they are compatible. There are certain schemes, obviously, if you wanted to put a tidal array along the line of the barrage, which would only generate one-twentieth as much electricity. DECC themselves said that that would be a waste of the energy resource. I tend to agree with them on that. But if you find the right spots to put them, we could do all of them, and we should.

**Q145 Barry Gardiner:** Mr Shenkman, you said in your opening remarks that you felt that there would be a very positive impact from the barrage on flood defence. I am sure that you have great respect for the Environment Agency but their assessment is that, over



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a 100-year period, the overall impact on flood risk management cost may be neutral. How do you reconcile their assessment, as the Environment Agency, the very agency charged with looking at this and providing the nation's flood defences, with your assessment that—what is it?—500 square kilometres might be defended from it? Is it because you have not taken into account the fact that in the upper basin, there would be an overcoming of the existing flood defences? How do you reconcile those two positions?

**Gregory Shenkman:** I will ask our expert, Professor Falconer, to reply.

**Professor Falconer:** I wonder if it would be possible for me to make a brief comment on the last point by Sir Robert Smith first. Is that okay?

**Chair:** Yes.

**Professor Falconer:** If you look at the power potential in the estuary, power is proportional to the wetted planned surface area and the square of the water level difference either side of the barrage. If you look at maximising that in the Severn Estuary, you get an overwhelming maximum power from a line drawn from Cardiff roughly to Weston. Your planned surface area, impounded upstream, is 500 square kilometres. That is one and a half times the size of Lake Garda, to put it into a physical context, and the water level difference is virtually a maximum at that point. If you work out the potential power from that planned surface area, it is by far and away the maximum you will get from any other combination from impoundments etc. in the Severn Estuary. Putting tidal stream turbines along that line is out of the question because it is not deep enough.

Having looked at the estuary over some considerable period of time, I believe that the potential power you get from a barrage is significantly bigger than you get from any other combination integrated over the estuary as a whole. Turning to the point—

**Q146 Sir Robert Smith:** Other people will be coming to questions on the other impacts of the barrage on environment and so on.

**Professor Falconer:** Yes, I know, but I do not agree with them.

**Q147 Sir Robert Smith:** But the point would be that society would have to look at the impact and the benefits in the whole, and therefore, obviously, the knowledge of what other schemes could not be done that would have perhaps less environmental impact. But that is going to be later.

**Professor Falconer:** I could refer to that in terms of papers with regard to the Bay of Fundy. I have papers on the Bay of Fundy that cite major concerns about the impacts of coastal impoundments as well, but perhaps I could now pick up the point about the flooding.

I disagree with those points. I could divide the estuary, if I may, into four components with regard to flooding: river flooding, that is beyond the tide limit; estuary flooding from the impoundment up to the rivers; estuary and barrage flooding from the barrage out to the edge of the Bristol Channel and then far-field effects. I will take those four separately.

The new barrage, the two-way generation, based on my research in my research centre at Cardiff University—funded by two major projects, both funded by the EU—shows the following. Assuming no pumping, upstream of the barrage there would be a reduction in the water level; it depends how you operate the turbines and so forth, but there would be if you operate them as we would normally expect to operate them—maximising the power.

One of the reasons there is not a lot of information on the website is that we want to work with the NGOs, and it is something I have encouraged Hafren Power to try to do. But assuming we maximise power generation, we would have a reduction in the water levels upstream of the barrage and up to the tide limit of typically two metres, so it would drop from typically zero to 14 metres, tidal range maximum, to about three to 12. That is a drop in roughly my height, or a typical average male, for example, two metres. For example, if you had a property in Newport at the moment, the water level would be two metres lower, so you would be much less likely to flood in the estuary between the barrage and the tide limit. That is the first point.

We have also looked at the far-field effect, so let me deal with the far-field effects, if I may. We have taken our model right out to the continental shelf. That has never been done before in DECC studies. When we look at the modelling to the continental shelf, first of all, with the previous DECC studies, we do in fact find—exactly as the Environment Agency say—that there will be a lot of implications in the far field. However, with the two-way generation, we find there are no significant far-field effects in the Irish Sea and Morecambe Bay and so forth. In other words, all of the far-field implications are contained within the Bristol Channel and the Severn Estuary, so we do not find any far-field effects of any significance outside the Bristol Channel and the Severn Estuary—this is work that we will be publishing shortly in the international literature. In other words, if we build a barrage, the problems are almost entirely contained within the Bristol Channel and the Severn Estuary.

**Q148 Barry Gardiner:** There are problems and they are contained within the Bristol Channel, not in the far-field effect.

**Professor Falconer:** Yes, I am coming on to that.

**Barry Gardiner:** I will let you continue to your third element.

**Professor Falconer:** Then we come to the point between the Severn Barrage and the edge of the Bristol Channel, i.e. from Hartland Point to St Govan's Head. Again, it depends on how you operate the barrage, but we are typically finding values of an increase of the water level, a maximum of 20 centimetres. Immediately downstream of the barrage, in the region of Bridgwater, for example, we are finding a small reduction of the water level, so we are not going to increase the water levels in the Somerset Levels, for example.

Furthermore, Hafren Power is subsequently proposing to build a bund around Bridgwater Bay, and that leads to reductions in the water levels. I have the graphs

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and the results here. With storm surges and so forth, I am finding quite significant reductions in the water levels. Downstream, apart from the relative far field—far field within the Bristol Channel, not out in the Irish Sea—we will have some slight increase of the order of the shorter side of an A4 sheet of paper.

Then we look at the effect of the water levels upstream in the river. If we drop the water levels in the Severn Estuary, upstream of the impoundment, by two metres, then we create a huge area to absorb much more water from the river. If, as the Environment Agency is doing in many other areas, we were to remove the weirs to allow much better fish migration, then we have the potential to reduce flood risk considerably up the Severn River, in areas like Upton-upon-Severn and so forth.

In my view, the opportunities to reduce flood risk are considerable. There will be no far-field effects of any significance in the Irish Sea and Morecambe Bay. There would be a considerable reduction in the Severn Estuary, and there will be potential to reduce the flood risk in the Severn River, Wye River, the Usk and so forth, because the water levels would be lower in the Severn Estuary, assuming we do not pump.

**Q149 Barry Gardiner:** Professor Falconer, thanks very much. Can I just check with you? You disagree with the EA assessment, and you say you will shortly be publishing further information in a professional journal that should bring the Environment Agency onside with what you say.

**Professor Falconer:** Some of it has already been published.

**Q150 Barry Gardiner:** The notion of increased tide locking and erosion caused by a higher water table upstream, you dispute. You say it will be a lower water table upstream?

**Professor Falconer:** Can I just clarify why I think the Environment Agency might be making those comments? They may still be basing their assessment on the DECC studies, and those studies refer to the previous ebb-tide generation only scheme. I might split hairs with them over some of their conclusions on the previous scheme, but on the whole, I would not disagree with their assessment of the previous scheme. But this scheme is quite different.

**Q151 Barry Gardiner:** Let me ask you specific questions because these are the challenges that I have and, therefore, I need to put those to you.

**Professor Falconer:** Yes.

**Q152 Barry Gardiner:** The increased tide locking from the barrage would worsen the pluvial and fluvial flooding. You disagree with that?

**Professor Falconer:** No, because this—

**Barry Gardiner:** You will publish academic papers to show that.

**Professor Falconer:** I have the data now to make it available.

**Q153 Barry Gardiner:** But you said you were going to publish it.

**Professor Falconer:** Yes.

**Q154 Barry Gardiner:** You are happy to make it available to this Committee before that?

**Professor Falconer:** Yes, I have the draft papers now.

**Q155 Barry Gardiner:** Thank you very much. On erosion caused by a higher water table upstream, you have informed the Committee that in fact there will be a lower water table upstream.

**Professor Falconer:** No, I would not say it is lower.

**Q156 Barry Gardiner:** I thought it was 2 metres lower.

**Professor Falconer:** No, sorry, let me just clarify that point. Let me say, for the sake of simplicity, that the tidal range was from zero to 14. The old scheme chopped off the bottom of the tide, so let us say it went from seven to 14. The new scheme will chop a bit off the top and a bit off the bottom, so the mean water level now stays the same. With the old scheme, we chop off the bottom, so the mean water level would have gone from zero to 14, so it would have gone up. That is why we have the tide locking problem. Now it will stay roughly the same. So the mean water level, the groundwater level, effectively, will stay the same. High water level will lose 2 metres. I just want to clarify that point. I am not saying that the groundwater will be lowered by 2 metres. The groundwater will effectively stay roughly the same. Under extreme spring tides, the high water level will be reduced by about 2 metres. In other words, if I owned a house at Newport, I would be less likely to be flooded.

**Barry Gardiner:** Thank you.

**Chair:** Can I also draw attention to my entry in the Register of Members' Interests?

**Q157 Mr Lilley:** You said that this would be the cheapest form of power, that the real costs would be in the order of £48 per MWh.

**Gregory Shenkman:** Yes.

**Q158 Mr Lilley:** Why do you need a guaranteed price from the taxpayer of up to twice that?

**Gregory Shenkman:** The intention is to fund the scheme privately. To fund it privately, we need to provide a return to investors and, therefore—

**Q159 Mr Lilley:** A 100% return?

**Gregory Shenkman:** No.

**Q160 Mr Lilley:** Well, if you could produce economically at £48 per MWh and you want something up to double that, that is 100% return I think.

**Gregory Shenkman:** The time is involved as well of course. The barrage will last for 120 years. Ultimately, the final investors in the scheme are likely to be very big investors who are attracted by a steady level of yield from a reliable utility-style activity, which this will be. In order to attract the investment we have to provide that return, and it is because of the need to

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provide that return that, like other renewable sources, we need the consumer support.

**Q161 Mr Lilley:** You are saying your investors do not really believe you can produce it and get a good return at £48 per MWh?

**Gregory Shenkman:** The £48 is the average over the life. The levelised cost is calculated very simply by taking the full capital cost, all the operating costs, adding them together and dividing it by the number of megawatt hours produced over the life of the asset. On that basis, which is a very straightforward basis, the barrage produces at £48, compared to £88 for nuclear, if they have a 60-year life, and £190 for a 30-year wind farm.

**Q162 Mr Lilley:** Not discounting future at all?

**Gregory Shenkman:** Yes, discounting.

**Q163 Mr Lilley:** At what rate do you discount the future?

**Andre Karihaloo:** Well, it depends.

**Q164 Mr Lilley:** What do you actually use?

**Andre Karihaloo:** The rate that we use is the rate that we expect sovereign wealth funds to be able to raise debt and equity for in the market.

**Q165 Mr Lilley:** And even so, you get £48. That is quite good, isn't it?

**Andre Karihaloo:** Yes.

**Mr Lilley:** I might invest in this.

**Barry Gardiner:** Is that a declaration of interest, Peter?

**Q166 Mr Lilley:** It is. But it is an interest that if I did, would save the taxpayer money.

In the background material it says that it was going to produce power for only 15¼ hours a day. What does it do the other 8¾ hours?

**Ian Gardner:** Perhaps I can respond. You are right; it is an ebb and flow system. Unlike the previous scheme, which was ebb only, it has stretched the delivery period of the power generation. It is producing power for up to 60% of the day. The reason for that is linked to the tidal movements, obviously, which are linked to the lunar cycle—which I think we all understand—and the lunar cycle moves slightly relative to the daily cycle, as again we know.

**Q167 Mr Lilley:** I think we've got that. I was just checking. To cut a long story short, therefore, there will need to be a back-up?

**Ian Gardner:** Yes.

**Q168 Mr Lilley:** Is the cost of that back-up of power featured into your costings?

**Ian Gardner:** Not per se, but this is a contribution to a diverse and resilient mix of UK energy. It produces 5% of the UK power. It produces it in a way that is totally low-carbon. It is a very predictable form of energy. We know exactly when this energy is arriving, unlike, say, the equivalent in wind power. A resilient and reliable energy mix for the UK relies upon the

grid operating, knowing when power is available. This will have the absolute security of availability. To give a context, this is producing 6.5 GW of energy. Looking at the latest published figures for a couple of days ago, the peak demand on the UK system was 55 GW. The minimum demand during the daily cycle was 31 GW. We are at 6.5 GW. It is accepted that during the winter period the energy demand is greater than in the summer period, but in the summer period, that daily range is perhaps slightly over 50%—50% to 60% of the winter figures. That would put the minimum power demand of the UK around 15 GW to 18 GW in a daily cycle. The minimum baseload that the UK is looking for is in that 15 GW to 18 GW range. Our power source—whether during day or night generating, because of that lunar shift—is producing very reliably, very predictably 6.5 GW. There is always a capacity within the UK, in a diverse, mixed generating economy, with self-reliance for the UK and resilience and security for the UK, for this sort of power supply, particularly given that it has a zero marginal cost and it is totally predictable. It has no consumable fuel that it is reliant upon and it has no pollution legacy. All of these things give it a very strong point of applicability and relevance in a diverse UK market.

**Q169 Christopher Pincher:** I take your point, Mr Gardner, about the predictability of the barrage's power supply, but you accept it is an intermittent supply. Does the predictability of its supply match the peaking demands of most of the user community? In other words, are you providing power when people need it, because if you are not, then we still have to find peak capacity load from elsewhere? Surely you should factor those costs into your overall costs.

**Ian Gardner:** The point I am trying to make, and perhaps I have not made it well enough, is that even with the minimum demands of our economy at the moment, it is well above—factors of three above—the power generation of the scheme. Therefore, like all power generators that provide power into the market to match different categories of demand, this is a variable baseload supply generator. The ability and the predictability of putting other sources of power into the grid will be completely determinate. I am not for a minute saying that this scheme alone will provide the whole of the UK's power because it will only provide 5% in total, and it will provide up to about 30% of the minimum demand in the whole of the UK at any point in time.

**Q170 Sir Robert Smith:** Does that mean you would have to design your nuclear load not to get above, or would you have to switch off your nuclear?

**Ian Gardner:** That is an interesting debate for DECC and others. The UK needs a resilient, diverse energy balance. It needs the ability of supplies to be predictable. It also has other supplies that will be more variable. As I have suggested, that peak will go up to 55 GW, 60 GW. This is providing 6.5 GW. You are right, it will require that planning. Importantly, this is a synchronised supply, unlike certain other sources such as wind that are

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asynchronous. When you bring in different types of supply, you have to do different things to load balance and bring them into the system. This is a synchronous supply, very predictable. It is available on a known basis, 60% of the daily cycle.

**Q171 Chair:** Predictability, as you have just acknowledged, is not the same as being continuous.

**Ian Gardner:** It is not continuous.

**Chair:** No.

**Ian Gardner:** Perhaps one further point is that the UK is moving towards dynamic response modelling. It is moving towards a more intelligent grid. It is moving towards distributed storage. There are various technologies that the UK is moving towards, and needs to move towards, to optimise its use of energy. This is a major component of that or, in our view, I would like to see DECC seeing this as a major component of that informed, smart mix that will look after the UK's power generation in the future, particularly bearing in mind its low-carbon delivery and its zero marginal cost.

**Q172 Barry Gardiner:** I need to ask this question sensitively because I respect the fact that Professor Falconer has responded substantively to the questions that I put to him, and, therefore, whenever you are defeated in an argument in that way, the best way of doing things is to try to undermine the person, which is what I will try to do in my next question. I wanted to make that quite clear, so that at least it was open and respectful.

Professor Falconer, is it right that you are the CH2M HILL-Halcrow professor? Is that the sponsorship of your chair?

**Professor Falconer:** Yes, but my comments are not linked to that. They do not fund this particular research project.

**Q173 Barry Gardiner:** So there is no funding of your particular research project, only of your professorship?

**Professor Falconer:** No. The research I am doing, which I am referring to here, and the outcome of these results, is funded by two projects in the main. One is the Low Carbon Research Institute project, funded by the EU. The other is an international programme—international in the context of Europe—called MAREN. Both of those projects are funded through the EU.

**Q174 Barry Gardiner:** Thank you. Grand. Therefore, there is no information that you have, through being a member of the expert panel for Hafren, which has been fed into this research programme that others would not have access to?

**Professor Falconer:** No. All the research I am talking about here is completely independent. I have had no funded research from Hafren Power.

**Q175 Barry Gardiner:** Thank you very much. Mr Pryor, you were previously at CH2M HILL, I understand.

**Anthony Pryor:** Yes.

**Q176 Barry Gardiner:** And Halcrow, the engineering consultancy, is now part of CH2M HILL. I know these things all sort of merge into one another. A former member of the Corlan Hafren consortium, who has had a six-year involvement in the project, estimated a cost of energy between £150 and £350 per MWh. How do you reconcile that estimate, from somebody from your former company with a six-year involvement in the programme, with the figures that we have heard today?

**Anthony Pryor:** Just for the record, I was Chairman of Halcrow for some five, six years and my last task, as Chairman, was to persuade the board that they needed to sell themselves to CH2M HILL, a sale that was completed in 2011. I was involved, as part of my activities and duties in Halcrow, in the Corlan Hafren grouping of companies, which has now morphed into Hafren Power. I cannot comment on why the individual in question, I know who he is, put £350 in there. I have not questioned him on it because he put in his submission. I do not recognise the £350 per MWh from the meetings we used to have in Corlan Hafren, some 18 months ago.

**Q177 Barry Gardiner:** Therefore, you dispute his analysis. Or do you impute any malevolent intent?

**Anthony Pryor:** No, I would not dream of imputing any intent to individuals. He obviously felt—

**Q178 Barry Gardiner:** It is simply an expert view that differs from your own?

**Anthony Pryor:** I must say he has a very wide range there, in terms of price. You mentioned £100 and something?

**Barry Gardiner:** Yes, indeed. It is between £150 and £350.

**Anthony Pryor:** It seems to me he must have made some assumptions on both ends of that, which I do not recognise. We have spent the last five, six months here in Hafren Power refining the business model, refining the costs and, as Greg Shenkman has advised, we believe we have a pretty robust idea of where our gross strike price should be.

**Q179 Barry Gardiner:** Coming back to you, Mr Shenkman, why was it that in the *FT* article you talked about a net strike price?

**Gregory Shenkman:** We talked about a net strike price because we do not know—there are all sorts of numbers out there as to how much money—and there are all sorts of forecasts about what the flooding damage will be, how much the tide will rise, how much of an increase there will be in storm surge as a result of climate change. The rising sea levels are a matter of record, so you can imagine that by the time we are fully operational in 2025, things are just moving on, and without a barrage, tidal flooding is likely to become much more common and perhaps fairly catastrophic. For example, there are storm surges. There was a storm in 2010 called Storm Xynthia, which narrowly missed the Severn Estuary. It went off and hit the French coast. It killed about 68 people in Europe and did something like \$4 billion worth of damage.

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**Andre Karihaloo:** \$1.3 billion.

**Gregory Shenkman:** It depends on who you read actually. I have read \$1.3 billion. I have read \$4 billion. These are newspaper reports. Anyway, it was a lot of damage. If that had gone up the Severn Estuary, it would have done terrible damage to Cardiff, Newport and Bristol.

**Q180 Barry Gardiner:** Yes, indeed, but come back to why it was—

**Gregory Shenkman:** What we are saying is we are in discussion with Defra, but only right at the beginning, because they have produced numbers on what they think the flood damages and the cost of flood defences might be. We would like to verify what those numbers are. When we have agreed those numbers with Defra, we will be able to propose what we think we are going to be saving on average—well, when the barrage is up—over 30 years, but then after that for the remainder of its life, for free, an amount of X hundred million pounds a year. We think it would be nice, when you look at the consumer support that we are getting, to take into account that although the consumer support has been given to enable the project to go forward, at the same time the nation is getting something back.

**Q181 Barry Gardiner:** Yes. Interestingly, you start off by saying you do not want to talk about strike price and the negotiations but now you are beginning to reveal something of the way in which you propose to negotiate, are you not, because the way in which you are presenting things to the Committee now is to say, “Look, there are these uncertainties in the future and we think that if there is increased potential for a storm surge and so on, we may be saving the nation such and such and, therefore, we will begin to negotiate on a net strike price with the Government, trying to take account of those exigencies in the future”. Is that what you are trying to do? Are you trying to negotiate with the Government on those unknowns, on those very uncertainties that you started speaking of, and incorporate those into your strike price negotiations?

**Gregory Shenkman:** No, we are not.

**Q182 Barry Gardiner:** Categorically, you will not do that?

**Gregory Shenkman:** We will certainly discuss this issue when we are doing it.

**Q183 Barry Gardiner:** Why? If it is not actually going to affect the strike price, why?

**Gregory Shenkman:** For the reasons I have already explained. If the consumer is going to be providing support on the one hand and, on the other hand, there is going to be a benefit to the nation, it would make sense, would it not, as in any other situation of that kind, to look at the two together.

**Q184 Barry Gardiner:** So it is affecting your strike price negotiation.

**Gregory Shenkman:** However, we would like to be involved in the large amount of money that is going

to be available from the levy control framework. The money has already been decided: £7.6 billion I think it is. The question is which types of generation are going to participate in that. When that decision is made, one of the questions is gross strike price, and the other question that should be beside it is: are there any other reasons why we should choose this? And we say the answer is, yes.

**Q185 Barry Gardiner:** So you think it is a reason for choosing the project but it will not, in your view, affect the strike price?

**Gregory Shenkman:** That is not a matter for us to decide.

**Q186 Barry Gardiner:** It is, because it is a matter of negotiation and if you do not present it as a subject of negotiation—Mr Pryor, yes?

**Anthony Pryor:** Can I just add something? At the last session, the Chairman said—I forget who was giving evidence at the time—“I hope you understand that Government Departments cannot put one pot of money against another particular project”.

**Gregory Shenkman:** Yes, exactly.

**Anthony Pryor:** That led us to say, “Ah, all our debates about, ‘Well, isn’t it interesting our net strike price’—” because we wanted to net off the flood savings, a figure still to be decided, because I met with Defra last week to start that process of trying to agree a number—“is probably not the right way”. We accepted the Chairman’s guidance that you could not do that. So we had to go back to that to say, “We are now going to talk about gross strike price. Justify the project on gross strike price, which we believe we can. Justify it on gross strike price, and then invite the decision-makers to accept that there is an additional benefit somewhere, maybe in Treasury, maybe somewhere else.”

**Q187 Barry Gardiner:** That is absolutely clear. You have changed your position.

**Anthony Pryor:** Exactly.

**Barry Gardiner:** Thank you.

**Q188 Chair:** The reason I made that point is because, of course, the support available from the levy control framework does not come directly from the taxpayer. It is not a question of offsetting a bit of Defra spending against a bit of DECC spending. It is saying to electricity consumers, “You are going to pay more for your electricity but there is some hidden benefit, at an unknown time of an unquantified amount, to Defra’s flood budget”. There is simply no way to offset these things and talk about a net strike price.

**Anthony Pryor:** Understood. We understood that very, very clearly from your comments.

**Gregory Shenkman:** I am sorry, I was not clear. Although I think we probably would like to make it clear, we still think, on a gross strike price basis, we are going to be very competitive with offshore wind. That is without thinking about these benefits.

**Q189 Albert Owen:** Good morning. I remind the Committee of my membership of the all-party group

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on the Severn Barrage. In your opening remarks earlier on you talked about the legitimate concerns of NGOs and others, and they have certainly raised them in evidence sessions that we have already had. One of the criticisms is that there is very little detail in the proposals, thus far. We heard for the first time today about your studies, which you have not published and will publish. When do you propose to publish your full proposals?

**Gregory Shenkman:** Perhaps I can pass over to you, Tony.

**Anthony Pryor:** One of the huge benefits of this Committee's inquiry has been to raise the profile and to encourage us to concentrate—

**Q190 Albert Owen:** We are brilliant at doing that, but we are talking about your proposals.

**Anthony Pryor:**—to concentrate all our minds. What it has also done is create an insatiable demand for detail that is not normally present at this stage of a project. We have not started the environmental impact assessment and the economic impact assessments. We have done a lot of work so far, but we have to build all that into a comprehensive piece of work to produce an environmental impact statement, which will then hopefully underpin a hybrid Bill approach, and I am sure there will be a question on that shortly. We do not have all the data, and we do not have a detailed proposal to present. Defra's new guidance, which I have right here, on the Habitats Directives for birds and floods, habitats, water framework—they are all here—defines a process aligned to the EU process, the three-stage of alternatives, IROPI and the mitigation measures. They define their process, and they will put in place the lead competent authority to lead on all those events. We have opened the debate with Defra. We asked them last week, "Who is the lead competent authority?" We are waiting to hear back from them who it is and then we will engage with them in a rolling process—it is a rolling process—to produce the detailed proposal, which we then have to submit for their acceptance.

**Q191 Albert Owen:** I understand that. But the line of questioning that I was putting to you is that there has been a vacuum, and that vacuum has been filled by NGOs and others asking questions and making statements, which you raised in your opening comments. One of the criticisms is that you are waiting for in-principle backing by the Government before you produce these details. How would you respond to that?

**Anthony Pryor:** When you say "backing", we are not looking for financial backing.

**Albert Owen:** No.

**Anthony Pryor:** Ideally, we would like a positive response from this Committee, obviously, and following that, ideally we would like—as in the process with HS2—the Minister to say that, in principle, they will support a hybrid Bill sometime in the future when all the detailed work has been done. That is how HS2 has been done.

**Q192 Albert Owen:** I will come to the hybrid Bill in a second, but again I put it to you that because of this vacuum and because of what we consider to be, as a Committee, slowness in the detail coming forward, we are having to extract this at this session, whereas others are coming in with slightly more organised standpoints, if I may say that. Do you feel this has eroded a bit of public trust, that you are having now to play catch-up to engage with the public?

**Anthony Pryor:** Can I classify "the public" as being the relevant people who put submissions into this Committee?

**Albert Owen:** Public opinion is a broad spectrum, I understand that, but what we have heard from members of the public, yes.

**Anthony Pryor:** Clearly, we would not want the RSPB to stand up and put in a newspaper article—

**Q193 Albert Owen:** No, not NGOs to one side. I am talking about the public in general.

**Anthony Pryor:** The public in general?

**Albert Owen:** Yes.

**Anthony Pryor:** Well, our plan is to undertake a full consultation process. We have already appointed the two companies who will do it, one in South Wales and one in Bristol. The one in Bristol happened to have done the consultation process for Hinkley Point, so they have understood all the local players. That consultation process starts with consulting on consulting. You go round to all the stakeholders and you ask them what they want to be consulted on, what are their key issues, their key problems, and then we have a 12-month period of time. That will be our approach to the public.

**Q194 Albert Owen:** When do you envisage starting that, Mr Pryor?

**Anthony Pryor:** As soon as we kick off this project, we are going.

**Q195 Albert Owen:** You mentioned the hybrid Bill. You will know that that will take some time to go through Parliament, if the Government agree—up to three or four years. So you are saying that you will have a pre-Bill consultation with the public and with stakeholders?

**Anthony Pryor:** Yes, absolutely.

**Albert Owen:** Fine.

**Anthony Pryor:** If I may just mention the parallel example of HS2. The Minister for Transport stood up at least 12 months ago and said, "We will have a hybrid Bill approach to this project". They put a project team in place. I do not think they had even settled the line of the railway track when she said that. So there was not much data out at that time. It is exactly the same process for major projects of this nature.

**Q196 Albert Owen:** But HS2 is already up and going, by the Government.

**Anthony Pryor:** Yes.

**Q197 Dr Whitehead:** We have mentioned the question of capital for construction, which we

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understand you are saying will all come from private investors, sovereign wealth funds and so on. Is that a supposition on your part, or do you have evidence that that funding is potentially available?

**Gregory Shenkman:** To answer your question directly, yes, we plan to finance this project entirely from private sources. Indeed, it has taken about five or six years to get here, so far, and something like £18 million has been spent to get to this point. There is money out there and it has been invested, so yes, there is evidence.

Money has been spent to get to this point, and I must say that we are very grateful to your Committee for deciding to hold this hearing, because it has provided the perfect platform for us to explain what we are trying to do and what is involved. We are now fully ready and we are now approaching the second stage. The second stage involves the things that Tony has just referred to: the creation of the environmental impact assessment; the public consultation; and the preparation for the hybrid Bill, which we would have to pay for ourselves. We are currently in the early stages of second-stage funding, to fund us through the next period of about two and a half years, which will carry us to the moment when, if you like, political risk is gone and when the hybrid legislation is pretty much definitely going to happen.

At that point, there will be a third funding that will be very much larger, and the third funding will be a commitment, effectively, by a range of very large investors to invest over the nine-year period to pay for the construction and commissioning of the barrage.

**Q198 Dr Whitehead:** But you have only just formed as a company, Hafren Power, and you are the successor of Corlan Hafren that dissolved. As a newly formed company with yet unknown investors, how do you think you are going to be able to gain the public trust and confidence to carry out something on this scale?

**Gregory Shenkman:** I have had about 38 years of financial experience and I have seen many companies and projects come and go, fail, and do well and do badly. I must say that this is really the project of my life. This project really should be delivered. I have become a real, true believer in this project. It is a huge national asset. We have the second highest tidal range in the world and we are not exploiting it. The only way to exploit it, as Professor Broyd said at the 10 January hearing, the only way of commercially viably exploiting it is a barrage along the Cardiff-Weston line as we are proposing.

We have gathered together a group of about 30 pretty hardened professionals who are, across the piece, able to deliver this project. We have also teamed up with a number of companies—and Arup is obviously one of them—which will fill any gaps that might be there. We have a wide range of skills. They cover engineering, project management, engagement with the environmental stakeholders, local communities, financing, operations and maintenance. Basically it is soup to nuts. We have agreed with two very large global-scale consulting/engineering operations. They are very interested in what we are doing and they have

already given very clear indications that they want to work with us on this project. We have no doubts at all about our ability to deliver this project.

**Anthony Pryor:** Let me just add to that, Mr Whitehead. I have been working very hard on what I call the supply chain side, the alliance team that is going to deliver this project. As you rightly said, we are a small start-up company. We have chosen Arup. Arups are our lead engineer designer. We have chosen an architect firm, Marks Barfield—who were responsible for the London Eye—to add some architectural features to this barrage. We have chosen Swansea University to undertake fish studies. We have chosen our consultation group. Greg has mentioned that we have had discussions with two very large engineering firms. We have talked to the construction companies. We are in quite detailed discussions with one of them. We have talked to five turbine manufacturers. We are about to talk to National Grid. We have not been able to do that because of the Christmas break. In the total supply chain to deliver this project—with my own experience of major projects, and Arup's—we are confident that we have the right team to deliver it.

**Q199 Dr Whitehead:** I hope you will forgive me, but it would be possible to make those claims as to whom one has talked to, without having any substance behind the claims. Who are the companies that constitute Hafren Power and are associated with them? Secondly, why did Corlan Hafren dissolve?

**Anthony Pryor:** I will explain Corlan Hafren because I was Corlan Hafren and Greg was not there. From memory, Corlan Hafren had five or six shareholders. They were quite disparate shareholders. One was Sancroft, which was headed up by John Gummer or Lord Deben, as he now is. One was Halcrow. One was an entrepreneurial start-up investment company called Zercin. One was Temporis. I think that was it. We were disparate and, in my opinion, we were not the right form. At that time, I had just sold Halcrow to CH2M HILL. They looked at their portfolio of risk and decided that staying in the project for them at the time—which is why Halcrow is not involved today in this project, Mr Gardiner—Arup were involved at the time. They stayed and Halcrow did not.

Anyway, for various reasons, we decided to dissolve ourselves. Two or three of those shareholders felt it was worthwhile continuing. They raised some more money to keep going and they encouraged Greg to join. They have encouraged me to join and we feel—on the basis of this 1,000-turbine barrage spreading across the estuary, with its better operating characteristics and better flood characteristics—that this is now the project to go. Also in that time, the Government has moved, through the Energy Bill, to an acceptance of having to pay a contract for difference. I think 18 months ago it was almost, “Well, produce the electricity at the price we need to match the current price”. But there has been a shift in understanding of how we, the nation, are going to pay for electricity.

My personal belief is that it has been driven by the nuclear industry. The nuclear industry could not match



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gas. Someone has to pay for the nuclear industry and we need nuclear power in this country. The whole debate about building a new nuclear fleet was that the country had to have it to meet renewables and to reduce carbon, but it costs more. So the whole contract for difference debate has come up and we are now in that same position. This is the right project at the right time.

Your second question was when will we tell you who is behind Hafren Power. Not the shareholders of Hafren Power, which are still a couple of entrepreneurial investment firms in Wales. In the future, Hafren Power will be sold to a sovereign wealth fund. Then they will have to deliver it with the delivery team that I am currently putting together. If you are asking which companies I have got to put together, I do not have their permission to give their names out today, but I probably would be comfortable to give you it in confidence, Mr Chairman, if you wish to know who the companies are behind being able to build this project.

**Chair:** If you indicate things you do not wish us to refer to in our evidence, we are happy to take those into account certainly.

**Q200 Dr Whitehead:** You stated that you think the barrage will be partially operable in nine years and you think it will be fully operational in 11 years. I think some people have raised eyebrows at that particular timescale. What is factored in the timescale for partial and complete operation? For example, you mentioned nuclear in terms of the factoring in of new nuclear. You have the generic testing and the planning process and so on, all of which has to be factored in prior to the build. Have you factored in, for example, marine licenses for dredging, planning consent, compensatory habitat, and so on? Is that all factored into that nine-year period?

**Anthony Pryor:** Yes, absolutely. I can produce my detailed chart, if you would like. But yes, we have factored all those factors in.

**Q201 Dr Whitehead:** Are you suggesting that those things should be done in parallel or in sequence?

**Anthony Pryor:** In many projects, things are done in parallel. One of the issues I suspect you might have a question on is the turbines. It is our intention, having discussed it with the turbine manufacturers, to certainly build a scale model of the turbine we wish to use, and probably a full-scale model, and test it either in situ, or in some suitable dock, because we want to prove its performance characteristics.

**Q202 Dr Whitehead:** And of course time for the hybrid Bill, with planning consent presumably obtained prior to the Bill being introduced.

**Gregory Shenkman:** We are not wedded in particular to a hybrid Bill, although a hybrid Bill seems to be the normal track down which a national scale project like this would go. It has been the way with HS1, HS2, and Crossrail and so on. Also, because this is a project between two countries—Wales and England—we think a hybrid Bill may be necessary. It also involves the Crown Estate and its ownership of the

seashore and the seabed. Probably the best way of bringing together the interests of the communities on both sides of the Severn, and the Crown Estate and Hafren Power, is through a hybrid Bill. That should handle the consents question, but if the Government would prefer to go down a different route we will simply do whatever is required.

**Anthony Pryor:** The local Hinkley Point is going through the planning process.

**Q203 Chair:** Mr Pryor, you were quoted a couple of weeks ago in one of my favourite bedside readings, which is *New Civil Engineer*, and you said once the project has a hybrid Bill and an environmental impact assessment—I do not know why my colleagues think it is so funny that I spend my evenings making preparations for these meetings.

**John Robertson:** It is obviously a cure for insomnia.

**Chair:** We can then look to sell it on to a sovereign wealth fund to take the project forward. What implications, do you think ownership of the Severn Barrage by a sovereign wealth fund, even before it has been constructed, would have in terms of commitments to UK manufacturing and jobs in the construction process?

**Anthony Pryor:** May I say first, Chairman, the circulation manager will be very impressed and pleased that you have a copy of the *New Civil Engineer* magazine.

My belief is—more than a belief—that the only way that a sovereign wealth fund would feel comfortable to invest in this company and take it—

**Gregory Shenkman:** Sorry, can I just break in for one second. We are not talking about one sovereign wealth fund. The final takers in this will be sovereign wealth funds plural: global infrastructure funds and pension funds—a class of investors that have an appetite for a reliable, long yielding, assets, so not just one, sorry.

**Anthony Pryor:** You are asking about their commitment to jobs. In my view, they are unlikely to say, “Thank you very much, we will buy this company for whatever it is and then we will start afresh and decide our own way”. They are much more likely to say, “What are the construction risks?” which is the big risk they have to face in terms of a project of this nature. They will want to know what is the in-place supply chain for building it, from turbines to design, to project management to construction, to connection to the grid. All that is going to have to be discussed and put into place in skeleton form in the next two and a half years. That will be the—I want to use the word guarantee. That will be the commitment, in that they will be buying a supply chain. For example, I am sure they will not turn around and say, “We are not going to build the caissons in Port Talbot. We will go and build them in country X somewhere else and turn round.” It will be part of the package they will be buying.

**Q204 John Robertson:** I would be interested in the companies that are associated with Hafren, and I am quite happy for you to write to us to tell us. But I would also, Mr Chairman, like to be able to ask some questions once we get that list of companies. I had

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some questions I was going to ask about a company, which I will not do at this moment in time and will wait until you send me the list.

**Anthony Pryor:** Yes.

**John Robertson:** I would obviously like to ask some questions at that point once you give it to us.

**Anthony Pryor:** I'll give you the list and if you would like to have a separate meeting to discuss it, any time.

**Q205 John Robertson:** Thank you. Can I go back to the timescale bit? I need to get my head around it because we have talked about several things on time. There was a two-year spell and then there were three to four years on top of that, and then nine years. Is that 13 years from today to operation? Is that what you are talking about?

**Gregory Shenkman:** Not quite that long, we do not think. Clearly it is very difficult for us. You are legislators, we are not and we are assuming that we move ahead when we get the environmental impact assessment underway. What we are hoping will happen is, exactly as Tony has described, the Government will say, "Subject to completing these necessary things: that we get a satisfactory environmental impact assessment, that there is an appropriate public consultation and that you conform to the Habitats Directive. Providing that, we are going to provide Government time to allow hybrid legislation to go through". At that point this whole process can get underway.

We are hoping—and you are experts, not us—that there can be an element of "in parallel," and that we will start off with these things but it does not have to be consecutive, so we are hoping the hybrid legislation will be able to pass through in the life of this Parliament, which we understand is fixed. Hopefully, that process could be completed by, let us say, the first quarter of 2015 at the latest. Therefore, we would hope to be digging out of the ground in 2015, and after that will be a period of seven years of construction, two years of full commissioning. You would look at a first full year of operation of about 2025, perhaps 2026, and you might be generating little bits of electricity in 2021, 2022 and then rising in scale.

**Q206 John Robertson:** There is good news and bad news in some of the things you have said. Government never give you what you want, by the way, so that is the bad news. The good news is that it will not really matter which party is in power. We are very similar on the hymn sheet we sing from when it comes to energy. My fear is that, if it is the 2026 time before we get anything from you, you will be completely swamped by gas, nuclear and renewables and that, in effect, the money on the Severn Barrage would be a waste, rather than being put into other areas of energy. Would you agree with that?

**Gregory Shenkman:** The Government currently anticipates a pretty large electricity gap. You are more of an expert on this than me, Andre.

**Andre Karihaloo:** Yes, I mentioned it before. There is a 60 TWh gap by the middle of the 2020s. I do not agree with that, because if we do go into offshore

wind, it has a life expectancy of about 30 years, tidal stream about 20 years, nuclear 60 years. We would be around for 120 years. The price support only lasts for 25% of the barrage's life.

**Q207 John Robertson:** I know what you are saying, but if you think about where we were 60 years ago and where we will be in 60 years' time, I think things will have moved on just a tad from where we are today. My point is that the energy that will be coming along will be coming along in the 2020 area, between 2018 and probably 2022. By the time we have invested as much money in gas as I think this Government, and probably the next Government, will have to do, it makes it, shall we say, not financially viable to go forward with such a large project as yours.

**Gregory Shenkman:** Can I make two points? I will give two examples. First of all, La Rance. It is small, but it is a barrage and it was built in 1966.

**Q208 John Robertson:** No, I know, but it is different. Give us two experts and you will get two different answers. I know that. "Our expert says something different from what your expert says."

**Gregory Shenkman:** The only part I was going to focus on—none of the controversial stuff—was simply the reality of what it costs. It is generating electricity at €20 per MWh, despite the changes that have taken place in the last 45 years. In Norway, 98% of consumer electricity is derived from hydropower. They did this huge investment programme 20 or 30 years ago, and now their consumer price is 65% lower than it is in this country for electricity.

**John Robertson:** Yes, but they are not starting in 2026. Unfortunately, we are where we are and we have to deal with the problems we have today and the problems that we are going to have, which I would suggest will be before your project will be even close to being complete.

**Q209 Barry Gardiner:** Mr Shenkman, you said that you were a true believer in this project. Your investors must be as well, must they not, because of the process that you have just taken us through—I was very interested that you said, "We are assuming that these things can be done in parallel." But if these things are done in parallel there is a huge sword of Damocles hanging over it, isn't there—the Habitats Directive and the EU. The danger of course, from the Government's point of view, of saying, "Oh, well, we can just let it trot along in parallel", is that they get, or you get, far enough down the road and then when the response comes back, "No, we can't do that", everybody says, "But we've got so far now we can't row back".

I wonder what discussions you have had with the EU Commission about the possibility of derogation from Natura 2000 and compensatory measures and so on. I heard what you said about having gone to the Government here, but you must know how long things take to get through the EU Commission to get approvals that are going to satisfy Natura 2000.

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Because this is not site-specific, this is a network of sites that has to be holistically maintained.

**Gregory Shenkman:** I am going to hand over to Tony to answer the bulk of this, but can I just say that when I said “handle these things in parallel”, I do not mean the whole process. I am hoping that once you have traction and the whole thing is going in the right direction, you don’t have to do them on a consecutive basis, so to some extent in parallel. Tony, this is your field.

**Anthony Pryor:** I am going to talk about the directives in the generic sense. The particular one is the birds’ habitat, and Ian will talk about the compensation measures we have been talking and thinking about.

This new guidance, which was published on 12 December—it is a draft for public consultation—looks to me like a guidance document and a menu list of how to work through the European sites directives. It talks about derogation, but derogation is the compensation measures of level 3, and we were talking about it on 10 January. This is a process that has in it that the competent authority, whoever the competent authority and the decision-maker is, should assist applicants like us for projects, and you decide whether the project has a negative impact. If it has, you go down a very well worked out flow path through IROPI, if it applies or not, and through into compensatory habitats.

In following this for the UK, I think we are going to be in pretty close concert with what is required for the European one because it is a mirror image of the European directive. We are going to engage with the Commission. We did some time ago. The Corlan Hafren company and DECC went to see the Commission two or three years ago, but of course people change and then you have to start to regenerate personal relationships on these things. We intend to meet the Commissioner for the Habitats Directive some time in the next month, I think was the plan, so we can start the process with him. But I do think this document is a good starter to get the thing running, to get the final approval from the European Habitats Directives.

**Q210 Barry Gardiner:** One of the key problems, and I know you—

**Anthony Pryor:** If we look at birds, in particular. That is the one that we are going to have to find compensation measures for.

**Barry Gardiner:** It is not just birds, but let me go through the final conclusions of the original DECC study. I know it was on a different scheme, but in a sense it was not scheme specific because it referred more widely to the possibility of compensatory measures. It said, “Compensation for declines in migratory bird populations might not be possible within commission guidance because of the limited potential for habitat creation within the Severn in some circumstances.” That is specifically dealing with the Commission’s view that there has to be co-location of the compensatory measures. It said, “Like for like compensation for changes to the hyper-tidal character of the estuary feature is not feasible”. It was far more definite on that point. Of course, one of the

reasons that this is such a good site for energy is precisely because of the range. It is a unique feature—or only one greater in the world—and therefore they said the recreation of that hyper-tidal character is not feasible.

They concluded, “This would mean that changes in the conservation objectives that depend upon the physical, chemical and ecological conditions generated by the extreme tidal range and shape of the Severn Estuary could not be addressed on a like for like basis”. There are a number of different areas, which—you are quite right—there is a process for addressing. But until they have been addressed, what does that do to your cost of capital? Because your potential investors, knowing that that sword of Damocles is hanging over you, are going to say, “There is a very substantial risk here”.

If I can say simply two more words to you. Rather like Robert Frost in *Mending Wall*, “I could say ‘elves’ to him,” I could say “migratory birds”, because to get the assessment of this is a matter of years. Compensatory habitat that can be shown to be effective for migratory birds can only be so over a time period that I would suspect is longer than your investors’ patience.

**Anthony Pryor:** I would like to pass to Ian on the particular, because he has been studying and doing the work on the birds and compensatory habitat. But in general terms, we already have a bird survey done. Hargrove did one 18 months ago. We know it takes time. You have to measure birds over a period of time, the same with fish. We are going to have to do a fish survey, which is going to take certainly a breeding cycle. We know it takes time. If we start now, we have about 18 months to do it all.

DECC have said in their submission—they are coming to see you next week, aren’t they—and in our meeting with them last week, that there is more detail and more data they would like. I have taken note of their comments that you rightly quoted from, but we do believe that we can work through, with DECC and with the NGOs in particular, to satisfy their concerns for compensatory habitat. Ian, do you want to talk about that?

**Q211 Barry Gardiner:** Sorry, but including hyper-tidal character of the estuary, which they say is a feature that it is not feasible to compensate for. That sounds pretty damn conclusive to me.

**Anthony Pryor:** Roger, do you want to take the hyper-tidal?

**Professor Falconer:** I would say that the loss of inter-tidal habitats with the new scheme is significantly less, so I think there is far less concern with the new scheme, in terms of the loss of inter-tidal habitats, than the old scheme based on computer simulations that we have undertaken with our research at Cardiff University, and secondly—

**Q212 Barry Gardiner:** It is not the inter-tidal habitats. It is the hyper-tidal nature of the scheme. You are saying you are going to reduce a very unique feature that the directive is saying needs to be recreated and compensated for in the locality, and it cannot be.

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**Professor Falconer:** The concern that DECC referred to—

**Andre Karihaloo:** Sorry, Roger, I just wanted to say that with the turbines, unlike bulb turbines, they enable an element of control that did not exist with bulb turbines. We would be able to flood the basin periodically and, therefore, replicate the hyper-tidal nature of the estuary, occasionally.

**Q213 Barry Gardiner:** Occasionally.

**Andre Karihaloo:** Well, when it would be required, yes.

**Q214 Barry Gardiner:** At the moment it happens how many times a day?

**Andre Karihaloo:** No, but in particular at spring tides and—

**Q215 Barry Gardiner:** In terms of an ecosystem, the difference between an occasional hyper-flooding and twice a day is pretty big.

**Andre Karihaloo:** Mr Gardiner, what I am trying to impart is that there is—

**Professor Falconer:** Could I just make one important point? The previous scheme was going to change the upstream tidal characteristics completely. The current tide upstream of the barrage or the theoretical line where the barrage would go is basically sinusoidal in form. The shape of the tidal curve upstream of the barrage was going to be completely different from a sinusoidal tide, so the whole characteristics of the estuary would have been completely different in the previous scheme.

**Barry Gardiner:** That is the point.

**Professor Falconer:** Yes, but the new scheme will still be sinusoidal in form upstream. The tidal range will be different and it will be reduced in amplitude, and how much that amplitude varies by, in my view, will be dependent on our discussions between Hafren Power, which is what I am proposing, and the NGOs, and that is one of the reasons why we do not have much information in the public domain.

**Q216 Barry Gardiner:** Professor Falconer, nobody on your panel is suggesting that in order to make appropriate compensatory measures, what you are going to do is hyper-flood to the level that it was before—twice a day—because that would completely defeat the objective of the scheme. This is precisely the point of the conclusion of the previous DECC study, is it not, that this is a feature that is irreparable—no.

**Chair:** Irrevocable?

**Barry Gardiner:** No. Unreplicable.

**Anthony Pryor:** Can I just go back to the operation of the barrage? You are right, you would not say every six months or so you would flood it up or not. The barrage is a complete control mechanism. The thousand-odd turbines can obviously be used in ebb and flood. They can be turned to—I say—freewheel, but feather the blades because the pitch can be changed. So they can let the water flow through, which could actually replicate the whole tide, but when would you do it? We would like to have a

discussion with the ecologists and the NGOs to ask how often would they like the tide to be filled up to the top, bearing in mind that if we do nothing we are going to lose inter-tidal habitat anyway. If we do nothing we are going to lose 20%.

**Q217 Barry Gardiner:** There are projections that show that it could be up to that, yes indeed.

**Anthony Pryor:** Sea level rise is going to do it.

**Barry Gardiner:** Schemes like this are trying to stop that.

**Anthony Pryor:** I have seen figures ranging from 35 centimetres to over a metre.

**Barry Gardiner:** You may have also seen the Delft study, which says that because of the gravitational field—

**Q218 Mr Lilley:** The IPCC—we spent a lot of money on it.

**Anthony Pryor:** Well, even 35 centimetres is quite a bit.

**Mr Lilley:** Thirty to 60.

**Anthony Pryor:** Yes. So sea level rise is a significant effect and the EA is going to have to spend money to prevent flooding from the sea level rise. This barrage will get rid of sea level rise problems completely.

**Q219 Mr Lilley:** Upstream?

**Anthony Pryor:** Upstream. Oh, yes, upstream. Downstream is a different—

**Q220 Mr Lilley:** About the width of a paper, about 20 centimetres.

**Anthony Pryor:** That is not sea level rise. That is the general operation of the tide. But can I just go back to Mr Gardiner's point. We want to have a discussion to say, one, you can raise the tide, and if you operate the turbines in a pumping mode you can do it as well because you can raise the tidal height. You are talking about the loss of the two metres at the top of the inter-tidal habitat at that area. That is what you are talking about with hyper-tidal.

I have seen somewhere that if you did it once a fortnight you can regenerate the mudflats. I have seen that as a paper somewhere. Once a fortnight, if that is acceptable to everybody, then we regenerate the flood plains and then we have to factor that into our business model in terms of how much power is generated. You just say that for that window of tide you do not generate any power.

**Q221 Barry Gardiner:** Once a fortnight may regenerate the mudflats. What it may not do is attract the bird species that need to eat not once a fortnight but all day, every day. Habitats are part of an ecosystem and it seems to me that a response like the one you have just given precisely ignores that.

**Anthony Pryor:** Let us ask Ian to talk about the habitats precisely.

**Ian Gardner:** If I can contribute, I think major infrastructure projects such as this one clearly have an impact. The sequence that is needed is that the first stage would be a decision in principle on whether or not the barrage is an attractive contribution to the mix

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of the UK's energy. If that is established as principle, as a team we fully understand that there is then due process but there is then a mechanism and a shape to that due process. We fully accept that part of taking that process forward, to test the viability of the process, is that we would have to convince and work through the necessary mitigation, environmental impact and associated mitigation measures. We would expect that process to go in parallel with the formulation and the powers needed in the hybrid legislation, or whatever other legislation, because some of those powers being sought might be the very powers to enable the necessary mitigation, so we would bring those two together.

We have done this sort of thing before. We did it on High Speed 1. Crossrail is doing it. As an example, Crossrail, as part of its obligations and powers, is creating wildlife habitats in Wallasea Island. It is creating new wetlands for birds, so it is possible you can translocate ancient woodlands, you can do things. Clearly you have to find ways of doing them that satisfy the environmental balance, the economy—

**Q222 Barry Gardiner:** Mr Gardner, we have a fundamental point of disagreement. What you are saying is decide to do, justify later. If you look at the *Natural Environment White Paper*, which came out last year, precisely the way in which the Government is moving—and I applaud them for moving in that direction—is to say, “Start looking at natural capital as a whole and look at these in a holistic way. Look at the whole value to the wider economy”, exactly the point you make about energy, but also look at the value, so that nature, the natural environment and the various ecosystem benefits and services that accrue from it are taken into account. If you begin to do things in that way, then I am all with you, but to do it on a basis that says, “Start by taking the decision that we have to go ahead with this and then find reasons to justify it,” is exactly the old-fashioned way that gets us into so much trouble time after time after time.

**Ian Gardner:** I am not saying that you take a decision that is an absolute. You take a decision to take the thing forward. I am not saying you take a decision that you immediately are guaranteed a result. We fully accept that, but it is putting it into the agenda in a way that there is a willingness and a commitment to work these issues. If the issues are not solvable—and I fully agree with you—then you do not have a solution.

For instance, we are talking here of 60,000 birds. We are talking of six species of birds. We know what the characteristics of those six species of birds are. We know what their feeding grounds are. We know what areas of equivalent habitat might exist for them or not exist for them. For instance, we know that the shelduck, if we put some measures in around Bridgwater Bay we could provide compensatory habitat within the estuary, further protect that species in the estuary.

What I am saying is we would work through these issues with the right people involved and seek to find the right solutions. But we put our hands up—if we cannot satisfy those right solutions, we do not have a solution. But if we can in an acceptable way then we

can take the whole thing forward. That is what we would be seeking to do. That is the sort of process that has been happening on these other major projects. It is enabling things that are benefits to come out of these projects—sometimes that have not been foreseen; that, as the process works its way through, the right opportunities with the right minds are hopefully identified. If they cannot be, then a decision has to be made. We fully accept that and we accept that risk, but we want the ability to take the agenda forward.

As an example in this complex debate, climate change, sea level rising would take out areas of the estuary at the moment that are deemed to be—absolutely the point you are making—the status quo that at the moment is crucial. There are things happening in the natural systems with sea level rising that will move that status quo. In some respects, the barrier will compensate for that because areas that would be lost, with actual sea level rising, would not be lost. Other areas would. So there is a balance here, we fully accept, and we fully take responsibility for seeking with the right contributions to achieve a result.

**Q223 Barry Gardiner:** Last time, my colleague Peter Hain outlined that there was a budget of, I think, £1 billion for compensatory measures. Have you put in place yet a process for acquiring the land that will be necessary for the replacement habitat that you are talking about?

**Ian Gardner:** That is exactly what the process of working towards the hybrid Bill would be. It would be doing the work on the environmental impact. It would be doing the work on the need or opportunity for mitigation measures. It would need to assemble the register of land impact. All of that comes together in whatever legislation is needed, be it the hybrid Bill or whatever, but that is the process. It is a known process that we would absolutely comply with, so the answer is yes.

**Q224 Albert Owen:** Can I just move from the important issues of wildlife and environment to equally important issues of socio-economic impact? If you could briefly—I know we have time restraints—outline how you see the benefit in terms of jobs, industry and growth.

**Andre Karihaloo:** In terms of jobs—the sheer scale of this barrage. It is going to be 18 kilometres long. We need to build about 250 massive concrete Lego blocks, effectively, that are 75 metres by 50 metres by 30 metres, and we need to build 1,000 turbines that weigh 400 tonnes each. Now, because of the size, they need to be built in the area—you do not want to ship them in. So we are going to need to assemble the turbines in turbine halls in the Bristol area, and in Port Talbot or perhaps in Cardiff. We are going to need to build the caissons nearby. We have identified a spot in Port Talbot. Geographically it makes sense to do it there. It is going to take about 20,000 workers to build this thing. We are going to need construction workers, engineers, surveyors, crane drivers, truck drivers, barge operators.

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**Q225 Albert Owen:** In your evidence you said 20,700 full-time jobs and potentially a further 30,000 indirect jobs.

**Andre Karihaloo:** Yes, that is right.

**Q226 Albert Owen:** Do you stick by those figures?

**Andre Karihaloo:** That is using Office of National Statistics multipliers. You have 20,000 direct jobs, give or take, and then you have a supply chain effect. The supply chain will be improved so there is another 20,000 there. Then you have an induced effect, which is effectively an income effect, whereby those 40,000 people have new jobs, they spend their new-found money and increase employment.

**Q227 Mr Lilley:** You are assuming that they were entirely unemployed beforehand. They are not resources available in the economy to do more productive things, but they are otherwise unemployed resources.

**Andre Karihaloo:** Not necessarily, that is just the normal calculation.

**Q228 Mr Lilley:** You are if you start going into this sort of thing if they had no incomes before. If they had incomes before then there is no multiplier.

**Andre Karihaloo:** There will be an element of that obviously. But there are currently 40,000 people on jobseeker benefits out of a population of 700,000 in the area.

**Q229 Albert Owen:** I think upskilling people is a good thing for the under-employed at the moment, and giving them other opportunities in the future on energy projects is a positive thing but I do want to pin you down on certain figures. Mr Pryor, you said about South Wales having the opportunity to build the turbines, which would be advantageous because of close proximity. But we have heard evidence—and it is only fair to raise it—from Bristol and Avonmouth, and associated British ports, that say there would be some displacement of jobs. Have you factored this into your figures?

**Anthony Pryor:** I will answer that one because you mentioned Bristol, and—

**Albert Owen:** They are the ones that gave evidence so we are using them as an example.

**Anthony Pryor:** Yes. I have read their evidence and seen their evidence, and clearly they have some differences of opinion in their two written submissions to you. I met with the Bristol Port senior management last week, and you can imagine we had a somewhat robust debate about all these issues.

If I may just make one clarification, Chairman, of our written evidence for the record. I think we used the wrong tense. We used the first person rather than the third person and we said, “We will consider building a ULC port at Port Talbot.” That is not the case. We should have used the third person and said, “It could be considered by somebody”. We intend to build the caissons in casting basins, which we will create at the Port Talbot brownfield site and then they are there. We will either fill them in at the end of it or someone

can use them, but we have no plans to build a new port at Port Talbot.

Yes, we had a debate with Bristol Port. The first issue was the effect on their operations of the barrage, which ranged from locks we would put in the barrage and the transit time, the siltation that will or will not occur, and the effect on the sill heights of their entrance locks to their existing docks. The fourth point was their plans—they have not built it yet—for a new deep draught container port in the river rather than the docks. We debated all those issues. I think we have opportunities to show benefits from the barrage to them. We can actually improve their access to their existing docks by raising the height of the tide at particular times to suit them. We have a meeting—

**Albert Owen:** Can we get on to the jobs?

**Anthony Pryor:** I will come back to jobs, because the second point was jobs.

**Albert Owen:** This is a question on jobs.

**Anthony Pryor:** The second point was jobs. We have an agreement between us to meet again for us to present more details with my experts to go through the issues.

Now, on jobs, we have a difference of opinion, which we have not resolved yet and we did not resolve last time. They believe that once the barrage is in operation that there will be a significant job loss. If, as I believe, we can find all the right measures to make sure their port is in full operation—including their new deep sea port that they have not built yet—then I do not see why they could claim some figure of 60% job losses. I do not believe that will happen. In the intervening time, there is 10 years of construction with £20 billion worth of stuff 10 miles from your port. We are going to need a port.

**Q230 Albert Owen:** In an area of low GVA that is very important. Again, on your figures in evidence, can I ask you how confident you are that you could ensure that 80% of this £25 billion investment remains in the UK and in the local economy? What kind of studies have you done specifically on that?

**Anthony Pryor:** We did some lengthy studies about 18 months ago in Corlan Hafren on this. At that time we were relying on a solely UK turbine supplier, who unfortunately in the intervening time has decided to withdraw from the market. However, these turbines are of such a size—9 metres in diameter, the size of this room—and there are 41,000 of them, that the turbine manufacturers we have talked to realise that they will certainly have to assemble them and probably manufacture large parts of them. Bearing in mind the construction is all going to be done in the UK and the electrical supply equipment done in the UK, I am pretty confident we will be around about the 80% figure.

**Q231 Albert Owen:** That is a good figure to use and obviously it will have a huge impact. Can I ask the other side, where would the specialist 20% come from and is that available now?

**Anthony Pryor:** When you buy a Rolls Royce jet engine, what proportion do you think is not made in England?

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**Albert Owen:** You can get some cars made 100% in—

**Anthony Pryor:** Fifty per cent of a Rolls Royce jet engine delivered to you from Derby is made outside of the UK. I would expect—

**Q232 Albert Owen:** This is not a guesstimate, you have some figures?

**Anthony Pryor:** We have done some sums. It is not a guesstimate, no.

**Gregory Shenkman:** Andre, do you want to come in?

**Andre Karihaloo:** We did a breakdown; our engineering consultants identified the supply chain and roughly where the components would come from. It was 38% Severn Estuary, 43% the rest of the UK and the remainder outside.

**Q233 Albert Owen:** One final question. Have you been liaising with the TUC and the CBI in Wales? Are the skills going to be there in the timetable you envisage?

**Andre Karihaloo:** We have started having conversations with district councils and some of the bodies you mention. We want to leave a legacy of improved skills, and where the skills do not exist then we would like to work with colleges and training providers to upskill local workers.

**Q234 Albert Owen:** Don't forget North Wales—plenty of skills there.

**Andre Karihaloo:** No, obviously.

**Anthony Pryor:** More than the legacy, I think we are going to require to support, sponsor, whatever it takes with local colleges—as an ex-mechanical trade apprentice—a proper apprentice training school for all the skills necessary for this, not only just for building it but for running it.

**Q235 Albert Owen:** But many of these are transferable skills from nuclear industry and from other energy sectors.

**Anthony Pryor:** Bridgend has a very good technical training school. It draws in people from all over the UK.

**Albert Owen:** Thank you.

**Q236 Ian Lavery:** Employment is very important in the area surrounding the barrage, and the Bristol docks behind that are mainly areas of social deprivation, areas of lower employment. Unite the union claim simply that if this barrage is constructed it will be the end—the death—of Bristol docks. Why would they say that?

**Anthony Pryor:** As I said, I disagree with Bristol Port's evidence that they would lose 60% of their jobs once the barrage is built. They based that on the fact that they would not get access to ships. We have started a debate with them. We will continue that debate with Bristol Ports, because I believe some of the things we are going to do will provide benefits to them; for example, the operation of the locks. We are going to provide the locks in the barrage free of charge, plus tugs.

**Q237 Sir Robert Smith:** Why is it a benefit to put an extra process in shipping locks?

**Anthony Pryor:** Two things occur. There is a transit time of an additional 45 minutes but many ships anchor up off Swansea at present waiting for the tide. They wait already.

**Q238 Mr Lilley:** There will be less of a tide to wait for.

**Anthony Pryor:** They will not have to anchor up, they can spend the 45 minutes in the lock, and the flow of water upstream will be less, which makes it easier for navigation. There are some benefits. As I said, I am committed to discuss this through, and the managing director of Bristol Ports has agreed to meet again in the near future—I will not say immediate future—when we will bring my experts and discuss with his experts how we can make sure that his port can operate properly. I do not accept the local union Unite saying that it is the death of Bristol Ports. The Unite union in South Wales of course has a different view.

**Chair:** Robert?

**Sir Robert Smith:** I think we have covered the ports.

**Q239 Mr Lilley:** Can we go a little further? I just remembered doing a study for the Port of London Authority, about 40 years ago, on the need to dredge the entrance to the Thames, because it turned out that very large carriers came in on the tide and if they met a fog halfway they could not turn back, they could not stop, they had to keep going on the high tide. I do not know whether it is the same in Bristol—that they need the high tide to get there. If they do, then the worries of the port authority would strike me as very serious.

**Gregory Shenkman:** Roger, would you like to address that? Siltation.

**Professor Falconer:** I do not think the siltation problem is going to be anywhere near as serious as has been implied. Another big advantage of this—

**Q240 Mr Lilley:** Certainly the draught of ships that can get in will be reduced by 2 to 4 metres, 2 metres you said.

**Professor Falconer:** The very highest tide.

**Mr Lilley:** Those that come up.

**Professor Falconer:** We can increase that. I was talking about the situation with no pumping.

**Q241 Mr Lilley:** You cannot turn 5% of the nation's electricity off every time a ship arrives.

**Barry Gardiner:** Every time a ULCC comes up the river.

**Gregory Shenkman:** That would not be the outcome. You would not lose 5% of the country's electricity. Clearly it would be a brief period.

**Mr Lilley:** They are having ships all the time.

**Anthony Pryor:** Well, this is the debate that I would like to have with Bristol Port—to discuss their actual shipping in 10 years' time. Today they are having something like, I believe, seven ship movements a day and not all of them are deep draught ships. The current draught is 14.5 metres and the number of 14.5 metre ships is extremely rare, from my studies and surveys. I want to discuss with them when those times are,

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what we could do to assist to achieve that. Interestingly, their new port, which they have planning permission for, says they will take 16 metre draught container ships, and they claim the low water tide is 16 metres above the bottom. We are going to make it 18 metres, so we will make it easier for the deep draught ships to get in.

**Professor Falconer:** I was specifically addressing—sorry.

**Anthony Pryor:** We are raising the low tide.

**Gregory Shenkman:** Drop the high tide, raise the low tide.

**Anthony Pryor:** They say they can get in up the navigable channel at low tide. We are going to make it easier for them because it will be 18 metres rather than 16 metres.

**Q242 Sir Robert Smith:** Can I just clarify about the locks? Who would be designing the locks in terms of the kind of ships they would be able to operate?

**Anthony Pryor:** My colleague from Arup will be designing the locks.

**Ian Gardner:** We will be designing them based on the discussions and the criteria that we establish.

**Q243 Sir Robert Smith:** How will they be managed in terms of which ship gets to go through when?

**Anthony Pryor:** All to be debated and decided. That is what I would like to have a meeting with Bristol to talk about, because AB Ports also have ports there. Bristol have said they would like two locks so we will certainly consider building two locks. We will have to have some management mechanism between the four major ports on the river and the shipping movements and the barrage operator.

**Q244 Sir Robert Smith:** How would they be funded?

**Anthony Pryor:** The lock? The locks will be funded through the revenues from the barrage electricity stream.

**Gregory Shenkman:** It is part of the operating costs factored in.

**Q245 Mr Lilley:** What about silting? If the effect of having a barrage is to lead to greater deposition of silt, presumably that will reduce the draught of ships that can go in unless it is all dredged away. Who will be responsible for dredging away if there is any serious silting?

**Gregory Shenkman:** Roger.

**Professor Falconer:** Let me just clarify the point on flooding first, because it is related to this point. I have a plan in front of me here, which seems to be arbitrary but I can leave it with you. The water level for the tidal cycle varies over the spring neap cycle and the 2 metres I was referring to was a maximum water level reduction; the blue here is without the barrage and the red is with the barrage. This is over 100 hours. Over the spring neap cycle, which is 14 days, the highest water level difference is at peak spring tide and the lowest water level is at neap tide. The peak variation in the spring neap cycle will be 2 metres, and that is

when the house is most likely to flood or the embankment is most likely to be overtopped. If you build a barrage the water level remains fairly constant over the spring neap cycle, so the peak that we were referring to before is the maximum water level difference of the spring neap cycle. As far as the ship coming in is concerned, that peak water level is varying continuously from the spring value to the neap value during the 14-day cycle.

That is the first point I wanted to make. In terms of siltation, the big attraction of this barrage over the previous barrage, in my view, irrespective of what turbines you use, is that the turbines are located over the whole of the length of the wall. In the previous scheme, the turbines were only located over the middle third and you had sluice gates over the first third and the last third, so power was only produced over the middle third. Therefore, you had very high velocities on the ebb tide generating a lot of power, but also making it particularly damaging to fish. This scheme, having all that water going out over the turbines over the whole of the wall makes the scheme less damaging to fish because the velocities are a third of what they would be with the previous scheme.

Then we come on to siltation. If you have all the flow going out through just the middle third, you generate very high velocities, very high circulation, and the siltation is proportional to the third power velocity, so you have very high proportions of sediment being picked up in the region close to the barrage and that has to settle out somewhere. So it is quite understandable that on the basis of the previous scheme, Bristol Port would quite naturally assume that we would get very high levels of sediment being picked up and then deposited elsewhere. That is far, far less likely to occur with the current scheme, and on the basis of those—

**Q246 Barry Gardiner:** But the reference point is not the scheme, the reference point is the status quo.

**Professor Falconer:** No, but they are basing their assumptions on the previous scheme.

**Mr Lilley:** I do not know what they are basing their assumptions on. I was basing my assumptions on common sense.

**Chair:** Sorry to interrupt this exchange, but we are going to have to draw this session to a close. We have been going for nearly two hours and we have another panel of witnesses who we have to conclude before we get to Prime Minister's Questions. If you want—

**Q247 Mr Lilley:** Siltation is a major issue and you have not come back to my point.

**Professor Falconer:** Okay, I will come back to your point.

**Chair:** Perhaps that answer could be given in writing.

**Anthony Pryor:** We will submit a written answer on siltation.

**Chair:** I am very grateful to you for all coming in. We have had a very good tour d'horizon of the issues, and we look forward to reaching some further conclusions in due course.



### Examination of Witnesses

*Witnesses:* **Andrew Shirley**, Chief Surveyor, the Country Land and Business Association, **Johnny Gowdy**, Programme Director, Regen SW, **Rupert Armstrong Evans**, Proprietor, Evans Engineering and Power Company Ltd, and **Vincent de Laleu**, Offshore and Marine Engineering, EDF Energy, gave evidence.

**Q248 Chair:** Good morning. I am sorry you have been waiting a while for this session to start. We have to conclude before 12 o'clock so we have an absolute maximum of about 40 minutes. I will come directly to the point rather than go through introductions. We do know who you are.

First of all, can I ask the CLA about your view that compulsory purchase orders should only be used as the last resort? Can you explain what the shortcomings of a CPO are and what alternatives you are proposing?

**Andrew Shirley:** Thank you, Chairman. I suppose the starting point is to look at the hybrid Bill process. Compulsory purchase orders work from the point of view of the acquirer. They have little reference to the landowner who is afflicted by the procedure. If you look at the hybrid Bill, the full scheme will not be available until the hybrid Bill is about to go into Parliament; you can see this particularly with HS2. You can only see where the compensatory habitat is going to be provided when the environmental impact assessments and environmental surveys are all complete, which is at the time it comes into Parliament. The problem with all these things is that the compulsory purchase system is driven by the acquiring authority. The acquiring authority will be the company, the commercial company, that will stand to make a substantial amount of money over a substantial period of time for the scheme.

The landowner will not be able to choose when he has his land acquired, or what land he has acquired. What is for certain under the present system and even the systems proposed under HS2, is that the landowner will get the minimum amount that can possibly be given to him as a result of the scheme. The uplift is minimal and, no, I have not met one person over my—whatever it is—25 years of professional experience, who feels that he has been anywhere near compensated for any compulsory purchase across his land. That is where we stand.

The proposal is that compulsory purchase should not be the forerunner, it should just be the very last resort, and whatever can be done should be done through negotiation. If you look at the provision of compensatory habitat, I would argue it seems sensible to have a system where you can encourage people to offer the best environmental land to put that habitat on, and for it to be managed the best way. That is not by taking it off the landowner necessarily, and at some point giving it to someone else to deliver who is perceived to have a better knowledge of that land than the landowner himself.

**Q249 Chair:** Given the scale of the land that is needed for compensatory habitat, will a voluntary scheme be able to deliver it?

**Andrew Shirley:** I think it will. If you look at large areas of land, the problem we have is that we know from the Hafren evidence that you are looking at 49 square kilometres—call it 5,000 hectares—of habitats being lost. If you were to say that would be

compensated for to the rate of 1:4, you would be looking at 20,000 hectares. So you have a substantial area of land that needs to be compulsorily purchased, or purchased. It does offer real potential to look at a system that will work in much the same way as an auction, but it would allow profitable management of the conservation habitat. That is a really big step forward and it is something that a scheme of this size could look towards achieving.

**Q250 Chair:** How do you think the barrage scheme is going to impact on local fisheries and the wider rural economy?

**Andrew Shirley:** What you need to do when you are looking at this scheme is not look at the 18 kilometres of barrage that creates all the excitement. What I was going to say—prior to my evidence, when I was preparing myself for today—was that you should look from Weston-super-Mare to Cardiff all the way up into the Welsh hills, because that is what we are talking about with the River Usk and the River Wye. From the evidence that Hafren gave earlier, I think perhaps you might be looking all the way from Land's End right up because that is going to be the impact, both the tidal impact but also the fishery impact.

Having spoken to the Wye and Usk Foundation, the evidence they put forward was that a huge proportion of the salmonid population depends on the River Severn. What the salmon do, I understand, is not just swim straight up the Severn and into the Wye but they tend to—for want of a better expression—hang around a bit, and the concern was that, if you put a barrage across there, it would not just be the salmon swimming through the barrage, they would swim through it and then swim back and then swim through it again. So there are considerable risks, but I think there is also an argument that the Severn, the Wye and the Usk perhaps are not offering the best conservation habitat for the salmon at the moment and numbers are under threat. It is all about having the proportions of fish in a favourable conservation condition. The thinking is that they are not at the moment. One argument might be perhaps, before embarking on a scheme like this, you should try to get them into a good conservation condition, otherwise numbers are going to continue to go down. If you look at the capital value, the last assessment, which admittedly is over a decade ago, undertaken by the Environment Agency, put a value on an individual salmon of something like £9,000.

**Q251 Chair:** Your evidence suggested that the provision of compensatory habitat would be detrimental to UK agriculture. Can you explain that?

**Andrew Shirley:** It is necessary to take account of the amount of compensatory habitat and the financial implications. Just simply, if you take a figure that has been bandied around quite a lot, which is 16,000 hectares of compensatory habitat, if you were to work that out, it is somewhere around £25 million worth of lost production. That is grain production. It is slightly

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less if you are looking at livestock production. But that is the sort of order you are considering. It depends where you provide the compensatory habitat, whether it is provided on good quality land, which these figures are probably based on, or whether you are looking to have it based further away where you might look at less productive land. The argument for a voluntary scheme is that you can choose the land that is going to produce the best environmental potential.

**Q252 Ian Lavery:** Mr Gowdy, Regen Southwest's paper suggested that there would be 40 GW of electricity harnessed from the barrage, using a balanced multi-technology approach. I wonder if you could briefly describe, first of all, what this approach would be, and second, outline the new technologies.

**Johnny Gowdy:** The paper we wrote came out of work that Regen Southwest has been doing, mainly with the industry but with other stakeholders as well through the Bristol Tidal Energy Forum and the Southwest Marine Energy Park, which we have been party to setting up. The basis of our approach—and it went back to early 2011, so it is just after the Severn Estuary feasibility study was published—was our assumption that the barrage would not be built, because at that point it seemed very clear that the barrage had been kicked into touch. The question we set ourselves was: what alternatives could we look at that would generate a significant amount of energy within the Bristol Channel area from a variety of technologies? How could those technologies be deployed in a way in which we could manage the environmental impact, the economic impacts, and look to develop technologies as they became mature and as they became more cost-effective? The other thing that we were focused on was: how can we support new technologies that are UK-based that could be exported?

That was the exam question we set ourselves, as opposed to writing a paper that was anti-barrage. The energy estimate is up to 14 GW, not from just tidal energy, I have to say; it is a mixture of technologies. Some technologies are relatively mature, for example, a tidal lagoon, which could be built with existing technology, tidal stream, or tidal fences, which are the new way of looking at how you can combine both tidal stream energy with a degree of head without necessarily creating a hard barrier across the Bristol Channel. Then of course we also looked at wind energy, floating wind energy and wave energy. The basis of the approach was to look holistically at all the potential energy sources in the Bristol Channel area, and indeed out to the western approaches, and think carefully about how they can be used in combination and also how they can be deployed over a time continuum, because I am very much of the opinion that we need to do something quickly. Our feeling was that by starting perhaps with smaller projects, which would nevertheless be significant—a 600 MW tidal lagoon would be the biggest tidal project in the world today—we could develop the technologies, export them and build on it.

The 14 GW figure is our upper estimate. It is 5 GW to 14 GW. There are other estimates around the place. The Crown Estate recently did a study where they

estimated 16 GW of tidal and 8 GW of wave energy, so there are a lot of numbers around the place. We looked both top down at the resources but also bottom up at what would be feasible in terms of projects.

**Q253 Ian Lavery:** Thanks for that. Could you elaborate ever so slightly on what your paper says about inter-technology impacts? I wonder if you could explain how a single barrage might impact on the development or deployment of other marine resources.

**Johnny Gowdy:** You mean a single large-scale barrage, and would that stop you developing other resources?

**Ian Lavery:** Yes.

**Johnny Gowdy:** The question was asked earlier on about the opportunity cost of a large-scale barrage, and it is quite right you could still develop wave energy. You could develop some of the tidal range projects, tidal lagoons for example. You could develop the wind energy project. Our starting point was not to think about an either/or, our starting point was to think about what is an optimum approach. There are other opportunity costs. We mentioned the CFD Levy Control Framework, the cap on the amount of subsidy that would be available, so there is an opportunity cost there. There is an opportunity cost in terms of the grid capacity to handle more projects, in addition to the barrage in the Bristol Channel and South Wales area. There is a fundamental opportunity cost about the environmental impacts because we will then be getting into the cumulative impacts of doing multiple projects. In the short-term there is an opportunity cost in terms of resources. For example, the DECC officials, who are focused on preparing for this committee and looking at the barrage, are the same DECC officials who would otherwise be supporting the wave and tidal sector.

**Q254 Ian Lavery:** Are you anti-barrage?

**Johnny Gowdy:** I am not anti-barrage, because I believe we need large-scale projects. If we are going to tackle climate change and other issues—ocean acidification, our own energy security—we need to have large-scale projects. Tidal lagoons are very similar to tidal barrages. It is the same sort of concept, in terms of an impoundment of water and then running that through either a single direction or a multi-directional turbine. We think that a lagoon-type concept, which would enable us to develop these new concept turbines more quickly, would get us to the point of being able to generate more energy.

We can look at what is happening around the world, Korea for example. I was with a group of Koreans yesterday down in Cornwall talking about marine energy. They have started smaller. They have five projects at the moment. We would define them as lagoons rather than barrages. They are not actually blocking a channel or an estuary. The one they have built to date at Shiwa is 250 MW. Of the other four, three are less than 500 MW; only one is over 1 GW. That seems to us to be a sensible approach when you are trying to develop a new technology, particularly using a new turbine concept that has not yet been deployed.

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**Q255 Dr Whitehead:** In your paper, you mentioned that the various technology solutions you are looking at are still under development. Do you consider, in terms of the alternative sources you are thinking of using, that the timescale involved would be right for the sort of imperatives we have heard about in terms of the power sources being needed?

**Johnny Gowdy:** We have heard a lot about timescales today. I have some thoughts about the timescales that we heard about this morning, but in terms of the new technologies, there is a range within that. We are talking about offshore wind, for example, where the timescale is relatively quick with the technology that could be deployed. There is a sort of continuum, as I said. Tidal lagoons would face some of the same issues as a tidal barrage, but much smaller in terms of habitats, for instance, impact on ports, which would enable you to develop, in a shorter period of time, a technology that could be exported. Wave energy is something that we are looking at from 2025 onwards, basically, in terms of large scale deployment. Nevertheless, today, there is a huge amount of activity in terms of technology development and research. One of the pieces of work that we have been looking at is on jobs in the south-west already engaged in the offshore wave and tidal sector. It is not just the south-west, it is also south Wales, Pembrokeshire, Southampton, Scotland, for example. There is a huge amount of activity going on today. It would be good if the Committee could consider how much work is being done in the UK, and the companies that are already engaged in this sector, as well as the opportunity for a single project.

**Q256 Dr Whitehead:** The view that this might be a series of projects that could be perhaps exemplars and, as you say, guidance points through further development, would presumably include, among other things, very substantial upfront costs and high strike prices, perhaps £190 per MWh, for those early projects. How would that compete with other, cheaper, renewable options, or would it simply be a high cost development exemplar?

**Johnny Gowdy:** Yes. Let us take wave and tidal stream, because they are probably the least developed of the technologies that we are talking about. At the moment, they receive five ROCs, which is a subsidy equivalent to around about £200 per MWh. That is limited, in the sense that it is time-limited to 2017, and it is size-limited to 30 MW. It is intended to jumpstart the industry, to get some of the early commercial projects in the water, so that we can then drive down costs and reduce those costs over time. The discussion about levelised cost of energy and strike price kind of focuses on mature technologies, because it is a slightly static way of looking at it. When you are looking at embryonic technologies, you have to look at how those costs can be reduced over a period of time. I think, from a UK Government point of view, we should not just be looking at market incentives like the strike price to support new technologies. We need to have a combined approach with a market incentive, grant subsidies and co-investment. That is a much better way of doing it. It does worry me that if wave and tidal stream is put in

the mix with the mature technologies, we will lose the support from, particularly, people in Treasury, for example, who will say, "These are too expensive". We will lose the opportunity to develop the jobs and the capability that we can then export around the world. That does worry me.

**Q257 Dr Whitehead:** Perhaps I am caricaturing things a little bit, but the Severn Barrage proposals, both the previous ones and the present ones, I think would say that this is all fairly feasible technology now, to the extent that you put a large concrete bund across the Severn, and you put turbines that already work in it, and you are away. Whereas you are talking here about a number of different technologies that are far less mature, are you not?

**Johnny Gowdy:** Which would spread over a longer period of time, but which we could potentially start sooner, I would say. Characterising the barrage as a done deal in terms of technology ignores the fact that we are talking about a new-concept, bi-directional turbine, one that has not been built yet. During the previous study, Rolls Royce and Atkins did a concept design for such a turbine. We have heard today that Hafren Power is talking to a number of different turbine manufacturers.

In terms of timetable, I find it hard to believe that a turbine manufacturer is going to develop a new turbine and test it. The comment (from Hafren Power) was that you could build a scale model and perhaps test it in a dock. I understand this industry, and I know exactly what the investors and the utilities will ask for. They will ask the turbine manufacturer for a performance guarantee and a warranty. A performance guarantee means that the turbine manufacturer will guarantee what the output of that turbine is. Those take years to develop. I have a question about the assertion that because they might weigh 400 tonnes, they would have to be built in Port Talbot, for example. The wind turbines weigh 300 tonnes and they are quite happily brought over from Bremerhaven. If it was the argument that they could only be built in Port Talbot, then that would lead to the conclusion that they would not be able to be exported from Port Talbot, because it would be a one-off project basically. So I do find that quite hard to understand. In particular, the timetable required to develop those things is going to take a lot longer, as it will do with wave and tidal energy. I am not saying that all the technologies are available today at all.

**Q258 Dr Whitehead:** Mr Evans, your company has outlined a radically different proposal for a tidal reef. In terms of reef equivalents, we have heard from Hafren that that would produce 1/20th of the power that a barrage would. But I think your proposal would dispute that, and would dispute it on particular grounds. Could you outline a little further what your reef proposal—

**Rupert Armstrong Evans:** Yes. I have come to rescue the reef concept, because Hafren—and they will have to admit it—have actually adopted the reef operating concept. It is all very well documented, because I filed the original patents and offered them for public use, so I cannot complain that they have taken on some of

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the clothing of the reef. But in my opinion they have made major mistakes in terms of how they want to implement it. Even now, they are distancing themselves from the original Severn tidal barrage project. I designed and built the world's first tidal stream turbine, which has now gone on to the project in Strangford Lough, which is the biggest one around. Although my main area is small-scale hydro, I was brought into this by Dr Linley at Plymouth Marine Laboratory, who was working on snails in the Severn Estuary, and they were terrified about the prospects of building the Severn Barrage. She said, "Would it be possible to come up with an environmentally friendly version to try and harness the amazing potential?" What came out of this is that projects of this kind of scale, I think, are approached in totally the wrong way. The Hafren project is finance-driven, project-driven. You start with the machinery and then you look at the environmental impact afterwards as mitigation in various environmental things. My fundamental starting point was that you have to address all the fundamental issues of birds, fish and ships, and how the project is owned. It is not going too far to say that, first of all, morally, you cannot take a piece of Wales and England and sell it off to a foreign multinational company. They have admitted themselves just now that they want to develop the project and sell it on. You cannot sell a piece of the UK. I think there is enough interest and good will out there in the British public to be able to float a green bond so everybody can take part in this project; good side or bad side, but it is part of our heritage, something that we are going to do for a long time. But if you do not have the project right to start with, then it is dead in the water.

**Q259 Dr Whitehead:** Your proposal, so I understand, starts and finishes in an entirely different place, and encloses a larger amount of water, and happens to land in the middle of a national park.

**Rupert Armstrong Evans:** Yes. Applying the reef technology to the Severn Estuary, we were looking at a route that was much further to the west, between Minehead and Aberthaw or that part of the estuary, because it encloses just about double the area of water. The thing with any big engineering proposal is flexibility. Building a conventional barrage is, in my opinion, an elephant, because you cannot change the civil engineering on a conventional barrage. Whereas the idea behind the reef was that it was not only a modular construction, from the point of view of installing it, owning it, maintaining it, but also, if things go wrong or if you want to future-proof it, if you want to update the technology at a later date, it is built in there. You can change the way it operates. If you have adverse flow effects in the estuary, you can change your operating system and learn and build on it. You are not tying yourself down to a major piece of civil engineering that is totally inflexible. This goes right through to things like the shipping interests. Further out in the estuary you have plenty of room to manoeuvre big ships. We are not talking about conventional lock gates that stop the ships for an hour. There are openings in this structure where the ships can just go through.

**Q260 Dr Whitehead:** I think you contend that you would gain a greater amount of power from that sited reef than you would from the proposed site of the barrage, even though you would be using the same sort of turbines, essentially. Or rather, they would be using the same sort of turbines that you originally proposed. Is that right?

**Rupert Armstrong Evans:** No. I do not think they have gone nearly far enough. They have simply taken conventional technology and are trying to move down to what I was suggesting. I have moved more from the tidal stream turbine, which is the original, and moved up.

**Q261 Dr Whitehead:** These would be bi-directional?

**Rupert Armstrong Evans:** Yes. There are two things that are working against each other are the higher the head difference, the more environmental problems and the more shipping problems, the more flooding problems. It is better to encompass a bigger area of estuary, where you have more potential, because there is more room in the design to be able to bring in these other factors, which are vital.

**Q262 Dr Whitehead:** DECC rejected your reef proposal in 2009 and said it was unworkable, didn't they?

**Rupert Armstrong Evans:** I can be fairly blunt. As far as I am concerned, it was—how does one put it?—a stitch-up. I think people would agree that it was a total disgrace and what happened with the various other parties is all on the internet. I do not object to people taking the ideas, but it is a hard pill to swallow when people take the ideas, do not give credit for it, and then go and change it and use it to dress up their own project, to make their own project look environmentally friendly.

**Q263 Dr Whitehead:** My point is that whether it is a stitch-up or not, they rejected your design as unworkable in 2009. Have you changed your thoughts since then to deal with a number of those issues.

**Rupert Armstrong Evans:** With all due respect, they did not even investigate the way it was built. It has evolved. The detail has come in, and with my somewhat limited resources, we have worked on it, put flesh on the bones, even in terms of developing fish-friendly turbines, because fish-friendly turbines are certainly not pie in the sky. For conventional river work, you end up with machines where—this is a small version of it—you could literally take a car through the spaces between the blades on the turbine, which is about the size of this room. So it is not particularly helpful when certain environmental groups say all turbines will act as mincing machines. Yes, certainly, conventional machines, if they are run on this, would be absolutely devastating to fish. I am saying you start at the other end and you have to design machines that will not do any damage. It is perfectly feasible.

**Q264 Dr Whitehead:** In summary, you are working from the other end?

**Rupert Armstrong Evans:** I am working from the other end, so that there cannot be an objection from

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environmental groups because one is working from the basis of consensus, and identifying those things that are the crown jewels, the really important habitat factors, and those things which are on the wish list. Because if people are not going to compromise—and there will be compromises on a scheme of this magnitude—then it simply will not get built, and it will end up in the European Court for the next 50 years.

**Chair:** We may need to move on, because we are running out of time.

**Q265 Barry Gardiner:** Specifically, the report said that they had found fundamental engineering flaws in the design. Have you addressed those specific criticisms?

**Rupert Armstrong Evans:** The specific things that they said were misunderstandings that they admitted—

**Q266 Barry Gardiner:** Have you published a response to those misunderstandings? Could we have it?

**Rupert Armstrong Evans:** Yes.

**Q267 Barry Gardiner:** That would be very helpful. Thank you. Turning to Vincent de Laleu, EDF has said that La Rance has been a technical success. That rather implies to me that it may not have been a financial success, or it may not have been a success in some other way. Why that word “technical” in front of the word “success”?

**Vincent de Laleu:** Thanks to La Rance, EDF has acquired unique experience in tidal barrage. We have been involved in worldwide feasibility studies on tidal projects. If we go back to La Rance, it was a very challenging project. Remember, it was designed in the 1950s and built in the beginning of the 1960s. There are many lessons learned from La Rance, despite the fact that La Rance is a very small scheme compared with the Severn Barrage. But we can still learn, because the first point is that innovation is the key to deliver a successful project. There were a lot of technical innovations. The turbines were the first bulb turbines used for the tidal barrage; the corrosion protection. From the way they built La Rance, we know that the construction has had a massive impact on the ecosystem, so now we should build in a very different way.

From the technological point of view, it is very successful, because regarding the maintenance of the turbines we have less maintenance on these turbines than the run-off-river plants using the same bulb turbines. So it is quite successful.

**Q268 Mr Lilley:** More than what?

**Vincent de Laleu:** If we compare La Rance with a dam using the same bulb turbine in a river, a conventional run-off-river plant, at La Rance we have less maintenance work thanks to corrosion protection, which is very effective. There are many successful technology developments. Regarding the environmental impact, we know that it took approximately 10 years, according to the experts, to have a new ecosystem in the estuary. Now we have a

new ecosystem, but we have to bear in mind that the ecosystem is very fragile and it depends heavily on the way we operate La Rance. This is why EDF is part of a local committee with different stakeholders—

**Q269 Barry Gardiner:** Is it a qualitatively different ecosystem from the one that you had before?

**Vincent de Laleu:** Yes. Experts say that the estuary has been turned into a sea, a small sea. We have new fish, new species, so it is a different estuary from before. We have new fishing activities. It is a significant change; now we have a new biological environment.

**Q270 Barry Gardiner:** What is the price of electricity that La Rance is delivering at the moment? What were the financial arrangements? How was the barrage financed?

**Vincent de Laleu:** Regarding the price of electricity, I am afraid I do not have a real figure, but I could provide you with the information. It is confidential within EDF. This project was funded by EDF. EDF was created in 1946 and the study started just before that. It was a huge programme in France after the war, to rebuild the energy system, and La Rance was part of a massive programme of hydro-development in France. It was funded by EDF, so by the state at that time.

**Q271 Barry Gardiner:** Environmental groups in the UK have said that La Rance is perhaps not an appropriate comparator to the Severn Estuary. Do you think that is a fair comment?

**Vincent de Laleu:** It is difficult to compare, because the site conditions are not the same. We have less turbidity in the La Rance river. But there are some interesting comparisons, also, due to the magnitude of the project.

**Q272 Barry Gardiner:** Have EDF developed any other tidal power facilities after La Rance?

**Vincent de Laleu:** EDF carried out various feasibility studies in France until the beginning of the 1980s. Unfortunately, in France we do not have suitable large estuaries. La Rance is quite a unique site. But there were some very innovative projects in Mont St Michel Bay, close to the Channel Islands, based on multi-basins, on land-connected lagoons. It was a strategy decision at the end of the 1970s to launch the nuclear programme, so most of these projects were ruled out. But EDF have also been involved in international projects. We have supported, for example, the Shiwa project in South Korea. We helped them to commission the powerplant.

**Q273 Barry Gardiner:** Do you have knowledge of very low head turbine technology and design?

**Vincent de Laleu:** Yes. We have a good knowledge, and we are in touch with turbine manufacturers, because there are a lot of innovations. In Russia, they are developing a very innovative concept based on vertical axis turbines, which have been tested in existing tidal barrages near the Barents Sea, so we are in touch with these kinds of people. We are in touch

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with the developers. We believe that a conventional barrage using turbines nowadays is unlikely to be the most cost-effective solution. We need to increase the energy yield of barrage schemes, and the idea of having a 100% reversible turbine is a good one, but it will take many years to develop such a turbine. It is quite a technical challenge.

**Q274 Barry Gardiner:** The design that Hafren Power have proposed to use, you would say would take many years to develop?

**Vincent de Laleu:** Yes. It will take several years, because we have to make sure it works. We need to test it. This is an opportunity to say that La Rance could be a suitable test, because there is room to test such a turbine. We need to test these turbines in real conditions, not only in a dock. We believe that is not enough. Therefore, it requires several years to develop it to make sure it will be cost-effective, efficient, and it will work properly.

**Q275 Mr Lilley:** Within the French context originally, I believe, La Rance was intended to be the precursor of a bigger project from Granville or wherever, but it was decided that such bigger projects would not be attractive vis-à-vis nuclear—less attractive than nuclear?

**Vincent de Laleu:** From EDF's point of view, we are committed to developing low-carbon emission solutions, including nuclear and renewables—hydro, tidal and wind. We need a mix of different solutions, and the tidal range could be part of this energy mix, provided it is a cost-effective solution and all the different issues are well addressed. It requires time; everybody here is aware of the different environmental and economic issues. It will take time to be sure that such a large scheme is feasible, but it could be part of the energy mix, because the key advantage of tidal range is predictability, and for a manager of energy it is very interesting.

**Q276 Mr Lilley:** Has La Rance been economically successful?

**Vincent de Laleu:** Now, yes. We consider—

**Mr Lilley:** Now?

**Vincent de Laleu:** Yes. Of course, at the beginning, like every innovative technology, we had to cope with some failures in terms of the design, because the design of the alternator was not very suitable for the many stops and goes, due to the cycle, because we pump as well. La Rance is an ebb and flow generation plant, so we needed to refurbish and to modify the alternators. Now, 44 years after we commissioned La Rance, we are starting a maintenance programme on the turbine, mainly on the alternator. So it is quite a success in terms of technology, yes.

**Q277 Mr Lilley:** Is there a silting problem at all?

**Vincent de Laleu:** There are some sediment deposit issues, but in the upstream part of the estuary where the fresh water meets salty water. But it is a very local issue, and we are working with the various stakeholders to find the best way to trap the sediment. We carry out a dredging operation every 10 years. But it is a very local issue.

**Q278 Mr Lilley:** Why do you think areas with more advantageous tides, like the Severn and, the biggest of all, the Fundy basin or wherever it is, in Canada, have not been inspired by La Rance to introduce tidal barrages?

**Vincent de Laleu:** In Canada, in New Brunswick and Nova Scotia, some representatives visited La Rance in 1967, and they started to launch a massive programme to harness the tidal range in the Bay of Fundy, but most of the projects were ruled out due to the environmental impact. There were some issues, so they decided to rule out most of the projects, but now they are involved in the development of tidal stream energy. But some developers have resumed the feasibility study of lagoons—not a barrage across an estuary. A lagoon would be more suitable in the Bay of Fundy.

**Chair:** I am afraid the witching hour is now upon us. If you have any further points you would like to make, I would ask you to submit them in writing if you would not mind. Thank you very much for your time this morning.

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Thursday 28 February 2013

Members present:

Mr Tim Yeo (Chair)

Barry Gardiner  
Ian Lavery

Dr Phillip Lee  
John Robertson

### Examination of Witnesses

*Witnesses:* **Ed Mitchell**, Director of Environment and Business, Environment Agency, **Dr Richard Cresswell** MBE, Director South West, Environment Agency, and **Mike Evans**, Strategic Environmental Planning Manager, Environment Agency, gave evidence.

**Q279 Chair:** Good morning. Thank you very much for coming in. Welcome to this, our last oral evidence session on this particular subject. For the benefit of the broadcasters, I am supposed to ask you to identify yourselves first even though we know perfectly well who you are. Dr Cresswell, perhaps we could start with you. Just say your name and position, and we will work our way across, please.

**Dr Cresswell:** I am Richard Cresswell. I am the Director for the Environment Agency in the south west of England.

**Ed Mitchell:** I am Ed Mitchell. I am the Director of Environment and Business for the Environment Agency.

**Mike Evans:** I am Mike Evans. I work as Strategic Environmental Planning Manager in the Environment Agency in Wales.

**Q280 Chair:** Thank you very much. As you know, there is a great deal of interest in this inquiry, and we have taken quite a lot of oral and written evidence already. Obviously, we have seen your written evidence. There seems to be a significant difference between your views and those of Hafren Power. What can you tell us about what you think is the potential flood risk and environmental impact of their scheme?

**Ed Mitchell:** Thank you very much. I will start on that, and I will ask Richard to come in on it as well, if I may. We have a strategy going forward about 100 years for the Severn Estuary and flood risk, which shows that we would expect to spend something like £1 billion over that period to maintain and improve the defences. That is based on current assessments of what the optimum level of defence is, in terms of cost-benefit analysis and so on. A barrage across the Severn has potentially both positive and negative implications for flood defence. For instance, it may provide additional defence against storm surge but may provide difficulties in terms of land drainage upstream of the barrage. Therefore, that could increase fluvial flood risks because, if the tide does not go down as far, it is more difficult to get the water off the land. In broad terms, we think it is probably cost-neutral in terms of the flood defences. Richard will be able to give more detail.

**Dr Cresswell:** Chairman, the only additional thing I would add is on the downstream effects. From Professor Falconer's work we know that he is suggesting that there may be a 20 centimetre rise around the Swansea area. There would obviously need to be more defences, but we would need far more

detailed modelling from Hafren to be able to say exactly the effect. Of course our studies on the previous model saw far-field effects as far as southern Ireland and around Wales. That will probably need refining anyway, but we would need to see the detailed modelling.

**Q281 Chair:** There is quite a big difference. They are claiming between £2 billion and £8 billion of savings. You are saying roughly neutral. Why is there such a huge disparity?

**Ed Mitchell:** The main thing is that probably one is a comparison of the cost of damage if defences were not there, and the other is the cost of ongoing maintenance of existing defences. We have spent quite a bit of money in that area in the last few years. That area of the coast is pretty well protected, so our £1 billion over 100 years is based on maintaining those defences. You get a much bigger figure if you assume that those defences are just left to decay and the damage that then ensues. As I say, we also protect to this optimum level based on Government guidelines between costs and benefits. It is possible that a barrage would give additional benefit over and above that, but it isn't money that we would have spent because, for instance, it would be against very rare tidal surges or something like that.

**Q282 Chair:** In relation to your first answer, are you saying that above the barrage there might need to be extra expenditure to address the higher risks that would come?

**Ed Mitchell:** Yes. As Richard said, the details are relatively sketchy and the devil is always in the detail. You can imagine that, if the tidal range is reduced, a lot of the discharge from the land, a lot of getting the water off the land, happens at the lower part of the tide. If you restrict that lower level, then you might have to physically pump. For instance, instead of gravity drainage you might have to install pumps. That is one possible additional cost that might ensue.

**Q283 Chair:** In practice, are these figures pretty speculative anyway? Where would they come from? I think they are trying to agree with Defra some common ground, but are they really guesstimates more than estimates?

**Ed Mitchell:** If I may, I will ask Richard to comment on our £1 billion figure. Obviously, a 100-year horizon, there is a degree of estimation and experience

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in that. Richard, I don't know if you are able to add more.

**Dr Cresswell:** Our figures of £1 billion are built on our best estimates of condition of assets now and predicted sea level rise. £600 million of that is maintenance of existing flood defences, which at present are in relatively good condition for places like Newport, Cardiff, Weston-super-Mare and Burnham. Just to try to help comparison, we have added in an amount of about £200 million for a barrier that we would put in, in 20 to 30 years' time, to protect Bridgwater, and, also speculatively, another £200 million additional to our costs, bringing it up to £1 billion for a barrier for the Bristol Avon. That is very speculative. We have only just started talking to Bristol City regarding that. Our billion is as accurate as we can get it. We have not had enough detail from Hafren Power to know where they have their costs from.

**Q284 Ian Lavery:** Professor Falconer from the University of Cardiff has stated that the high water would be reduced by approximately 2 metres under the Hafren power scheme project, resulting in reduced fluvial flooding. He also states that the mean sea level would remain unchanged, avoiding the drainage problems associated with tide lowering. Are you familiar with the Cardiff University research and, if you are, do you accept these conclusions?

**Ed Mitchell:** We have had some conversations with Professor Falconer. Indeed, he has agreed to send us more detail on it, so our familiarity with him is partial at the minute. The proposed barrage from Hafren doesn't collect the water on the high tide, restrain it and then let it through; it allows the water in both directions on both tides, so I think the professor's assertion that the mean sea level is likely to be largely unaffected seems reasonable. I think what he said is, as you say, that you lose the top 2 metres of the tidal range and the bottom 3 metres. Both sound very plausible. We have not seen the full detail yet.

**Dr Cresswell:** If I may, I suppose our major concern is at the lower end of the tidal range, where he is saying that at present it is from nought to 14 metres and in future, on his predictions—and we haven't seen the detail of his modelling, but if we accepted that—it would be from 3 to 12 metres. It is the 3 metres at the lower end with which we have the greatest concern because of the freeboard for getting water out of rivers. Certainly, around the Severn Estuary one of the biggest problems is land drainage.

**Q285 Ian Lavery:** Professor Falconer's research also states—and that is to quote him—that there will not be any significant far-field effects associated with the proposed barrage. How does this compare with your own assessment and your own research?

**Ed Mitchell:** The previous assessment was done by the Government, not by the Environment Agency, and, as Richard said earlier, it did show some slightly surprising far-field effects around, for instance,

southern Ireland. As I understand it, the professor believes that that was a factor of the way that the models operated. We have not seen the detail of Professor Falconer's modelling, so it is a little bit hard to comment, to be honest.

**Q286 Ian Lavery:** You do not have any comparative evidence, really?

**Ed Mitchell:** To be honest, the most robust evidence that we have relates to the earlier Government study, which did show those bigger far-field effects, but we hope to get underneath the detail of the professor's study and be able to take a judgment about whether his modelling looks more accurate.

**Q287 Ian Lavery:** How might existing flood defences be impacted by the construction of such a barrage?

**Ed Mitchell:** Perhaps I could ask Richard to comment on that.

**Dr Cresswell:** I will try not to repeat some of the stuff I have said already. The key bits are land drainage upstream, and certainly in places like the Somerset water levels, we do rely on the river running right down to be able to pump for as long a period as possible. The far-field effects that you have just been asking about are under that area that we would be concerned to fully understand. If you constrain the tide to 3 to 12 instead of nought to 14, then the tidal action is acting on the coastline in a much narrower band and, therefore, we want to look at whether it will erode defences more than it does now. Those are the effects that we would want to understand better.

**Q288 Ian Lavery:** Could you give a brief outline of your current Severn Estuary flood risk management strategy at this point in time? Briefly, of course.

**Ed Mitchell:** I would look to Richard again, I am afraid.

**Dr Cresswell:** We are right in the throes of producing the strategy. We are hoping to publish a strategy for this by the end of this year. It is based on protecting the 75,000 homes and the 25,000 businesses that are at risk to the level in line with the Government criteria over the next 100 years. That is where we get our estimate, in current cost terms, of about £600 million. That is not net present value.

**Q289 Ian Lavery:** The strategy, will that include the possibility of a barrage scheme?

**Dr Cresswell:** No, it excludes the barrage scheme because the strategy is still speculative and so that would have to be considered. A major part of our flood defence strategy is, because we have hard defences extensively around the Severn Estuary, we have had to find compensatory habitat or be able to convince Government of the fact that we can find compensatory habitat, so that we comply with the Habitats Directive.

**Ed Mitchell:** If I may just add to that. Because we are planning over such a long time scale, all of our flood risk strategies are adaptive. Rather than assuming,



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right now, that we can predict what sea level rise is going to be in 100 years, they allow for levels of sea level rise but we do not need to spend the money until we are certain. The plan is not set in stone now and then lasts for 100 years without alteration. We would clearly get into conversation with the developers of a barrage about how the plan would have to adapt.

**Q290 Dr Lee:** Good morning, gentlemen. Moving on to potential impact on wildlife, the Environment Agency has a regulatory responsibility to protect migratory and freshwater fish. What are your main concerns about how the barrage would impact on these fish populations?

**Ed Mitchell:** Thank you. Our two main concerns about barrage proposals across the Severn generally are the flood risk one, which we have covered, and then the second one is compliance with the Habitats Directive, both in terms of the habitat itself, the intertidal habitat, but also migratory fish. Again, the very detailed Government study that predates the Hafren proposal looked at that in some detail. It looked at various different barrage options, none of which is exactly the same as the Hafren one, as far as we can tell, but it appears to show some fairly significant effects on protected fish species.

**Q291 Dr Lee:** Hafren claim that their VLH turbine is fish friendly. I don't know how it can be, but they claim it. However, you have stated that you are not familiar with any turbine technology that allows for the safe passage of fish. What lessons can be learned from your experience in tidal turbine technology?

**Ed Mitchell:** Yes, our comments were made very specifically about tidal turbines. You can have low head Archimedes screw type turbines on rivers, which we believe are fish friendly. We haven't seen the full detail of these turbines. I have seen in Hafren's proposals that they are sets of counter-rotating turbines where, for instance, the tip speed is around 9 metres per second, so you have one tip going one way and one tip going the other way at 9 metres per second. It is difficult to envisage how that could be fish friendly. However, a fish friendly tidal turbine would be a great prize for renewable energy for UK industry. It is a case of we have not seen the detail. I do not believe any of these exist, as Hafren currently envisage them. For me, the obvious thing would be to get a trial going to demonstrate whether or not they are fish friendly.

**Q292 Dr Lee:** My own view on this is if we cannot do this what can we do? Your principal aim is to protect and improve the environment for people and wildlife, but you are also committed to reducing the effects of climate change and promoting sustainable development. In the case of the Severn Estuary, where does the balance lie between guarding against climate change and protecting the natural environment?

**Ed Mitchell:** That is a very difficult question. We fulfil three roles: we are an environmental regulator; we are an adviser to Government; and we are an

operator, in terms of operating flood defences and flood warning systems and the like. Of course, we would offer advice to Government on that balance. I am not trying to avoid the question, but it really is a matter for Government about where that balance is drawn. It is a very complex and difficult balance.

**Q293 Dr Lee:** In offering that advice you clearly do not have policies in the agency; that is not your reason for existence. I mean, I asked the RSPB and the Angling Trust, "It is okay you are against this. What are you for?" because there is absolutely no way we can hit decarbonisation targets that we are signed up to by 2050 unless we start generating energy in a different way, such as this or nuclear or carbon capture and storage. They are the choices currently on the table. Do you have that in the back of your mind, that if you offer advice that makes the politicians say, "Okay, we are not really going to go down that path" that you recognise that by default you are then saying it has to be one of the other two? Is that in your mind? The Environment Agency's approach to nuclear, say, there are three nuclear sites in the Severn Estuary. Presumably, if you offer advice that is not negative but certainly is discouraging, you recognise, therefore, that increases the likelihood of more nuclear power stations in the Severn Estuary?

**Ed Mitchell:** We are very aware that, in its analysis of how you get to the 80% by 2050 target, the Climate Change Committee says that you have to almost completely decarbonise energy generation by the 2030s. So that is a very important factor. As I say, we have these three distinct roles. We would advise Government particularly on the implication of a particular scheme, in terms of the regulation that we and others are asked to enforce. As I say, details are still quite sketchy and I think it is a very difficult balance. It is also important to flag up early that we see the flood risk issues as important, but we also see the habitat and migratory fish issues as probably the more difficult challenge for any proposal to meet the legislative requirements.

**Q294 Dr Lee:** But you recognise that there is—

**Ed Mitchell:** Absolutely recognise that there is a balance.

**Q295 Chair:** Going back to this question about the fish friendly or unfriendly nature of the turbines, I think you said in your answer that it would be very helpful if we could design something that was fish friendly. Do you know of research that is taking place to try to achieve that goal?

**Ed Mitchell:** If I may, I will bring in Mike in a second. There are two extant barrages, one in France at La Rance and one in Nova Scotia, which potentially offer some opportunity to use that as a research test bed. As I understand it, at the one at La Rance there has been very little analysis of the impact on fish. At the one at the Bay of Fundy, I understand that there are some results showing a high fish mortality. They are both modest in size compared with the Hafren proposal. The problem is that at the minute the evidence is sparse, and I think any serious proposal

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needs to work on developing that evidence as their ideas develop, but Mike?

**Mike Evans:** Yes. The challenge in the Severn is quite different to other estuaries or rivers, where we have this issue of the multiple passage of fish across a barrage. For example, the salmon and the other migratory fish may enter the estuary and remain there for three months. You can imagine an adult salmon, which is waiting for the right conditions to enter its natal river to spawn, may go across a barrage four times a day for three months. So the actual impact of turbine on fish has to be extremely low, because over the years just a very small attrition in that population will drive it to extinction. It is a huge quantum shift in turbine technology in terms of safe fish passage that we are looking at. It is not moving it from Fundy's 50% kill of shad down to a 5% kill. We are looking at kills below 1% and negligible strike or mortality. It is a very, very big challenge indeed.

**Q296 Barry Gardiner:** I want to pick up on that because it is my understanding—and I am turning now to the IROPI test more particularly—that the proposed compensation package must not be pursued if it cannot be guaranteed or where failure to compensate for residual adverse impacts might drive a feature or a species towards irreversible decline throughout its range. The first thing I want to establish is: is that your understanding of the IROPI test?

**Ed Mitchell:** We are subject to IROPI tests rather than the determinant of IROPI tests. For instance, some of our coastal flood plans have to go through an IROPI assessment. Frankly, we are not expert in exactly how the test works. My understanding is that, first of all, you have to look at all possible mitigation measures. Where mitigation cannot reduce the risk sufficiently you have to look at providing alternative habitat. That habitat has to be in place prior to the development going ahead. It is a hugely complicated area that is not our particular expertise.

**Q297 Barry Gardiner:** Mr Mitchell, I agree with all that you have said, but my question is specifically pointed to try to elicit two answers from you. One is the nature of the guarantee that has to be implicit before the compensatory package can be put in place. That is a guarantee that there will be the desired result in terms of the impacts on the species. The other is about the range. I want to know the degree of certainty that one has to have that the compensatory measure is going to be successful before you are allowed to proceed. Because if that is necessary, then presumably one would have to—and I go back to your remarks earlier about putting in place a trial of the turbines to prove that they were fish friendly, and how that guarantee would work unless a trial were carried out, and it goes to Mr Evans's point—do that over quite an extensive period of time to see the nature of the depletion of the stocks.

**Ed Mitchell:** I understand the point you are getting at. I am afraid I am not expert in the detail of the test and as an organisation I do not believe we are. Richard, you have taken some coastal zone plans through the IROPI test or are in the process of that. I don't know if you are able to add anything, otherwise

I would suggest that that might be a question better directed at the conservation agencies that deal more directly with the IROPI test.

**Dr Cresswell:** Two points that I hope are helpful: one is that obviously the way that the turbines work and the degree to which they are fish friendly would not be compensation. That is the mitigation part of it, and we would need that proven. I know you understand that. Our experience with IROPI with our flood risk strategy, we are required to prove that our flood defences are necessary, which we are able to do fairly well, but then to provide the compensatory habitat, we have to be able to prove satisfactorily to Natural England—who are the Government's advisers—that the habitat that we are providing will be equivalent to the habitat that we are losing, and the methods that we are going to use over the period will provide that habitat, and that there is evidence that we or others have been able to provide intertidal habitat elsewhere.

**Q298 Barry Gardiner:** Sorry, Mr Evans, did you want to come in there?

**Mike Evans:** The only thing I could add is, the best evidence we had of the potential damage on the SAC species of fish—the five species we are talking about—is that there would be local population extinctions. Of course the test then is: how would you compensate for that? The Government study spent a great deal of time looking at the various options for compensation and did not conclude anything firm on how you would replace one of those rivers in terms of it being able to support shad, salmon, lamprey and so on.

**Q299 Barry Gardiner:** My next question follows from that and it is the second point. I want to establish what you consider the range of the species to be. Are we talking about here a biogeographic region, or are we talking about specific to the member state? Because, of course, the nature of our species is that they don't confine themselves to national boundaries. So what I want to establish from you is: one, what do you consider to be the biogeographic range; and, two, is it your understanding that any compensatory package or measures would have to take place within the member state or across that biogeographic range.

**Ed Mitchell:** It is a good question. As I understand the way the Habitats Directive works—and colleagues at Natural England are more expert in this than us—is that it is about the integrity of the designated site. There are various designations around the Severn Estuary, but I think they are all within our territorial waters. I don't know about the point about whether you can provide compensatory habitat outside the site. I think you can and I think that then becomes designated automatically. Mike, are you able to—

**Mike Evans:** There is some guidance from the European Union on this, which is to provide like-for-like compensation. That will be the challenge, whether you can find the quantum of either intertidal habitat within that region, as you have described it, and I am not an expert on that. Of course the other difficulty then is that with salmon they are loyal to their natal rivers. They do return to the same river to spawn, so there is a particular challenge there. We have poor

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understanding of shad, which only spawn in four rivers in the United Kingdom at present, three of which would potentially be upstream of the Severn barrage. We don't quite know what makes a shad prefer those three rivers to similar adjacent rivers, which they do run into but don't successfully spawn in. The challenges are about our knowledge and how then the application of the law and the guidance works, and, as we said, the law and the guidance is not an area of our particular expertise.

**Q300 Barry Gardiner:** Just to see how you plug and play into the machinery of potential decision-making here, you would be advising Natural England, who would be advising Government?

**Ed Mitchell:** I think it slightly depends on the vehicle by which a development comes forward. My understanding is that if a hybrid Bill route is used, then all of these considerations are part of the legal process that generates the Bill. We would be advising Government directly in that process but would not obviously be the decision makers. If it is done through the administrative planning route—and I don't know exactly what that would look like—but then we would be a statutory consultee to whatever the planning authority was in this particular instance.

**Q301 Barry Gardiner:** If you are a statutory consultee, though, is it not incumbent upon you to have clarity on all of these legal issues? Because unless you have absolute clarity on what constitutes the biogeographic region or where the compensation has to happen or what sort of guarantees have to be in place before you are allowed to put in a mitigation or compensation package, then you are not going to be able to fulfil that role as an adviser in that statutory consultation effectively.

**Ed Mitchell:** Our role would be to advise on the likely impact of the development on the protected species that we are responsible for looking after. I think the conservation authorities would provide the advice to Government on what the implications of those impacts were in terms of the legal tests. We can only provide advice based on knowledge, so if research does not exist it does not exist.

**Q302 Barry Gardiner:** Of course, I understand that. Let me not pursue that further. Look, the barrage is likely to require significant land change, both within and outside of the estuary. Can you tell us about your experience of delivering such land change projects, such as with managed coastal realignment?

**Ed Mitchell:** If I may, I will pass to Richard as we have a couple of good examples down in the south west.

**Dr Cresswell:** As part of the Severn Estuary flood risk strategy, we have had to try to find areas for the managed realignment. We have had one very successful one that we are now building at Steart Point, which is on the edge of the Parrett Estuary, where we are creating 400 hectares of intertidal habitat. That has probably taken us eight years in the

negotiations and getting local communities happy with the proposals. I am sure we could do it quicker than that having learnt some of the lessons. Indeed, around the estuary, we are now talking to communities about what changes will happen over the next few decades and what opportunities there are for working with landowners to find some habitat. The amount of land that we need would be small compared with possibly the compensation that would be needed for a habitat with regard to a barrage.

**Q303 Barry Gardiner:** Indeed. You stated in your evidence that the IROPI tests can in themselves prove a significant stumbling block. Perhaps the time scale that you have averted to, for a much smaller compensatory scheme when scaled up for the Hafren barrage, might prove an enormous stumbling block, certainly to an investor I would have thought, if we are talking eight years and over.

**Dr Cresswell:** I think some of that will be for Government. The way that the Environment Agency has tackled this is through wanting to work with landowners, not to impose things but to do it with their agreement. There are other methods of doing that, but that is not the way that we have done it.

**Ed Mitchell:** If I may add to that, the examples we have are about recreating intertidal habitat, which I think is an easier prospect than recreating fish habitat. You can get a piece of land, realign the flood defences, open it up and create intertidal habitat. We know how to do that. We have done that in many parts of the country. As Mike has explained, recreating a fish habitat for migratory fish, particularly in a different place, is a different issue.

**Q304 Barry Gardiner:** How would a barrage developer be affected by the requirements of the Water Framework Directive?

**Ed Mitchell:** Within the Water Framework Directive, there is a particular test—I think it is called the Article 4.7 test—which allows for development that will have a negative impact on the quality of the Water Framework Directive status if it is in wider socioeconomic interest. That process has been used several times within Europe. It is perhaps more of a well understood and well trodden path than the IROPI test under the Habitats Directive. The requirements of the Water Framework Directive would either be embedded in the legislation that was necessary for a scheme or in the planning permissions. We would advise on those. There are some significant challenges in that, but, compared with the challenges of the Habitats Directive, I think they are of slightly less order.

**Q305 Barry Gardiner:** Could you describe the work you are currently undertaking to improve the Severn Basin and how that might be affected by the proposed barrage?

**Ed Mitchell:** We are doing a great deal of work around the country to meet the requirements of the Water Framework Directive, which, as I am sure you know, operates in six-year cycles. We are about halfway through the first of three six-year cycles envisaged under the Water Framework Directive. We

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are spending a lot of time, money and effort with many partners in terms of improving the water quality, the biological diversity of rivers in the west country and in the Severn Basin. Without further detail on the barrage itself, it is quite difficult to be certain about what the implications are for the Water Framework Directive status. Fish population is an important

component of how you assess a river body for good ecological status, so, clearly, if you impact the fish population you impact on the Water Framework Directive status.

**Barry Gardiner:** Thanks very much.

**Chair:** Thank you very much for coming in. That has been much appreciated.

### Examination of Witness

*Witness:* **Alan Seatter**, Deputy Director-General, DG Environment, European Commission, gave evidence.

**Q306 Chair:** Good morning. Thank you very much for coming in. You have obviously heard some of the previous evidence. I will begin by asking you: Hafren Power have said that the barrage project requires an environmental impact assessment. We understand that an appropriate assessment would also have been necessary under the Habitats Directive. Could you set out what initial assessments are needed for projects of this sort under the Habitats Directive?

**Alan Seatter:** Chairman, under the Habitats Directive, you would be required to do an assessment of a project that would have a significant impact on a Natura 2000 site. The Environmental Impact Assessment Directive requires environmental impact assessments to be done in certain specific cases. We have recently put a proposal to member states to have a one-stop-shop where we unify those requirements, but that is not yet in place. For a project that would have a significant impact on a site, on a Natura 2000 site, one would be required to do an appropriate assessment under the Habitats Directive.

**Q307 Chair:** What kind of data is involved in an appropriate assessment?

**Alan Seatter:** It is almost impossible to give a general answer to that because every site is unique and has its own characteristics. It would depend on what the objectives are; what are the conservation objectives for the site that were set when that site was designated? One would reasonably expect that in designating a site there is a base line. What would be really important would be for a base line of data in relation to the objectives for conserving that site, so the habitats and the species that are important in that area. That data is then monitored over time, and that process would then inform public authorities as to what kind of impacts might happen and what you would need to do to address those.

**Q308 Chair:** Once that assessment had been carried out, how would that affect the development of a potential project?

**Alan Seatter:** First, it would determine what would be the likely impact of the development on the conservation objectives of the site, in particular the species and the habitats that are concerned. The question would be: is the integrity of that site significantly affected by the proposed development? You would look at all the alternatives that would be available to that particular project, including a zero option. So, what works well is a good assessment of the zero option, the project in question, and the

alternatives to determine what kind of measures would be needed to mitigate the impact of the project on the species and habitats in question, and then what changes to the design of the project would be needed to mitigate those effects. That would be the first step. If it becomes clear that there is no alternative and that there is a major impact on the integrity of the site, then you would need to go into considerations of: is there an overriding public interest to proceed with the project?

**Q309 Chair:** Hafren Power told us that they intended to meet the commissioner for the Habitats Directive during February. Do you happen to know if that meeting has taken place?

**Alan Seatter:** They have not asked for a meeting and there has been no meeting with the developer. We have had a meeting with our colleagues from the Department of Energy and Climate Change in February 2011.

**Q310 Chair:** Would it be normal for developers of projects of this kind to try to have discussions with the Commission?

**Alan Seatter:** At this point in time, I don't think we are the right address yet for the developer. We are always happy to meet anybody that would like to discuss what approach should be taken to projects that are big projects in Natura 2000 sites, but the main address I would say would be the local authorities and agencies involved, the local community, local people, and the Government. That is the first port of call. We are happy to provide any assistance that we can to developers, or primarily to the Government if it decides that this is the sort of thing it would like to go ahead with.

**Q311 Chair:** The company have said they hope to begin construction of the barrage in 2015. Obviously, by that time they would have had to have completed all the relevant assessments. In your experience, does that sound like a realistic timetable?

**Alan Seatter:** Again, it is almost impossible to give you an answer to that question because every project is unique. I understand that this particular project is likely to be completely unprecedented. I don't know that anybody has ever dealt with a project of this scale as we understand it. That very much depends on national planning procedures and not on anything to do with the Habitats Directive. Our experience is that the earlier the local community is engaged, the more data there is—the base line data and monitoring data

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in relation to the species and habitats there is. The clearer the management plan for the site in question is, the earlier the assessment of alternatives is. These things tend to go quicker.

**Q312 Barry Gardiner:** Could you briefly outline for us the purpose of the Habitats and Birds Directive and its implications for large-scale infrastructure projects?

**Alan Seatter:** The Habitats Directive has a clear environmental outcome in mind, and that is to achieve good conservation status for every site that is listed in the Natura 2000 network. That objective is far from being met in many cases, particularly in the Atlantic region. The first objective is—

**Q313 Barry Gardiner:** Sorry, I want you to continue, but I want to elucidate the point I think that you are making. That is that, therefore, it is not sufficient if a site is in poor condition simply to leave it in poor condition because the purpose of the directive is to enhance the ecological condition of that site. Is that correct?

**Alan Seatter:** Yes. Member states are required to put in place measures for each site that maintain and, where possible, restore the conservation status of the site. The objective of the directive is the one related to biodiversity and ecosystems. That is to achieve favourable conservation status. It is also to put in place a network of sites that meet the needs of people and nature. There is a sustainable development concept, where one would take into account environmental objectives, economic objectives and social objectives, based on a good scientific underpinning—which is why I stress the issue of base line data and monitoring of that data—and also of public involvement in the process. Those are a quick summary of the kinds of objectives that one is trying to achieve. It is an outcome-based directive and we are all working together to achieve that outcome across the network.

**Q314 Barry Gardiner:** You will have heard the questions that I put to the earlier panel, specifically relating to the nature of the site and the proposed mitigation compensation package and the guarantees that were required in order to commence the derogation process. Could you respond to those questions? I do not want to waste the time of the Committee by restating it because I know you were sitting immediately behind.

**Alan Seatter:** There might be a misunderstanding of precisely at what point there is any involvement of the Commission and what role we have in that, because this is a directive that is implemented by member states in the way that they feel best meets their own requirements and the requirements of the directive. Since 2007, there have been 15 notifications by the United Kingdom of compensatory measures under Article 6.4 of the directive, so it is not something with which the Government is unfamiliar.

In answer to one of the previous questions, I took you to the stage where it became clear that, in the light of an assessment of alternatives, a project could only go ahead if there was an overriding consideration of public interest. Where that consideration is met—and

I can go into some detail of that if you want later—then in order to address the specific damage that the project would do to the conservation objectives of that site, and the habitats and species concerned, there would need to be a package of compensation measures put in place.

Again, I can explain the like-for-like issue a little bit more if you want, but the compensation measures can be taken by the Government, or whichever authority is taking the final decision, and the Commission is informed. There is no need to seek an opinion if there is no species or habitat in the area that is of priority status, meaning of global importance. As far as we know from the data that has been provided for this area, there is no priority of species or habitat concerned. One is assuming that all of the steps that I have just described have been gone through, and then, if the project were to go ahead, the Government would simply inform the Commission of the compensatory measures, why those had been taken and what the scientific underpinning of them would be.

**Q315 Barry Gardiner:** Thank you. That is clear. Can I ask you to address the issue of the biogeographic region of the site—whether a species must be restored across its biogeographic range, or whether it need be restored only within the member state?

**Alan Seatter:** If you take the case of migrating birds, for example, the criteria is over the natural range of migration of that species, and it could be outside the biogeographic region, outside Europe, in other parts of the world in many cases. The guidance that we have worked out with member states, NGOs and others, is site specific because that is the most useful thing and the most commonsense thing we can say in general terms about what you do to repair damage. If a project damages a habitat and species in that particular region, the first step is to try to find measures that repair that and address that in the region concerned. That is what happens in pretty well all cases. If somebody was to say, “But it is impossible to do that,” then clearly we are not asking for the impossible. It would depend on what would be the measures that addressed a specific problem. If there is a specific habitat that is destroyed or damaged or a specific species that is destroyed or damaged, what would be the alternative if it was not located in this particular area? First of all, we would look to something very close by. Then one looks at the biogeographical region within the member state. We have not had cases that have gone anywhere beyond that, so it is difficult to say anything sensible in relation to an unprecedented situation.

**Q316 Barry Gardiner:** Indeed. Can I try to draw you out on one point here in relation to this? That is that if there was an adverse impact, which drove a species to decline throughout its range because of a failure to compensate within the site, then am I right in thinking that—I hate to use a double negative here—that then would block the derogation process getting under way?

**Alan Seatter:** It is difficult to answer hypothetical questions.

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**Q317 Barry Gardiner:** As you said, we are in uncharted territory here, so they are all hypothetical questions.

**Alan Seatter:** The guidance is only useful if they are for the usual kind of case. This is speculating.

**Q318 Barry Gardiner:** My understanding is that the proposed package cannot proceed where there is a failure to compensate for adverse impacts that might drive a feature towards irreversible decline throughout its range. That is what I want to get clarity on.

**Alan Seatter:** Yes. If there is that kind of impact, then you would initially fail the test. I am not saying that is the end of the story; I am saying that it would need to lead to another discussion.

**Q319 Barry Gardiner:** Thank you. That is what I wanted to establish. Can you provide some examples of European precedents where derogation has applied?

**Alan Seatter:** Since 2007, we have had 34 cases where some form of derogation has been applied by member states and the Commission has been informed, and a further 19 where we have had to give an opinion because it has affected a priority species—that is for the EU as a whole—of which, as I said earlier, in the UK there have been 15 notifications. We have published each of those cases and they are all unique. They are all cases where—I think I am right in saying, in the case with your earlier witness—the question of the timing of the measures came up. In the case of the Elbe Estuary in Germany, we have accepted compensatory measures that were not put in place before the dredging project that was in question. In spite of our guidance, we have accepted in that particular case that it made no sense to try to do that, so we have extended the period over which the compensatory measures could be put in place. That is one example of a derogation to the timing rule.

**Q320 Barry Gardiner:** Thank you. Many stakeholders have expressed a concern about the lack of transparency and information relating to the barrage. Could you comment on whether the Aarhus Convention offers any remedies for public access to information?

**Alan Seatter:** The Aarhus Convention—to which the UK is a signatory, and the European Union is also a party to that convention—requires the public to be informed and involved in decisions affecting the environment. That requirement has been put into the European Environmental Impact Assessment Directives and is something that the Court of Justice is particularly attached to. It is a requirement to keep the public informed and involved, and to allow them to participate in the process before the decisions are taken. That is something to which all member states have signed up to and to which the EU is also a party. There are some cases that have been presented by several NGOs. The World Wildlife Fund for Nature has highlighted a place in Germany where experience is that public involvement and public information in that particular area, where there are 1,000 planning applications a year that affect that site, go very much quicker the earlier the public is involved and the more that it is participating in the process. There are legal

requirements to it and there is also a practical consideration, which means that things go much smoother if that happens.

**Q321 Barry Gardiner:** Thank you very much. Final question: my understanding of the whole process of derogation under the directive is that there is a precondition, and the precondition is if there is no suitable alternative solution. What we are talking about here is power generation. This is what the barrage is designed to do, to generate power. I would have thought that manifestly there are innumerable alternative suitable solutions, in that one could look at an offshore array; one could look at onshore wind; one could look at any number of low carbon energy generation technologies. How could the barrage claim that there were no suitable alternative solutions?

**Alan Seatter:** I might irritate you by not being able to go into the details of this project—

**Barry Gardiner:** I am sure you will not irritate me, Mr Seatter.

**Alan Seatter:** because we are not involved in this project at the moment, so I don't want to say anything about whether there are or are not.

**Q322 Barry Gardiner:** Let us take this barrage out of it. How could any low-carbon energy project state that there were no alternative suitable solutions, given that manifestly one can create low-carbon energy in many, many different places and in many, many different ways?

**Alan Seatter:** I think the first alternative is the zero option. Everything should be assessed against the option of not actually going ahead with the project at all and what that would mean, in terms of climate change objectives as well as economic and social impacts and environmental impacts on the region itself. It would be difficult to conceive of a project, and it is not our experience, in terms of the derogations that have been given by member states for this type of project, that there is never an alternative. Having said that, if this was an unprecedented project it is difficult to say anything more about it, but it would be difficult to conceive of absolutely no alternatives at all, whether they are of local scale or whether they take longer time to put in place.

**Q323 Barry Gardiner:** In fairness, I think it says if there are no suitable alternative solutions. It is not a question of could there be no feasible alternative; it is no suitable alternative solutions. I would have thought an offshore array instead of a barrage one was as suitable as another.

**Alan Seatter:** The Court of Justice has expressed an opinion about this topic in the case of the Castro Verde motorways in Portugal, where the Government was found not to have considered sufficiently the alternatives to a project. This is clearly a topic that is of particular importance in a very large-scale project with an impact on a Natura 2000 site.

**Q324 Ian Lavery:** Touching on what Barry was saying, I wonder if you could give any examples of precedents where alternative feasible solutions have

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been accepted or perhaps rejected and the reasons behind such decisions.

**Alan Seatter:** I think there are many examples. There are thousands and thousands of these decisions that are taken each year—not involving us, I mean involving local authorities and member states—so they are judging this all the time. What is clear to us is that the very small proportion of these that ever get to looking at the derogations have all looked at alternatives. In some cases, they have altered the project because they have taken what is called mitigating measures, so the project has been designed differently in order to cope with the problem. That process is a normal part of everything that is done under this directive. It is difficult to find an example where there isn't a discussion involving project design that then changes during the course of a process, so it is part of the normal process.

**Q325 John Robertson:** For the record, could you please outline the meaning and application of “imperative reasons of overriding public interest” under EU Law?

**Alan Seatter:** In our guidance document, we have given quite a few examples of what has been used by member states in the past. There are examples of projects that have taken place in areas of very high unemployment, where there is significant poverty in the region and where the project is designed to address that kind of social objective. There are examples where projects have met considerations relating to the fight against climate change, the reduction of traffic congestion, competitiveness of a particular port, technological advances and competitiveness of an industry. There are many cases where those sorts of considerations have come into play and have been accepted by member states when they have had to take decisions on these projects. As I said, the Natura 2000 network is meant to be one for sustainable development, so that has an environmental objective, an economic one and a social one. Each of these has been used in the past to look at what is overriding public interest.

**Q326 John Robertson:** Would either of them be given precedence over another? When these things happen, there is usually a positive in some aspects of what you said but also negatives as well.

**Alan Seatter:** That is part of the assessment that would be required for the site to look at what its impact is. In relation to the Natura 2000 site, the main question is: what is the impact on the habitats and the species of that particular site and does it affect the integrity of the site? We are always coming back to the objectives for that site in question. How far are they disturbed by this kind of project? Even if you decided to go ahead with a project, because it has overriding public interest concern, you would then need to address the question of can you or can you not provide compensation to address the damage that is done to the species or the habitat?

**Q327 John Robertson:** Whereabouts would climate change come in this? If there was, say, a project that had 16.5 terawatt hours worth of power coming out,

and shall we say it would be there to combat climate change, would that be given high precedence over habitat or would habitat come first?

**Alan Seatter:** These are decisions that have to be taken by elected people who are responsible for taking that kind of decision. As public servants, what we need to do is to provide the facts and the scientific basis for elected people to take that decision. You cannot say in one case it is more important than another, but clearly the fight against climate change in a major project is a question of great public interest.

**Q328 John Robertson:** Would it be fair to say there is no legislation in place that would clarify that exactly? Again, it would be down to somebody just to say “Yes” or “No”?

**Alan Seatter:** Yes, that is correct. There is no ultimate clarification of that. This is the decision that belongs to the level where it is closest to the project. Whoever is taking this decision would need to have that information available, but they would need to take the decision as to what balanced out what. We have given guidance on questions related to renewable energy projects in Natura sites before, such as wind farms, and we have given quite a lot of examples of the ways those have been dealt with. This is a project of a slightly different nature.

**Q329 John Robertson:** Are there precedents then in the provision of compensation for habitat on the scale of, say, the Severn barrage?

**Alan Seatter:** Because we don't know the details of this project, we don't know how big that would be. From looking at various pieces of information in the public domain, what I have gathered—I think I would be right in saying—is that on the scale there appears to be for this project there has never been another case like that that I can think of.

**Q330 John Robertson:** Obviously, you can't give me examples, but could we say that in the habitat of, shall we say, equal value, it is accepted under EU law or must compensation be on a like-for-like basis?

**Alan Seatter:** What we have said in our guidance, which is meant to be useful to people that are taking these decisions so it cannot address an unprecedented thing by definition. It has to address what is the commonsense way of dealing with this. Like for like is a commonsense way of saying something is of equal value. It is just sensible that if a project is damaging a particular species or a particular habitat, that is the problem that you should address. So you should find a way to compensate the loss of that particular habitat and as close as possible to the project. That is the principle on which we would operate.

**Q331 John Robertson:** Should this compensatory habitat be in place before the project begins, during or at the end?

**Alan Seatter:** The guidance we have given is that it should be in place before the project is completed. There is a case where we were asked for our opinion by Germany for the Elbe Hamburg Estuary, where it

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was clear that there was no alternative but to give compensation after the project.

**Q332 John Robertson:** DECC concluded in 2010 that under a barrage scheme the hypertidal nature of the estuary would not be recreated to a like effect through compensation measures. In your view, then, would you consider that the loss of this ecological feature breaches the terms of the Habitats Directive?

**Alan Seatter:** No, formally it doesn't breach the terms of the directive. The directive does not define the detail of what is the right kind of compensation. It is not the Commission's job to second guess member states as to what is the right kind of compensation. Member states would be responsible for taking that decision, and we would look at: do they have the scientific underpinning; is the base line data there; is the monitoring there; has there been a consideration of alternatives; has there been public involvement in the process? If the Government then said it is absolutely impossible to provide compensation on a like-for-like basis within that region, then that is something that we would have to look at with them. Again, we are talking about a hypothesis here.

**Chair:** Barry.

**Barry Gardiner:** Sorry, Chairman, locked in thought.

**Chair:** Just briefly.

**Q333 Barry Gardiner:** I was trying to pick up on something that you said about equal value and like for like. In terms of ecological equivalence, my understanding is that the current EC guidance, EC2007A, requires delivery of compensation within the member state. But ecological equivalence—and this was the point I began to pursue earlier with the previous witnesses, which I think you may have heard—will be over the biogeographical range of the species. Therefore, I wonder if you want to comment, because I think these terms are thrown around quite indiscriminately, “like for like” and “of equivalent value” and “ecological equivalence”, and they may not mean the same thing. I wonder if you would like to tease out that distinction about the ecological equivalence across the range of the species.

**Alan Seatter:** In terms of the objective of the Natura 2000 Directive, what is important is the coherence of the network. Whatever is done on a particular site, and the compensation that then results, has to respect the coherence of the Natura 2000 network. That is a principle that is in the directive. I know what “like for like” means but I don't really know what “equal value” means. To me, it is kind of the same. Our guidance on like for like is saying, “It is of equal value if you compensate for that particular habitat and that particular species in the region concerned.” Everybody can understand that, which is why it is in the guidance. The question is: what happens if that becomes impossible and then you have to look outside the site? It is possible to do that. You can look outside. Some member states just next to it have designated new sites, designated new habitats and have provided compensation of several times the damage. In the Rotterdam Port case, one of the habitats that was damaged, which was a priority habitat, was compensated for five times in an adjacent—

**Q334 Barry Gardiner:** A global priority habitat?

**Alan Seatter:** A global priority habitat was compensated for five times in an adjacent area, and another one with an area that was 10 times bigger. In that case it is a different kind of region. It is more connected than the one that you are talking about here.

**Q335 Barry Gardiner:** Here what we may be talking about, in terms of these species, is actually the Atlantic biogeographic region. Is that considered to be part of the Natura 2000 network or not?

**Alan Seatter:** The network is defined. Member states make their proposals for the sites that they want to designate. They are then subject to a peer review by member states who are in the same biogeographic region, to make sure that we have a coherent set of proposals. After that examination, they then go into the directive. So they are already defined with respect to a biogeographic region and that is obviously a relevant consideration. I don't think we have ever had a case where a project in one member state has required another member state to take compensatory measures. I am not quite sure. That might be an objective one day that will be reached, but it is by no means an easy thing to do.

**Q336 Barry Gardiner:** We understand that the relevant competent authority in this case is likely to be DECC, and that they will have to make a judgment as to whether the project can qualify for consent in the light of IROPI. What role does the Commission play during this process, if any?

**Alan Seatter:** The responsibility for the decision lies with the competent authority of the member state in all cases. Where there is no priority species or habitat of global importance, the only role of the Commission would be to be informed of the decision that the competent authority has taken. Obviously, in pretty well all of these kinds of cases, we make ourselves available informally to our colleagues in Government throughout the process. But, formally speaking, the Commission would not have a role other than to be informed of the decision of the competent authority on the compensatory measures. If there were to be a complaint addressed to us, then it is our duty to register that complaint, see whether it is well-founded and then see whether it needs any further discussion with the member state concerned. It could end up in an infringement case or in court.

**Q337 Barry Gardiner:** Before we get to that—thank you for outlining the process—but I want to ask if there were a complaint, what sort of considerations would inform the Commission's view on whether the interests served by a particular project outweighed or were outweighed by the environment harm it causes?

**Alan Seatter:** Our role would not be to second-guess the Government or to propose alternatives or anything like that. Member states have asked the Commission to take on the role of these derogations, in order that they can be sure of equal treatment across the whole of the European Union. It is not our role to come in and say it should—



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**Q338 Barry Gardiner:** Surely, that is a guarantee that they will not be considered equally across the European Union. If you delegate it down to 27 different Governments, then 27 different Governments are probably going to arrive at 27 different conclusions as to whether something is of overriding public interest or not. That is just a way of avoiding the Commission having to take a decision.

**Alan Seatter:** That is what they have decided, that this directive is implemented nationally. In questions relating to derogation, where they have ask the Commission to look at that, it is precisely in order to be assured that everybody is subject—

**Barry Gardiner:** There is consistency.

**Alan Seatter:** That there is consistency.

**Q339 Barry Gardiner:** Indeed. That is what I am asking you. At that point, what are the considerations that the Commission would then take into account, in

judging whether in fact the benefits of a particular project outweighed or were outweighed by the environmental harm that it causes?

**Alan Seatter:** We would judge whether the Government had carried out their own assessment according to the steps that are set out in the directive: has there been a proper assessment in the first place? Is there baseline data and is it being monitored? Is there a scientific underpinning for the decision? Has there been public involvement and information in the process? Has there been proper consideration of alternatives, including the zero alternative? What were the reasons of overriding public interest that came into play in this particular case? Is the compensation addressing the specific objectives of that site?

**Chair:** I am sorry; we are running over time now. We have the Minister waiting outside to give evidence, so we will have to leave this. Thank you very much indeed for coming in.

### Examination of Witnesses

*Witnesses:* **Gregory Barker MP**, Minister of State, DECC, **Trevor Raggatt**, Head of Small Scale and Emerging Renewables, and **Barbara Garnier Schofield**, Head—Marine Energy and Tidal Range, gave evidence

**Q340 Chair:** Good morning, and welcome back; always a pleasure to see you.

**Gregory Barker:** Thank you, Mr Chairman.

**Q341 Chair:** A new subject that has attracted a lot of interest, and so this is our last bit of oral evidence. Looking back, your Department's study in 2010 rejected the Cardiff-Weston barrage scheme. Is it a bit surprising that these proposals have now popped up in August 2012 in 10 Downing Street?

**Gregory Barker:** I don't quite follow what you mean, they've "popped up in 10 Downing Street".

**Chair:** The momentum that is behind the Hafren Power proposals seems to have been significantly increased by the meeting that took place with the Prime Minister last year, which follows barely two years after the relevant Department had rejected the whole idea.

**Gregory Barker:** Yes. You may be relying on perhaps a partial account of that meeting. The PM was very much in listening mode at that meeting. Might I suggest, Mr Yeo, I pre-empt some of your questions by giving a very short introduction to summarise exactly where we are.

**Chair:** Sure.

**Gregory Barker:** You will recall I sat here about a year ago talking about the potential of wave and tidal stream energy sources, and obviously, in principle, we are very keen to maximise the opportunity to extract energy from the seas around our coast. Today I am signing a memorandum of understanding between the South West Marine Energy Park and the marine energy park in the waters of the Pentland Firth and Orkney Waters. Wave and tidal power are something that this Government is very keen to pursue, and, clearly, harnessing the power of the Severn Estuary specifically could be a very significant asset for the UK.

However—and it is a big “however”—if it were to be done it would need to be done sustainably, and any plan that would go forward would need to take account of the quite unique ecology of the Severn Estuary. It would have to take account of its existing socio-economic activities, and most importantly, perhaps, in terms of considering this particular proposal, the costs associated with harnessing that power. Because one thing is absolutely clear, before you go down that road much further of considering these other environmental and social impacts, any decision on a Severn power scheme or schemes would need to be based on incredible compelling evidence of the full set of costs and benefits.

In terms of the specific proposal that you wish to discuss today, we have received an outline proposal from Hafren Power—and indeed, its predecessor Corlan Hafren—and there have been some discussions between my Department and the company. However, the information that the Department has seen so far certainly does not allow us to assess if the proposal is credible, or if it could stand a chance of achieving the benefits Hafren Power claims the scheme would achieve.

There are a number of issues that Hafren Power would need to explore in much greater detail, before we could take a view as to whether their proposal warrants further interest from Government. Key among these are how the project would propose to tackle the enormous environmental challenges that a barrage would create; how they would work to mitigate potential negative impacts on the local economy, such as Bristol Port; and also, most importantly, evidence that the project is affordable and represents good value to electricity consumers. Crucially, the project will require substantial revenue support to provide a return on investment. It is vital that Hafren Power provide robust evidence that the

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level of support sought for the project would compare well with the expected future costs of other alternative low-cost carbon technologies, such as nuclear or offshore wind, that a barrage would likely displace.

In summary, Mr Yeo, to date the Hafren Power proposal does not go far enough at this stage to justify Government endorsement of the project. That said, as is the case for any similar project, should Hafren Power develop the proposal further and, in particular, provide credible robust evidence to substantiate their claims in their outline proposal—which to date has yet to be forthcoming—the Government would, of course, be prepared to look at that closely and consider it more fully.

**Q342 Chair:** Thank you. That is very helpful indeed. Of course you will know that this Committee is also an enthusiastic supporter of marine renewable energy, from both wave and tidal sources, and we reported on that last year, though we also noted that the costs currently make it unlikely that this is going to be a significant contributor to electricity generation in the UK in the next decade.

**Gregory Barker:** If I may say, I think the difference between this type of harnessing of energy from the sea and others—such as the very different technologies that are currently being exhibited over the road at the QE II Centre, at the RenewableUK Wave and Tidal Conference—is that there is no great prospect for progressively bringing down the cost of those technologies as they are deployed. It is a one-time investment in a large infrastructure project, effectively, rather than a steady rollout along a declining cost curve, which is effectively what the other technologies are.

**Q343 Chair:** What you have told us is that you do not have enough information to judge whether this is economically viable, or whether it is environmentally sustainable, and in fact some pretty big questions remain insufficiently answered.

**Gregory Barker:** Correct.

**Q344 Chair:** Is it the intention to publish what Hafren Power have told you so far?

**Gregory Barker:** We have a copy of their business model, but I understand that is commercially confidential. I don't believe that there is any other information that the company has provided us with that we could put into the public domain. I have to say there is not a great deal of information, so it is not that we are sitting on great piles of data.

**Q345 Chair:** Given the controversy that this proposal has already generated, it would seem to me possibly in Hafren Power's interest to be a little more transparent about what they are proposing if they are going to win much public support. There may well be some commercially in-confidence aspects to it. Although I don't think there is exactly a queue of people producing schemes to build a barrage in the Severn Estuary, who are going to be looking at the figures and stealing the IP. Would it be possible for you to encourage them to—

**Gregory Barker:** I am not going to reveal it, but this is the executive summary that we have. It is not exactly a warehouse full of data.

**Q346 Chair:** Perhaps if you have the opportunity to urge Hafren Power to share that with the Committee, they might get a more fulsome response to their proposal. For example, does that give any further detail on the proposed design of the turbines?

**Gregory Barker:** No, it doesn't. That is a critical element because, without knowing about the design of the turbine, we can neither come to an informed view about the likely impact on the ecology, fish in particular, nor can we have a view on the cost.

**Q347 Chair:** Again, it is very helpful to have a clear picture of the level of information that has been made available. They have talked about a hybrid Bill being passed during this Parliament, which now has just over two years at best to run. Is that a realistic timetable?

**Gregory Barker:** Not at all. In my understanding, you would need to be talking to the Public Bill Committee. We don't even have the beginnings of the information to take a decision as to whether or not that would be necessary. To talk of there being a Bill before 2015 would require some transformational level of information, in order for us to give up Government legislative time, which would be very squeezed, as well as all the political time and effort that would need to go into pursuing what is a very substantial project alongside—as you know and your Committee knows, Mr Yeo—an extremely packed DECC agenda.

**Q348 Chair:** We are certainly aware of the packed DECC agenda, absolutely. However, is it conceivable that this might not be dealt with by a hybrid Bill and that you could proceed through an application for a nationally-significant infrastructure project instead?

**Gregory Barker:** Yes, there is a potential route through the 2008 Planning Act and a consent process is an alternative. However, for a proposal like the Severn barrage to be pursued under the Act, the consenting process would be most likely to work efficiently if a national policy statement on this technology—and possibly also on this specific location—were put in place, and putting in place such a national policy statement in itself would take at least 18 months to two years.

**Q349 Dr Lee:** In view of the fact that there is a danger here of ridicule of the fact that the executive summary is so short, could you explain why Hafren Power have gone about this in this way at this time and so seemingly laid themselves open to the charge that they are not providing enough information for anybody to make a considered judgment?

**Gregory Barker:** I don't want to put words into Hafren Power's mouth, and I don't want to belittle the proposition. I think it is just very early days. All ideas and projects start from a standing start. It may be that they will come forward with a further level of detail, but it needs to be a much greater level of detail, and thought through, on a range of issues. I haven't mentioned financing either.

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**Chair:** We are coming on to that later.

**Gregory Barker:** So, no, I couldn't say why that is. If I were to give them any advice at all—and it is not really for me to give them advice—I would say, generically, any company or consortia wishing to come forward with a project for Government of this scale and size, before they engage at a serious level certainly in the public domain, should be doing so with a much greater level of data at their fingertips.

**Q350 Ian Lavery:** The Chief Executive of Hafren Power, Anthony Pryor, I think said to this Committee that the company would require in-principle support from the Government through a statement of the House before developing the project any further or starting the consultation process. Is it usual for Government to give such in-principle support? I understand what you just said that you have, but I think it is fairly critical to say that as Hafren policy, "This is what we've got until now." The decision-making process has been very, very important.

**Gregory Barker:** I think what Mr Yeo referred to in his opening remarks, the report that was published in 2010 made clear the Government's position on this. We are not against this in principle, but the evidence that we have seen to date, in terms of cost and environmental impact, are not sufficiently compelling. We have left the door open for that to change, but there is no precedent in recent times for the promotion of an energy project by means of a hybrid Bill, and we would need to see a substantial amount of evidence to back up the current proposal before we could even consider providing a statement of support as they suggest.

**Q351 Ian Lavery:** What they have provided until now certainly means that, if they could not get support in principle by the Government in the House, then the possibility is that they would withdraw. Do you see that as being the case?

**Gregory Barker:** I don't know. That is for them to decide.

**Q352 Ian Lavery:** Discussions regarding the Hafren Power scheme have so far been behind closed doors, and this has many people concerned about the potential lack of transparency. There are businesses and landowners who fear that there may be adverse impacts on their businesses, in and around the barrage. If a barrage were to go ahead, how would the Government ensure full public consultation and adequate compensation to affected parties?

**Gregory Barker:** At the moment, it is just such early days. I can assure you that if we were to go forward on a scheme then there would be full due process to cover this, but there are no proposals at the moment for a scheme and at the moment we are part of a pre-consent process.

**Barbara Garnier Schofield:** I think what the Minister meant to say here is that, as part of either a hybrid Bill or a Planning Act consent process, if we were going to go with a barrage, public consultation and an extensive environmental impact assessment would be needed in the same way as it would be for all other projects that go through the consent process.

**Q353 John Robertson:** Minister, it is not often I congratulate your Department, but your opening statement has pulled the rug from a lot of our questions.

**Gregory Barker:** Very good.

**John Robertson:** I am sure I will find something to have a go at.

**Gregory Barker:** Have a crack at it.

**Q354 John Robertson:** It wouldn't be me if I didn't. Having said that, I totally accept that bit of paper that you showed us—or papers—strikes me as being embarrassing for a company that is looking to have a project this size in value, and the effect it will have on not just the habitat but the people of the region. To send you a four-page A4 document, I am embarrassed for them and I am embarrassed that they think that it would be considered. I am surprised you have not thrown it out completely.

Anyway, having said that, some of the questions are obviously going to be hypothetical in this case because you don't have the information, but I would appreciate if you could position it as best you can. The company say that, basically, the cost of energy for the first 30 years is around about £160 per MWh. We understand that most renewables will only receive a 15-year period of price support. Would DECC consider a level of strike price and contract duration acceptable under the CfD mechanism or would you tell them they are going to have to pay 15 years at whatever the price should be?

**Gregory Barker:** It is not for the Government to say what level of revenue support would make a private sector project economically viable, but we would expect projects to come forward with views on whether they needed support and the level of revenue support that would be required. Our priority nowadays is EMR, as set out in the current Energy Bill going through Parliament. The Energy Bill also includes a power to allow the Secretary of State to direct the counterparty body to issue a contract in specified terms, including the strike price, but the precise mechanism for doing this is currently being developed.

However, at this point we would expect projects to come forward with their views on whether they needed support and the level of revenue support that would be required before DECC could assess the project's value for money in comparison with other projects of the same or different technologies. That is a roundabout way of saying that we would look for a comparison with either nuclear or offshore wind. We certainly would not be looking to pay more than that on behalf of the consumer.

**Q355 John Robertson:** You would not be setting a separate price for, say, tidal projects?

**Gregory Barker:** We may set a separate price, but that price would not be above nuclear or offshore wind.

**Q356 John Robertson:** It would be, shall we say, set for tidal projects? You would not be able to classify it as something else?

**Trevor Raggatt:** I think you need to be careful about specifying what you mean by tidal projects. There will

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be work to be done on a range of different technologies, and of course, there is tidal stream as well, which will have a completely different sort of lifecycle and commercial journey to something like a barrage project. In terms of something like a barrage, whether it is the Hafren Power project or some other one, it is such a large and unique project. I think our initial view is that we would probably look to use the individual route rather than taking a standard price within the EMR suite of prices. Certainly, I think the work that is being done on the Hinkley Point passage at the moment, which again is a single large project being done in advance of having set out the range of strike prices, will inform the way that we would be likely to take a barrage-type project forward, in terms of negotiation of the CfD, in terms of the strike price but also in terms of the length of contract and so forth.

**Q357 John Robertson:** In these types of projects, which are quite complicated—and obviously, other than the energy that will be created, the effect on habitat and the areas that people are employed and other places further up the estuary in this case—how are you going to ensure you get best value for the customer, at a stage where you don't know by the end of it exactly what the effect is going to be?

**Gregory Barker:** It is very difficult to say without having much greater detail on the project. All I can say is that we would robustly and critically analyse the project as it comes forward. We have not had enough data for us to even begin that process yet, and we are certainly not going to tie up a large amount of resource in thinking about this, and how we might do something like this, when it remains entirely hypothetical.

**Q358 John Robertson:** Flood damage is something that has been in the news for a while. You would take that into consideration.

**Gregory Barker:** Absolutely. As you say, Mr Robertson, there are a whole range of issues that would need to be thought through very carefully, which would be a shopping list to this Committee.

**John Robertson:** Minister, in all honesty, you have answered all the questions. I am really upset I can't find anything to have a go at you on. I will get you next time.

**Gregory Barker:** I will look forward to next time.

**Q359 Chair:** Going back, if I may, to the strike price for a moment. I think one of the suggestions has been that this might need a longer period. I think we have been talking about a 15-year period typically for most renewable technologies, but would you consider agreeing a price for a longer period because of the nature of the project?

**Gregory Barker:** I think we would not rule out the time scale. We would probably need to have a more open mind with that. What we would look at is the absolute cost to the consumer but, given the long-term nature of that sort of asset, it would have a very different lifecycle to, say, an offshore wind farm or something. We would take a different view.

**Q360 Chair:** I think we understand that, yes. Given the scale of this project, if the strike price has to be somewhere at the upper end, where we are looking at offshore wind or nuclear or whatever, is there a risk that it would then pre-empt such a big chunk of the money available under the Levy Control Framework that it would perhaps prejudice the emergence of other investment projects for different technologies?

**Gregory Barker:** Theoretically, it could do that. It would very much depend on the price and size, but the Levy Control Framework is something that is set over a number of years. This is a project that is anticipated to run for a number of decades, so you are talking about a project that would draw down the Levy Control Framework—if indeed there still was a Levy Control Framework—in the 2030s.

**Q361 Chair:** Is there also a difficulty in principle in taking into account savings that may very well be achieved, but savings which would accrue to the taxpayer costs in another Department's spending but which are effectively financed if it is coming through the strike price from electricity consumers?

**Gregory Barker:** Sorry, I am not quite sure—

**Chair:** When we took evidence from the company, they were saying that there could be savings in terms of the cost of flood defences and so on, although these figures are not accepted by the Environment Agency. Putting that on one side for the moment, if there were savings those savings would accrue to the Defra budget, because that is where the money for flood defences comes from. But of course the cost goes on to the electricity consumer because it is coming through the strike price. What I am saying is, is there a conceptual difficulty about taking account of savings when they don't come back to the people that are spending the money?

**Gregory Barker:** Yes, that does present very real practical difficulties. I can see there could potentially be wider benefits. But there could also be wider negative impacts as well, ecologically and environmentally speaking.

**Q362 Chair:** I will pass on in a moment, but just one final point on the costs. For most of the projects that are looking to get support via a strike price and a contract for difference, there will be a number of competing projects. There is more than one offshore wind farm and hopefully more than one nuclear proposal as well, if we are lucky. In this case, there will not be a range of competing projects. It is essentially a one-off.

**Gregory Barker:** Exactly.

**Chair:** Does that make it more difficult to work out what is an acceptable strike price?

**Gregory Barker:** It must do. On one hand it is simpler, but you don't have the driver of competition in there. In many ways it is more like the Channel Tunnel or another large-scale infrastructure project, rather than a competing renewable energy technology.

**Chair:** As you just mentioned the Channel Tunnel, I should draw attention to my financial interest as a director and shareholder in Eurotunnel, which, of course, did achieve the construction of the Channel

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Tunnel without a single penny of taxpayer's money from either Britain or France.

**Gregory Barker:** Although I seem to remember the shareholders didn't fair too well.

**Chair:** The shareholders and the bondholders were almost wiped out.

**Q363 Barry Gardiner:** Minister, DECC presumably would be the competent authority for any decision on a barrage at Hafren Power. Yes?

**Gregory Barker:** Yes. I think we would be the lead Department, but of course, for a project of this scale, size and spread, there would be interest across Government.

**Q364 Barry Gardiner:** Absolutely, and, certainly, in terms of the competent authority from taking a decision on the Habitats Directive, you would be that competent authority?

**Barbara Garnier Schofield:** I think Defra probably would be the competent authority for compliance with the Habitats Directives. We would be closely working with them on that.

**Q365 Barry Gardiner:** That is not what we have been advised. How interesting.

**Trevor Raggatt:** This isn't something we have taken detailed legal advice on in the context of this project, because it is at such an early stage.

**Q366 Barry Gardiner:** Come on. I mean, in 2010, you had the Weston barrage, so presumably you knew what you were doing on that. You were the competent authority on that. Why do you not think you might be the competent authority on this?

**Gregory Barker:** Because we don't normally do ecological impacts in DECC. We are the Department for Energy and Climate Change and the Department for the Environment is the one that does have that.

**Q367 Barry Gardiner:** There would be a lot of people who are statutory consultees on it, and there will be a lot of people who are giving a lot of advice to a lot of people, but ultimately—

**Gregory Barker:** I can't think of a single example, Mr Gardiner, where we have taken such a lead role on matters of ecology.

**Barry Gardiner:** Very interesting.

**Gregory Barker:** Perhaps you could.

**Q368 Barry Gardiner:** I was going to proffer the Weston barrage in 2010, where I believe you were the competent authority. But perhaps you can check out with your colleagues in Defra and then write to the Committee to establish precisely who would be the competent authority in this case.

**Gregory Barker:** Very happy to.

**Barry Gardiner:** I don't mind either way, Mr Barker.

**Gregory Barker:** I am all in favour of mission creep when it is me who is creeping.

**Q369 Barry Gardiner:** Yes. Let me ask you then, DECC's estimates for the net regional benefit to the economy of a barrage range from £5.9 billion to negative £1.5 billion GVA. Estimates for the net jobs

created post-construction—I emphasise, “post-construction”—vary from plus 700 to minus 2,500. Why is there such a vast range in the figures and doesn't that huge uncertainty render them rather useless?

**Gregory Barker:** Yes.

**Q370 Barry Gardiner:** Thank you. Hafren Power estimate that up to 50,000 indirect and direct jobs would be generated as a result of the barrage. How does that calculation compare to DECC's assessment of the potential economic benefits of a barrage, and in what detail have they substantiated their figures to you?

**Gregory Barker:** We have not seen the details behind the Hafren Power figure. They have not been made available to us. So we can't comment in detail, but they do seem very high. They certainly don't compare to our feasibility study estimate or to the number of jobs we would expect from a similar generation capacity for, say, nuclear energy. Our feasibility study estimated that a Cardiff-Weston barrage, impacting Bristol Port with deep-sea container facilities, would give net regional employment during construction of 440 jobs. As you say, the range of central estimate was from plus 5,500 through to minus 2,200 during an operation, and a net loss of 80 jobs within the range of plus 700 to minus 2,500 per year. Mr Gardiner, I would have to say again, in the absence of any definitive information, it is—if not meaningless—hardly helpful at all to speculate at this point.

**Q371 Barry Gardiner:** Let me clarify. Hafren Power indicated that they wanted the Government to take an in-principle decision, rather like HS2 where there was a public consultation and then there was an in-principle decision that this was a goer, subject to a lot of other things that then had to be worked out. They want you to take an in-principle decision, and yet what you are saying to us is that they just have not provided you with the details that could in any way be expected to lead you to take an in-principle decision.

**Gregory Barker:** Correct. I do understand that there—

**Q372 Barry Gardiner:** How humiliating is that for them?

**Gregory Barker:** That is for them to judge.

**Q373 Barry Gardiner:** I was asking for your opinion, Minister.

**Gregory Barker:** We appreciate that, if a project like this were to go forward, Government would have a clear role and you would not expect them to get all the way from drawing board to takeoff without considerable Government collaboration. But we are a long way from seeing a serious, meaningful proposal with which we can effectively engage, and which would be a useful deployment of taxpayer money and resources in terms of evaluating such a proposal, as I say, particularly coming so soon after the 2010 report commissioned by the last Government.

**Q374 Barry Gardiner:** Turning to that 2010 report, the Cardiff-Weston barrage was identified in that report as the best value for money—I think that is a

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direct quote by DECC—and it was subsequently disregarded on financial rather than environmental grounds. Can you elaborate on what concerns, if any, either DECC had or that were expressed across Government about environment impacts and, if so, did those influence the decision not to take the proposal forward at that time?

**Gregory Barker:** Most of that report was drawn up before I was in Government, so on this one I might defer to my officials if I may.

**Barbara Garnier Schofield:** The type of impact that we were concerned about were mostly on the wildlife and the habitats, particularly birds and migratory fish. On birds, we found that a Cardiff-Weston type of barrage would impact significantly on a number of water birds and that numbers would be expected to fall by between 25% and 49%. Also, with respect to fish, we found that there would be a significant negative effect on migratory and estuarine fish, and also on freshwater fish in the catchment of the Severn River.

**Q375 Barry Gardiner:** Indeed. Did those influence your decision not to take the proposal forward at that time?

**Barbara Garnier Schofield:** I think there were a range of issues around the Cardiff-Weston proposal. You do state rightly that it was seen as the most cost-effective of the five solutions, but it was still quite expensive; a huge amount of capital costs and the economic benefits were relatively limited compared to the huge scale of the environmental impact.

**Trevor Raggatt:** Of course, it is also worth remembering that the actual cost of the proposal for the Cardiff-Weston barrage under the previous report was not simply the cost of putting casings in the water and buying turbines for support. It would wrap up within it all of the costs of the project, a substantial amount of which would reflect the environmental concerns and the need to ameliorate damage and create compensatory habitats. While the headline statement was that it was not economically viable, that, of course, hides a huge amount of detail and many factors leading into that single-summary statement.

**Q376 Barry Gardiner:** Sure, and I take that. Perhaps you could give us a feel—and it may be no more than that—for how DECC would weigh up the climate change, the energy security, the environmental benefits and impacts that go into taking this decision. I think all of us see that here we have a potential energy resource that, if one could capture it free of any dis-benefit and extraneous costs, then it would be wonderful if we could do so. How are you going to weigh up the costs and benefits here, and could you say what role the Natural Capital Committee might have in this and the reports that they would make through to the Economic Sub-Committee of Cabinet? This seems to me, through your White Paper last year, a particularly obvious source of advice that you might be seeking.

**Gregory Barker:** First, with respect to Natural Capital, you are absolutely right, Mr Gardiner. We have not done this before, so we would be slightly

inventing the process with those particular mechanisms. We would be setting a precedent, but that would seem a very sensible way to make sure that we drew on that excellent work that they have done. I think the first comparison would be with other forms of low-carbon or zero-carbon generation. We would say, what would be the environmental and financial implications of investing in an equivalent in offshore wind or nuclear or other? That would be the first test, and if it was significantly out of kilter with the impacts, financial or environmental, with those other technologies then that would be—

**Barry Gardiner:** Predispose you one way or the other.

**Gregory Barker:** If the answer then came forward, “It compares favourably with those technologies, on either one or both of those,” we would then drill down to the next level. We have no doubt that there could be clear energy and climate change benefits from a barrage, in principle. It is also clear that a barrage is technically feasible, although there would be technical challenges specific to the Severn Estuary, such as the potential for turbine siltation, and the size of the barrage would need to be carefully considered. However, as I say, there are a number of other technologies that provide similar energy and climate benefits to a barrage. We would have to drill down further and see that those benefits are coupled with a number of factors, which we would summarise as being an acceptable impact on the environment of the estuary. There are a number of indicators that you would have to look at in order to come up with that. Flood impacts on the wider area would be a key element. I think Mr Lavery or Mr Robertson mentioned the flood impacts.

Obviously, we would look at the job benefits, at both local and national level, and the impacts on local industry as well—the long-term impact of putting a barrage in place—and we would look at value for money. The environmental element would play a very significant role in that thinking, and we would look to use the new architecture that we have put in place.

**Q377 Barry Gardiner:** Thank you. That is very helpful. You will know the IROPI test?

**Gregory Barker:** I don’t.

**Barry Gardiner:** Now I have to remember it myself, what it stands for. It is overriding public interest, basically. It is to make sure that there is an overriding public interest.

**Gregory Barker:** Sorry, yes. I remember now.

**Chair:** Imperative Reasons of Overriding Public Interest.

**Barry Gardiner:** Thank you, Chair.

**Chair:** Such as by-election results.

**Barry Gardiner:** Very good. Of course, in relation to that, the Habitats Directive requires that the IROPI tests are met. You can get a derogation under specific terms and conditions of mitigation and compensation for the degradation to biodiversity and the ecology. When you are considering this—and let us say, while I perfectly understand you would be advised by Defra and by other statutory consultees—when you are taking an eventual decision on this, how do you feel the relevant weight of combating climate change and

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protecting our natural environment as it currently stands can be weighed one against the other?

**Gregory Barker:** A very good question, and very difficult to answer except to say you would have to look at—in terms of the fight against climate change, it is very simple—are we on track to meet our 2050 commitments? Are we on track to play our part in reducing global emissions, which are a fraction of global emissions, but, nevertheless, it is very important that we meet that, and are we on track? If there were no alternative to the barrage that would enable us to meet our 2050 target, then I think the question that you pose would be at its most acute, i.e. unless we went down the road of the barrage Britain would miss its 2050 target, but I am not aware that anyone is seriously saying that is the case. It is not in our 2050 road map. It is not deemed as yet to be an essential element of a successful 2050 package and, therefore, I think, weighing it up, there are better arguments.

**Q378 Barry Gardiner:** Thank you. I think that is possibly the most interesting answer we have heard today because, of course, the Habitats Directive sets out that the primary consideration here—it is almost a precondition—is if there are no suitable alternative solutions to the project. In effect, what you have done for us, Minister, is to define in what context that phrase must be interpreted, and that is the context of, “Are we going to be able to solve our problem of reaching our 2050 targets?” The primary question that the barrage would have to answer is, “Are there no suitable alternative solutions to getting to our 2050 targets?”

**Gregory Barker:** I think the alternative would need to include cost to consumers as well as technical solutions.

**Barry Gardiner:** Absolutely, yes. Thank you very much.

**Q379 Ian Lavery:** If I can ask you a number of questions on marine technology and alternative technologies. First of all, Hafren Power have stated that once the hybrid Bill legislation has been passed and that an AIA would be completed then they would look to sell the entire project off to a sovereign wealth fund. If that happened, how would the Government ensure that the full investment benefits remained here in the UK?

**Gregory Barker:** Firstly, I think it almost incomprehensible that a single sovereign wealth fund would want to acquire the entirety of a £50 billion sterling project, because one of the guiding principles of sovereign wealth funds is to have a balanced portfolio and, even for the largest sovereign wealth fund, £50 billion sterling is a pretty healthy chunk. In terms of end ownership, it might be that one wealth fund could conceivably underwrite even such a large figure as that. Sorry, I think I said £50 billion. I mean £25 billion but the comment remains the same. It is still a very big chunk for a single investor to swallow. I think it would be more likely to be syndicated among a number of sovereign wealth funds or institutional investors.

I don’t see this as being a problem in itself because if they are a financial investor I am not clear what you would be concerned might be exported. The supply chain for the barrage clearly would have an impact on UK jobs, potentially. We would want to make sure that, if it did go ahead, there was maximum UK content, but I think in the longer term you can’t export the maintenance and the—

**Q380 Ian Lavery:** You would not have too many concerns about that?

**Gregory Barker:** In terms of the hierarchy of concerns, that is not my largest. I would be concerned to ensure that there was a high level of UK content in the project, and that the economic benefits to the UK of such a scheme were compelling, but I don’t see the fact that potentially it could be backed by a sovereign wealth fund from abroad necessarily being a barrier to that. Could I ask what you were thinking there? What was your concern about?

**Ian Lavery:** Well, the whole issue. If Government is prepared to put a lot of British taxpayers’ money and consumers’ money into a scheme, such as the barrage, and that is then basically passed on to a sovereign wealth fund, just to make sure that the benefits remain here in the UK.

**Gregory Barker:** Which benefits are you talking about, the financial benefit or the—

**Ian Lavery:** Any potential benefit.

**Gregory Barker:** But what?

**Ian Lavery:** Jobs, security, maintenance, consumer costs.

**Gregory Barker:** In terms of jobs, security and maintenance, it would not matter who owned it, you could not export those. If the China Investment Company invested, they would be hard pushed to export the maintenance jobs to Beijing. For example, London Array, a big energy project, the largest single investor in that is the sovereign wealth fund from Abu Dhabi, and we are very happy indeed to have them as a shareholder. Our concern is not about the underlying ownership. Our concern is about the supply chain because, with London Array, I think around 80% of the content there was sourced from abroad. It is not the underlying ownership. It is where the supply chain and the value are for the project, particularly the construction of the project, because the ongoing maintenance jobs, by definition, have to be local. I think we would want to make sure, if there were such a project, that it had a high level of UK content in construction.

**Q381 Ian Lavery:** Yes. The issue on marine technology, with regards to the best way to oversee the development of such technology in the UK, and to ensure best value with minimal environment impact, is through a public body. That is what some commentators have said at this moment in time. Looking at the Scottish Government, they have set up a directory to manage marine resources. Would DECC consider setting up such an agency to potentially manage the Severn Estuary project and other tidal resources in England and Wales?

**Gregory Barker:** The conclusion of the STP study made it clear that any barrage scheme, coming

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forward in future years, would be privately led and privately funded. Therefore, it is not our intention that the Government should co-ordinate or lead such a project. But if such a project provided compelling evidence that it could be viable, affordable and environmentally and economically sound, and it was decided that such a project was in the interests of the UK then obviously we would play an active role.

**Q382 Ian Lavery:** The marine energy projects have upfront capital costs and are likely to require a high level of strike price—which you mentioned before—until the technologies and sales mature and become more commercially viable. Do you think there is a risk that the contracts for difference mechanism will perhaps side line marine resources in favour of more mature technologies, more affordable technologies, undermining what potential opportunity there is to take advantage of the UK's significant tidal resources?

**Gregory Barker:** No.

**Ian Lavery:** Not at all?

**Gregory Barker:** No. I was speaking yesterday at the RenewableUK Wave and Tidal Conference, and was very clear that we want to work with the industry to ensure that that is not the case.

**Q383 Ian Lavery:** Getting back to the Severn barrage, it has been discussed for decades, and I think, as a Minister, you say the Government remains open to considering any well-developed proposals for harnessing the Severn Estuary energy. It has been discussed for decades that there is a proposal from Hafren. Isn't it time that the Government gave less consideration and more action, in terms of tidal projects, so it can get them off the ground? This Committee is terribly committed to wave and tidal projects, as the Chair outlined earlier.

**Gregory Barker:** In terms of the biggest opportunity, which is technically the Severn, we still rely on the relatively recent report that the last Government commissioned, that reported in 2010, which basically said to date the economic case was not proven. Until we see that the economic case is proven, I don't think the British consumer would thank us for embarking on these massive infrastructure projects that are not fundamentally economic. As I have said—and I hope it has come across very clearly in this evidence session—if the private sector can return to us and show that things have changed or a new economic model has been developed or technology costs have come down, so that it would be economically feasible, we remain open to it. But the best judge of that is the private sector rather than Government.

**Q384 Ian Lavery:** There has been a lot of evidence put before the Committee with regard to the proposal

from Hafren. A lot of it has been pretty negative and a lot of it has expressed opposition to a suggestion that there would be a better way, advocating a more step-by-step approach. What would your response be to those organisations that recommend a more incremental approach than this huge approach of the Severn barrage?

**Gregory Barker:** We are still committed to considering well-developed proposals for harnessing the energy of the Severn Estuary. Whether these are smaller projects and, as such, part of a step-by-step approach, or a single large project, we will apply the same criteria, namely, "Are they economically feasible and do they have an acceptable environmental impact?" So, it should be affordable, environmentally responsible, and most of all represent good value for consumers. We are open-minded about this, Mr Lavery, and don't in any way wish to rule out smaller, incremental, step-by-step projects as you suggest.

**Q385 Ian Lavery:** I take it there have been discussions with DECC regarding the tidal lagoon at Swansea Bay. I wonder if you could perhaps—

**Gregory Barker:** I have not personally but—

**Trevor Raggatt:** Yes, indeed. We have had some contact with the company that is proposing that project. In fact, Barbara and I are meeting them next week to get an update on how they are going. Certainly, they are one of the other potential suite of projects that could be pursued in the Severn.

**Q386 Ian Lavery:** At this point in time, are you able to make any assessment of the technical and economic viability of the Swansea Bay scheme? I think it has been suggested that they aim to deliver 10 GW of electricity.

**Trevor Raggatt:** Not as of yet. That is what we are hoping to talk to them about next week. I would be surprised at 10 GW, which is larger than the barrage itself, bearing in mind that Swansea Bay is a relatively modest project compared to the Cardiff-Weston project, but certainly we look forward to hearing from them.

**Gregory Barker:** Could I suggest, Mr Yeo, that I might write with an update on my officials' meeting?

**Chair:** Yes, that would be helpful. Thank you very much. We have come to the conclusion. A very interesting and useful session from our point of view, and can I assure you this Committee is on this issue—as on all others—completely open-minded as well, and our open-mindedness has been increased by the evidence you have been able to give us this morning.



# Written evidence

## Written evidence submitted by the Department of Energy and Climate Change

### INTRODUCTION

1. Due to its outstanding tidal range resource, the Severn estuary has been considered for the siting of a number of tidal barrages and other tidal schemes over the years. A barrage across the Cardiff-Weston alignment is widely considered as the main option for a tidal barrage scheme, which would allow maximum energy extraction from the Severn.

2. Recognising the potential of the Severn Estuary for renewable energy generation, the Government carried out an extensive feasibility study on Severn Tidal Power (STP).<sup>1</sup> The study, which investigated in depth a number of schemes including a Cardiff-Weston barrage, concluded in 2010 that there was no strategic case for public investment in a Severn tidal power scheme at the time, as there were cheaper and easier alternatives. The Government did not, however, rule out a privately-funded scheme coming forward. This position still holds.

3. Since the outcome of the feasibility study, a number of developers interested in proposing schemes for the Severn estuary have engaged with the Department of Energy and Climate Change (DECC). The most advanced proposal to date is the outline business case submitted to the Government in November 2011 by the Corlan Hafren consortium for a Cardiff-Weston barrage. The consortium subsequently broke down. It has now reformed with a different membership and management team into Hafren Power. Their proposal remains largely unchanged. Although the terms of reference of the inquiry do not mention the consortium by name, we understand that it aims to focus on the Hafren Power proposal.

4. The answers below are based on the in-depth STP feasibility study carried out by the Government and, where possible, on our knowledge of the Hafren Power proposal. It should be noted, however, that, due to the very early stage of development of the proposal to date, it is in most cases difficult to anticipate what the real impacts of the Hafren Power proposal will be and how these would really differ from the Cardiff-Weston barrage model investigated as part of the STP study.

#### *Q.1 What contribution could the Cardiff-Weston Barrage make to UK energy security and climate change objectives?*

5. The 14 metre tidal range of the Severn estuary is among the largest in the world and represents 8–12GW of energy capacity. A Cardiff-Weston barrage could provide up to 5% of our current electricity needs from an indigenous renewable source, as a result benefiting the UK energy security. The STP study estimated that a 8,640 MW installed capacity Cardiff-Weston barrage could generate 15.6 TWh/a.

6. Although intermittent, the provision of electricity through a tidal scheme (barrage or other) is highly predictable and, as such, could bring benefits to the balancing of the energy system.

7. A barrage would generate carbon-free electricity over a long period of time (c 120 years). The carbon savings from a barrage would depend on the type of alternative electricity generation it would displace. Should a strong case be made to take this forward we anticipate a barrage would replace generation type against which it could be proven to be more cost-effective—most likely Carbon Capture and Storage (CCS) and/or offshore wind—although this also depends on the future costs of these generation types.

8. Based on the STP study assumptions and on a scheme replacing a mixture of CCS and offshore wind, we estimate that a Cardiff-Weston barrage would displace 110Mt CO<sub>2</sub> during its operations. Against coal with CCS, CO<sub>2</sub> saved during operation is estimated at 219 Mt.

9. The STP study estimated that the carbon payback period (the number of years it would take for a barrage to pay back the carbon debt of its construction and operation) would range from -0.8 to seven years. This wide range illustrates the high level of uncertainties associated with the benefits and risks of a Cardiff-Weston barrage.

#### *Q.2 What risks and opportunities could it pose with regard to flooding in the Severn estuary, and how might any risks be mitigated?*

#### *Q.3 What risks and opportunities could it pose to wildlife and habitat in the Severn estuary, and how might any risks be mitigated?*

10. Although there could be some benefits for flood risk management upstream of a barrage from reduced spring tide and surge tide heights, the negative impacts could be very significant. For the Cardiff-Weston barrage model used in the STP study, the mean tidal heights increase upstream of the barrage were found to be potentially as much as seven metres. The change in tidal regimes is likely to cause extensive foreshore erosion within the impounded areas of the Estuary, undermining the integrity of existing flood defences.

11. The rise in water level could impede existing drainage systems in the low lying land around the Estuary, increasing the flood risk to property and agricultural land. The STP study estimated that the effects on drainage

<sup>1</sup> [http://www.decc.gov.uk/en/content/cms/meeting\\_energy/wave\\_tidal/severn\\_tidal\\_power/severn\\_tidal\\_power.aspx](http://www.decc.gov.uk/en/content/cms/meeting_energy/wave_tidal/severn_tidal_power/severn_tidal_power.aspx)

of a Cardiff-Weston barrage would increase the flood risk to some 50,500 residential and commercial properties, 28 critical infrastructure assets and 372km<sup>2</sup> of land. Mitigation would need to be provided by installing a network of pumping stations or other measures.

12. STP study modelling work for a Cardiff–Weston barrage also shows an increase in spring high tide levels along much of the west Wales coast, with up to 30cm in the northern part of Cardigan Bay and the Llyn Peninsula. Smaller increases (up to 10cm) were predicted for the coasts of north Cornwall and south-east coast of Ireland. There are significant limitations to the modelling work and further study would be needed before it could be used

13. Any tidal barrage proposal across the Severn Estuary is also likely to have impacts on the wildlife and habitat in and around the estuary. Before such a proposal could proceed, these impacts would need to be carefully assessed in order to confirm the feasibility of providing appropriate mitigation or compensation.

14. The Hafren Power proposal is aiming to use a Very Low Head turbine concept which is being developed with lower environmental and flooding impact in mind. However the turbine hasn't as yet been developed beyond concept stage and we have not seen any evidence confirming its potential.

15. More work to validate the effectiveness of the turbine and further impact assessment will need to be carried out for that particular proposal before the opportunities, risks and possible mitigating actions of the proposal can be adequately assessed—both with regards to wildlife and habitat and to flooding.

*Q.4 What lessons can be learned from the successful development of La Rance tidal barrage in France and other tidal power projects?*

16. There are significant difference between La Rance and proposal for a Cardiff-Weston projects, ranging from different environment, status, size, location and infrastructure. This makes attempting to use the La Rance barrage as a test case to inform an assessment of a proposal for a Cardiff-Weston barrage challenging.

17. We would however expect an assessment supporting a Cardiff Weston proposal to incorporate learning (design/environmental/planning/operational) arising from the other three tidal barrages elsewhere in the world.

*Q.5 What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular, what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

18. The STP study concluded that a barrage could benefit the regional economy with net value added to the economy and jobs created but that these would come at the expense of potential negative impacts on the current ports, fishing and aggregate extraction industries in the estuary.

#### Impact on ports

19. Ports upstream of a Cardiff-Weston barrage would be adversely affected by the scheme, most of all Bristol Port.

20. Bristol (Avonmouth and Royal Portbury Dock) is the 16th-largest UK port by tonnes handled and has a broad range of traffic. The Port also has plans for a consented deep sea container terminal (DSTC) with up to 1.5M teu<sup>2</sup> capacity. The Barrage proposals represent a major potential threat to the viability of this project.

21. Proposals for a Cardiff-Weston barrage, to the extent that it is perceived that there is a serious possibility they would proceed, are already seen as an immediate risk factor for customer commitment and investment at Bristol Port. Prolonged uncertainty over the scheme is perceived as harmful to the Port and other businesses in the region.

22. Implementation of a barrage would require adequate provision for sea-locks for large ocean-going vessels to be built into the project specification to allow continued operation of the Port as a major commercial facility. Even with sea-locks of appropriate size, traffic would be slowed with consequent potentially significant damage to the Port's competitiveness. Estimates from the STP study suggested a delay of around 45 minutes for each vessel berthing. Changes in siltation patterns from the barrage would also likely have adverse commercial effect on the Port.

23. Most traffic lost to Bristol as a result of a Barrage project would be likely to find another UK port of entry/exit, but at very significant (though difficult to quantify hypothetically) cost in economic and environmental terms, including detriment to inland connectivity (which is very favourable at Bristol)

24. A number of other ports east of the barrage will be affected by the scheme, including Cardiff and Newport, which are commercially substantial at over 2Mt/a each, although these generally handle smaller vessels. The extent of potential damage to these ports will depend upon the details of the proposal.

<sup>2</sup> teu—twenty-foot equivalent unit (standard container capacity measure).

### Impact on the fishing industry

25. The STP assessment noted that reductions in fish abundance would have adverse effects on commercial and recreational fisheries contributing to local economies. The assessment calculated commercial fisheries for salmon and juvenile and adult eel in the Severn catchment to be valued at £96,200, £299,000 and £36,000pa respectively in 2010, with recreational fisheries, particularly for salmon, valued at £28m. Sea angling is a major recreational activity in the Severn Estuary/Bristol channel: charter boat annual turnover was valued at c £1 million. These fisheries, and related economic activity (eg local hospitality industry, fishing tackle retail) would be adversely affected by a barrage and likely to seek compensation.

### Impact on the aggregates industry

26. The STP assessment also noted that the aggregates industry, supporting around 1,100 regional jobs, would also be affected by the impacts of a barrage on water levels, sediment movement and deposition, access to currently licensed areas and by the necessity to pass through locks.

### Net regional benefits

27. Taking these impacts on port, fishing and aggregates industries and the positive benefits on regional economy into account, the STP study estimated that a Cardiff-Weston barrage is expected to generate a net regional benefit in terms of gross value added (GVA) of £2.4 billion (with a range between £6.1 billion and -£0.8 billion).

28. In terms of regional employment, the central estimate is for 840 net additional jobs per year during construction (+5,500 to—1,600) and 120 during operation (+800 to—2,000).

29. Should the Bristol Port DSCT proceed then additional negative impacts of a barrage would be reflected on both GVA (£5.9 billion to—£1.5 billion with a central estimate of £2.1 billion) and employment range (annual employment during construction at +440 (+5,300 to—2,200) and operation—80 (+700 to—2,500)).

30. The above impacts were assessed on the basis of the Cardiff-Weston barrage model in the STP study which provided appropriate locks. Impacts from the current proposal may differ depending on the specific features of the proposal including adequate provision for sea-locks as well as location and scale of manufacturing, supply chain etc. If the project were to maximise use of domestic construction, manufacturing and supply chain, it could have the potential of providing 80% of the value of the project to the UK. A proportion of this would be accrued to the local area.

### Further economic considerations

31. In addition, any local jobs and economic benefits need to be considered in the context of broader economic and job displacement from other generation technologies across the UK (including impact on longer term private sector investment in building UK supply chains for other technologies). Using offshore wind as a comparator, around 9,000–16,000 direct jobs could be created in this technology up to 2021 from a similar generating capacity to that of a barrage—including jobs in the associated supply chain. Also, it is estimated that up to 66,000 jobs could be generated by 2020 if the industry continues the long term investment and building the supply chain to support offshore wind deployment.<sup>3</sup>

*Q.6 Would the project require support under the proposed new Contracts for Difference mechanism? If so, approximately what level of strike price would be required to make the project economically viable?*

32. It is not for Government to comment on what level of revenue support would make a privately funded project economically viable. We would expect projects to come forward with their views on whether they needed support and the level of revenue support that would be required, before DECC could assess the value for money of the project via the CfD regime.

33. Although the capital for the Hafren Power proposal would be provided by private investors, the consortium has informed us that it would require revenue support via CfD in order to provide a suitable return for investors. Government would need to take a view as to whether the level requested represented value for money such that offering a CfD would be in line with the principle of decarbonisation whilst minimising the cost to consumers.

34. Any CfD funding would need to be value for money and considered against support for other low carbon technologies in the context of the Levy Control Framework.

<sup>3</sup> Data taken from Renewable-UK (2011) "Working for a Green Britain: Vol 2" and Carbon Trust (2008) "Offshore Wind Power: Big Challenge, Big Opportunity". Estimates of job per MW calculated using data within reports, and high and low estimates used to provide estimated range of jobs from a similar capacity of offshore wind compared to Severn Barrage.

Q.7 How does the company plan to engage and consult the community in the development of the project?

35. This is a question for potential developers of projects, including Hafren Power.

Q.8 Are the proposals in breach of EU legislation, and if so how will this be addressed?

36. It is not possible to judge at this stage whether a proposal (or a decision to allow a proposal to be constructed) would or would not be compliant with European legislation—this would require a robust assessment of the project which cannot be undertaken until plans have reached a much more detailed stage.

37. However, the Severn Estuary is protected under the EU Habitats Directive as a European site and any tidal barrage proposal across the Severn Estuary is likely to have impacts on the wildlife and habitat in and around the estuary. Any proposal would need to be able to show these impacts would not have an adverse effect on the ecological integrity of the estuary or that the impacts could be compensated for elsewhere to maintain the coherence of the wider “Natura 2000” network of European sites.

38. There are however limits on whether compensation is possible:

- First it would need to be shown that there are no alternatives to the project and that there are imperative reasons of overriding public interest (IROPI) for it going ahead.
- Second there are practical constraints such as the technical feasibility of recreating habitats, and the need to find sufficient land for habitat recreation.

This situation is in line with 2010 STP feasibility study, which concluded:

*“...the scale and impact of a scheme would be unprecedented in an environmentally designated area, and there is significant uncertainty on how the regulatory framework would apply to it. The study has considered ways in which to reduce impacts on the natural environment and also how to provide compensation for remaining impacts on designated features. It is clear that the compensation requirement would be very challenging, however defined, and require land change within the Severn estuary and probably outside it also”.*

Q.9 Are any other proposals for tidal power projects in the Severn estuary currently under consideration?

40. Besides the Hafren Power proposal, the Government is aware of other active Severn tidal power projects under consideration by other developers. These projects are mostly in early stage of conceptualisation and would need significant further work. In November, Regen SW published, as a discussion document, an alternative vision for the generation of power from the Bristol Channel/Severn Estuary.<sup>4</sup> The report suggests that using a multi technology strategy (utilising a mix of new concepts such as tidal lagoons and tidal fences, deployed in conjunction with tidal stream technology, wave and wind power) there is scope to provide up to 14GW low carbon/renewable energy capacity in a manner which benefits the communities on both the Welsh and English sides of the channel and with lower risk to the environment.

41. Other individual projects of which DECC is aware include tidal lagoons, tidal fence and tidal reef schemes. Although some of these projects are more advanced than others, we have not seen evidence that these proposals have secured financing or been sufficiently progressed to warrant detailed consideration by DECC at this stage.

Q.10 What could be the wider international implications of the scheme for UK engineering and UK low-carbon industry?

42. The UK is a world leader in tidal device innovation and has a strong and growing supply chain, including a creative engineering base and expertise in marine foundations and moorings. As a result there could be valuable export opportunities from a Severn tidal scheme.

43. The export potential from a tidal barrage may be more limited as there are only relatively few sites around the world with the combination of features (height of the range, dimensions of the basin, depth of the water) to make a tidal barrage viable.

44. The actual implications for UK industry and engineering of the Hafren Power proposal or any other tidal scheme depend on the exact nature of the project, including confirmed use of UK manufacturers and supply chain, among other things. As noted above, if the project were to maximise use of domestic construction expertise, manufacturing including of the turbine and associated supply chain, it could have the potential of providing 80% of the value of the project to the UK.

## CONCLUSIONS

45. The STP study provided invaluable evidence of the complexity of balancing the positive and negative impacts of a potential Cardiff-Weston barrage.

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<sup>4</sup> Bristol Channel Energy—A Balanced Technology Approach: Discussion Document. Regen SW, 27 November 2012. <http://www.regensw.co.uk/news/2012/11/27/media-release—bristol-channel-has-massive-renewable-energy-potential>

46. The Government remains open to considering any well-developed proposals for harnessing the Severn estuary energy, including barrage and other alternatives. Any scheme would need to demonstrate strong evidence of value for money, economic benefits, energy saving and environmental impact mitigation before the Government could take a view on its potential.

47. The current proposal from Hafren Power makes efforts to address some of the key issues highlighted in STP study. However we have not seen, to date, sufficient evidence that the proposal has yet been developed in enough detail to address the many uncertainties of the scheme.

48. Furthermore, value for money and affordability of the scheme need to be carefully considered against other technologies, as, whilst the scheme would rely on private finance for upfront capital, it would require Government revenue support to provide a suitable return for investors. The level of the required revenue support would need to compare favourably to the alternative generation technologies it would displace.

49. Should it develop further, the Government will consider the Hafren Power proposal with interest, in particular for further clear evidence and the robust work on impacts and mitigation that would be necessary to demonstrate a viable proposal against all the criteria mentioned above.

*December 2012*

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**Supplementary written evidence submitted by the Minister of State, Department of Energy and Climate Change**

I promised to follow up on a couple of points raised when I provided evidence to your Committee on 28 February, as part of its inquiry into the possibility of a Severn Barrage.

Mr Gardiner asked who would be the competent authority for taking a decision on the Habitats Directive for a Severn barrage project. The Government's position is that as between Government Departments, the lead responsibility for dealing with Habitats matters would lie, in the case of a Severn barrage, with DECC, whilst recognising Defra's co-ordinating role in this area. The Government also respects Parliament's position as the ultimate decision making body in the case of a hybrid Bill.

Mr Lavery's sought further information about DECC's discussions with developers for a potential Swansea Bay lagoon. My officials met last week with the project developers, Tidal Lagoon Power, and, as a result, I can provide the following information on the project, which I would be grateful if you could treat as commercial in confidence.

The developer has plans for a step-by-step approach to develop tidal lagoons starting with a 220MW lagoon in Swansea Bay. The project is currently at pre-application stage in the Planning Act process for seeking a development consent, with the expectation that a formal application for the consent will be submitted to the Planning Inspectorate later in the year. I cannot, therefore, offer any comments on the merits or otherwise of the proposal.

<REDACTED TEXT>

I trust this answer the queries the Committee had but do not hesitate to contact me or my officials if we can be of further help with this inquiry.

*March 2013*

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**Supplementary written evidence submitted by the Minister of State, Department of Energy and Climate Change**

Thank you for your letter of 18 March 2013, seeking clarification on a number of points from my oral evidence to the ECC Committee as part of its inquiry into Hafren Power's Severn Barrage proposal.

In response to the concerns raised by Gregory Shenkman, I believe it is quite clear both from my evidence and the transcript of it that the pages I showed the Committee are the Executive Summary not the business case itself. I am however happy for this to be clarified by a footnote in the transcript and will ask my officials to liaise with the Committee clerk on this matter.

I would like, however, to reiterate the point that I made to you at the hearing that, although we have seen the Hafren Power's business case, we are not exactly sitting on a pile of compelling data. The document runs to around 124 pages. Of these, five are the executive summary, about 42 form the main body of the text and the remaining are annexes giving general information (for example charts of various programmes such as caisson construction).

The document does not address the various questions which DECC would need to see addressed before it could take a view on the credibility or otherwise of the project. Rather the document sets out, in broad terms, a programme of work which would be required to provide evidence to underpin any application to DECC for support for a hybrid bill.

The type of evidence we would need to see in support of the Hafren Power proposal includes, amongst other things:

- In-depth study of environmental impacts. We anticipate that this would require both baseline studies and estimation of likely effects.
- Detailed environmental compensation and mitigation plans.
- Evidence of financial backers for the pre-planning/development stage.
- Detailed information on turbines, including modelling of impacts, plans to move from concept stage to commercialisation including in-situ testing.
- Gaining commitment to the project from low head turbine manufacturers.
- Clear in-depth analysis of how much of the proposed benefits can be delivered in the UK.
- Evidence of readiness for a Hybrid Bill—this includes, at least, major steps towards completing an Environment Impact Assessment and extensive stakeholder consultation.
- A clear, understandable breakdown of the level of public support Hafren Power think they would need and a thorough, robust evidence base to support this.
- Analysis of impact on upstream ports and navigation as well as detailed mitigation plans.
- Detailed evidence supporting job creation figures.
- Detailed evidence of the flood impact figures.

I have strongly encouraged Hafren Power to share the document with the Committee on a confidential basis so that the members of the Committee can draw their own conclusions on the document. I am very pleased to hear that they have provided you with a copy of the document.

With regards to the other 3 points for clarification which you raised in your letter:

(1) *Can you set out what “full due process” would entail for a project of this scale, including what is involved in the “pre-consent process”? (Q352)*

(a) If the Planning Act route is followed, there would be consultation as provided for in the Planning Act: first, on a National Policy Statement (“NPS”) and then on an application for development consent in respect of whatever barrage proposals were brought forward by developers.

The scope of NPS consultation would depend in part on how wide or narrow the focus of the policy statement was and on whether it dealt with the Severn Estuary specifically as a site potentially suitable for development. An NPS would need to set out both the generic case for tidal and wave power and policy on assessing applications. Under the Act, it would also require an “Appraisal of Sustainability”, which would assess the environmental impacts of the technology and, if specifying one (or more) potential sites, the impacts of developing each individual site in some detail, but still at a relatively high level. There may also need to be a high-level appraisal of the NPS from the point of view of the Habitats Directive if there was a potential to affect nature conservation sites designated under that Directive, as there would be for the Severn Estuary.

It is likely that an Appraisal of Sustainability of a draft wave and tidal NPS that referred to the Severn Estuary as a suitable site would need to address the economic consequences of a barrage (eg on the Port of Bristol) as well as what one might more conventionally think of as “environmental” impacts.

The final stage before a new NPS is designated by the Secretary of State is of course approval by Parliament—after scrutiny by Select Committee and in the House of Lords, followed by a vote on the floor of the House.

The “full-process” for a project of this scale submitted as an application to the Secretary of State under the Planning Act 2008 is set out in the Act itself, secondary legislation and in guidance documents issued by the Planning Inspectorate. I attach an internal overview of the process at Annex A.

(b) While we fully understand that interested parties would like to have a similarly detailed picture of how they would be consulted in the event of a barrage project being promoted under a hybrid Bill, we are not able to give this at present. First, the consultation processes that might lead to a hybrid Bill are not prescribed in detail by legislation to the same degree as is the case under the Planning Act—although there is provision in the Standing Orders of both Houses for accommodating the environmental impact assessment process. Secondly the process would depend on whether Government were to decide that there should be a Severn barrage or similar project and that Hafren’s proposals were the best proposals for such a project.

We have not yet reached a decision on these points and cannot, therefore, be specific on consultation. What we can say is that there would be consultation, and that any consultations would have to be designed and carried out having regard to the same underlying principles—many of them dictated by the requirements of EU law as to public participation in environmental decision-making—that have shaped the relevant provisions of the Planning Act. Within any consultation there would be opportunities for interested parties, both locally and nationally, to comment on both the principle of Government support for a barrage scheme and on the details of any scheme which was proposed to be the subject of a hybrid Bill. Such consultation would have to involve both economic and environmental considerations.

(2) *Who would be the “lead competent authority” for making a decision on the barrage under the Habitats Directive derogation process of IROPI? (Q363–368)*

(3) *Could DECC provide an update on the discussions with the Swansea Bay Lagoon developers?*

I believe that my letter of 14 March, which I enclose, has answered these two points but please do let me know if you request further information or any clarification.

I trust this answer the queries the Committee had but do not hesitate to contact me or my officials if we can be of further help with this inquiry.

March 2013

## **Annex A**

### **PRE-APPLICATION PROCESS**

#### **CONSULTATION**

Part 5 of the Planning Act sets out statutory requirements for applicants to engage in pre-application consultation with local communities, local authorities and those who would be directly affected by the project. The front-loaded emphasis of consultation in the major infrastructure planning regime is designed to ensure a more transparent and efficient examination process.

Pre-application consultation [...] should [...] be carried out to a certain standard. Issues about the adequacy of consultation should be considered prior to the Inspectorate.

Applicants are required under section 37 of the Planning Act to produce a consultation report alongside their application, which details how they have complied with the consultation requirements set out in the Act.

The Secretary of State [Note—in practice PINS] will consider this report when deciding whether or not the applicant has complied with the pre-application consultation requirements and, ultimately, whether or not an application can be accepted

#### **ENVIRONMENTAL IMPACT ASSESSMENT**

Most major infrastructure projects will fall within the scope of the Environmental Impact Assessment Directive, and will require an Environmental Statement to be prepared and submitted as part of the application. At an early stage the applicant needs to either inform the Secretary of State of their intention to submit an Environmental Statement along with its application, or where the developer is unsure whether an Environmental Statement is needed, that they intend to seek a screening opinion. A screening opinion should be sought as early as is possible for the environmental effects of the proposed development to be properly considered. The Secretary of State can also, through a scoping opinion, advise applicants on the content of any required Environmental Statement. The scoping opinion will be based on advice received from statutory consultees and other relevant organisations.

For major infrastructure projects, the Environmental Impact Assessment process is governed by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009. These Regulations ensure that the pre-application publicity and consultation requirements for the Environmental Impact Assessment process are consistent with those of the Planning Act.

#### **HABITATS REGULATIONS ASSESSMENT**

When considering whether a project has the potential to significantly affect the integrity of a site protected under the Habitats Regulations<sup>18</sup> or any Ramsar site, the applicant must provide a report (normally in the form of a Habitats Regulations Assessment), with the application showing the site(s) that may be affected together with sufficient information to enable the decision-maker to make an appropriate assessment, if required. It is the applicant's responsibility to consult with the relevant statutory bodies and, if they consider it necessary, with any relevant non-statutory nature conservation bodies, in order to gather evidence for the Habitats Regulations Assessment. This consultation should take place as early as possible in the pre-application process.

### **CONSENTING PROCESS**

#### **APPLICATION**

Having completed the pre-application processes outlined above, the applicant submits an application for a Development Consent Order (DCO) with the appropriate reports and assessments—including a draft of the proposed DCO—to PINS (acting on behalf of SoS). The form of the application is set out in secondary legislation. PINS has 28 days to decide whether to accept or reject the application.

#### **PRE-EXAMINATION**

If accepted, PINS advertises the application and invites interested parties to register with PINS. The developer and PINS will agree a date on which registration should close. There is no statutory time-limit and

it may be around four months. After close of registration, PINS will hold a pre-examination hearing to set out the examination process (eg how many Inspectors will be involved, scheduled public examination hearings etc).

#### EXAMINATION

The formal examination period begins the day after the pre-examination period and lasts up to six months. PINS will take evidence from interested parties, hold public hearings on the application and may seek further information or advice from interested parties and statutory consultees.

#### PINS RECOMMENDATION

After examination, PINS will consider the evidence and make a recommendation to the Secretary of State on whether to grant a DCO. There is a deadline of three months from the end of the examination for submission of a Recommendation to SoS.

#### DETERMINATION

The SoS has a further three months in which to consider the Recommendation from PINS and determine either to make a DCO or refuse consent.

At the end of this period, SoS will make a DCO, or issue a report giving reasons why a DCO has been refused.

#### POST-DETERMINATION CHALLENGE PERIOD

After a DCO is made, there is a period of 6 weeks during which the DCO may be legally challenged (in effect a judicial review). If there is a JR, consent may be delayed for between one and two years.

#### HYBRID BILLS

For a Hybrid Bill on an energy project, the Secretary of State for Energy and Climate Change would be the “Competent Authority” for Habitats Regulations Assessments and for approval on IROPI grounds:

Environmental Impact Assessments would fall within the general provisions of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (2011/1824). These regulations implement requirements for EIAs, including publicity and consultation, set out in the EIA directive 2011/92/EU.

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### Written evidence submitted by Evans Engineering & Power Company Ltd

#### 1. EXECUTIVE SUMMARY

This Paper makes it plain that not only are there other proposals for Tidal Power Projects in the Severn Estuary under consideration, but that the project known as the “**Reef**” is quite simply “head and shoulders” above the rest. It would produce more power (30.4 TW per year), while protecting the environment; by not killing the fish and by maintaining an inter-tidal habitat for bird life. The Reef would also allow shipping to pass through it, to and from the Ports of Bristol, with less disruption than any of the other major energy generating proposals for the Severn. This includes the Coram Hafren proposal for the Severn Estuary, known as the Severn Barrage, a project which in its latest incarnation attempts to copy some of the Reef’s properties, such as bi-directional flow, but puts it in the wrong place (Cardiff to Weston), where less energy will be captured and where the high silt load will in all likelihood foul its operation. The Reef on the other hand is the only “future proof” design, allowing upgrading or modification after initial installation. It is the only project seeking to engage with environmental and shipping issues from the outset. It is the only project actively seeking the participation and investment of the British people in a “Green Legacy Project”.

#### 2. INTRODUCTION

The simple answer to the question “Are there any other proposals for Tidal Power Projects in the Severn Estuary currently under consideration” is “yes”, this paper however seeks to shed further light on just one of these proposals known as the “Evans Tidal Power Reef”, named hereon as the “Reef”, a concept of the Cornish engineer and inventor Rupert Armstrong Evans. In 2009 Atkins, at the behest of the RSPB, undertook a study<sup>5</sup> of a concept developed by Rupert Armstrong Evans (RAE) known as the “Tidal Reef” or “Tidal Power Reef”. The findings of this independent study were interesting in that they affirmed the claim that the Reef would do far less damage to the environment than the Severn Barrage and estimated that it could produce more power. So what is the Reef, how would it work? and what would the benefits be over a conventional barrage or a similar scheme built on the Cardiff to Weston-Super-Mare line? This paper seeks to address these three questions

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<sup>5</sup> Severn Barrage, Feasibility of “Tidal Reef” Scheme, ATKINS 2009 5079276/RPT/01 available at: [http://www.severntidal.com/pdfs/atkins\\_tcm9-203975-1.pdf](http://www.severntidal.com/pdfs/atkins_tcm9-203975-1.pdf)



### 3. HISTORY

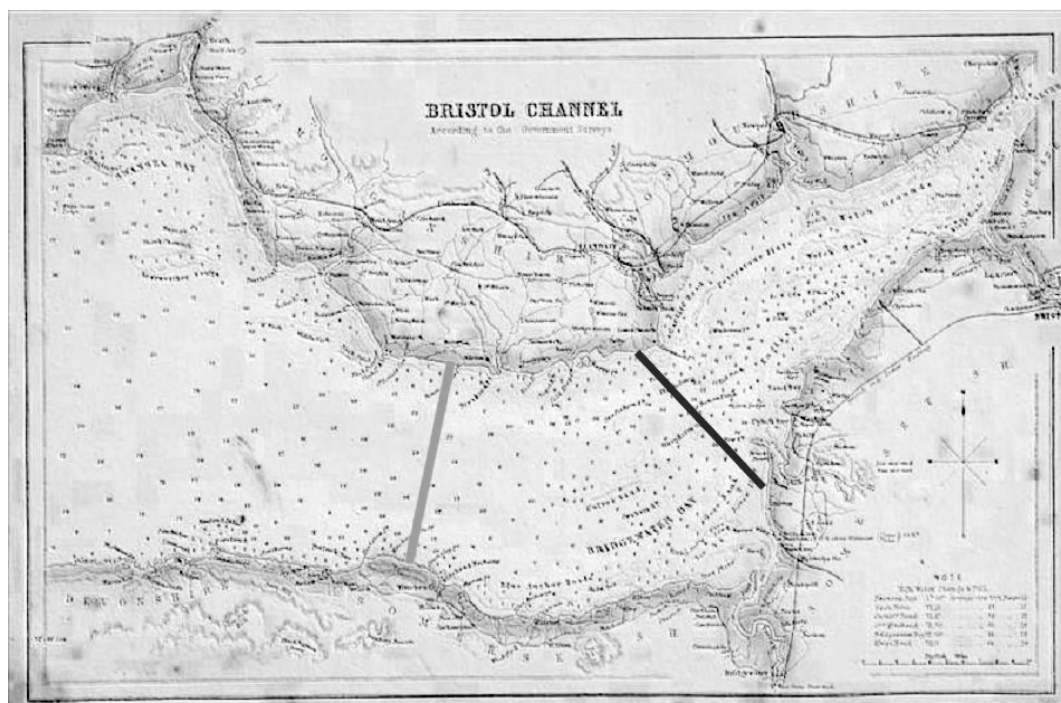
The Severn Estuary has the second highest tidal range in the world. There is huge potential to harness this power and many proposals have been put forward throughout the last 100 years. Most of these proposed schemes (tidal range technology) would work by blocking off the estuary or lagoon with a dam/barrage, and by delaying the tides, these barrages produce a significant difference in water level between the inside and the outside of the dam in order to operate the hydroelectric turbines. These proposals are likely to be both expensive and environmentally damaging. The damage mainly would be caused by changes to water flow patterns and levels within the estuary. This in turn would impact on the mudflats and salt marshes and their bird populations, while the pressure differentials in the barrages themselves would be likely to kill a large proportion of any fish attempting to swim through the turbines. More recent developments in tidal stream technology (extracting kinetic energy) are also expensive and give a significantly lower power output.

#### 4. What is the Reef and how would it work?

The REEF system, is a totally new concept, it is based on a relatively light impounding structure spanning the 12-mile estuary that maintains a small but constant head difference between the outer sea level and the inner estuary when the tide is coming in and the reverse when the tide is going out. Introducing only a short delay to the natural tidal cycle avoids almost all the adverse environmental consequences of a large fixed barrage of the type proposed between Cardiff and Weston Super Mare. The Reef proposal has already had positive feedback and support from a wide range of environmental groups including: the RSPB, Avon Wildlife Trust, The Wildfowl & Wetlands Trust, The Anglers Conservation Association, the Wye and Usk Foundation, The Burnham and Somerset Levels Sea Flood Study Group, the Green World Trust, Friends of the Earth, The Bore Forum, and TENONS the environmental network of North Somerset.

#### 4.1 Location of the Reef

The favoured location for the Reef is between Minehead in Somerset and Aberthaw in South Wales. A recent study conducted by consultants W.S. Atkins suggests that a Reef type structure in this location could yield an annual energy output as much as 50% greater than a “conventional barrage” located between Weston Super Mare and Cardiff. Such a structure, it also concluded, would also be significantly cheaper and faster to build and would have significantly less environmental impact when compared to a conventional “barrage” between Cardiff and Weston.



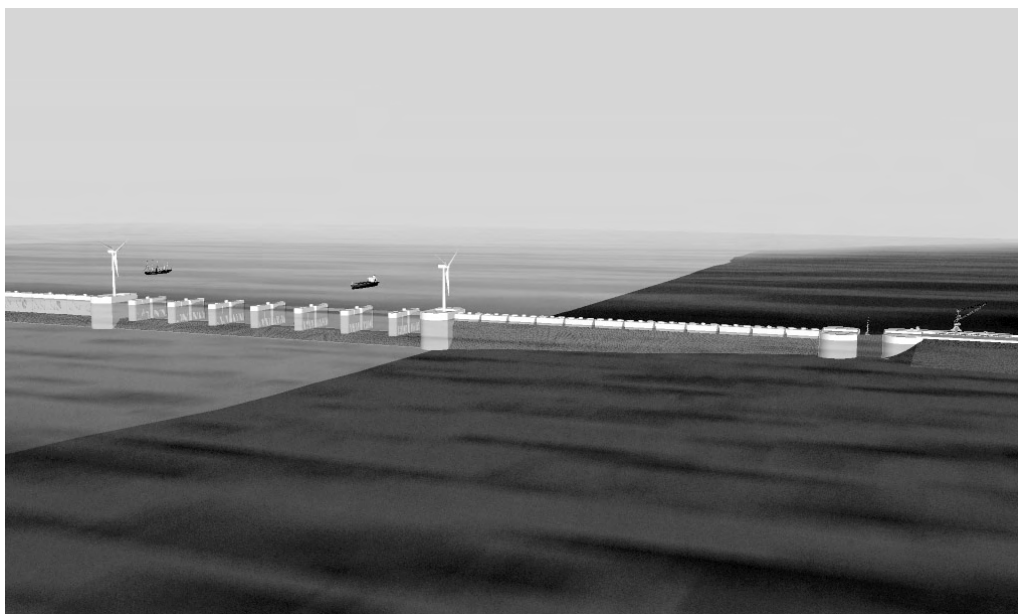
**Map showing the proposed location of the Reef in green and the Barrage in blue, this also graphically illustrates the difference of the impounded areas of the two schemes, with the Reef exploiting almost twice the volume of water.**

The water turbines used in a barrage scheme, are usually unidirectional, so a significant portion of the civil engineering cost is associated with sluices and by-pass channels to let the tide into the inner basin, but this is “dead investment” in that it does nothing to increase the energy output and actually dissipates energy in friction. The Reef system uses bidirectional turbines and a “differential head” of less than three metres to minimise environmental damage and maximise the utilisation of the plant. The power output is lower but the operating

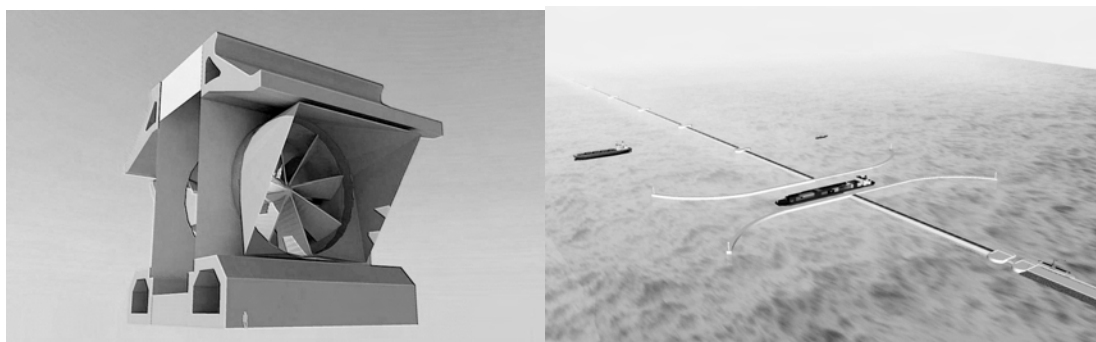
period is longer, making it easier to integrate with the National Grid and to supply the national base load power requirement. Around 600 water turbines with diameters between 15 and 20 metres diameter will be required to generate up to 6000MW.

#### 4.2 Navigation

Navigation has always and will continue to be vital to the community and commerce along the Severn estuary. To consider installing conventional ship locks that would cause significant delays to the passage of ships is unrealistic. Bristol Ports now account for over 12 million tons of freight annually and has embarked on a £600m development of a new “Deep Sea Container Terminal”, so only an innovative solution to the passage of very large containers ships with minimal delays will be acceptable, and this is what the Reef offers. For small craft wishing to navigate the Reef, a lock would be provided on both the Welsh and English sides of the Estuary.



*Above: Proposed mini lock gates for small craft passing through the Reef*



*Above left: a schematic view of one of the proposed 600 reef turbines “man to same scale”.*

*Above right: how the Reef might look from above, showing how ships could pass through openings in the structure.*

#### 4.3 Structure of the Reef

The Reef is not so much a “power station built in the sea” as a chain of ships or floatable structures sitting on the seabed. The key to reducing both short-term risk and “future proofing” the whole project is flexibility. By separating physically and if necessary financially, the provision of the infrastructure (a seabed foundation) and the movable “power generation modules”, many partners can easily be combined and thus reduce individual risks. As an example of a similar marine technology, the Mulberry Harbours, a project involving similar scale, were built in secret during WW2 in only 6-months and installed in Normandy over a period of a few weeks; it is therefore not unreasonable to assume that with our present knowledge of offshore structures and project planning, that we are able to build a not dissimilar scale of project in a time scale of a few years rather than the ten to fifteen years for a “conventional barrage” or a nuclear power plant.

#### 4.4 National Vision

Galvanising the many interested groups and getting the “nation” behind this project is important. A significant part of the capital investment and “direction” could come from the people of Britain. Both the Welsh and the English have major parts to play and would benefit from very significant numbers of jobs, both during construction and for ongoing maintenance. Our objective is to bring together the constituent parts of a major “green energy project” that we could be proud to leave for future generations, instead of a stockpile of spent nuclear waste.

#### 4.5 Connection of the Reef to the National Grid

Grid connection may be achieved in a number of ways. Aberthaw power station on the Welsh side is already connected to the grid with a 400,000-volt line. This power station is scheduled for closure in about 15 years time. An underground connection would be possible on the Minehead side, running for part of its route along the West Somerset Railway before being connected into an upgraded but existing (132,000 volt) overhead line near Wiveliscombe. Another possibility could include an undersea cable (possibly superconducting) connection laid directly to the Hinkley Point Power station take off, without the need for pylons.

#### 4.6 Energy storage and other uses for energy produced by the Reef

Extra energy could also be stored by converting water into hydrogen using electrolysis and then by pumping the gas to the existing British Oxygen plant at Port Tolbert, or it could be used for desalination in drought years.

#### 4.7 Technical feasibility of the Reef

The technical feasibility of a Reef like structure was outlined in a report by W.S. Atkins and Rolls Royce entitled “Concept Design of a very low head dual generation tidal scheme for the Severn Estuary, published in February 2010<sup>6</sup>. Some of findings of this report are listed below and indicate that such a structure:

- May produce a peak power output in a Minehead-Aberthaw alignment of 10,000MW with a total annual energy yield of 30.4 TWh (5)
- May substantially reduce the loss of intertidal habitat relative to the STPG ebb-only barrage (8).
- May theoretically reduce fish mortality significantly through the turbines (19).
- Should be less disruptive to shipping than an ebb-only barrage due to the retention of existing navigation channels, shorter lock transitions, and higher structure permeability during construction, although a ship lock structure will still be required (12).
- Would require reduced grid reinforcement for a given energy yield due to the lower peak capacity and longer generating window.
- Be more likely to retain the natural flow patterns of the estuary, however higher fidelity modelling will be required to confirm this conclusion (13).
- Have a majority of the components for a very-low head bi-directional turbine within the current supply chain scope and production of the required number of turbines is reasonably feasible (18).
- And very-low head bi-directional turbines with high reversible efficiency are technically feasible and no new technology or engineering methodology is required (16).

#### 5. What would the benefits be over a conventional barrage or a similar scheme built on the Cardiff to Weston-Super-Mare line?

The benefits of the Reef over a conventional barrage sited between Cardiff and Weston -Super-Mare are outlined above and can be summarised as follows: The Reef would produce more energy, while protecting the environment by not killing so many fish and by maintaining an inter-tidal habitat for bird life. The Reef would also allow shipping to pass through it to the Ports of Bristol with less disruption than any of the other proposals.

##### 5.1 Coram Hafren

A consortium known as Coram Hafren is now proposing a barrage between Cardiff and Weston-super-Mare that has been modified to incorporate the Reef system of operation, namely bidirectional flow and a low differential head. They have however overlooked the other critical factors that make the Reef concept particularly attractive.

- The Cardiff-Weston alignment is not as attractive as the Minehead-Aberthaw alignment because it captures less energy, is in the path of mobile silt, and makes navigation more dangerous and time consuming. Further more, storm surges are likely to be heightened in parts of northern Somerset and there will be considerable impacts from construction traffic.

<sup>6</sup> “Concept Design of a very low head dual generation tidal scheme for the Severn Estuary”, Rolls-Royce plc and Atkins Ltd, as part of the Severn Embryonic Technologies Scheme, part-funded by the Department for Energy and Climate Change, Welsh Assembly Government, South-West Regional Development Agency, and the Department for Environment, Food and Rural Affairs. Published in February 2010 (bracketed numbers indicate the order of the points from the conclusion on pages 46–47).

- The Reef additionally provides the opportunity for efficient energy storage without the risk of flooding. The innovative approach to turbine and caisson construction will provide far more local and UK jobs because it is based on “shipyard technology” as opposed to the conventional high precision water turbines that have very few potential suppliers.

## 6. THE LEGACY AND WAY FORWARD

The Reef is our generation’s opportunity to build an “iconic green energy project”, it would be the “Greatest Machine on Earth” and visible from outer space with the naked eye. It would be our generation’s “Hoover Dam” or “Great Wall of China” and it would “say” that we care enough about future generations to invest in them, rather than leave a legacy of a resource depleted planet and a stockpile of spent nuclear waste”.

### 6.1 Public investment and funding

Public investment in the form of a “green bond” could mean that thousands or even millions of ordinary British people could own a stake in what is a part of our natural heritage.

The Reef proposal has had no public funding. A formal expression of interest by Government would be sufficient to bring forward the funds to proceed with an outline design and “due diligence”. The Reef cannot be dismissed on technical grounds, and there are significant “green energy” benefits, without many of the environmental or commercial impacts associated with the Cardiff-Weston Barrage. The economics depend to a large extent on the value placed by Government on renewable energy, energy security and “load levelling” within the “grid system”. If the value placed on “head-range tidal with storage” were comparable with “offshore wind”, then the project would almost certainly be able to attract the necessary investment.

### 6.2 Future proof design

The Reef is the only “future proof” design, allowing upgrading or modification after initial installation. It is the only project seeking to engage with environmental and shipping issues from the outset. It is the only project actively seeking the participation and investment of the British people in a “Green Legacy Project”.

November 2012

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## Supplementary written evidence submitted by Evans Engineering & Power Company Ltd

*Matters arising from evidence submitted to the DECC 2013 Committee on 30th January addressing the Tidal Power Projects in the Severn Estuary Currently under consideration.*

### 1. EXECUTIVE SUMMARY

This documents seeks to counter any claim that the REEF Tidal Concept is unsound from an engineering perspective, and to show that it is superior to all other proposals, in the light of evidence given by the author and others including Hafren Power to the Select Committee. The original “Evans Engineering Concept” considered in a report by W.S.Atkins for the R.S.P.B is still valid, and it is only aspects of “some possible engineering solutions” that have been questioned. The Hafren Power Barrage now uses the REEF bi-directional low-head operating concept, but does not go far enough to mitigate the environmental and commercial shipping impacts. Further, the developers have admitted to the Select Committee that it is not their intention to see the Barrage built, but to sell on the project after three years to a Sovereign Wealth Fund. So my continued objections to the Cardiff to Weston Hafren project are that it is the wrong structure, in the wrong location and the developers are not interested a “Public Participation” in a “Green Legacy Project”.

### 2. BACKGROUND

The “Tidal Power Reef”, or the “REEF” was, at the behest of the RSPB, studied by consultants W.S.Atkins.<sup>7</sup> The findings of this independent study affirmed the claim that the Reef would do far less damage to the environment than the Severn Barrage and estimated that it could produce as much or more power than a conventional design of Cardiff to Weston Barrage. Lord Porritt, now an official advisor to Hafren Power, said of the new Hafren Power Barrage in an e-mail to my colleague Dr Brian Mathew (18<sup>th</sup> January 2013) “as you said in your paper, this proposal is now in many respects closer to the idea of the Reef initially developed by Rupert, and you must be (to a certain extent!) gratified by that” The Hafren Power Barrage however, differs from the REEF in several key respects, resulting in the continued concerns of both environmental and shipping interests. The REEF uses a lower differential head, which in turn reduces the environmental impacts. The lower “solidity” presents less resistance to the tidal flow, smaller change in navigation depth and greater operating flexibility.

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<sup>7</sup> Severn Barrage, Feasibility of “Tidal Reef” Scheme, ATKINS 2009 5079276/RPT/01 available at: [http://www.severntidal.com/pdfs/atkins\\_tcm9-203975-1.pdf](http://www.severntidal.com/pdfs/atkins_tcm9-203975-1.pdf)

### 3. THE OPERATING SYSTEM

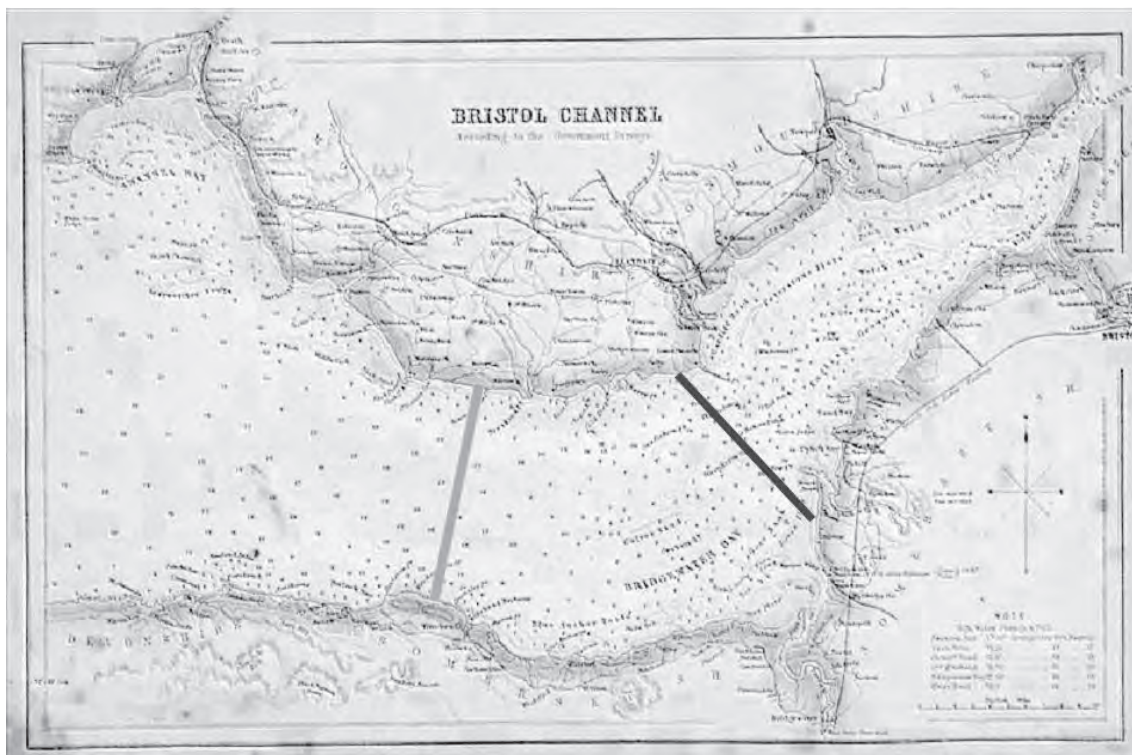
*The Severn Estuary* has one of the highest tidal ranges in the world. It is the differential head across the barrage structure and the inherent delay to the natural tidal cycle that causes the difficulties, but reducing this head/delay also reduces the commercial viability of any scheme. It is a fundamental premise of the REEF Concept that the environmental and shipping interests dictate the envelope into which any project fits. The Hafren Power Barrage patently approaches this from the traditional perspective of a commercial project seeking to “Mitigate” any environmental problems. In the case of the highly complex systems that exist in the Severn Estuary, this is not possible. Evidence presented to the Select Committee suggests that providing compensatory habitat with a similar hyper-tidal range and scale would in effect require the construction of another Severn Estuary! Hafren, on their own admission did not even contact Bristol Ports, so could hardly have included their requirements into their engineering proposals.

### 4. FISH MIGRATION

The REEF system, is a totally new concept, it is based on a relatively light impounding structure spanning the 12-mile estuary that maintains a small but constant head difference between the outer sea level and the inner estuary. The very low head differential totally removes any risk to fish resulting from the pressure change through the turbines. The free discharge of the water is about 6 metres per second and the relative speed of the turbine runner to any fish passing through it, can be significantly lower. Smooth internal passages and the total lack of “pinch points” means that a totally “fish friendly” turbine can be built. There is no reason to believe that a turbine cannot be designed that presents less of a danger to migrating species than a natural river obstruction of the same height such as rapids or a small waterfall. There will undoubtedly be some trade off against power output but there is no other feasible mitigation measure.

### 5. NAVIGATION

*The favoured location for the REEF* is between Minehead in Somerset and Aberthaw in South Wales. Others have been considered but this route offers the best power output with the lowest impact, because it is possible to offset some efficiency in favour of lower environmental impacts and easier navigation.



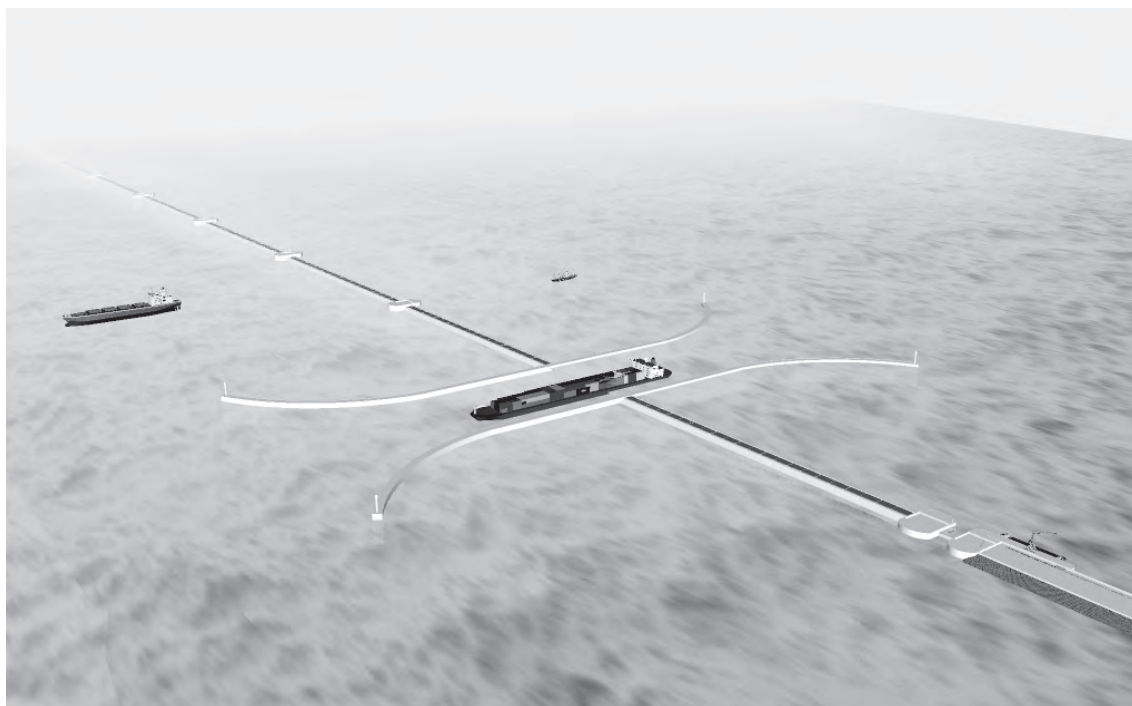
*Map showing the proposed location of the Reef in green and the Barrage in blue, this also graphically illustrates the difference of the impounded areas of the two schemes, with the Reef exploiting almost twice the volume of water.*

Navigation has always and will continue to be vital to the community and commerce along the Severn estuary. Evidence has been presented outlining concerns over safety and transit times through any structure. Conventional locks would result in different sizes of vessel congregating in a restricted area with consequent dangers of collision or grounding. A REEF structure located much further to the West, has several advantages. *Large container ships* can be scheduled to pass directly through the REEF during and for an hour or so each side of “slack water”. Should they wish to “lay to” before moving across the REEF, there is ample room in



the estuary. If they wish to cross the REEF and “lay to” before proceeding up the estuary, there is also ample room. With a Cardiff-Weston barrage, they simply isn’t enough room for several large vessels to manoeuvre in safety in poor weather conditions.

*The navigation structures* would comprise two large ship pounds measuring approximately 200 metres in width by a kilometre in length. Controlling gates that do not have to form any watertight seals (because of the low head) would rise (aided by compressed air) from the seabed (similar to the Mose Project currently under construction to protect Venice from storm surges). Even at times when the gates would normally be closed, some ships could pass through without having to tie up or require tug assistance. The evidence of Hafren Power suggests that their design would introduce a delay of 45 minutes or more for a large container ship. Transiting the REEF would only require a reduction in speed or a delay of ten to fifteen minutes.



*Above right: how the Reef might look from above, showing how ships could pass through openings in the structure.*

*The navigation depth will be reduced* on account of the energy extracted, but given that the REEF presents very little “parasitic” loss/friction, it would be possible to “free flow” the system when appropriate to achieve the required water depth at Avonmouth. Evidence was given that cast doubt on the economics of “free flowing” or even “pumping” to maintain navigation depths. Since this aspect is of a commercial nature, it is a relatively straight forward procedure to determine whether the cost of a delay is greater than the loss of generation, so compensation is appropriate according to the state of the tide and time of the day. For example, on a particular tide it might be economic to delay generating for an hour in order to coincide with navigation requirements or meeting an evening peak generation requirement. The REEF is thus a more “flexible” and adaptable option than the Hafren Power Barrage.

## 6. REEF STRUCTURE

The REEF is not so much a “power station built in the sea” as a chain of ships or floatable structures sitting on the seabed. The key to reducing both short-term risk and “future proofing” the whole project is flexibility. The Hafren Power Proposal is for a conventional fixed structure with a finite operating system and life. The REEF by contrast is built, maintained and “future proofed” by its modular “dismountable” design. Should the operating requirements or technology change over the years, the REEF can change to meet them. Changes in sea level, materials or estuary morphology, may make it necessary to alter or even remove the structure. This is possible with a REEF but very difficult with a conventional barrage.

## 7. FLOOD ALLEVIATION

*Evidence has been heard* that suggests that storm surges coming up the estuary will spill onto the Somerset Levels if there is a barrage between Cardiff and Weston, as there is no where else for the water to go. Hafren Power are suggesting an increase in the bund height in Bridgwater Bay, but the capital cost might be better spent on a REEF structure further to the West to stop the problem in the first place. The REEF between Minehead and Aberthaw is better able to offer a buffer to surges and river flooding on account of the larger enclosed area.

## 8. NATIONAL VISION

Galvanising the many interested groups and getting the “nation” behind this project is the only feasible way forward. The Hafren Power proposal is in danger of being divisive and out of touch with public opinion. It may increasingly fuel conflicts with environmental groups, shipping interests and the general public, who would not tolerate an effective privatisation of the Welsh and English coastline for private profit. A significant part of the capital investment and “direction” should come from the people of Britain. Both the Welsh and the English have major parts to play and would benefit from very significant numbers of jobs, both during construction and for ongoing maintenance. Hafren appeared to sate at the second of the Select Committee hearings (30/01/2013) that they intend to sell out after three years and have already indicated that the majority of the finance would come from overseas investors, who may be less inclined to use UK contractors and labour.

February 2013

### Written evidence submitted by Associated British Ports (ABP)

#### INTRODUCTION

1. ABP is the UK’s largest and leading ports operator with 21 ports around Britain handling around one quarter of the UK’s seaborne trade.

2. ABP owns and operates the five ports located on the northern shore of the Severn estuary comprising from the west, Swansea, Port Talbot, Barry, Cardiff and Newport. ABP is the statutory Harbour Authority for the 5 ports and the port limits encompass areas of the Severn estuary.

3. These ports handle some 13 million tonnes of cargo annually, including a broad range of import and export cargo and they service a hinterland extending well beyond South Wales into the Midlands, London, Northern UK, M4/M5 corridor and the South West.

4. In addition to general cargo trade for distribution within the hinterland area, several ports service industry and manufacturing plants located on or near the port estate. In particular Port Talbot, Barry, Cardiff and Newport provide essential facilities for such businesses handling both inbound raw materials and product shipped to markets in the UK, Europe and globally.

5. ABP has significant reservations regarding potential negative impacts if a tidal barrage is constructed, including restrictions to vessel size and access and the overall competitive position of its ports relative to other ports in the UK. These effects may also impact on substantial parts of the South Wales economy which rely on these ports for their supply chains.

6. ABP also believes it is important to note the lack of detailed information about the new barrage proposal which is in the public domain. This issue was raised by ABP and the Port of Bristol in a separate letter to the Chairman of the Energy and Climate Change Committee on 7 November 2012.

#### PORTS AND THE SOUTH WALES ECONOMY

7. The UK Government has identified ports as crucial international gateways and key drivers of economic growth. For example, the National Policy Statement for Ports (“NPS”) (applicable to England and Wales) published in July 2012 states:

*“... the provision of sufficient sea port capacity will remain an essential element in ensuring sustainable growth in the UK economy.” (p.9)*

*“Ports continue to play an important part in local and regional economies, further supporting our national prosperity.” (p.10)*

8. A report by the Welsh Economic Research Unit in 2009 indicates that ABP’s ports in South Wales support at least £79.8 million of output with a GVA of £32.4 million. The activities of ABP’s port tenants accounts for an estimated 9,711 FTE jobs with a direct and indirect output of £2.78 billion and GVA of £902.5 million (2% of the Welsh total).

9. South Wales’ ports are vital strategic assets that continue to have a role in attracting investment to the Welsh economy. This role is highlighted through recent examples of inward investment which will assist in re-balancing the economy and encouraging export-led growth; however such development requires good access to the ports with which a Severn Barrage would interfere.

#### ACCESS TO SOUTH WALES PORTS

10. Previous studies have indicated a potential reduction in high water tide height of c. 1 metre caused by a barrage which would limit port capability to handle deeper drafted vessels and impact on port trades including coal, scrap, steel and animal feeds. Additional transit time and tug resources required to navigate through barrage locks would add to vessel freight costs placing ports behind a barrage at serious disadvantage.

11. A non-exhaustive summary of potential impacts requiring numerical and/or physical modelling and economic assessment is as follows:

- Lock size, location & number.
- Lock congestion & time through locks.
- Locks to berth transit times & navigational routes.
- Analysis of existing vessel dimensions using Severn ports & future demand profiles.
- Authority responsible for management/operation of locks/charging regime.
- Effect of reduced tidal range within the impounded estuary—vessel draft constraints.
- High water reductions/variations both sides of barrage.
- Accretion/erosion either side of barrage.
- Flood risk outside barrage.
- Affect on existing navigable channels.
- Maintenance dredging factors—increased dredging/alterd siltation patterns/relocation of spoil grounds in response to new current/turbidity regimes.
- Shipping freight cost effects.
- Effect on surface transport infrastructure demand/congestion—population increase, tourism, construction etc.
- Economic impact on ports including competitive position.
- Potential heightened water table effects on port structures/foundations.
- Effect on inter-tidal port structures of increased mean tide height—inspection/maintenance/corrosion.
- Water quality (water impounded to docks from estuary).

#### CONCLUSIONS

12. It is essential that the **major opportunity cost** of constructing a Severn Barrage is taken seriously and the implications, both economic and physical, must be comprehensively assessed.

13. It may be that construction of the barrage generates significant but ultimately transient economic benefits. The Government must consider the **long term impact of the permanent loss or impairment of key strategic economic assets**.

14. There are clear indications that the construction of a barrage may cause severe long term damage to the economy and jobs in South Wales.

*November 2012*

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#### Written evidence submitted by the Country Land and Business Association

##### THE CLA

The Country Land and Business Association (CLA) represents 34,000 members who between them own and manage about half the rural land in England and Wales. This includes the low lying agricultural land (much of it highly productive) that may be required to deliver compensatory habitat in England and Wales, and the fishery assets on the Severn and its tributaries which are important to the rural economy.

Importantly, our membership owns and manages the assets that will be affected should the proposal go ahead, and we accordingly have a key stakeholder role.

However, many of our members are very small sole traders or small businesses who have no other representation and are relying on the CLA submission to protect their property rights, the sustainability of their businesses and their right to fair treatment, and to ensure that they are not forgotten or disregarded in this potentially enormous scheme.

The CLA's members are involved in all forms of renewable energy and area are also energy consumers and depend on security of energy supply in their businesses. We share the view that climate change is one of the biggest issues facing the world in the 21st Century.

##### DISCLOSURE

We share Government's objective to properly assess the costs and benefits of capturing tidal power from the river Severn. However those respondents submitting evidence have little information on which to base their representation. There must be substantial and detailed disclosure of the scheme proposals both regarding the construction of the barrage itself but also, and perhaps more importantly the wider impacts which will be far reaching both within and beyond the Severn estuary itself.

In summary there are likely to be significant impacts across the following areas on which there must be sufficient consultation supported by full details so it can be clear as to the full impacts of such a major development. These consultation should include the impacts on:



- Land use—both for construction, mitigation and compensatory habitat.
- Water levels—an assessment of water levels both sides of the barrier and an assessment of how this affects current EA proposals for coastal re-alignment<sup>8</sup> including drainage and flooding impacts on both sides of the barrier.
- Agriculture and rural business—how much productive land, of what quality and where, will be lost to construction of the barrage and the extensive mitigation measures proposed.
- Fisheries—the impact on fish stocks and migratory fish and the businesses that rely upon them.

Where it is relevant for us to comment CLA has provided evidence in response to the questions set out in the terms of reference which is set out below. However there is little detail provided on the current proposal so our response is not as full as it should be.

#### ANSWERS TO THE QUESTIONS SET OUT IN THE TERMS OF REFERENCE

This section addresses the specific questions posed in the terms of reference.

##### *1. What contribution could the Cardiff-Weston Barrage make to UK energy security and climate change objectives?*

The CLA does not have the expertise to comment specifically on the potential for energy generation from a Severn Barrage.

We recognise that low carbon generation of this scale may benefit the UK's energy security as well as reducing the carbon intensity of our energy supply. However, it is vital that consideration is given to the alternative renewable energy scenarios and the different options available to achieve the UK targets.

For example in the 2010 consultation it was suggested that an area of up to 64,000 ha could be required to replace habitats lost as a result of a Cardiff—Weston barrage. It should therefore be considered what the impact of using this equivalent land area for alternative energy resources (biomass, biofuel or anaerobic digestion feedstock). If this area was planted with short rotation coppice willow, this would provide huge biodiversity benefits in its own right and deliver 1.1GW of energy, without any harm to intertidal habitat or protected salmonid and other fish species.

Moreover, renewable technologies are developing quickly, and efficiency gains and cost reductions are being achieved so there may be more cost effective alternatives which may become viable before completion of the barrage<sup>9</sup> e.g.:

- The replacement of up to 50% of the gas supplied to the UK gas grid by renewable biogas from anaerobic digestion and syngas.<sup>10</sup>
- The falling costs of thin film solar photovoltaics.<sup>11</sup>
- The potential for algae as a biofuel.<sup>12</sup>
- The development of marine energy technologies.<sup>13</sup>

We also are concerned at the potential GHG implications of the construction volumes involved. The manufacture of concrete is a significant source of GHG,<sup>14</sup> and the energy involved in the many millions of tonnes required will affect the carbon balance of a barrage and must be accounted for.

There are additional concerns around GHG implications from Indirect Land use Changes as a result of the provision of compensatory habitats. In a world of freely traded food supplies and rising demand, productive capacity lost in the UK will be replaced either by deforestation (with attendant GHG emissions) in tropical countries, or by intensification of production (with attendant GHG emissions) in other parts of the world.<sup>15</sup> These second order effects of land use change were analysed and considered by Professor Gallagher in the context of his review of UK biofuels policy<sup>16</sup> and have recently come under review in relation to EU biofuels targets.

CLA urges that the same level of work and expertise is devoted to the indirect impacts of habitat creation which will be required to mitigate the effects of the Severn proposals and how this will relate to agricultural, fishery and other rural businesses.

<sup>8</sup> The revised version of the Severn Estuary Flood Risk Management Strategy is due in the Spring 2013

<sup>9</sup> See [www.regensw.co.uk/news/2012/11/27/media-release—bristol-channel-has-massive-renewable-energy-potential](http://www.regensw.co.uk/news/2012/11/27/media-release—bristol-channel-has-massive-renewable-energy-potential)

<sup>10</sup> See [www.nationalgrid.com/uk/Media+Centre/Documents/biogas.htm](http://www.nationalgrid.com/uk/Media+Centre/Documents/biogas.htm)

<sup>11</sup> See [www.glassonweb.com/news/index/7986/](http://www.glassonweb.com/news/index/7986/) and “Solar module sales price of \$1 per Watt no longer theory: Revolutionary price level will mark start of solar revolution” [www.thesolarfuture.com](http://www.thesolarfuture.com)

<sup>12</sup> See [www.guardian.co.uk/environment/2008/oct/23/biofuels-energy](http://www.guardian.co.uk/environment/2008/oct/23/biofuels-energy)

<sup>13</sup> See <http://www.carbontrust.com/client-services/technology/innovation/marine-renewables-proving-fund>

<sup>14</sup> 2,900 kg CO<sub>2</sub> per cubic metre of heavy concrete

<sup>15</sup> UK agriculture is amongst the most carbon efficient per unit of production in the world.

<sup>16</sup> <http://webarchive.nationalarchives.gov.uk/20110407094507/renewablefuelsagency.gov.uk/reportsandpublications/reviewoftheindirecteffectsofbiofuels>

CLA argues that any barrage development should be subject to whole life GHG accounting, and that this should take into account both direct and indirect effects.

*2. What risks and opportunities could it pose with regard to flooding in the Severn estuary, and how might any risks be mitigated?*

Low lying areas on both the inward and seaward side of barrages are likely to face a changed and increased flood risk. Existing drainage systems that rely on low tide to drain the collected waters (eg the seaward Somerset levels, or inward Severn Vale) will face reduced opportunities for natural drainage and existing systems will require revision.

These impose costs and risks to the rural economy locally, and in addition place additional costs on local business and householders for flood defence and management, as well as increasing GHG emissions from the energy required to pump water that previously drained by gravity.

There are other potential risks to landowners, farmers and fishery operators which we have expanded on in our response to question 5 of the terms of reference.

*3. What risks and opportunities could it pose to wildlife and habitat in the Severn estuary, and how might any risks be mitigated?*

Other organisations are better placed to comment on the impacts of a Severn Barrage on wildlife and habitats. Whilst it is thought that mitigation will be delivered through compensatory habitat there is no detail as to how much will be required and where it will be located. There is also no process outlined for the purchase, the engineering works required to put it into an intertidal range and ongoing management of this habitat. The CLA strongly opposes the use of the slow compulsory purchase regime as a cheap way to deliver commercial profit yielding projects.

By way of example, the acquisition of land required for the Abberton Reservoir in Essex undertaken by Essex and Suffolk water started in 2000. All in all, the process is estimated to have taken nine years. The delivery by land through compulsory acquisition for compensatory habitat is unlikely to be achieved any more quickly.

CLA urges Government to look to private sector commercial delivery of compensatory habitat, after all landowners are already in place, they are good habitat managers and know their land.

CLA urges Government to investigate and adopt alternative mechanisms for the delivery of compensatory habitat. Delivery of compensatory habitat by voluntary means will reduce the loss to UK agriculture as those coming forward will select the most appropriate land with the lowest farming potential. Moreover, their management skills will be applied to the new habitat to ensure delivery of co-product along with the habitat, such as salt marsh lamb and samphire.

The CLA opposes the compulsory acquisition of land or resources for use by profit seeking commercial operators when compensation is only paid at existing use value and there provides inadequate financial consideration.

The present Compulsory Purchase system came into being so that the state could deliver essential infrastructure. Over the last 50 years this has been further refined, but still on the same premise. Things are very different now with almost all infrastructure being delivered by commercial companies (including renewable energy infrastructure). All these companies seek to use compulsory purchase to maximise their profits while delivering their projects.

The main problem is that the current Compulsory Purchase systems show only scant regard for the landowners across who's land the scheme passes. The impact and control of the scheme is all at the behest of the delivering company, and often the argument used is that landowners are compensated for this uncertainty. The reality is, however, large schemes take many years from conception to completion which adds to uncertainty, blighting property for many years, sometimes decades. Accommodation works are often agreed but then reneged upon, compensation payments delayed or never finalized. With little penalty for the acquiring authority and the costs of appeal are so high the property owner is severely handicapped in their negotiations.

The CLA proposes that compulsory purchase should only be used as a last resort and then some additional measures be added that respect the unique position of the rural property owner who is likely to remain in position from the start of the scheme to completion, suffering the uncertainty of the proposals, the construction of the scheme and then the severance or disruption of its operation.

The CLA proposes:

- Compulsory acquisition should only be a last resort when a negotiated settlement cannot be reached.
- A duty of care to consider the impact on the property owner/occupier.
- An additional duty of the acquirer to appoint an "independent person" to ensure fair play and resolve disputes.
- A bond backed Blight Scheme to ensure property owners do not lose out as a result of the scheme

- Proper statutory provision for the sale back of land surplus to requirement.

#### POSITION OF LANDOWNERS WHO DO NOT HAVE LAND COMPULSORILY ACQUIRED

Current UK compensation law is unlikely to be able to deliver a fair outcome to those fisheries owners who lie at some distance from the Severn, but whose income and capital value will be affected by the construction of a Severn tidal scheme.

Where no land is taken, compensation law limits claims to those that can be directly linked to the action of the acquirer<sup>17</sup>. This limits compensation to losses in land value directly arising from the development.

Under nuisance law, while the effects of the development will be observable on a wide scale, it will be almost impossible to link cause and effect to the standard of proof required by a court of law to establish that a drop in average catch on a mile of river 40 miles from the barrage is directly a result of the barrage.

Thus CLA fears that, without a special scheme of compensation being put in place, the construction of barrages that bar migratory species from making their way upstream may well affect the rights of the fishery owners and lead to litigation. We assume that the Government has taken legal advice on this point, and that the human and property rights of fishery owners upstream of the proposed development will be factored into the study.

#### *4. What lessons can be learned from the successful development of La Rance tidal barrage in France and other tidal power projects?*

The CLA has no position on this question.

#### *5. What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular, what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

CLA is unable to comment on the impact on all the local industry sectors specifically mentioned in this question.

There appears to be no detail as to how the proposals would impact on the commercial viability of Bristol and Avonmouth docks and on a smaller scale but just as important any leisure use of the estuary.

However, the development of a Severn Barrage would pose substantial risk to the business activities and assets of landowners, farmers and fishery operators who would be impacted both directly and indirectly by such a scheme.

#### THE IMPACT ON UK AGRICULTURE

- More than 50% of the highest quality productive land (Grade 1 on the Soil Survey of England and Wales) lies close to or below sea level. Thus any coastal setback to meet the need for new intertidal habitat will have a grossly disproportionate effect on UK food production and the rural economy. This may be worsened by the effect of habitat creation on adjacent farmland drainage and the wider impact on the maintenance of coastal defences.
- Government has recognised that food security is an increasingly important issue, particularly in the light of climate change impacts on productive capacity worldwide and rising levels of world population and consumption.
- Whilst the Severn proposals may be able to make use of less valuable land for compensatory habitat, they cannot be viewed in isolation. Land use planning policy recognises that cumulative effects should properly be taken into account when looking at proposals, and in this context CLA draws attention to the various active proposals for tidal power around the coast (Solway, Morecambe bay, Thames, Wash and others) which cumulatively will certainly require a reduction in British farming output, and exacerbate the coastal set-back already under consideration in many low lying areas.
- Any decision should be informed by the range of habitat creation schemes likely to be required should the UK tidal power potential be exploited by barrages, and include best estimates of a range of productive land loss which would arise. This should cover mitigation at the range of compensation that has been found adequate in other schemes (generally in the range of 2:1 to 4:1)<sup>18</sup> and apply the same analysis as that used by Professor Gallagher in addressing the indirect land use change implications.

<sup>17</sup> See the helpful guidance published in booklet format (Chapter 3 of Booklet No.3 *Compensation to Agricultural Owners and Occupiers*) by DCLG at [www.communities.gov.uk/documents/planningandbuilding/pdf/147645.pdf](http://www.communities.gov.uk/documents/planningandbuilding/pdf/147645.pdf)

<sup>18</sup> 2007 Commission guidance on Art 6 (4). says that, what it calls, “compensation ratios” are best set on a case by case basis, but that they “should be generally well above 1:1”

#### THE IMPACT ON UK FISHERIES

The salmonid fisheries that would be destroyed by a Severn barrage are irreplaceable. They contribute millions to the rural economy (the Environment Agency quote the value of a single salmon at £9000). They are part of the fabric of rural life, are an important tourism resource, and generate much pleasure to those that have access to them.

- CLA shares the concern of the researchers that mitigation of the effects on fisheries of the Severn tidal proposals is at best deeply uncertain, and most likely to be ineffective.
- CLA argues the second order effects on the wider rural economy and the tourism industry have not yet been properly assessed. A separate study is required to build on the current state of knowledge of the value of fishing in the affected rivers.
- Given the potential irreversible and catastrophic effects on irreplaceable resources, CLA argues that a full barrage across the Severn may prove to be unacceptable, and thus consideration to schemes that can accommodate the passage of migratory fish should be considered.

#### FLOOD RISK

The impact on flood risk management is important as the Environment Agency has plans for “managed realignment” of coastal defences in certain stretches of the Severn coastline. The revised version of the Severn Estuary Flood Risk Management Strategy is due in the Spring 2013. A barrage in the Severn could have a fundamental effect on the coastal and fluvial water levels and attendant flood risk upstream and downstream of the barrage due to its tidal nature. The effects of this would have to be factored in to the assumptions on sea level rise and “coastal squeeze” which are the basis of the EA proposals for future flood risk management in the estuary for the next 100 years. Opinion on the barrage proposals would need to be sought from the EA, local Internal Drainage Boards and of course local communities and landowners who will be affected. The question of “blight” on property as a result of the proposals would have to be addressed from the outset.

*6. Would the project require support under the proposed new Contracts for Difference mechanism? If so, approximately what level of strike price would be required to make the project economically viable?*

CLA does not have the expertise to respond to this question in detail. However, we think it is likely that in order for the project to be financially viable and attract sufficient private sector investment, support under the proposed Contracts for Difference would be required.

*7. How does the company plan to engage and consult the community in the development of the project?*

CLA is not able to comment on any plans to consult on the development; however, we believe that full and detailed consultation needs to be carried out prior to any firm proposal being submitted so that individuals and business have sufficient information to fully understand the potential impacts and raise any concerns. Currently there is simply insufficient information available.

Due to the scale of the proposals and potential impacts we feel there is a role for central government in consultation on the development to ensure that the interests of individuals are heard and protected.

*8. Are the proposals in breach of EU legislation and if so how will this be addressed?*

The CLA has no position on this question.

*9. Are any other proposals for tidal power projects in the Severn estuary currently under consideration?*

CLA is not in a position to respond to this question, but as far as we are aware there are no other tidal power projects currently under consideration in the Severn estuary.

*10. What could be the wider international implications of the scheme for UK engineering and UK low-carbon industry?*

The CLA has no position on this question.

November 2012

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## Supplementary written evidence submitted by the Country Land and Business Association

### THE CLA

The Country Land and Business Association (CLA) represents 34,000 members who between them own and manage about half the rural land in England and Wales. We have 170 members owning 13,000 ha along the Severn Estuary from Cardiff and Weston-super-Mare up to Gloucester, this figure does not include members on the important tributaries of the Wye and Usk. We also have members with agricultural and other businesses on the Somerset levels who may also be impacted by any changes in water levels.

The landownership includes low lying highly productive agricultural land that may be required to deliver compensatory habitat in England and Wales, and the fishery assets on the Severn and its tributaries which are important to the rural economy.

For many years now, the CLA has led the debate both on compulsory purchase reform and land based renewable energy.

On compulsory purchase reform it was the CLA who set up the Property Industry Group which precipitated the establishment of the Compulsory Purchase Review Advisory Group and the Law Commission Review on compulsory purchase. The Law Commission report *Towards a Compulsory Purchase Code* published 2003 was very detailed and outlined the many shortcomings of the current system and recommended reform. It is iniquitous that after 10 years successive governments have ignored these recommendations whilst compulsory acquisitions by profit seeking companies continue to take place. This demonstrates a woeful lack of regard for private property rights.

In November the CLA launched “Fair Play” which seeks to open the debate about how to overcome problems of blight through a property Bond Scheme, introduces a duty of care and a right of appeal to an independent expert and codes of practice to ensure that the impact on the land and business owner remains foremost in the discussion making process.

### *What are the shortcomings of compulsory purchase?*

Overall the CLA has many misgivings about the operation of the current compulsory purchase system which are detailed within the CLA Policy Document “Fair Play”. The details pertinent to the Severn Barrage are dealt with below:

Compulsory Purchase is a blunt instrument for purchasing land required for public infrastructure. Whilst this might suit the developer, it raises many issues in relation to the property owner.

The current statutory regulation deals poorly with issues of Blight. This arises when property cannot be sold because of the existence of a proposed scheme—this impact starts when the scheme, or its many proposed options, first appears on a map through to its completion. During this time it may be very difficult for the property to be managed as its future use is always under threat. In some cases infrastructure proposals can take as long as 30 years to come to fruition—that is one generation’s worth of stagnation. Even the most optimistic timescales for the Severn barrage estimate that it will take over 15 years to complete. Blight is already an issue as artists impressions have already appeared in local papers showing the impact on properties (in one case showing one of the main routes on the Welsh side going straight through a property owned by a CLA member).

Because acquirers have a duty to pay for no more than the owners’ direct loss, this has led to agents acting for the acquirer being overzealous and offering only to pay rock-bottom for the property.. It is important not to under-estimate the financial and time penalties that a landowner endures as a result of compulsory purchase, often being the only person in the vicinity to make sure that contractors stay within the boundaries and that stock are either not let out or are retrieved promptly.

If there is a dispute over the level of compensation offered then the only right of appeal at present is to the Upper Tribunal (Lands Chamber). This is a litigious step that is usually prohibitively expensive for the normal landowner—and the acquirer knows this which further strengthens their position. There needs to be the right of appeal to an Independent Person or expert that is quick and cost effective.

Furthermore when Compulsory Purchase is applied to the provision of compensatory habitat there is no guarantee as to how that land will be managed and whether the acquiring authority has prior knowledge or the ability to manage the land to the best standard (these are often decided after the event).

The delivery of the Severn Barrage through a Hybrid Bill is of particular concern to the CLA. The true extent of the scheme, including the areas of compensatory habitat will not be known until the Draft Bill and the Draft Environmental Statement are published shortly before the proposal goes before parliament. Whilst the Hybrid Bill process may be seen as democratic because of its passage through Parliament, however it is very difficult for the individual land or business owner to petition parliament. By the time the proposal reaches Parliament many see the opportunity of getting alterations to the scheme as slight.

*Why should it not apply in this case?*

Firstly the scheme is being put forward by a profit-seeking company that aims to achieve an income stream either by the operation of the barrage, or a capital receipt through the sale of the concept once they have the powers through the Hybrid Bill.

No such opportunity is afforded to the landowner. He will face years of uncertainty and blight with only the knowledge that should the scheme progress that he will have a protracted battle to negotiate what will only ever the minimal compensation for a proportion of his loss.

If the property or business owner suffers from the construction of barrage or its associated works but does not lose land to the scheme then his ability to claim is severely limited and can only be made a year after the scheme has been completed (more than 15 years away).

Landowners not acquirers are best placed to choose the best land for compensatory habitat.

The areas discussed for the compensatory habitat are huge and cannot be met wholly in the Severn Estuary. This may lead to landowners with land no where near the estuary being compulsory purchased. In the last proposals it was thought that some of this habitat might be found as far away as the east coast estuaries.

There are currently no figures that suggest the land requirements for the barrage itself, nor the amount of compensatory habitat. The only figure within Hafren's evidence relates to the loss of habitat being 49km<sup>2</sup> (4,900ha). Compensatory Habitat provision is set out in the Habitats Directive and its accompanying Guidance which says that it should be at a greater ratio than 1:1. In reality this is delivered in the range 1:3 or 1:4 (14,700 to 19,600ha). However a figure of 16,000ha has been referred to.

Hafren are a commercial company proposing a commercial scheme, they should not be given access to preferential land purchase so that they can make money from that purchased land. In addition it is important that the land best able to provide the compensatory habitat is selected and the best management applied. This is arguably best managed by individuals that have owned and occupied the land for generations.

*What do you think should be used instead—Voluntary system?*

If you remove the threat of compulsion there will be a change of stance by many affected by the route. From opposing the scheme there may be real benefit derived of engaging within the scheme, rather than just an imposition after many years of blight. A voluntary scheme would work well both for the purchase of land required for the scheme as well as the provision of land for habitat creation.

The key factor is that land required for compensatory habitat may not necessarily have to be purchased; it could be managed on a long term contract for the environmental objectives of the scheme. The important aspect of the voluntary scheme is that it can have total flexibility, and there will only be a need to purchase land that needs to be owned.

A voluntary scheme would work in two ways. The promoter could look for the land that it wishes to purchase and then reach agreement with the landowner. Or it could look at the compensatory habitat that it wishes to create and draw up specifications for its character and its management and then ask individuals to tender both for the creation of the habitat and its management.

This could create a tender situation where there may be a choice of sites and a "value for money" decision can be taken to ensure that the best habitat can be delivered for the best price. This would be true commercial delivery and an example demonstrating what can be delivered through partnership.

*Level of compensatory habitat:*

- *Is there enough land available?*
- *Is a voluntary scheme realistic considering the levels of land needed?*

If one takes 16,000ha as the amount of compensatory habitat required it would be difficult to understand as to how this can be provided within the estuary itself.

If this is the case then a voluntary scheme may work well because there is a sizeable requirement for new habitat and therefore preparing and promoting a scheme becomes worthwhile. It can also open up the delivery of additional habitat to different locations. It also provides for that habitat to be provided in such a way that that land remains in profitable management into the future, rather than more marginal schemes the only compensate for generic losses.

However, greater than that, it will allow sites with the best potential to be married up with the project funding to ensure the best environmental outcome.

*What is the impact on local fisheries and the wider rural economy?*

The Severn Estuary gives access to 25% of the UK's salmon spawning grounds. The Severn itself provides plenty of fishing opportunities and the Wye and Usk tributaries well known salmon fishing rivers. The capital value attached to salmon fishing was found by the Environment Agency to be £9,000 per salmon (or £129

million total market). The Wye and Usk Foundation report that both Salmon and Shad are found in less than favourable conservation condition. There is a need to improve their habitat and increasing breeding numbers and arguably this should be done before the scheme progresses. If the scheme impacts on migratory fish then the £129 million value of salmon fishing would be lost forever, not to mention the loss on other fishing receipts.

It is more difficult to quantify the impact on tourism. There may be an increase in visitors to see the barrage, there may be greater leisure potential within the estuary, but the estuary will be a very different place. Tidal flows will be different, the estuary character will be different, and this may deter people who currently visit from returning.

What, however, is clear is that there will be mismatch between those who lose and those who gain as a result of this scheme. Whilst the scheme spends years in the planning stages, there will only be losers in the rural economy—There will not be anyone who gains.

As soon as any large proposal is unveiled local housing markets are thrown into turmoil because of the uncertainty. Properties with land taken will be compensated after the purchase takes place, but other properties with no land taken will suffer from noise, traffic, dust and will only be able to claim limited compensation resultant from these nuisances a year after the scheme is completed (perhaps 15 or more years hence). It is questionable whether the housing of additional workers would make any difference to the market.

*Would we support other tidal power schemes- maybe one that allowed the passage of fish?*

The CLA has no objection to tidal power, and indeed has always supported renewable energy schemes. However the CLA is not convinced by the arguments put forward for this proposal and the lack of information available regarding the impact of the scheme.

Having a scheme that protected migratory fish would resolve only part of the problem. The impact on flooding (both sides of the barrage), tourism, farming, property values and construction are also big issues. However the delivery of tens of thousands of hectares of compensatory habitat is by far the biggest challenge.

Hafren need also to study the impact of their proposals on flooding in the Somerset Levels. This is already a sensitive area and the impact on this area (which stretches many miles inland) needs to be considered at a very early stage in the process, it is unclear as to why there appears to be no detail on this within the proposal. If flooding of this area increases, it will have a negative impact on farming land many miles inland.

Nothing in Hafren's evidence sheds any comfort on these, very real, current concerns. Hafren must disclose their full plans and all the mitigation measures necessary. Local papers have already published plans showing the barrage which are already impacting on individuals/businesses.

*Should the scheme be started on a smaller scale and built up?*

The main advantage in building the project up is that you can monitor and regulate the environmental impact. As the scheme develops you can ensure that the most up to date equipment and construction techniques are used.

The disadvantage is that you can never benefit from the economies of scale of the construction and there will always be a lack of vision as to what the project will look like and whether the full benefits will materialise. In addition smaller phased losses of habitat might be seen as acceptable when the cumulative impact would not.

*Given the large amounts of land that will be taken out of food production what effect will that have on UK agriculture and food security?*

In order to deliver the compensatory habitat of 16,000 ha there would be a considerable impact on local agriculture. Crudely if you assumed that half this area was grass and half cereals the loss would be 55,000 tonnes of grain at a £13 million and the loss of £12 million meat sales. Therefore it is estimated that the total loss from agriculture would be approx £25 million per annum.

Grain and meat would have to be imported or produced elsewhere. Local markets would change leading to increased transport.

Whilst other forms of renewable energy might not deliver the energy output of the Severn Barrage, they would allow the management of habitat whilst generating the energy, rather than needing huge areas of artificial habitat creation.

February 2013

## Written evidence submitted by Regen SW and South West Marine Energy Park

### INTRODUCTION

1. Regen SW is a leading independent, not-for-profit, centre of expertise in sustainable energy [www.regen-sw.co.uk](http://www.regen-sw.co.uk). Regen SW has been working with the marine energy sector for almost a decade and has been engaged in a number of leading projects including the Wave Hub and the Atlantic Array Windfarm.

2. The South West MEP was designated as the UK's first Marine Energy Park in January 2012 by DECC and covers the geographic area from the Severn Estuary and around the coast of Cornwall to the Isle of Wight. The aim of the South West MEP is to create a business environment that will accelerate the commercial development of the marine energy sector. To do this the South West MEP has established a powerful partnership which now consists of over 80 organisations from the private sector, research organisations, universities and public bodies.

3. The steering board of the SW MEP is made up of representatives from the private sector; the universities of Bristol, Exeter and Plymouth; Bristol City Council, Plymouth City Council and Cornwall Council; Cornwall and IoS LEP, Heart of South West LEP and the West of England LEP.

4. Regen SW and the SW MEP are fully committed to the development of marine renewable energy technology and the deployment of offshore projects around the south west coast. We are actively engaged to supporting the growth of an active marine energy sector which currently employs over 500 people in world leading companies. For more information about the South West Marine Energy park and the fantastic supply chain companies in the offshore sector please visit <http://www.regen-sw.co.uk/projects/offshore-renewables>

### SUMMARY POSITION ON A CARDIFF-WESTON BARRAGE

1. While we welcome the Energy and Climate Change Select Committee's investigation of this issue, and the renewed interest in energy generation from the Bristol Channel, it is very difficult to comment in detail on the questions which have been raised in the absence of any firm publically available project proposals.

2. Without further details it is also difficult to add to the very thorough investigation of barrage options which was completed as recently as 2010, which led the government to conclude that there was not a strategic case to bring forward a Severn Tidal Power Scheme in the medium term.

3. The challenges faced by a large scale barrage project such as the Cardiff-Weston proposal include the:

- financial capital cost;
- cost of energy produced;
- environmental impacts—especially to intertidal habitats and fish;
- zero sum economic benefits which provide jobs in some areas but threaten jobs in other areas;
- potential flood risk (and benefits) and coastal erosion;
- impact on Bristol Port and other marine users;
- loss of opportunity for other marine energy technologies such as lagoons and tidal stream;
- very high risks and uncertainties of such a large scale project.

Some of these issues are discussed in the detailed response below. If a barrage proposal could address these issues—and generate significant low carbon energy—then we would support such a scheme. However, it would seem very unlikely that these issues can be addressed and therefore it is unlikely that a large scale Severn barrage will be viable in the near term—even with the adoption of new low head turbine technology and the possible availability of overseas finance.

4. We do however believe that there are fantastic energy resources in the Bristol Channel including tidal range, tidal stream, wind and wave energy. Harnessing these energy resources with **large scale projects** should be a key part of the UK energy strategy. However such projects will only be built if there is a strong consensus and support from industry and stakeholder communities on both Welsh and English Sides of the English Channel, and if they can be shown to be both cost effective and have an acceptable impact on the environment.

5. Regen SW, Marine Energy Matters and the SW MEP has now published a new discussion paper, **Bristol Channel Energy: A Balanced Technology Approach** which promotes a new strategic approach to generating large scale energy from the resources within the Bristol Channel utilising a mix of technologies—tidal range, tidal stream, wind and wave power—and which offers a lower risk and more sustainable alternative to a single big barrage proposal.

6. This approach also has the potential to enhance the UK's position as a leading centre for marine energy technology development building on the superb innovation and exciting companies who are already clustered around Bristol, the South West and South Wales including Marine Current Turbines, Tidal Generation Limited, Tidal Energy Limited, IT Power, PB and GL-Garrad Hassan.



## TERMS OF REFERENCE QUESTION RESPONSES

*What contribution could the Cardiff-Weston Barrage make to UK energy security and climate change objectives?*

7. No new output figures have been provided—The Severn Tidal Power Feasibility Study (STPFS) reported that a Cardiff-Weston Barrage would generate of the order of 16TWh/yr compared to a UK total generation of 368 TW/h of electricity in 2011. Whether this level of output is achievable in practice, and using a potential new concept low head turbine needs to be further investigated.

8. A Cardiff-Weston barrage could provide a valuable contribution to low carbon energy generation objectives, however we believe that **large scale energy generation could be delivered by a multi-technology approach with several projects rather than a single mega-project which has major economic and environmental and impacts.**

9. It has been suggested that the latest proposal is to install an ebb and flow scheme, based on a concept design for a low head turbine, to help minimise environmental impact. It is difficult however to see how this technology could be developed and demonstrated within the (rumoured) timetable of the unpublished proposals.

10. It is agreed that the low head turbine has potential benefits which should be explored—it also has potential drawbacks in terms environmental impacts on tidal range at high water. This new concept technology would need to be developed from an embryonic level with all the development risks associated with bringing forward new technology.

11. Given the potential benefits of the low head turbine concept, and the relative immaturity of the technology, we would recommend that a) more public funding is made available for research and development and b) such technology needs to be properly demonstrated and proven on a smaller scheme such as a tidal lagoon as recommended by the “Stepping Stones”<sup>19</sup> proposals.

12. Conventional, ebb only, hydro-dam technology presents less technology risk, but, as detailed in the STPFS, the environmental impacts are extremely significant.

*What risks and opportunities could it pose with regard to flooding in the Severn estuary, and how might any risks be mitigated?*

13. Neither Regen SW nor the SW MEP have expertise in flood defences and related issues. We do note however that, while it has been claimed in the press and media that the Cardiff-Weston scheme would provide a viable flood defence, in fact this was not the conclusion of the Severn Tidal Power Final Report, Flood Risk and Land Drainage April 2010. We understand that this claim was not supported by the Environment Agency who are promoting a more targeted flood defence strategy such as the Avon Barrier.

14. A barrage scheme may help to reduce the impact of Coastal Flooding caused by Tidal surge and anticipated sea level rises caused by climate change in areas upstream of the barrage. However, as documented in the STPFS report, these potential benefits are offset by an increased risk of coastal flooding in areas downstream of the barrage caused by the INCREASE in tidal range in those areas. The extent of the net benefit will depend on the impacts on tidal range upstream and downstream of the barrage, and the type of technology adopted.

15. In the case of Drainage/rainwater flooding—which is the most common type of flooding in areas adjacent to the Severn and Avon rivers—the analysis of the STPFS was largely negative with an increased level of flooding caused by the adverse effects on the evacuation of water during “tide lock” conditions. Analysis for the STPFS conducted by specialists Black and Veatch<sup>20</sup> concluded that there would be an increased risk and/or impeded drainage affecting up to 372 KM2 of land and over 50,000 properties and 28 critical infrastructure assets.

16. The STPFS also identified that coastal erosion and the undercutting of existing defences, caused by the changes in tidal range, both upstream and downstream could be a major factor—it estimates that 44–87 km of flood defences will need to be improved and erosion protection to be established along 134 km (+/-50%) of coastline.

17. The analysis above is based on the STPFS study which looked primarily at a conventional “Ebb only” barrage. An “Ebb and Flood” scheme (using low head technology concept) would it is assumed have less impact on the overall tidal range but would potentially increase the impacts on drainage at low water. **Much more modelling and research is required to fully understand the hydrodynamic impacts of this technology.**

<sup>19</sup> [http://regensw.s3.amazonaws.com/120831\\_stepping\\_stones\\_tidal\\_lagoon\\_presentation\\_for\\_bristol\\_tidal\\_forum\\_ead4881f6fce116d.pdf](http://regensw.s3.amazonaws.com/120831_stepping_stones_tidal_lagoon_presentation_for_bristol_tidal_forum_ead4881f6fce116d.pdf)

<sup>20</sup> Severn Tidal Power Final Report, Flood Risk and Land Drainage, April 2010.

*What risks and opportunities could it pose to wildlife and habitat in the Severn estuary, and how might any risks be mitigated?*

18. The Bristol Channel is an extremely complex hydrodynamic environment supporting a wide variety of habitats and local communities. As the STPFS clearly identified a large barrage would be an extremely high risk project and “many years of further detailed work would be needed to plan, finance and assess the impacts of such a large structure as a Severn power scheme before a case could be put forward for planning consent”.

19. An incremental approach, with the deployment of a mix technology of smaller schemes including tidal lagoons and tidal fence technology, would enable impacts to be assessed on a more contained basis and environmental impacts better managed and mitigated. There is also the potential for schemes using tidal stream, tidal fence, wind and wave energy to be built out in stages and increased once their impact is better understood.

20. Unfortunately the focus on a single large scale barrage solution has polarised the debate and created an artificial argument between energy and the environment. We very much hope that the Balanced Technology Approach can provide a basis for a more constructive dialogue between industry and environmental groups.

*What lessons can be learned from the successful development of La Rance tidal barrage in France and other tidal power projects?*

21. Regen SW has not carried out any extensive analysis of the La Rance project to date but our understanding is that—due to the construction methodology—the estuary environment was initially destroyed but since recovered. (Although there are no baseline comparisons to indicate whether the new environment differs significantly from the original environment, or which species have been impacted). Note La Rance is not a good comparator to the Severn owing to significantly different scale, sediment and habitat conditions.

22. It is also noted that while leading the field in tidal barrage technology in the 1960’s the French government has not invested in further barrage schemes, and that the focus of French government is now on the development of Tidal stream, Wind and Wave energy technologies.

23. More recent examples from the Netherlands such as the storm barrier erected across the Oosterschelde estuary in the 1980’s have shown significant environmental impacts and loss of habitats, mudflats and saltmarshes and damage to shell fish fisheries. Oosterschelde estuary in the late 1980s. Report by Erik van Zanten and Leo Adriaanse on behalf of Netherlands government.

24. It is understood that the cost of energy for Le Rance was at the outset extremely high but has now come down as other forms of energy have become more expensive and the initial construction debt has been repaid. The lesson here is that large scale energy schemes—including barrages and lagoons—can be cost effective over the long term.

*What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular, what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

25. The Cardiff-Weston Scheme being an extremely large civil engineering project will produce economic benefits overall—2.4bn GVA (Gross Value Added), under a base case according the STPFS Economic Appraisal). However, the economic benefit as a proportion of capital expenditure is much poorer than other tidal range projects considered by the STPFS, or other marine renewable technology deployment considered by the ORRAD project conducted by the SW RDA (2010). A good comparison is Bridgewater Bay lagoon option studied in the STPFS which produces a net regional GVA of £2.3 billion with a project capital cost estimated at about half that of a Cardiff-Weston scheme.

26. This poor economic return for a Cardiff-Weston scheme is in large part due to the negative impact on Bristol and in particular the port. Of all the projects considered as part of STPFS a Cardiff-Weston scheme has largest impact on Bristol port, the largest of all ports in the scheme area with over 5300 employed directly or as a result of port activities. During construction of a Cardiff-Weston scheme it is estimated (STPFS) that employment will be 2100 lower each year than it otherwise would have been. Should the Deep Sea Container Terminal be in place, this job reduction would increase to 2500 during the construction phase. During the operational phase, annual employment would be 700 lower than it would have been. If the Deep Sea Container Terminal was in place, job reductions increase to 900. The STPFS Regional Economic Impacts Study concluded that the overall port related lost GVA is likely to be between £0.9 billion and £2.9 billion, or £1.1 billion—£3.6 billion if the Deep Sea Container Terminal is in place.

27. The development of alternative tidal schemes (upstream Barrage, Tidal Fence, Tidal Stream or Lagoon) which do not impound the port will have far less impact on port related employment—indeed an alternative balanced technology approach to development of marine renewables in the Bristol Channel could potentially increase port economic activity.

28. According to the STPFS, job reductions the fishing sector as a result of a Cardiff-Weston project has been estimated (STPFS) at 40. In the aggregates industry job reductions are likely to be approximately 180. Whilst the Job losses associated with fishing activity are likely with all the feasible options in STPFS, **the 180 job losses associated with the aggregates industry are unique to the Cardiff-Weston scheme.**

29. In addition to the above negative economic impacts, the development of a Cardiff- Weston barrage would also impact on the burgeoning tidal stream technology hub based around the Bristol Channel. Technology developers present include Tidal Generation Limited and Marine Current Turbines based in Bristol, as well as Tidal Energy Limited based in Cardiff—all global leading (top 10) companies in the evolving tidal stream industry. Moreover there are others globally who already have an interest in the resource including Pulse Tidal Limited, Keplar, Verdant and VerdErg Renewable Energy Limited. These technology developers are also supported by locally expanding supply chain and leading support organisations including consultants, lawyers and finance specialists. It is estimated that there are over 120 organisations linked to the offshore renewables sector in the Bristol City Region—many who are members of the Bristol Tidal Energy Forum. Creation of a Cardiff-Weston barrage would negatively impact on the tidal stream resources in the inner and outer Bristol Channel—making it far less attractive as a potential deployment location. **The removal of this potential deployment location would significantly inhibit the growth of this sector in and around the Bristol Channel.**

30. The negative economic impact of a Cardiff-Weston barrage could be avoided by consideration of more holistic development approach in the Bristol Channel using potentially all the marine energy technologies in a more balanced manner as presented in discussion document “Bristol Channel Energy: A Balanced Technology Approach”. As well as creating more sustainable jobs, across a wider geography on both Welsh and English sides of the Channel—this approach would also enhance the UK’s position as a leader in marine energy technology development.

*Would the project require support under the proposed new Contracts for Difference mechanism? If so, approximately what level of strike price would be required to make the project economically viable?*

31. We do not have details of the projects capital costs, LCoE or required rate of return to comment on the project directly.

32. Currently all marine renewable energy technologies require additional support above the market price for electricity. However most technologies will have a downward cost trajectory through economies of scale, new innovation and learning helps to drive down cost.

33. The government is encouraging tidal stream and wave deployment using the Renewable Obligation Certificate (ROC) support mechanism until 2017. However this is only available for limited cumulative installation capacity of 160MW. The benchmark for most marine renewables is driven by the cost of offshore wind, which has target of around £100/MWh by 2020.

34. The STPFS estimates the levelised cost of energy of a Cardiff-Weston scheme to be just over £200/MWh (assuming an internal rate of return of 10% and a write-off period of 40 years). **A high level of support (against a wholesale market price of £40–50 per MWh) for around 5% of the UK’s electrical power supply will have a significant impact on consumer bills in the medium term.**

35. Providing a high “strike price” to attract investment would however generate significant super-profits for the project developer over the longer term. It is therefore important that the full lifecycle value of the project be considered.

36. It is unlikely that a 100% privately financed scheme will be viable or offer UK taxpayer/consumer value for money. The project risks are too high, and so a co- financed model, and/or underwritten by UK government, is likely to be a more viable option.

*How does the company plan to engage and consult the community in the development of the project?*

37. We presume this question is directed at the developer?

38. No significant scale energy scheme of any technology in the Bristol Channel will succeed without a strong support from stakeholders on both the English and Welsh sides of the channel. It is essential therefore that a consensus is established about how to balance the need to generate green energy with the wider environmental, economic and social interests that will be affected.

39. One of the most disappointing aspects of the project to date is the singular lack of engagement with the stakeholder community, in its widest sense. There has been a concerted PR media campaign, lobbying by political proponents but very little information has been provided in the public domain.

40. Regen SW and the South West Marine Energy park would welcome a much more inclusive and open dialogue which will enable government, industry, environmental groups and local stakeholders to work together to utilise new technology which will generate significant low carbon energy and sustainable jobs.

*Are the proposals in breach of EU legislation, and if so how will this be addressed?*

41. We have not seen the proposals!

*Are any other proposals for tidal power projects in the Severn estuary currently under consideration?*

42. We are aware of a seabed lease that exists in the outer Bristol Channel to deploy tidal stream demonstration technology. There are other developers looking at tidal stream projects off North Devon which are expected to come forward for leasing in the next year. There are also a number of developers looking at tidal lagoon projects on both Welsh and English sides of the channel. All of these projects and investments would be impacted by a proposed barrage scheme.

43. More broadly the Bristol Channel Tidal Forum (a largely private sector forum) is, along with other stakeholders, considering an alternative strategic approach to the development of marine renewables in the Bristol Channel. A recently published discussion document is attached to this evidence.

*What could be the wider international implications of the scheme for UK engineering and UK low-carbon industry?*

44. A Cardiff-Weston barrage would potentially allow the UK to develop a new range of turbines suited to tidal range installations (rather than conventional hydro dam turbines) and so open up a new international offering. However, advanced tidal range turbines are only at the conceptual stage (as evidenced by the Severn Embryonic Technologies Scheme) and there are better ways to develop this technology through smaller projects such as Tidal Lagoons.

45. Tidal Barrage technology may have a limited market—there are no other sites we are aware of for a barrage being planned in the UK nor any plans for a barrage in Europe. Tidal Lagoons and Tidal Fence technologies are likely to have a wider export market.

46. There is a growing tidal industry focused around the Bristol Channel, who have devices applicable to the global market already at the full-scale prototype stage. We are aware of a number of project proposals for tidal stream and tidal lagoon projects which are under development. **Installation of a Cardiff-Weston scheme will make the down stream resource unattractive to tidal stream developers and hence potentially hinder the development of the Bristol Channel cluster and ultimately its place in the global marketplace.**

November 2012

### Supplementary written evidence submitted by Regen South West and South West Marine Energy Park

Thank you again for the opportunity to give evidence to the Energy and Climate Change Select Committee hearing on 30 January 2013. As you indicated at the end of the session, the time available for questions in the second session was very limited and so I would like to take up your kind offer to submit additional written evidence.

The submission below expands on the questions that I was asked at the committee and also reflects on some of the new information which has now been made public by Hafren Power. I would also like to acknowledge the contributions made by the members of the South West Marine Energy Park and in particular Parsons Brinckerhoff, whose detailed knowledge of the tidal power challenges and opportunities in the Severn has been particularly helpful.

Firstly I would like to reiterate, as I said in my evidence to the committee, that the position of Regen SW and the South West MEP is not “anti-barrage” in principle. In fact, as organisations, we spend most of our working day supporting and winning approval for large scale renewable projects, which will be essential to meet the challenge of climate change.

We do however have serious concerns about the practical viability and wider impacts of a barrage solution and, while we have come to the conclusion that *a Severn Barrage is extremely unlikely to be built*, we are also concerned that the focus on a barrage proposal will reduce the likelihood that other more realistic schemes will come forward.

#### *Fundamental difficulties with the Severn Barrage as proposed by Hafren Power*

- Technology readiness and timescale.
- Environmental Impacts—including fish migration.
- Zero sum economic impacts—on strategic ports and wider UK industry.
- Cost and Financing Assumptions.
- Loss of stakeholder goodwill and mistrust of Hafren Power’s proposals.

(Appendix A gives more detail as to why we believe these issues have not been addressed, and therefore make the construction of the barrage extremely unlikely.)

While the debate around the barrage continues, there is a clear consensus that the Severn Estuary and wider Bristol Channel offers the UK a massive energy potential. We believe that this energy potential could be harnessed using a range of technologies in a way which would balance the objective of securing large amounts of low carbon energy with the impacts such schemes will have on the environment and other marine interests. Our approach would also provide a springboard to support the development of new technology and enhance the UK's leadership position in the growing global marine energy sector thereby creating further jobs and export opportunities.

Since the publication of our discussion paper (Bristol Tidal Energy: A Balanced Technology Approach), we have received a huge amount of positive interest from the industry and from other key stakeholders. No one, on either side of the barrage debate, seems to disagree with the proposition that we ought to explore ways to harness the energy potential of the estuary, and indeed many of the protagonists against the barrage are actively engaged in looking for alternative solutions.

*Bristol Tidal Energy Forum 8th March & Sustainable Severn 18th April*

This is a theme which the tidal industry will explore further at the 4th Bristol Tidal Energy Forum on 8th March at the National Composites Centre, and with wider stakeholders at the Sustainable Severn event on 27th April—both events to which you and your committee members would be very welcome to attend.

So there is clearly a huge amount of goodwill and support from the industry, environmental groups and wider public to the idea of developing renewable projects in the Severn estuary and Bristol Channel. The challenge for the industry is to come up with a strategy which will enable the UK to generate significant energy capacity, using both established and new technology, at a cost which is acceptable to the UK energy consumer.

The challenge is also to show how energy projects can be deployed in the near term. The issue of climate change and energy security is immediate and so we fully support the ethos of getting projects into production as quickly as the technology costs and risks will allow.

We believe that a multi-technology approach, as outlined in our discussion paper and described in more detail below, can provide the basis for a new strategy. Our next step will be to work with industry partners to develop the Balanced Technology approach and to bring forward specific energy project and technology development proposals. Our perspective on the Severn is not different to that of the Government's in 2008 when it published the terms of reference for the Severn Tidal Power Feasibility Study—"generate electricity from the renewable tidal range resource of the Severn Estuary in ways that will have an acceptable overall impact on the environment and economy both locally and nationally".

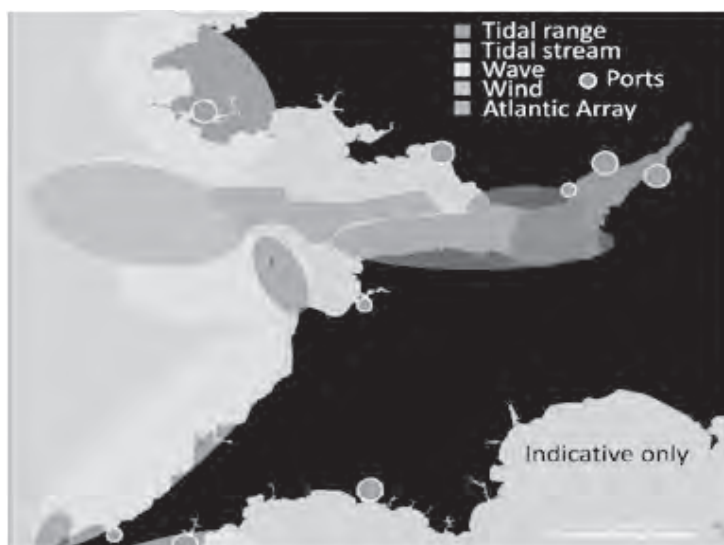
#### SUPPORT FROM ECC SELECT COMMITTEE AND UK GOVERNMENT

To enable this to happen however we need support from the ECC Select Committee and from UK Government. Specifically we would like the Select Committee to make a strong statement of support to:

- Reinforce the UK *Government's commitment* to the development of marine technologies and the development of tidal energy projects, not only in the Bristol Channel, but around the UK. This commitment is especially important at a time when Government is setting investment priorities through the EMR process.
- Establish a *proper process and governance structure* to lead and evaluate options for energy development in the Bristol Channel. This needs to bring together industry and stakeholders on both Welsh and English sides of the Bristol Channel together with national bodies such as the MMO and Crown Estate.
- Support a *twin track approach* of using existing technology solutions such as smaller scale tidal range lagoons to achieve short term delivery whilst developing more innovative tidal technologies for subsequent deployment in the UK and overseas.
- Create a *collaborative technology development programme* to both develop and evaluate new tidal range technology, and to understand its economic and environmental impacts. This could be run through the Technology Strategy Board

#### 1. BALANCED TECHNOLOGY APPROACH OVERVIEW

I was asked by the committee to give an overview of the "Balanced Technology Approach", which was the title of a paper published by *Regen SW and Marine Energy Matters* in November 2012. This paper has had significant review and input from industry both through the Bristol Tidal Energy Forum and the South West Marine Energy Park.



In my response, I described the overall approach we took which was to look holistically at the range of energy resources in the channel—tidal range, tidal stream, wind and wave energy. Using multi technology approach our analysis suggests could deliver up to 14 GW on renewable energy capacity.

The advantage of this approach is that we can develop and adopt new technologies as they become cost effective. By focusing on technology that can be deployed incrementally we also have the opportunity to drive down costs and understand their environmental and other impacts before deploying large scale projects. We can also use this approach as a catalyst to support supply chain development and technology export around the world.

Some technologies eg wind are available today. Tidal Lagoons could also be built using existing technology or used to develop a new generation of Low Head Bi-directional turbines. Floating wind, tidal stream and tidal fences will take longer but already the leading companies are moving forward with commercial projects. Wave energy is the furthest behind, but once developed at large scale—probably in the mid 2020's—wave energy has the potential to become a truly global low cost energy resource.

#### *South Korean Experience*

In my evidence to the committee I briefly mentioned the approach which was been taken in Korea. There are five tidal range projects currently built or planned in Korea. We would describe these as Tidal Lagoon projects since they impound a body of water, using islands and headlands to create tidal lagoons, *without blocking main channels or estuaries*.

The major difference in approach is the size of the projects—the first Shiwa barrage which has been built is only 250 MW. Three other proposed projects are between 250 and 500 MW. Only the Incheon barrage—which has not yet received planning—is over 1 GW. This approach means that the Koreans have a succession of projects to develop and prove technology—and understand risks—before moving to larger schemes.

## 2. TIDAL ENERGY POTENTIAL

The Balanced Technology approach suggests that we look at all forms of renewable energy generation in the Bristol Channel including Offshore Wind, Floating Wind and Wave Energy. We have taken this holistic approach because from the point of view of cumulative environmental impacts, grid, supply chain development, economic development, port infrastructure, skills etc—all these technologies are linked. Our wider vision is to turn the region into an energy cluster bringing benefits to both Welsh and English sides of the channel.

It is also important that we continue to support projects such as the *Atlantic Array Offshore Wind Farm* which will be the first mega project in the Bristol Channel, and as such can play a key role to kick start investment in the supply chain and port infrastructure that we will need to support future energy projects.

In total our high level analysis suggested that a multi technology approach could provide 5 to 14 GW of renewable energy capacity using wind, wave and tidal technology. For the purpose of this submission to the committee I will however focus on Tidal Energy so that a direct comparison can be drawn with the Severn Barrage proposals.

### 2.1 Tidal Range

Our balanced technology approach uses both tidal range and tidal stream technologies but recognises the environmental and regional economic impacts of tidal range and the cost and development timeframes of tidal stream.

From an engineering perspective, the technology to develop tidal range options exists and, as is evident from La Rance, whilst it is expensive to construct and finance, it can become one of the least expensive forms of generation and also one of the most reliable. As the committee heard from Vincent de Laleu of EDF, after 40 years La Rance is now one of the cheapest forms of energy generation in France and technically has been viewed as a success with its original bulb turbines still in operation.

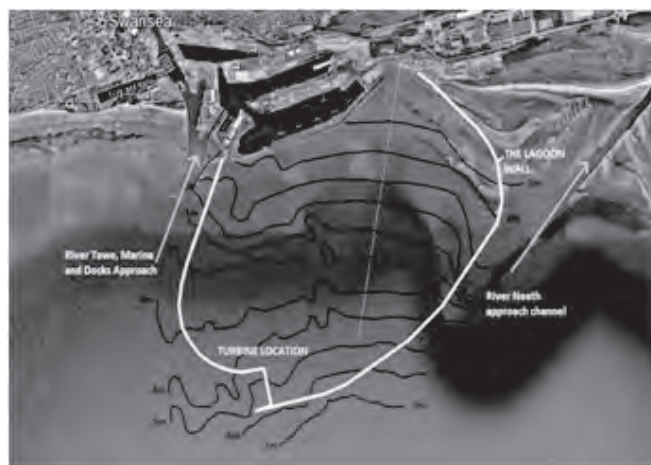
The advantage of tidal range technology is its predictability and the potential for long term cost reduction.

In our view the development of a number of *Tidal Lagoons* could be a better alternative to realise these advantages without the inherent disadvantages of a barrage blocking the entire estuary. Tidal Lagoons could be developed today, using existing turbine technology or used in part to develop and demonstrate a new generation of low head bi-directional turbines. A series of individual Lagoons could be tailored and compartmentalised to provide more flexible energy generation over a longer tidal cycle.

Critically Tidal Lagoons offer the potential to start relatively small—200–300 MW—and then to increase scale as technology costs are reduced and impacts fully understood. The construction of the Lagoon wall—using pre-fabricated caissons—could also be streamlined and cost engineered. While Lagoons would also have environmental impacts—and loss of intertidal habitat—their location could be carefully chosen to limit these impacts and given the smaller size of the schemes mitigation in the form of compensatory habitat put in place. Lagoons would have to be designed to be fish friendly—but would not have the same impacts on fish migration. . To our knowledge there has not yet been a study of tidal lagoon potential in the UK but the sites identified on the Severn are indicative of their potential.

The 2010 DECC study showed that land connected tidal lagoons performed more strongly than had been previously recognised, providing the appropriate location was selected. Whilst this study was focused on maximising the energy potential of the Severn.

Since that study was completed, a number of options for smaller land connected lagoons have also been developed including the *Swansea Bay Lagoon* and the *Stepping Stones Lagoon* (a larger option developed by the lead consultants on the DECC Feasibility Study).



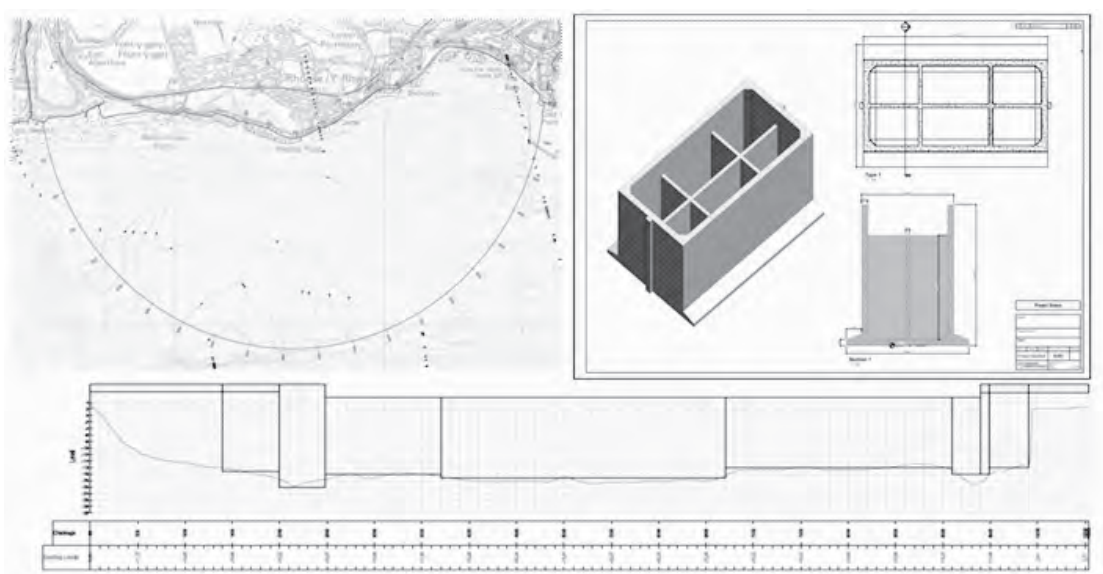
*The Swansea Bay Lagoon project—250 MW—planned to be connected by 2020.*

The EIS Scoping Report for this project has now been submitted to the IPC and can be found on their website. <http://www.tidallagoonswanseabay.com>

In their work on the *Stepping Stones Lagoon*, Parsons Brinckerhoff and Black & Veatch have developed and costed a design that has a lower levelised cost (c£195 at a 10% discount rate for a £1.7 billion capital cost and annual energy yield of 1.2TWh/yr) than the equivalent Severn Barrage (c£23 billion cost and annual yield of c16TWh/yr) using the same cost principles and discount rates.



## STEPPING STONES LAGOON—LOCATION AND CAISSON DESIGN



*Images courtesy of Parsons Brinckerhoff*

It is worth noting their comments that a levelised cost will be higher than the equivalent strike price due to the effects of inflation—the strike price is inflated whilst levelised costs are not—as capital cost intensive projects incur most of their costs in the construction years, the effect of future inflation is to increase revenues through an indexed strike price but not the costs. They have also established that a tidal lagoon could be consented *within five years* and, because of its relatively small size relative to the estuary, could be helpful in developing the evidence base on the Severn whilst minimising adverse impacts relative to other larger options.

As with other long life projects, the Stepping Stones costs reduce after the financing period to £30/MWh@10%, less than the wholesale cost of electricity. Although the Stepping Stones Lagoon uses existing mature technology (which is why it can be consented and constructed reasonably quickly subject to it being embraced by future marine energy policy), it could also be used to test new, more innovative turbines in addition, again informing future energy options. The above referenced tidal lagoons are located downstream of the protected areas under the Habitats and Wild Birds Directives and thus present a less resistant route to development than other options further upstream. Their downstream locations also mean that they should not compromise the development of other tidal power options.

Successful deployment of smaller land connected tidal lagoons will increase interest in larger options whilst the time taken for consenting and construction will see other technologies such as tidal stream become more mature and commercially proven. Collectively this builds the position of the UK as a leader in marine technology both in terms of generation capacity and supply chain capability.

#### *Industry Support for Tidal Lagoons*

In their submission to the barrage enquiry the original **Severn Tidal Power Group**, while not ruling out a future barrage, have suggested that a Tidal Lagoon options would be a good first step towards harnessing tidal energy in the Bristol Channel.

*The “Stepping Stones” lagoon concept developed by Parsons Brinckerhoff and Black & Veatch seems to meet the requirements of a first step on the pathway. It has little impact on protected environmental areas, is of a size that can be developed by the private sector (given planning consent), and uses proven technology. Also, it does not interfere with the development of larger barrage proposals, nor the operation of the existing ports.*

*Lessons learned from the construction and operation of such a scheme, including environmental impacts, would provide valuable for evidence-based evaluation of a CardiffWeston barrage later along the pathway.*

*We therefore consider that the merits of developing such a scheme should be carefully considered by the Select Committee.*

The STPG includes major industrial companies including Sir Robert McAlpine, Balfour Beatty, Alstom and Taylor Woodrow.

## 2.2 Tidal Stream and Tidal Fences

The UK is a world leading centre for the development of tidal stream technologies. Indeed two of the leading companies—Tidal Generation Limited (Owned by Alstom) and Marine Current Turbines (Owned by Siemens) are based in Bristol.

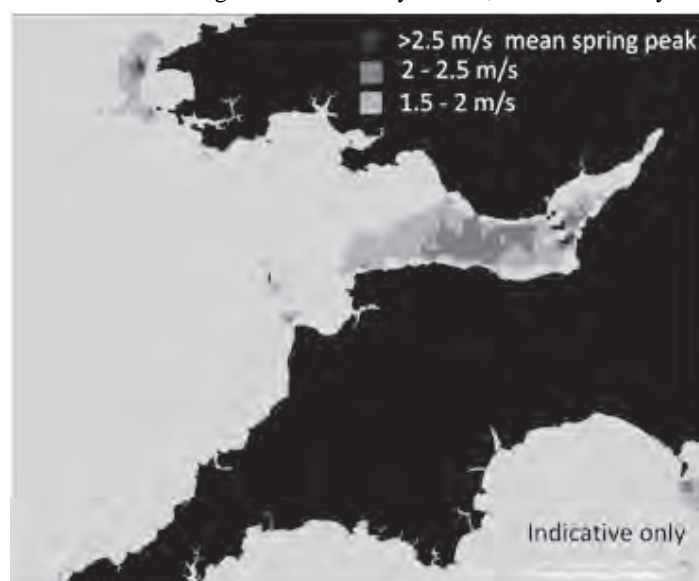


Although the leaders in the field of tidal stream technology development are currently focused on high current ( $>5\text{m/s}$ ) deep channels around the UK such as Pentland Firth, and elsewhere in the world, the potential to exploit fast currents ( $2.5\text{ m/s}$ ) in shallower waters has a much larger potential market world-wide. It is therefore essential that the UK continues to support tidal stream technology development and research and open up new sites for deployment to maintain its leadership position.

This is why we are seeing technologies using new concepts such as cross flow, hydrofoil, multi turbine foundations and tidal fences now coming forward. The leading turbine technology developers are also looking ahead to see how the next generation of tidal turbines could be adapted for shallower waters exactly like the Bristol Channel.

The Bristol Channel combines good tidal velocities with comparatively shallow water 20–30m. in the medium term, we expect the 2nd generation of tidal stream technology to target lower velocity sites ( $<2.5\text{ m/s}$ ) in shallower waters which are close to areas of high energy demand.

The unique characteristics of the Severn are ideal for this and a number of proposals have been developed to pursue this. These include the licensing of an area off Lynmouth, North Devon by Pulse Tidal.



Tidal fence technologies—such as the design from *Kepler*—could increase energy output by combining the both tidal velocity (stream) and tidal head (range) energy sources.



The Severn Tidal Fence Proposal by IT Power between Aberthaw and Minehead which was reviewed by the STE's study could have a potential capacity of 400–600 MW.

### 2.3 Tidal Energy Development Pathway

The *Bristol Channel Energy: A Balanced Technology Approach Paper* provide a very broad range estimate of the energy capacity potential for Tidal Range and Tidal Stream:

- Tidal Range—1–5 GW.
- Tidal Stream—0.5–1.25 GW.

We have been asked by the committee and by others in the industry to provide more detail on the potential projects with some idea of the possible deployment timescales. This is difficult to do precisely since in many cases these projects and their supporting technologies are at an early stage of development.

The table below however gives an overview of the possible projects which could be brought forward, with a potential upside estimate of over 7 GW of capacity, without compromising the ports, with reduced environmental impact and providing a platform for a sustainable and developing export market in tidal energy.

TIDAL ENERGY BRISTOL CHANNEL—POTENTIAL PROJECTS AND TIMSCALES

| <i>Time frame</i> | <i>Option</i>  | <i>Status</i>   | <i>Capacity (MW)</i> | <i>Energy PA (TWh/yr)</i> |
|-------------------|--|---|----------------------|---------------------------|
| <b>2010–20</b>    | Swansea Bay Lagoon   | Scoping Study submitted to IPC (2012)                               | 200                  | 0.4                       |
|                   | Stepping Stones Lagoon (see Fig 1))                                | Outline Design & Costings developed & stakeholders consulted (2012) | 600                  | 1.2                       |
|                   | Lynton Tidal commercial demonstration site                         | Licence granted   | 3                    | n/a                       |
|                   | Pembrokeshire—Ramsey Sound Demo Site                               | Licence granted   | 3                    |                           |
|                   | North Somerset Tidal Demo/ Early Commercial                        | Site scoping  | 10–30                | n/a                       |
|                   | Ramsey Sound Early Commercial                                      | Site Scoping  | 10–30                | n/a                       |
| <b>2020–30</b>    | Bridgwater Bay Lagoon (see Fig 1—L3d)                              | Outline Design and Costings developed (DECC 2010)                   | 3,600                | 7.2                       |
|                   | New Lagoon between Clevedon and Weston                             | Potential site identified (2012)                                    | 750                  | 1.5                       |
|                   | Tidal Fence (See Fig 1—between Minehead and Aberthaw)              | Outline design and costings developed under SETS (DECC 2010)        | 400–600              | 0.88                      |
|                   | Tidal Arrays—around headlands and islands in outer Bristol Channel | Potential sites identified (2010)                                   | 800                  | 1.8                       |
|                   | Shoots Barrage (see Fig 1—B4)                                      | Outline design & costings developed (DECC 2010)                     | 1,150                | 2.7                       |
| <b>Totals</b>     |  |   | <b>7,200</b>         | <b>15.7</b>               |

### 3. A WIDER UK OPPORTUNITY

We did not have time at the committee hearing to discuss the potential economic benefits from marine energy development. I would however like to take this opportunity to emphasise again that the UK is a leading centre for the development of wave and tidal technologies.

Regen SW has estimated that in the south west there are currently over 500 people employed in the marine energy sector. A key to this sector growth has been the engagement through the universities and supply chain companies in the regions.

For more information about the growth of the marine energy sector in the south west of England please download the South West Marine Energy Park Prospectus and the South West Marine Energy Supply Chain Directory.

While the barrage discussion has focused on opportunities within the Bristol Channel there are also emerging hubs for tidal energy deployment and technology development in:

- Scotland—especially around the Pentland Firth and Orkney Waters—but also opportunities for Tidal Lagoons in the western Isles.
- The Channel Islands—massive resource potential.
- Isle of Wight and Southampton.
- Ramsgate/Thanet.
- Liverpool Bay—Tidal Lagoons.
- North Wales and Anglesey.
- Northern Ireland—600 MW currently in leasing.

There are also emerging tidal energy markets in France, Canada, Korea, Japan and China.

The sector has now begun to attract investment from a number of major multinational companies. MCT has now been bought by Siemens and TGL is now owned by Alstom. Other industrial investors in the sector include

DCNS, ABB, Kawasaki, Voith, Hyundai. The lack of investment by UK industrial companies is however a concern.

The UK marine energy sector will play a small but important role in meeting the UK's 2020 renewables target but it will be an increasingly important contributor to decarbonising the electricity sector in 2030 and meeting the Climate Change Act's 2050 target.

It will also play a significant role in meeting other countries decarbonisation targets, particularly if it is supported in developing a sustainable pathway that embraces both tidal range and emerging tidal stream advances and has the widespread support of stakeholders. Other countries will also have tidal energy resources that double as shipping lanes. If the UK is to be successful in marine energy on a global basis, it is important that we develop a marine energy sector that is able to demonstrate how it can exploit energy without compromising important economic activity and with broad stakeholder support.

## APPENDIX A

### FUNDAMENTAL DIFFICULTIES WITH THE SEVERN BARRAGE AS PROPOSED BY HAFREN POWER

Significant concerns have been raised that a barrage on the Severn estuary will impact on strategically important ports and legally protected environment.

We are further concerned that proposals for a barrage, that involve turbine technology that has not yet been developed let alone prototyped or tested, can make substantiated claims regarding its impact on fish or its ability to replicate the existing tidal sinusoidal shape. A barrage operating in ebb and flood mode would truncate the tide at the top and bottom of its cycle reducing high water levels that are problematic to the passage of large ships and increasing low water levels that result in still significant inter-tidal habitat loss (albeit less than a barrage operating in ebb only mode) and compromising the free discharge of land drainage outfalls.

It was these concerns relating to the barrage options, whether they be tidal reefs, bars or ebb and flood or ebb only barrages—and the associated evidence from DECC's 2010—that we decided to look at what alternatives were possible for utilisation of the huge energy potential of the Severn.

From the evidence presented to date we have concluded that the Severn Barrage faces 5 fundamental challenges which have not yet been addressed.

#### 1. TECHNOLOGY READINESS

At the 30th January hearing we learnt that Hafren Power do not yet have a turbine manufacturer partner and are not working with the Rolls Royce/Atkins team. It is not clear if Hafren Power even now have a concept design for a turbine. As the committee heard from my evidence, and from Vincent de Laleu of EDF, this is a very significant factor which means that the Severn Barrage could not be built within the timetable suggested by Hafren Power.

There is no doubt that the development of a new concept, low head, multi-directional turbine (which is low cost, highly energy efficient and environmentally friendly) would be of significant benefit. Such a turbine could be applied across a range of projects in the UK and abroad including Tidal Lagoons to which it is perhaps best suited. Development of a new low head concept turbine is however a significant engineering challenge. With the right priority support from Government and the industry, the technical challenges could be overcome in an accelerated timeframe but this would still represent several years of technology development.

However, even if the physical technology development could be accelerated, the *commercialisation* of the technology would still require several years of demonstration and deployment to reach the stage where the turbine can be “bankable”—ie backed by a manufacturing capability, performance guarantee and warranty (as well as environmentally proven) which investors will require before investing in large scale projects. We have seen the same in offshore wind, wave and tidal energy—and this is why it is almost impossible to imagine a scenario whereby a credible new turbine technology would first be deployed as a critical component in a £25 billion project.

Our approach would be to first fund a collaborative low head turbine development programme with the industry and then to deploy the technology firstly at a demonstration site and then as a small lagoon project. Ideally it should be possible to test two or three designs—a good example of this is the approach currently being taken by the ETI to support floating wind technologies.

#### 2. ENVIRONMENTAL IMPACT—ESPECIALLY FISH MIGRATION

There is a huge amount that has been said about the environmental impact of the Severn Barrage. The committee has already heard evidence about the loss of inter-tidal habitat and the difficulty of mitigation through the provision of sufficient compensatory habitat. This issue in itself is probably enough to stop the barrage proposal from proceeding.

Added to the loss of inter-tidal habitat, the issue of fish mortality and fish migration is however critical.

Hafren Power have claimed that the new concept turbine would be designed to ensure very low (approaching zero?) fish mortality. This claim is however very difficult to evaluate—not least since we do not have clarity on the turbine design or any field data.

We do know however that development of a fish friendly turbine, which is also power efficient, is a difficult engineering challenge. The concept design developed by Rolls Royce and Atkins for the SETS study in 2010, approached the problem by focusing on a number of design parameters which were agreed by academics and environmentalists to be of key importance for fish mortality including a) the blade velocity b) rapid pressure transients c) blade separation d) exposure to hydraulic shear forces and e) entrapment in hub and tip gaps.

The biggest step forward was to reduce the blade velocity to approximately 20–30% of a traditional bulb turbine. Measured against these specific parameters the Rolls Royce turbine should, *at least in concept*, be more fish friendly than a traditional bulb turbine. However it is important to note that this turbine has not been prototyped and no field data exists to show how fish friendly the new turbine would be in practice.

The Rolls Royce turbine also introduced additional design features which may potentially increase fish harm. For example there are now two sets of counter-rotating turbine blades. So we would need to consider the closing speeds between the two sets of blades as well as absolute blade velocity. There is also a question about what will happen to fish who have made it through one set of blades but are now in the inner turbine chamber between the blades—as far as we know this has not been modelled for fish passage.

The number of blades in the Rolls Royce turbine has also significantly increased from three to 13. Put simplistically this means that although slower and with larger gaps, the number of blade edge revolutions has actually increased (three blades x 60 RPM = 180 blade revolutions compared to 13 x 15 rpm = 195 blade revolutions).

The key message here is not that the Rolls Royce turbine design is or isn't fish friendly—it is that all turbine designs will need to be properly modelled, prototyped and field tested to understand their full impact—which in fairness is exactly what Rolls Royce have said.

The challenge for the Severn Barrage is however more complex than just fish turbine mortality. The simplest way to reduce fish mortality is to discourage fish from swimming into the turbines—as can be done for a Tidal Lagoon for instance using acoustic and other devices. The fundamental issue for the barrage is that it cuts across an important channel for fish migration—including Spawning Salmon, juvenile Salmon and European Eels—making their way to and from Welsh and English rivers. This introduces a far wider environmental impact, for example, one can envisage increased bird predation on young smolts caught in ebb tide shallows waiting to pass through the barrage. So it is not just a question of turbine mortality but the overall impact the barrage will have on fish migration which needs to be considered.

In this respect the Hafren Power proposal may in fact have a bigger impact on fish migration than the original Severn Barrage project which was reviewed in 2010. The Hafren Power barrage would operate on both the Ebb and Flood tides—so fish are impacted on both tidal cycles. The number of turbines has also significantly increased (over 1,000 compared to over 200) and the turbines are now spread across the length of the barrage rather than clustered in the middle. This means that it will be more difficult to create clear channels for fish passages and more difficult to use acoustic and other methods to dissuade fish from entering turbines.

Of course there are mitigation measures that can be adopted but the problem is to know how effective these will be in advance of the barrage construction. Given the risk to spawning fish, potentially destroying internationally protected species in Welsh and English rivers, it is very difficult to see how a barrage proposal can be fast-tracked through.

### 3. ECONOMIC IMPACTS ON UPSTREAM PORTS AND UK INDUSTRY

I do not have any evidence to comment on the 20,000 direct jobs or 50,000 total jobs it has been claimed the Severn Barrage would create. These numbers do not correspond with the analysis which was completed as part of the Severn Tidal Feasibility Study.

In part this is because Hafren Power have not included the potential job losses at Bristol Port and other ports impacted by the barrage. At the committee hearing 30th January, Hafren Power said that they did not accept the numbers produced by the Bristol Port company in their evidence—in fact the numbers submitted by Bristol Port are taken directly from the DECC Severn Tidal Power Feasibility study.

The economic impact on upstream ports including Cardiff and Bristol has been highlighted to the committee, and it is clear that the delays and congestion for shipping passing through lock gates, combined with the loss of tidal head and issues of siltation, are expected to have a serious detrimental impact on upstream ports. This was the conclusion of the 2010 Severn Estuary Tidal Study, and has not been changed by the new proposals brought forward by Hafren Power. Indeed an Ebb and Flood barrage can overall be expected to have a higher impact on upstream ports due to the increased loss of high water tidal range which would be reduced by at least 2m.

Whilst pumping and/or temporary cessation of operation has been promoted as a solution to the loss of high water level, engineering experts we have spoken to have questioned the feasibility of pumping at the barrage

to raise water levels at Avonmouth which is a considerable distance upstream of the barrage, both from a hydrodynamic perspective and the ability to procure the energy economically for pumping when it was required. Allowing the barrage not to operate when large boat movements are required would seriously damage its business case (and the UK's energy supply) particularly when the volume of future shipping movements cannot be accurately predicted.

Bristol Port have made their own position clear throughout these hearings, and have drawn on the evidence which was previously gathered by DECC to highlight that the net loss of jobs at the port and from surrounding businesses would offset the jobs created by the barrage itself. This is why the Severn Tidal Feasibility Study showed a comparatively low GVA and net job creation from the Severn Barrage.

What has not been highlighted to the committee is the potential knock-on impact for UK manufacturing and other businesses in the Midlands, South West and South Wales. Bristol Port is a key gateway port for both imports and exports to the heartland of the UK's manufacturing industry. Its proximity to the Midlands and links to both road and *rail transport* networks, make the survival and future expansion of the port a critical element of the UK's prosperity. This is one reason why Bristol Port has now received planning for a new £600 million deep water container terminal which will be able to handle 1m container annually.

If the port expansion were to be curtailed, or the port itself decline, because of the barrage this would have a significant economic impact far beyond the direct port employees. The committee has heard that container traffic is very likely to go elsewhere if Bristol Port is not able to handle the largest container ships. It is quite possible that some of this traffic will go to other European ports (to be transhipped back to the UK) which would have a direct cost to the UK economy in terms of transhipment freight.

However even if the bulk of container traffic went to other UK container ports, the additional mileage from the South West, South Wales and Midlands to, for example, Southampton, Liverpool, Felixstowe or Teeside would have a substantial impact of freight costs (approx £2 per mile according to the Haulage Association) as well as increasing road traffic and carbon emissions.

It is inconceivable that the Severn Barrage will proceed if the scheme is deemed to have a detrimental impact on one of Britain's key trade ports.

#### 4. COSTS OF ENERGY & TECHNOLOGY DEVELOPMENT

I was asked by the committee about the costs of alternative technologies and about whether these technologies would ever be cost effective.

At present the Wave and Tidal Stream sector receives a support subsidy of 5 ROC's per MW/h—worth roughly £200 per MW/h (based on ROC price of around £40).

This support is however limited both in terms of time—to April 2017—and the size of the project—up to 30MW. The expectation is that probably less than 150 MW will be deployed in that timeframe and so the exposure of the market incentive scheme and impact on energy consumers will be extremely limited.

The 5 ROC marine scheme is intended to jump start the industry and enable it to get to a scale where it can prove the technology and *begin* to reduce costs. The intention then is that costs will continue to reduce over time through economies of scale, innovation and learning—as we have seen happen with other technologies including onshore wind and PV.

Understanding the cost curve for new technology—how and when cost reduction will be achieved—is fundamental to enable government and other agencies to put in place an appropriate support mechanism which will nurture the industry, creating jobs and export opportunities, while ensuring value for money for consumers and taxpayers.

This also applies to mature technologies—as the committee is aware, the high cost of Offshore Wind is not considered sustainable and there is a stretch target to reach an LCOE of £100/MWh by 2020.

#### *Barrage LCOE calculations*

In the case of the Severn Barrage there is much less opportunity for incremental cost reduction and technology innovation over time. The Hafren Power proposal is for a one off large scale project that will generate up to 5% of the UK's energy demand and utilise a significant portion of the UK's subsidy support within the Levy Control Framework. Getting the level of subsidy right is therefore of critical importance for the UK consumer and the rest of the renewable energy sector.

We do not know what strike price Hafren Power is discussing with government and we have not seen any details of their cost of energy estimates. At the Select Committee evidence session it was suggested by Hafren Power that the subsidy required would be at, or less than, the support given to Offshore Wind. It was not clear however whether this is the subsidy given to Offshore Wind projects today (equivalent of 2 ROCs) or the much lower subsidy expected in 2025, or later, when the barrage would be commissioned.

The Severn Estuary Tidal Feasibility study estimated a LCOE of £211 MW/h for the Cardiff Weston Ebb only barrage using an investor rate of return on 10%. The Rolls Royce/Atkins tidal bar (Ebb and flood) was

looked at in high level by the study with a predicted LCOE of £200 per MW/hr. Without further evidence it is not clear how the Hafren Power proposal would be significantly cheaper—although intuitively moving from 216 bulb turbines in the original ebb only scheme to over 1,000 bi-direction turbines would normally be expected to increase costs.

Hafren power have suggested in their evidence to the committee that one way in which they have reduced the LCOE calculation is by using a different discount rate—*“The rate that we use is the rate that we expect sovereign wealth funds to be able to raise debt and equity for in the market.”*

Changing the discount rate will of course have a significant impact on the LCOE calculation. For a scheme with a £25 billion capital cost and energy yield of 16TWh, the levelised cost of electricity at a 10% investor rate over a 30 year period is between £210 and £225/MWh—the exact figure depends on the detail which of course we haven’t seen. If you used public sector procurement guidelines with a discount rate of 3.5% (the financing coming from Government), the LCOE cost drops to £110/MWh.

If Hafren Power are using an intermediate rate (say 7.5%) then of course the LCOE will be lower—as it will be for any energy project. The actual cost of capital will vary between projects—and this is one of the key areas where Government intervention such as co-investment by the GIB can reduce energy finance costs for Offshore Wind—but it is completely wrong to use different discount rates when making comparative policy decisions where all options need to be considered using the same assumptions.

If Hafren Power are using a lower discount rate then there is an inherent gamble about the future cost of finance. Given that the project will most likely be financed and re-financed several times over during the planning and construction period there is therefore a risk that the project will incur higher finance costs than expected and may require future Government support.

#### *Lower Long Term Costs*

It is true however that barrages, lagoons and some other energy projects can generate lower cost energy when this is considered over their *much longer operating period*. One of the drawbacks of the LCOE analysis under Green Book rules is the limited timeframe in which projects are considered.

In the case of the Haffron Power proposal it is clear that operating costs will drop very substantially once the initial financing period (25–30 years) has passed. The analysis the Haffron Power presented to get to an average LCOE cost of £48 pMW/h is however misleading and incorrect. The proper analysis should be done by extending the LCOE calculation period which discounts future costs and revenues or by presenting the LCOE within a time bound (for example during or after the financing period).

The committee should also note that a fall in operating costs after the finance period *does not necessarily translate into lower energy bills for the energy consumer* but could in fact lead to super-normal profits for the operating company and its investors. How these future profits are handled should be part of the negotiation with government—for example, one option would be to claw back the initial financing subsidy, another would be to take the asset into state ownership and allow the operating company to manage the asset as a concession.

One model to use for long term energy projects such as tidal range (Lagoons or Barrages) is a DBFOT finance model (Design Build Finance Operate Transfer). This works on the basis that the Government owns the asset and invite tenders for a 30 year concession to design, build, finance, operate the asset over 30 years before it is handed back to the public sector at the end of the concession period—the highways sector uses this model, for example on the Second Severn Crossing.

After the concession period the Government then owns an asset that is operating, de-risked and generates significant revenue at a much lower operating cost. The Government then have a number of choices—they can operate directly (in which case they can reduce the wholesale electricity price by selling their energy for less), or they can award another concession (in which case the premium they receive could be offset against the initial investment made during the DBFOT period—ie the gap between the CfD and wholesale price) or a hybrid approach based on the latter where there are conditions to ensure there is a price cap on the second and subsequent concessions to achieve a balance between return and impact on wholesale price.

The key message here is that long term energy projects need to be evaluated over the project generating lifetime. It is then a policy judgement whether the long term benefits of lower operating costs outweigh the shorter term subsidy that is required to finance the project. The assessment of the Severn Tidal Feasibility Study in 2010 was that this was not the case for a barrage project of this scale, level of finance and risk.

#### *Could a smaller Tidal Lagoon project be financed?*

The same arguments apply in terms of a high initial capital cost v a much lower long term cost of energy. A Lagoon project would also be more financially viable because it would be smaller (easier to raise finance) and arguably of much lower risk.

There is also a value argument for government because:

- The opportunity cost in terms of subsidy Control Framework Agreement caps and also the energy resource is much less.

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- There is the potential to develop new technology and drive down installation costs which could then be used to generate export opportunities and generate cost saving for future projects.

## 5. LOSS OF GOODWILL AND MISTRUST OF HAFREN POWER PROPOSALS

As the “Bristol Channel Energy: A Balanced Technology Approach” document highlights—it will be essential for a large scale project to succeed to secure support from a wide range of stakeholders (industry, environmental, political) on both sides of the Bristol Channel. It is also clear that in order to secure support, renewable energy projects need to deliver long term economic benefits to both English and Welsh sides of the Bristol Channel.

Unfortunately the Hafren Power Severn Barrage proposal has become extremely divisive and, as the Select Committee noted, is faced with a high degree of mistrust and opposition.

It is vitally important now that the UK Government (and other key stakeholders such as the Welsh Assembly, Bristol City Council, MMO and Crown Estate) steps in to establish a clear governance and process to determine the future strategy for the Bristol Channel, and that sustainable energy and economic development is put at the forefront.

February 2013

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### Written evidence submitted by Engineering the Future

#### INTRODUCTION

The 2010 Severn Tidal Power Feasibility Study by DECC detailed a number of conclusions which led to DECC’s decision not to proceed with public investment into the Cardiff-Weston scheme considered. Since then, an alternative scheme has been developed, Hafren Power barrage, which addresses some of the conclusions reached. This evidence answers the ECC questions with respect to the Hafren Power Barrage scheme where possible, but we would like to make the Select Committee aware that details of this scheme are not in the public domain.

Some general issues relating to a Severn barrage are addressed in *The Royal Academy of Engineering, Academy briefing: The Severn barrage*<sup>21</sup>.

#### SUMMARY

We would like to make the Committee aware that the engineering community has differing views on proposals for a barrage. This response aims to represent these different viewpoints in a balanced, evidence-based argument.

The key points are:

- There are issues related to the fact that a Severn barrage would only generate power for limited periods of the day, but these could be addressed. The overall energy economics, socio-economic and environmental impact of the scheme would need further exploration.
- A tidal power scheme in the Severn Estuary could be important in the overall achievement of a secure low-carbon electricity supply but local environmental and economic impacts must be taken into account, as well as the cost of its electricity production compared to other sources.
- Computer model results for ebb/flood generation, similar to the Hafren Power scheme, indicate the barrage would defend against flooding from the sea.
- It is expected that the barrage would affect several aspects of existing environment and wildlife. These include positive and detrimental changes. Risks to bird habitat need to be clarified but could potentially be partially mitigated through engineering interventions.
- While capital costs are high, tidal generation would work reliably for >100 years with low operating costs, few breakdowns, predictable power and some flexibility in energy generation. Challenges created by the output profile of the barrage would need to be addressed.
- The barrage would provide several positive opportunities for local communities, local employment and marina development. However, shipping times and navigation would be negatively affected. The tidal window for accepting large ships would be reduced and shipping times lengthened. The engineering interventions to mitigate these changes need further study.
- Development of a Severn barrage would create international interest. Successful development of the barrage could lead to other schemes being built using UK-based low-carbon engineering and technology. The UK is also well placed to export engineering and project development, delivery advisory services, and its policy expertise.

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<sup>21</sup> <http://www.raeng.org.uk/events/pdf/Severn%20Barrage%20transcript.pdf>

*Q1. What contribution could the Cardiff-Weston barrage make to UK energy security and climate change objectives?*

#### OVERVIEW OF HAFREN POWER SCHEME

1. The subject of DECC's feasibility study of the Cardiff-Weston barrage was an ebb generation barrage leading to two spells of power generation each day with a maximum power output of about 8 GW. This would provide about 11 hours generation each day.

2. This response focuses on the scheme proposed by Hafren Power (HP). The HP scheme includes the use of Very Low Head (VLH) contra-rotating turbines and would generate in both ebb and flood tides. This would have four generation phases a day. Generation would be for about 15 hours a day with a peak power output of about 6 GW. The amount of energy generated by the HP scheme would be similar to that of the scheme considered by DECC.

3. Summary of the HP scheme benefits (compared to the scheme considered by DECC):

- lower cost;
- better generation profile and higher load factor;
- reduction in flood risk;
- better scope for private financing.

#### CONTRIBUTION TO UK ENERGY SECURITY

4. The UK electricity system has a peak demand of around 60 GW. The proposed HP Severn barrage could provide large volumes of low-carbon electricity, for an indefinite period, with peak outputs up to 6 GW. Over a year, this could provide up to 5% of the total present UK electricity demand.

5. In contrast with many forms of low carbon energy, for example wind and solar, electricity generated by the barrage would be available at predictable times each day. The amount of power that would be generated could be calculated for any period in the future. However, the timing of energy production would vary with the tides and the amount of power generated would vary significantly between spring and neap tides. Even though there are engineering possibilities to hold back and control water flow through impoundments, there would be some days every month when electricity was produced at times when ordinarily demand would be very low.

6. All tidal power varies in the amount of energy generation depending on the size of the tide. The HP ebb/flood scheme, with its four pulses a day, would generate more energy for a greater proportion of each day when compared with the ebb-only scheme of only two pulses. The energy is predictable and this short term intermittency of about three hours could be mitigated, initially by conventional back-up, and by developing energy storage technologies or controllable sources of electricity demand that exploited the daily predictability of the output, such as electric vehicle charging. Storage technologies are already being researched and tested and should be developed not just to exploit generation from the barrage but also for other renewable energy sources.

7. The scheme would add much-needed diversity to the UK's renewable energy portfolio. Given the barrage's generation characteristics, it could complement nuclear and wind and reduce the reliance on imported gas, providing the UK with flexibility for the future.

8. Tidal barrages have a far longer life expectancy than most other forms of electricity generation infrastructure. A Severn barrage would be expected to contribute to the UK's energy needs for over a century, at a low cost for most of its life once the capital cost is repaid. The anticipated maintenance costs for the barrage would be very low and if designed well, lower than any other form of generation as demonstrated by the La Rance project. In addition, a barrage would have limited end of life issues, all of which could be managed with currently known technologies.

9. The cost of electricity from the project versus alternatives is a major consideration. Without valuing predictability, the studies undertaken for DECC in 2010 do not give great cause for optimism in this regard, with quoted costs of 30p/kWh. That compares with around 15p/kWh for offshore wind today, which is expected to fall by 2020. It has been noted that the HP scheme appears to offer the potential for significant reduction, possibly to the level of current offshore wind costs, but this requires further analysis and validation.

10. Should it prove possible to reduce costs of construction significantly through innovation in turbine design, civil works and method of operation, to the point where costs were comparable with other low carbon options currently being pursued in the UK, then the predictability of output would bring a potential additional source of value, provided ways could be found to exploit it.

11. Before any decision is made to proceed further, a comprehensive assessment of full energy system costs should be undertaken, considering scenarios with and without a Severn barrage using the latest HP cost and performance data. Should this show a favourable outcome, then independent third party review of the cost and performance data would be advisable before further commitment by government.



## CONTRIBUTION TO UK CLIMATE CHANGE OBJECTIVES

12. If a Severn barrage could produce 5% of the electricity demand, without excessive embodied carbon, it would make a significant contribution to meeting the post-2020 targets. Assuming that the HP scheme were commissioned in the mid-2020s, the barrage would allow an annual carbon dioxide saving of 1–2 million tonnes (using a conversion factor based on the current carbon intensity of the UK grid). The emission savings would be expected to decline as more low carbon energy generation was brought into the generation mix, thus lowering the carbon intensity of the grid and hence the conversion factor. The value of 1–2 million tonnes is calculated using the current, and more aggressive, DECC energy conversion figures which push for 0.1kgCO<sub>2</sub>/kWh by 2030.

13. It is crucial that the methodology for estimating carbon savings is well established by adopting the principles of Life Cycle Assessment (LCA). LCA is a tool used to assess the environmental impacts of a product from design to disposal, that is, across its entire lifecycle. The methodology for LCA should be fully transparent so the lifetime carbon benefits are articulated in the proposal. This can then be compared with other energy generation alternatives of similar scale such as nuclear power, use of fossil fuels with carbon capture and storage (CCS), wind power, and solar capture with *high-voltage, direct current* transmission.

Q2. *What risks and opportunities could it pose with regard to flooding in the Severn Estuary, and how might any risks be mitigated?*

14. HP has undertaken computer model studies for flood risk assessment for their Business Case presented to DECC, but these results are not currently in the public domain.

15. Professor Roger Falconer FREng, Director of Hydro-environmental Research Centre at Cardiff School of Engineering, leads a team that has been undertaking simulations to establish the hydro-environmental impacts of a barrage. His team has studied the impacts of different barrage configurations including ebb/flood generation with traditional turbines and with boundary conditions set just beyond the Continental Shelf. The specific details of the turbines in the HP scheme have not been made available and have not been used at Cardiff. Other simulations have been undertaken with the HP scheme (work not undertaken by Cardiff) but boundary conditions only taken to the edge of the Bristol Channel.

16. The Cardiff computer model results for ebb/flood generation with traditional turbines (similar to the HP scheme but not modelling the same turbine) indicate that:

- Flood risk upstream would be *reduced* with the barrage lowering the maximum water levels by between 1–2 m for spring tides.
- For ebb/flood generation, the peak water level is reduced by typically 0.2 m just downstream of the barrage in the Severn Estuary. However, in the Bristol Channel the peak water levels *increase* by up to 0.2 m for 764 bulb turbines, primarily in the Swansea region along the South Wales coast.
- There is no significant change (less than 0.05 m) in the water levels outside the Bristol Channel for ebb/flood generation, i.e. far-field effects. In contrast, ebb-only generation shows significant regions of the Irish Sea where the water levels are increased by typically 0.1 m.
- Flood risk caused by surges would be *reduced*. In an event of a storm surge, the turbine generation on the flood tide could be reduced and then stopped, thereby controlling the basin water level.
- Models have shown that the mean estuary water level upstream of the barrage remains similar to the status quo and there will be little or no change in the mean ground water level. The peak spring tides (with a current range of about 14 m) are reduced to less than 10 m.
- The land inundation extent that would be protected from flooding as a result of a barrage is estimated to be of the order of 50,000 hectares.

17. The region just outside the line of the main barrage, such as Somerset, has been considered. The hydrodynamics of the Somerset area have been modelled. The peak tidal level outside the barrage is predicted to be about 0.2 m lower with the barrage than without it. Thus a barrage would slightly reduce the flood risk in the region of the Somerset Levels and reduce the expenditure by the Environment Agency and others in having to raise the coastal flood embankments to cope with climate change induced sea level rise.

18. The barrage would likely be in operation for over a hundred years. In the long term, the barrage would continue to control maximum basin levels, and defend against flooding from the sea with only a small loss of power during peak spring tides. Any small increased risk to properties or communities would need to be addressed in a more comprehensive and case by case design study by the developer.

19. With sea level projected to rise up to 0.76 m by 2095<sup>22</sup>, putting much of the UK coastline under threat, a region free of or at least defended against flooding is likely to be attractive for international industrial investment. Therefore, the barrage has a role in climate change adaptation.

<sup>22</sup> UK Climate Projections 2009, UKCP09: Briefing report, [http://www.ukcip.org.uk/wordpress/wp-content/PDFs/UKCP09\\_Briefing.pdf](http://www.ukcip.org.uk/wordpress/wp-content/PDFs/UKCP09_Briefing.pdf)

Q3. *What risks and opportunities could it pose to wildlife and habitat in the Severn Estuary, and how might any risks be mitigated?*

20. A barrage would affect several aspects of existing environment and wildlife. These include positive and detrimental change.

21. Changes to wildlife and habitat posed by the HP barrage could include:

- Loss of inter-tidal habitat (the spring tidal range would be reduced from 14 m to less than 10 m).
- Reduced tidal currents upstream of the barrage.
- Reduced suspended sediment levels upstream and therefore a reduction in sediment bacteria transport.
- Increased light penetration because of less sediment present in the water column.
- Increased dissolved oxygen.
- More stable bed of the estuary due to lower spring tide velocities which are the prime cause of erosion, thus allowing biodiversity a more stable base.
- Increased primary productivity and a changed biodiversity on the bed of the estuary.

22. These changes would increase the biological productivity of the area and the water would be significantly clearer.

23. To mitigate the loss of inter-tidal habitat, material dredged from beneath the caissons and from the shipping channels could be used to raise the bed of the estuary in selected places replacing some of the bird feeding habitat that would become submerged. However, more work is required to clarify the impact of existing habitat and the extent and nature of the remedial work required.

24. Fishing in the Severn Estuary is limited. There is concern for salmon which occur in the Usk, Wye, and Severn. Along with most UK rivers, the number of salmon in these rivers has reduced considerably in the last few decades. There is little evidence available about how and when salmon migrate. There is also concern for eel populations. Before any scheme went ahead, HP would have to demonstrate how the VLH contra-rotating turbines (which have a slower blade speed) would affect salmon, and other species, in the estuary.

Q4. *What lessons can be learned from the successful development of the La Rance tidal barrage in France and other tidal power projects?*

25. The La Rance scheme was built on the Brittany coast near St Malo during the early 1960s. It dams off a long thin estuary to produce tidal power using bulb turbines. It has been operating continuously ever since, producing about 240 MW of tidal power on an ebb-only generation mode.

26. The La Rance project is different from the Severn for several reasons. One is the narrowness of the estuary, which meant that the scheme was constructed in a coffer dam, cutting off all migratory species and changing the salinity. Another is that no proper environmental base studies were done before the scheme was built. For these reasons, there are very few environmental lessons to be learned. Other, more recent, tidal barrier schemes may offer more such insight, including the Eastern Scheldt in the Netherlands and Annapolis Royal in Canada.

27. However, the La Rance scheme has demonstrated that tidal power can work very reliably, that maintenance and breakdowns are very low, and that there is some flexibility in energy generation. EDF, the operator of the scheme, claims that the resultant environment is a good environment in itself, albeit significantly different from that what was there before. We would like to make the Select Committee aware of the work of Vincent de Laleu, Marine & Offshore Wind Senior Engineer at EDF R&D, in which he describes the lessons learned as including proven low operating costs, long-life, predictability of power, and a degree of controllability<sup>23</sup>.

Q5. *What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular, what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

#### LOCAL EMPLOYMENT AND COMMUNITY

28. Many of the towns on either side of the estuary have high unemployment levels and the barrage could offer opportunities for employment in these areas.

29. There are currently minimal opportunities for recreational activities in the estuarine and coastal waters because of strong currents. For example, the Waverly cruises in the summer<sup>24</sup> are often cancelled because of strong currents. With a barrage in place, the tidal currents would be reduced, the waves in the basin much smaller as ocean waves would be precluded by the barrage, and the water clearer, making the estuary much safer for yachting and other recreational activities. This could encourage opportunities for marina developments

<sup>23</sup> Vincent de Laleu, Presentation at BHA Annual Conference, Liverpool, 14–15 October 2009, La Rance tidal Power Plant: 40-year operation feedback—lessons learnt, <http://www.british-hydro.org/downloads/La%20Rance-BHA-Oct%202009.pdf>

<sup>24</sup> Waverley is a paddle steamer, <http://www.waverleyexcursions.co.uk/index.htm>

at towns such as Newport and Weston. The clearer water could also make the waterfront on either side of the estuary more attractive for restaurants and small businesses.

30. The major connection between South Wales and the South West of England could also bring benefits through additional infrastructure links.

#### CURRENT PORTS

31. The main port in the Severn Estuary is Bristol Port which currently operates down to mid tide, with ship movement occurring on average for 12 hours per day. Avonmouth and Portbury are part of Bristol Port and are accessed by locks.

32. The HP scheme would include a large lock in the barrage and a new deep water channel. An analysis would need to be done but it is likely that shipping times would be lengthened, slowing down the turnaround time of ships by about 40 minutes each way. Choosing ebb/flood generation would reduce basin water levels making it likely that the window for accepting large ships would be reduced.

33. This disruption to shipping could be mitigated by constructing deeper entrance locks to the ports and this was considered as part of the previous DECC studies. However, the owners of Bristol Port have expressed great concern at the proposals for development of a barrage and their concerns should be properly investigated. Bristol Port is the largest in South West England and a major UK facility, handling 1.5 million TEUs (twenty-foot [cargo container] equivalent units) per year and has seen investment of over £450 million since its privatisation in 1991. The port supports around 8,000 jobs and outline plans for still greater investment (£600 million) exist<sup>25</sup> to accommodate major forecast growth in containerised traffic.

34. HP proposes to construct the barrage caissons in a new deep water facility near Port Talbot. HP proposes that, after the end of caisson construction, this be converted into a Ultra Large Container Ships port. This could be a good use of such a facility. However, onward transport of containers would need to use the M4 or the Victorian rail tunnel under the Severn. While rail is well-suited to dealing with large, bulk cargos, the increasing size of shipping containers poses challenges. “High Cube” containers (9ft 6 inches tall) are becoming more common and can only be carried in wagons that have a higher weight and lower capacity than standard flatbed wagons<sup>26</sup>, meaning that fewer can be carried per train with implications for track capacity and the Severn rail tunnel’s maintenance regime. In the longer term, a route could be provided along the barrage to link with the existing rail and road system. These aspects would need further study.

*Q6. Would the project require support under the proposed new Contracts for Difference mechanism? If so, approximately what level of strike price would be required to make the project economically viable?*

35. Undoubtedly the project would need support under the proposed new Contracts for Difference (CfD) mechanism. Presumably, private financing would be conditional on this. There would of course be many complexities associated with negotiating for the CfD but this should be no different from that presently going on for nuclear and, in the future, for abated gas and coal plant. In the case of the Severn barrage there is limited scope, if any, for competitive tendering. However, this is not dissimilar to the situation the government has already encountered with the new nuclear build programme and the CCS competition.

*Q9. Are any other proposals for tidal power projects in the Severn Estuary currently under consideration?*

36. Since the DECC feasibility studies, three proposals of different scales have been reported. These are:

- HP’s barrage using VLH contra-rotating turbines—the primary subject of the current inquiry (details have not yet been published).
- The considerably smaller Stepping Stones Tidal Lagoon concept (600 MW generating 1.2 TWh/yr)—a hybrid commercial/research proposal located so as not to compromise future development of any other option and inform future development of those options through operating experience (a first step if a more incremental approach was taken).
- A yet smaller option in Swansea Bay promoted by a private company that has recently submitted a scoping report to the Planning Inspectorate (250–350 MW project generating 0.4 TWh/yr).

*Q10. What could be the wider international implications of the scheme for UK engineering and UK low-carbon industry?*

37. The development of a Severn barrage would create international interest, with several countries already showing interest in barrage research. It could generate interest in UK engineering, specifically low-carbon energy generation technologies developed in the UK. The turbines proposed by HP are a new development of VLH contra-rotating turbines. As far as we know, this is a unique design and there are no such turbines operating anywhere else in the world. If the scheme went ahead with these turbines and was successful, then they would then be available for other tidal power schemes in the UK and export around the world. Examples

<sup>25</sup> <http://www.bristolport.co.uk/home>

<sup>26</sup> Network Rail, Freight Utilisation Strategy 2007, <http://www.networkrail.co.uk/browse%20documents/rus%20documents/route%20utilisation%20strategies/freight/freight%20rus.pdf>

of potential large schemes in the UK include the Solway Firth and the Mersey, and potential international schemes include northern Russia, and India. There could be export opportunities if turbines were developed that demonstrate significantly improved performance. In addition, the UK has the potential to develop low or carbon neutral material solutions, for example low carbon concrete. Successful development of the Severn could lead to other schemes being built using UK-based low-carbon engineering and technology.

38. The UK is also well placed to export engineering and project development and delivery advisory services. The Olympics demonstrated the UK ability to deliver massive infrastructure projects. This would be further demonstrated by the barrage and transferable to other areas. While tidal barrage schemes for energy are limited internationally, coastal flood protection schemes will be in demand around the world with sea level rise. This would be a major business opportunity.

39. Opportunities for the UK need not only be in the construction and technology aspects. As with other low carbon technologies, a Severn barrage is only feasible with an appropriate and sustainable policy regime. The UK government is currently grappling with a pioneering Electricity Market Reform to enable a balanced and secure low carbon generation portfolio at modest cost to consumers. If it succeeds, then there may also be potential for the UK to export its policy expertise. Whilst this might be difficult to commercialise, the growing body of knowledge on designing, financing, constructing and operating a complex system of less dispatchable, low carbon generation sources may provide more commercial potential. Proven expertise on redeveloping transmission networks, managing different forms of intermittency, incentivising and managing investment in back-up (especially fossil fuels), and perhaps even integration of demand-side measures such as a smarter grid and appliances and increasingly electrified heat and transport may be attractive to overseas investors.

## Annex

### ADDITIONAL INPUT: TRANSMISSION REQUIREMENTS

Although outside the scope of the questions, the IET believes that it would be useful for the Select Committee to have an understanding of the transmission requirements of a barrage and its impact on costs and public opinion.

The grid can cope technically with so much electricity going into it but as new power stations are built in different areas, new lines and upgrades to existing parts of the grid will be required.

The capital costs of any transmission connection or reinforcement works undertaken by National Grid would normally be borne by National Grid. The grid costs would therefore not be included in the capital cost of the tidal generation project. National Grid would make the investments, build and commission the assets, and then recover the allowed remuneration in accordance with the regulatory arrangements, via the locational transmission tariffs. These tariffs are paid by the owners of new generators once they commence operation. Although the grid costs are not borne by the generation developer, the developer is liable for these costs if the project is cancelled and the costs and investments become redundant and stranded. To cover this liability, a generation development is required to provide the appropriate financial securities, which will increase over the construction programme.

National Grid was asked in 2010 to consider how the DECC scheme could be connected to the grid and whether this would require any new infrastructure or upgrading of existing infrastructure.

The study by National Grid<sup>27</sup> concluded that for a Cardiff-Weston barrage the optimum solution was for an equal amount of power (4.32 GW) to be taken off on the English and Welsh sides. It identified three options—one with no transmission cables across the barrage and two with cables (one AC and one DC). All have similar costs of between £2.25 billion and £2.35 billion, though the option with no cable across the barrage could take at least three years longer to complete because that option may need a 125 km new overhead line to the south coast.

The study found that in principle it should be possible to accommodate this level of tidal generation and gave indicative costs for the works necessary. However, there were concerns over both system stability and electrical inertia that would require further detailed study and might require significant further investment to resolve. These also assumed greater levels of international interconnection and use of smart technology to manage demand and power flows.

*November 2012*

<sup>27</sup> Non-technical summary:  
<http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/severn-tp/662-grid-study-nontechnical-summary.pdf>  
 The full National Grid technical report:  
<http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/severn-tp/663-stp-grid-study-technical-report.pdf>

## Supplementary written evidence submitted by Engineering the Future

SPEAKING NOTES PROFESSOR TIM BROYD 11.15 THURSDAY 10 JANUARY

### PART 1: ENERGY INFRASTRUCTURE

*Advantages and disadvantages of hydro generation:*

1(a) *How can intermittency of tidal power be overcome via engineering interventions?*

There are two approaches to managing the intermittency of tidal range power:

- within the scheme itself, and
- within the wider power system.

Within the scheme itself

Opportunities to hold back tidal flows can extend (and even out) the generation period to allow generation for more hours in the day, and/or to delay generation to times of greater demand. We understand the Corlen Hafron scheme has explored this in some detail, though this should be subject to third party review as part of any case for Government support.

Whilst this will improve the generation profile it will not allow full control of generation over the 24 hour daily cycle.

Within the wider power system

There are three main ways of managing intermittency—*supply management, demand management, and storage*. These would need examination and optimisation in the context of the whole UK electricity system. Overall the extent to which the intermittency issue will be problematic and costly will depend on how far and how fast other Government policies around *electrification of demand* are progressed, and the success in delivering the *smart grid* necessary to support these policies.

The “conventional” *supply-side* way is to provide higher levels of reserve or *back-up generation* so that any shortfalls can be quickly met and any excesses are managed by constraining generation output or exporting/importing electricity to/from another country’s system using *interconnectors*.

*The mix and flexibility of other connected generation will be important here with generation becoming less flexible. Nuclear plant is relatively inflexible, and wind and solar plant have intermittency issues of their own. Gas and coal fired plant can be specified to be more flexible (but this needs to be engineered into the design and there are trade-offs between flexibility and thermal efficiency. It is currently unclear the extent to which carbon capture and storage equipment would impact flexibility.*

On the *demand side*, there are likely to be emerging classes of demand that could offer flexibility within the 24 hour cycle, notably the *charging of electric vehicles*, and the *replacement of gas heating boilers by electric heat pumps*. The extent to which these could be integrated with the time varying output of a Severn Barrage would need further study, but in principle these demands could be varied to match the project’s output. To do this would require a full smart grid implementation, *making even stronger the case the IET and others have been arguing consistently for some years that the planned smart meter rollout for the UK be made smart grid ready.*

Where economic, *storage* has a role, described in 1b below.

1(b) *What energy storage technologies are available? What R&D is being undertaken in this area?*

The full range of energy storage technologies, and current developments, are usefully summarised in the IET briefing document published earlier this year. (See table appended) <http://www.theiet.org/factfiles/energy/energy-storage-page.cfm>

However, it should be emphasised that a barrage scheme is itself a form of short term energy storage at the largest levels of power and energy currently engineered. It is therefore improbable that a complementary large scale energy storage system associated with a barrage is economically viable or even desirable.

A large number of smaller storage devices distributed through the electricity network would enable more effective use of barrage production, although their economic value would need careful assessment versus supply and demand management alternatives, and other forms of generation than a barrage.

The whole storage area is subject to massive R&D effort worldwide from both companies and governments, with the aim to reduce costs and improve round trip efficiencies.

1(c) *Cost effectiveness of a tidal barrage: Are we able to say whether the Hafren estimates are accurate?*

The generation costs stated in Corlen Hafren's evidence are £160/MWh for the first thirty years, and £20/MWh thereafter, though the evidence does also cite non-electricity revenue opportunities such as flood protection which would need further exploration.

Whether a strike price of £100/MWh could be sufficient to support this cost base would also need further exploration.

£160/MWh is substantially less than historic estimates for Severn Barrage designs, and we understand have been driven by consideration of novel turbine types together with a re-appraisal of all aspects of the scheme's design and duty. We are not at this stage convinced that the capital cost reductions are sufficient to support a generation cost of £160/MWh for the first 30 years of the scheme, especially when the full range of total capital costs including financing costs are taken into account. We have not seen sufficient information to allow an authoritative independent review of the pricing, and would recommend Government commissions such a review from an independent engineering firm not previously involved before it considers any further investigations.

After the capital committed for construction has been paid off, which we would expect to take place over the first 30 years, the marginal costs of continuing generation should be small. We would expect these to comprise on-going maintenance of the asset, employment costs for staff, insurance, grid connection, rates and similar charges. Review is again needed, but £20/MWh in 2012 terms does not seem unreasonable as a first view.

*Integration of Hydro to existing energy system:*

1(d) *What are the transmission requirements?*

Due to its high output—it would be equivalent in MW terms to around four new nuclear reactors (though with much less energy production owing to its lower load factor)—the barrage scheme would need to feed directly into the high voltage transmission system. The grid designed in the 1940s to connect power stations located near coal fields to centres of high demand is not necessarily in the right places to connect in renewable energy. As new power stations are built in different areas, new lines and upgrades to existing parts of the grid will be required.

The grid costs are not borne by the generation developer, but the developer is liable for these costs if the project is cancelled and the costs and investments become redundant and stranded. To cover this liability, a generation development is required to provide the appropriate financial securities, which will increase over the construction programme.

National Grid was asked in 2010 to consider how the DECC scheme studied at that time could be connected to the grid and whether this would require any new infrastructure or uprating of existing infrastructure. *We understand the Corlen Hafren scheme has a lower maximum output than the DECC scheme, and as such National Grid's conclusions would need re-evaluation to a degree.*

The study by National Grid<sup>28</sup> concluded that for a Cardiff-Weston barrage considered by DECC the optimum solution was for an equal amount of power (4.32 GW) to be taken off on the English and Welsh sides. It identified three options—one with no transmission cables across the barrage and two with cables (one AC and one DC). All have similar costs of between £2.25 billion and £2.35 billion, though the option with no cable across the barrage could take at least three years longer to complete because that option may need a 125 km new overhead line to the south coast. *All options would require major new transmission lines with associated public debate over their environmental impact.*

The study by National Grid also assumed greater levels of international interconnection and use of smart technology (Smart Grid) to manage demand and power flows.

The study found that in principle it should be possible to accommodate this level of tidal generation. However, there were concerns over both system stability and electrical inertia that would require further detailed study and might require significant further investment to resolve.

January 2013

<sup>28</sup> Non-technical summary:  
<http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/severn-tp/662-grid-study-nontechnical-summary.pdf>  
 The full National Grid technical report:  
<http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/severn-tp/663-stp-grid-study-technical-report.pdf>

## Annex taken from IET Briefing on Electricity Storage, 2012

Table 1

## COMPARISON OF STORAGE TECHNOLOGIES

| <i>Technology</i>                       | <i>Typical<br/>Rated<br/>Capacity<br/>(MW)</i> | <i>Nominal<br/>Duration<sup>(1)</sup></i> | <i>Cycle<br/>Efficiency<br/>(%)<sup>(2)</sup></i> | <i>Technology<br/>Maturity</i> | <i>Usual/Anticipated<br/>Scale</i> |
|---|--|---|---|--------------------------------|------------------------------------|
| <b>Mechanical</b>                       |  |   |   |                                |                                    |
| Pumped Hydroelectric Storage            | 100–5,000                                      | 1–24+ hrs                                 | 70–87   | Mature & Commercial            | Large Grid                         |
| Compressed Air Energy Storage           | 50–300   | 1–24+ hrs                                 | 70–89   | Commercial                     | Large Grid                         |
| Cryogen-based Energy Storage            | 10–200   | 1–12+ hrs                                 | 40–90+  | Early Commercial               | Grid/EV(3)/Commercial UPS(4)       |
| Flywheel                                | 0.4–20   | 1–15 mins                                 | 80–95   | Demo/Early Commercial          | Small Grid/House/EV                |
| <b>Electro-mechanical</b>               |  |   |   |                                |                                    |
| Hydrogen Storage & Fuel Cell            | 0–50   | Seconds—24+ hrs                           | 20–85   | Demo                           | Grid/House/EV/Commercial UPS       |
| Battery—Flow                            | 0.03–3   | Seconds—10 hrs                            | 65–85   | Research/Early Demo            | Grid/House/EV/Commercial UPS       |
| Battery—Lithium                         | 1–100  | 0.15–1 hr                                 | 75–90   | Demo                           | Grid/House/EV/Commercial UPS       |
| Battery—Metal-Air                       | 0.01–50  | Seconds—5 hrs                             | ~75   | Research/Early Demo            | Grid/House/EV/Commercial UPS       |
| Battery—Sodium Sulphur                  | 0.05–34  | Seconds—8 hrs                             | 75–90   | Commercial                     | Grid/House/EV/Commercial UPS       |
| Battery—Nickel                          | 0–40   | Seconds—hrs                               | 60–90   | Early Commercial               | Grid/House/EV/Commercial UPS       |
| Battery—Lead-Acid                       | 0–40   | Seconds—10 hrs                            | 63–90   | Mature & Commercial            | Grid/House/EV/Commercial UPS       |
| <b>Primary</b>                          |  |   |   |                                |                                    |
| Superconducting Magnetic Energy Storage | 0.1–10   | Milliseconds—seconds                      | 90–97+  | Early Commercial               | Small Grid/Commercial UPS          |
| Supercapacitor                          | 0–10   | Milliseconds—1 hr                         | <75–98  | Early Demo                     | Small Grid/House/EV                |

(1) The typical period that the technology can maintain its rated output from a fully charged state.

(2) The proportion of the energy used to charge the device that can will be returned to the system.

(3) EV = Electric vehicle

(4) UPS = Uninterruptible Power Supply

(Source: All data sourced from “Pathways for energy storage in the UK”—Centre for Low Carbon Futures)

## Written evidence submitted by the Environment Agency

## SUMMARY

The Government’s Severn Tidal Power (STP) Feasibility Study presented a thorough assessment of the issues of developing tidal energy in the Severn Estuary. Its conclusions on the environmental impact of a Severn Barrage are still valid and we believe merit full consideration by the Select Committee Inquiry.

The Environment Agency supports the development of appropriate energy schemes in the Severn Estuary and elsewhere to help secure the reduction in greenhouse gas emissions required to cut UK emissions by at least 80% from the 1990 level by 2050.

Any proposal must be designed and operated to minimise the adverse impacts on people and the environment. Key to this are:

- Considering, the specific needs of, and mitigating the impacts on, species and habitats in the estuary; and

- Reducing the exposure of communities to flood risk.

Compliance with the Habitats Directive, with respect to migratory fish and inter-tidal habitats, is probably the most difficult challenge for a proposed Severn Barrage.

We are keen to work with Governments and developers to help identify a project that can generate the maximum sustainable energy from the Severn Estuary whilst meeting the necessary environmental protection identified in legislation.

## 1. INTRODUCTION

The Environment Agency is the Government's principal environmental regulator and advisor in England and Wales. We play a major role in the sustainable management and protection of estuaries. This includes regulating the abstraction of water and managing migratory fish, flood and coastal erosion risk, and water quality. We also support progress towards a low carbon economy through our regulatory and advisory work.

The Government's Severn Tidal Power (STP) Feasibility Study presented a detailed and thorough assessment of all aspects of developing energy schemes in the Severn Estuary. We contributed to this work. We believe the conclusions in the report on the environmental impact of a Severn Barrage are still valid and merit full consideration by the Select Committee.

We are aware of media reports of a proposal by Hafren Power for a barrage from Cardiff to Weston-super-Mare. We have not seen details of this proposal. As such our comments here are limited to consideration of a generic barrage from Cardiff to Weston, similar to the one considered in the Government report.

## 2. *What contribution could the Cardiff-Weston Barrage make to UK energy security and climate change objectives?*

The Committee on Climate Change has advised that electricity generation must be nearly fully decarbonised by the 2030s if the UK is to meet its carbon budgets and its commitment under the Climate Change Act to cut greenhouse gas emissions by at least 80% from the 1990 level by 2050. We support the development of appropriate energy schemes in the Severn Estuary and elsewhere to help secure the reduction in greenhouse gas emissions required by 2050 and beyond.

Given its particular tidal movement, the Severn Estuary offers clear potential for the development of renewable energy. However the Severn Estuary is also a unique natural environment, with some of its habitats and tributary estuaries being among the most important of their kind and highly protected in Europe. Given the potential impacts on the environment, any proposal must be designed and operated to minimise these impacts. Government must make sure that any energy development in the Severn Estuary is justified by its contribution to greenhouse gas reduction and energy security, taking full account of the environmental impacts.

We will continue to work with Governments and developers to help identify a project that can generate the maximum sustainable energy from the Severn Estuary while meeting the requirements of environmental legislation.

## 3. *What risks and opportunities could it pose with regard to flooding in the Severn Estuary, and how might any risks be mitigated?*

The flood risk consequences of any structure that might be developed in the estuary depend very much on its design, construction, location and mode of operation.

The Government report identified that water levels would be affected and that to maintain current flood protection levels in the Severn Estuary, additional flood defences would be required.

Some of the possible impacts would be:

- Potential upstream protection from storm surge and tidal flood risk;
- Potential to erode existing flood defences upstream of a barrage;
- Potential to increase the upstream flood risk due to gravity discharge from rivers and drains being prevented ("tide-locking"); and
- Potential increase in coastal flood risk around Wales, North Devon and Ireland from a Severn Barrage.

The management of flood risk must be key in any design. In line with our approach to other developments, we believe there should be no increase in flood risk as a result of a Severn tidal energy scheme.

The total cost of capital works to manage the flood risk for the Severn Estuary communities for the next 100 years is estimated at £600 million, with a Present Value cost of £156 million. This will safeguard 62,700 existing residential properties and 24,800 existing non-residential properties.

If a barrage were constructed, some of these costs would be avoided as the extreme tidal surges would not reach the upper estuary. However, very significant additional costs would be created to manage the effects of



a barrage, to address, for example, erosion caused by a higher water table upstream, and to deal with “tide-locking”. A barrage would not protect all the properties that currently receive protection from flood defences. In addition, as a result of a barrage, there would also be potential costs from the downstream and “far-field” effects, for example increasing water levels on the Welsh and Irish coasts.

Our initial assessment is that over 100 years the overall impact on flood risk management costs may be neutral, although further work is required to understand the effects on coastal regions far from the Severn. We believe additional flood mitigation measures should be included in the scheme.

*4. What risks and opportunities could it pose to wildlife and habitat in the Severn Estuary, and how might any risks be mitigated?*

The Severn Estuary is a unique environment and its habitats and species are protected under national, European and international law. A barrage would result in irreversible changes to the ecology of the estuary.

Of all the options considered, the Government report clearly highlighted that a Cardiff-Weston barrage would have the greatest impact on habitats and bird populations. Of particular concern to the Environment Agency is the impact on migratory fish, an issue for which the Environment Agency is responsible in England and Wales. From media reports, we understand that Hafren Power believe their scheme to be “fish-friendly”. We have many years of experience in this area and employ some of the leading experts in the country. We are not aware of any turbine designs which would allow the safe, repeated passage of fish through a barrage at the scale proposed.

The Government report examined the issue of fish migration in detail and recognised that fish would be severely affected with population collapses predicted for species which are protected under law. Indeed, the Government report predicted local extinctions of Atlantic salmon and twaite shad as a result of a Severn tidal scheme.

To mitigate risk, we think more detailed baseline monitoring of the estuary is required to understand the distributions of species and habitats. In particular, further study of fish behaviour and movement within the estuary is essential. If a scheme were to go ahead, it is vital that its environmental impact is monitored.

*5. What lessons can be learned from the successful development of La Rance tidal barrage in France and other tidal power projects?*

From an environmental perspective, there are only very limited lessons that can be learned from La Rance. This is due to three principal reasons:

- La Rance and the Severn are different in nature: they are of a different scale, have different ecologies and support different habitats and species;
- La Rance and the Severn have different protections under law; and
- There is a lack of baseline environmental data to understand the impact of the La Rance barrage.

*6. What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular, what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

The Government report highlighted that benefits to the local economy would come at the expense of negative impacts on the current ports and the fishing and aggregate extraction industries in the estuary.

We understand Bristol Port has had their Harbour Revision Order for their new container terminal approved since the Government report concluded. There are considerable implications for the viability of this scheme if the barrage were to be built.

*7. Are the proposals in breach of EU legislation, and if so how will this be addressed?*

There are two pieces of European Union environmental legislation that would be key in the development of a Severn Barrage: the Habitats Directive and the Water Framework Directive.

Compliance with the Habitats Directive, with respect to migratory fish and inter-tidal habitats, is probably the most difficult challenge for a proposed Severn Barrage. The Government report made good progress in understanding the complexity of the issues in relation to the Habitats Directive. It acknowledged, however, that the scale and impact of a scheme would be unprecedented in a protected area and that there was significant uncertainty on how the regulatory framework would apply.

The Habitats Directive does allow for designated sites to be damaged for imperative reasons of overriding public interest if there are no alternative solutions to the projects. In our experience, these tests can be very difficult and time consuming to apply and may in themselves represent a significant stumbling block. This justification does not remove the need to compensate for damage, which is a prerequisite for any project relying on imperative reasons of overriding public interest to proceed. The Habitats Directive does not stipulate how to provide compensation. However, this is normally done by replacing the protected habitats affected on a “like for like” basis as close as possible to the location of the negative impact.

The report acknowledged that the compensation requirement under the Habitats Directive for projects of this nature would be very challenging but failed to arrive at a mechanism to manage this. It may prove impossible to compensate for any residual damage to fish populations, particularly those using the tributary rivers as spawning areas.

The scale of potential inter-tidal habitat loss will make it very difficult to identify and develop adequate sites for compensation. The Government report identified that a Cardiff-Weston barrage would result in a loss of up to 16,300 hectares of habitat. This, it noted, could require compensation 60 times greater than the largest existing UK compensation scheme.

Moreover, given the scale of the compensatory habitat required, it is unlikely that this could be accommodated within the Severn Estuary. The compensatory habitat areas may consequently be some considerable distance away. The creation of new intertidal habitats may in itself be as controversial as building a barrage.

The report also recognised that land change will be required within the Severn Estuary and probably outside it also. Our experience of managed coastal realignment projects suggests that practical delivery will prove very difficult, contentious and time consuming.

The Water Framework Directive aims to protect and improve the water environment. As required under the Directive, we are undertaking an ambitious programme of work to improve the River Severn and other river basins. The operator of any future barrage would have to ensure that the scheme does not lead to deterioration of the ecology of the River Severn and the rivers and aquifers in the catchment.

There are defences in the Water Framework Directive (Article 4.7) to permit development that causes deterioration, provided the following conditions are met:

- All practical steps are taken to mitigate the adverse effect on the status of the body of water;
- The reasons are explained in the River Basin Management Plans; and
- The reasons for permitting the development are of overriding public interest and/or the benefits to the environment and to society (of achieving the Directive's objectives) are outweighed by benefits to:
  - sustainable development;
  - human health; and
  - maintaining human safety; and
- The benefits of the development cannot (for reasons of technical feasibility or disproportionate cost) be achieved by significantly better environmental options.

*8. Are any other proposals for tidal power projects in the Severn Estuary currently under consideration?*

We are not aware of other tidal projects coming forward in the Severn Estuary.

*9. What could be the wider international implications of the scheme for UK engineering and UK low-carbon industry?*

We welcome Government's commitment to technological innovation in the tidal energy sector. There is a real opportunity for the UK to lead the world in the development of innovative tidal and wave energy technologies, supporting the delivery of the UK's renewable energy targets and creating green jobs and investment.

**10. CONCLUSIONS**

Given the potential impact of a barrage, the Environment Agency is keen to work with developers to help them understand the environmental and flood risk issues associated with their proposal.

We are also keen to work with the Department of Energy and Climate Change, the Department for Environment, Food and Rural Affairs, the Welsh Government, the Marine Management Organisation and other statutory agencies on the development of guidance and offer expertise where we can.

*December 2012*

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## Written evidence submitted by Wildfowl and Wetlands Trust

### EXECUTIVE SUMMARY

1. In 2010 WWT submitted a final response to the DECC consultation on options for a Severn Tidal Power project in the Severn Estuary. This stated that, from the five favoured schemes, the then proposed Cardiff Western Barrage was unacceptable from at least the perspective of its impacts on wildlife. Questions also remained regarding the suitability of some of the other schemes proposed at the time (the two other barrages, and the two lagoon options). We supported the view that there was no case for Government investing in a scheme at that time and that it was appropriate to wait until 2015 to review the situation. We welcomed the prospect of a future review which could incorporate further analysis of, in particular, more innovative and potentially less environmentally damaging schemes such as those considered through the Severn Embryonic Technology schemes (SETs). We remain supportive of the search for renewable energy schemes within the estuary and agree that the location lends itself to the search.

2. Many issues, some of which remain unresolved, were raised regarding the acceptability of a large Cardiff-Western scheme; the unpopular prospect of Government being required to provide financial support for such a scheme was just one of them. As far as we can determine given the information available, very little has changed since the findings of the previous feasibility study. We have not yet had sufficient insight into the apparently reconfigured scheme design to reasonably comment on whether it has dealt with any of the previously identified barriers. We do not therefore propose to speculate as to the merits or otherwise of this new scheme. However, we have provided some initial comments based on information gleaned from meetings with the company.

3. We recommend that the impacts of the current proposal be properly and independently assessed before Government takes any decisions or promotes or supports the scheme in any way. We believe that a framework is required that requires that environmental damage is reduced as far as possible; prioritises schemes whose environmental impacts can be mitigated for in a clear and appropriate way; duly considers all possible options. It is important that this is allowed to happen at a suitable time according to the “triggers” associated with reviewing the situation, as detailed in the STPF study.

### COMMUNICATIONS

4. As far as we can ascertain, there is no clear “communication plan” relating to the current proposal. We consider it important that engagement and communication extend as soon as possible to the broader community, especially the residents and businesses who live around the estuary and are most likely to be directly impacted by such a scheme. The company’s website provides insufficient detailed information to fully inform views on the proposal and the Government/DECC website, which formerly hosted the detailed outputs from the STPF study, is no longer functioning. We have been unable to find sufficient detail of the current proposal, eg specific landing sites and exact turbine design.

5. We believe that balanced and informed decision making requires that the full range of options that could be deployed within the estuary be considered simultaneously. All of their associated impacts should be clarified, and communicated clearly to all stakeholders including the general public. Once the detail of the current proposal has been independently assessed, it should then be presented and evaluated alongside other emerging technologies and energy management options. It appears that the current proposal is being presented as the only viable and feasible option on offer, and we disagree with this approach.

We also have some concerns regarding the detail of how the current proposal is being communicated. For example:

- *“Fish friendly”*. While there are many promising technological advances with regards to turbine designs that reduce fish mortality, especially those now being deployed throughout rivers in the United States, we have yet to see any evidence that merits the liberal use of this term in relation to this scheme. Such turbines have yet to be tested or deployed in the UK, or tested in environments as extreme as the conditions found within the Severn Estuary, or on a range of species and life stages such as those found within the Severn Estuary. The use of new designs can only lead to uncertainties relating to power yields and costs of the project. We understand that the new design may have four times as many turbines as previous designs (over 1,000), which again leads us to question how the scheme can be called “fish friendly” without empirical evidence identifying the likely cumulative impacts both direct (eg death through collision with turbine blades and differential water pressures) and indirect (eg increased predation from, for example, seals).
- *“Environmentally benign”*. To merit this statement, it is necessary that the impacts of the scheme can be mitigated and compensated for within the realms of the law, both domestic and international. We agree that the new proposal would likely have fewer impacts on the wildlife of the estuary (in part due to the adoption of an ebb and flow design, and a lower head) than the previously proposed Cardiff Western barrage. However, to claim the scheme to be “environmentally benign” requires confidence that all damage can be adequately and appropriately compensated for. We have seen no evidence of this and until this has been confidently demonstrated we consider this term to be inappropriate and misleading.

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- “*A saviour for the estuaries wildlife*”. We are alarmed that claims are being made that a barrage of this nature is required in order to safeguard the wildlife of the estuary in light of sea level rise. Were the natural processes associated with the Severn Estuary disrupted by a large barrage, even if it were in part permeable and allowing ebb and flow tides, then the outlook of the wildlife it supports would become entirely dependent upon an inflexible and static defence system. We consider that the best long-term prospects for the wildlife for which the estuary is designated require management systems that can be adapted to changing sea level and work with, not against, the natural processes that have resulted in its unique ecology. In addition, although the wildlife complement of the estuary may change somewhat in response to climate change, it may become even more important as a refuge for species that require new climate space, moving on from elsewhere. Additionally, Government is already obliged to compensate for the impacts of climate change on intertidal and coastal habitats and species under the terms of the Birds and Habitats Directive. To this end, the Environment Agency has already delivered a number of compensatory schemes within the estuary (eg the Steart Peninsular Managed Realignment project managed by WWT, which will create 429 ha of habitat of which 324 ha will be intertidal habitat), and is actively looking for other opportunities to offset future losses. By 2025 there will be a loss of 639 ha of internationally designated intertidal habitat, which the Steart Peninsular Project is making the major contribution towards offsetting. A barrage to protect the wildlife is therefore not the answer to this problem. There is legal precedence and a procedure already underway in order to support a more sustainable way of safeguarding the estuaries wildlife. The message that a barrage is needed in order to protect wildlife is particularly confusing and misleading.
  - “*Cost neutral*”. The suggestion is that this scheme would be privately funded, and therefore of little burden to UK Government and tax payers. The reality is that a certain amount of financial risk associated with such a project would always need to be underpinned by Government. We know that electricity generation would be expensive from this scheme in comparison to other forms of technology, and that previous estimates of costs have needed to be repeatedly revised upwards. The previous feasibility study only scraped the surface in terms of identifying wider costs (in addition to benefits), and we have seen no evidence as yet of how these further impacts would be ameliorated, or whether the costs will also be covered by the private finances. There needs to be a full and transparent evaluation of costs before this or any scheme can be communicated as cost neutral.

#### IMPLICATIONS FOR WILDLIFE

6. The predicted impacts of a Cardiff-Western barrage on the wildlife and ecosystem of the Severn Estuary were immense compared with previous development projects in the UK. We appreciate that under the requirements of the Habitats Directive, significant development within a Natura 2000 site can take place under specific circumstances (eg imperative reasons of overriding public interest), but this has to be *sustainable development* which includes appropriate safeguards and compensation measures. We can only comment in detail in relation to the previous Cardiff-Western scheme design as insufficient information has been provided on the detail of the new scheme. The impacts associated with such a large barrage scheme were multi-faceted:

- Drastic reductions in populations of protected wetland birds including: circa 50% reduction in each of Wigeon, Teal, Pintail, Shoveler, Knot, Dunlin, Ruff, Curlew, and Redshank. It is not known how a Cardiff-Western barrage would affect species for which Slimbridge is particularly iconic, the European White-fronted Goose, and the Bewick swan, but impacts have been qualitatively assessed as negative. In total, a large barrage of this kind would adversely impact 30 species of birds. We have seen no evidence that impacts on all affected bird species can be confidently compensated for.
- Drastic reductions in the extent of intertidal habitat of around 45% (again, based on the design as promoted in 2008).
- Significant impacts on economically and ecologically important fish stocks, some of which are genetically distinct to the region including Salmon and Shad in rivers such as the Wye, Usk, Severn and Taff. It is thought that a Cardiff-Western barrage would totally eliminate populations of Shad. In addition, the Severn Estuary is one of the most important nursery ground for Eels, a species whose population has drastically plummeted of late, and which is now protected via a dedicated EU instrument.
- Significant loss of locally important habitats and nationally important biotopes including honey comb worm reefs and piddock-bored bedrock.
- Further likely impacts on: 25 Special Areas of Conservation (SACs), 231 Sites of Special Scientific Interest (SSSIs), 5 Ramsar sites, 22 National Nature Reserves (NNRs) and 44 Local Nature Reserves (LNRs) and the potential for impacts on a further 302 rare plant species and 20 mammals were also considered likely under a Cardiff-Western barrage scheme.

7. The reality of mitigating and compensating for the impacts of a Cardiff Western style proposal are compounded by:

- The sheer extent of compensation habitat required (over and above that which could be mitigated for within the project design), much of which would inevitably be sought outside of the confines of the Severn Estuary. A compensation ratio has not been suggested for this project, but similar (but much smaller schemes) have been required to deliver between 2.6:1 (Cardiff Bay) and 14.5:1 (TGV schemes in France). The upper figure of likely habitat damage from the previous Cardiff-Western is 163 sq kms.
- Functional habitat has to be in place before construction commences. This may take many years to locate and many further to develop into a functional state that target species can make use of. Although compensation habitat might be theoretically available on the east coast, this would not fulfil the same functions as the Severn Estuary.
- The inability to compensate for the full range of features found within the estuary, for which it is also designated eg the tidal range itself, and associated mudflat conditions.
- The inherent risks involved in delivering large scale compensation habitat, and in predicting the exact consequences of a large scheme on a still poorly understood ecosystem.
- The technical complexity involved (extensive land purchase/swaps, likely use of compulsory purchase) with securing appropriate compensatory habitat, and the long-term land management implications associated with delivery.
- The need to ensure acceptability of compensation schemes to local stakeholders, which is critically important.

8. Due to the large scale of impacts from a Cardiff-Western barrage, and even if it could account for many of the impacts detailed above, Government would almost certainly need to breach the Habitats Directive were it to proceed. This is due to a likely inability to secure sufficient compensation habitat, and impacts on fish populations that can probably not be legally compensated for. Investigations into the potential to re-interpret the EU Commission guidance detailing the responsibilities imposed on a Member State in order to deliver a “coherent network” of Natura 2000 sites have already been undertaken. Together with a number of other NGOs, WWT commissioned legal advice to determine whether such reinterpretations (known at the time as “equal value”) could be compliant with the Directive (this can be provided on request). The findings of this advice were unequivocal in reporting that such a concept—of delivering “alike”(similar wetland habitat types) but not the same type of habitat in compensation for damage, and of undertaking species conservation measures outside of the UK in compensation for damage particularly to fish stocks—did not meet the legal requirements of the Directive.

#### IMPLICATIONS FOR WWT

9. WWT was established on the shores of the Severn Estuary in 1946 by the late Sir Peter Scott. Our Slimbridge Wetland Centre is the headquarters for the entire organisation, which includes nine other wetland centres throughout the UK. We are a major tourist attraction in the region, welcoming in the region of 160,000 each year. A large barrage, such as a Cardiff-Western barrage would likely affect us in the following ways:

- A potential major reduction in the numbers of key wetland bird species visiting and utilising our wetland reserve, which is connected to the estuary.
- Implications for how we manage our wetland reserve—with the potential for increased salinity levels, and for damned water to back up into the reserve requiring pumping.
- Implications for the ability of our business to attract customers, offer educational experiences and experience close contact with nature. Many of our visitors come purely to see the wildlife that we attract, wildlife which makes use of both the estuary and our reserve and which would be affected by a large scheme. Although a large barrage could benefit some species that also visit our wetlands (in contrast to reducing the populations of around 30 species) the species that would benefit (eg Common Gull) are not those which our visitors typically seek out and for which we are famous (eg Bewick Swan).

10. The ramifications of a large destructive scheme on Sir Peter Scott’s legacy and all who cherish it have not been quantified. We estimate that many land managers and businesses around the estuary would be affected in similar ways to our Slimbridge centre, and these impacts should be identified, quantified and compensated for.

#### OTHER ENERGY GENERATION OPTIONS IN THE SEVERN ESTUARY

11. The STPF study considered a number of alternative options for energy generation in the estuary, investigating some particularly interesting and innovative ones including a tidal fence scheme, explored via the SETs. It concluded that these schemes had merit, but required much more development to increase confidence that they would be both effective and commercially viable. The STPF study also concluded that one of the lagoon schemes was technically feasibility, the Bridgewater Bay option. Low head barrages have also been considered in the past, and we understand that the current proposal may be of a low head design. The impacts

of low head barrages have not yet been sufficiently explored or modelled, especially in a UK context, and so extensive work would be required to understand the impacts. There is potential to explore tidal stream technology devices, in addition to other locations for the deployment of lagoons. “Tidal Lagoon Power” are currently investigating installing a lagoon near Swansea to generate power. Were this to be successful, up to five other sites on the Severn could potentially accommodate lagoons, producing up to 2GW per site. Free standing tidal turbines offer potential, as does further exploration of tidal fence options which access (largely) tidal stream energy and may have significantly less impact on wildlife while also allowing compatibility with the deployment of other technologies such as lagoons. There may also be scope to harvest energy via the deployment of wave energy devices, but these prospects seem least developed. VerdErg’s proposal for a scheme in the estuary developed under the SETs offered a form of technology that contained no direct turbines and promised a much reduced impact on intertidal habitat. Such a design is actively being considered in the Solway. However, this may possibly have continued to have adverse impacts on fish due to pressure effects on swim bladders and we do not know whether this impact has been or could be overcome.

12. In summary we would conclude that many interesting forms of technology and means to generate electricity from the estuary exist, or are under development. Many of these have the potential for either few or manageable impacts on the natural environment and could be sequenced in delivery to maximise energy generation and reduce risks if deployed holistically. We do not consider it necessary or appropriate to opt for a scheme which would cause significant environmental damage and reduce the options for more natural adaptive management of the estuary in response to climate change. We believe that all options for energy generation from the estuary, along with their cumulative environmental, social and economic costs and benefits, should be evaluated.

#### OTHER EXAMPLES TO LEARN FROM

13. We believe there is significant merit in incorporating lessons from the development of barrage technologies elsewhere across the world, for example in France, Canada and in South Korea. In both La Rance and the Bay of Fundy small-scale barrage technology has been deployed, however environmental concerns have led to no further deployments. These concerns include shoreline erosion, concentration of pollutants, and trapping instances of large mammals. WWT recently hosted a representative from the South Korean Government for two years, to compare and contrast approaches to tidal barrage technologies between the two countries. We would be happy to provide further details of the findings of this work.

*December 2012*

#### Written evidence submitted by The Bristol Port Company

##### EXECUTIVE SUMMARY

A. This Inquiry comes just two years since the Government’s comprehensive examination of Severn Tidal Power (“DECC Study”) rejected the option of a fixed Cardiff-Weston barrage on economic and environmental grounds.

B. In correspondence, the Committee Chairman revealed that this Inquiry seeks to shed light on the unpublished proposal to build a fixed barrage by a dormant and under-capitalised company called Hafren Power Limited (“HP”).

C. HP’s public statements are already significantly damaging The Bristol Port Company’s (“Bristol Port”) business, customer confidence and hundreds of millions of pounds of fully consented investments.

D. The Severn Estuary (“Estuary”) is an extraordinarily dynamic marine environment and its conservation value is protected by multiple designations under European and national law. A barrage would transmute the Estuary and cause environmental damage on an unprecedented scale, with loss of protected habitats, birds and designated fish species.

E. The HP proposal would also alter water levels and cause erosion and subsequent siltation, constraining access to the Port even more severely than the Cardiff-Weston barrage that was the subject of the Government’s 2010 report.

F. The barrage would not provide a net benefit to the economy. Any temporary gain from construction employment opportunities would not outweigh the significant value lost from the permanent damage to ports and associated businesses.

G. Bristol Port submits that the Committee should conclude that any proposal to build a fixed barrage across the Estuary should be rejected as it would cause exceptional environmental damage and have severe adverse economic consequences which could include closure of Bristol Port.

H. Bristol Port supports the exploitation of the Estuary’s extraordinary power to generate energy. However, a fixed barrage across the Estuary offers the worst possible solution. Alternative generating technologies are lower risk, scalable and would neither cause catastrophic environmental damage nor result in potential closure of the Port. Many of the alternative technologies have applications that offer significant potential to export

world-class expertise; the export opportunities for barrage technology are extremely limited. The Committee should recommend a detailed evaluation of alternative renewable energy solutions that could together provide comparable generating capacity without such adverse environmental and economic impacts.

I. Consent to develop any large-scale generating capacity in the Estuary should follow the agree procedure for nationally significant infrastructure projects (NSIPs) and not, via a Hybrid Bill, escape the rigorous and proper public scrutiny to which other major projects are subject.

## INTRODUCTION

1. The Committee's Terms of Reference refer to "the company" and the Committee's Chairman has identified in correspondence that this Inquiry is investigating a vague aspiration to build a Cardiff-Weston barrage put forward by Hafren Power, a dormant private company. HP has not published any detail about its plans which it has described in correspondence as "inchoate".<sup>29</sup> It seems incredible to Bristol Port to be commenting on a proposal for which no details are available.

2. Bristol Port is surprised by HP's promotion of a proposed Cardiff-Weston barrage so soon after a similar proposal was rigorously tested at significant cost to the Government and many stakeholders.

3. The Committee needs to know that the existence of its Inquiry, together with HP's media campaign, is blighting Bristol Port's existing trade, colouring third party decisions to invest in major new infrastructure at the Port and requiring the Port to expend significant time and resources, including commissioning expert reports to provide the Committee with relevant information.

4. The lack of any detailed proposal from HP means that, unless stated otherwise, this evidence relates to any proposal for a fixed barrage across the Estuary.

5. Bristol Port reserves its position generally and requests a right of response to evidence which may be submitted to the Committee.

## ABOUT THE BRISTOL PORT COMPANY

6. In 1990, the Port, owned by Bristol City Council, was losing c £10 million per annum and costing each Bristol ratepayer c £30 annually in subsidising the losses. There was a real chance that the Port would close. First Corporate Shipping purchased the Port from the Council in 1991 and initiated a regeneration process that resulted in it becoming a profitable, successful enterprise, trebling cargo flows and giving productive employment to over 500 people directly and 7,000 indirectly.

7. With over £450 million invested since 1991, Bristol Port is the only fully-equipped multi-user dry bulk commodities port south of Immingham, Lincolnshire, capable of handling bulk carriers of 130,000dwt. Cargo owners rely upon its capability to accept very large deep-draught ships to import strategic materials at economic rates. In the last year alone Bristol Port has discharged 6.6 million tonnes of cargo from vessels over 70,000dwt.

8. Bristol Port is strategically located close to the major population centres of the UK; it is the only UK deep-water port with direct access to North, South, East and West on both motorway and railway networks.

9. Bristol Port handles a wide range of nationally significant cargoes including:

- the second largest steam coal import facility in the UK;
- 27% of the UK's imported aviation spirit;
- 22% of total UK animal feed imports; and
- the leading UK port for deep-sea motor vehicle imports and a major exporter for UK manufactured vehicles including Jaguar Land Rover, JCB, GM, Honda and Toyota.

10. Full consent has been granted and preliminary work is underway for three nationally significant investments with combined value of £1.2 billion—a £600 million Deep Sea Container Terminal and two biomass power stations. These developments depend upon Bristol Port's ability to accommodate deep-draught ships, its efficient cargo handling ability and first class inland infrastructure links.

11. Bristol Port is a statutory harbour authority, responsible for the safety of shipping and the provision of port facilities, and also the competent harbour authority for pilotage within its area of jurisdiction. It has a statutory duty to protect the Estuary environment that falls within its Statutory Harbour Area.<sup>30</sup>

12. Bristol Port has unique expertise in the Estuary's environment and in implementing national and EU legislation here. As the principal provider of hydrographic surveys in the Estuary, Bristol Port possesses both extensive data on, and expertise in, changes in the shape of main navigation channels. Its engineers are experts in maintaining vital equipment subject daily to the harsh and highly abrasive conditions in the Estuary.

<sup>29</sup> Appendix A—Letter from Hafren Power (5 November 2012).

<sup>30</sup> See map at Appendix B.

#### KEY IMPACTS ON THE PORT

13. The Estuary's location, size and funnel-shape combine to generate exceptional tides rising up to 14m in six hours. The resulting strong tidal streams mould the Estuary's extensive tidal flats, scour the deep-water channels and entrain millions of tonnes of mud and sand in the water column which are re-deposited at slack water.

14. A barrage would affect those characteristics and adversely interfere with navigation to and from the Port as listed below:

##### *Water levels upstream of a barrage would be reduced*

14.1 Ships navigate largely deep-water channels between extensive sandbanks in the Estuary, which in the approaches close to the Port become narrower and shallower.

14.2 Having examined the DECC Study in detail Bristol Port concluded that the depth of water upstream of a barrage would be reduced by up to 2m with lower high-water and increased siltation.

14.3 This reduction in available water would make it impossible for deep-draught ships to enter/exit the Port on 80% of tides. This would make the Port realistically unviable for vessels over 70,000dwt without substantial works in dredging and new locks.

14.4 New proposals for ebb and flood generation would reduce high-water levels even further<sup>31</sup> with over 2m less depth at high-water making the situation for the Port worse.

##### *Siltation would significantly increase the need for maintenance dredging*

14.5 To keep the Port open, Bristol Port dredges five metres annually from its entrances where water is slowed. The DECC Study concluded that a barrage would cause siltation firstly by sediment dropping out of suspension (up to 2m) and secondly by erosion from inter-tidal areas to the deeper (currently self-scouring) navigation channels, continually making them shallower. The shape and position of the Estuary's sandbanks would also change, with serious adverse impacts on navigation. Ongoing dredging would be needed in order to maintain access by deep-draught ships to the Port. Arrangements would have to be made to dispose of an estimated 20m tonnes of mud annually just to keep shipping channels clear; further accumulations of mud in the vicinity of turbines would dramatically impact on their effectiveness.

##### *Delay and extra cost of transiting barrage locks*

14.6 Ships currently using the Port pass through its locks, attracting each-way costs which include 40 minutes of ship time, tugs, line handlers and traffic control. Any barrage would have to include deep-water channel locks to facilitate shipping movements, at least doubling these costs. This would be highly significant for ship/cargo owners and severely impair Bristol Port's competitive advantages resulting in the loss of significant revenues.

14.7 The downstream approach to any barrage would be significantly more hostile for shipping as the deflected rising tide surge would cause significant turbulence. To ensure vessel safety, any barrage design would have to include lead-in jetties and associated marine infrastructure.

14.8 Barrage lock design and size would have to be future-proofed to accommodate the increasing size (draught, length and beam) of deep-sea ships. During the DECC Study, DECC confirmed that any barrage built downstream of the Port would include at least two locks, with indicative dimensions of 500m length, 70m width and 18.4m draught. A single lock in the barrage would be wholly unacceptable.

14.9 Provision would need to be made to secure and fund the future management of the operation and maintenance of the barrage locks, associated infrastructure and the provision and maintenance of new navigation channels.

14.10 If a barrage design included superimposed road or rail systems, the structure would also need to be future-proofed to facilitate the unrestricted passage of very large ships under them.

##### *The Port's locks would need to be deepened or replaced*

14.11 The reduced depth of water upstream of any barrage means that the Port's existing entrance locks would have to be deepened. This would involve lowering the lock sills, new lock gates, dredging the approach channel and substantial works on the approach jetties. This would necessitate closing the Port for a prolonged period which would dislocate trade, much of which would never return.

15. The combined impacts of the barrage would be severe and incapable of mitigation, with the result that the Port could be forced to close.

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<sup>31</sup> HP Presentations indicate that new barrage proposals generating on both the ebb and flood would reduce high tide water levels by around 1.4m greater than the previous ebb-only barrage (Prof Falconer, Halcrow Professor of Water Management, Cardiff University 16 October 2012).



## KEY ECONOMIC IMPACTS

16. The DECC Study included the detailed, peer-reviewed socio-economic impact assessment study produced by the Welsh Assembly Government (2010). A review of this study and its relationship to HP's claimed 50,000<sup>32</sup> jobs that might be created is attached.<sup>33</sup>

17. In summary this concludes that claims in presentations by Professor Brian Morgan<sup>34</sup> on the economic benefits of HP's barrage are spurious and contrary to previous detailed studies as follows:

17.1 There would be no overall gain for the economy as the temporary economic benefit from the construction of the barrage approximates to the value lost from the closure of ports and damage to associated businesses;

17.2 The majority of the capital expenditure would leak outside Wales and the South West as those areas would not be able to supply all the materials, caissons, machinery and man-power for the project;

17.3 The barrage is predicted to cause a minimum loss of 900 direct jobs in ports in the operating phase whilst creating around 1,000 operational jobs—a net gain of only 100 jobs from which small gain other job losses from port-related businesses need to be subtracted;

17.4 The fishing industry of the Estuary and its tributaries would collapse in Wales and the South West with a loss of 60 jobs; and

17.5 Around 180 jobs would be lost in the nationally strategically important marine aggregates industry. The cost of construction projects in the North West and South Wales would rise as they are dependent on marine-dredged sand from the Estuary.

17.6 Hafren hope to provide 5% of UK electricity. The comparative capital cost of providing this power (2,700 megawatts at 85% load factor at 2010 prices) is:

|                |                |
|----------------|----------------|
| Severn Barrage | £25–35 billion |
| Nuclear        | £7 billion     |
| Coal           | £4 billion     |
| Gas            | £1.65 billion  |

17.7 Whilst the promoter alleges that the barrage will be privately funded, they also indicate they require “Contracts for Difference” which, although it does not appear on the HMG balance sheet, is paid by the consumer and is therefore clearly a subsidy.

## ENVIRONMENT

18. The importance and conservation value of the wildlife and habitats of the Estuary are recognised in its multiple designations under international, European and national law including extensive areas of inter-tidal and sub-tidal habitat and the migratory bird and fish populations they support.

### *Negative effects*

19. The Estuary's sheer scale and extreme dynamic physical environment shapes its ecology and sets it apart from other UK and European estuaries. Any barrage would irreversibly alter those features and have long-term adverse ecological effects on an unprecedented scale. These include:

- loss of saltmarsh and mudflat through reduced inundation/lack of tidal exposure (up to 163,000ha);
- water levels downstream will be higher increasing the risk of flooding on the Somerset levels;
- immediate reduction in suspended sediments and deposition of up to 2m of sediment in the deep-water channels;
- ongoing erosion, leading to further loss and decline in quality, of inter-tidal habitats and continual deposition of sediments in sub-tidal areas over the long-term;<sup>35</sup>
- widespread smothering of habitat caused by sediment deposition, including the loss of designated sub-tidal *Sabellaria* reefs;
- reduction in the Estuary's carrying capacity for birds resulting in a significant decline in up to 30 bird species;
- decline in designated migratory fish populations, with up to seven SAC fish populations at risk of extinction/collapse; and
- consequential adverse effects on the integrity of the Severn Estuary SAC/SPA, the Rivers Wye and Usk SACs and up to 16 other SACs.

<sup>32</sup> *Bristol Post* cutting at Appendix C (2 November 2012).

<sup>33</sup> See Appendix D—Severn Tidal Power: Cardiff-Weston Socio-Economic Impacts.

<sup>34</sup> Professor Brian Morgan is a Member of Hafren Power's Regional Board. His presentation (“The Economic Potential of the Severn Barrage”) was delivered at Cardiff Metropolitan University on 16 October 2012.

<sup>35</sup> In relation to geomorphological changes in the Estuary following construction of a barrage, long-term can be defined as a period greater than the life of the barrage and possibly exceeding 1,500 years

20. An initial analysis of HP's barrage proposals<sup>36</sup> describes the process of change, focusing on the Estuary's morphological response to a barrage and the associated impacts on habitats and wildlife drawing on comparable examples worldwide.

21. The Estuary is also an area of major archaeological importance<sup>37</sup> which would be vulnerable to being lost or destroyed by changes in the intertidal zone.

#### *Mitigation*

22. Bristol Port is aware of recent assertions that environmental risks associated with HP's barrage may be reduced using different technology, such as two-way generation and "fish-friendly" low-head turbines. However, no evidence exists to demonstrate that proposed mitigation measures will genuinely reduce impacts. Extensive study, modelling and turbine trials are required to test generating efficiency and reductions in fish morbidity.

23. Similarly, HP's claims that siltation impacts with two-way generation would be insignificant lack all credibility. Changes to estuary geomorphology and sediment processes could be just as damaging as the ebb-only barrage and must be thoroughly assessed. The Estuary's sediment transport systems are so complex that it is not possible to predict post-barrage geomorphological change with certainty. The risk of disastrous unintended consequences is unacceptably high.

#### *Development consent*

24. The scale of damage means that any barrage proposal would need to overcome significant issues before obtaining consent, including the requirements of the Habitats Directive. Those issues include consideration of alternatives and provision of compensatory habitats.

25. Bristol Port has significant experience of complying with those requirements—most recently with its successful application to develop a new £600 million Deep Sea Container Terminal. Its approach to mitigation and compensation has been recognised as an example of best practice by Natural England and the RSPB.

#### *Compensation*

26. EU law requires the creation of comparable inter-tidal habitats in the Estuary or other UK/EU estuaries to compensate for habitat loss. Adjusting for HP's error,<sup>38</sup> HP estimate that 5,000ha of compensation would be required. This is more than three times the total inter-tidal habitat created in all UK managed realignments to date and is greater than anything attempted elsewhere in Europe.

27. The compensation requirement is likely to be much greater than initial estimates, requiring an unfeasible number of large managed realignment sites, probably in several UK estuaries, each of which must be acquired, assessed and consented separately. There are no means of mitigating the impacts of a barrage to an acceptable level that can realistically be compensated for in accordance with the Habitats Directive.<sup>39</sup>

28. The Committee should note that some impacts of a barrage cannot be compensated fully (including loss of an extreme hyper-tidal estuary, *Sabellaria* reefs and Twaite shad and sustainable intertidal mudflats required for certain migratory birds, such as Dunlin).

#### LA RANCE AND OTHER BARRAGE SCHEMES

29. Very few tidal barrages have been built, all are of a much smaller scale than the Severn and all that have been studied have been shown to have created environmental damage.<sup>40</sup>

30. La Rance is not a safe comparison site: it is an effectively silt-free rocky-ria with largely fluvial influence and bears no similarities to the Estuary.

31. The Eastern Scheldt site in the Netherlands is an extensive semi-permeable tidal surge barrier built in 1987. As a dynamic estuary with high sediment loads and a largely marine influence it is a reliable comparator to the Estuary.

32. Very significant, on-going erosion problems have been caused by the Eastern Scheldt barrier:<sup>41</sup> intertidal habitats are predicted to halve by 2050 and around 86% of the original habitat will be lost by 2100. Erosion is causing the bird population to plummet—the oystercatcher population has already halved in less than 20 years—and undermining the flood defences the barrier was designed to protect.

<sup>36</sup> See Appendix E—Preliminary Analysis of Hafren Power proposal to construct a Tidal Barrage (Roger Morris, 29 November 2012).

<sup>37</sup> Bell, M. *British Archaeology* (July/August 2008).

<sup>38</sup> HP presentations indicate a habitat loss and compensation requirement of 5km<sup>2</sup> (Prof. Falconer, Cardiff University 16 October 2012). Bristol Port assumes this is a factual error as the same presentation stated the compensation land required in the DECC Study as 14km<sup>2</sup> when the true figure is 140km<sup>2</sup> or 14,000ha.

<sup>39</sup> Appendix F details the enormous scale and difficulties of delivering the required compensatory habitat.

<sup>40</sup> Appendix E and Appendix G provide details of the key schemes for which information is available.

<sup>41</sup> Van Zanten, E and Adriaanse, L A 2010. Sand Demand in the Oosterschelde, Rijkswaterstaat Report.

33. Sediments from the erosion of inter-tidal banks are being deposited in sub-tidal areas, resulting in shipping channels becoming narrower and shallower and sand bars being formed which require dredging. The problems in the Eastern Scheldt have not yet abated and Rijkswaterstaat<sup>42</sup> is currently funding a multi-million Euro study into possible measures to restore the estuary.

#### Other Tidal Power Projects

34. Feasible alternatives exist to a barrage including tidal range and tidal stream technologies. Any consent application for a barrage would by law have to consider whether alternative technologies are less damaging to the Estuary. The DECC study identified two feasible alternatives with considerably less impact.<sup>43</sup>

35. Regen SW's October 2012 report ("A Balanced Technology Approach") outlined how multiple technologies could be deployed in the Estuary in preference to the barrage to generate energy with far less damage to the environment and in balance with other marine uses. This combination of technologies would produce at least as much energy as the large barrage and generate power 24-hours a day (unlike a barrage which would require permanent back-up capacity). Bristol Port is actively involved in encouraging sustainable development of the Severn in this way.

#### CONSENTING PROCESS

36. HP has indicated that it may promote a Hybrid Bill to authorise the barrage. This would be wholly inappropriate as it would enable HP to evade rigorous scrutiny of this proposal despite its highly significant environmental and economic impacts. Having spent five years securing approval for its £600 million Deep Sea Container Terminal, Bristol Port cannot countenance a procedure which seeks to circumvent the process other businesses, which do not benefit from political patronage, have to go through.

37. The correct route would be for HP to seek development consent under the recently-streamlined planning process for NSIPs. That process would allow independent scrutiny of any proposal. It provides a transparent regime, requiring publication of a detailed proposal for public consultation at an early stage.

*December 2012*

### **Supplementary evidence submitted by The Bristol Port Company**

#### PRELIMINARY

1. This Supplementary Submission represents The Bristol Port Company's ("Bristol Port") response to the evidence lodged by Hafren Power ("HP"), and others, in two ways.

- First, it summarises—as best it can given the paucity of available detail about the barrage proposal—the likely adverse impacts the proposed barrage would have upon Bristol Port and thus on the regional and national economies and interests.
- Second, it responds to important errors and omissions in HP's submission to the Select Committee.

#### PART I: SUMMARY OF THE ADVERSE IMPACTS OF THE BARRAGE ON BRISTOL PORT

2. Bristol Port, in its first submission to this Select Committee, has already indicated that, whilst it ... "supports the exploitation of the Estuary's extraordinary power to generate energy ... a fixed barrage across the Estuary offers the worst possible solution" and that ... "any proposal to build a fixed barrage ... should be rejected as it would cause exceptional environmental damage and have severe economic consequences which could include closure of Bristol Port". The elements of adverse impact on the Port itself include:

- 2.1 The barrage is apparently to include two permanently available locks. Even assuming these were built sufficiently large, queuing for all traffic to and from upstream ports to use the locks plus the time spent approaching and transiting the locks would add a material time-penalty and delay for both existing and proposed traffic. In terms of trade for the existing Port this additional delay would be a seriously adverse factor. Put simply ships will seek other ports rather than face delay to use Bristol Port.
- 2.2 Additional time would be required for many vessels that would require tugs and pilotage; in adverse weather conditions, particularly downstream of the barrage, entry to and egress from the locks would be progressively more time consuming to the point of such manoeuvres becoming simply too hazardous in certain sea states.
- 2.3 In terms of the consented but yet to be built Bristol Deep Sea Container Terminal ("DSCT"), access for container vessels to the Port is intended to be free of any requirement to lock-in or out since such vessels would simply lie alongside in dredge pockets without need of locks.

<sup>42</sup> Rijkswaterstaat is the arm of the Dutch Ministry of Infrastructure and the Environment responsible for the design, construction, management and maintenance of the main infrastructure facilities including waterways.

<sup>43</sup> Including the Bridgwater Bay Lagoon, for which a 5–8% loss of designated habitat was predicted, in comparison to a Barrage's 50% loss.

Construction of the barrage—with lock-controlled access to and egress from the upper part of the Estuary—would introduce a substantial additional passage time and delay for these very large, Post-Panamax vessels using the DSCT, removing one of the key reasons for constructing this facility of strategic importance to the UK.

- 2.4 Point 2.1 above assumes that at least two locks would be built, available at all times and of sufficient size (in terms of beam, length overall, draught and air draught). Whilst HP have given vague indications that any locks would be sufficient to accommodate current vessels using the Port, Bristol Port is not aware of any precise proposed dimensions. Any such locks would have to be “future-proofed” in order that any increases in size of vessels plying their trade could also be accommodated. No such enforceable guarantees have been forthcoming. Significant questions about constructability and maintenance have likewise yet to be answered satisfactorily.
- 2.5 Similarly, there is the question of charges for any vessels using the barrage locks. In the absence of an enforceable guarantee in perpetuity that no such charges would be levied, the adverse impact is patent.
- 2.6 HP have as yet provided no adequate indication of how maintenance of the barrage as a whole, and of the locks (including permanent availability) in particular, is to be guaranteed. Nor of how the maintenance of new shipping channels is to be achieved.<sup>44</sup>
- 2.7 Crucially, HP have not explained how they will guarantee in perpetuity the operation and maintenance of the locks and their approaches; the provision of pilotage and vessel traffic services; and the management of commercial priorities for access to the locks by multiple vessels all requiring passage through the locks on the same tide.
- 2.8 The preceding impacts would be exacerbated by the barrage’s reduction of upstream water-depth by up to 2m with lower high-water and increased siltation. This would make it impossible for deep-draught vessels to enter or leave the Port on 80% of tides and would impact on the viability for handling vessels over 70,000dwt unless there were substantial works, including dredging and replacement of existing locks; such works would not only require further and substantial capital expenditure, they would also themselves potentially have adverse environmental impacts.
- 2.9 Increased siltation upstream of and referable to the barrage would materially increase the requirement for maintenance dredging adding further environmental and financial cost.<sup>45</sup>
- 2.10 The reduced water level upstream of the barrage would produce a requirement to deepen Bristol Port’s existing locks; this would involve a fundamental rebuild of those locks with significant disruption and at substantial cost. The business displaced by closure of the Port to carry out this work may never return.
- 2.11 Downstream of the barrage, the structure is highly likely to exacerbate local sea conditions. All the sea energy, currently dissipated along the full length of the Estuary, will hit the concrete barrage wall causing considerable turbulence immediately downstream. This would cause delays and significant extra costs for shipping and therefore further harm Bristol Port’s competitive position. It would also require the designation of a number of new, safe deep water anchorages to house delayed vessels for up to several days.
- 2.12 Bristol Port has excellent rail and road connections to its hinterland and the country as a whole. Through the recent granting of consent, without a public inquiry, for the DSCT, the national strategic importance of Bristol Port has very recently been recognised. The impact of the barrage on Bristol Port is a direct detriment to the UK’s strategic and economic interests. The suggestion which has apparently been made in parallel with the barrage proposal—namely of a new port in South Wales—perhaps reflects an implicit recognition of these adverse effects. Any port at Port Talbot would suffer from inadequate and materially inferior transport links, particularly rail, compared to those enjoyed by Bristol Port. Again, the UK’s interest would be harmed.
- 2.13 The adverse impacts of any job losses at Bristol Port are obvious, in terms of both direct and induced employment. As Bristol Port is an anchor company with a catalytic effect on a wide geographically area, the adverse impacts would be significant at regional and national level, in terms of both strategic and economic consequences.

<sup>44</sup> Any guarantee would have to provide adequate funding to ensure the continued operation and maintenance of the locks to an acceptable standard in the event of the barrage operator’s insolvency. In the latter situation, to protect the Port’s competitive position, priority operating and maintenance step-in rights would be needed in its favour. Even if the attendant costs were somehow funded by a guarantee mechanism, the long term nature of the obligations and the inherent insolvency risks mean that any guarantee would have to be underwritten by government.

<sup>45</sup> This financial cost would also have to be secured in perpetuity.

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PART II: ERRORS AND OMISSIONS IN HAFREN POWER'S WRITTEN SUBMISSION TO THE ENERGY AND CLIMATE CHANGE SELECT COMMITTEE (SEV70)

3. Bristol Port summarises below some of the more significant errors and omissions it has found in HP's written submission to the Energy and Climate Change Select Committee's Inquiry into the Severn Barrage. Bristol Port's silence on a particular point should not be taken as agreement with it.

4. HP's proposal is in places unrealistic and frequently presents only part of the full picture. In order for HP to be credible with a wide range of stakeholders, including Members of Parliament, it must present a complete, impartial assessment of the positive and negative impacts of its proposal; this it has failed to do.

5. The analysis below is divided into four sections:

- (A) Economic impacts.
- (B) Alternative technologies.
- (C) Environmental impacts.
- (D) Timescales.

6. The numbered quotation at the start of each sub-section (in bold) is taken directly from Hafren Power's submission to the Energy and Climate Change Select Committee's Inquiry into the Severn Barrage.

#### A ECONOMIC IMPACTS

7. ***"Construction of the barrage will employ at least 20,000 workers. The barrage project will induce or indirectly create another 30,000 jobs."***

7.1 The asserted economic benefit to the local area from constructing the barrage is central to HP's case for the barrage. These claims however fail under scrutiny. The 2012 report "Severn Tidal Power: Cardiff-Weston Socio-Economic Impact" (Bristol Port evidence Appendix D) summarises the output of the sound methodology used by the Welsh Assembly Government 2010 report Regional Economic Impacts Study, namely that around 76% of the economic benefit of the project would leak outside Wales and the South West. HP have presented no evidence to show how their scheme differs in this respect from the Cardiff-Weston barrage studied in the 2010 report or why such leakage would be any different for their proposal.

7.2 HP's submission is unrealistic in suggesting a benefit for Wales of 50,000 jobs. For example, HP have produced no evidence to support their claim that manufacturers would build turbine factories in Wales or the South West. Without confirmation of the intention of companies such as Rolls-Royce, often cited in presentations on the HP's scheme as a likely investor in these facilities, this claim is without foundation.

7.3 Furthermore HP have failed to take account of the impact on existing jobs. This omission can be contrasted with the methodology of the credible 2010 Economic Impacts Study which showed there would be considerable negative impacts amounting to a net loss of 80 jobs per annum once the barrage was operational.

7.4 As the DECC submission to this Committee noted:

"The STP study concluded that a barrage could benefit the regional economy with net value added to the economy and jobs created but that these would come at the expense of potential negative impacts on the current ports, fishing and aggregate extraction industries in the estuary."<sup>46</sup> (DECC)

8. ***"There should be minimum delay to shipping...The estuary will be dredged to ensure shipping lanes are kept open with minimal inconvenience to navigation. Hafren Power intends to minimise any impact on current business at ports upstream."***

8.1 The HP submission contains no understanding of the impact on shipping of the changes in water levels, navigation channels, dredging and associated disposal that the barrage would create. The 2010 study acknowledged these issues without being able to find solutions to them. As stated in Bristol Port's earlier evidence, there would be a substantial adverse impact on the Port caused by the barrage; as an example, the changes to water levels and siltation in navigation channels would result in vessels over 70,000dwt being unable to access the port on 80% of tides making the port effectively unviable. The prospect of temporary work during construction of the barrage and some role in maintenance once the barrage is operational and in the leisure sector in no way compensates for this loss of business.

8.2 HP merely asserts an intention to minimise impact on current business at ports upstream. This is wholly inadequate and reveals a lack of concern about the future of such nationally important infrastructure, which, in Bristol, includes one of the UK's most important ports. HP cannot simply ignore future port requirements. Shipping, vital to bringing in 95% of all imports to this island nation, has changed dramatically over the past 100 years and continues to change constantly to reflect global and local needs. As a 100+ year project, the barrage must take account of the changes likely to occur in shipping over at least that timescale.

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<sup>46</sup> Written evidence submitted by the Department of Energy and Climate Change  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/111>, paragraph 18

9. *“The barrage may help regenerate fishing in the area as has happened in La Rance. The increased photosynthesis and nutrients in the waters upstream of the barrage could stimulate to the creation of new mollusc and fish farming industries.”*

9.1 HP hypothesizes about regenerating fishing but in the case of La Rance, the waters surrounding the barrage were devoid of fish for 10 years after construction.<sup>47</sup> (EDF) When fish returned most of the indigenous fish species such as conger eels, flat fish and sand eels had disappeared. Jonathan White sums up the position at La Rance admirably in the concluding paragraph of his submission.

“The obvious difference between the Rance and the Severn is the scale of the rivers concerned and range of species affected. The Rance is a small river, which prior to the barrage did not have significant populations of migratory anadromous fish (salmon, sea trout, shad), with a comparatively small estuary. The rivers that flow into the Severn estuary, by contrast, cover a massive watershed, and are home, inter alia, to important populations of migratory salmonids, shad and eels.”<sup>48</sup>

9.2 The Angling Trust dramatically describes the acute risks to the fishing population through any interference with their habitat and they make it clear that:

“Estuaries are probably the most important habitats for fish and many of the species are already threatened by a host of other environmental challenges.”<sup>49</sup>

9.3 As DECC stated:

“The STP assessment noted that reductions in fish abundance would have adverse effects on commercial and recreational fisheries contributing to local economies. The assessment calculated commercial fisheries for salmon and juvenile and adult eel in the Severn catchment to be valued at £96,200, £299,000 and £36,000pa respectively in 2010, with recreational fisheries, particularly for salmon, valued at £28m. Sea angling is a major recreational activity in the Severn Estuary/Bristol channel: charter boat annual turnover was valued at c. £1m. These fisheries and related economic activity (eg local hospitality industry, fishing tackle retail) would be adversely affected by a barrage and likely to seek compensation.”<sup>50</sup> (DECC)

10. *“It will not require public money for construction... Since Hafren Power will fund the construction privately, the barrage will be highly affordable for the nation.”*

10.1 It is incorrect to portray this project as having no cost to the public. HP must reveal how much their project will cost energy consumers each year as the costs will be considerable in the first 30–40 years. As DECC’s submission to this Committee states:

“Although the capital for the Hafren Power proposal would be provided by private investors, the consortium has informed us that it would require revenue support via CfD in order to provide a suitable return for investors. Government would need to take a view as to whether the level requested represented value for money such that offering a CfD would be in line with the principle of decarbonisation whilst minimising the cost to consumers.”<sup>51</sup> (DECC)

“Any CfD funding would need to be value for money and considered against support for other low carbon technologies in the context of the Levy Control Framework.”<sup>52</sup> (DECC)

10.2 The RWE Npower Renewables Ltd submission states:

“The direct and indirect impacts of the Cardiff Weston Barrage on existing power generation and transmission require careful consideration. A scheme of this size would have requirements for major changes to grid and other infrastructure.... through the Levy Control Framework, the substantial size of this one scheme and its requirement for Government support mechanisms could significantly offset the development of other established renewable generation technologies. Therefore the direct investment benefit from this scheme is not as attractive as first presented. A spread of investment in a number of proven technologies, projects and development companies presents a lower risk profile and a cheaper option to the UK.”<sup>53</sup>

<sup>47</sup> Written evidence submitted by the EDF Energy  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/128>, paragraph 9

<sup>48</sup> Written evidence submitted by the Jonathan White  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/88>, executive summary, 7th bullet point

<sup>49</sup> Written evidence submitted by the Angling Trust  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/112>, paragraph 15

<sup>50</sup> Written evidence submitted by the Department of Energy and Climate Change  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/111>, paragraph 25

<sup>51</sup> Written evidence submitted by the Department of Energy and Climate Change  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/111>, paragraph 33

<sup>52</sup> Written evidence submitted by the Department of Energy and Climate Change  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/111>, paragraph 34

<sup>53</sup> Written evidence submitted by the RWE Npower Renewables Ltd  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/63>, paragraph 4 and 5

11. *"The barrage will defend 90,000 properties and 500km2 of flood plains from flooding. Government forecasts of coastal and tidal flood damage and defence costs in the Severn estuary over the next century range from £2bn to £15bn on a net present value basis. From 2023, when the barrage structure is complete, taxpayers would therefore save many hundreds of millions of pounds a year in flooding costs."*

11.1 This is a spurious, partial calculation. HP have apparently included only the aspects of flooding that are favourable to their proposal. They have omitted fluvial and pluvial flooding impacts (which have been experienced widely across the area in recent years and months) as well as downstream flooding impacts and the potential for the contamination of freshwater, all of which will be made worse by the barrage. Whilst the potential for a storm surge to cause damage needs to be taken into account, this cannot be to the exclusion of other highly significant, and very regular, flood events.

11.2 HP have also apparently not taken account of the negative impacts on existing flood defences upstream as a result of long-term erosion as evidenced in the Eastern Scheldt.

11.3 The Environment Agency's submission concludes:

"Our initial assessment is that over 100 years the overall impact on flood risk management costs may be neutral, although further work is required to understand the effects on coastal regions far from the Severn. We believe additional flood mitigation measures should be included in the scheme."<sup>54</sup> (Environment Agency)

11.4 Rather than the £2 billion–15 billion flood defence cost savings in the Severn Estuary over the next 100 years claimed by HP, the EA submission estimates total increased costs for the next century of £600 million, with a Present Value cost of £156 million. Claims that taxpayers would save many hundreds of millions of pounds a year in flooding costs would appear to be greatly exaggerated.

11.5 DECC's submission confirms that the "change in tidal regimes is likely to cause extensive foreshore erosion within the impounded areas of the Estuary, undermining the integrity of existing flood defences".<sup>55</sup> Hafren Power have not taken account of the very significant additional costs of addressing erosion problems and reinforcing and repairing existing flood defences over the long-term, as evidenced in the Eastern Scheldt where worse case estimates for additional investment in failing flood defences are up to €260 million over the next 50 years<sup>56</sup> (RSPB). This is an expensive problem for Government and tax payers to address post construction of a barrage.

11.6 The evidence from Parsons Brinckerhoff states:

"The change in the tidal regime in the impounded estuary has an adverse effect on evacuation of flood water and drainage systems during 'tide lock' conditions. For the Cardiff-Weston Barrage, specialists at Black & Veatch concluded that there would be an increased flood risk and/or impeded drainage affecting up to 372 km<sup>2</sup> of land, over 50,000 properties and 28 critical infrastructure assets. Whilst most of those adversely affected in this way would also benefit from the reduction in flood risk from extreme tide levels, the impeded drainage issue would occur many times a year, whereas the additional protection against extreme high tides would be beneficial on rare occasions."<sup>57</sup>

11.7 Further evidence on the impacts and costs of increased flood risks from the barrage has been presented to the Committee by, amongst others, the Severn Rivers Trust, Countryside Council for Wales, DECC, The Wildlife Trusts, Country Land and Business Association and the Natural Environment Research Council.

12. *"After construction, Hafren Power will consider converting the caisson casting basins into a port for ultra-large container ships."*

12.1 HP is correct that the UK will need increased container handling facilities with fast access to major markets, particularly the Midlands and South East. However they have omitted to carry out an assessment of demand which would have revealed that there is no demand for a ULC port at Port Talbot.

12.2 Cargo owners and shipping businesses are in a highly competitive market where the requirement to drive down the costs of inland transportation, avoid congestion, reduce CO<sub>2</sub> emissions and move to more sustainable modes of transport are highly significant. Put simply, Port Talbot is too far from the end destinations for inbound UK containers. If it was a suitable location it would already be under consideration by global investors. By contrast the fully consented Deep Sea Container Terminal at Bristol Port with its excellent road and rail links is ideally placed to reduce CO<sub>2</sub> and costs with its easy access to customers in the Midlands, Wales and much of Southern England.

<sup>54</sup> Written evidence submitted by the Environment Agency  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/95>, page 3

<sup>55</sup> Written evidence submitted by the Department of Energy and Climate Change  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/111> paragraph 10

<sup>56</sup> Written evidence submitted by The Royal Society for the Protection of Birds  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/101> Paragraph 5.7

<sup>57</sup> Written evidence submitted by Parsons Brinckerhoff  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/21>, paragraph 9

13. *"The UK would be able to export its expertise in turbine technology and barrage construction from here to many sites around the world."*

13.1 HP have omitted to include any evidence of demand for barrage construction around the world. The submission by DECC states:

"The export potential from a tidal barrage may be more limited as there are only relatively few sites around the world with the combination of features...to make a tidal barrage viable."<sup>58</sup>

13.2. Similarly, RWE Npower Renewables Ltd see very limited opportunities for exporting engineering skills. They point out that:

"the number of suitable international sites for tidal barrages are limited and all would require significant government funding. It is considered that export opportunities could be limited."<sup>59</sup>

14. *"The calmer estuary waters upstream of the barrage will encourage tourism and water sports."*

14.1 HP's evidence is contradictory. On the one hand it claims that the tides will not be very different from the current conditions (hence their claim for minimised impact on the environment and shipping) but on the other hand they seemingly claim lake-like conditions upstream of the barrage for leisure users. These statements cannot both be correct.

14.2 There will be a 10m difference between high and low water upstream of the barrage. With this 10m rise and fall happening twice a day, plus currents which have not been assessed, this will be far from a placid lake for leisure users. Take sailing for example. How will a small yacht return to its marina after a few hours sailing when the marina is behind locks up to 10 metres above the level of the Estuary? Comparisons to Lake Garda or the impounded area of Cardiff Bay are wholly misleading.

## B. ALTERNATIVE TECHNOLOGIES

15. *"To Hafren Power's knowledge, there are no viable alternatives of a similar scale to the barrage proposal."*

15.1 To comply with the Habitats Directive, alternatives do not need to be on a similar scale; the Directive instead identifies a need to show an absence of alternative solutions. Indeed with HP's proposals it is the very scale of the project that is the problem and results in such unacceptable levels of environmental and economic damage. HP's evidence expressly accepts that the barrage would be likely to have an impact on a number of European sites; yet it not only fails to demonstrate that any appropriate assessment would not be negative but also contains no tenable basis upon which to conclude an absence of alternative solutions or the existence of imperative reasons of overriding public importance. It further fails to provide any robust basis upon which a decision-maker might be satisfied that all necessary compensatory measures can be achieved. The onus is on HP to prove these matters and, had such robust evidence existed, it is to be assumed HP would have adduced it.

16. As Energy and Climate Change Minister Greg Barker said in December 2012<sup>60</sup> in response to the European Commission's announcement of EU funding for two UK tidal projects:

"European funding for Scottish Power Renewables and Marine Current Turbines' tidal projects is great news for the UK's marine energy sector and further underpins the UK's position as a world leader in this source of clean green power."

16.1 As Regen SW and the Marine Energy Park stated in their submission:

"There is a growing tidal industry focused around the Bristol Channel, who have devices applicable to the global market already at the full-scale prototype stage. We are aware of a number of project proposals for tidal stream and tidal lagoon projects which are under development."<sup>61</sup>

16.2 Bradshaw and Daborn note:

"The Canadians are forging ahead to test and refine tidal in-stream energy devices to create a commercially viable technology appropriate to the Fundy environment. They have partnered with Marine Current Turbines Ltd. (MCT)—based in Bristol, UK—to test its technology in the Bay of Fundy. This has the potential to provide economic impacts in the Atlantic region and position Canada as a world leader in marine renewable energy."<sup>62</sup> (Bradshaw and Daborn)

<sup>58</sup> Written evidence submitted by the Department of Energy and Climate Change  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/111> Paragraph 43

<sup>59</sup> Written evidence submitted by RWE Npower Renewables Limited  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/63>, final paragraph

<sup>60</sup> [http://www.decc.gov.uk/en/content/cms/news/barker\\_eutidal/barker\\_eutidal.aspx](http://www.decc.gov.uk/en/content/cms/news/barker_eutidal/barker_eutidal.aspx)

<sup>61</sup> Written evidence submitted by Regen SW and South West Marine Energy Park  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/71> paragraph 37

<sup>62</sup> Written evidence submitted by Natasha Barker Bradshaw and Professor Graham Daborn (SEV67)  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/106>, paragraph 5.7



17. *“Under the EU Habitats Directives and application of IROPI, the question has to be asked: ‘Are there other better or more viable marine energy technologies which would be preferable to the Hafren Power barrage and which would provide the same energy at less environmental cost?’”*

17.1 HP have misinterpreted relevant guidance on the requirements of the Habitats Directive which indicates that the alternatives do not have to be “more viable” or necessarily “provide the same energy” as the barrage. The pertinent question is whether there are viable alternatives that are less damaging to the European protected sites.

17.2 There are undeniably a number of feasible options (at least as feasible as a barrage of this scale) which generate tidal energy without building a concrete wall across the mouth of the estuary and with significantly less environmental impacts, alone or in combination.

17.3 The effect of HP’s failure to make out its case in respect of impact on European sites is fatal.

17.4 The Angling Trust illustrates the sheer enormity of the compensatory task facing the developer:

“The Habitats Directive would require compensatory habitat to be created elsewhere to replace that which is damaged in the Severn. This could involve the creation or restoration of thousands of hectares of intertidal habitat and/or hundreds of miles of salmon and shad river habitat. If the damage to habitats is on the scale that we believe it might be, this would be even more unfeasible than stocking salmon to the Wadis of the Yemen, and considerably more expensive. What’s more, this habitat would have to be in place and functional before work could begin on the proposed barrage.”<sup>63</sup>

### C. ENVIRONMENTAL IMPACTS

18. *“This proposal focuses above all on mitigating the environmental impact on the Severn estuary.”*

18.1 The proposal pays lip service to mitigating the environmental impact but provides no adequate evidence whatsoever of how this will be done; it is an aspiration without foundation in reality.

18.2 There has been no testing of many of the proposed mitigation measures including the low-head turbines and evidence suggests that much of the proposed mitigation cannot be achieved.

18.3 The RSPB’s evidence reflects the serious doubts apparently felt by many stakeholders on reading HP’s claims for mitigation:

“Impacts should be mitigated and where possible avoided through good design, and any unavoidable residual impacts must, as a minimum, be brought within the realms of the realistically compensatable and therefore potentially acceptable (subject to rigorous application of the tests set out in Article 6(4) of the Habitats Directive ‘alternative solutions’, ‘imperative reasons of overriding public interest’ and compensation secured). We remain deeply sceptical that any shore-to-shore barrage could achieve this.”<sup>64</sup> (RSPB)

18.4 The serious expressions of doubt by stakeholders are both predictable and to be viewed with the utmost gravity. HP’s failure to adduce cogent evidence to deal with these doubts is fatal to its case.

18.5 It should give major pause for thought to realise that in the only other estuary in the world to have a tidal range higher than the Severn, the Bay of Fundy in Canada, the environmental consequences of barricading the estuary were regarded as completely unacceptable by the Canadian Government.

18.6 HP have failed to demonstrate an understanding of how siltation will impact on their proposals. With over 30 million tonnes of suspended sediment moving on spring tides, the silt in the Severn is a force to be reckoned with. As Bradshaw and Daborn point out in their submission:

“Experience from the Bay of Fundy on the response of estuaries to the construction of causeways and dams has raised awareness of the unpredictable consequences where there are high silt concentrations.”<sup>65</sup>

18.7 To demonstrate how unrealistic the Hafren Power claims are, it is worth drawing attention to the comprehensive and compelling evidence submitted by Natasha Barker Bradshaw and Professor Graham Daborn (SEV 67) in respect of the long term evaluation and research conducted by the National Canadian and State governments into the energy potential from the massive tidal range in the Bay of Fundy. Many years of study based on smaller barrages and causeways resulted in the Canadian Government abandoning any plans for a major power generating barrage. The primary reason was the evidence from the smaller schemes which suggested that:

“Predicted impacts of a larger tidal barrage in Fundy were shown to substantially change the tidal regime with largely unpredictable consequences...”

<sup>63</sup> Written evidence submitted by Angling Trust  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/112>, paragraph 5

<sup>64</sup> Written evidence submitted by The Royal Society for the Protection of Birds (SEV64)  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/101>, paragraph 5.14

<sup>65</sup> Written evidence submitted by Natasha Barker Bradshaw and Professor Graham Daborn (SEV67)  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/106>, Conclusion Paragraph 3

“Rapid accumulation of mudflats seaward of the causeway grew to 6–8 metres above the original sand bar, with nothing growing on them for over two decades after the causeway was constructed. Ecosystem responses to modifications of these macro tidal estuaries take decades to develop, so the environmental effects are prolonged. These changes are continuing (albeit at a slower rate) some 40 years after the construction. In both the Avon and Petitcodiac causeway cases, new large mudflats developed progressively for many years at rates so great that they did not consolidate. They remained so fluid that the typical fauna of bivalves, amphipods and polychaetes was established only decades later.”<sup>66</sup>

19. *“Hafren Power’s innovative turbines spin slowly, so fish can swim unharmed through the turbines or bespoke fish passes... Our turbines are also bi-directional and do not hold back high heads of water, so the tides are more natural. This means we preserve 60% more intertidal habitat than previous schemes proposed, saving the feeding and roosting grounds of wading birds.”*

19.1 These claims are without foundation. Rolls-Royce/Atkins developed a concept design for Very-Low Head Turbines funded under the Severn Embryonic Technologies Scheme (SETS). The summary report<sup>67</sup> suggested that one of the two concept designs would have “no detriment to fish survivability” however these turbines have not been developed even to prototype stage let alone tested as to their effects on fish, energy production, tides or any other aspect.

19.2 HP’s claim to preserve 60% more habitat is theoretical and cannot be relied on unless evidence is provided that is fully tested and peer reviewed. In making such claims, Hafren Power have failed to address the potentially greater scale of longer-term loss, and reduced quality, of intertidal habitats in the estuary likely as a result of ongoing foreshore erosion.

19.3 The DECC evidence states:

“The Hafren Power proposal is aiming to use a Very Low Head turbine concept which is being developed with lower environmental and flooding impact in mind. However the turbine hasn’t as yet been developed beyond concept stage and we have not seen any evidence confirming its potential.”<sup>68</sup> (DECC)

19.4 The Environment Agency evidence states:

“We are not aware of any turbine designs which would allow the safe, repeated passage of fish through a barrage at the scale proposed.”<sup>69</sup>

19.5 The Salmon and Trout Association state:

“The proposed Severn Barrage would have a serious impact on fish populations within the Severn estuary, especially as it would create a barrier to migratory species such as Atlantic salmon, sea trout, shad, lampreys and eels, all of which are protected by European legislation. Salmon in particular could become non-viable in important rivers, such as Severn, Wye and Usk. As well as upward migrating adult fish being impeded, the turbines could also potentially kill high numbers of outward migrating juvenile fish.”<sup>70</sup> (Salmon and Trout Association)

19.6 It is unclear how the claim that tides are “more natural” fits with other claims that the barrage will provide a placid lake upstream. As stated previously, such statements cannot both be correct.

19.7 HP’s asserted intention to create mudflats in compensation needs full explanation. Creating habitat is difficult and expensive and it is not possible to create sufficient mudflats to compensate fully for the impacts of the barrage in accordance with EU law.

19.8 The STPG studies undertook initial modelling to investigate the possible scale of this long term erosion, concluding that a barrage could result in 39–66% of total intertidal habitat to be lost over 120 years. RSPB’s submission points out that:

“experience from the Eastern Scheldt suggests that erosion could continue far beyond the modelled 120 year period, and could in the worst case scenario eventually result in the loss of all such habitat.”<sup>71</sup>

<sup>66</sup> Written evidence submitted by Natasha Barker Bradshaw and Professor Graham Daborn  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/106>, paragraph 4.2

<sup>67</sup> <http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/severn-tp/650-severn-embryonic-technology-scheme—final-report-.pdf>

<sup>68</sup> Written evidence submitted by the Department of Energy and Climate Change (SEV01)  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/111>, paragraph 14

<sup>69</sup> Written evidence submitted by the Environment Agency  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/95> Page 3

<sup>70</sup> Written evidence submitted by The Salmon and Trout Association (SEV51)  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/78>, paragraph 7

<sup>71</sup> Written evidence submitted by The Royal Society for the Protection of Birds  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/101> paragraph 5.10

19.9 The RSPB also state:

“it is reasonable to assume that a low head barrage would result in less habitat loss than a high head barrage at the point of construction, because a lesser area would become permanently inundated behind the barrage. However, it should be noted that this would still constitute habitat loss on an unprecedented scale from a site protected under national and EU legislation, that the STPFS predicted ongoing erosive effects resulting in further intertidal habitat loss post-construction, and that experience on the Eastern Scheldt suggests that intertidal loss at the point of construction may represent only a small proportion of that which could subsequently occur as a result of changes to the structure and function of the estuary.”<sup>72</sup>

19.10 Failure to mention and address the risks to wildlife and flooding as a result of such long-term erosion and the mitigation and compensation costs in addressing these impacts is a major omission by HP.

20. *“Hafren Power is exploring the opportunity to use the barrage for pumped storage.”*

20.1 Much more detail is needed on this aspiration which could have a major impact on habitat, erosion and many other key environmental issues.

21. *“Around 49km<sup>2</sup> of intertidal habitat will be lost. This is almost the same amount as would be lost anyway due to rising sea levels, according to Defra projections.”*

21.1 HP have omitted to include the loss of habitat due to ongoing erosion after the barrage is built. For the scheme in the Eastern Scheldt, 85% of total intertidal habitat is predicted to be lost by 2100, far exceeding loss due to sea level rise.

21.2 Even at La Rance, where suspended sediment levels were always much lower than in the Severn, Jonathan White suggests that currently 30,000m<sup>3</sup> of silt are being added each year to the marine basin and that, for example, the level of silt at Mondreuc is now 8 metres above sea level and:

“Intertidal habitat has been reduced from 70% to 50% of the area of the basin.”<sup>73</sup>

22. *“To create new habitats for birds and to fund other mitigation measures, Hafren Power will invest up to £1 billion.”*

22.1 Based on the direct experience of Bristol Port, HP will need over £1bn for the creation of compensation habitat for birds alone (around £115k/ha for an estimated 9,800ha [98km<sup>2</sup>] of intertidal habitat at a 2:1 compensation ratio).

22.2 There will be considerable additional costs for the extensive environmental mitigation, compensation and monitoring programme required for a barrage to meet the requirements of the Habitats Directive. The environmental mitigation measures and the compensation schemes required for a barrage (eg managed realignment schemes to create saltmarsh) are in themselves major engineering projects, requiring full assessment of the impacts in order to understand the very significant additional mitigation and compensation measures required to offset the impacts that they will cause in both the Severn Estuary and other designated UK estuaries.

22.3 The full scale of mitigation and compensation costs must be accurately identified by the promoters of the scheme, not only for the immediate impacts of a barrage but also importantly for the likely long term impacts as a result of foreshore erosion, subtidal deposition and gradual declines in the quality of habitats and the bird and fish populations that depend on them. These costs appear to have been considerably underestimated at present.

22.4 Compensation must be secured prior to consent for the scheme. It is entirely unclear how HP expects to obtain funding for that purpose ahead of consent being granted.

23. *“Hafren Power is already engaging with all stakeholders to minimise this impact to a level that is as low as reasonable possible.”*

23.1 This claim overstates the situation considerably. HP have published neither a business plan nor any evidence on any issues which can be peer reviewed. HP have only given overview presentations based on untested hypotheses; this is not consultation.

24. *“Bridgwater Bay bund: As part of its mitigation strategy, Hafren Power is studying the option of building a bund around the entrance to the Parrett River.”*

24.1 The proposed mitigation strategy of building a bund in Bridgwater Bay is a major infrastructure project in its own right, with significant adverse environmental and economic impacts likely on the River Parrett and

<sup>72</sup> Written evidence submitted by The Royal Society for the Protection of Birds  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/101> Paragraph 5.12

<sup>73</sup> Written evidence submitted by Jonathan White  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/88>, paragraph 4

surrounding area, requiring further mitigation and compensation measures that have yet to be considered. The assessment and consenting process for this engineering scheme alone would take many years.

24.2 HP should be aware that such a structure is highly likely to be in direct conflict with the habitat creation schemes at the Steart Peninsula by the Environment Agency and Bristol Port and jeopardises the millions of pounds already invested in them.

24.3 It is not clear if the cost of the Bridgwater Bay bund and its associated compensation are included in HP's suggested capital costs.

25. *"The barrage will create a number of opportunities... Reduced turbidity will increase light penetration and photosynthesis and result in an increase in biological productivity...higher invertebrate densities, greater fish populations and better opportunities for birds to feed"*

25.1 HP cite the "great conservation opportunities" offered by the barrage. The reality is that it would require more than three times the total inter-tidal habitat created across the UK to date. This is totally without precedent, greater than anything attempted elsewhere in Europe and hugely risky.

25.2 HP's claim about reduced turbidity is entirely unproven. As discussed in detail in Appendix E of Bristol Port's submission to the Committee, although reduced turbidity would increase primary productivity, this will not solve the problem of damage to designated wildlife assets. The law requires the existing attributes of the Severn Estuary to be protected. It is not acceptable to change the particular characteristics of the existing dynamic, extreme and unusual ecosystem with a loss to its designated features and claim that it is a benefit that other non-designated habitats or species may develop, making the Severn Estuary more typical of other estuaries.

25.3 There is no certainty that improved primary productivity would improve mudflat productivity or carrying capacity of SPA birds. Evidence from the Eastern Scheldt, where similar increases in light penetration have arisen, indicates the opposite; mudflat productivity and bird populations have decreased as a result of widespread ongoing foreshore erosion and loss of intertidal habitats.

25.4 This view is supported by Bradshaw and Daborn's submission based on evidence from case studies in the Bay of Fundy which states:

"Claims from La Rance that biodiversity may increase (eg Kirby, 2006) are probably only valid because habitat diversity has increased (and not necessarily productivity). By comparison, the very high productivity of the Upper Bay of Fundy is related to the highly dynamic behaviour of the sediments and the low biodiversity that is found there. Changes to the Severn Estuary could cause loss of species that are particularly well adapted to the special environmental conditions: the fact that other species may establish themselves doesn't compensate for that loss."<sup>74</sup> (Bradshaw and Daborn)

25.5 Bradshaw and Daborn explain that new mudflats in some sites in the Bay of Fundy took many decades before they functioned as habitats:

"In both the Avon and Petitcodiac causeway cases, new large mudflats developed progressively for many years at rates so great that they did not consolidate. They remained so fluid that the typical fauna of bivalves, amphipods and polychaetes was established only decades later."<sup>75</sup> (Bradshaw and Daborn)

26. *"There are other examples of tidal barrage projects around the world."*

26.1 As previously discussed, the rocky nature of La Rance is fundamentally different from the Severn. It is not appropriate to use La Rance as a comparator.

26.2 The Sihwa Tidal barrage Scheme in South Korea is a small fraction of the scale of the Severn with little to no information available. Again is not an appropriate comparator. It is understood that other tidal power schemes proposed in South Korea are all currently on hold at various stages of the assessment and consent process pending further consideration by the Government.

26.3 Cardiff Bay is not a comparator although the action of the law of unintended consequences is worth noting; the barraged Cardiff Bay has so far suffered from lack of dissolved oxygen (requiring extensive piped oxygen), invasive zebra mussels and toxic algae.

26.4 HP should provide analysis and commentary on the schemes at the Eastern Scheldt and the studies carried out on smaller barrages and causeways in the Bay of Fundy, at the same time as making clear the scale of these projects is a fraction of that of the Severn Barrage. The experience of the Canadian and Dutch Governments will reveal the considerable problems experienced as a result of smaller scale tidal barrages and barriers. Producing evidence on this is necessary to understand why the Canadians no longer consider further

<sup>74</sup> Written evidence submitted by Natasha Barker Bradshaw and Professor Graham Daborn  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/106>, paragraph 1.2

<sup>75</sup> Written evidence submitted by Natasha Barker Bradshaw and Professor Graham Daborn (SEV67)  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/106>, paragraph 4.4

or larger tidal barrages in the Bay of Fundy as viable and have instead moved on to more benign and reversible technologies.

27. *“There are precedents of EU developments where similar large scale projects reconcile the three conditions of the Habitats Directive (paragraph 53). See Appendix item 2 for a Case Study of the new port in Granadilla, Tenerife illustrating the approach to compliance adopted in one instance.”*

27.1 There are no similar scale projects in the EU.

27.2 The port development cited in Tenerife is largely irrelevant to HP’s proposal as it is very small scale compared to the Severn Barrage, relates to compensation for subtidal sandbanks and turtles and fails to reflect the accepted approach for the loss and damage to intertidal habitats and SPA bird species in the UK.

27.3 By contrast, Bristol Port’s Deep Sea Container Terminal in the Severn Estuary (also small scale compared to the barrage) is a good example of how the Habitats Regulations should be applied in the Severn Estuary for intertidal habitats and SPA birds, including the need to provide compensation for damage to intertidal habitats caused by deposition or erosion of the type which has been ignored by HP to date. The approach to providing appropriate compensation for these habitats is clear, tried and tested in the UK and should be the focus for HP’s attention.

#### D. TIMESCALES

28. *“We will need two years for design, turbine testing and development, an Environmental Impact Assessment (EIA) and further detailed fish and bird studies, seven years to build the barrage and two years to reach full installation. The barrage could be partially operational by the end of 2020 and at full capacity by the start of 2025.”*

28.1 This timetable is a gross underestimation of the period of time required for planning, EIA, mitigation, consultation and compensation: it is not based in reality. For example EU law requires compensation to be secured, delivered and functioning in advance of impacts. As a minimum 10 years would be required for this before construction could substantially begin; realistically for a project of this unprecedented scale, complexity and controversy it is likely to take longer.

28.2 The submission from the British Marine Aggregate Producers Association makes it clear that at least three years would be required to achieve new Marine Licences. In addition, each of the compensation schemes would require planning permissions and a number of other terrestrial and marine consents, opposition to which in the Severn Estuary is likely to be considerable, and, as indicated by the Environment Agency,

“may in itself be as controversial as building a Barrage”.

28.3 It is therefore unrealistic to offer the barrage as a means to achieving any part of the 2020 targets even if it were possible to compress construction.

28.4 Other smaller scale tidal schemes may be able to be permitted and constructed sooner, although timescales are still ambitious.

28.5 Statutory consultee, the Countryside Council for Wales, places the likely timescale for a barrage in context in their submission:

“The STPFS [Severn Tidal Power Feasibility Study] concluded that many years of further detailed work would be needed to plan, finance, and assess the impacts of such a large structure as a Severn power scheme before a case could be put forward for planning consent. Even over a period of two years the study was only able to consider feasibility and impact at a strategic level. If consented, the construction times would be between four and nine years depending on the scheme. In addition, any of the schemes would first require new habitats to be created, or species re-introduced, to replace those that would be displaced; these habitats and measures require time to be effective.”

“These investigations would take a number of years and given the significant lead in time we believe it is crucial that this requirement is promoted early. Addressing these data gaps would allow greater certainty in any future assessment, in the design process, understanding of environmental impact and

<sup>76</sup> Written evidence submitted by Countryside Council for Wales  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/66>, paragraph 6 and 7

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effectiveness of mitigation measures. These significant uncertainties and data gaps are not development specific but are fundamental gaps in our knowledge of the estuary functions.”<sup>77</sup>

December 2012

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**Supplementary written evidence submitted by Simon Bird, The Bristol Port Company**

**PROPOSED SEVERN BARRAGE**

I gave evidence to your Committee on 10 January in response to the current investigation regarding the proposal by Hafren Power to construct the Barrage across the Severn. I listened carefully to the previous two sessions, in particular the evidence given by Peter Hain MP.

Mr Hain in his evidence stated that there had been consultation between Hafren Power and Bristol Port and that he could not understand why Bristol Port was so against the proposal, as shipping would not be affected by any Barrage. Mr Hain was incorrect in the points he made regarding Bristol Port, namely there had been no consultation, except for one brief meeting in early September, with his wife representing Hafren. No details on the Barrage proposal were tabled at that meeting or since. The only information regarding the proposed Barrage is what we have seen as part of the evidence submitted by Hafren Power to your Committee.

Yesterday, I met with Mr Tony Pryor, CEO of Hafren Power. He, along with his colleagues, is due to give evidence to the Committee next Wednesday. We agreed not to release the minutes of our discussion, but I would wish to make clear to you, and through you to the members of your Committee, that Bristol Port remains deeply concerned with the Hafren proposal and the impact it will have on the environment and this business. No details were tabled at the meeting; instead Mr Pryor suggested far-fetched “solutions” which he contended would enable the Port to have the same depth of water for shipping as we currently enjoy. I urge your Committee to question the viability and consequences of all such claims and not to be duped by fabrication and fantasy. Fundamental questions remain; in particular:

1. The loss of water depth upstream from a Barrage.
2. Level of increased sedimentation, resulting in further loss of water depth and the increased dredge requirement.
3. Lack of any detail regarding locks, location, dimensions, operational management and costs. It has been claimed the locks will only delay vessels by 45 minutes; there is no evidence to support this.
4. Job losses in Bristol and the South-West of England, against claims of 50,000 new jobs associated with a Barrage construction.
5. Why Hafren thinks the UK economy can withstand the loss of one of its few nationally significant deep water ports at Bristol.

I wish to put on record that the continuing statements made by Peter Hain and Hafren Power regarding a proposed Barrage has a destabilising effect on this business, as we seek to develop projects which are already consented and planned (two biomass power stations for Eon and Heliuss respectively and a Deep Sea Container Terminal), as well as with our existing customer base.

We believe the energy in the Severn Estuary is able to be harnessed by a number of alternative technologies, some of which are further advanced than the Hafren proposal, which will be far less damaging environmentally or economically. I would urge your Committee to investigate the alternative schemes and to press Hafren Power to make available all the details with the evidence of its Barrage proposal.

Yours sincerely

*Simon A Bird*  
Chief Executive

January 2013

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<sup>77</sup> Written evidence submitted by Countryside Council for Wales  
<http://data.parliament.uk/writtenevidence/WrittenEvidence.svc/EvidencePdf/66>, paragraph 6 and 7

### Supplementary written evidence submitted by The Bristol Port Company

Dear Mr Yeo

The Bristol Port Company wish to provide the following additional information to the Energy and Climate Change Select Committee, in order to correct errors in the evidence given to the Committee by Hafren Power on 30 January 2013.

Hafren Power contend that access to the Port of Bristol would be improved following the construction of the barrage; this is incorrect and ignores a number of crucial factors:

1. All the shipping to the five docks (belonging to three independent and competing companies) upstream of the barrage would converge on locks, increasing the risk of collision and delays, and requiring active traffic management and a complex system of prioritisation. The safety of shipping will need to be regulated and assured by a new Statutory Authority and prioritisation of shipping movements will need to be independent and fair.
2. It is not clear where the locks will be positioned, but by definition these will need to follow the deep water channels, where they will be exposed to the full force of the weather. There are likely to be delays to shipping unable to transit the locks when they have to be closed in bad weather. By contrast, ports are located in relatively sheltered positions and rarely affected by the weather today.
3. The transit through these exposed locks would introduce the risk of damage to vessels using them, as well as a significant time delay from the slow approach speed, the duration of the levelling period and the time taken to build up speed once clear of the lock. To suggest that this time delay will be as short as 45 minutes and no more than the current time delay resulting from waiting for the tide to flood is wrong and demonstrates a fundamental ignorance of port operations. Today, with the pressure to provide maximum efficiency, ships calculate their speed of advance so as to arrive at their pilot boarding time (which in turn is calculated to maximise the benefit from the speed of the flood tide) to minimise fuel consumption and emissions and achieve a minimum passage from pilot station to port.
4. The number of locks to be provided in the barrage was unclear from the evidence session; we would contend that there would need to be at least two in order to provide concurrent ship movements and business continuity in the event of a lock failure. Severn Tidal Power guaranteed a minimum of two locks with dimensions sufficient to provide a future proof solution.
5. Bristol Port has some 3,000 vessel movements per annum. The predicted reduction by c2.0m in the height of high water levels upstream of the barrage affects the docks of both Royal Portbury and Avonmouth. At Portbury, the current Panamax plus trades (65,000 tonnes dwt) would be killed off, with insufficient water for the deepest draught ships (13.0m and above). Access to Avonmouth by many current vessels would also be severely restricted by the loss of water depth. For example an existing 11.0m tide would be reduced by the barrage to 9.0m or less meaning that only vessels with a maximum draught of 7.8m would have unencumbered access to Avonmouth. The loss of water depth would impose an unacceptable limitation and leave the port commercially unviable.
6. Hafren Power has portrayed a projected higher low water level as a benefit, which is incorrect. A 2.0m increase in a 3.0m low water level would limit the maximum draught movement in or out of Avonmouth to 4.0m, which is well below the arrival draught of virtually all commercial shipping. In addition, ballasted lock gates require a minimum water level in excess of this raised low water level in order to operate.

Hafren Power sought during their evidence to allay our fears of a reduction of up to 2 metres in the water level upstream of the barrage by stating that the barrage would be a “complete control mechanism”. They confidently asserted that the water level upstream could be (a) adjusted by allowing unimpeded flow through the turbines and (b) further increased by pumping. Whilst we have seen no detail of this control mechanism, we find it surprising that the power capacity of the pumps could enable the upstream water level to be raised by 1 metre when the area involved is 600 million square metres. This would imply pumping an estimated 600 million tonnes of water; a barely conceivable challenge, yet alone one which would be compatible with generating a reliable supply of electricity.

Bristol Port is seeking independent expert analysis of Hafren Power’s claims in order to quantify the true effects on upstream water levels of a barrage conforming to the scant design detail available to us. This analysis will be made available to the Committee.

Hafren Power accepted that the barrage operating company would absorb all the costs associated with the integration of the barrage into the shipping activity in the area. It is not clear whether or not Hafren Power recognise the full span of services which would need to be provided, free of cost in perpetuity, to all commercial shipping in the Estuary. These include VTS providing traffic organisation and information, pilotage, towage, line handling and conservancy (including frequent surveys and the dredging of an estimated five million tonnes of mud each year which will be required to keep our deep water channel clear). A substantial fleet of tugs,

dredgers, survey craft and pilot launches will be needed to meet this requirement. It is also unclear how Hafren Power intends to guarantee performance of its resulting financial obligations for the lifetime of the barrage.

It is regrettable that there was insufficient time for your Committee to debate in detail the effects of siltation on the barrage and the Estuary; the effects in navigational channels need particular scrutiny, and the consequences of the probable build up of material in the vicinity of the turbines would appear to have been ignored thus far. From the information we have, it is by no means certain the proposed barrage could generate power in the long-term without the removal of millions of tonnes of silt. We note that further written evidence will be submitted covering these points and would ask that, in view of our considerable experience of this subject, we may be permitted to comment on that evidence. We believe that our 120 years of experience of actually operating in the conditions prevailing in the Estuary gives us an unrivalled understanding of the subtleties and variations present that cannot be modelled by academic studies and predictions.

For the avoidance of doubt, Bristol Port has requested from Hafren Power details of the effect any barrage would have on water levels and increased siltation. Hafren Power has to date been unwilling to share any information with Bristol Port and has not responded to our requests made in writing, or in the meeting held with the Chief Executive, Mr Pryor, on 24 January. I attach a copy of a letter sent to Peter Hain MP, which was also passed to Mr Pryor in advance of the meeting in January.

During Hafren Power's evidence, we were extremely concerned to hear that it is their intention to sell Hafren Power if development consent is granted. This was stated by Mr Pryor, who also said that he thought any new purchaser, while not starting afresh, would wish to discuss the commitments made by Hafren Power. This statement is of great concern as we, and no doubt others, will question the validity of guarantees and statements made by Hafren Power prior to sale. We also question why, if it only intends to monetise a development consent, Hafren Power considers itself suitable to promote the barrage scheme at all.

Finally, Mr Hain, in responding to the Committee following his oral evidence, questioned why I had raised in my oral evidence the involvement in Hafren Power of his wife, Elizabeth Haywood. The point I was seeking to highlight was the lack of consultation between Bristol Port and Hafren Power. My comments were limited to matters of fact, but if Mr Hain or his wife found this discourteous then I am very happy to apologise.

*February 2013*

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### **Supplementary written evidence submitted by The Bristol Port Company**

#### **INTRODUCTION**

1. Hafren Power (HP) has submitted a proposal to the Energy and Climate Change Committee (ECCC) to construct a power generating barrage from Cardiff to Weston.<sup>78</sup> In both their written and oral evidence, HP have made a number of claims about the effects that their proposed barrage will have on the tidal levels upstream of the construction. HP have not yet made available any detailed plans of their barrage proposal which support accurate analysis of their claims. However, the broad dimensions of the barrage can be estimated, its approximate route identified, whilst the size and number of turbines has been stated at 9.0m diameter and 1026; these factors can be used to underpin some basic analysis of the effects of the barrage on the tidal regime in the Estuary. The Bristol Port Company (TBPC) has commissioned HR Wallingford (HRW) to comment on HP's claims, and to answer some specific questions on the way the barrage is likely to affect tidal levels at Avonmouth.

#### **HAFREN POWER CLAIMS**

2. HP's claims are as follows:

- (a) Claim 1: "Reduction in tidal range: for spring tides, the range would reduce from around 14m to around 10m".<sup>78</sup>
- (b) Claim 2: "The barrage is a complete control mechanism. The thousand-odd turbines can obviously be used in ebb and flood. They can be turned to—I say—freewheel, but feather the blades because the pitch can be changed. So they can let the water flow through, which could actually replicate the whole tide".<sup>79</sup>
- (c) Claim 3: "You can raise the tide, and if you operate the turbines in a pumping mode you can do it as well because you can raise the tidal height".<sup>79</sup>
- (d) Claim 4: "We can actually improve their [TBPC's] access to their existing docks by raising the height of the tide at particular times to suit them".<sup>79</sup>

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<sup>78</sup> Hafren written evidence dated December 2012

<sup>79</sup> Oral evidence submitted by Hafren Power to the ECCC January 2013



## TBPC/HRW ANALYSIS—CLAIM 1—TIDAL RANGE EFFECTS

3. Extensive analysis exists on the ebb-only generating barrage considered under the Severn Tidal Power (STP) Feasibility Study,<sup>80</sup> as well as an assessment of a “conventional turbine technology” flood-ebb generating scheme. Whilst the HP proposal seeks to use very low head bi-directional turbines with high reversible efficiency and which would allow both ebb and flood generating windows, the earlier STP work nonetheless provides a reference point.

4. Further modelling of UK tidal power resources have been undertaken by HRW for the Energy Technology Institute (ETI). The Severn Barrage was studied, including flood-ebb generation schemes.<sup>81</sup> However the particulars of turbine characteristics remain under development and so these results not used for the present review.

5. Professors Roger Falconer and Binliang Lin at Cardiff University have produced a model used widely by Hafren which indicates that that new proposals for ebb and flood generation would reduce high water levels by around 1.4m greater than an ebb-only barrage.<sup>82</sup> This is reported to verify the results of Hafren’s numerical model used to support the business case for their proposed Severn barrage. This modelling suggests that the reduction in high water levels upstream of a barrage could be in the order of 2m for spring tides.<sup>83</sup>

6. HRW state in a response sought by TBPC to the tidal level claim:<sup>84</sup> “Upstream of the barrage, the tide would have a reduced tidal range compared with now (a lower mean water level with a higher low water and a lower high water) and the tide would probably have this sort of shape (with pumping, the lows and highs would become more pointed)”. “Probably” because in reality the form of the upstream water level variation would depend upon the detailed equations describing flows through the turbine ducts (and any sluices) when not generating power and when generating power (and usually different equations at different power levels), etc:



7. For example, when HRW simulated a flood/ebb scheme during the DECC STP studies,<sup>85</sup> upstream of the flood/ebb generating barrage at Avonmouth a >4m reduction in high water and a >2m rise in low water was predicted. Downstream of the barrage (near field) the tide would appear similar in shape to now, but would have a reduced high water and a raised low water. The flood/ebb barrage HR Wallingford tested led to a near field reduction in high water of <0.5m and an increase in low water by 1.3m just downstream of the barrage. Further downstream, in the Bristol Channel at Ilfracombe there was a small reduction in high water and ~0.5m rise in low water.

8. The HP scheme is different in that it uses future technology and has many more turbines and a lower starting head for generating electricity than modelled in the DECC STP studies. Rolls Royce and Atkins have considered the technical feasibility of future technology (ie very low head bi-directional turbines<sup>86</sup>). They report that 0D modelling for the 1000 turbine case suggests a 2–3m reduction in spring tide high water levels in the upstream basin and a 2m rise in low water, both changes reduced however by a factor of two with pumping. Although 0D models are useful for concept design, 2D/3D models (rather than 0D) would usually be required for a detailed assessment of impacts (eg on tide levels) associated with a scheme. Roger Falconer’s team does not appear to present results for the 1000 turbine case. Additional evidence presenting the effect of the Hafren scheme on tidal levels should be sought.

<sup>80</sup> DECC, SWRDA & WAG, 2010. Feasibility study conclusions and summary report. DECC 2010. Severn tidal power SEA—Hydraulics and geomorphology topic report.

<sup>81</sup> The Energy Technologies Institute (2012). Tidal Modelling (Modelling Tidal Resource Interactions around the UK). Interactions (analysis and conclusions report). Implementation of Extraction Modelling Scenarios. Report MA1009 PM03.07 from Black & Veatch and HR Wallingford.

<sup>82</sup> Professor Falconer, Halcrow Professor of Water Management, Cardiff University, Presentation at a conference on Green Energy—The Severn Tidal Power Debate, 16 October 2012.

<sup>83</sup> Hafren written evidence dated December 2012

<sup>84</sup> HRW email response to TBPC 28 Feb 2013 at 1645

<sup>85</sup> SEA Topic Paper Hydraulic and Geomorphology Annex 8—Investigation of changes to hydraulics for short-listed options (water levels and flows)—Addendum 2

<sup>86</sup> Rolls Royce & Atkins, 2010 Severn Embryonic Technology Scheme, Final Report and Development Route map.

9. The analysis reviewed suggests that the reduction in tidal range at Avonmouth could be as much as 6.0m, or as little as 2–3m with pumping taking place. However, there can be no certainty of the scale of the impacts on water levels both upstream and downstream of the barrage, without first seeing the turbine technology and associated sluices further developed and tested as prototypes, and then appropriately detailed hydrodynamic modelling undertaken which can be thoroughly peer reviewed and verified.

**TBPC/HRW ANALYSIS—CLAIM 2—THE BARRAGE IS A COMPLETE CONTROL MECHANISM WHICH CAN LET THE WATER FLOW THROUGH TO REPLICATE THE WHOLE TIDE**

10. The flow rate through the barrage would be the sum of flows through the numerous turbine ducts (with turbines either generating power or freewheeling), sluices and any other openings. There would unavoidably be some head loss across the structure from the interaction of the flow with the various elements of the structure which would cause the tide range upstream to reduce to some extent. Pumping can be used to mitigate the effect on tide range.

11. The proposed (future) technology is a very low head bi-directional turbine with high reversible efficiency. This is considered by Rolls Royce to be technically feasible in their Report.<sup>87</sup> (Annex A of this report suggests that 1000 turbines are feasible because of the “pushed out” plan shape of the barrage). The blades are variable pitch blades. Section 3.2.6 of the same report states “With a pumping mode of operation, it is possible to *more closely* replicate the natural tide”. The results presented by Rolls Royce suggest that with pumping the whole tide can be replicated during neap tides but not for a large spring tide.

12. Pumping at around the time of high and low water brings more water through the barrage at a time when the head difference is not large enough for power generation. It takes energy to do the pumping (cost) but the benefit is a reduction in the time before power generation may resume, an increase in the power that may be generated during the next generating phase, and a slight reduction (improvement) in high and low water level changes compared with present day levels.

13. From the reviewed information it appears that the pumping capacity would be unlikely to be able to fully replicate large spring tides and so reduced operability may be an impact for larger vessels entering Portbury Dock (for larger vessels DECC STP navigation studies considered 130,000dwt vessels with 14.5m draught). To comment fully TBPC would need to see more detail as to how this commitment might be met for the larger vessels.

**TBPC/HRW ANALYSIS—CLAIM 3 AND 4—PUMPING TO RAISE TIDE**

14. When HRW modelled a flood/ebb Cardiff-Weston barrage as part of the DECC STP studies,<sup>87</sup> (note this was a smaller barrage with a smaller basin area than the Hafren proposal), a discharge rate of 200,000m<sup>3</sup>/s into the area upstream of the barrage gave a tidal level rise of 4m in 3.5 hours or 1.15m per hour. So roughly 600,000,000m<sup>3</sup> water would need to be pumped to raise water levels upstream of a barrage by 1m (for a spring tide). Inside the basin the tide level peaked at 8–8.5m OD.

15. In order to calculate the pumping requirement to move this volume of water in a practical time frame during which no power will be generated (say a single tide of 6 hours), the 1026 turbines are assumed to be capable of working in a pumping mode. Each pump would need to be capable of pumping close to 600,000 tonnes of water in a six hour period, or 100,000 tonnes per hour in order to raise the depth at Avonmouth by one metre. This is clearly a significant technical challenge, which will also require a considerable consumption of power. It seems highly questionable that a power generator would find it tolerable to support the loss of generating capacity and the cost of pumping 600,000,000 tonnes in order to restore, let alone improve, depths of water for Bristol shipping.

**CONCLUSIONS**

16. It is regrettable that the paucity of detail available from HP does not allow more meaningful analysis of their claims for the effects on the tidal regime upstream of their barrage proposal. Analysis of such detail that is available show clearly that their claims are unrealistic and based upon many assumptions.

17. The loss of HW at Avonmouth will remove TBPC’s unique access to deep water and the associated deep-draught trades which use it. Any notion that allowing free-flow through the turbines to replicate the existing tidal regime, let alone pumping to improve the water levels available today, simply does not stand up to the most basic of scrutiny.

March 2013

<sup>87</sup> SEA Topic Paper Hydraulic and Geomorphology Annex 8—Investigation of changes to hydraulics for short-listed options (water levels and flows)—Addendum 2

## Written evidence submitted by The Royal Society for the Protection of Birds

### INTRODUCTION

1.1 The RSPB welcomes the Energy and Climate Change Select Committee's intention to scrutinise Hafren Power's Severn Barrage proposal. However we are concerned that the ability of the Committee to do so, and our ability to respond to the questions posed by the Committee, are seriously constrained by the absence of any detailed or publicly available information on this proposal.

1.2 The RSPB has had some early discussions with Hafren Power and their supporters (including Peter Hain, MP). These have provided a welcome opportunity to outline our concerns and to seek to inform the scope of the substantial amount of work that would be required before the nature and scale of the impacts of the Hafren Power proposal could be properly assessed. They have also provided an opportunity for the RSPB to make clear to Hafren Power our position on their proposal, based on what little information has been shared to date:

- We attach great value to the Severn Estuary for its international importance for wildlife, as is recognised through its designation as a Site of Special Scientific Interest (SSSI), a Special Protection Area (SPA), a Special Area of Conservation (SAC) and a Ramsar site.
- Climate change is the greatest medium to long-term threat to biodiversity. The deployment of renewable energy is essential for decarbonising the UK economy and putting us on the right trajectory to avoid the worst of the climate change impacts that have been predicted.
- That said, we recognise that, like all forms of development, inappropriately designed and/or sited renewable energy developments can cause serious, irreparable and unnecessary harm to biodiversity.
- To date we have not been presented with sufficient detail on the current proposal, or on the impacts of that proposal, to properly assess to what extent the impacts would differ from those of the completely unacceptable high head Cardiff to Weston barrage considered by the Severn Tidal Power Feasibility Study (STPFS) and rejected by Government in 2010.
- We remain deeply sceptical that a shore-to shore barrage on the scale of that envisaged by Hafren Power can be delivered without unacceptable damage to the Severn Estuary, its wildlife, and its communities.

1.3 At this time it is unclear that a major barrage scheme can be brought forward for the Severn which would be affordable for the consumer, and acceptable in terms of its environmental impact. An alternative would be a step by step approach, given the potential for severe adverse environmental impacts to the Estuary and our lack of detailed understanding of the nature and scale of actual impacts. This would begin with a smaller project or projects which could be monitored carefully and used as test cases for evaluating the impacts of potential larger scale projects further down the line (which might be located within the Severn or elsewhere). By this point there may also be a wider range of wave and tidal stream technologies available to deploy, with lower environmental impacts than the tidal range technologies currently available.

### 2. THE RSPB

2.1 The Royal Society for the Protection of Birds (the RSPB) is the charity that takes action for wild birds and the environment. We are the largest wildlife conservation organisation in Europe with a membership of over one million. The RSPB manages 213 nature reserves in the UK covering an area of 143,780 hectares, of which 98,800 hectares are classified as Special Protection Areas (SPAs), 73,995 hectares are designated as Special Areas of Conservation (SACs) and 53,392 hectares are designated as Ramsar sites.

2.2 The principal objective of the RSPB is to save nature. The RSPB therefore attaches great importance to all international, EU and national law, policy and guidance that assist in the attainment of this objective, including those aimed at mitigating climate change. The RSPB campaigns throughout the UK and in international fora for the development, strengthening and enforcement of such law and policy.

### 3. THE RSPB, CLIMATE CHANGE AND RENEWABLE ENERGY GENERATION

3.1 Climate change is the greatest medium to long-term threat to biodiversity. It 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<sup>88</sup>. The RSPB therefore believes that an energy revolution is needed to enable a rapid transition to a low carbon economy to avoid the worst of the climate change impacts that have been predicted. We therefore strongly support the UK's greenhouse gas reduction targets and recognise 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.

3.2 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

<sup>88</sup> Thomas et al. (2004) *Extinction risk from climate change* Nature 427 pp.145–148

has a duty to ensure these targets are met with minimal environmental impact. Our aim is to ensure the delivery of the maximum capacity of renewable energy for the minimum impact on the natural environment.

3.3 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 between 2001 and 2010, overall we objected to just 8% of onshore wind farm proposals we engaged in, and our objection rate had fallen to just 3% by 2010.

#### 4. THE RSPB AND TIDAL POWER

4.1 The RSPB was heavily engaged with the Severn Tidal Power Feasibility Study (STPFS). 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 (£0.5mn). As a result, the £20mn STPFS ultimately delivered recommendations that were unworkable because of their excessive costs, due in part to their enormous environmental impacts. Soon after the Government's rejection of the case for support for tidal power generation in the Severn estuary in 2010, the Mersey barrage proposal by Peel Holdings followed a similar trajectory to that of the STPFS, with plans shelved because of costs and opposition on the grounds of environmental impact.

4.2 The RSPB set out both our response to the findings of the STPFS, and our views on priorities for any future consideration of tidal power proposals in the Severn in our letter to the Department for Energy and Climate Change in January 2011 (attached at Annex I).

4.3 Subsequently, the RSPB also set out its view on tidal range in its evidence to the Energy and Climate Change Select Committee's Inquiry into "The Future of Marine Renewables in the UK" in November 2011 in which we stated (at para 3.3) that:

*"The UK's tidal range resource is considerably more difficult [than tidal stream or wave] 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."*

This position also applies to the level of support that would be made available to renewable and low carbon sources through Contracts for Difference, as set out in the draft Energy Bill.

4.4 The RSPB's views on tidal range in general, and on tidal power proposals in the Severn Estuary in particular, remain as stated in the afore-mentioned submissions to DECC and to the Committee.

#### 5. ANSWERS TO COMMITTEE QUESTIONS

Q1. *What contribution could the Cardiff-Weston Barrage make to UK energy security and climate change objectives?*

5.1 In terms of UK energy security, there are two main concerns that need to be addressed: meeting UK electricity demand at any given time, particularly at times of peak demand, and the risk of interruption to imported fuel supplies. All renewable energy technologies help to minimise the risk posed by the latter, but as many renewable energy technologies are intermittent in supply, the need for low carbon baseload generation is particularly acute. A low-head barrage would partially fit this requirement as it generates a predictable and consistent supply of electricity. Although this is beneficial for providing a base load on the network, the amount of electricity would not be flexible and it would therefore be restricted in its ability to respond to peaks in demand.

5.2 In terms of helping the UK to meet its climate change objectives, we consider sustainable tidal range technologies to offer potentially significant amounts of low carbon electricity. No detailed or published information has been made available about the proposed level of electricity generation from Hafren Power's low-head tidal barrage, but the estimate for the previous high-head Cardiff-Weston Barrage was 17TWh per year, and we understand from Hafren Power that they believe their proposal could generate a similar amount of electricity. This is 4.56% of predicted electricity generation in 2020 and 3.86% by 2030<sup>89</sup>. This would be

<sup>89</sup> [http://www.decc.gov.uk/en/content/cms/about/ec\\_social\\_res/analytic\\_projs/en\\_emis\\_projs/en\\_emis\\_projs.aspx#2012](http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx#2012) Annex E—Total energy generation by source

a significant proportion of total UK electricity supply, and energy demand more generally as uses such as home heating and transport are increasingly converted to electricity. However, the evidence shows that existing commercial technologies are not capable of harnessing this without causing major and unacceptable environmental impacts.

5.3 The total UK carbon budget for 2023–2027 is 1950MtCO<sub>2</sub>e, which is equivalent to 390MtCO<sub>2</sub> per year. It was estimated that the Cardiff-Weston barrage could save up to 1 million tonnes of carbon dioxide per year which would make a significant contribution to achieving this target. However, for comparison, DECC estimated that in 2011 approximately 6.3 million tonnes of carbon dioxide were avoided in the UK by displacing electricity generated from fossil fuels with onshore wind<sup>90</sup>. A further 3 million tonnes were saved by offsetting fossil-fuels with offshore wind, and this figure is set to grow significantly in coming years.

5.4 If carbon targets are to be met without causing severe and in some cases, irreparable, damage to biodiversity, it is clear that we need to understand how we can deliver the maximum amount of electricity output for minimum environmental impact. We believe, therefore, that Government should direct greater effort and support to research, development and demonstration of renewable technologies that could have lower environmental impacts.

*Q2. What risks and opportunities could it pose with regard to flooding in the Severn estuary, and how might any risks be mitigated?*

5.5 In the absence of any detailed or publicly available information on the Hafren Power proposal, it is not possible to provide a properly informed response to this question.

5.6 While barrage proposals have often been promoted in part on the basis of assumed flood risk benefits, the conclusions of the STPFS made clear that a high-head Cardiff-Weston barrage would in fact increase both flood risk and the costs of maintaining flood defences. For example, to seaward of the barrage, the study identified “far-field effects” including increased high tide levels along the west coast of Wales, the north Devon coastline and the east coast of the Republic of Ireland<sup>91</sup>. Upstream of the barrage, the study showed that the loss and erosion of intertidal habitats caused by the construction and ongoing presence of a barrage would threaten the integrity of 67–201 km of flood defences, necessitating additional expenditure of £672 to £2, 015 million<sup>92</sup>. Furthermore, impacts on land drainage were predicted to increase flood risk over an area of 370km<sup>2</sup>, containing 45,000 residential properties, 3,400 non-residential properties and 28 critical infrastructure assets<sup>93</sup>.

5.7 The findings in respect of intertidal erosion and associated flood defence impacts appear broadly consistent with the observed impacts of the construction of a storm surge barrier on the Eastern Scheldt (“Oosterschelde”) in the Netherlands (see paras 5.18 to 5.20 below) where ongoing erosion of intertidal habitat post construction is resulting in the need for additional investment in flood defences, with extra costs over the next 50 years estimated at between at best £25–45, and at worst £90–260 million euros<sup>94</sup>.

5.8 Until the technical details of Hafren Power’s barrage proposal are defined, and the impacts of the proposal assessed, it is not possible to assess the extent to which flood risk impacts will differ from those identified for a high head Cardiff to Weston barrage by the STPFS. Impacts of a low head barrage could be lower in terms of the effects on land drainage (assuming that a lower head should result in lower water levels behind the barrage and therefore a lesser impact on gravity outfalls and fluvial flood risk), but in all other respects it is not possible to identify how far-field, downstream and flood defence impacts might differ, especially in the long-term post construction, or to identify what, if any, mitigation measures might be viable and appropriate.

*Q3. What risks and opportunities could it pose to wildlife and habitat in the Severn estuary, and how might any risks be mitigated?*

5.9 In the absence of any detailed or publicly available information on the Hafren Power proposal, it is not possible to provide a properly informed response to this question.

5.10 The findings of the STPFS made clear that a high-head Cardiff to Weston barrage would have entirely unacceptable and unprecedented impacts on wildlife and habitats both within, and far beyond, the boundaries of the estuary itself. For example, it was concluded that it would result in the loss of 39–66% of the entire area of intertidal habitat over a 120 year period. (Experience from the Eastern Scheldt suggests that erosion could continue far beyond the modelled 120 year period, and could in the worst case scenario eventually result in the loss of all such habitat<sup>95</sup>). It should be noted that such losses would be far in excess of those expected as a result of sea level rise. It was also concluded that the high-head barrage would reduce bird populations of up to 30 bird species<sup>96</sup>, and would severely affect fish populations with local extinctions and population

<sup>90</sup> [http://www.decc.gov.uk/en/content/cms/meeting\\_energy/wind/onshore/delivering/why\\_onshore/why\\_onshore.aspx](http://www.decc.gov.uk/en/content/cms/meeting_energy/wind/onshore/delivering/why_onshore/why_onshore.aspx)

<sup>91</sup> HM Government, 2010. *Severn Tidal Power: Feasibility Study Conclusions and Summary Report*, Pg 38

<sup>92</sup> HM Government, 2010. *Severn Tidal Power: SEA Topic paper—Flood Risk and Land Drainage*. Pg xxii

<sup>93</sup> HM Government, 2010. *Severn Tidal Power: Feasibility Study Conclusions and Summary Report*, Pg 38

<sup>94</sup> [http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal\\_tcm9-240984.pdf](http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal_tcm9-240984.pdf)

<sup>95</sup> [http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal\\_tcm9-240984.pdf](http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal_tcm9-240984.pdf)

<sup>96</sup> HM Government, 2010. *Severn Tidal Power: Feasibility Study Conclusions and Summary Report*, Pg 5

collapses<sup>97</sup>. In addition, ancillary development such as additional transport links would put increased pressure on terrestrial habitats and species, including on other designated sites including the Somerset and Gwent levels.

5.11 Until the technical details of Hafren Power's barrage proposal are defined, and the impacts of the proposal assessed, it is not possible to assess the extent to which impacts on wildlife will differ from those identified for a high head Cardiff to Weston barrage by the STPFS.

5.12 Hafren Power have suggested that their barrage proposal would entail 60% less loss of intertidal than the high-head barrage considered by the STPFS. There is no detailed information available to substantiate this claim although it is reasonable to assume that a low head barrage would result in less habitat loss than a high head barrage at the point of construction, because a lesser area would become permanently inundated behind the barrage. However, it should be noted that this would still constitute habitat loss on an unprecedented scale from a site protected under national and EU legislation, that the STPFS predicted ongoing erosive effects resulting in further intertidal habitat loss post-construction, and that experience on the Eastern Scheldt suggests that intertidal loss at the point of construction may represent only a small proportion of that which could subsequently occur as a result of changes to the structure and function of the estuary<sup>98</sup>. Without a detailed technical design, and detailed modelling of long-term effects (over whatever time period such effects continue to occur) it is not possible to assess to what extent, if any, the long term impacts of a low head barrage might differ from those of a high-head barrage.

5.13 A number of potential wildlife "benefits" have been claimed by proponents of both the high-head and Hafren Power barrage proposals, based in part on inappropriate reliance on the La Rance tidal barrage (see paras 5.16 to 5.17 below). There are two key points that should be noted in relation to such claims. First, in both nature conservation and legal terms, the value of the Severn lies in its particular geomorphological, hydrological and ecological characteristics. It is therefore essential that the "gross" impacts on the Severn are assessed and addressed by any barrage proponent, as it is inappropriate to "discount" losses against any future non-characteristic habitat or species that might develop as a result of barrage construction. Second, all such claims have, to the best of our knowledge, not been substantiated. It is claimed that low-head turbines operating at slower rotational speeds and on both the flood and ebb tides would be "fish-friendly" by comparison to the high-head, higher velocity and ebb-tide only turbines considered by the STPFS. This could be the case, but to date as far as we are aware Hafren Power have not undertaken work to address gaps in understanding of how fish species use and move through the Severn, and they do not have a confirmed turbine design. Therefore, there has been no testing of these—or any other—low head turbines, or of any potential mitigation measures under the relevant environmental conditions (including multiple passages by individual fish of a wide range of species both with and against the flow).

5.14 Given the severity of the predicted impacts of a high-head barrage, any new design would have to reliably demonstrate a scale of impact on geomorphology, hydrology, habitats, birds, fish and other wildlife some orders of magnitude less than those identified by the STPFS. Impacts should be mitigated and where possible avoided through good design, and any unavoidable residual impacts must, as a minimum, be brought within the realms of the realistically compensatable and therefore potentially acceptable (subject to rigorous application of the tests set out in Article 6(4) of the Habitats Directive ("alternative solutions", "imperative reasons of overriding public interest" and compensation secured). We remain deeply sceptical that any shore-to-shore barrage could achieve this.

*Q4. What lessons can be learned from the successful development of La Rance tidal barrage in France and other tidal power projects?*

5.15 While no two estuaries or barrage developments will be the same, there is a clear value in identifying relevant comparator sites to inform both technical design and impact assessment.

5.16 The tidal barrage at La Rance was constructed and has been in operation since the 1960s, and as such may be of some relevance in terms of technical design.

5.17 However, in terms of understanding and assessing potential impacts of a tidal barrage on the Severn Estuary, reliance on La Rance as a comparator for the Severn is wholly inappropriate for the following reasons:

- The estuary at La Rance is a relatively small steep-sided ria (an estuary created by the flooding of a rocky river valley), with low suspended sediment loads—and therefore has little in common with the Severn which is a large muddy coastal plain estuary with high suspended sediment loads. At the most basic level, the Severn is therefore a dynamic estuary where sediment is key, and which will fundamentally change its shape and function in response to changes in erosion and accretion driven by alterations to factors such as the tidal prism (the cross section of water that flows in and out on each tide), and flow rates etc, while the shape of La Rance is largely fixed by hard substrate.
- The construction of the barrage at La Rance was, according to its operator, the first time that coffer dams were used to facilitate development in the intertidal and subtidal environment. This means that the estuary was completely cut off from the sea throughout the 3 year construction period<sup>99</sup>, thereby

<sup>97</sup> HM Government, 2010. *Severn Tidal Power: Feasibility Study Conclusions and Summary Report*, Pg 5

<sup>98</sup> [http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal\\_tcm9-240984.pdf](http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal_tcm9-240984.pdf)

<sup>99</sup> Pers comm. with the EDF operators of the La Rance barrage

fundamentally changing the nature of the environment upstream of the barrage before the barrage became operational.

- There was no proper environmental assessment prior to the construction of the barrage, and no pre-construction monitoring or survey was undertaken to provide a baseline against which the impacts of the barrage could be monitored. Furthermore, post-construction monitoring of the barrage which became operational in the 1960s did not commence until the 1980s<sup>100</sup>. As such, there is no robust evidence to allow any assessment of the impacts of the barrage on the estuarine system or wildlife at La Rance.
- There are a number of claims made about the environmental performance of the barrage (for example in relation to fish mortality). However, despite repeated enquiries, we are unaware of any robust data to support such assertions.

5.18 Long-ignored during the early stages of the STPFS, research by the RSPB suggested that the construction of a storm surge barrier on the Eastern Scheldt was likely to provide a much more robust comparator for a Severn barrage, and we therefore worked with the Dutch government scientists charged with understanding the impacts of that development to translate key aspects of their research into English<sup>101</sup>, and to provide briefings by those scientists to decision-makers in the UK.

5.19 The construction on the Eastern Scheldt is not a tidal barrage—it is a storm surge barrier, but in the simplest terms it—like a tidal barrage—is a solid wall with holes in, built from shore to shore across an estuary. Instead of turbines (as in the case of a tidal barrage) the holes contain sluice gates, shut only on the highest tides to protect the hinterland from storm surges. We consider the Eastern Scheldt storm surge barrier to be a robust comparator for a Severn barrage because:

- Both the estuaries and the structures concerned are physically similar—construction of large and only partially permeable barriers across dynamic coastal plain estuaries with high suspended sediment loads
- There was extensive monitoring to establish baseline conditions in the Eastern Scheldt prior to construction, and detailed post-construction studies and analysis continue to this day. These studies show that the barrier, constructed in the 1980s, has had, and continues to have, massive negative implications for both wildlife and flood risk including:
  - Significant and ongoing erosion following construction: By c2050 the area of intertidal will have halved - by 2100 only 1500 hectares of the original 11,000 hectares will remain
  - The losses of intertidal habitat due to the construction of the barrier far exceed losses due to sea level rise—5100ha and 1200ha respectively by 2045
  - As intertidal areas in front of flood defences (“dikes”) are lowered or lost to erosion, flood risk increases, resulting in a need for additional investment to protect lives, land and property. Extra costs over the next 50 years on the Eastern Scheldt are estimated to be at best 25–45 million euros, and at worst 90–260 million euros depending on factors such rates of sea level rise
  - As tidal flats are eroded, the area and duration of their exposure for feeding birds is reduced—calculations suggest an 80% decline in Oystercatchers by 2045<sup>102</sup>.

5.20 The RSPB therefore welcomed the findings of the STPFS<sup>103</sup> which noted the short-comings of the La Rance scheme as a comparator for the Severn (in terms of both the lack of pre-and post construction data and the significant differences in the physiography of the two estuaries). Whilst rightly recognising important differences between the Severn and the Eastern Scheldt, the study also concluded that of the three potential comparator sites considered, (La Rance, Annapolis Royale and the Eastern Scheldt), the latter was the only comparator that could be assigned a high level of confidence.

5.21 It is essential that potential comparator sites (which also include Annapolis Royale in Canada and could also include recent developments in South Korea) be assessed to determine their relevance in terms of both similarities between the estuaries concerned and the structures installed, and their value in terms of the available pre-and post construction data available to inform and support impact assessment. Appropriate and well-evidenced comparators should be used to identify the key environmental and technical parameters likely to determine the nature and scale of effects, and to inform assessment of the nature and scale of those impacts. Once impacts have been properly assessed and are understood, it may also be possible to use appropriate comparators to assess the likely efficacy and viability of mitigation and compensation measures. For example, in the Eastern Scheldt there are ongoing studies looking into the viability of options to mitigate against, and compensate for, ongoing losses of intertidal habitat.

<sup>100</sup> Pers comm. with the EDF operators of the La Rance barrage

<sup>101</sup> [http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal\\_tcm9-240984.pdf](http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal_tcm9-240984.pdf)

<sup>102</sup> [http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal\\_tcm9-240984.pdf](http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal_tcm9-240984.pdf)

<sup>103</sup> HM Government, 2010. *Severn Tidal Power: Hydraulics and Geomorphology Topic Paper—Appendix 2: Analogues*, Pg 28

*Q5. What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular, what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

5.22 We note that the STPFS study<sup>104</sup> concluded that the number of jobs created by construction of a Cardiff to Weston barrage could potentially be more than offset by the number of job losses in the region owing to impacts on the Estuary's ports, aggregate extraction, commercial fisheries, and tourism. The net job impact was estimated to fall between minus 1,600 and plus 5,500 (construction phase). In the medium to long-run (operational phase), the total impact on the overall number of jobs in the region was shown to be trivial.

*Q6. Would the project require support under the proposed new Contracts for Difference mechanism? If so, approximately what level of strike price would be required to make the project economically viable?*

5.23 The proposed barrage would require support under the proposed Contracts for Difference mechanism. The cost of building the high-head Cardiff-Weston barrage was previously estimated at over £30 billion, the majority of which was expected to come from public funding. Due to the scale of the risk involved and a lack of confidence in the financial returns, the scheme did not attract private investors. The proposal was dismissed in 2010 because the Government did not think there was a strategic case for public investment in that, or any of the other short-listed tidal power options considered by the STPFS at the time.

5.24 Although few details are known about the Hafren Power proposal, including whether the costs are likely to be more or less than initially estimated, the developers have claimed that the project could be funded entirely by private investors. However, these investors will only commit providing the Government "...stabilizes the electricity price for 25–30 years"<sup>105</sup>, ie the Government introduces Contracts for Difference with a specific strike price for electricity from tidal barrages.

5.25 The Energy Bill (published 29<sup>th</sup> November 2012) does include a mechanism for Contracts for Difference which could involve, initially at least, setting individual strike prices for different technologies. However, the question will be whether the strike price needed to persuade investors that this project represents a sound investment will be significantly higher than that needed for other forms of renewable or low carbon technology. The Government has clearly stated that "any variations agreed will have to represent value for money..."<sup>106</sup>.

5.26 Based on the 2010 cost estimates for the Cardiff-Weston Barrage (in the absence of any equivalent information from Hafren Power), a barrage development would almost certainly require considerable price support, given that it is a relatively uncompetitive technology compared to other forms of renewable energy generation. Any new proposals would need to be subject to a comprehensive economic assessment. In this context it is important to note that according to the STPFS, the costs per MWh of alternative low-carbon technologies may be as little as a quarter of the cost for a large Severn barrage<sup>107</sup>.

5.27 The UK's tidal range resource is very difficult to exploit without causing major alterations to estuarine geomorphology, resulting in unacceptable damage to wildlife and flood risk, and at an unacceptable 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 support through Contracts for Difference would be needed to develop and commercialise lower-impact tidal range technologies. This should be coupled with removal of 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.

5.28 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.

*Q7. How does the company plan to engage and consult the community in the development of the project?*

5.29 The RSPB considers that release in the public domain of the full details of the Hafren Power barrage proposal and assessment of its impacts is an essential prerequisite for an informed debate and effective engagement and consultation. We therefore urge the Energy and Climate Change Select Committee to recommend that this information be made available at the earliest possible opportunity, and that any further consideration of the proposal by Government be postponed until such time as this information has been made available and subject to robust review.

<sup>104</sup> HM Government, 2010. *Severn Tidal Power: Feasibility Study Conclusions and Summary Report*. October 2010. HM Government.

<sup>105</sup> <http://www.guardian.co.uk/environment/2012/aug/20/severn-estuary-tidal-power-project>

<sup>106</sup> <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/energy-markets/7090-electricity-market-reform-policy-overview-.pdf> p.16

<sup>107</sup> HM Government, 2010. *Severn Tidal Power: Feasibility Study Conclusions and Summary Report*.



Q8. *Are the proposals in breach of EU legislation, and if so how will this be addressed?*

5.30 In the absence of any detailed or publicly available information on the Hafren Power proposal, and a detailed assessment of its impacts, it is not possible to provide a properly informed response to this question.

5.31 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*<sup>108</sup>. In the vast majority of development 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.

5.32 For tidal range, we acknowledge that even the least damaging alternative may have adverse effects on the integrity of one or 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.

5.33 Application of the Habitats Directive Article 6(3) and 6(4) tests will act as a litmus test for the viability and acceptability of any proposal. These require that the nature and scale of impacts on all Natura 2000 sites affected (SPAs, SACs and (as a matter of UK Government policy) Ramsar sites) be thoroughly assessed. If it is not possible to ascertain that there will be no “adverse effects” on the integrity of the site or sites affected, development may only proceed if it can be demonstrated that there are no less damaging alternative solutions that could deliver the same *public* interest, that there are imperative reasons of overriding *public* interest why a development should proceed in spite of “adverse” effects on the integrity of Natura 2000 site(s), and that sufficient, adequate and effective compensation can be secured to maintain the coherence of the Natura 2000 network.

5.34 In addition, we believe that the EIA Directive will be relevant due to the size of any proposal, its location and possible impacts it may have. Compliance with the Directive would require inclusion of an outline of the main alternatives studied by the developer and an indication of the main reasons for its choice, taking into account the environmental effects. As a matter of government policy (and good practice) the nature of certain developments and their location may make the consideration of alternative sites a material consideration. More generally, consideration of alternatives (including alternative sites, choice of process, and the phasing of construction) is widely regarded as good practice, and resulting in a more robust application for planning permission. Ideally, EIA should start at the stage of site and process selection, so that the environmental merits of practicable alternatives can be properly considered.

5.35 However, before the above can occur, the SEA Directive requirements should be applied and all possible alternatives considered. The purpose of the SEA Directive is plain—it is to ensure that environmental considerations are properly taken into account at all stages in the decision making so as to ensure that the projects which ultimately emerge have taken into account and sought to limit adverse environmental implications. This is an aid to effective decision making—and is no more than common sense—to think about and design out implications in working up options, rather than seeking to mitigate harm once options have been chosen. Thus it is vital that a full consideration of alternatives occur before a finalised project is identified and proposed.

5.36 The STPFS concluded that a high-head Cardiff-Weston barrage would have an adverse effect on 19 SACs, five SPAs and five Ramsar sites, including not only the Severn SPA, SAC and Ramsar sites but also the riverine SACs upstream of the Severn which would be affected by population crashes and localised extinction of migratory fish species, and other sites including those designated for the bird populations affected. Furthermore, the STPFS found that it was not possible to conclude no adverse effect on another 96 SPAs and 84 Ramsar sites<sup>109</sup>, and it is possible that these numbers would have been higher (particularly in respect of SPAs and Ramsar sites designated for the migratory bird populations), had the study not limited the assessment of effects to UK sites. It was noted that in any future assessment, studies of effects on other Natura 2000 sites (SPAs and SACs) should be considered.<sup>110</sup>

5.37 It seems reasonable to conclude that it would not be possible to progress a scheme with impacts on the scale of those identified by the STPFS for a high-head barrage in compliance with EU legislation because no such development could pass the tests set out for development under Articles 6(3) and 6(4) of the Habitats Directive. Any new proposal would have to reliably demonstrate a scale of impact on geomorphology, hydrology, habitats, birds, fish and other wildlife some orders of magnitude less than those identified by the

<sup>108</sup> Sustainable Development Commission, 2007. *Turning the Tide: Tidal Power in the UK*

<sup>109</sup> HM Government, 2010. *Severn Tidal Power: Report to Inform Stage 2 (Appropriate Assessment) Habitats Regulations Assessment*, Pg xviii

<sup>110</sup> HM Government, 2010. *Severn Tidal Power: Report to Inform Stage 2 (Appropriate Assessment) Habitats Regulations Assessment*, Pg 17, 2.9.5

STPFS in order to potentially satisfy those tests. On the basis of the little evidence available to date we are sceptical that the Hafren Power barrage proposal could achieve this.

5.38 Impacts of any barrage or other tidal power proposal should be mitigated and where possible avoided through good design. In the context of the Severn this will be particularly important in relation to impacts on fish, as we do not consider that population crashes and localised extinction of fish species in the Severn catchment could be compensated for in a way that would secure the coherence of the SAC network for these species as required by the Habitats Directive. Any unavoidable residual impacts (such as loss of intertidal habitat and associated bird populations) must, as a minimum, be brought within the realms of the realistically compensatable on a “like for like” basis and therefore potentially acceptable (subject to rigorous application of the tests set out in Article 6(4) of the Habitats Directive (“alternative solutions”, “imperative reasons of overriding public interest” and compensation secured).

*Q9. Are any other proposals for tidal power projects in the Severn estuary currently under consideration?*

5.39 The Severn Embryonics Technology Scheme (SETS) carried out as part of the STPFS considered a range of innovative, and potentially less damaging tidal stream and tidal range technologies, at least one of which (the VerdErg Spectral Marine Energy Converter) is subject to ongoing development work and testing. In addition, we are aware of a proposal for a land-attached tidal lagoon in Swansea Bay, with a quoted generating capacity of 250/350MW.

5.40 As described at para 1.3, above, the RSPB considers that at this time it is unclear that any acceptable major barrage scheme can be brought forward for the Severn. Instead we would suggest that an alternative approach would be to focus on options for a smaller project, sited so as to minimise its environmental impact and impacts on other estuary users, which could none-the-less generate a significant amount of electricity, and could facilitate a better understanding of the impacts of tidal energy generation at much lower risk to investors, the environment, and the wider business and resident communities.

5.41 We note that RegenSW and partners are advocating a similar approach in a useful new discussion document, “Bristol Channel Energy: A Balanced Technology Approach”<sup>111</sup>, which outlines most of the known ideas for marine energy generation from the Bristol Channel/Severn system and proposes adopting a multi technology approach encompassing concepts such as tidal lagoons and tidal fences, deployed in conjunction with tidal stream technology, wave and wind power. The report’s authors highlight that the key advantage of this approach would be to enable the incremental roll-out of a series of large scale energy schemes as technologies are proven and their environmental impacts can be properly managed. Ultimately they suggest that this lower risk strategy could provide up to 14 GW of low carbon energy capacity and would enhance the UK’s position as a hotbed for new technology development. The RSPB welcomed this discussion document and believes its publication marks a good starting point for a more conscious strategy for building up renewable energy outputs that build in the high nature value of the Bristol Channel and Severn estuary.

5.42 We also note that SW Parsons Brinkerhoff, and as a logical consequence of their work for DECC, the Welsh Assembly Government and the South West Regional Development Agency as lead contractor for the STPFS, have sought to take the lessons learnt from that study and to develop a “next steps” concept—the 600MW “Stepping Stones Tidal Lagoon”. Development of this concept appears to be broadly in line with the approach advocated in the RegenSW report.

5.43 Development of any scheme should be conditional upon its compliance with the requirements of the EIA, SEA and Habitats Directives, and also in our view upon its use to monitor, test and develop tidal power technologies and their impacts. It may be necessary and appropriate for the state to support such activity in order to maximise benefits to inform future technology design and impact assessment, and thereby support future renewables deployment.

*Q10. What could be the wider international implications of the scheme for UK engineering and UK low-carbon industry?*

5.44 We consider this to be a question for industry.

## Annex I

### RSPB COMMENTS TO DECC ON THE OUTPUTS OF THE SEVERN TIDAL POWER FEASIBILITY STUDY

Submitted January 2011

The RSPB welcomes the opportunity to share its views on the outputs of the Severn Tidal Power Feasibility Study. We think that there is much to be learnt from the process that should inform future discussions about the deployment of low Carbon infrastructure. Here we include a commentary on the process, the geomorphological impacts and the interpretation of the regulations.

<sup>111</sup> [http://regensw.s3.amazonaws.com/bristol\\_channel\\_energy\\_balanced\\_technology\\_approach\\_20121127\\_c541010d0b3719f8.pdf](http://regensw.s3.amazonaws.com/bristol_channel_energy_balanced_technology_approach_20121127_c541010d0b3719f8.pdf)

## SCOPE OF STUDY

While it was understandable, from a political perspective, why the UK Government chose to put a spotlight on the Severn and determine how best to harness the power of the estuary, the case for need was not clear and as a result, the debate became divisive. The process would have been helped by establishing the contribution that tidal power needed to make to help move towards a low C economy. This would have provided the right context and justification for exploring the potential contribution from the Severn, compared to other estuaries.

## SEA ENVIRONMENTAL REPORT AND THE SEVERN EMBRYONIC TECHNOLOGIES SCHEME

The RSPB welcomed DECC's decision to conduct a Strategic Environmental Assessment of options for harnessing tidal power in the Severn, and is grateful for the opportunities to provide input through participation in the Steering Group.

The SEA process made a thorough analysis of the five options selected, generating a wealth of valuable information to inform any future proposals to harness the Severn's tidal energy resource. Unfortunately, however, the process for selecting those options was defective in our view, undermining the prospects for finding an acceptable scheme to take forward. The short-listing process over-emphasised technical and economic considerations, thereby favouring established technologies such as large barrages to the exclusion of schemes that seek to minimise environmental impacts from the outset.

While we wholeheartedly welcomed DECC's decision to provide some financial support to the Severn Embryonic Technologies Scheme for technical development, we believe that the decision to exclude these schemes from the full SEA process was a mistake and that it unfairly disadvantaged the SETS developers.

Looking forward, and notwithstanding current financial constraints, we urge Government to provide further funding for research and development on environmentally benign tidal energy technology, and to send a clear signal to the engineering community that, when the debate about harnessing tidal power from the Severn reopens, it would expect all designs to take environmental considerations into account from the outset.

## REPORTS TO INFORM STAGE 1 AND STAGE 2 HABITAT REGULATIONS ASSESSMENTS

These reports serve to confirm the scale of damage that all of the short-listed options would entail, with each having an adverse effect on the integrity of multiple features on multiple Natura 2000 and Ramsar sites.

We note that analysis for both the screening and Appropriate Assessment Reports has been limited to the consideration of Natura 2000 sites and Ramsar sites within the UK, on the basis that the Habitats Regulations, and the jurisdiction of the UK Government and its agencies apply only to Great Britain and Northern Ireland. However, the same cannot of course be said of the Habitats Directive, which applies across Europe. Therefore, any future Habitats Regulations assessment(s) of any option(s) for tidal power generation in the Severn (or elsewhere) must consider effects on all Natura 2000 sites, regardless of their location. This would be in line with the approach adopted by other Member States (eg the Appropriate Assessment of offshore wind proposals in the Dutch North Sea which considered effects on biogeographic seabird populations, including UK breeding colony sites).

## HYDRAULICS, GEOMORPHOLOGY, FLOOD RISK AND LAND DRAINAGE

It is clear that a significant amount of work has been done to investigate the likely impacts of the short-listed options on hydraulics, geomorphology, flood risk and land drainage. However, the value of this is clearly compromised by the high levels of uncertainty around some predictions and limitations associated with the age and paucity of baseline data (an issue which we have raised throughout the STPFS process).

We must also reiterate our comments made in response to both the Phase 1 consultation, and to the SEA 2 H&G Technical Workshop, that the effects of sea level rise and climate change cannot be used to discount the effects of a barrage or other tidal power construction, as there is a separate obligation (under Article 6(2) of the Habitats Directive) to address those. In addition, there is broad agreement amongst the scientific community that protecting, buffering and extending the best sites for wildlife is essential to buy species time to adapt to climate change. Any attempt to discount damage done now against that which may later occur as a result of climate change is therefore logically—as well as legally—flawed.

The results of the hydraulics, geomorphology and flood risk analyses confirm that the hydraulic and geomorphological impacts of all of the short-listed options—and of the Cardiff to Weston barrage in particular—are as severe, if not more so, than previously suggested. For example, the results are broadly consistent with the predictions made by Pethick, Morris and Evans (2009)<sup>112</sup> before the detailed STPFS work had been undertaken.

In particular the results highlight the extent to which technologies often promoted as beneficial to reducing flood risk could in fact exacerbate it, with the Cardiff-Weston barrage predicted to increase flood risk over an area of 372km<sup>2</sup> containing 45,436 residential properties, 5,037 non residential properties and 28 critical

<sup>112</sup> Pethick, J.S., et al. Nature conservation implications of a Severn tidal barrage—A preliminary assessment of geomorphological change. *Journal for Nature Conservation*, (2009), doi:10.1016/j.jnc.2009.04.001

infrastructure assets<sup>113</sup>. They also highlight the extent to which barrage development could exacerbate the erosion of existing flood defences, with the cost of revetment works to address this for the Cardiff-Weston barrage option being estimated at between £672 million and £2,015 million.

Both prior to, and during the life of the STPFS, the RSPB has criticised the inappropriate focus on La Rance as a comparator for the Severn, and we note that the results of the STPFS reinforce the value of the Oosterschelde storm surge barrier as an analogue—in particular in relation to flood risk issues. We therefore warmly welcome inclusion of the Analogues report at Appendix 2 of the Hydraulics and Geomorphology Topic Paper and broadly endorse its assessment of levels of confidence in, and the relevance of, the analogues identified to the Severn case.

#### COMPENSATORY MEASURES AND EQUAL VALUE

The RSPB broadly agrees with the main findings of the assessment of the nature and magnitude of the main compensatory measure requirements identified by the strategic level study, and which of those is, or is not, likely to prove possible to supply on a “like for like” basis. In general, the assessment confirms the RSPB’s view that the ecological impacts of the short-listed schemes would be severe. This is manifest in the efforts to consider so-called “equal value” compensation due to the inability to identify suitable measures to compensate for key impacts: this strains the limits of what could be considered “sustainable”.

The RSPB considers the approach to “equal value” compensation outlined in the SDC paper and the underlying report to be flawed, both legally and from a conservation perspective. It argues for a system of species or habitat “substitution” but fails to justify this in legal or conservation terms. It essentially accepts that network coherence cannot be protected for the impacted species and habitats, thus undermining the purposes of the Habitats Directive. We are disappointed that the SDC report fails to acknowledge legal advice received from WWF and others.

At the other end of the spectrum, the RSPB would suggest that the approach adopted to the definition of “like for like” compensation is sometimes too narrow and unduly constrained. A key reason for this is that it frequently fails to adopt a functional and purposive approach to the compensatory requirement or understand its relationship with the delivery of favourable conservation status (FCS), especially at site level. As a consequence, options that could support FCS at site or network level are unnecessarily ruled out, e.g. the role of saltmarsh in supporting waterbird populations as an alternative to intertidal mudflat provision in locations where roost availability is known to be a limiting factor on foraging.

In this context, we do not agree with the blanket branding of any managed realignment compensation for birds at a distance from the Severn Estuary as “non like-for-like” compensation. The situation is more complex and requires more detailed and case-specific consideration. This is recognised in relation to recommendations for future work, but that complexity is generally downplayed elsewhere in the report.

We disagree with an approach that considers there is greater flexibility in the compensation options for SAC features that are not a “primary reason for selection” compared with those that are a “primary reason for selection”. The EU Habitats Directive draws no such distinction in terms of compensation provision.

The RSPB is concerned that socio-economic impacts were included as a criteria for evaluating compensatory measures, although we note that no options were excluded on this basis. While we would accept their listing as a factor to be aware of for future planning purposes, they should not have been included as a weighting factor in considering the viability of possible compensatory measures.

#### REGIONAL ECONOMICS IMPACTS

Much local and regional interest in a Severn tidal energy project has been focussed on the prospect of a Severnside economic windfall. The feasibility study reports a set of economic impact estimates<sup>114</sup>.

The Cardiff-Weston barrage (by far the largest scheme and associated impacts) with a cost of £20.5 billion and construction taking nine years is expected to generate a net regional benefit (as a central estimate) in terms of GVA of £2.4 billion. In terms of employment, the estimate is for 840 net additional jobs per year during construction and 120 during operation, with this latter figure being based on a range from +800 to—2000, in recognition of the fact that potential negative impacts on the ports industry could actually result in a net loss in employment—not much of a legacy from a £20 billion project. These figures include estimates of leakage and a local multiplier. Impacts of the other barrage and lagoon options are much smaller.

#### LETTERS TO THE EU ENERGY AND ENVIRONMENT COMMISSIONERS

The RSPB welcome the confirmation provided here that environmental legislation was not the reason for the Government’s recommendation not to proceed with a tidal power scheme in the Severn at present, and the clear statement of the Government’s support for the Habitats Directives tests. That said, we were somewhat

<sup>113</sup> These figures are taken from the Flood Risk and Land Drainage Topic Paper—it is noted that these do not match those presented in the STPFS summary report

<sup>114</sup> Severn Tidal Power Feasibility Study Phase 2: Regional Economic Impacts Study Produced by the Welsh Assembly Government on behalf of Severn Tidal Power Feasibility Study Regional Workstream April 2010.

surprised to see the Cardiff-Weston Barrage described as offering “the greatest value for money” of the short-listed options considered by the STPFS, given that the decision not to proceed was attributed in large part to excessive costs and risks for tax payers and energy consumers.

However, the RSPB does not accept the fundamental premise of Ms Spelman and Mr Huhne’s enquiry to the Commissioners—i.e. that large scale renewables projects cannot be delivered without impacts so severe that they cannot be compensated for within the current regime.

The RSPB has repeatedly criticised the folly of an approach which focuses on economic and technical considerations, without due regard to environmental impacts. It is unsurprising that such an approach has led to the identification of schemes which—when their environmental implications are eventually considered—have impacts so severe that they are impossible to compensate for on a like for like basis, and thus impossible to deliver without causing serious and irreparable harm to the environment in general, and Natura 2000 in particular. Instead, we would urge the Government to prioritise action towards finding less damaging schemes which bring impacts within the realms of the compensatable.

The RSPB supports the need for large scale renewables deployment, and recognises that this will not be possible to achieve without causing some environmental harm. However, all possible steps should be taken to avoid and to minimise damage. This is important not just to avoid needless harm but also to help secure public acceptability for these schemes—crucial to the success of the much needed low carbon energy revolution. We would argue that a process akin to the STPFS, if focussed on environmental sensitivities and impacts as a matter of primary concern from the outset, should be able to come up with the least damaging alternative means to harness large scale renewable energy—something that the STPFS has manifestly failed to do.

We acknowledge that even the least damaging alternative may, none-the-less, have significant—and potentially adverse—effects on the integrity of one or more Natura 2000 sites. However, we would argue it should be possible to achieve this within the realms of the compensatable—and would argue that any scheme which fails to comply with the Directives would not be sustainable—a point that was very clearly made by the SDC in their Turning the Tide Report in 2007, prior to the establishment of the STPFS (as presented on Page 15 of the STPFS summary report).

December 2012

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### **Written evidence submitted by Hafren Power**

Hafren Power is a private limited company, incorporated in the UK and owned and controlled by a group of British entrepreneurs and investors. It was previously named Corlan Hafren. It has been created to build and operate a privately financed electricity barrage across the Severn estuary. Thus far, the company has remained dormant while its owners have financed the research and development necessary to bring the project to a point at which the next tranche of private investment could be attracted. The company is now active. In the last six months a team of specialists has been funded to fine tune the business case, verify the technology, address the environmental and commercial issues for the estuary, plan the execution of the project and determine how best to handle both delivery of the project with potential partners and its financing.

A confidential business case and supplementary documentation, prepared for the Department of Energy and Climate Change (DECC), was submitted to government by Corlan Hafren in November 2011 and February 2012. They were also sent to a number of Secretaries of State and Ministers whose departmental briefs touched upon the project. This included a number of Treasury Ministers, and those in the Welsh Office and the Department for Environment, Food and Rural Affairs (Defra). We understand that the document was well received on the basis of encouraging but informal feedback from various ministries, including HM Treasury.

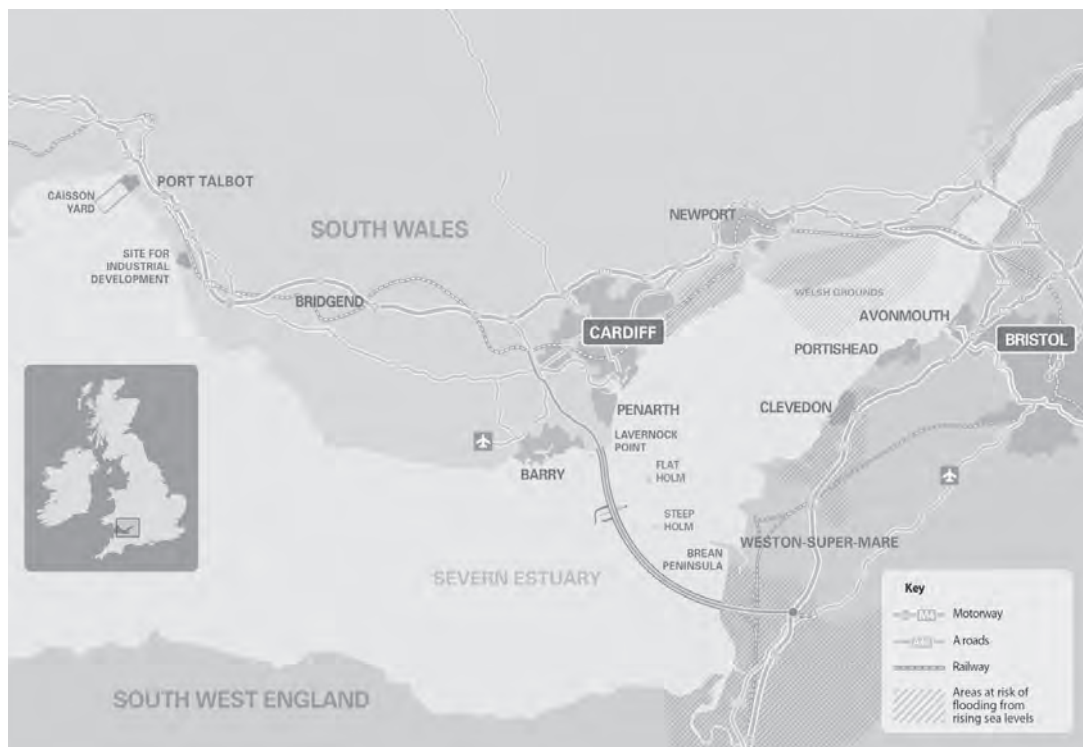
The business case was also shared with the Welsh government, with whom a formal meeting took place in December 2011. Again, the Welsh government was supportive of what the Business Case aimed to achieve, and understood the economic benefits for Wales were the barrage to be built. This October the Welsh Assembly debated the creation of an electricity barrage over the Severn and Hafren Power’s proposal in particular. The Assembly unanimously passed the following motion:

*“The National Assembly recognises the potential to produce renewable energy from the Severn estuary and the importance of such a project for the Welsh Government in achieving its renewable energy targets as well as the potential for the creation of employment and training opportunities; and believes that, in the development of such energy, the technology for extracting such energy should be designed to ensure that as far as is reasonably practical and proportionate, it has the minimum possible environmental impact.”*

Hafren Power is now planning the preparation of an Environmental Impact Assessment (EIA) to support a hybrid bill to be placed before Parliament.

## EXECUTIVE SUMMARY

Hafren Power plans to harness one of the world's largest potential sources of renewable energy: the huge tidal range of the Severn estuary. Building an 18km barrage between Brean in England and Lavernock Point in Wales will be one of the largest privately funded engineering projects in the world.



*Why is the barrage so important to the UK economy?*

Powers 5% of the UK...

- The barrage will be one of the biggest power stations in Europe, producing 5% of the UK's electricity (16.5 TWh/year<sup>115</sup>). One barrage is equivalent to three to four nuclear reactors or more than 3,000 wind turbines. It will offset 7.1m tonnes of CO<sub>2</sub> per year, which according to DECC figures is worth £2 billion net present value to the nation.

...very cheaply for over 120 years

- The barrage will deliver clean, secure, consistent and predictable base-load power generation for at least 120 years, and probably for much longer. For at least 90 years, it will produce by far the cheapest electricity in Britain.

Creates 50,000 jobs...

- Our proposal will regenerate the economies of South West England and South Wales. Construction of the barrage will employ at least 20,000 workers. We plan to set up skills centres to train local residents. The barrage project will induce or indirectly create another 30,000 jobs.

...over 10 years

- We will need two years for design, turbine testing and development, an Environmental Impact Assessment (EIA) and further detailed fish and bird studies, seven years to build the barrage and two years to reach full installation. The barrage could be partially operational by the end of 2020 and at full capacity by the start of 2025.

A £25 billion direct investment into the UK...

- The barrage will cost up to £25 billion to build and will be financed by Sovereign Wealth Funds and other infrastructure investors. It will not require public money for construction. During a time of public-sector contraction, it will provide the UK with a private-sector stimulus, including multiplier effect, of around £70 billion.

<sup>115</sup> 1 terawatt hour (TWh) = 1,000,000 megawatt hours (MWh). Roughly speaking, 1 MWh of electricity is enough to power 1000 homes for 1 hour.

...of which 80% will be spent in the UK

- 80% of the £25 billion investment will remain in the UK. Hafren Power and its associated companies will build components locally and will develop a heavy industry and technology hub by:
  - creating two turbine manufacturing plants, one in Wales the other in the Bristol area for the assembly, build and maintenance of the 1,026 turbines;
  - expanding the steelworks in Port Talbot;
  - building concrete plants and casting basins for the 238 caissons.

*How will the barrage affect the environment?*

Reduces the environmental impacts of previous schemes...

- This proposal focuses above all on mitigating the environmental impact on the Severn estuary. Hafren Power's innovative turbines spin slowly, so fish can swim unharmed through the turbines or bespoke fish passes. Our turbines are also bi-directional and do not hold back high heads of water, so the tides are more natural. This means we preserve 60% more intertidal habitat than previous schemes proposed, saving the feeding and roosting grounds of wading birds.

...and compensates for the remaining impacts

- Around 49km<sup>2</sup> of intertidal habitat will be lost. This is almost the same amount as would be lost anyway due to rising sea levels, according to Defra projections. To create new habitats for birds and to fund other mitigation measures, Hafren Power will invest up to £1 billion.

*Saves the UK billions in flooding costs*

- The barrage will defend 90,000 properties and 500km<sup>2</sup> of flood plains from flooding. Government forecasts of coastal and tidal flood damage and defence costs in the Severn estuary over the next century range from £2 billion to £15 billion on a net present value basis. From 2023, when the barrage structure is complete, taxpayers would therefore save many hundreds of millions of pounds a year in flooding costs.

*A sustainable legacy for Wales and the South West*

A legacy of industry, jobs, and growth

- After construction, Hafren Power will consider converting the caisson casting basins into a port for ultra-large container ships. This ULC port would enable safer navigation and faster transit. The UK would be able to export its expertise in turbine technology and barrage construction from here to many sites around the world.

Boosts tourism and leisure activities

- The calmer estuary waters upstream of the barrage will encourage tourism and water sports. The barrage will be one of the world's great structures, with architectural input from the designers of the London Eye. It will become a major attraction, much like the Øresund Bridge, which was designed by the UK consultant that is engineering the barrage.

*How does the barrage fit into the UK's energy mix?*

Barrage electricity is reliable...

- Tides can be forecast for centuries ahead, making tidal power the most predictable and consistent of all renewable energy technologies. The barrage will produce clean, completely predictable base-load electricity on average for 15.25 hours a day.

...and secure

- The UK currently imports 30% of its energy. The barrage will help reduce fuel imports and price fluctuations, thus improving the UK's energy security. Over the next decade the UK will lose around a fifth of its generating capacity<sup>116</sup>—a gap that the barrage can help fill. By 2030, based on DECC forecasts, the barrage will offset 30% of this "electricity gap".

Power from the moon

- Tidal power is primarily lunar power. All other renewable energy sources are effectively solar: both intermittent sources (wind and wave) and consistent ones (hydro and biomass) ultimately depend on the sun. The barrage will diversify UK energy production by adding tidal to the nuclear, coal, gas and solar-based renewable mix.

<sup>116</sup> DECC, Annual Energy Statement 2012

### What will the barrage cost the nation?

Less than other low-carbon technologies

- Uniquely, the cost of price support can be netted out against savings in flood defence and flood damage, consequent increases in land and property values and the offset of carbon dioxide. Since Hafren Power will fund the construction privately, the barrage will be highly affordable for the nation.

UK's cheapest electricity into the 22nd century

- Uniquely, price support lasts for less than 25% of the barrage's minimum working life. After the initial period of price support, it will produce inexpensive clean electricity at around £20/MWh—a quarter the price of coal, gas or nuclear—for over 90 years<sup>117</sup>. The levelised cost<sup>118</sup> of the barrage is much lower than all other forms of generation, as depicted below.

Severn barrage—the UK's cheapest electricity over 120 years

*Levelised (lifetime) costs, £ per MWh, based on DECC and Committee on Climate Change (CCC) 2011 figures.*

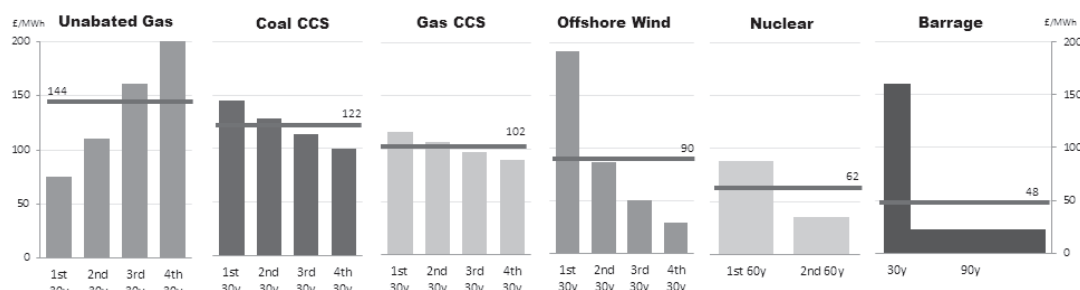
*Barrage chart shows the market price of £160/MWh for the first 30 years, then £20/MWh for 90 years.*

*Levelised costs of coal, gas, wind and nuclear are best possible forecasts, as CCC learning rates are assumed to persist for 120 years and not taper off.*

*Levelised cost of Severn Barrage is worst possible forecast.*

*Assumed lifespans: 30 years for coal and gas plants and wind farms; 60 years for nuclear plants, 120 years for the Barrage.*

*= average levelised (lifetime) cost over 120 years in £ per MWh*



### What does the government need to do?

Authorise the project...

- The government will need to sponsor the passage of a hybrid bill through Parliament, and agree the scope of the Environmental Impact Assessment, public consultation and ratio of habitat compensation.

...and support the electricity price

- In order to provide a commercial return, we require the standard renewable support for 30 years. This price support could be through the Renewables Obligation Certificate (ROC) scheme or a Feed-in Tariff with Contract for Difference (FiT CfD), as introduced in the Energy Bill. If electricity prices rise above an agreed level, FiT CfDs ensure that consumers benefit from the rise.

### Q1. What contribution could the Cardiff-Weston barrage make to UK energy security and climate change objectives?

The barrage will make a positive contribution to both energy security and climate change objectives. It will also enrich and diversify the energy mix.

#### Energy Security

1. The key benefits provided by the barrage for security of UK electricity supply are diversity and predictability. The barrage will harvest the electricity from the world's second largest tidal range (14 metres), not only capturing power from a massive latent national asset, but also thereby reducing dependence on non-renewable fossil fuels and introducing a highly desirable diversification into the mix of renewable energy generation. The barrage<sup>119</sup> would generate on average for 15.25 hours out of the 24 hour 50 minute tidal cycle, generating on both ebb and flood tides to provide annually 16.5 TWh<sup>120</sup> of low carbon renewable energy. Relative to the National Grid Gone Green scenario<sup>121</sup> of 328 TWh, this represents 5% of UK electricity demand. This amount of electricity is equivalent to that produced by three to four nuclear reactors.

<sup>117</sup> Committee on Climate Change, *Cost of low carbon technology*, 2011

<sup>118</sup> The levelised cost is the cost of generation, including capital costs, averaged over the life of a generating asset.

<sup>119</sup> Figures taken from Hafren Power document "The Severn barrage project overview", November 2012.

<sup>120</sup> 1 terawatt hour (TWh) = 1,000,000 megawatt hours (MWh). Roughly speaking, 1 MWh of electricity is enough to power 1000 homes for 1 hour.

<sup>121</sup> As per National Grid UK Future Energy Scenarios, September 2012, "Gone Green" scenario and confirmed by Arup knowledge of the Industrial Emissions Directive (IED) requirements (a limit of industrial and power plant emissions)



2. Variability of output is one factor for power provided by a barrage as it is dependent on tidal cycles that have slack periods. More importantly, however, the barrage can be considered as variable “base load”<sup>122</sup> generation, since the tides are entirely predictable. Tidal power is lunar<sup>123</sup>, being dependent on gravity, principally from the moon. Tides can be predicted hundreds of years in advance. This means that electricity from the barrage is completely predictable. Whilst other renewables are intermittent and unpredictable, the barrage would provide consistent and predictable electricity. This predictability allows the national system operator to know, with considerable certainty, the output that would be provided by the barrage in any future half-hour period. Wind, wave and solar renewable energy sources are intermittent and unpredictably variable with the disbenefit that, overall, it is difficult to know what availability can be relied upon. This specifically reduces the security risk that could arise from a widespread period of low wind across the UK. Indirectly is also reduces the risk from fossil fuel interruptions, especially gas, whilst increasing the UK’s energy resilience and reducing the balance of trade deficit.

3. Variable base load power is superior to intermittent generation because it enables predictable balancing of supply and demand. This is likely to be further reinforced by the development of storage technologies and the increased use of electric vehicles (inherently these are dispersed storage) so that the predictable but variable barrage base load will be able to be matched with demand profile. By 2025 it is anticipated that fully functioning dynamic demand response (DDR) measures will be in place using smart grid and smart meter technology. This will be particularly well suited to balance the predictable variability of the output of the barrage.

4. Unlike conventional power plants, the barrage is not susceptible to “single-point failure”. As electricity from the barrage is generated by 1,026 very-low-head (VLH) bi-directional turbines, the loss of one or more turbines due to breakdown would cause only minimal reduction in total output, whereas for nuclear, for example, the loss of a reactor would reduce output significantly, by as much as 1.65 GW<sup>124</sup>.

5. By 2020 the UK will face an electricity generation gap<sup>125</sup> of 60 TWh and will require a mix of generation sources to meet this need. The UK will lose around a fifth<sup>126</sup> of its current electricity generating capacity over the next decade as old plants reach the end of their lives. By 2025, when the barrage is in full operation, most existing coal-fired plants are planned to be closed.<sup>127</sup> The barrage will provide a major component of the new required replacement generation, as depicted in Figure 1.

6. It has recently been announced that much of the coal-fired generation will be replaced by up to 30 new gas-fired turbine plants<sup>128</sup>. These have the flexibility to complement the barrage power generation profile, filling the fully predictable periods of non-generation. However, gas is still a fossil fuel, albeit half as pollutive as coal, so it will not contribute to meeting the UK’s renewable energy targets.

7. It is understood that the new power plants will be fired by gas imported primarily from Qatar and Norway<sup>129</sup>. To an extent which is unclear at this early stage, gas may also be available through fracking. The barrage will generate electricity securely through the movement of tides in British waters.

8. Hafren Power is exploring the opportunity to use the barrage for pumped storage. When other renewables produce surplus energy, the barrage could pump and store water, ensuring that excess electricity is not wasted. The scale of the barrage is such that even if pumped storage is only used to a limited extent, it could nevertheless provide a significant boost to the UK’s pumped storage capacity.

<sup>122</sup> Electricity power demand varies through daily and seasonal cycles, with some of the demand being longer term and other aspects being more peaky and shorter in duration. The “base load” represents the longer duration, constant component of the demand profile.

<sup>123</sup> Tidal motion is dependent on gravitational attraction and interactions from various planets, but principally the moon and the sun. As a result power is lunar, being dependent on gravity from the moon, and tidal elevations, and hence energy generating potential, can be predicted hundreds of years in advance.

<sup>124</sup> 1 gigawatt (GW) = 1,000 megawatts (MW)

<sup>125</sup> DECC, Updated Energy & Emissions Projections, October 2012

<sup>126</sup> DECC, Annual Energy Statement, 2012

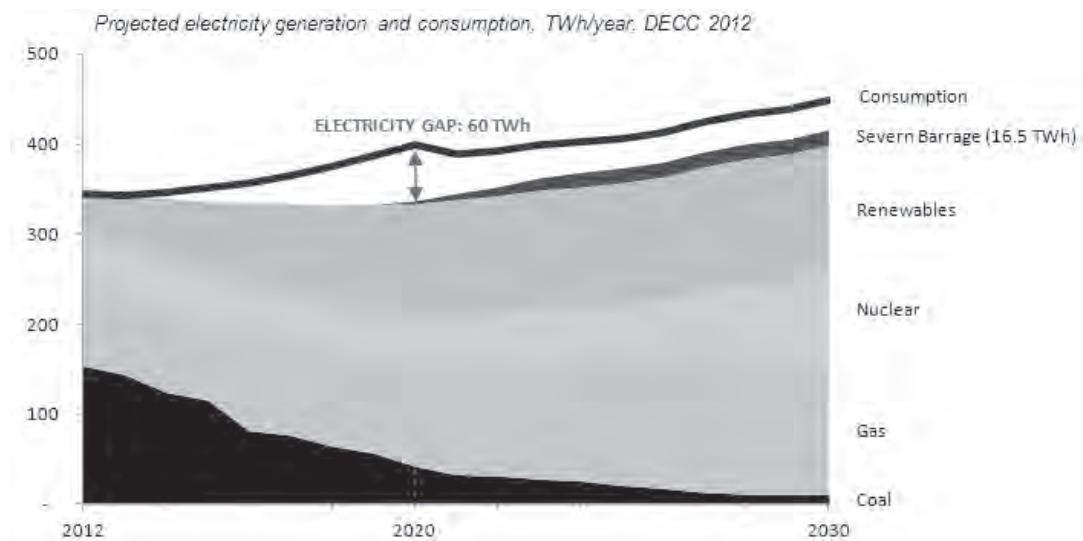
<sup>127</sup> As per National Grid “Gone Green” scenario and confirmed by Arup knowledge of the Industrial Emissions Directive (IED) requirements.

<sup>128</sup> Financial Times, “Chancellor backs gas to fire up Britain”, December 3 2012.

<sup>129</sup> DECC, Digest of UK Energy Statistics 5.4

Figure 1

## SEVERN BARRAGE REDUCES ELECTRICITY GAP BY 30%

*Contributing to Climate Change Objectives*

9. The barrage will save 7.1m tonnes of CO<sub>2</sub> per year compared to equivalent fossil fuel generation. It will be carbon neutral after the first 2.1 years of operation. This payback period secures a much longer period of zero carbon generation of at least 118 years—much longer than all other renewables.

10. The government's energy and climate change goals are "reforming the electricity market for purposes of encouraging low carbon electricity generation or ensuring security of supply"<sup>130</sup>. The government intends to use a variety of sources for energy—nuclear, coal, gas, wind (onshore and offshore), biomass, wave and tide. It is also understood that, to fill any gap in production of electricity, the government will import the shortfall in the form of liquefied gas. Not all of these sources support binding commitments towards the 2050 carbon emissions target. The barrage does.

11. The Climate Change Act 2008 sets legally binding targets to reduce greenhouse gas emissions by at least 80% below 1990 levels by 2050, with an interim target of 35% by 2020<sup>131</sup>. The 2009 Renewable Energy Directive sets a target for the UK to achieve 15% of its energy consumption from renewable sources by 2020.

12. The Department of Energy and Climate Change (DECC) estimates that the 2020 target of 15% renewable energy converts to a 31% renewable *electricity* target<sup>132</sup>. On this basis, if the total end user electricity demand by 2020 is 328 TWh<sup>133</sup>, this would suggest that 102 TWh should come from renewable sources. The barrage, at 16.5 TWh, therefore represents 16% of this 2020 target renewable power share. Hafren Power is engaging with experts to investigate the compression of the construction period to assess whether it is possible to produce some initial electricity by 2020. Although the barrage will probably not be generating at full capacity until 2025, the EU will look favourably on schemes under construction.

13. The Committee on Climate Change's objective is to decarbonise the UK power generation sector by 2050 (i.e. <50g CO<sub>2</sub>/kWh). In 2011, the power sector mean carbon intensity was 486g CO<sub>2</sub>/kWh<sup>134</sup>. If the 50g target by 2050 is met, the value of the barrage's carbon offset, according to DECC's central forecast for carbon prices<sup>135</sup>, is £2 billion net present value over the life of the barrage. However, if the 2050 target is not met, then this offset will be worth far more.

14. If some degree of pumped storage were to be introduced, as mentioned above, the carbon offsetting value of the barrage would also be significantly increased, as well as its contribution to the financial value of the re-sale of peak demand electricity.

15. Norway produces 98% of its domestic electricity from hydro power. After making substantial initial investment to build their hydro plants, Norway now enjoys wholesale electricity prices 65% lower than in the

<sup>130</sup> The Energy Bill 2012

<sup>131</sup> 35% rather than 34% for the 3rd Budget (2020). These percentages have changed since 2009 when legislated and quoted in the Low Carbon Transition Plan (DECC (2009) The UK Low Carbon Transition Plan) owing to an update in the National Greenhouse Gas Inventory which revised total 1990 baseline UK GHG emissions from 777.4 MtCO<sub>2</sub>e to 783.1 MtCO<sub>2</sub>e. This number is the denominator in this calculation, hence while the budget levels (in MtCO<sub>2</sub>e) have not changed, the 1990 baseline and percentage reductions have.

<sup>132</sup> Public Accounts Committee—Seventh Report, Funding the development of renewable energy technologies, November 2010

<sup>133</sup> National Grid, *Future UK Energy Scenarios*, "Gone Green" Scenario, September 2012

<sup>134</sup> The Committee on Climate Change 2012 Meeting the Carbon Budgets—2012 Progress Report to Parliament

<sup>135</sup> DECC, Updated short-term traded carbon values used for UK public policy appraisal, October 2012

UK.<sup>136</sup> In the same way, after the 30 year period of price support, the barrage will be the cheapest electricity source in the UK for at least the next 90 years, producing electricity at just £20/MWh.

16. Hafren Power submits that the barrage will generate much cheaper electricity than all other generating sources when cost is considered, as it should be, over the full lifetime of the generating assets. Coal and gas plants and offshore wind farms only operate for a maximum of about 30 years. Over the 120-year minimum life of the Barrage, therefore, these other types of generating assets would need to be built or substantially replaced four times. Similarly, nuclear plants, with a lifespan of about 60 years, would need to be built twice. To make a fair cost comparison with the Barrage, therefore, the levelised costs of offshore wind, nuclear, coal and gas must be averaged over several cycles (the red line in Figure 2, below). As shown in Figure 2, over its 120-year life, the Barrage will be the cheapest electricity source in the UK, with the lowest levelised cost.

**Figure 2**

**SEVERN BARRAGE—THE UK'S CHEAPEST ELECTRICITY OVER 120 YEARS**

Levelised (lifetime) costs, £ per MWh, based on DECC and Committee on Climate Change (CCC) 2011 figures.

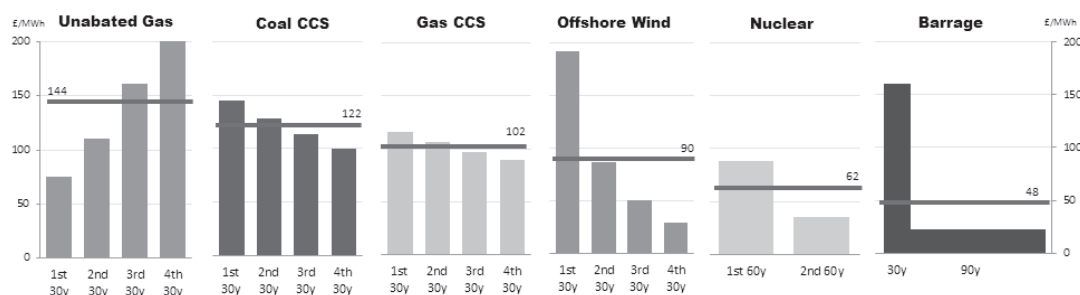
Barrage chart shows the market price of £160/MWh for the first 30 years, then £20/MWh for 90 years.

Levelised costs of coal, gas, wind and nuclear are best possible forecasts, as CCC learning rates are assumed to persist for 120 years and not taper off.

Levelised cost of Severn Barrage is worst possible forecast.

Assumed lifespans: 30 years for coal and gas plants and wind farms; 60 years for nuclear plants, 120 years for the Barrage.

— = average levelised (lifetime) cost over 120 years in £ per MWh



**Q2. What risks and opportunities could the Severn barrage pose with regard to flooding in the Severn estuary and how might any risks be mitigated?**

The Severn estuary at present suffers from major flooding and is at risk of extreme events such as storm surges. The barrage will provide a means of controlling both tides and water flow, defending the estuary's residents from marine flooding and producing significant flood cost savings for the nation.

17. The barrage and turbines will be operated to eliminate coastal, storm and tidal flooding upstream (to the east of the barrage). The barrage will defend an estimated 50,000 hectares of land from flooding and protect 90,000 existing properties<sup>137</sup> for at least 120 years, in much the same way as the Thames Barrier protects London. Therefore, as well as saving the anticipated costs of flood damage in this area as sea levels rise, the barrage will also enhance the value of the land thus protected for potential commercial, industrial and residential development. It will also reduce insurance risk and consequently premiums for properties and companies in the region. The map below illustrates the extent of existing flood risk.

<sup>136</sup> Statistics Norway, Electricity prices in the wholesale market, Q3 2012

<sup>137</sup> Department of Energy and Climate Change, 2010. Severn Tidal Power—Sea Topic Paper (Flood Risk and Land Drainage)

**Figure 3**  
**ENVIRONMENT AGENCY FLOOD RISK MAP**



18. As Hurricane Sandy in New York demonstrated in October 2012, storm surges can be devastating. In 2010, a storm surge from the Atlantic, dubbed Xynthia, narrowly missed the Severn estuary. When it made landfall in France, it overwhelmed flood defences and caused €1.3 billion of damage<sup>138</sup>. Funnel-shaped estuaries, such as the Severn, exacerbate the threat. The notorious 1607 Great Flood, which inundated swathes of the Severn and Bridgwater flood plains, resulting in considerable loss of life, is now believed to have been a storm surge and not a tsunami<sup>139</sup>. As sea levels rise over the next century, the incidence of severe storm and tidal events (depicted in Figure 4) are expected to increase. According to DECC, the Severn estuary can expect surges of 2m above the normal tide<sup>140</sup>. The barrage will be designed to ensure that such events could not overwhelm Cardiff, Bristol and Newport and would protect all upstream coast line. In the event of extreme weather, the barrage would simply be closed and act as a sea defence. It is hard to place a clear monetary value on this protection. However, it is undoubtedly substantial, as extreme weather becomes a more regular natural phenomenon around the world.

19. The Department for Environment, Food and Rural Affairs (Defra), the Environment Agency and DECC predict that over the next century annual average flood damages in the Severn estuary will increase as sea levels rise. However, their projected costs of flood damage and defence vary substantially, from £2 billion to £15 billion on a net present value basis<sup>141</sup>. It is incontestable that the construction of the barrage will result in substantial reductions in flood costs. On the basis of these government numbers, Hafren Power estimates that the barrage will reduce flood costs by at least £2 billion but probably closer to £8.5 billion net present value. This is a saving to taxpayers and to the nation. Hafren Power has sought to verify the government cost estimates with Defra, but has been unable to arrange meetings to do so. The estimates will be refined and discussed with Defra and the other relevant government departments in the course of preparing the Environmental Impact Assessment.

20. Hafren Power is studying the option of building a Bridgwater Bay bund to protect the 160,000 hectares of Somerset Levels from seawater flooding, which would otherwise be particularly vulnerable to sea-level rise. The bund could comprise an additional small barrage with locks and turbine electrical powered generation.

21. Further analysis is provided in Appendix Item 1.

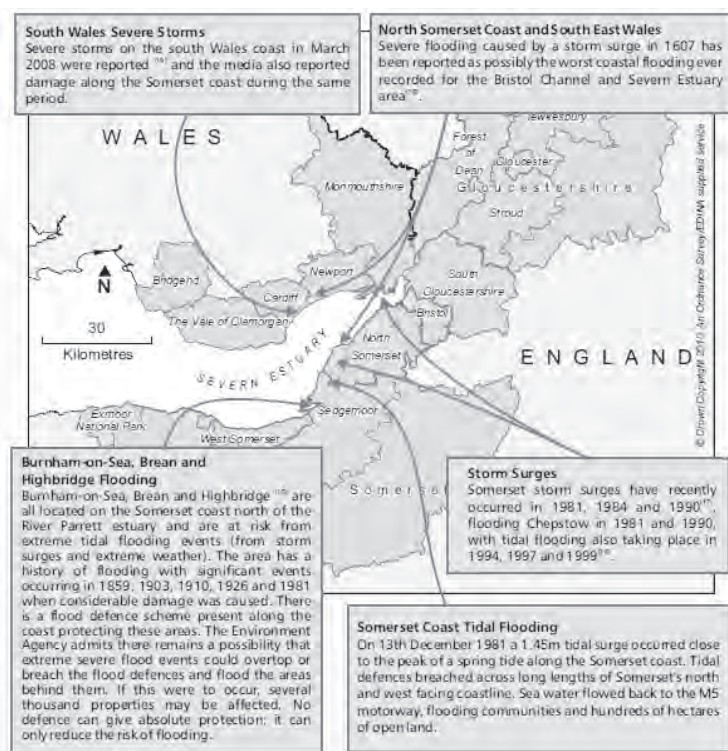
<sup>138</sup> Cour des Comptes, *Lessons from the 2010 floods on the Atlantic coast (Xynthia) and in the Var*, July 2012

<sup>139</sup> Study commissioned by Defra Flood Management, *The threat posed by tsunami to the UK*, June 2005.

<sup>140</sup> DECC, *Severn Tidal Power Feasibility Study Conclusions and Summary Report*, October 2010.

<sup>141</sup> Net present value is the value in today's money of a series of future cash flows.

Figure 4

EXAMPLES OF SEVERE STORM AND TIDAL EVENTS AFFECTING THE SEVERN ESTUARY<sup>142</sup>

Q3. What risks and opportunities could it pose to wildlife and habitats in the Severn Estuary and how might any risks be mitigated?

The barrage will affect both birds and fish. Hafren Power will work with all stakeholders to minimise this impact to a level that is as low as reasonably possible. Hafren Power's turbines will be designed to be fish friendly and additional mudflats can be created.

22. The barrage was designed from the outset with concern for its impact on both birds and fish uppermost. Hafren Power is already engaging with all stakeholders to minimise this impact to a level that is as low as reasonable possible. Hafren Power's turbines will be designed to be fish friendly and additional mudflats can be created for wading birds.

23. There will be a number of changes to the tidal regime upstream (to the east) of the barrage:

- Reduction in tidal range: for spring tides, the range would reduce from around 14m to around 10m.
- Reduction in tidal currents: the bed of the estuary will be subject to less erosion.
- Reduction in suspended sediment levels: increase in light penetration through the water column.
- Increase in photosynthetic activity: enhanced biodiversity in the estuary.
- Reduction in wave heights and turbidity.

24. The main risks of the barrage to wildlife and habitats of the barrage would be:

- *Intertidal habitat* (mudflats and saltmarsh): This is protected under the EU Habitats Directive and the Ramsar Convention. The spring tidal range upstream of the barrage will reduce from 14m to around 10m. This will reduce intertidal habitat by 49km<sup>2</sup> and affect biodiversity. However, current projections for a sea level rise of 0.76m by 2095<sup>143</sup> will reduce intertidal habitat anyway by around 30km<sup>2</sup>. Sea level rise of 1.43m by 2140<sup>144</sup> will increase the loss.
- *Wintering birds*: These rely on intertidal habitat and are protected under the EU Birds Directive and the Ramsar Convention. Changes in tidal regime and estuary morphology would affect the extent, availability and quality of the intertidal feeding resources and therefore the appeal of the estuary to vulnerable and dependent species in the absence of appropriate mitigation.

<sup>142</sup> Severn Estuary Partnership | Climate Change Report Card 3: Sea level, waves, storms and surges (Sept. 2010)

<sup>143</sup> UK Climate Projections 2009, UKCP09: Briefing Report, [http://www.ukcip.org.uk/wordpress/wp-content/PDFs/UKCP09\\_Briefing.pdf](http://www.ukcip.org.uk/wordpress/wp-content/PDFs/UKCP09_Briefing.pdf)

<sup>144</sup> Defra FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities—Climate Change impacts, October 2006



- *Migratory fish*: These move past the barrage line and six species are protected under the EU Habitats Directive. For fish, the main risks are likely to be damage passing through turbines or from pressure, disorientation leading to predation and delays to migration and predation.
- *Other risks*: These include secondary effects on terrestrial and marine ecology further afield as a result of the proposed development (temporary and permanent works, ancillary and associated development), impact on habitats downstream of the barrage affected by flooding and the economic impact on businesses dependent on the estuary i.e. fishing etc.
- The impact on biodiversity will be mitigated through the operation of the barrage and the optimisation of the turbine design. The development of turbines specifically designed to allow safe transit for fish and crustacea (eg shrimp) is key to this proposal, and there has been considerable progress in the past few years by manufacturers worldwide—such as Rolls Royce, Voith, MJ2 Technologies, and Alstom—who recognise the absolute significance of this to the future of tidal energy. Hafren Power will work in collaboration with several manufacturers. Among them, Rolls Royce<sup>145</sup> have designed a high efficiency turbine which also has “fish friendly” characteristics including: low risk of physical damage, low turbulence and low pressure changes. Research and product design is on-going in conjunction with turbine manufacturers and with internationally recognised aquatic biologists. The objective is 100% survival of all species of fish transiting the barrage, including resident marine species.
- The bi-directional VLH turbines require a much lower head of water than conventional bulb turbines and so can operate both across the breadth of the estuary and over a longer part of the day. They generate on flood as well as ebb tides, in contrast to conventional bulb turbines, and will more closely emulate the natural tidal flows. This results in significantly less damage (up to 60% less) to intertidal habitat than previous proposals.
- The tip speed of the turbine blades (around 9m/s) will be significantly lower than for conventional bulb turbines (around 25m/s). Turbines operating at below 12m/s result in negligible fish mortality<sup>146</sup>.
- Turbine design will be optimised to minimise the runner gap (the area between blade tips and turbine casing) and other potential sources of fish trapping and damage.
- The turbines will have geometry that can be varied during operation to pass more or less flow and also to control any rates of change of pressure to reduce incidences of fish injury from pressure during passage through the turbines.
- These provisions are expected significantly to reduce the risk of strike and pressure damage as well as the disorientating effects of the turbines on fish passage and thus the propensity for fish predation around the barrage without them.
- Screening technologies will be considered for reducing or preventing the passage of fish through the tidal energy turbines. These are likely to be based on behavioural guidance, which exploits the reactions of the fish, such as a preference for swimming in specific parts of the channel or in specific layers of the water column. This would include consideration of fish ladders, which over the past decade have been developed by the US Army Corps of Engineers together with turbine manufacturers, or by using bubble technology to guide fish into fish passes.

25. Other mitigation measures include:

- Bridgwater Bay bund: As part of its mitigation strategy, Hafren Power is studying the option of building a bund around the entrance to the Parrett River. This would defend shelduck breeding grounds in Bridgwater Bay and Stert Point, as well as defending Bridgwater and the Somerset levels from sea-level-rise induced flooding.
- Marine construction works: These can provide additional or improved intertidal mudflats and saltmarsh habitat for wintering birds upstream of the barrage. For example, topographic raising to increase foraging space for wading birds which, in combination with habitat enhancement, can improve quality of feeding, ameliorating the loss of habitat. Salt marsh creation is also beneficial to support wildlife and offset habitat loss.
- Preventing the recession of salt marshes: A benefit of reducing the tidal range, current speeds and wave heights will be to reduce the current progressive recession of salt marshes and thus bird foraging around the perimeter of the estuary. This was demonstrated in recent geomorphological studies for Welsh Water to be around 1m per year over the past 120 years.
- Proposed compensation for residual loss of intertidal habitat: It will not be possible to retain the entire intertidal habitat that currently exists in the Severn estuary, with or without a barrage. Therefore, following mitigation works, and in order to offset this loss, it will be necessary to create compensatory habitat for the residual losses (which includes improvements to habitats elsewhere).

<sup>145</sup> Atkins PLC and Rolls Royce Limited 2010: Concept Design of a Very Low Head Dual Generation Tidal Scheme for the Severn Estuary. Volume 1: Summary Report

<sup>146</sup> US Department of Energy (Idaho Operations Office), A Summary of Environmentally Friendly Turbine Design Concepts, 1999

26. The barrage will create a number of opportunities:

- Changed sediment characteristics, resulting from decreased turbidity upstream of the barrage, decreased erosion and increased deposition of fine sediment.
- Reduced turbidity will increase light penetration and photosynthesis and result in an increase in biological productivity.
- Higher invertebrate densities, greater fish populations and better opportunities for birds to feed as a result of probable increases in water temperatures.
- Improved habitats such as salt marshes, although changes in the tidal range may affect the balance of the bird species in the estuary.
- An increase of life in the estuary facilitated by the consequential increase in dissolved oxygen levels
- Support for as many, or even more, wading birds and wildfowl<sup>147</sup> than at present, based on comparison with other UK estuaries, even though the species composition might change.

27. The barrage provides the UK with one of the great conservation opportunities. Hafren Power has begun speaking to NGOs and to Swansea University about the potential to create the equivalent of several Newport Wetlands, Slimbridges or Wallasea Islands.

*Q4. What lessons can be learned from the successful development of La Rance tidal barrage in France and other tidal power projects?*

The La Rance barrage has proved the concept of tidal power. It now generates the cheapest electricity in France at €20 per MWh. Wildlife and fish proliferate around the La Rance barrage and its construction has provided the region with an economic stimulus that is still ongoing after nearly 50 years. Hafren Power will engage with the operator at La Rance to gain full knowledge of the lessons learned and best practice.

28. The Severn barrage has the potential to generate much more electricity than the La Rance barrage. However, La Rance embraces the same fundamental principles as proposed by Hafren Power. La Rance has for 46 years produced cheap, predictable, consistent power (240 MW). It provides the cheapest electricity generated anywhere in France, currently at around €20/MWh. No turbines have needed replacement. Based on the proven experience of La Rance, the Severn barrage should produce very cheap electricity for the nation over many years without significant mechanical problems and without a need to replace turbines regularly. The prime difference between the Severn project and La Rance is the scale of the Severn and the much greater contribution it can make to the UK's national energy needs.

29. La Rance was constructed using a cofferdam, which involved draining all the water from the basin. Consequently, there was significant impact on wildlife during the three-year build. However, less than a decade later, the estuary was richly diversified, with over 70 fish species, 110 worm species, 47 crustacean species and 120 bird species<sup>148</sup>. There is even a seal that lives in the basin. As construction took place in the 1960s, it is unclear whether a survey of wildlife was conducted prior to construction. It is therefore difficult to draw definitive rather than anecdotal conclusions.

30. La Rance barrage has become a tourist attraction, with around 50,000 visitors per annum. It has regenerated the surrounding area by providing a steady stimulus, creating new jobs and economic activity in the form of oyster and scallop farming. A new road over the barrage is also a benefit to the local region and in connecting communities.

31. In the case of the Severn, the potential stimulus is very much greater than this. The Hafren Power project will regenerate the whole region of South Wales and South West England. It is likely to attract many more tourists than La Rance, as it would be on the scale of the Øresund Bridge or Millau Viaduct. Upstream, calmer and clearer waters will provide the right conditions for the development of a marina-driven tourist industry, previously impossible in the Severn's fierce tides and currents. The construction of the barrage and its supply chain will provide a major increase in regional and national employment. The creation of two large turbine manufacturing plants for the manufacture, assembly and maintenance of the installed equipment, one in Port Talbot and one in the Bristol area, will lay the foundation for a new export-led industry. As has been the case at La Rance, the stimulus will therefore carry on beyond the construction of the barrage itself.

32. There are other examples of tidal barrage projects around the world. The Cardiff Bay barrage, completed in 1999, provides further solid evidence of the positive regenerative outcome which could be expected. The Sidney A. Murray Jr barrage at Vidalia on the Mississippi, built in 1989, has produced similar results to La Rance. The recently constructed Sihwa Tidal barrage Scheme in South Korea has addressed similar issues to the Severn barrage. Hafren Power is learning as much as it can from these barrage projects, has consulted with all the leading turbine manufacturers and scheme designers, and will seek to incorporate their best practices into its design.

<sup>147</sup> This includes swans and geese which are also part of the estuary designations.

<sup>148</sup> EDF, *La Rance Tidal Power Plant—40 year operation feedback and lessons learnt*, 2009

*Q5. What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

The construction of the barrage will provide a major opportunity to increase employment in the region and to create a new UK based renewable technology. Some local communities will be affected during construction, but Hafren Power will consult with all stakeholders to keep disruption to a minimum. During construction of the barrage, all significant ports in the region will be kept very busy. All ports upstream will be able to continue their businesses, as today, both during and after construction of the barrage.

33. Hafren Power estimates that 20,700<sup>149</sup> direct jobs will be created in South Wales and South West England over the ten years of its construction. These will be supplemented by a further 30,000 indirect and induced jobs<sup>150</sup>. The influx of material in the shape of hard rock, cement, sand and other construction material is likely to create much increased activity in all the ports in the region, especially in Bristol, Cardiff and Port Talbot. The ports will also have a major role in supporting the extensive maritime fleet that will be utilised during construction and, afterwards, in servicing and maintenance. The increased activity that will result is likely to provide a substantial new impetus not only in each of these cities but also to the economy of the region. According to a study commissioned by the UK Contractors Group<sup>151</sup>, every £1 spent on construction output generates a total of £2.84 economic activity, i.e. GDP increase. Once the barrage is completed, there will be a permanent staff of around 1,000 working on the barrage alone—24 hours a day, 365 days a year. It is highly likely that, as with La Rance, the general stimulus in the region over 10 years, combined with the tourist opportunities and enhanced local infrastructure, will result in a permanent upswing in economic activity there. Hafren Power will offer opportunities for many local companies and small and medium-sized enterprises to work in the supply chain.

34. The barrage will consist of an 18km line of large caissons (approx. 75m x 50m x 30m). These caissons will be constructed in specialised casting basins, most likely in Port Talbot. It is intended to create two manufacturing plants, one in Wales and the other in the Bristol area for the assembly and maintenance of 1,026 turbines. Additionally there will be many further job opportunities in areas such as concrete/cement manufacture, mechanical, civil and electrical engineering, turbine manufacture and maintenance, environment management, project management/supervisory, managerial and administration.

35. It is Hafren Power's intention to work with local partners in the South West and South Wales to offer civil and mechanical engineering training and apprenticeship schemes and, if necessary, to open its own training centre. The barrage team intends to work closely with local employment and skills schemes and colleges, not only for the supply of trained staff for the project, but also to make the technology exportable thereafter, potentially creating new longer-term job opportunities for those with specialist skills.

36. More generally, the barrage will make the estuary a safer and more attractive place to live by calming conditions upstream. The creation of a new maritime recreational activity—in an area at high tide of 500km<sup>2</sup>, equivalent to 1.5 times the size of Lake Garda—will clearly create jobs in tourism. The precedent of the Cardiff Bay barrage is a good indicator of the regeneration and development potential and the associated employment and community benefits that come with it. The challenge would be to realise this opportunity.

37. There will be locks in the barrage to allow all current shipping movements. There should be minimum delay to shipping, which anyway already has to wait to move upstream for an appropriate tide. The estuary will be dredged to ensure shipping lanes are kept open with minimal inconvenience to navigation. Hafren Power intends to minimise any impact on current business at ports upstream.

38. The barrage may help regenerate fishing in the area as has happened in La Rance. The increased photosynthesis and nutrients in the waters upstream of the barrage could stimulate to the creation of new mollusc and fish farming industries.

39. Hafren Power is in discussion with The Crown Estate over long-term lease of the sea bed and the need for aggregate and sand. The Crown Estate has the remit to maintain and increase the value of its assets including the UK coastal areas. The barrage has the opportunity to support these objectives, as it will need their aggregate from the estuary to construct the barrage and create new wetland areas.

40. By eliminating the upstream risk of coastal, storm and tidal flooding and the impact of sea level rise, the barrage would increase land and property values in the upstream region, and facilitate inward investment for commercial and industrial development.

<sup>149</sup> Full time equivalent jobs.

<sup>150</sup> Direct employment is directly related to construction. As a result of this direct employment, employment is also generated indirectly in businesses that supply goods and services. Finally, when these directly and indirectly generated incomes are spent and respent on a variety of items in the broader economy (e.g., food, clothing, entertainment), it gives rise to induced employment effects. (Adapted from [www.ccfm.org](http://www.ccfm.org))

<sup>151</sup> Source ONS (2002); LEK analysis for Construction in the UK Economy—A Study commissioned by the UK Contractors Group. This increase in GDP may be broken down into £1 direct impact (wage income and corporate profit generated in the construction sector), £1.09 for indirect impact (supply chain impacts of construction and their knock-on effects) and £0.75 for induced impact (increase in household income as a result of increased employment where income in construction and other sectors leads to increase in spending and demand/output in the overall economy).



41. It is clear that the construction of a barrage of this nature could facilitate the creation of permanent road and rail links. Hafren Power plans to build the barrage as a power station and that is the full extent of the proposal. However, if it is felt desirable, Hafren Power is open to discussion with government and other parties over the possibility of road and rail links. It should be noted, however, that a decision on this question would be needed at an early stage since the design of a barrage to carry road and/or rail would differ significantly from a barrage for the generation of electricity only.

*Q6. Would the project require support under the proposed new Contracts for Difference mechanism? If so, approximately what level of strike price would be required to make the project economically viable?*

In common with all other renewables, the project will require support from the Feed-in Tariffs with Contract for Difference (FiT CfD) or Renewables Obligation Certificate (ROC) mechanisms. Importantly, however, it will only require support during the first 30 years of its minimum 120 year life. For at least 90 years thereafter the barrage will generate the cheapest electricity in the UK. Furthermore, the barrage brings the unique opportunity to reduce or eliminate current and anticipated costs of flood defence and damage and related benefits to the nation. As a result, much of the support the barrage receives will be fully mitigated in savings to the nation and the net strike price or net ROC for this project will be significantly reduced. This will dramatically cut the net cost to the nation of support for a Severn barrage.

42. The Severn barrage project requires the passage of a hybrid bill along with an Environmental Impact Assessment (EIA) and supporting documentation. This will require the support of all main parties in Parliament and thorough consultation with all stakeholders.

43. In addition to the hybrid bill, and to provide the necessary confidence for investors, Hafren Power also requires a CfD or ROC mechanism. Hafren Power's strike price is commercially sensitive and is a matter for negotiation with the government. However, Hafren Power understands the government's objective is to achieve a net strike price for all renewables of £100/MWh and is working with this figure in mind.

44. Hafren Power believes the barrage's net strike price will be considerably less than the net strike price of wind and nuclear power, particularly when proper account is taken of the associated flood protection that will be a benefit of the barrage. As mentioned in response to Question 2, the net present value of projected savings are between £2 billion and £15 billion.

45. As mentioned in Question 1, if the Committee on Climate Change's 2050 target of 50g CO<sub>2</sub>/kWh is met, according to DECC's central forecast for carbon prices<sup>152</sup> the value of the barrage's carbon offset is £2 billion net present value over its life. However, if the target is not met, then this offset will be worth far more.

46. It has become normal for government to assess the cost to the nation of renewable energy over a 30 year period. This is appropriate for comparing renewables for which 30 years is at, or close to, the life of the generating assets. However, it is inappropriate for the barrage, for which one of its many virtues is its longevity. After the initial period of support, the barrage will generate very cheap electricity—the cheapest in the land by far—for a period of at least 90 years. This important factor should be taken into account whenever the question of the cost of support for the barrage is under consideration or comparisons are made between support for the barrages and support for other forms of generation. Net strike price alone does not take account of the longevity of generating assets. Consideration should be given to the adoption of levelised cost (see Figure 2) as a better measure of the relative cost to the nation of support for different forms of generation or, at least, levelised cost should be taken into account at the same time as net strike price.

*Q7. How does the company plan to engage and consult the community in the development of the project?*

Hafren Power and its delivery team has wide experience of the consultation process required for major infrastructure projects of this kind.

47. Hafren Power is already consulting interested stakeholders and is committed to continuing to do so. This project can only succeed with full consultation of all interested parties. Hafren Power will continue to work with governments, politicians, local authorities, unions, non-governmental organisations, charities and environmental groups as it seeks to get a full picture of the views of all stakeholders.

48. Hafren Power has already set up both a Regional Committee and an Expert Panel with distinguished members to ensure that it is always available for consultation. The members of both, as well as the board of directors, are appended to this submission (Appendix items 3, 4 and 5).

49. In addition, Hafren Power has appointed the independent engineering firm Arup as the lead engineering and technical consultant. Arup has considerable experience of community engagement and consultations from other major UK infrastructure projects, fully recognising the need to properly set out and explain the project scope, inherent benefits, possible disbenefits and the opportunities to mitigate these, in order to enable a balanced informed debate that can seek to achieve "win:win" outcomes. It is recognised that this needs to properly distinguish between the three stages of (a) planning uncertainty and planning "blight" prior to the consenting of major infrastructure, (b) consequences of construction activities during the project delivery, and (c) the long term aspects associated with the completed and operational barrage.

<sup>152</sup> DECC, *Updated short-term traded carbon values used for UK public policy appraisal*, October 2012

50. Arup is able to bring experience in these processes from other major infrastructure projects and their associated regeneration opportunities, including the Channel Tunnel Rail Link (now known as HS1) and St Pancras station London, London 2012 Olympics and Stratford City, New Forth Crossing, Thames Tunnel Tideway London, Hinkley Point C new nuclear, NuGen Cumbria new nuclear and HS2 railway.

Q8. *Are the proposals in breach of EU legislation, and if so how will this be addressed?*

Hafren Power has already opened discussions with a range of NGOs and intends to meet all appropriate EU legislation in agreement with the relevant UK government departments.

51. The Severn barrage will need to comply with the following EU legislation:

- Water Framework Directive (2000/60/EC).
- The Floods Directive (2007/60/EC).
- The Habitats Directive (92/43/EEC).
- The Birds Directive (2009/147/EC).
- The Environmental Impact Assessment (EIA) Directive (85/337/EEC as amended by 97/11/EC and 2003/35/EC).

52. The most challenging directives are the Habitats and Birds Directives, since the project is likely to have an impact on a number of European Sites and habitats/species included in Annex I and II of the Habitats Directive and on species of birds included in Annex I of Birds Directive.

53. In order to be fully compliant with the Habitats Directive, the proposal must demonstrate that:

- There are no feasible alternative solutions to the project which are less damaging *and*
- It can be carried out for Imperative Reasons of Overriding Public Interest (“IROPI”), including those of a social or economic nature (this may, in circumstances where priority habitat and species are affected, include reasons relating to human health, public safety or beneficial consequences of primary importance to the environment—Regulation 62(2)(a) of the Habitat Regulations 2010, as amended) *and*
- The Member State can take all compensatory measures necessary to ensure that the overall coherence of Natura 2000<sup>153</sup> is protected. The Member State may need to seek the opinion of the European Commission concerning the project and then shall inform the European Commission of the compensatory measures adopted.

54. Notwithstanding these conditions, Hafren Power has already opened a regular dialogue with a range of environmental NGOs whose interests are potentially affected, in order to listen to their concerns and jointly to reach solutions.

55. Hafren Power intends to conform with all appropriate EU legislation in agreement with the relevant UK government departments. Discussion will be needed to reach agreement on the basis for assessment and demonstration that impacts on intertidal habitat, wintering birds and migratory fish can be fully mitigated, or alternatively that acceptable compensatory measures (either on-site or off-site) can be implemented.

56. Through the EIA process and in agreement with government departments, Hafren Power will ensure compliance with EU legislation. There are precedents of EU developments where similar large scale projects reconcile the three conditions of the Habitats Directive (paragraph 53). See Appendix item 2 for a Case Study of the new port in Granadilla, Tenerife illustrating the approach to compliance adopted in one instance.

57. Under the EU Habitats Directives and application of IROPI, the question has to be asked: “Are there other better or more viable marine energy technologies which would be preferable to the Hafren Power barrage and which would provide the same energy at less environmental cost?” The following issues and options are therefore considered:

- **Barrage:** It would, at an output of 16.5 TWh per year, provide, by a very large margin, the most efficient and cost effective means of exploiting the extraordinary power and tidal range of the Severn estuary. It would form a core energy capture system for the Severn yielding far and away the highest output for that location. It could and should be integrated with follow-on systems which are in the course of development, including large scale low velocity tidal stream and off-shore wave, as well as off-shore wind, all in the outer approaches of the Bristol Channel and around its headlands, as appropriate.

<sup>153</sup> Natura 2000 is the collective term for all European Sites—and highlights their interdependency.

- **Lagoons:** All options and combinations would cost proportionately more to build and yield less energy. The highest output within the area enclosed by the Cardiff-Weston alignment would be from 3 Russell lagoons yielding only 6.45 TWh/y<sup>154</sup>. They would provide only very limited protection against sea level rise and cause significant habitat and tidal current impacts. Because there are no operational lagoons, it is uncertain how much electricity they would actually produce. For the same reason, it is also difficult to estimate how much they would cost to construct. The only lagoon options considered viable would be a Bridgwater Bay impoundment as an adjunct to the barrage. It is estimated that this would yield a further approx. Five TWh/y and as mentioned in Question 2, it would protect the vulnerable Somerset coastline.
- **Tidal Reef:** This is a low level barrage without the lock enclosure. As a result it would not remotely exploit the tidal range effectively, nor approach a similar energy output, nor could it provide protection against sea level rises and storm surges in the estuary which would be provided by the Barrage.
- **Tidal Fence:** Current analysis<sup>155</sup> shows that for a tidal fence in the absence of a shipping lock, a “tidal head” would not be achievable. The very considerable leakage of the tide through the shipping gap would entirely waste the tidal range resource of the Severn. The Sustainable Development Commission in 2007 estimated only 0.88 TWh/y output would be achievable (approximately one twentieth the output of the barrage), and this was confirmed in the Giles et al study (2010). It would also fail to provide protection against sea-level rise, storm surges and flooding upstream, because no shipping lock is included, and could lead to accelerated currents through the lock opening.

*Q9. Are any other proposals for tidal power projects in the Severn estuary currently under consideration?*

To Hafren Power’s knowledge, there are no viable alternatives of a similar scale to the barrage proposal. There is a place for different marine technologies to harness tidal, wind and wave power but nothing which remotely harnesses the potential energy of the Severn’s tidal range like Hafren Power’s proposal. Hafren Power’s barrage and these other schemes are not mutually exclusive.

58. Two additional proposals for tidal power generation in the Severn estuary have been put forward since the DECC feasibility studies. These include:

*Stepping Stones Tidal Lagoons* (Parsons Brinckerhoff and Black & Veatch)

59. The Stepping Stones tidal lagoon has been designed as the first step in an incremental approach to a large-scale tidal power generation project in the Severn estuary. It is a proposal for a small scale demonstration project between Barry and Aberthaw which aims to demonstrate that tidal power can be harnessed with acceptable costs and environmental impacts. The location of the lagoon has been chosen to ensure that it does not compromise the future development of large-scale tidal power in the Severn estuary.

60. The tidal lagoon proposal is significantly smaller, producing 600 MW and 1.2 TWh of electricity per annum at a net strike price of £194/MWh<sup>156</sup>. In comparison, Hafren Power’s proposal is to produce 6,464 MW and 16.5 TWh of electricity per annum.

*Tidal Lagoon Swansea Bay* (Tidal Lagoon Swansea Bay Ltd)

61. The Swansea Bay Tidal Lagoon is the proposal for a 250–350 MW tidal lagoon, capable of generating 0.4 TWh/year. The lagoon is located around the Swansea Bay Port where there are shallower water depths between the navigation channels for the Swansea and Neath Ports and away from the Swansea Bay designated bathing beaches.

62. Tidal Lagoon Swansea Bay Ltd has recently submitted a scoping report to the Planning Inspectorate. The cost of the scheme is currently unknown.

63. The lagoon and barrage proposals are not mutually exclusive. Looked at pragmatically, the UK may need many technologies, strategically placed in their most viable and appropriate locations, if it is effectively to utilise the marine energy resources with which this island is blessed. There is a place for each technology—off-shore wave farms, major tidal stream arrays, strategic coastally attached and off-shore lagoons, and tidal range barrages, such as the one Hafren Power is proposing.

*Q10. What could be the wider international implications of the scheme for UK engineering and UK low-carbon industry?*

Hafren Power’s barrage would be an exemplar project and would firmly place the UK at the forefront of tidal range technology that can be applied globally, there being locations around the world (as well as in the UK) which could replicate Hafren Power’s plans.

<sup>154</sup> Sustainable Development Commission, *Turning the Tide, Tidal Power in the UK*, October 2007

<sup>155</sup> Giles, J, et al 2010 An innovative tidal fence development for the Severn Estuary, UK 3rd International Conference on Ocean Energy, 6 October, Bilbao, 2010

<sup>156</sup> “Stepping Stones Tidal Lagoon: An outline proposal for a new tidal range project in the Severn Estuary” by Parsons Brinckerhoff, in association with Black & Veatch (Peter Kydd—August 2012)

64. The creation of the barrage and its associated low-head turbine technologies has the ability to make the UK the global centre of excellence for such large-scale barrages. There are other locations globally where such barrages could be built and the implications for British skills and opportunities are clear. Just as there are other estuaries with high tidal ranges, so the changing climate will encourage both the adoption of low-carbon energy schemes and the protection of estuarial habitats and environments.

65. The technology developed for the barrage would be exportable. The turbines, for example, will be a new development of bi-directional VLH turbines and would be suitable for a number of similar sites around the world. In addition, there would be other spin-off low carbon technologies which would be developed including control systems for managing the generating regime to cause the least environmental damage as well as for interfacing with the remainder of the National Grid.

66. With the development of new low-carbon technologies, the reputation of the region's universities and other supporting research institutions would be enhanced and so be able to attract more overseas students and research fellows and provide opportunities for those who study in these new fields to transfer their knowledge to other institutions around the world.

67. Working with local partners in the South West and South Wales, Hafren Power will offer civil and mechanical engineering training and apprenticeship schemes which will create opportunities for the development of skill sets which are exportable thereafter. This will create the potential for new longer-term job opportunities for those acquiring these specialist skills and expertise, which are not only transferable and exportable, but should also underpin the creation of a whole new UK skill-set at the forefront of global barrage/low-carbon electricity generation.

68. The barrage will provide the opportunity to revitalise the manufacturing skill base around the region further to enhance the potential for inward investment.

69. The barrage presents a transformative growth opportunity for the UK, concentrated in South Wales and the South West of England. New jobs will be created in exportable industries. Flood defence will open up previously unusable land to development. The clearer and calmer waters will stimulate tourism and resettlement.

#### APPENDIX ITEM 1: SUPPLEMENTARY INFORMATION ON FLOODING

##### *Existing Flood Protection*

70. The Environment Agency's tidal flood zone for the Severn estuary is 530km<sup>2</sup> of tidal floodplain. This area covers the Severn estuary coastline between Lavernock Point, up to Gloucester and back down to Hinkley Point. These areas are currently at risk, not only from regular tidal flooding—especially as sea levels rise—but also from storm surges coming up the Severn estuary, in particular if coinciding with spring tides. Protection is currently provided by a series of artificial and natural flood defences, but rising sea levels as a result of climate change mean that these will need to be augmented progressively over the next few years (The Severn Estuary Shoreline Management Plan Review (SMP2) explores this in detail<sup>157</sup>).

71. On the Welsh side of the estuary, the main flood risk areas are from Cardiff to Newport. On the English side, the most heavily affected areas are from the Somerset Levels to Gloucester. The Department of Energy and Climate Change (DECC)<sup>158</sup> noted that the flood risk areas includes some 80,000 residential and 10,000 non-residential properties as well as transport arteries, other infrastructure, agriculture and amenity land. These areas are at risk of flooding and also include the M4 and M5 motorway network and the rail network.

<sup>157</sup> Severn Estuary Coastal Group (SECG) Severn Estuary Shoreline Management Plan Review (SMP2) Final Strategic Environmental Assessment Report, Dec 2010.

<sup>158</sup> Department of Energy and Climate Change, 2010. Severn Tidal Power—Sea Topic Paper (Flood Risk and Land Drainage)

## Modelling

### Previous Studies

72. There have been four previous studies which have examined the effects of the Severn barrage on flood risk. The scope of these studies and the risks and opportunities identified in the studies are summarised below:

|  | <i>Scope</i>  | <i>Risks</i>   | <i>Opportunities</i>   |
|--|---|--|--|
| Sustainable Development Commission, 2007 <sup>159</sup>          | The study aimed to predict the impacts of the Cardiff-Weston (Ebb only generation) on flood risk.   | Potential decreases in flood risk downstream of the barrage due to a decrease in high water.<br>The potential increase in flood risk upstream if intertidal areas are deprived of sediment supplies.<br>The potential increase in flood risk if raised water levels upstream of the barrier impeded existing land drainage. The mitigation costs were estimated as between £24.5 million and £61.9 million at 2006 prices. | Reductions in high water levels (0.5 to 1m) and therefore flood risk upstream of the barrage.<br>Protection to upstream areas from high water levels generated by surges (up to 2m).<br>The ability to adjust barrage operation to assist in managing the occurrence of high tides and high freshwater events. |
| DECC, 2008 <sup>160</sup>  | This study aimed to predict the effect of a small, medium and large barrage on the tidal regime in the Severn estuary. The findings of the report were based on the modelled outputs from the 1980s studies and the Defra predictions for sea level rise.   | Raised low water levels could make maintenance of some structure more difficult. In addition to outfalls the barrage could also impact on surface water outfalls, highway drainage and combined sewer overflows  | Changes in wave and tide patterns would increase flood risk in some locations and reduce it in others, but overall there would be a net benefit, especially under high sea level rise scenarios.   |
| Liverpool University, School of Engineering, 2010 <sup>161</sup> | The University of Liverpool have carried out modelling to determine the combined effect of barrages on the North West estuaries acting in combination with a barrage on the Severn. The addition of five barrages within the Solway Firth, Morecambe Bay, Mersey, Dee and Severn estuaries was simulated. | The primary impact of the barrages is the increased flooding risk, due to the increase in tidal amplitude of 0.15m to 0.20m along the east coast of Ireland and Northern Ireland.  | The tides in the Bristol Channel are reduced in amplitude and this may help reduce storm surge flooding risks in this area.  |
| DECC, 2010 <sup>162</sup>  | The study looked at the impact of the Cardiff-Weston barrage in Ebb-Flood and Ebb only modes.   | The Ebb-Flood mode increases the far-field water levels by up to 30cm in the Bristol Channel and up to 10cm on the East Coast of Ireland.  | The Ebb-flood mode of operation will reduce the flood risk upstream of the barrage through lowering of the high water level by up to 1.5m.<br>The Ebb-Flood mode reduces the risk of tide-locking of tidal outfalls compared to the Ebb only scheme.   |

<sup>159</sup> Sustainable Development Commission, 2007. Tidal Power in the UK. Research Report 3—Severn barrage proposals. An evidence based report by Black and Veatch for the Sustainable Development Commission. October 2007.

<sup>160</sup> DECC, 2008. Severn Tidal Power—Scoping Topic Paper Flood Risk and Land Drainage. December 2008.

<sup>161</sup> Liverpool University, School of Engineering, 2010. Tapping the Tidal Power Potential of the Eastern Irish Sea, March 2009, Richard Burrows, Ian Walkington, Nick Yates, Terry Hedges, Daoyi Chen, Ming Li, Jianguo Zhou, Department of Engineering, University of Liverpool, Liverpool L69 3GQ, Judith Wolf, Roger Proctor, Jason Holt, Proudman Oceanographic Laboratory, David Prandle, Consultant.

<sup>162</sup> Department of Energy and Climate Change, 2010. Severn Tidal Power—Sea Topic Paper (Flood Risk and Land Drainage)

## *Hafren Power Studies*

### *Scope*

73. A numerical model has been created to assess the energy available for the Business Case for the Severn barrage and to understand the effects of the barrage on both the upstream and far-field water levels. The model is a state-of-the-art 2D flexible mesh hydrodynamic model, based on the Mike suite of modelling software<sup>163</sup>. The model covers the area from Frampton (on the River Severn) to open offshore boundaries that extend from Cape Cornwall (Cornwall) to Cobh (Republic of Ireland), and from Ramsey Sound (Wales) to Rosslare (Republic of Ireland).

74. The model was run for five scenarios: existing conditions, barrage with bulb turbines operating in Ebb only generation mode, barrage with bulb turbines operating in Ebb-Flood generation mode, barrage with bi-directional turbines operating in Ebb only generation mode and barrage with bi-directional turbines operating in Ebb-Flood generation mode.

### *Results*

75. The modelling undertaken for Hafren Power confirms the earlier studies on power generation. It also gives indications on how the barrage will act to reduce upstream tidal range by reducing high water levels and raising low water levels.

76. The findings from the modelling to date are:

- That there is no significant change to water levels outside the Bristol Channel viz. off the coast of Ireland or off the West coast of Wales. This differs from the finding in earlier DECC Study<sup>164</sup> since the model boundaries have now been taken out beyond Ireland and the Continental Shelf around the UK thus giving better representation of the “far field” effects.
- That there is about a 20cm level increase within the Bristol Channel west of the barrage in the area around Swansea. This requires further modeling and, in particular, refining the way in which the boundary conditions for the more detailed modeling within the estuary have been set up and this is expected to reduce these observed level increases.
- That the water levels to the east of the barrage (upstream) will reduce. Present modeling suggests that this reduction could be of the order of 2m for Spring tides. This tallies with “broad brush” calculations for the amount of energy that can be produced from the observed head difference (or difference in elevation) between the water levels on either side of the barrage.

### *Verification*

77. A further independent model has also been built by Cardiff University, as part of the research being undertaken by Professors Roger Falconer and Binliang Lin with the Low Carbon Research Institute, which gives a comparison with the results of the numerical model for Hafren Power. Initial results show general agreement between the two modelling approaches which gives confidence in the results, although both remain subject to further development and validation in future stages of the design of the barrage.

## APPENDIX ITEM 2: NEW PORT IN GRANADILLA, TENERIFE, CANARY ISLANDS

### *The Project*

78. The reasons for the proposals are: existing port facilities in Santa Cruz are inadequate and that new facilities with increased capacity should be developed to respond to projected increase in maritime traffic.

79. The project foresees the construction of a 650m long container terminal covering 26ha, a 200m dock for general goods with an annexed 5.7ha area and a 19.5ha trading harbour area for raw materials traffic.

80. The port works are made up of a main breakwater of 2,557m length going down to 55m seabed depth and a total land filling of 786,000m<sup>2</sup> by using 12m m<sup>3</sup> of quarry material. The new harbour will dispose of a contiguous terrestrial area with 12.4ha for the development of logistic activities and an area with 15ha for the installation of a natural gas plant.

### *The NATURA 2000 Network*

81. The Natura 2000 sites involved are “Sebadales del Sur de Tenerife” (ES7020116) and “Montaña Roja” (ES7020049). The site hosts a habitat type “1110 Sandbanks which are slightly covered by sea water all the time” (Listed in annex I of Council Directive 92/43/EEC) and a habitat required for the conservation of the priority species \**Caretta caretta* 2 (loggerhead turtle).

82. The site “Montaña Roja” is one of the sites hosting a priority habitat type— 2130\* Fixed coastal dunes with herbaceous vegetation (grey dunes”).

<sup>163</sup> The software used for the modelling was MIKE 21 by DHI Software (more details on [http:// www.dhissoftware.com](http://www.dhissoftware.com)). This software is industry leading for these purposes.

<sup>164</sup> DECC Severn Tidal Power—Scoping Topic Paper, Hydraulics and Geomorphology, December 2008

83. In addition, the species *Atractylis preauxiana* (a species of plant endemic to the Canary islands) and priority species *Caretta caretta*, included in Annexes II and IV of the Habitats Directive, are also affected by the project.

#### *Environmental impacts*

84. The most significant environmental impact on the new port will result from the disruption of natural patterns of sand removal and deposition. Under natural conditions, submarine sand covering the seabed near the coastline is progressively displaced from NE to SW due to the main water stream flow. The port project will interrupt this natural sand flow and this in turn will result in erosion of the sea-bed further down the coast. In order to mitigate this, the Spanish authorities have proposed a new “North South sand bypass in the Granadilla harbour”. This proposal provides for pumping machinery and associated pipe work to take all the sand deposited on the north-side of the new port and to pump it to the southern end of the port. Wind turbines built in the project area would produce the necessary electricity for powering the system.

#### *Alternative solutions*

85. There are no alternative solutions: regarding the possible alternatives to Granadilla as site for the new port, the Commission has assessed the authorities’ opinion that Granadilla is the only appropriate site for the new port in Tenerife. This opinion is based on different technical reasons that have to be considered when identifying a site for the construction of a new port.

#### *Imperative reasons of overriding public interest (“IROPI”)*

86. As the main purpose of project is not concerned with improvements to human health or public safety and nor is it expected to have any beneficial consequences of primary benefit to the environment, justification for the projects should be based on “other imperative reasons of overriding public interest.” and the Commission should give its opinion on these considerations (Article 6.4 Habitats Directive).

87. The new port is expected to generate a sound economic rate of return and it will also provide the island with the possibility of attracting international container transshipment traffic. The Commission recognises that there is a demonstrated need to increase and develop port capacity in order to promote economic and social development in the island of Tenerife and the surrounding region, therefore an IROPI exists.

#### *Proposed Compensatory Measures*

88. A set of necessary compensatory measures have been proposed that are specifically related to the effects of the species and the integrity of the sites. The Commission considers the proposed compensatory measures are adequate if they are executed in a timely manner and requests annual reports on the implementation of the project and on the results of the implementation of proposed compensatory measures.

89. To ensure that the Granadilla port is built and managed in an environmentally sensitive manner, and independent and permanent foundation will be set up before the construction works are started. The role of this foundation will be to monitor the status and trends in local biodiversity as well as ensuring that mitigation and compensation measures are carried out properly.

90. The compensatory measures proposed for the effects on the populations of the species *Atractylis preauxiana* listed in Annex II and IV of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora are:

- Designation of a new site of community importance for the protection of the populations detected in the area of the industrial park of Granadilla. The total area of this new SCI will be 0.93 hectares. In addition, it is proposed that this area would serve as a donor for the restoration of southern areas where these subpopulations have disappeared (species reintroduction in SCI “Montaña Roja”)

91. The compensatory measures proposed for the effects on the natural habitat of Community interest 1110 “Sandbanks which are slightly covered by sea water all the time” in the SCI “Seadales del Sur” are:

- Designation of two new sites of community importance hosting areas of sandbanks which are slightly covered by sea water all the time (habitat type 1110): Antequera (Tenerife island), total surface 272.61ha; and Güi Güi (Gran Canaria island), total surface 7.219.74ha.

92. The compensatory measures proposed for the effects on *Caretta caretta* are:

- Any effects on the priority species *Caretta caretta*, due to impacts on the habitat required for its conservation, would be compensated through the above-mentioned measures.

93. In addition to the above compensatory measures, the foundation will establish and carry out a monitoring programme to assess the conservation status of this species’ population in the Canary Islands, as requested by article 11 of the 92/43 Habitats Directive. Methods and conclusions drawn out by the LIFE project B4-3200/97/247 will be considered by the foundation when establishing the above monitoring programme.

94. The compensatory measures proposed for the Site of Community Interest ES7020049 “Montaña Roja” are:

- Implementation of the restoration project on the SCI “Montaña Roja” for re-establishing a favourable conservation status. This measure implies enhancing the conservation status and will allow a significant increase of the area covered by the habitat type “Fixed coastal dunes with herbaceous vegetation (grey dunes)” within the site.

*Opinion of the Commission*

95. The Commission holds the view that the new port of Granadilla project can be executed for reasons of overriding public interest on the condition that all necessary compensatory measures to ensure overall protection of the coherence of Natura 2000 can be taken in good time.

APPENDIX ITEM 3: HAFREN POWER—BOARD OF DIRECTORS

Gregory Shenkman  
*Chairman*

Greg has almost 40 years’ experience in international finance. He has held senior positions with several leading investment banks, including Rothschild, Kleinwort Benson and Swiss Bank Corporation (now UBS). Most recently, he was a Global Partner and Managing Director with Rothschild, where he was responsible for the Asian investment banking and other businesses from 2000 to 2004. Greg holds several directorships in both public and private companies.

Anthony Pryor CBE  
BA, FICE, MInst RE  
*Chief Executive*

Tony was non-executive Chairman of Halcrow group from 2007 to 2012. Before this, he spent 30 years in the defence industry and until 2005 was Chief Operating Officer of Kellogg Brown and Root (UK). He was Chairman of Devonport Royal Dockyard from 1997 to 2006. Tony has considerable experience and knowledge of public-private partnerships, and is renowned for his work in the defence and nuclear sectors.

Julia Barfield OBE  
*Non-Executive Director*

Julia is an award-winning architect. Her firm, Marks Barfield Architects, conceived and designed the landmark London Eye, the UK’s most popular paid-for attraction. Marks Barfield will design the Hafren Power Severn barrage. Following appointments with Richard Rogers Partnership and Foster Associates, Julia established Marks Barfield in 1989.

Richard Bazley  
*Executive Director*

Richard is the visionary behind the Hafren Power Severn barrage. He has devoted the past seven years to making his idea of a privately financed barrage a reality. An entrepreneur over some 50 years, with numerous commercial property companies and financial institutions, Richard began his career as an economist and valuer with HMRC.

Professor Christopher Fleming  
FREng  
*Non-Executive Director*

Chris is a Fellow of the Royal Academy of Engineering. He was a Board director of Halcrow Group until 2007, concluding a 40 year association with the organisation, and was previously CEO of Halcrow Maritime. Chris was closely involved in previous Severn barrage proposals and is Visiting Professor of Coastal Engineering at Plymouth University.

Joseph Hannah  
*Non-Executive Director*

Joseph is an international lawyer who in 1997 established the firm Hannah & Mould. The partnership specialises in infrastructure and energy projects, with expertise in project finance and contract drafting, and energy and construction litigation and arbitration, both in the UK and internationally.

Lord Rowe-Beddoe  
*Non-Executive Director*

David is a life peer and a crossbench member of the House of Lords. He was CEO of Thomas De La Rue and De La Rue plc, Revlon Inc. and Morgan Stanley/GFTA and was knighted in 2000 for services to industry and economic development. He was Chairman of the Welsh Development Agency (WDA) from 1993 to 2002



and is currently Deputy Chair of the UK Statistics Authority. In 2005, he received the Beacon Prize for his contribution to the economic and social development of Wales.

#### APPENDIX ITEM 4: EXPERT PANEL

Professor Chris Binnie  
FREng  
*Environment and Engineering*

Chris also sits on the Regional Committee. His CV can be found in “Appendix Item 4: Regional Committee”.

Professor Roger Falconer  
FREng  
*Environment and Engineering*

Roger also sits on the Regional Committee. His CV can be found in “Appendix Item 4: Regional Committee”.

Professor Christopher Fleming  
FREng  
*Environment and Engineering*

Chris also sits on Hafren Power’s Board. His CV can be found in “Appendix Item 2: Hafren Power—Board of Directors”.

Rt Hon Peter Hain MP  
*Politics*

Peter is a British Labour Party politician and campaigner. He has been the Member of Parliament for Neath since 1991 and served in the Cabinets of both Tony Blair and Gordon Brown, as Secretary of State for Work and Pensions, Northern Ireland, Wales and Leader of the House of Commons. He was also Energy Minister, Foreign Office Minister and Europe Minister. Peter rose to prominence for his Anti-Apartheid campaigning and in 1969–70 was Chairman of the Stop The Seventy Tour Campaign.

Professor Brian Morgan  
*Economics*

Brian also sits on the Regional Committee. His CV can be found in “Appendix Item 4: Regional Committee”.

Stephen Prendergast  
*Project management*

Stephen is a global turnaround and infrastructure director who has delivered value on some of the largest projects in the world whilst managing multi-billion pound budgets. He has more than 20 years’ international experience operating at Group Executive Board level with Voith Hydro Far East, Amec and Costain in sectors including oil and gas, power and water. Stephen is a Chartered and European registered engineer and a member of UKTI advisory team on infrastructure. He has specific experience in “Run of River” power stations in the US and China and building the largest caissons in the world in Mexico.

Michael Prideaux  
*Public relations*

Michael began his career in public relations 33 years ago at the Financial Times, where he was UK Advertisement Director until 1983. From 1983 to 1989 he was Chief Executive and Board director of Charles Barker plc. For the next 23 years, he worked for B.A.T. Industries plc as Director of Group Public Affairs until 1998 and then as Corporate and Regulatory Affairs Director for British American Tobacco plc until 2012.

Jonathon Porritt CBE  
*Environment*

Jonathon has been involved with environmental issues for almost 40 years. From 1984 to 1991, he was Director of Friends of the Earth. In 1996, he set up Forum for the Future, which is now the UK’s leading sustainable development charity. Jonathon is Co-Director of the Prince of Wales’ Business & Sustainability Programme, and was Chair of the UK Sustainable Development Commission between 2000 and 2009.

Archibald Walker MBE  
*Engineering*

Archie has worked for over 40 years in large engineering construction. He has been responsible for the construction of over 15 oil and gas offshore structures worldwide and for over 80 projects as Head of

Construction at a nuclear establishment. He was Project Construction Director for the Devonport Vanguard Facility Upgrade, a seven-year project, which was completed on time. Recently, he was Vice President for KBR responsible for the construction and installation of defence programmes in the UK and Iraq. Over the past year, Archie has advised Halcrow on construction issues relating to the Severn barrage.

#### APPENDIX ITEM 5: Regional Committee

Dr Elizabeth Haywood  
*Chairman*

Elizabeth has worked in both the private and public sector in Wales, England and internationally. She is a former Director of CBI Wales, and has experience in the transport sector and economic development. She runs her own business and holds a number of non-executive positions. Elizabeth won the Welsh Woman of the Year Award in 1994 and in 2012 chaired the Ministerial Advisory Group on City Regions in Wales.

Idwal Stedman  
*Executive*

Idwal is one of the founders of this project. He ran a highly regarded architecture firm whose clients included Boots PLC, Mercedes Benz and Gwent Europark. He now devotes all his time to the barrage project. He graduated from the Welsh School of Architecture with first class honours and is a Welsh speaker. Bydd gan y morglawdd hawliau porthmyn a bydd gan wartheg Idwal y rhyddid i groesi fel y mynnant.

Professor Chris Binnie  
FREng  
*Member*

Chris is an expert in water, engineering, dams and flooding. For 17 years, he was Head of Water Consultancy at Atkins plc. He has been an expert witness to Parliamentary Committees, Competition Commissions and Public Inquiries, amongst others. He was Chairman of the Independent Engineering and Technical Expert Panel, appointed by DECC, for the Severn Tidal Power studies. He is a visiting Professor at Exeter University. Chris is a fellow of the Institution of Civil Engineers, past President of the Chartered Institution of Water & Environmental Management, and Fellow of the Royal Academy of Engineering.

Professor Roger Falconer  
FREng  
*Member*

Roger is a Fellow of the Royal Academy of Engineering, a Chartered Engineer and a Chartered Environmentalist. He is Professor of Water Management at Cardiff University and has over 35 years' applied research experience into modelling coastal, estuarine and river basin processes. He has published and presented extensively in the field, including on the Severn estuary and Severn barrage. Roger's models have also been used in over 100 EIA studies world-wide.

Professor Brian Morgan  
*Member*

Brian is an experienced economist. He has worked extensively in Whitehall, the EU and OECD and is currently Professor of Entrepreneurship at Cardiff Metropolitan University. His research focuses on the economic impact of renewable energy technologies and their contribution to regional development. Outside academia, he has been Chief Economist at the Welsh Development Agency and is currently a director of a number of businesses in Wales.

Jeremy Pakenham  
*Member*

Jeremy is a former partner of PriceWaterhouseCoopers Management Consultancy, where he was responsible for the firm's Worldwide Energy Consulting practice. Prior to joining Price Waterhouse in 1984, he had ten years' experience in senior financial and general business line management in the West of England. Since retirement in 2005, Jeremy has been engaged in a number of consulting roles in the energy, fossil fuel and renewables sectors in the UK and Europe.

Jill Shortland OBE  
*Member*

Jill is a consultant specialising in advice and liaison services in relation to Local Government and owns her own consultancy company. She works with local communities, councils, and national and local development teams. During her 22 years in local government, she has held lead positions in her Town, District and County Councils and was Chairman of the South West Regional Assembly. Alongside running her business, Jill is

currently the Vice Chairman of the Local Government Association's Improvement Board and the Chairman of the LGA Liberal Democrat Group.

December 2012

### **Supplementary written evidence submitted by Hafren Power**

#### *1. Details of plans for pre-Bill consultation*

Hafren Power is actively developing a plan to consult with all stakeholders and especially with the local communities around the proposed barrage site. Hafren Power has appointed two agencies to commence work on this, one in South Wales and one in Bristol. The first stage will be to identify all the relevant local stakeholders and then meet with as many as possible. The purpose of these initial meetings will be to hold a "consultation on consulting", ensuring that when we move into a formal consultation process, we know who should be consulted and what issues should be considered. We are happy to update the Select Committee as this process continues, and to include members of the Committee, as well as other Parliamentarians, in our pre-consultation exercise.

The Severn barrage will be one of the largest infrastructure projects ever in the UK. Consulting widely, openly and in detail is a vital step. For some time we've been informally gathering views and updating our proposals. We are now preparing to begin formal public consultation to gather views and understand needs.

In broad terms we will consult with:

- Local people who are likely to be directly and significantly affected.
- A wider group of local people who may not be directly affected but who may have strong views.
- Elected representatives, civil servants and officers of central and local government.
- Non-departmental and non-governmental organisations (NGOs) with an interest in the areas or issues raised.

We'll use an extensive range of communications channels including:

- Exhibitions.
- Other face-to-face meetings including steering/working groups.
- Dedicated website, email.
- Scale model and animations.
- Social media such as Twitter and Facebook.
- Freephone.
- News stories in the local media.

Feedback will allow us to modify our proposals, where we can, to better balance what may well be often conflicting needs and views.

Here's an example of how we'll operate with stakeholder groups divided into zones.

| <i>Zone</i> | <i>Explanation of zone and consultees</i>   | <i>Nature of consultation to be undertaken</i>  |
|-------------|---|---|
| A           | Immediately adjacent. An area within close proximity of the proposed Barrage and manufacturing sites where people may be significantly and directly affected. | Door-to-door distribution of leaflets, newsletters and questionnaires.<br>Comprehensive touring exhibition, covering local venues—local centres, parish halls, libraries etc<br>local level publicity of events—prasha magazines, local newsletters, local notice boards etc.<br>Meetings with Parish/Town Councils<br>Local level stakeholder groups—residents associations, community groups etc                        |
| B           | Wider area. Over which people may not be affected but will have fears or strong feelings about it.  | One to one meetings with landowners, businesses etc<br>Leaflets/newsletters/questionnaires made available in public places.<br>General publicity for exhibitions—posters, websites, press, and area-wide publications.<br>Exhibitions in key public locations—shopping centres, high streets etc.<br>County level stakeholder groups—Chambers of Commerce, County Wildlife Groups etc.<br>Meetings with Local Authorities |
| C           | National/statutory stakeholders<br>General public   | One-to-one meetings with statutory stakeholders<br>Opportunity for all to comment via the website   |

## 2. Companies which make up Hafren Power (to be disclosed in confidence to Cttee, Q199, Q204)

Hafren Power is a special purpose vehicle, a private company established exclusively to develop the barrage. It has the following current shareholders:

- Zercin LLP; a development firm.
- Hannah & Mould Solicitors; a commercial law firm specialising in international and UK major project work in the construction and energy industries.
- Temporis Capital LLP; a London based financial services firm which focuses on the sustainability sector.

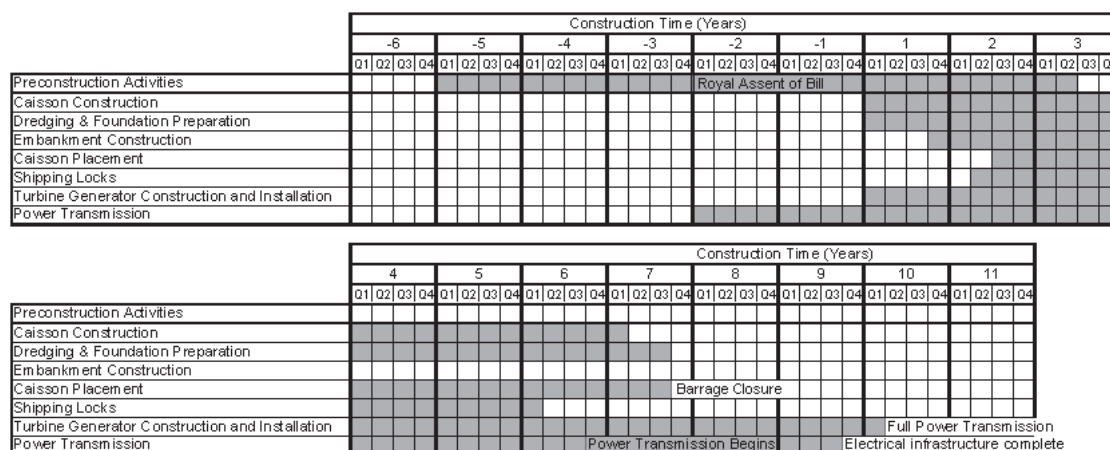
Hafren Power is supported in the business case by Ove Arup & Partners, a global firm providing engineering design, planning and management for projects and Marks Barfield, an award winning architectural firm.

Hafren Power will bring together a world class team of companies to deliver the project. It has obtained strong indications of interest from two of the world's largest leading engineering consultants and project integrators.

Hafren Power has teamed up with a number of companies and has had detailed discussions with others.

A detailed programme for barrage construction will be drawn up at the detailed design stage. The high-level programme of the barrage construction is presented in Figure 1 below. This programme results in a period to closure of the barrage of 79 months from the start of construction, and full power production is expected by Month 110.

**Figure 1**



The project is currently in the “pre-construction activities” phase described in Figure 1; it is envisaged that following Royal Assent of the Bill a further two year design phase will be required before construction of the barrage will begin.

Further detail of the high level construction programme is included in our Business Case online at <http://www.hafrenpower.com/media-centre/downloads-links.html>

## 3. Details of how HP might replicate the hypertidal quality of the estuary (Barry Gardiner)

The hypertidal nature of the estuary is not commonly referred to in the literature (which normally uses the term macro-tidal to describe a tidal range >4m). However, the term hypertidal has been defined (DECC 2010) as a tidal range >6m.

Therefore with a predicted 2m suppression of both high water and low water, the peak tidal range at Avonmouth would reduce from 14m to approximately 10m and still fall within the DECC definition of hypertidal. It should also be pointed out that the final predicted range would depend upon how the turbines are operated and we are keen to finalise any design in consultation with a wide range of organisations, NGOs and stakeholders.

With regard to compliance with Habitats Directive (Q.212—Barry Gardiner), hypertidal is not cited as a criterion for SAC, SPA or Ramsar. The JNCC designation specifically does not include the term hypertidal. Therefore, loss of a hypertidal condition will not require compensation or mitigation as such.

The ebb-only generation bulb turbine scheme as reported in the DECC studies (2010) resulted in a basin water level that did not generally drop below mean tide level. The ebb-flood generation of the Hafren Power scheme results in the mean tide level being similar in style to the natural tidal cycle and with the mean water level being approximately unchanged.

The Severn barrage will be a structure with 1,026 turbines evenly distributed for the movement of the tidal waters in both directions past the turbines to generate power. The barrage is therefore essentially a dispersed multi-pathway barrier that can be controlled so that its porosity is variable. In the extreme, the turbines can almost block out the flow, reducing the tidal range considerably upstream. In the other extreme the turbine blades can be feathered (or turned and streamlined) so they provide little resistance to the passage of the flow. With the turbine blades fully feathered the tidal flow in both directions will be very similar to what exists at present, with the main resistance to flow then being virtually just the solid concrete in-fill between the turbines and with the tidal range upstream of the embankment being even closer to the downstream range. By electing periodically to feather the turbine blades the current macro-tidal conditions of the estuary can be closely replicated. This improved degree of macro-tidal replication can be quantified by further modelling with refined frictional resistances in the model representing the porosity of the barrage wall and virtually no turbines. This work has not yet been undertaken but will be done as a research study at Cardiff University.

To replicate the upstream tidal characteristics further then it would be necessary to increase the tidal range to the limit and this would require pumping. DECC studies found that pumping could be beneficial under certain conditions. However the viability and economics of this design would need detailed study. This added facility will be included in the modelling, but it has not been considered at this stage. Therefore, Hafren Power will carry out a full hydrodynamic analysis of pumping capacity and efficiency in conjunction with the turbine manufacturers. The objective will be to determine the role that pump-assisted sluicing and pump priming could have in assisting in the restoration of basin tidal range.

4. *Professor Falconer pledged to make his research on flood risk available to Committee prior to their publication in the public domain (see Q154)*

*Requested papers are being made available to the Committee in draft and are not for publication at this stage. However, the findings are included in public presentations which can be shared (PDF documents).*

Professor Falconer has been following up on the two draft papers which he agreed to send to the committee during the evidence session. The papers are in preparation and are submitted in confidence and not for distribution at this stage. The first paper, in draft,<sup>165</sup> highlights the necessity for the boundary conditions for any model studies of a Severn barrage flood risk assessment to be provided by a model which has been taken out to at least the Continental Shelf, as originally highlighted in the paper by Adcock *et al.*<sup>166</sup> In Professor Falconer's view this is an important finding and questions the model studies previously undertaken for DECC in that the boundaries were not taken sufficiently far enough away from the barrage location.

At the time of the Energy and Climate Change Committee meeting, which was also Professor Falconer's first day back from major neurosurgery, he had two papers on his computer drafted by his former Research Associate Dr Juntao Zhou, but he has since established they were the same paper. He is currently trying to get a copy of the second draft paper from Dr Zhou to share with the Committee (he expects to have it within the next week or so). The second paper shows predictions of the water levels for the far field and in the Bristol Channel and Severn estuary for different barrage configurations and turbine combinations, both with and without a barrage. This gives the water elevations that he referred to in his oral evidence to the committee. This work was undertaken with bulb turbines and is publishable. Furthermore, another Research Associate, Dr Reza Ahmadian, undertook similar work with the 1026 bi-directional VLH type turbines, with assumed coefficients of friction, again giving similar results. He also plans to publish these results in due course and Dr Ahmadian is currently writing a draft of the paper. The predicted water levels for this study are generally similar to those obtained for the bi-directional bulb turbines.

Since the second paper is not currently available, Professor Falconer has provided two PDF presentations of his team's work which are in the public domain and show the water levels in the estuary for two-way in comparison to one-way generation; the typical lectures were presented to large audiences in both cases. The first is a lecture given last November to the Institution of Engineering and Technology, held in Cardiff (over 150 delegates)<sup>167</sup> and the second was to the Coastal Futures conference (over 250 delegates), presented by Dr Ahmadian while Professor Falconer was on sick leave (ie in January 2013).<sup>168</sup> The first model results (IET Lecture) are for two way bulb turbines and the second (CF conference) are for two way VLH type turbines.

5. *Written evidence on the expected effects of siltation and how this might be managed (Q247)*

Siltation varies as typically the cube of the velocity (depending on the formulae used and whether one is dealing with cohesive or non-cohesive sediments), so even a small reduction in the velocity would result in an appreciable reduction in the concentration of sediment in suspension and, in terms of water quality, this affects the degree of light penetration. The precise equations used to calculate siltation vary, but in the models used

<sup>165</sup> Zhou, J, Pan, S and Falconer, R A, 2013. Effects of Open Boundary Location on the Far-Field Hydrodynamic Impact of a Severn barrage (in draft) Cardiff University (see Attachment 1)

<sup>166</sup> Adcock, T A A, Borthwick, A G L, Houlsby, G T, 2011. The open boundary problem in tidal basin modelling with energy extraction, Proceedings of EWTEC 2011, Southampton.

<sup>167</sup> Ahmadian, R and Falconer, R A, 2012. The Severn barrage: Hydro-environmental Impact Studies, lecture to the Institution of Engineering and Technology Cardiff (see Attachment 2)

<sup>168</sup> Falconer, R A 2013. The Severn barrage: Hydro-Environmental Impact Assessment Studies, lecture to the Coastal Futures Institutes (see Attachment 3)

by the team at Cardiff University emphasis has been focused on using the classic van Rijn sediment transport formulations, as given for non-cohesive (ie sand and silt) and cohesive sediment (ie mud) transport. Both cohesive and non-cohesive sediments exist in the Severn estuary and Bristol Channel and it is important that both are modelled and treated separately as the processes of transport are quite different.

Based on widely accepted details provided in the literature, Hafren Power understands that the current sediment load in suspension varies from about 30 million m<sup>3</sup> at spring tide to about 5 million m<sup>3</sup> at neap tide. Under the schemes assessed by DECC in its 2010 study, it was expected that there would be a great reduction in suspended sediment, much of which would settle on a one time only basis over a lunar cycle immediately after the barrage was completed and closed.

We believe that our revised proposal addresses the problem identified by DECC in 2010, as the settling out of siltation will be more uniform with our model for the barrage, due to the more uniform velocity distribution across the estuary, as the turbines are spread across the breadth of the estuary, particularly along the barrage line where there will be turbines sited all the way across the barrage and not just across the middle third. By siting turbines across the whole wall, the velocity through the turbines will be lower, typically of the order of a third, thereby: reducing the level of turbulence, wake length, and degree of local scour (due to the significantly increased velocities in the region of the turbines); removing large scale horizontal circulation (a major factor in causing deposition and shoreline erosion); and, in particular, making the threat to fish less damaging—regardless of type of turbine used.

Hafren Power has not yet undertaken its own detailed computational morphological modelling of the estuary. To date, the company has focused more on the hydrodynamic impact of the barrage. However, bearing in mind that the new barrage design will not reduce the basin currents as much as the previous STPG scheme and that the suspended sediment concentration is roughly proportional to the third power of velocity, then the anticipated erosion and deposition in the estuary is expected to be less than that for the previously studied scheme. Hafren Power will not base its figures on the current estimates, as the effects of our proposal will be different, so we propose to carry out our own studies using experts in this field.

6. *You have claimed in your evidence that the barrage would result in 60% less loss of intertidal habitat when compared to the previous proposal for a Cardiff-Weston barrage. Can we see the methods used for calculating the amount of intertidal habitat which will be lost?*

Our engineering consultants calculated the amount of lost intertidal habitat by using a hydrodynamic model, coupled with input from the turbine manufacturer. The manufacturer's IPR is confidential.

The loss of intertidal habitats was also calculated directly within the model used by Professor Falconer's team by calculating the loss of computational grid cells which are flooded for the peak spring flood tide for the existing estuary and which are not flooded for the equivalent case with the Severn Tidal Power Group (STPG) scheme and then for the Hafren Power (HP) scheme with two-way bi-directional turbines. By evaluating the number of cells which are permanently dry for the STPG and HP schemes and multiplying by the area of each cell, one can evaluate the area of intertidal habitat lost through the design of each scheme.

Intuitively, it is clear that much more intertidal habitat will be preserved than under previous schemes. Unlike ebb-only schemes, there is no damming of the estuary. Ebb-flow generation allows the tides to more closely follow their natural flows, except for taking 2m off the top of the tide and adding 2m to the bottom.

7. *A fixed shore-to-shore barrage on this scale has never been attempted and there are significant uncertainties about the possible impacts; many commentators are advocating that we should "start small" to minimise financial and environmental risk. What is your response to those organisations advocating a more incremental, step-by-step approach to tidal power development?*

We do not believe there is uncertainty about the fundamental question: the capability of the barrage to deliver 5% of the UK's energy supplies over a minimum 120 year period.

According to Professor Tim Broyd, representing the UK engineering industry at the January 10 oral evidence session, the barrage is the only cost-effective way to harness the power of the estuary. He said:

*"I was a member of the expert panel used by DECC a couple of years or so ago to assess five different schemes, and there were three barrage schemes and two tidal lagoon schemes. We also looked briefly at reefs and tidal fences. Of those, the only one—and it was pretty much head and shoulders above the rest for any return on investment at all—was the barrage along the line, the type of line that Hafren Power are suggesting. Other schemes were less viable. They certainly produced less power. But of course a barrage itself, and again harking back to what has been said earlier today, does not prevent other types of renewable energy being tapped within the regions."*

As we mentioned in our oral evidence, tidal range, tidal stream, wave and offshore wind can all co-exist in the Severn estuary. The issue is to place them all in their most efficient and effective locations. None conflicts with the barrage.

To make tidal power commercially viable and competitive with other, more established, technologies, the nation requires economies of scale to keep costs down. Only a tidal range scheme on the scale of the Hafren

Power barrage would provide sufficient financial incentive for major turbine manufacturers and engineering firms to progress their concept designs through to production. Barrage technology is tried and tested. Our delivery team have built caissons and embankments of similar size elsewhere in the world. An incremental approach through a pilot project will not provide any data that does not already exist.

One example of an “incremental, step-by-step approach” others have advocated might be the Stepping Stone tidal power scheme. Lagoons and the Stepping Stones scheme are untried and unproven and would have similar impacts on ecology and wildlife to a barrage, which would need to be addressed. They would also take approximately eight years to become operational from now. This would mean that the first test data would only become available in approximately nine years’ time. The smaller Stepping Stones scheme would only produce about 1.2 terawatt-hours per year, while the barrage offers 16.5 terawatt-hours per year. Thus, the UK would lose about six years of a much larger energy source while it faces a looming electricity gap of 60 TWh by 2025.

One of the key points to appreciate in generating hydro-electric power in an estuary is that:

*Power (symbol to be inserted)  $A H^2$*

This equation demonstrates that the amount of power generated is determined by two factors: the head of water across the area impounded by the barrage (H) and the area of water that it impounds (A).

Whilst the Severn barrage project seems huge, it is attractive to private investors because it is highly efficient to be able to impound such a large body of water with a relatively short impoundment wall. It is well known that the estuary has the second largest tidal range in the world, but it is rarely appreciated that the barrage will impound a huge water body with a plan surface area of 500 km<sup>2</sup>, equivalent in area to approximately 150% of the area of Lake Garda. The impounded perimeter is approximately 210 km, while the constructed wall length is only 18 km. By comparison, a lagoon the size of 1,000 football fields, like the proposed Swansea Bay lagoon, requires a perimeter wall of 9 km just to impound an area of 5 km<sup>2</sup>. While the perimeter wall would therefore be half the length of the barrage, the lagoon would produce only around one fortieth of the electricity available from the barrage. These vast disparities in output and efficiency speak for themselves. In the unique Severn estuary, an enormous amount of power can be derived from a very short barrage wall.

It is worth reiterating that the construction of a barrage would not inhibit the development of other marine and wind power projects either elsewhere in the Severn estuary or in other parts of the UK. Indeed, we would encourage the Committee to consider supporting these developments. However, only the barrage has the potential to provide such a large proportion of the UK’s energy needs and to do so on an economically feasible basis.

If the Committee agrees that the potential of the Severn estuary’s tidal energy should be harnessed in full, then we believe that work on the barrage should begin as soon as possible.

*For further analysis of this topic, please see the submission by Blue Marble Sustainable Solutions Ltd.*

Figure 2 has been designed to provide a rule of thumb of comparative statistics in respect of the potential output of different types of power generation. While this table does not purport to provide a precise comparison, it provides a reasonable rough guide.

**Figure 2**

| <i>Comparison of electricity generating sources</i>                     | <i>Offshore wind</i>                           | <i>Nuclear</i> | <i>Tidal stream</i>   | <i>Tidal fence</i> | <i>Lagoons</i>                             | <i>Severn barrage</i> |
|---|--|----------------|---|--------------------|--|-----------------------|
| Number of equal output of Severn barrage <sup>(1)</sup>                 | 2,500 wind turbines over 2,750 km <sup>2</sup> | 3–4 reactors   | 9,200 turbines over 226 km <sup>2</sup> of sea-bed, in depths of >30m | Between 5 and 19   | 7, each the size of 1,000 football pitches | 1                     |
| Capital cost to equal output of Severn barrage (16.5TWh) <sup>(2)</sup> | £50bn  | £21bn          | £80bn   | £35.5bn            | £55.5bn                                    | £19bn                 |
| Capital cost per MWh over life of asset to generate 16.5TWh             | £206   | £47            | £309  | £137               | £98  | £33                   |
| Flood defence   | x  | x              | x   | x                  | x  | √                     |

| <i>Comparison of electricity generating sources</i> | <i>Offshore wind</i>                         | <i>Nuclear</i>  | <i>Tidal stream</i>                          | <i>Tidal fence</i>                   | <i>Lagoons</i>                                  | <i>Severn barrage</i>  |
|---|--|-----------------|--|--------------------------------------|---|--|
| Legacy  | None   | Decommissioning | Export                                       | Export                               | Export  | Flood protection, storm surge, protection, exports               |
| Investment stays in UK?                             | x  | x               | √  | √                                    | √   | √  |
| Potential to be world market leader?                | x  | x               | √  | √                                    | √   | √  |
| Shipping impact                                     | Minimal, if placed outside shipping channels | None            | Minimal, if placed outside shipping channels | Accelerates currents through channel | Acceleration of current and navigational hazard | Locking time through barrage and reduced peak water basin levels |
| Predictable electricity?                            | x  | √               | √  | √                                    | √   | √  |
| Daily period of transmission                        | Intermittent and unpredictable               | 24h             | 15.25h                                       | 15.25h                               | 15.25h  | 15.25h   |
| Lifespan (years)                                    | 15–25  | 60              | 20–25  | 20–25                                | 120–250   | 120–250  |
| Need for consumer support?                          | √  | √               | √  | √                                    | √   | √  |
| Price support as % of lifespan                      | 100%   | 50%             | 100%   | 100%                                 | 25%   | 25%  |
| Levelised cost per MWh <sup>(3)</sup>               | £192 (2015), with a target of £100 by 2010   | £88             | £325   | £226                                 | £148  | £48  |

8. *Experience from the Bay of Fundy barrage in Canada has led to the Canadians abandoning further barrage developments due to “rapid, unpredictable consequences and no foreseeable return to a state of dynamic equilibrium” within river ecosystems. Are you familiar with this research and what in-field studies have you undertaken so far to assess the possible impacts on the estuary’s morphology?*

On the specific question of the Bay of Fundy, we are aware of a wide range of research, but do not believe this example is directly comparable to the Severn estuary. Furthermore, Professor Falconer has personally looked at the Bay of Fundy and concluded unequivocally that this site was not suitable for a barrage.

First and foremost Canada is a sparsely populated country compared to the UK and, in contrast, ideally suited to small scale hydro-electric schemes. It also has considerable potential for small scale hydro-electric dams, which have been, and continue to be exploited. Because of the scale of the country there are difficulties in having a high concentration of power generated in a relatively sparsely populated part of the country.

Secondly, and more importantly, there have been several key hydrodynamic modelling papers on the Bay of Fundy and by some of the world’s leading ocean modellers in the field. Aretxabaleta et al. (2008)<sup>169</sup> highlight the complexity of the flows in the Bay of Fundy. These results, together with the low population density of Canada, led Professor Falconer to his conclusion.

It may also be of interest to the Committee to note that more recent highly regarded modelling research, Cousineau et al (2012),<sup>170</sup> shows that even small coastally attached lagoons in the upper part of the Bay of Fundy have a marked effect on the water levels further seawards and will significantly affect currents. This highlights the point that whilst much concern is raised about the hydro-environmental impact of barrages even relatively small lagoons can have a significant adverse impact on the hydro-environmental impact in semi-enclosed environmental water bodies.

<sup>169</sup> Aretxabaleta, A L, D J McGillicuddy Jr, K W Smith and D R Lynch, Model Simulations of the Bay of Fundy Gyre: 1. Climatological Results, J Geophys. Res., 113 (see Attachment 4)

<sup>170</sup> Cousineau et al, Hydrodynamic impacts of tidal power lagoons in the Bay of Fundy, Coastal Engineering 2012 (see Attachment 5)



The Canadians abandoned the Bay of Fundy scheme when research indicated it would result in sea level rises on the US eastern seaboard, which would give rise to possible legal action. A similar far-field rise in water level was found by early studies for the Severn barrage. However, this is thought to have been caused by the limited model boundary, which only stretched as far as Ireland and Anglesey. When Professor Falconer extended his model to the continental shelf these far field effects became insignificant.

Professor Falconer would be pleased to host any members of the committee wishing to visit Cardiff University to see his modelling in person.

*9. We understand from your evidence that the turbine design may be based on a concept design by Rolls Royce/Atkins. Do you have a commitment from these companies to work in partnership with Hafren Power to develop the design?*

We do not now have any business relationship with Rolls-Royce, who have withdrawn from the tidal-stream turbine market following the sale of its subsidiary, Tidal Generation Limited, to Alstom. However, Rolls-Royce did not sell the IPR on the bidirectional VLH turbines. We are in discussion with four potential turbine manufacturers, all of which are confident that they will be able to manufacture the turbines we require to the specification we require. This may involve acquiring the IPR from Rolls-Royce.

*10. Do you currently have a commitment from manufacturers to build turbine plants in South Wales and the South West?*

We have agreement in principle, but negotiations have not reached the point of detailed commitment.

*11. Do the contra-rotating blades spin at the same time?*

Yes, the contra-rotating blades do spin at the same time. The two sets of blades are separated by a gap of more than 1.5m, which is enough to allow the largest salmon through with full-body clearance. This will be studied further by our fish experts, and optimised during turbine development.

*12. What studies have you undertaken to determine the effectiveness of measures such as fish passes?*

We are aware of a number of studies looking at this area. This is being explored by researchers in the US and in Europe. We will take account of any practical tests being conducted, such as those by the DoE in Idaho and MJ2 Technologies in France.

We are currently in discussion with Dr Andrew Turnpenny (Director of Turnpenny Horsfield Associates), an expert in this field. His evidence to the Parliament Science and Technology Select Committee states: “there are much better prospects of quantifying possible damage to fisheries and, more importantly, designing and operating turbines to be more ‘fish-friendly’”. The development of acoustic fish guidance has advanced in the last ten years from concept to reality. The possibilities of safely diverting fish around a turbine should now be realisable.” We intend for full studies to be made of this area during the next phase of the project.

*13. Have you carried out any tests of fish (salmon—adults and juveniles; shad—adults and juveniles; eels—adults and elvers; lamprey—adults and juveniles) strike mortality in the bi-directional turbine?*

Hafren Power has not conducted tests itself at this point, but quite a lot of testing has been done. See, for example the research conducted by Idaho National Laboratory showing that a tip speed of 12.2m/s, significantly above the tip speed of the VLH turbines, is at the “limit of negligible mortality” for fish passage through a turbine. However, further study is needed to confirm that these conclusions apply to all types of fish, at all stages of their development.

As previously indicated, testing the migratory patterns of fish and the effects of the turbines on them will be part of the next phase of the project. Swansea University will lead the study. We will also investigate various mitigation and compensation measures. Hafren Power’s aim is to accomplish zero mortality for fish passage through its turbines.

Attention should be drawn to the fact that MJ2 Technologies have developed a fully operational VLH turbine which is accepted by the French authorities for deployment in environmentally sensitive locations. This turbine is now being exported to a number of European countries. Full scale field tests using live European eels have led to iterative development of the original production model. Some eels were being pinched at the outer edge. With a minor adjustment to blade design, this was resolved. These turbines now provide for 100% survival of eels of up to 1.0m in length. This is a highly vulnerable and endangered species particularly prone to turbine damage, and the 100% survival rate clearly marks a significant step forward in fish friendly turbine design. MJ2 technologies are carrying out tests on salmon smolts during 2013 and will be updating Hafren Power with their results. This indicates to us that computer aided turbine design to optimise output and minimise fish damage factors is a highly effective and reliable tool.

Hafren Power will seek ways to improve the spawning conditions of migratory fish by, if appropriate, removing weirs that block shad and providing salmon rearing facilities.

14. *Over the course of a tidal cycle and the barrages lifetime, by how much does the generator efficiency vary and how does this affect the amount of intertidal habitat which is lost?*

Hafren Power is confident that there will be little variance in turbine efficiency. In 46 years of continual operation, the turbines at La Rance have not needed to be replaced, which indicates how efficient turbine technology has proven to be. Precise estimates of the effect of turbine design on the intertidal habitat will be determined as part of the wider studies we intend to conduct during the next phases of the project.

15. *In your evidence you state that you are “studying the option” of building a Bridgwater Bay bund to protect the Somerset levels. When will you make a decision on this and have you made an assessment of the planning and mitigation requirements of this extra project?*

The decision on whether to proceed with a Bridgwater Bay bund will be made as part of the Environmental Impact Assessment, based on whether it is a necessary part of mitigating the impact of a Severn barrage. An assessment has been made of the planning and mitigation requirements of this extra project. As we understand it, the impact of such a bund would be positive, protecting the Somerset levels from flooding and the habitat of the shelduck.

The DECC studies of an ebb-flood tidal power lagoon in this area showed that the basin water level closely followed the natural level. Regarding flooding, the sluices or turbines could be shut during exceptionally high sea level conditions thus protecting the Somerset levels from marine flooding. When fluvial flooding occurred, the basin water level could be maintained close to low-tide level, thus allowing the Somerset levels to be drained much more effectively.

16. *Who will pay for the maintenance of the bund?*

Should the Environmental Impact Assessment process indicate that a Bridgwater Bay bund is needed as part of the environmental mitigation for the barrage, Hafren Power will take responsibility for the costs of ongoing maintenance.

17. *The barrage will offer protection against upstream tidal flooding and storm surges, however downstream river flooding, tide-locking issues and erosion of existing flood defences are likely to cause “very significant additional costs” according to the Environment Agency. How do you propose to address these flood risk issues within your proposal? (if not covered by Professor Falconers response on this issue)*

Modelling the peak sea level on the stretch of coast up to about 40km downstream of the barrage shows flooding would marginally reduce. Therefore, the barrage will reduce flood risk along the coast not increase it. Furthermore there will be even less risk of tide locking.

The DECC scheme with basin water level barely going below mean tide level was found to result in significant tide locking of the outfalls. This was analysed in the Severn Tidal Power Feasibility Study (STPFS). Mitigation works such as pumping stations were identified and costed at £80 million. With the Hafren Power proposal—an ebb-flood generation scheme—the basin water level is very much lower and the capital works required would be substantially reduced or eliminated.

The DECC scheme would have used bulb turbines which required a 3 to 4m head to start generation, whereas Hafren Power will use VLH contra-rotating turbines which have a much lower starting head requirement. They will therefore be able to start generation sooner. As a result, the period of high water stand is appreciably reduced. This would significantly reduce the risk of erosion due to high water stand, compared to the ebb-only DECC scheme.

It would appear that the Environment Agency arrived at “very significant extra costs,” because its submission to the Committee was based on modelling results relating to the previous ebb-only DECC scheme and not that of Hafren Power, which, as explained above has very different characteristics. Nonetheless, all of this would be studied in detail and any necessary mitigation measures such as pumping facilities or shore protection would be provided.

18. *Since the evidence session, have you had any further discussions with DEFRA regarding flood risk and savings? In particular, have they been able to verify your estimates for flood defence savings (see Q180)?*

Hafren Power has submitted a 50-page analysis of flood costs to Defra. Defra is currently in the process of reviewing the document. At this stage it has not yet verified our estimates for flood defence and damage savings. We have agreed to further meetings to clarify any outstanding questions Defra may have.

19. You mentioned that the price support for the barrage “only lasts for 25 [years]” (Q206). Can you clarify this with regard to the previous suggestion that a 30-year CfD period would be necessary?

The transcript (uncorrected evidence) was incorrect. The corrected evidence now reads: “We would be around for 120 years. The price support only lasts for 25% of the barrage’s life” (30 years of a total of at least 120 years).

March 2013

### Written evidence submitted by the Angling Trust

#### 1. OVERVIEW

The Angling Trust is the representative organisation for all coarse, game and sea anglers in England. We have more than 1,500 member clubs who have a combined membership of more than 350,000 anglers. Angling has been shown to have great benefits for individuals’ health and well-being, for community cohesion and for the national economy. It generates more than £3.5 billion each year, employs 37,000 people and is enjoyed by 3.5 million participants.

The Angling Trust welcomes the opportunity to provide evidence to this Committee, but we are constrained in so doing by the lack of specific information available about the latest proposals for a barrage.

Our principal message to the Committee is that the proposals must be worked up into much more detail before any firm view can even begin to be formed about the costs and benefits of this scheme. In addition, rigorous, independent, peer-reviewed assessments must be carried out to calculate the impacts of the proposals.

We remain highly sceptical that a development on this scale, in such a sensitive environment, will not cause unacceptable damage to the ecological and geomorphological functions of the Severn Estuary. For good reason, the estuary and many of the rivers which flow into it are heavily protected by domestic and European legislation. Any project of this scale would require a Strategic Environmental Assessment (SEA), as per the SEA Directive, to consider the impacts on the Basin as a whole including, *inter alia*, socio-economic impacts, impacts on Eel Regulations; the NASCO Precautionary Principle, Salmon Action Plans, Water Framework Directive, and the Habitats & Birds Directives.

The Habitats Directive would require compensatory habitat to be created elsewhere to replace that which is damaged in the Severn. This could involve the creation or restoration of thousands of hectares of intertidal habitat and/or hundreds of miles of salmon and shad river habitat. If the damage to habitats is on the scale that we believe it might be, this would be even more unfeasible than stocking salmon to the wadis of the Yemen, and considerably more expensive. What’s more, this habitat would have to be in place and functional before work could begin on the proposed barrage.

We do however believe that there are significant opportunities for generating renewable energy in and around the Severn Estuary, but these are far more likely to lie in a series of smaller-scale projects which would need to be co-ordinated strategically on a regional basis and should be developed in ways which minimise impacts on other ecosystem services.

#### 2. INDIVIDUAL QUESTIONS

*What contribution could the Cardiff-Weston Barrage make to UK energy security and climate change objectives?*

The Angling Trust believes that urgent action is required to reduce damaging CO<sub>2</sub> emissions and to slow the pace of climate change, which is one of the most significant threats faced by humanity.

A large barrage, if it achieves all the necessary approvals and is successfully constructed, could hypothetically generate significant amounts of electricity. The developers claim this might be as much as 5% of UK electricity demand. However, the proposals are at such an early stage that it is difficult to make any meaningful assessment; they cannot tell us what type of turbines will be used. There would be very substantial carbon emissions arising from construction.

It will be important for the Committee to assess the risk of a Barrage being unable to operate in the future due to unforeseen environmental damage becoming apparent and/or due to unexpected sediment accumulations which might prevent it operating.

Whatever the potential for power generation might be, the estuary’s vital functions as a habitat for wildlife and as a provider of ecosystem services to the South West of England and Wales and to the nation as a whole must be protected. The best way to do this will be to take a strategic view of the potential for energy generation at a number of sites and to select a suite of measures which are designed to have the lowest environmental impact and which optimise power generation in a particular location. This proposal appears to seek to generate too much power from a single project.

The scheme will also be extremely expensive to construct, particularly if compensatory habitats are created on an appropriate scale elsewhere. The electricity it might one day generate is therefore likely to be sold at a very high unit price.

*What risks and opportunities could it pose to wildlife and habitat in the Severn estuary, and how might any risks be mitigated?*

Our response to this question focusses principally on fish, because we have most expertise in fisheries and an obvious particular interest in the impact on fisheries. However it should be noted that fish living in the Severn Estuary are a vital part of the marine and freshwater ecosystem of the estuary, many large river systems and the Atlantic Ocean. Any significant impact on fisheries in the estuary would impact on fish that travel as far as Greenland and the Sargasso Sea. These include several species which are protected, such as eels, shad, lampreys and Atlantic salmon. Some of these species form part of the designation of habitats in and around the estuary as Special Areas of Conservation. Approximately 25% of all salmonid spawning habitat in England and Wales lies upstream of the barrage and the stock of fish in each of the rivers is genetically distinct from any other. It is difficult to see how compensatory habitat for such species could ever be constructed.

The River Severn is one river where the European eel remains relatively abundant. The population numbers of this species have declined by some 95% across Europe in the last few decades. Any significant impact on fisheries in the estuary would impact on recreational and commercial fisheries alike in a large number of rivers and potentially throughout the Irish Sea and Eastern Atlantic Ocean.

The Severn Estuary provides a habitat to around 100 species of fish, at every stage of their lifecycle from tiny larvae to large adults. It is a very important breeding site for many marine fish species, a nursery area for young fish, a feeding area for fish of all ages and a thoroughfare for fish migrating into and out of several large river systems that flow into the estuary. These species which migrate between freshwater and the sea have to carry out a remarkable transformation at this point in their lifecycle to adapt to changes in the salinity of the water. This puts them under considerable stress and makes them particularly vulnerable.

Most species will spend a considerable amount of time in the estuary (ranging from days to years) and will naturally move several miles in each tidal cycle. They would therefore be likely to pass through turbines many times and therefore even a small risk of damage to individuals on each passage could have a population-limiting impact. Estuaries are probably the most important habitats for fish and many of these species are already threatened by a host of other environmental challenges such as excessive commercial fishing, damage to habitats, pollution and over-abstraction. Our understanding of fish behaviour in estuaries is very limited and considerable work would be required to improve this understanding to make any realistic assessment of the impact of a barrage on the scale that has been broadly described.

What is known is that most fish will usually seek out the areas of maximum flow to pass an obstacle. Therefore any attempts to divert them from passing through turbines and into a fish pass are unlikely to be successful, because the vast majority of the water would be passing through the turbines.

We have asked the developers to allow us to input to the terms of reference for independent, peer-reviewed, assessments of the impact at an individual and population level of:

- their particular designs,
- specifically in the highly turbid waters of the Severn Estuary,
- on all relevant fish species at all life stages,
- swimming both with and against the flow, and
- passing through the turbines both head and tail-first.

Our concerns lie particularly, but not only, in the following areas:

- Fish being struck by turbine blades which would cause them injury or death. The developers have claimed that their turbines are “fish friendly” and that they have a tip speed of 9 metres per second. We have yet to see the design of the blades or any further technical data. The Severn Estuary is also extremely turbid; the water has a very high sediment load and visibility is extremely limited. Studies must be conducted that meet the requirements listed above.
- Fish being disorientated by passing through the turbulent water passing in and out of turbines (or any fish passes) and becoming more vulnerable to predation by birds and other fish.
- The feeding, spawning and nursery areas of fish being damaged by deposition and erosion of sediment as a result of changes to flows in the estuary. Because the water is saturated with sediment, even small changes to velocity and discharge could cause very significant changes to deposition of sediment. Water that has less sediment in it tends to have more capacity to cause erosion. These impacts have the potential to extend well beyond the Severn Estuary.
- Delays to fish migration leading to them failing to complete their lifecycle. Many fish will avoid passing obstacles, or spend considerable time seeking safe ways of passing over or round them. This could cause delays to fish migrating up rivers or out to sea which might make them more vulnerable to predation or pollution incidents. They might also miss key opportunities to continue their journeys, such as a spate in their natal river.

All of these impacts and more need to be rigorously assessed and tested on the basis of specific proposals from the developers. A strategic environmental assessment would be required for a project of this magnitude to consider its compliance with a wide range of environmental legislation.

In terms of mitigation, the options might include reducing the size of the head of water, reducing turbine speeds, reducing the proportion of the water which passes through turbines and preserving some natural flow, or considering alternative methods of generating power as part of a suite of measures compiled on a strategic basis for the region as a whole.

*What risks and opportunities could it pose to local employment and community, and how might any risks be mitigated? In particular, what are the consequences for current ports, fishing and aggregate extraction industries in the estuary?*

Until the proposals are more clearly developed it is very difficult to answer this question. Clearly there would be short term benefits to the economy from construction of such a large civil engineering project. However, these would not be realised for many years and possibly several decades because of the work that will be required to justify a project of this scale.

There are highly likely to be negative impacts from the scheme for employment and communities. The scale of the latter for the angling industry will depend largely on the impact of the proposals on fish stocks. Angling is a vitally important part of the social and economic fabric of communities along rivers throughout the Severn basin and along the coastline of South West England and Wales. Any further threat to already degraded fish stocks would have a very damaging impact on this existing industry.

The best way to maximise the long term benefits and minimise the negative impacts would be to identify a wide range of methods of generating renewable power which have the least impact on the natural environment.

### 3. CONCLUSIONS

We strongly recommend that the way forward for considering the generation of renewable energy in the Severn Estuary is:

- To carry out a strategic appraisal of the range of options available for generating renewable energy in and around the estuary (with proven technology);
- To conduct peer-reviewed, independent assessments of each of these options and their environmental impact;
- To develop a plan for harnessing renewable energy sustainably;
- To carry out a Strategic Environmental Assessment of that plan;
- To modify the plan accordingly and then implement it sequentially, with some elements of it awaiting development of new technology or further research into environmental impacts and their mitigation.

December 2012

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### Written evidence submitted by Wales TUC

The Wales TUC is a constituent part of the British Trades Union Congress. The Wales TUC has devolved responsibility for matters specific to Wales. The Wales TUC represents all TUC affiliated unions with members in Wales.

We thank the Committee for allowing a slight extension to the submission deadline in order to allow this Wales TUC evidence to be fully agreed through our democratic structure.

### INTRODUCTION

1. The Wales TUC supports a balanced energy mix of low carbon, secure and affordable energy. This will include investment in all renewables, in new nuclear capacity and in carbon capture/storage technology for coal and gas installations. The tidal power of the Severn estuary, if harnessed to its full potential, would make a major long-term contribution to the UK's renewable energy strategy.

2. Large scale renewable energy projects are essential to create the stimulus required to take us out of economic crisis, to deliver on climate change commitments and to create green jobs in a modern economy with sustainable economic growth. Unless that understanding provides the context for consideration of large schemes, the focus will always be on why we can't act decisively rather than why we must.

3. It is important that any scheme which seeks to harness the renewable energy potential of the Severn estuary, sets out in detail how it will ensure that the investment has maximum impact in terms of creating and securing for the UK high quality employment; building the skills base and securing procurement or supply chain opportunities. This must be a fundamental and priority concern in the consideration of any scheme.

4. It is important that the employment, skills, economic and environmental impacts of any scheme to harness the potential renewable energy opportunities of the Severn—are all properly evidenced. Consideration of a scheme must not be based on claims which, whether negative or positive, are not proven or which refer to unrelated evidence from previous schemes. All evidence, in favour or against should be robust and publically available at the earliest opportunity to allow stakeholders and the wider community to independently assess the potential benefits and costs of any scheme.

5. There have been suggestions in the media that the current proposal may reduce the number jobs in Bristol port. This has naturally caused concern for port employees and for their colleague trade unionists throughout the UK. Hafren have given a public commitment that the proposal will not have a negative impact on existing employment in the Port. It is important that Hafren take the opportunity to set out in detail how they believe the barrage can be delivered in a way that does not impact negatively on the existing employment in the Port in order that the concerns raised in the media may be fully addressed.

6. It is important that robust consultation processes are put in place in both Wales and South West England at every stage of the project in order for all views to be fully taken into account.

7. It is important that the UK government provides high level leadership and co-ordination on any scheme of this scale and that the Welsh Government must be a full partner in the co-ordination of schemes which impact directly on Wales.

8. It is important that the potential for other schemes coming forward should not be allowed to preclude the barrage proposal going forward. It is equally important that support for this barrage proposal should not preclude proper consideration of other potential schemes to harness the renewable energy potential of the Severn.

#### WALES TUC PERSPECTIVE OF THE ECONOMIC BENEFITS

9. The proposal for the Severn Barrage is for the development of a significant source of green energy without investing significant public funds.

10. The proposal provides for a social legacy by creating substantial new, permanent jobs through industrial regeneration and the creation of new leisure industries around the barrage.

11. The scale of the Severn Barrage proposal is unlike anything previously seen in Wales and the South West of England. It is transformational in scope and impact for our economy and would make a huge contribution to meeting the statutory renewables commitment.

12. The Barrage will inject an investment of around £25 billion into the economy and help to revitalise parts of Britain that remained economically depressed. According to the UK Contractors Group, UKCG, for every £1 spent on construction, output generates a total of £2.84 in total economic activity.

13. The electricity produced will offset currently imported energy sources and improve UK balance of trade, enabling the UK to become significantly more self-sufficient in energy.

14. Hafren have given the public commitment that they will work on both sides of the Severn with trades unions, local colleges, training providers and welfare to work services to ensure the right skill mix to support the barrage.

15. The development of a new ultra-large container ship terminal at Port Talbot would provide business opportunities and long term employment prospects in South Wales—one of the most economically deprived areas of the UK.

16. ONS figures for in the area on both sides of the Severn most directly impacted by the Barrage show there are currently almost 40,000 job seekers on benefits out of an economically active population of 770,000. It is precisely in this area that employment could be created in new leisure, tourism and fisheries industries. Hafren has also stated that it intends to co-operate with local colleges, and consider bespoke centres, in order to provide vocational training which will enable residents in the area to work in the newly created tidal-range technology export industry. The Barrage will contribute to the creation of large scale employment in South Wales and the West Country, and will contribute significantly to the regeneration of the region around the Severn.

17. The scheme proposers estimate that it generates 20,000 jobs during construction, in managerial and administration; civil, electrical and mechanical engineering; environment; project management; skilled & semi-skilled trades; and labour. The indirect effects of a £25 billion stimulus can be 50,000 jobs in total.

18. Post-barrage construction, employment can be maintained by the strengthening of the manufacturing base at, for example, Port Talbot and Baglan. There will be real potential to work with Welsh government in a targeted way to make sure economic benefit is delivered long term.

19. Supply chain jobs would be potentially significant, such as those involved in aggregates and transport which would directly benefit from the scheme. It could also help secure the long-term expansion of the Tata steel facility in Port Talbot where almost 600 job losses were recently announced.

20. There are other job creation opportunities more directly associated with the on-going operation and maintenance of the barrage.

21. The Hafren proposal entails the creation of a heavy industry and renewable energy technology hub in Port Talbot and commits to over 80% of the investment being spent in the UK—sourcing most of the components throughout the UK and assembling these locally. This use of local industry is in sharp contrast with other renewable energy industries where the technology and expertise are predominantly sourced from outside the UK.

22. The size of the proposed caissons and marine turbines make them very difficult to transport long distances and therefore the proposal requires them to be assembled and shipped through Port Talbot—giving a significant manufacturing opportunity.

23. Since a huge volume of materials for the construction of the Barrage will be brought in from the sea, all the South Wales/South West England ports will be able to benefit accordingly. Because of its location and because it is a natural deep sea harbour, Port Talbot docks are likely to be one of the main beneficiaries of redevelopment—allowing greater and long term economic use post barrage construction.

24. As the largest tidal Barrage in the world, the Severn Barrage will be a tourist attraction of greater potential than the smaller La Rance Barrage in France and would facilitate leisure and tourist use of the Severn above the barrage.

25. Hafren have stated that their proposal would not have the severe siltation/dredging issues of old high-head barrage upon which much of the criticism regarding dredging is based. A barrage that generates on both the ebb and the flow would more closely match the existing tides, tidal range and sediment regime and therefore minimise excessive siltation.

26. The “sea lake” on the Bridge side would create a much more benign environment for shipping, boating and leisure activity than the Severn’s extremely rapid tide which is hostile to such activity. This offers new opportunities for Bristol Port to supplement its existing shipping with additional traffic and therefore jobs.

27. Hafren believe that clearer waters upstream of the Barrage mean more photosynthesis and more oxygen, and hence more sea plant life and nutrients. They use the example of La Rance, to show that the fishing industry could therefore be dramatically expanded.

28. Hafren have made the following commitments in respect of existing shipping—locks will enable ships to continue to pass up the river as they do today with no change in water level, no fee, no change in the size of ship and current delays waiting for the tide not increased. The commitment is that relevant ports will be able to continue with their business as in the past and therefore the barrage does not present a threat to existing jobs at Bristol port.

## CONCLUSION

29. The Wales TUC believes that the environmental and employment concerns related to previous barrage proposal have been addressed in this new proposal. We will leave detailed consideration of environmental factors to those best placed to provide evidence in that area.

30. It is important for us that the Hafren proposal explicitly does not threaten existing shipping (and therefore existing jobs) at Bristol port.

31. Of great significance for the Wales TUC is the potential for transformational economic impact in Wales both from the project itself and from longer term economic activity, supply chain growth and infrastructure capacity.

32. Hafren have indicated their willingness to work in partnership with the Wales TUC and unions to ensure union recognition and collectively negotiated terms apply throughout the project.

33. Having taken account of all of the above we therefore believe that the proposal should be supported.

*December 2012*

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## Written evidence submitted by EDF Energy

### ABOUT EDF ENERGY

EDF Energy is one of the UK’s largest energy companies with activities throughout the energy chain. We provide 50% of the UK’s low carbon generation. Our interests include nuclear, coal and gas-fired electricity generation, renewables, and energy supply to end users. We have over five million electricity and gas customer accounts in the UK, including both residential and business users.

EDF Energy is a wholly-owned subsidiary of the EDF group. In France, around 6% of the Group’s electricity production is generated through hydropower. Together with its nuclear portfolio, this enables the EDF group

in France to produce over 95% of its electricity without carbon dioxide emissions, and helps make an essential contribution to the country's security of supply.

#### EDF ENERGY'S RESPONSE TO YOUR QUESTIONS

*Q1. What lessons can be learned from the successful development of La Rance tidal barrage in France and other tidal power projects?*

1. EDF's Rance tidal power plant is located at Ille-et-Vilaine, Brittany in France, and is the second largest tidal plant in the world (after Sihwa Lake in South Korea). The installed capacity of the Rance plant is 240 MW. It uses both the ebb and flow of the tides to create the height difference between the sea and estuary that is essential for generating energy. Plans and studies to build the Rance power plant began in 1943 and ended in 1961. The plant was commissioned in November 1966 and generates 540 GWh per annum.

2. Tidal power, although intermittent, is reliable because the tides have a regular daily cycle. This means that the time and force of the tide can be predicted. This allows tidal power plant to be scheduled in advance and therefore usefully complements other forms of electricity generation. The EDF group is committed to carrying out thorough and detailed research into recovering energy from the sea. By working closely with specialised bodies, including the French research institute for exploitation of the sea (IFREMER), EDF group is further strengthening its expertise in this area.

3. Worldwide, suitable sites for tidal power schemes are rare. They need to meet several conditions:

- very high tidal amplitude;
- a suitable natural site for the construction of a barrage; and
- proximity of the site to the electricity transmission network.

4. The Rance site was chosen for the project because it has the highest tidal range in France. This is on average 8.2 metres but can reach a maximum of 13.5 metres. In addition, the Rance estuary has a large reservoir of 184 million cubic metres and only required a 750 metre-wide estuary to be cut off. The barrage consists of 24 bulb turbines that are able to generate electricity during both ebb and flood tidal flows. In addition, there is a ship lock, which allows ships to pass through a dyke. After 40 years, on average, each of the 24 units had run 222,690 hours, with an immersed time of 324,494 hours and a cumulative gross output of about 21.6TWh.

5. Robert Gibrat, in researching the feasibility of a tidal power plant, identified in 1943 the four obstacles that would need to be overcome if the Rance barrage was to be built. These obstacles can be divided into the four following categories:

- Operational cycles.
- Choice of turbines.
- Protection against marine corrosion.
- Construction of the plant.

6. The Rance estuary is situated in a region that is subject to a high tidal range and this tidal range could be exploited for energy production using either single effect or double effect generation. The power plant at La Rance operates using double effect. This involves increasing the time of production by allowing the turbines to turn while the basin is filling. Pumping is also used in order to increase productivity. The average percentages experiences at La Rance are as follows: ebb generation results in 60% of the energy generated, reverse pumping accounts for 0–0.1%, flood generation results in 2–6%, direct pumping is responsible for 15–20%, and finally free flow through the turbine orifices accounts for 20% of the total energy produced.

7. The choice of the turbines was also an important factor studied in the years prior to the construction of Rance power plant. In 1943, an important question was how to deal with a wide range of head and flows. At the Rance site, for example, the flow range is between 4,000 and 18,000 cubic metres. The turbines at the Rance power plant are 5.35 metres in diameter, and weigh 470 tonnes. Their output is 10MW and they rotate at 93 revolutions per minute. The minimum head required is 3 metres, and the maximum head permitted is 11 metres.

8. The third obstacle was that seawater created a corrosive environment. In 1955, a committee was created in order to research ways to prevent corrosion. After multiple tests, it was decided that Cathodic protection would be used for all 24 bulb turbines, the gates and the metallic parts of the lock. The energy consumed by Cathodic protection is relatively very low and the benefit quite high as the parts no longer need painting and none of the 24 bulbs have had to be replaced.

9. The final challenge was the construction of the barrage itself. The construction was completed in three phases (lock, barrage (sluiceway), and power plant and dyke) and from within a dry enclosure composed of three cofferdams. The environmental impact of the Rance power plant and barrage was initially severe. Because of the three years in which the estuary was completely cut off from tidal flow, ecosystems, including marine flora and fauna, disappeared due to salinity fluctuations, heavy sedimentation and organic matter accumulating in the basin.



10. However, by 1976, ten years after the opening of the barrage and power plant, the Rance estuary was again considered to be biologically diverse, with aquatic life in the estuary flourishing. By 1980, the basin was providing a habitat for 110 worm species, 47 crustacean species and 70 fish species. It is also said that the species of birds are the same as they were before construction (around 120 species).

11. EDF operates the power station in accordance with procedures that limit the impact of its operation on the environment, and, through COEUR (Operational Committee of Elected Representatives and Users of the Rance), participates in the life of the estuary. This body brings together the Government and its technical services, elected regional representatives and the users. By involving every actor, COEUR promotes estuarine life and is a source of knowledge for intertidal zone management in the Rance area.

12. In order to guarantee the long-term safety and improve the performance and availability of a major source of electricity supply to Brittany, an ambitious investment programme for the renovation and modernisation of the plant has been undertaken and will run up to 2022.

13. The first stage of this programme is already underway with renovation studies and programming, preparatory work etc. The second stage will take place from 2013 with, in particular, the renovation of five production units over four years (replacement of the stators and work on the rotors). 10 additional turbines will be renovated afterwards. The control system will be entirely upgraded as well as the power plant auxiliary systems. Over and above this project, the maintenance policy of the Rance power plant consists of preventive and targeted maintenance of the 24 bulb units in a manner which does not require shutting down the power station.

14. The monitoring of the Rance power station is subject to strict regulatory requirements, including inspections by DREAL (Regional Directorate for the Environment, Development and Housing) in order to verify that the structures are holding up satisfactorily and that inspection measures are carried out effectively. EDF has developed a hydraulic safety policy that covers all the measures taken in design, operation and maintenance of the hydroelectric installations to ensure the safety of people, assets and the environment with regard to the risks associated with water and due to the presence and operation of the installations.

15. The barrage is also very well integrated into the community, and has contributed to the economic and social development of Brittany. For example, the road connection between Dinard and St. Malo was improved, with the distance reduced from 45km to 15km with the building of the barrage. This has helped link two previously isolated communities with an average of 30,000 vehicles using the four-lane road across the barrage each day. In addition, in 2011 39,000 people visited the Rance power plant. This helps promote tourism in the area and supports the local economy.

16. In summary, the Rance power plant has been a technical success and despite the severe operating conditions, the bulb turbines are still performing well. The estuary once again plays a nursery role for underwater creatures and remains a substantive home for birds. Nevertheless, the new ecological balance is delicate and depends heavily on the operation of the power plant (dependent on variation in the water level).

*December 2012*

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### **Written evidence submitted by the National Trust**

#### **EXECUTIVE SUMMARY**

1. The National Trust supports Government's ambitions to tackle climate change and the UK's targets to reduce carbon emissions and increase the proportion of overall energy generated from renewable sources. We share the sense of urgency in deploying and developing solutions to move the UK towards a low carbon society.

2. We believe that securing widespread public support for the transition to a low carbon economy is critical. This will be helped considerably if large-scale renewable projects are seen to respect the natural and cultural environment.

3. The National Trust recognises the Severn Estuary as a unique environmental asset of international importance requiring careful management on sustainable development principles. We also recognise the potential of the Severn Estuary's vast tidal range to generate electricity and welcome the assessment of a range of options for harnessing this power.

4. The National Trust owns various coast, countryside and heritage sites around the Severn Estuary which could be affected in some way by generation of tidal energy. Our response to emerging proposals will be informed by our statutory conservation objectives and our duty to maintain the integrity of these important places for the benefit of the nation in a changing environment.

5. Wave and tidal power will both have an essential part to play in moving to a low carbon power sector. We therefore support exploration into harnessing the tidal power resource of the Severn estuary in order to contribute to emissions reductions and harness the Severn's tides in a sustainable way.

6. The National Trust was engaged with its partners in the Government's Severn Tidal Power Feasibility Study. In our consultation response we said that the Government should seek to identify a project which

maximises the generation of renewable energy, while minimising damage to the Severn Estuary's internationally important wildlife, and natural and historic environment. It should be at an affordable cost to tax-payers and consumers, not in itself carbon-intensive in construction and operation, and form part of a coherent plan to put the UK at the forefront of sustainable tidal power technology.

7. Any solution should also be consistent with two tests. The first is compliance with EU law, eg the Habitats and Birds Directives. Secondly, the solution should form a significant part of a radical plan to tackle climate change, including reduction in energy demand, rapid deployment of sustainable, low impact renewables and development of a more decentralised energy system.

#### SPECIFIC ISSUES

##### *Finding the optimal solution using the most innovative technologies*

8. One of the concerns we raised during the feasibility study was how we assess proposals in a way that give environmental constraints equal consideration alongside economic factors, energy generation potential and technological advancement in the design of any solution to harness the power of the estuary.

9. We believe that an essential part of any discussion on Severn tidal power is identifying the optimal option in terms of environmental, economic and technical criteria. Any future project must therefore be developed on the basis of socio-environmental considerations, as well specified economic and technical outcomes in order to identify the option which is in the best public interest and take advantage of the most innovative technologies.

10. During the previous Feasibility Study, we concluded that, had the value of environmental assets been properly considered within the assessment framework, it is unlikely that the Cardiff-Weston barrage would have been short-listed. The Phase I analysis predicted that it would destroy 80% of the internationally important intertidal habitat and result in considerable mortality of the internationally protected fish populations. We are concerned that a disproportionate focus on a Cardiff-Weston proposal may result in resources and investment being diverted away from alternative solutions for harnessing the power of the Severn, which could be both sustainable and more easily transferable to other estuaries.

#### SCOPE OF ENVIRONMENTAL ASSESSMENT

11. Any assessment of the current proposal would need to ensure that the evaluation of energy, cost and environmental impact criteria is unbiased and weighted appropriately. We would like to highlight the following critical issues which need to be given full consideration as part of this, particularly in relation to the scope of the assessment of environmental impacts:

12. *Sea level rise, coastal change and flooding:* As a major coastal landowner, the National Trust supports flexible management solutions which can enable, or adapt to, the processes of coastal change and predicted sea level rise. Any development on the coast should take proper account of these factors and give sufficient consideration to the latest science on sea level rise, and that the implications for alleviating or adding to flood risk, in looking at the viability of the different options. This would mean taking into account the impacts of predicted sea level rise, informed by UKCIP projections, overtly and in detail.

13. There are a number of critical areas of research required into coastal processes and estuary dynamics based on i) how the estuary is going to respond to sea level rise in its current form and ii) how the system will respond to sea level when modified by the addition of the tidal power infrastructure. The key questions are:

- a calculation of the amplification of sea level rise impacts both spatially and temporally;
- how will estuary sediments respond to these changes—helpful data may exist as a result of marine aggregates studies;
- will contaminants held within with the historic sediment profiles be mobilised;
- what will be the impacts on shoreline erosion/accretion; and
- what will be the impacts on inland and coastal flooding?

We believe that modelling studies are required to enhance understanding of current and future estuary dynamics to inform decision making.

14. *Landscape and seascape:* Any proposal needs to give full consideration of impacts on landscape, settings and. The protected landscapes potentially affected are a vital part of the region's economy and culture and consideration would need to be given to how they will be affected. This includes potential loss of visual amenity and other impacts on the landscape and seascape and public access to those places. During the Feasibility Study we felt there was an inadequacy of information and understanding on these aspects. A full assessment of the potential impacts on the land and seascape is required together with an understanding of public perception of such changes.

15. *Historic environment:* Any proposal would need to study the historic environment and the potential loss of heritage and archaeological assets. This should include the impacts on historic gardens and landscapes and industrial heritage, as well as the well preserved archaeology and palaeoenvironmental records within the River Severn Basin.

16. *Ancillary development and indirect impacts:* A tidal power project and its construction will inevitably affect existing communities around the Severn Estuary. It will also create new development pressures, such as demand for housing and transport links, which are not currently planned for. Unplanned and ad-hoc planning permissions around the landfall of a tidal energy project could result in a loss of landscape and habitat, and could be inappropriate or unsustainable in a range of other ways, such as adding to water and sewerage demand. These pressures should be fully assessed, and will need to be taken into account in local plans.

#### RECOMMENDATIONS OF ATKINS ANALYSIS

17. In order to inform the previous feasibility study, and to inform our own response, the National Trust was one of a group of organisations that commissioned Atkins to undertake a critical review of the Technical Options Appraisal Report (Vols 1 & 2) from an engineering perspective.

18. We urge Committee to consider the full report attached at annex 1 as part of their evidence, in addition to the specific National Trust comments above.

December 2012

#### Written evidence submitted by Rt Hon. Peter Hain MP

##### STRIKE PRICE

The Chairman mentioned in I think his first question to me a figure of “£170 per kilowatt hour”; in fact this should have been *megawatt* hour.

Moreover, the Committee might have noted, I was puzzled as to the origin of this figure which I did not recognise. I had never seen it before. In fact, contrary to assertions made by Committee Members, there is no figure of £170 per megawatt hour in Hafren Power’s submission to the Committee. They do show a chart which compares levelised costs and refers to an illustrative figure of £160 per megawatt hour. Perhaps this is where the confusion lies. As mentioned in the chart footnotes, the Hafren Power calculation of levelised cost uses highly conservative assumptions, and the calculation for all other energy generating sources in the chart uses highly liberal assumptions. But this is *not* Hafren Power’s strike price. This will be at the same level, if not lower, than offshore wind, on a gross strike basis—with of course a negotiation to come. When you factor in the massive savings on flood damage and defence costs, their net strike will be much lower still.

##### HABITAT

Barry Gardiner questioning me said: “The new proposal is only for 60% less than that but that is still 27% of a loss of habitat”. The correct figure is actually 20%. Later, Kate Jennings (and still later Martin Spray) referred to “the 27% to which Barry Gardiner referred”; again this figure should be 20%.

I would add that sea level rise is predicted to destroy 10–20% of the intertidal habitat in any case.

##### TIDAL FENCE

In further answer to Alan Whitehead’s question, if you do not funnel the water through holes in the caissons, you will lose a lot of potential electricity. A tidal fence, simply a line of tidal stream devices, on the same site would generate *one twentieth* the electricity of the barrage.

##### LAGOONS

I am supportive of the proposed Swansea Bay Lagoon for Swansea where it is appropriate but not for the Severn; additionally, the Swansea one would be the size of 1000 football fields, and would produce just 0.4 terawatt hours per year, 40 times less electricity than the Barrage.

##### WIND POWER COMPARISON

In response to Dan Byles’ question can I add to my reply that, most importantly, electricity from the Barrage is predictable for centuries in advance. Electricity from wind is intermittent and unpredictable, even if it makes an important contribution.

##### BRISTOL PORT AND DR ELIZABETH HAYWOOD

Simon Bird referred to “a meeting with Hafren with Elizabeth Haywood, *Peter Hain’s wife* [my italics] back in the summer” as if the fact that she is my wife was at all relevant; this I am afraid is another instance of Bristol Port’s tendentious, aggressive and misconceived approach to the Barrage. She is Chairman of Hafren Power’s Regional Committee. This is a matter of public record and hardly a surprise since she is listed in Hafren Power’s evidence to your Committee as playing that role. She has an independent professional career including as Wales CBI Director long predating our marriage in 2003, and I strongly resent this reference especially since her role has been unpaid during the nine months or so since she has been involved. For that

reason I did not think to declare her role at the outset. Nor was I aware I needed to record my Chairmanship of the Severn Barrage APPG. But I am more than happy to record both now if that is in order.

Furthermore, I suggest that it would be in Bristol Port's interests seriously to engage—company to company—with Hafren Power rather than to continue whipping up an anti-campaign. There will be benefits to the Port from the Barrage, as indeed I outlined.

#### FISH FRIENDLY

In response to Christopher Pincher's question, again I did not recognise his attribution to Hafren Power and indeed upon checking I can confirm that Hafren Power did not say that their turbines would result in 100% survival. They said their *goal* was 100% survival of all fish and marine animals.

Martin Salter's language was, I regret, highly rhetorical and he grossly exaggerated the problem. He also took no account of the fact that, according to the Environment Agency, fish stocks especially of Salmon, have been in decline to the point where in some areas fishing has had to be banned or severely restricted.

Furthermore, scientific evidence produced by Dr Robert Kirby (who has monitored the Severn Estuary for many years) shows a serious decline in all fish stocks; he also has important evidence on birdlife. I am informed that he may have sent a memorandum summarising this evidence to the Committee; if so I would urge that it is studied carefully.

The key point is this. As I indicated in my evidence, there is no question that the Severn Barrage will change the nature of the Estuary, albeit very significantly less than earlier project designs. But wildlife—especially birds and fish—in and around the Estuary has been continuing to change anyway, mainly due to global warming. Last Autumn I saw a presentation at Swansea University which demonstrated this clearly and which I am sure that the Committee could draw upon if desired.

For me the question then becomes: what are the advantages of the Barrage set against any possible wildlife disadvantages? And the answer in my view is absolutely clear. As I described in my own evidence there will be huge benefit to the UK as a whole, and South Wales and the South West especially, from:

- (1) a massive renewable energy contribution to meet the UK's legal obligations unlikely otherwise to be met;
- (2) increased energy security and for over 100 years the cheapest energy in the UK;
- (3) combating climate change;
- (4) huge private investment and jobs;
- (5) flood protection;
- (6) extensive habitat compensation; and
- (7) new opportunities for upstream ports especially Port Talbot, but including Bristol and other South Wales ports.

Furthermore, although I defend the right and indeed the obligation of fish, bird and other wildlife groups—or for that matter Bristol Port—to advance their sectional interests strongly and to gain maximum possible protection (which Hafren have offered), I do not believe they should be able to exercise a veto on the Barrage by persuading decision-makers that their own interests trump those UK-wide interests as listed above and described in my evidence. The UK's interest should be paramount.

If for instance only 1% of fish passing up and down the Severn were to be damaged, would the Angling Trust agree that was an acceptable price to pay for the massive benefits of the Barrage? Or a figure of 5% or even higher? I invite the Committee to consider whether a balanced policy would be to recommend the Barrage goes ahead but only with maximum protection and where applicable habitat compensation for bird and fish life.

January 2013

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#### Written evidence submitted by Alan Seatter, European Commission

Thank you for your letter of 18 March 2013. I apologise for the delay in responding. I would of course be happy to meet with members of the Committee if they are visiting Brussels in the first part of July and I will make the necessary arrangements once the Committee has finalised the dates and areas of interest for discussion.

With regard to the additional questions you pose in follow up to my evidence to the committee on the Severn Barrage inquiry, you ask for further information on what considerations the Commission takes into account in judging whether in fact the benefits of a particular project are outweighed by the environmental harm caused.

As I explained in my oral evidence, an opinion of the Commission is only required in very specific circumstances. However, as Mr Gardiner MP rightly pointed out, the matter may still be brought to the attention of the Commission through a formal complaint or through a petition to the Petitions Committee of the European Parliament in which case the Commission would be required to assess any claims that a potential breach of

EU legislation may have occurred. In such a case, the Commission would assess the steps followed by the Member State and measure these against the requirements set out in the Directive.

The first question would be whether an adequate appropriate assessment has been undertaken which fully assessed the likely significant effects of the proposed project on the species and habitats for which the sites have been designated and their effects on the conservation objectives for the site. This should include an assessment of any mitigation measures designed into the project and their impacts on lessening or reducing any negative impacts. If, in spite of the mitigation measures, a negative assessment of the implications for the site cannot be avoided the next step is to consider alternative solutions. In the case of a large renewable energy project damaging a site, the question whether the same effect could be reached by other less damaging projects would need to be considered. It rests with the competent national authorities to assess whether reasonable alternative solutions exist, for example relocating the same project elsewhere, reducing its scale or using other energy generating systems. There would need to be a realistic assessment of these. If there are deemed to be no reasonable alternatives, which are less damaging, the imperative reasons of overriding public interest (IROPI) would need to be assessed. What is expected here is that the importance of the public interest is weighed against the severity of the impact on the site. Is the public interest truly overriding? If so, the Member State must then show that it has taken all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected and inform the Commission of these measures.<sup>171</sup> The compensation measures are independent of the project and aim to offset the negative effects identified. Typically that would be re-creation or restoration of habitat types or habitats for species that have been affected. The compensatory measures should aim to address, in comparable proportions, the habitats and species negatively affected and to provide functions comparable to those which had justified the selection criteria of the original site, particularly the adequate geographical distribution. In assessing the process followed by the Member State, the issue of the scientific underpinning of the assessment would be very important, in particular the availability of baseline data and monitoring of the habitats and species concerned.

In your second question you ask whether IROPI could potentially be applied to all developments which involve climate change mitigation. The answer to this question is clearly yes. However, this does not mean that all such projects would automatically be of a sufficiently overriding character, as their impact on the environment needs to be properly assessed and weighed against the interest of the feature damaged. The more damaging such a project would be the higher needs to be the public interest in the climate change mitigation project. Therefore such projects could not be given the green light regardless of their impacts. All projects, including those with climate change mitigation benefits, would still have to be assessed along the lines I have tried to set out above.

May 2013

<sup>171</sup> [http://ec.europa.eu/environment/nature/natura2000/management/guidance\\_en.htm](http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm)