

IS IT TIME TO PUT TIDAL LAGOONS TO THE TEST?

Tidal lagoons hold great promise, not least because they offer an ecologically sound alternative to tidal barrages. Yet uncertainty over cost means that one has never been built. Now though, plans for two major schemes on England's River Severn present the first real opportunity to put the technology to the test.

- By Mike Scott

Attempts to harness the power of the tides are pushing forward on two fronts. Tidal stream devices are at the smaller but widely applicable end of the scale. Devices are being tested by a number of companies and Marine Current Turbines has the world's first commercially operating tidal project up and running off Northern Ireland.

At the other end of the scale are tidal barrages. The UK government has put its support behind a massive barrage that would span the River Severn in southwest England and generate up to 5% of national electricity needs. The Severn has tremendous potential because it has a tidal range of more than 12 metres (40ft) in places, second only to the Bay of Fundy in Canada.

However, there is another technology with many advantages. Tidal lagoons are "man-made empty islands" that fill up with water during the rising tide. When the tide turns, the gates are closed and a small head is allowed to build up before opening a separate set of gates that allow the water to exit through a series of turbines. The potential energy in the head drives the turbines and in this sense a lagoon is a very low head dam, according to tidal developer Colin Pearce.

Lagoons can either be stand-alone, offshore structures or they can be linked to the shore. The latter share certain characteristics with barrages and because they are cheaper than the offshore,

man-made island variety, are proving more popular with policy-makers. Indeed, two shore-linked lagoons - Bridgewater Bay lagoon and the Fleming lagoon - are among five proposals for projects on the River Severn that have been short-listed for further consideration by the UK government. No offshore lagoons are on the shortlist on the grounds of cost.

Tidal lagoons, according to their supporters, offer significant advantages over barrages, not least from an ecological point of view. Barrages cause four main problems, according to Peter Ullman, chairman of Tidal Electric (TEL), one of the main players devoted to tidal lagoons. "Barrages block navigation, they impede fish migration, alter the intertidal zone upstream and change tidal conditions downstream," he says. "They are also enormously expensive and they cause some pretty serious environmental changes." Barrages would eliminate bird habitats of international significance and have a serious effect on fish populations, he adds.

A Severn barrage was first proposed in 1850, says Ullman, and again in 1925, 1950, a number of times between 1974 and 1988 as well as the current plans. The Severn Tidal Power Group scheme was scrapped in 1989 "for very good reasons" says Iain Roberts, associate maritime engineer at the engineering consultancy Atkins.

Apart from the cost, estimated at up to GBP 23bn (\$34bn), another key obstacle is the EU Habitats Directive, which would rule out a scheme that caused changes to the estuary. "The Severn Barrage does not appear to be real - it is an obviously ridiculous project," Ullman says.

Offshore tidal lagoons, on the other hand, allow fish to swim around them and ships can continue to use the estuary, plus they "have a very good chance of being consented," Roberts says, "so the main issue is economic viability".

"It is a good technology," says John Griffiths, of project developer Woodshed Technologies. "We prefer lagoons to barrages." One advantage of lagoons is that they are more flexible than barrages - they can be used in conjunction with tidal stream devices, other lagoons and even some of the small barrage proposals. Shore-linked lagoons also have coastal defence potential, which could be a big help in making schemes more viable.

In addition, a lagoon on the river Severn could act as a form of energy storage, using surplus energy generated at night by the nearby nuclear power stations at Hinckley Point to pump water into the lagoon and dispatch it during the day, Ullman says.

Although there are no lagoons currently operating anywhere, the technology "is all proven stuff", says Mark Henderson, head of power and renewables at Investec Bank. "Nothing has been done and I don't understand why," he says.

One reason is that "even a small lagoon would cost tens of millions of pounds," according to Roberts of engineering firm Atkins, which is why the government is reluctant to fund a pilot project. Tidal lagoons are caught in a Catch-22 situation, he explains: "The issue with assessing viability is that no-one has done one. It would really help if someone could build one."

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Tidal Electric, however, maintains that placing an impoundment structure offshore would resolve both the environmental and the economic problems of the tidal barrage. The company carried out preliminary work for a 60MW pilot scheme in Swansea Bay that it said would “put tidal power generation back amongst the choices for commercial-scale renewable power generation”. The proposal failed to win government approval.

There is considerable uncertainty over costs. On the one hand, Tidal Electric says lagoons are significantly cheaper per unit of electricity than barrages, with the walls being similar in structure to sea defences and the turbines the same as those used in low-head hydro schemes. Lagoons, it says, are built in relatively shallow water, minimising the cost and difficulty of installations.

A report for the company by Atkins suggested that its Swansea Bay scheme would cost GBP 81.5m and generate electricity at a cost of 3.5p/kWh. This was countered by a report for the UK government which concluded that the total construction cost of the TEL lagoon was likely to be around GBP 234m, almost three times as expensive, and that it was only likely to generate around 66% of the energy projected by TEL. “The cost of energy from the proposed lagoon is therefore



A shore-linked tidal lagoon as it might appear on the Welsh bank of the River Severn.

Source: UK Department of Energy and Climate Change

estimated to be more than four times greater than that presented by TEL,” the report said. This would make the cost of energy from the proposed lagoon at least 17p/kWh.

Ullman insists that this analysis is simply wrong, but even supporters of the technology suggest that Tidal Electric may have downplayed the challenge of building lagoons. “I think they have underestimated the amount of effort required to get the lagoon walls in place,” says Griffiths. “The more work we do on ocean energy of any kind, the more costs we find.” Nonetheless, he adds: “I wish someone would just grab the bull by the horns and do it.”

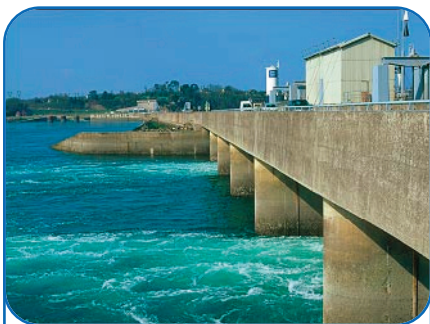
TEL is now focusing on North America and Asia, although it “has not given up hope” of developing projects in the UK. Ullman says it is working on a 280MW project in the Bay of Fundy and a 500MW scheme in the Sea of Cortez in Mexico that would be twice the size of the La Rance tidal barrage scheme in France. Transmission is the major issue for the Mexican project because the nearest landfall is a desert, but TEL says “the Mexican government is being very supportive and helping to organise finance from the World Bank and other organisations”. The project will be eligible for CDM credits “and it is very close

to California, which has very handsome subsidies for renewable power,” Ullman says.

TEL is also exploring opportunities in China and India, he adds, and has identified 21 areas worldwide suitable for lagoons. So far, it has raised around \$3m in private equity, on a project-by-project basis.

For lagoons to become a reality, some kind of innovation will be needed to bring down the costs, says Roberts. “The walls constitute 60% of the cost of a lagoon, so if you could use geo-tubes and fill them with dredged material, it would improve the viability of the technology.”

The UK government report concluded that “the issues surrounding the Swansea Bay scheme are sufficient to cast doubt on the economic viability of the tidal lagoon concept for the foreseeable future,” but added that “should TEL’s engineering solutions prove deliverable, then the economics of all the potential tidal barrage schemes around the UK would also be significantly improved”. As a result, while offshore lagoon technology may be out of favour at the moment, if TEL gets a scheme up and running elsewhere, lagoons will become a serious option once more. ■



Going with the flow: The 240MW tidal barrage at Rance, France, is a much smaller version of the projects planned for the River Severn.

“The issue with assessing the viability [of tidal lagoons] is that no-one has done one. It would really help if someone could build one.” – Iain Roberts, associate maritime engineer at the engineering consultancy Atkins