

Harnessing the Severn Estuary

The Severn Estuary has one of the highest tidal ranges in the world: between high and low tide there is a difference of 14 metres in water levels, beaten only by 17 metres recorded in Nova Scotia's Fundy Bay and Quebec's Ungava Bay.



The daily movement of the tides in the estuary is a huge source of energy that could be harnessed, with one proposal claiming it could supply up to 5% of Britain's electricity.

A handful of recommendations for power generation in the waters of the Severn by government committees have been rejected over the years as too expensive.

That was in the days of cheap oil and gas and before we realised the damage our carbon emissions were wreaking on the environment.



The UK government set up the [Department of Energy and Climate Change](#) (DECC) in October 2008 to look more seriously at sustainable energy generation.

In 2009, a feasibility study into power generation in the Severn Estuary by the DECC short-listed five projects "which have a realistic chance of being built".

If the government decides to give the go-ahead for one of the schemes after the second public consultation this year, the earliest we could see Severn tidal power generation is by 2018-23.

The mature technologies that are being considered for development are barrages and lagoons.

Barrages are like hydroelectric dams, consisting of a wall across the estuary that allows water to pass one way through a sluice, holding it until the tide turns, then releasing it through turbines to generate electricity.

Lagoons generate electricity in the same way, but hold water in a smaller area and can be connected to the land in a semi-circle.

Two unproven technologies that are being considered are tidal reefs and a tidal fence.

A tidal reef would consist of floating concrete chambers that maintain a constant water height difference of 2m to generate electricity on the both the incoming and outgoing tides.

A tidal fence would consist of a string of 800 tidal turbines strung across the estuary.

The five mature-technology schemes that will undergo "further analysis" in 2010 are:

1)The Inner or Shoots Barrage

Developed by Arthur Hooker OBE with engineering firm Parsons Brinckerhoff, the Inner or

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Written by Bill Heaney
Tuesday, 19 January 2010 15:02

Shoots Barrage would be located near the Severn road crossings and is estimated to cost £3.2 billion to construct.

The government estimates that it will generate 2.7 terawatt hours (TWh) of electricity per year, or just under 1% of the country's current consumption.

The DECC short-listed this scheme as it has the lowest cost per unit of electricity and would require the lowest capital contribution from government.

The disadvantages of the barrage are that it only generates electricity on the ebb tide, it could cause silting and it would affect migrating fish and result in the loss of 5,000 hectares of inter-tidal habitat.

2) The Beachley Barrage

This scheme is slightly smaller and further upstream than the Shoots Barrage, and upstream of the Wye, meaning less environmental impact.

The government estimates it will cost £2.3bn to construct and generate 1.6TWh/year, the lowest output of all the schemes.

The Beachley Barrage was short-listed as it has low unit costs like the Shoots Barrage and requires the lowest capital input from government. It would also have no impact on the major ports.

This barrage would result in the loss of 3,500 hectares of inter-tidal habitat and may also result in silting. It would affect migrating fish, but to a lesser extent than the Shoots Barrage.

The DECC said it included the scheme in the shortlist because of its smaller impact on the environment and on the operation of the ports in the estuary.

3) The Fleming Lagoon

The lagoon would be located on the Welsh shores of the estuary between Newport and the Severn road crossings, and the government estimates it will cost £4bn and generate 2.3TWh/year.

The lagoon was short-listed as it would have less impact on the environment, on local ports and fisheries than the barrage schemes.

The DECC says the lagoon will result in the loss of 6,500 hectares of inter-tidal habitat, but it claims the impact would be less than that caused by a barrage.

The department also warns of possible silting within the lagoon.

4) The Bridgwater Bay Lagoon

This lagoon would be on the English shore between Hinkley Point and Weston super Mare.

The government estimates it will cost £3.8bn and generate 2.6TWh/year.

The scheme was short-listed as it has the lowest unit cost of the lagoon options and would have less impact on the environment, on ports and fisheries.

The scheme could, however, result in the loss of 5,500 hectares of inter-tidal habitat and silt could build up in the lagoon.

5) The Cardiff-Weston Barrage or "The Severn Barrage"

This barrage would be located between Brean Down and Lavernock Point, and the government estimates it will cost £20.9bn and generate 16.8Twh/year or 5% of UK electricity.

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The government short-listed this scheme, despite costing more than five times any of the others, because of the huge potential it has to produce significant amounts so-called clean energy.

The barrage would also provide flood protection for areas like Avonmouth and the Gwent levels and create thousands of jobs, the government claims.

Being the largest scheme, it is also the most damaging to the environment: 20,000 hectares of inter-tidal habitat would be lost and migrating fish would be seriously affected.

The Severn Barrage would also cut off four main ports, which would be accessed through locks, but this would add time and cost to the operation of the ports.

Environmental groups tend to oppose barrage schemes because of the potential damage to breeding grounds and wetlands.

The [Wildfowl and Wetlands Trust](#), based at Slimbridge in Gloucestershire on the estuary, said in 2009 it was opposed to the "environmentally destructive" Cardiff-Weston barrage.

The Trust advocates "the need for any options to minimise harm to the natural environment of the estuary as a governing principle, rather than a secondary consideration."

The [World Wide Fund for Nature](#) (WWF) "is concerned that a Severn Barrage may impose unacceptable environmental impacts on the Severn Estuary and entail a serious breach of the [European Union's] Habitats Directive".

"We therefore call on the Government to ensure that alternative, lower impact options to exploit the Severn's tidal energy are not prematurely excluded from the ongoing feasibility study, and to

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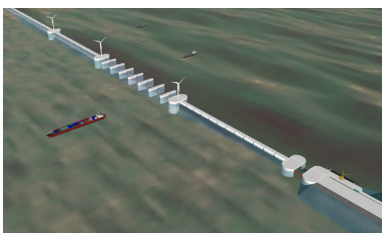
ensure that its overall energy policy is designed to deliver rapid uptake of lower-impact technologies both in the Severn and across the UK," the WWF said in a statement on its website.

The [Royal Society for the Protection of Birds](#) (RSPB) has come out in favour of a "tidal reef" instead of a barrage, as have [Friends of the Earth](#) and local fish conservation charity the [Wye and Usk Foundation](#).

"The reef gives the prospect at least of being environmentally benign, i.e. allowing fish to pass and only slightly reducing the inter-tidal zone, so important for birds. It would permit shipping to pass and generate at least as much electricity as any other scheme, probably over a longer period," the Wye and Usk Foundation said in a statement on its website.

The reef did not make it past the initial feasibility study as its technology was not considered mature enough.

Designed by [Joseph Evans and Sons Ltd. of Launceston](#), the [Severn Tidal Reef Project](#) would span the estuary from west of Minehead to Aberthaw.



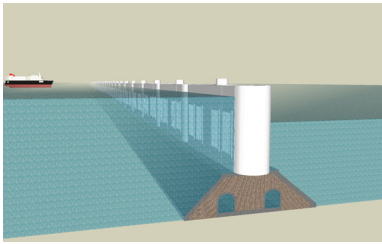
The reef would have a continuous line of up to 1,000 small turbines of about 3MW each, which would generate electricity on both the ebb and flow tide.

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The advantage of this system is that migratory fish can pass safely through the blades as they turn much more slowly than other proposals, and the working head of the turbines is just 2m, which will have very little impact on habitat.

The reef would need far less material to construct and it would not require a road, locks or new shipping channels.



A report by engineering firm [Atkins Ltd.](#) supports the viability of the tidal reef, confirms its conventional engineering and construction brief and, further, suggests that it would be significantly cheaper and quicker to build.

Meanwhile, the government's five short-listed schemes will undergo "further analysis" in 2010, meaning a Strategic Environmental Assessment that covers "the environmental, social and regional impacts of each of the schemes".

"If this work shows that these schemes cause unacceptable environmental or regional impacts, we will eliminate them from the feasibility study and publish our evidence for doing so on this site," a statement on the DECC website says.

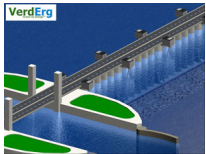
The earliest a scheme could start construction is 2015, which would then start operation anywhere between 2018 and 2023.

The DECC also launched its Severn Embryonic Technologies Scheme in April 2009 to support "embryonic technologies" that were not yet ready for further study.

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The department has short-listed three of the 17 proposals it received: a low-head barrage similar to the Evans tidal reef developed by Rolls Royce and Atkins using a new type of turbine; a tidal fence, developed by the [Severn Tidal Fence Consortium](#) and a unique low-head hydro technology by [VerdErg](#) called Spectral Machine Energy Converter (SMEC), pictured below.



The Severn Tidal Fence Consortium's fence is a line of underwater turbines which it describes as "porous", or not completely obstructing the flow of water through the estuary.

Jamie O'Nians, an official at IT Power, which heads the Severn Tidal Fence Consortium, welcomed the fact that the government had widened the feasibility study to include embryonic technologies.

"The Severn Embryonic Technologies Scheme has been very useful for the [consortium]. This is a new way of looking at tidal stream technology. I think it is good to have an overall systems approach rather than a technology approach," he told the Green Party on Friday.



France was the first country to take the plunge into tidal power generation in the 1960s, constructing the largest tidal barrage in the world to exploit a tidal range of 8m (reaching over 13m during equinox) at La Rance in Brittany.

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Run by [Électricité de France](#) (EDF), the 750m fixed concrete dam with 24 turbines has been criticised for causing silting in the Rance estuary.

EDF says the barrage generates 540GWh/year, which meets the needs of a city of 200,000 people, such as the Breton capital Rennes.

Friends of the Earth say that there has been "a lack of pre and post barrage studies at La Rance on which to base authoritative conclusions about ecological effects."

Friends of the Earth also point out that the La Rance scheme is only about one twentieth the size of the proposed Severn schemes.

Green Party Policy

"We believe it is appropriate to use the tidal energy potential from estuaries such as the Severn estuary, subject to satisfactory sustainability and environmental impact assessments. In particular we support the development of tidal lagoons and tidal stream turbines as a means of generating clean renewable energy, but reject any proposal for a single continuous barrage across the Severn estuary." ([Manifesto for a Sustainable Society, paragraph EN816](#))