BERR | Department for Business Enterprise & Regulatory Reform

SEVERN TIDAL POWER Q&A

INDEX **Page**

Q. What will the Severn Tidal Power Feasibility Study cover? 4

Q. What are tidal range technologies? 4

Q. What did the Sustainable Development Commission Tidal Power project conclude? 4

Q. Isn't the Severn Estuary a protected site under the EU Habitats and Birds Directive? 4

Q. Other than the recent Sustainable Development Commission report, weren't there a number of other studies on tidal barrages in the 1980s? 5

Q. Why has Government decided to undertake work on tidal power in the Severn given it was rejected in the past? 5

Q. If there have been earlier studies on tidal barrages but not on lagoons, doesn't mean there is more evidence already available on barrages? How will you make a fair decision between barrages and lagoons? 5

Q. Isn't support for a Severn Tidal Power project likely to mean reduction of support for wave and tidal stream / other renewables? 5

Q. Why is the study focussing on tidal range technologies ? 5

Q. Why is the study only looking at the Severn Estuary? What about locations elsewhere in the UK? 6

Q. How long will the study take and how much will it cost? 6

Q. How about the impact on the local population? Aren't you condemning them (again) to years of planning blight? 6

Q. What could be the impact on the local and regional economy? 6

Q How about the Severn Bore? 6

Q. The UK has recently submitted the Severn Estuary to the European Commission as a Special area of Conservation (SAC). Doesn't that make any tidal power development impossible to do? 6

Q Will there be a Strategic Environmental Assessment of the area? 7

Q. Does this mean Government has already decided to go ahead with tidal power in the Severn Estuary? 7

Q. Will you be using the new planning process for a tidal power scheme? 7

Q. How will you be involving stakeholders and the wider public in the feasibility study? 7

Q. What happens after the two year feasibility study if the Government decides to support a tidal range power project in the Estuary? 7

A Severn Barrage 8

Q. So how would a Severn barrage scheme work? 8

Q. Is this type of scheme technically feasible? 8

Q. So where exactly would a barrage be located? 8

Q. How much energy would a barrage produce? 8

Q. How much CO_2 would a barrage save? 8

Q Wouldn't building a barrage create extra CO2 emissions? 8

Q. How long would it take to build? 9

Q. How much would it cost to build? 9

Q. How would a barrage affect flooding in the Severn region? 9

Q. What about the damaging Environmental Impacts of a Severn Barrage? 9

Q. Will Government consider transport possibilities such as new road or rail links that could be combined with a Severn Barrage? 9

Q. Has Government considered other options to a barrage in the Severn such as Tidal Lagoons, or barrages in other estuaries? 10

A Severn Lagoon 11

Q. So how would a Severn lagoon system work? 11

Q. Is this type of scheme technically feasible? 11

Q. So where exactly would lagoons be located? 11

Q. How much energy would lagoons produce? 11

Q. How long would they take to build? 11

Q. How much would they cost to build? 11

Q. How would lagoons affect flooding in the Severn region? 11

Q. Are the environmental impacts of lagoons less than the environmental impacts of barrages? 12

Map of Possible Locations 12

SEVERN TIDAL POWER FEASIBILITY STUDY

Q&A

Q. What will the Severn Tidal Power Feasibility Study cover?

A. The study, which aims to enable Government to decide whether and on what terms a tidal range power scheme in the Severn Estuary could be supported, will focus on tidal range technologies, including barrages and lagoons. It will assess in broad terms the costs, benefits and impact of such a scheme, including environmental, social, regional, economic and energy market impacts. It will consider what measures Government could put in place to bring forward a scheme that fulfils regulatory requirements and it will include a Strategic Environmental Assessment to ensure a detailed understanding of the Estuary's environmental resource, recognising the nature conservation significance of the Estuary.

Q. What are tidal range technologies?

A. Tidal range is the vertical difference between the high tide and the low tide. Tidal range technologies make use of this height difference to generate electricity by creating a differential in the water levels either side of a structure and then passing this water through turbines. There are two main tidal range technologies – barrages and lagoons.

Q. What did the Sustainable Development Commission Tidal Power project conclude?

A. The recent report of the Sustainable Development Commission, commissioned by the 2006 Energy Review, confirmed the potential of the huge Severn tidal range to generate some 5% of UK electricity from a renewable indigenous resource. The SDC expressed their view that a Severn Barrage or other tidal power project could be built within the principles of sustainable development, subject to conditions including meeting the requirements of environmental protection legislation.

The report can be seen at www.sd-commission.org.uk/pages/tidal.html

The Sustainable Development Commission is the Government's independent advisory body on sustainable development.

Q. Isn't the Severn Estuary a protected site under the EU Habitats and Birds Directive?

Yes and a tidal power scheme would have to meet legislative requirements. The feasibility study will consider whether and, if so, how a tidal power project in the Severn could proceed in compliance with these requirements.

The Severn Estuary is of National, European and International nature conservation significance – and so has been afforded the corresponding levels of legal protection. It is designated as both a Ramsar Site and Special Protection Area (SPA) under the EU Habitats Directive and is in the process of being designated as a Special Area of Conservation. The Estuary also comprises a series of Sites of Special Scientific Interest (SSSI).

Q. Other than the recent Sustainable Development Commission report, weren't there a number of other studies on tidal barrages in the 1980s?

A. Yes. Tidal energy was the subject of a comprehensive programme of studies in the 1980's costing over £20 million. Several schemes were considered in the UK estuaries including the Severn and Mersey. One of the schemes studied was known as the 'Cardiff-Weston' barrage. This involved building a 10 mile long structure across the estuary, just downstream of a line between Cardiff and Weston-super-Mare. Another option considered was the larger 'Outer Barrage' between Minehead and Aberthaw. It was decided at that time not to pursue the development of a barrage.

Q. Why has Government decided to undertake work on tidal power in the Severn now, given it was rejected in the past?

A. The growing evidence of climate change and rising fossil fuel prices have changed the economics and our view of them. To have the best chance of delivering our energy goals it makes sense to consider all reasonable options. That is why we asked the Sustainable Development Commission, at the time of the 2006 Energy Review, to look again at tidal power options in the Severn Estuary.

Q. If there have been many earlier studies on tidal barrages but not lagoons, doesn't this mean there is more evidence already available on barrages? How will you make a fair decision between barrages and lagoons?

A. Our feasibility study will gather further evidence on both barrages and lagoons and we will make a fair assessment based on all the information we collect, with input from stakeholders.

Q. Isn't support for a Severn Tidal Power project likely to mean reduction of support for wave and tidal stream / other renewables?

A. We already have a number of policies that support the development and deployment of renewables including the emerging wave and tidal-stream technologies. For example we have committed around £35M to industry led R&D, a £50M Marine Renewables Deployment Fund to support the first commercial scale demonstrations and we have just announced (in our response to the Renewables Obligation consultation) proposed changes to the Renewables Obligation that will provide greater levels of support for wave and tidal stream technologies. Collectively these and other measures provide the most comprehensive package of support for wave and tidal-stream anywhere in the world.

Q. Why is the study focussing on tidal range technologies?

The key resource of the Severn Estuary is its tidal range – it has the second highest tides in the world, and around 90% of total UK practical tidal range resource. As the SDC study confirms, it has only a small part of the UK's tidal stream resource. Therefore our initial view is that this study should focus on the huge potential for power from tidal range technologies.

Tidal stream technologies are not yet ready for full deployment – currently at early prototype demonstration phase. They will attract higher levels of support under proposed revisions to the Renewables Obligation which are

currently under consideration by Parliament as part of the Energy Bill. Under the new banding proposals, tidal stream technologies will receive 2.0 ROCS/MWh.

Q. Why is the study only looking at the Severn Estuary? What about locations elsewhere in the UK?

A. The Severn estuary is a potential source of much greater amounts of tidal energy than other locations. Since potential options for tidal power elsewhere in the UK are relatively small compared to a Severn scheme, they are likely to require more limited Government involvement than any project in the Severn Estuary.

The study does not rule out other potential tidal energy projects. Again, the proposed high levels of subsidy under the revised Renewables Obligation, should enable potential projects in other areas (such as the Mersey) to be brought forward by the private sector. (Tidal impoundment schemes below 1GW – eg lagoons and barrages will receive 2.0 ROCs/MWh). The Renewable Energy Review will consider whether any further support for implementation is needed and affordable.

Q. How long will the study take and how much will it cost?

A. The study is expected to last roughly two years, with the cost estimated at around £9 million. It will be split into two stages with a decision point at the end of each. The first, which is likely to run until late 2008, will focus on high level issues and reach an initial view on whether there are any fundamental issues that would preclude a tidal scheme in the Severn Estuary. Subject to the decision at the end of the first phase, the second phase will look at the issues in more detail and culminate in a full public consultation in early 2010.

A Strategic Environmental Assessment will be an important part of this process.

Q. How about the impact on the local population? Aren't you condemning them (again) to years of planning blight?

A. Further work will be carried out in a transparent and consultative way, and as quickly as possible to minimise the uncertainty for the people who live around the Severn Estuary. There are potential benefits for the local population – increased employment opportunities for example – but the Government is keenly aware of the downsides as well.

Q. What could be the impact on the local and regional economy?

A. This needs to be carefully considered. There are many organisations that could be affected, including the ports on the Severn. Previous studies estimated construction of a barrage would bring with it a number of socio-economic benefits to the region, including job creation and inward investment. These will be looked at afresh together with potential negative impacts.

Q How about the Severn Bore?

A A barrage would stop the bore. The impact of a tidal lagoon development needs to be assessed.

Q. The UK has recently submitted the Severn Estuary to the European Commission as a Special area of Conservation (SAC). Doesn't that make any tidal power development impossible to do?

A. Designation does not rule out the possibility of future development in appropriate circumstances. Any plan or project likely to have a significant affect on the site will be subject to an appropriate assessment of its implications, in view of the site's conservation objectives. A developer will be expected to take appropriate steps to mitigate potential environmental damage.

If any compensatory measures are necessary, the European Commission must be informed of them.

Q Will there be a Strategic Environmental Assessment of the area?

A. Yes, the feasibility study will include a Strategic Environmental Assessment of any plan for the Severn Estuary.

Q. Does this mean Government has already decided to go ahead with tidal power in the Severn Estuary?

A. No. The energy resource in the Severn estuary is substantial and could provide up to 5% of UK electricity demand. But lots more work is needed on the pros and cons before a decision could be taken to go ahead. We need to understand the implications for the environment and how far this could be mitigated. Also the costs, the economic, social and regional impact and many other aspects, including the likely effect on the energy market.

Q. Will you be using the new planning process for a tidal power scheme?

A. We will be looking at planning consents as part of the feasibility study.

Q. How will you be involving stakeholders and the wider public in the feasibility study?

A. This work will require both close inter-departmental working and stakeholder and public engagement throughout the study together with the full public consultation in 2010. Further information on stakeholder and public engagement will be on the BERR website shortly.

Q. What happens after the two year feasibility study if the Government decides to support a tidal range power project in the Estuary?

A. If the outcome of the feasibility study is a decision to proceed, extensive and detailed further work would be needed to plan and implement a tidal power project, and secure the regulatory consents that would be required.

A Severn Barrage

Q. So how would a Severn barrage scheme work?

A. It would work by building a wall or 'barrage' across the estuary effectively converting it into a hydroelectric dam. This would be achieved by placing a number of large concrete caissons across the estuary, some of which would house conventional hydro-electric turbines.

The electricity would be generated by allowing the incoming tide to pass through sluices in the barrage. This body of water is then held as the tide ebbs. When the water level on the seaward side of the barrage is low enough the water behind the barrage is released back to the seaward side through the turbines, generating electricity.

There would be locks in the barrage to ensure access to the docks upstream.

Q. Is this type of scheme technically feasible?

A. Yes. A barrage would be a very complex project but the basic concept is well understood and is the application of mature and commercially available technology. A tidal barrage has been successfully operated at La Rance, Northern France since the 1960's.

Q. So where exactly would a barrage be located?

A. Tidal barrages were the subject of a comprehensive programme of studies in the 1980's costing over £20 million. Several schemes were considered in UK estuaries including in the Severn and Mersey.

One of the schemes studied in the Severn estuary known as the 'Cardiff-Weston' barrage would involve building a 16km long structure across the estuary, just downstream of a line between Cardiff and Weston super-Mare (see map).
There is also a smaller scheme known as the 'Shoots' barrage that would be located above Avonmouth Docks (just below the second Severn crossing) and a larger 'Outer Barrage' scheme from Minehead-Aberthaw. The feasibility work will look at all practicable options, including tidal lagoons.

Q. How much energy would a barrage produce?

A. It depends on where it would be located. The Cardiff-Weston scheme could have a generation capacity of some 8640 MW (Mega Watts) and an annual electricity output of 17 TWh/y (Tera Watt Hours per Year) or around 5% of UK annual electricity demand.

The Severn Estuary has the second highest tidal range in the world (after the Bay of Fundy between Maine and Nova Scotia). It can top 14 metres on a spring tide - tides vary with the lunar cycle.

Q. How much CO_2 would a barrage save?

A. The SDC Report estimates that a Cardiff-Weston barrage would provide an estimated annual CO_2 saving of 5.6 MtCO2 (this estimate is based on the barrage displacing new build gas-fired plant).

Q. Wouldn't building a barrage create extra CO_2 emissions?

A. The SDC reported that the CO_2 payback period on the construction of a barrage is around 5-8 months. Though the SDC weren't able to do a full lifecycle analysis, their work suggests that the emissions created would soon be outweighed by the savings.

Q. How long would it take to build?

A. Previous studies suggest that a large barrage scheme would take between 5 and 7 years to construct. There would also be a period prior to construction needed to undertake necessary work on things such as engineering design and environmental assessments so previous estimates suggest it could take around 12 years.

Q. How much would it cost to build?

A. The Sustainable Development Commission report estimates construction costs of £15billion for a 'Cardiff-Weston' barrage and £1.5billion for a 'Shoots' barrage (see map at end for location). These costs were based on the last detailed estimates of these schemes in 1988 and 1990 respectively. These were then scaled up for inflation. The costs are not therefore based on revised data. Our feasibility study will include a revised and detailed cost analysis.

Q. How would a barrage affect flooding in the Severn region?

A. A barrage would not have provided protection against the recent flooding in the Severn (which was driven by water coming downstream) but could provide some protection against flooding coming from strong tidal surges and potentially help with flood management in this way.

Q. What about the damaging environmental impacts of a Severn barrage?

A. Clearly any development would have an impact on the local environment. A Barrage would create a permanent lake – this wouldn't be larger than the current high tide but the water wouldn't fully drain away. The SDC estimated that a Cardiff-Weston barrage would result in 65% of the estuary's existing inter-tidal areas becoming permanently under water. Arguably, a barrage would actually deliver a richer environment – it's a seriously harsh one now – but some of the biodiversity would be lost. It's this we must look at, to understand the impact of a tidal power scheme and assess what could be done, with real commitment and imagination, to mitigate the damage and if necessary create compensatory habitats.

Q. Isn't a barrage an expensive and risky option? Aren't you just doing this to meet an ill-judged EU target?

A. A large Severn barrage would be a complex scheme and the further work that we have commissioned will help us to fully understand the costs, risks and benefits of such a scheme. A rough estimate of costs at this point is £15bn, based on work done in the 1980s and 1990s, updated to 2006 prices. In principle, the benefits of developing tidal power in the Severn are very strong but we need to understand the whole picture.

The UK is firmly committed to the EU's ambitious energy and climate package as a major contribution to reducing GHG emissions and tackling climate change globally.

Q. Will Government consider transport possibilities such as new road or rail links that could be combined with a Severn Barrage or similar structure?

A. We are looking at whether there is a strategic need for new transport links. In line with the conclusions of the Eddington Review, the Government believes that action should be focussed on the key pinch points on the networks where congestion is holding back economic growth.

A Severn Lagoon

Q. So how would a Severn lagoon system work?

A. Tidal lagoons are free standing structures built offshore or in a semi-circular type arrangement connected to the shoreline at each end. They operate on similar principles to barrages in that they exploit the difference in tidal height to generate electricity. Unlike barrages they would not fully obstruct the estuary, but instead create a narrow channel running in-between the lagoons.

Q. Is this type of scheme technically feasible?

A. Tidal lagoons are generally thought to be achievable from an engineering perspective, but there are some differences of opinion on how they might be constructed.

Currently there is no example of a tidal lagoon development anywhere in the world.

Q. So where exactly would lagoons be located?

A. Currently the most well known location (from previous report considerations, including the 1981 Bondi Committee report) is the Russell Lagoon concept – a series of three enclosures constructed against the banks of the Severn using dredged material to build artificial embankments in shallow water areas. (See map on next page). More recent proposals have suggested completely offshore impoundments (not connected to the shore) to be constructed in shallow water areas.

We will be considering feasible locations for lagoons as part of our Feasibility Study.

Q. How much energy would lagoons produce?

A. The Sustainable Development Commission report estimates that the Russell Lagoon concept could capture around 6480GWh of energy a year. However, it is difficult to estimate how much energy lagoons can produce as there are differences in opinion on whether they are able to achieve a higher load factor as a result of ebb-flood generation, rather than ebb-only generation. We will be looking in detail at cost and electricity output estimates as part of the feasibility study.

Q. How long would they take to build?

A. This would be dependent upon the location and design of any lagoon type scheme.

Q. How much would they cost to build?

A. As there is currently no tidal lagoon anywhere in the world and different estimates on how they might be constructed, it is difficult to estimate how much tidal lagoons will cost to build. Our feasibility study will be looking at cost estimates in detail.

Q. How would lagoons affect flooding in the Severn region?

A. This would also be dependent upon the location and design of any lagoon type scheme.

Q. Aren't the environmental impacts of lagoons less than the environmental impact of barrages?

A. The SDC Report concludes that it "Does not consider that large-scale tidal lagoon development in the Severn Estuary would offer any environmental or economic advantage over a tidal barrage." We will be looking at potential environmental impacts in detail in the feasibility study.

MAP: LOCATIONS OF SOME PROPOSALS FOR BARRAGES AND LAGOONS

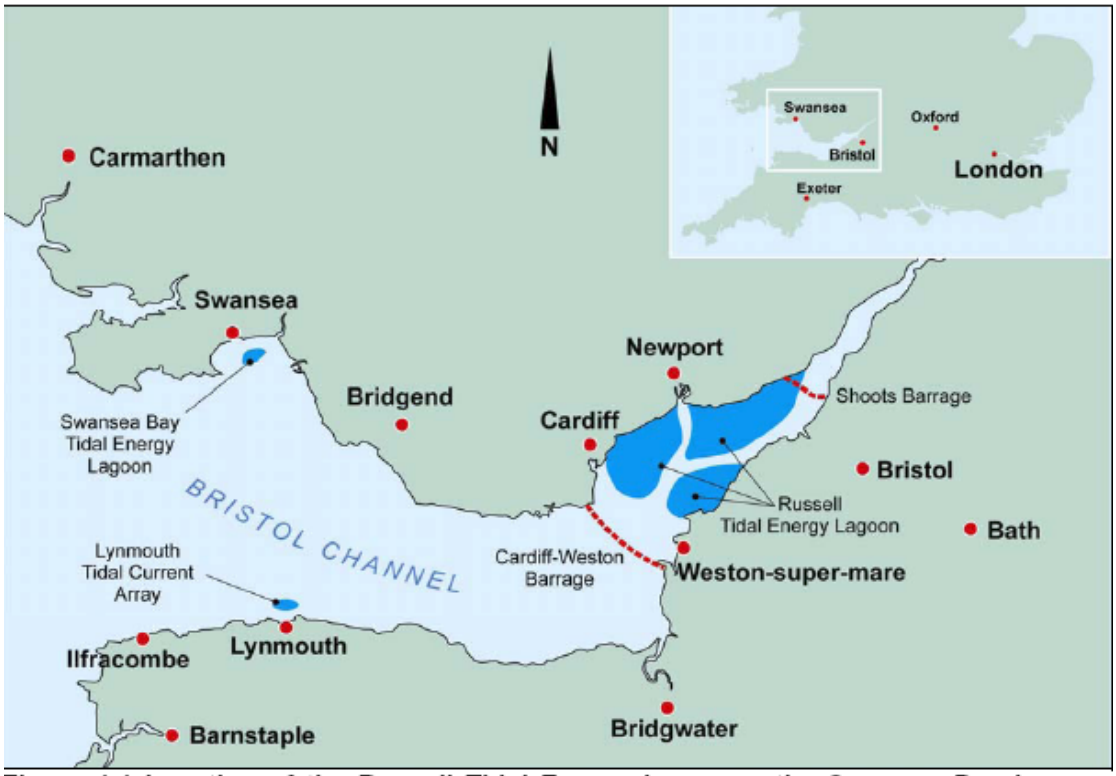

Figure 1.1 Location of the Russell Tidal Energy Lagoons, the Swansea Bay Lagoon and the Lynmounth Tidal Current Array. The position of the Cardiff-Weston and Shoots tidal energy barrages are shown for comparison.