

A Severn Barrage

A summary of the Sustainable Development Commission report.

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1 General.

I summarise the findings of the report, and also add in data derived from the 1989 report where the SDC does not give it. The SDC examines the case for a barrage at the English Stones as well as at Weston-Lavernock, but the former would produce so little that I have left the details out. The SDC also notes that tidal stream technology should be supported, though it would be most use in the Western Isles and off the Scottish north coast which have no transmission lines, and that, as there is no example of a tidal lagoon system anywhere the theoretical case for that cannot be tested.

2 Severn Barrage, basic facts.

A barrage on the Weston-Lavernock line would be 16.1km long, composed of prefabricated caissons resting on a flat rock base, with two locks for large and small craft, and a short embankment at either end. There would be 216 turbines, each 9m in diameter, housed in caissons, and 166 tidal-sluice caissons. An annual total of 17 TWhours might be generated, which would be 4.4% of the total of 387TWhours produced in 2005. This would represent 0.6% of our total energy needs which were 247m tons oil equivalent in 2005. It would have an average annual load factor of 22.5% (ie the time that it would actually be working). It might save 5.6m tons of CO2 emissions annually, or 0.9% of annual emissions. Its main output would come between 1.00 and 3.00am and 1300 to 1500 daily. During the night it would compete with base-load nuclear power. Its maximum power output would occur for four days twice a month, and would decrease to a minimum of one quarter of that level at mid month.

Its estimated cost of construction would be £15bn, it would need 200,000 man years of labour, with a maximum at peak of 40,000 men. It could be built in 15 years from the decision to proceed. The caissons would be 40m wide, 80m long, and 35m deep, made of concrete or possible steel construction like North Sea oil platforms, and floated out from fabricating yards. They might weigh 90,000 tons each.

The price per KWhr of the power produced would depend on the rate at which the capital cost was discounted. If it was paid for by taxation, with the Treasury discount rate of 2% the price would be 2.3p per kwh, compared with coal at 4p. If there were a commercial discount of 8% the price would be 9.2p per kwh, almost as expensive as biomass (11p).

The existence of the barrage would help to sustain the era of centralised electrical supply and cheap fuel which is itself a major contributor to waste and excess CO2 emission. Any attempt by commercial concerns to use the barrage as an excuse for further economic development in the region would be similarly counter productive to sustainability.

3 Consequences of a barrage

a) Navigation. The main ship lock to enable the Ports of Bristol and Cardiff and Newport to continue as at present with ships of up to 70,000tons (which handle 17m tons of goods, 3% of UK trade) would be 360m long, 50m wide and 20m deep. Extensive dredging would be required to ensure they could get to Portbury because the ship lock could not use the main channel where the turbines would be, and the new channel would have to cut through an extensive sand bar. The estimate is that 18million cubic metres of sand and rock would need to be dredged for both the new shipping lane and the caisson foundations, and would be reused as ballast and infill. The Port of Bristol plans for a new dock to handle the next generation of cargo ship of up to 120,000tons and a 16m draught would require both a larger lock and a deeper channel because the maximum tide height inside the basin would be reduced by some 2 metres, and which would cut access to about four days a month. In effect the Barrage would make the Port of Bristol's plans uneconomic.

b)Tides. The tidal regime inside the basin would be one in which the tidal range would be halved. The highest tides would fall by 1metre. At Avonmouth the range would be cut from 12m to 5m at springs and from 6.5m to 3.5m at neaps. Low tide would disappear, as levels would never fall below mid tide level. It is also possible that the dam would lead to increased high tide levels on the seaward side of the barrage in Bridgewater Bay, though the models used surprisingly suggest the reverse.

Mudflats. The changed tidal regime would lead to the loss of 14,428ha of intertidal mudflats at spring tides and 5,842ha at neaps in the enclosed basin.

Currents. There would be considerable changes to tidal currents, but these have not been modeled on a 3D basis.

Turbidity The new tidal regime could lead to some or all of the 30m tons of mud that is in suspension in the estuary being deposited. There is no estimate of the depth of mud that this would lead to, and what the consequent reduction in water depth would be. It might make the existing operation of Royal Portbury Dock untenable. The impact of what is in effect liquid sandpaper on the turbine blades is another unknown, though those in the Rance Estuary have survived forty years.

Saltmarsh. The new tidal regime would lead to the loss of 540ha of existing saltmarsh, as upper levels would become salt free, and revert to fairly normal pasture; at the same time existing saltmarsh would migrate down the existing mud, but it is quite unclear how or when this would happen.

Wave erosion. The height at which wave erosion of saltmarsh occurred would alter, because the period of high water would increase from about two hours a tidal cycle to about six, and even more if the turbines were used as pumps at the top of the tide, which would lead to a 3% increase in power output.

Salinity. The salinity of the estuary would alter, and SDC estimated that the fresh/saline interface would move between 5 and 30km downstream depending on river flow. That might mean that at times the whole basin might become fresh water, with unknown consequences for all organisms living in it.

Eutricification. It is possible that the increase in light penetration as a result of the fall in turbidity would lead to eutricification, as has happened in the enclosed Cardiff Bay, where £10m a year has been spent on pumping oxygen into the basin to clear the water.

Pollution. Heavy metal concentrations might double at worst. The level of coliforms as a result of sewage outfalls is uncertain, as standards have hugely improved. (Avonmouth Sewage Works used to dump sewage sludge in the estuary, but this ceased many years ago. What happens to it now?)

c) Power Distribution. The CDC is vague about this but the 1989 report stated that there would need to be three 400KV lines from the English end and two from the Welsh. That 370 km of new lines would have to be built to connect to Southampton, London and Birmingham and a further 85 km of rebuilt lines. The fact that the supply would not be constant, but surge up and down, and then cut off completely would involve complex switching substations. The fact that the power would not be needed locally because of the three local nuclear power stations has the consequence that up to 50% of power actually generated by the barrage would be lost in transit to the consumer because of the resistance of the power lines.

d) Rock and sand for construction. At present about 1.5m tons of sand are abstracted from the Estuary each year. The SDC makes no estimate of the amount of rock and sand required either for construction the caissons or for the 3km length of embankment possibly needed- though that would depend on whether the Brean Down end of the Barrage began at the tip of the Down (with a tunnel under it) or on Brean Sands to the south. An early estimate (1974) suggested a minimum total of 55m tons of sand might be needed, and 41 m tons of rock. The rock requirement compares with an annual production in the whole region of around 34m tons of rock. This implies that here is no serious threat to the Mendips. Were the Caissons to be all steel construction the total of aggregates needed would fall considerably. There is no estimate of the consequences for beaches of the 18m cubic metres of dredging required for the construction.

e) Flood prevention.

i) From the sea. The existence of the barrage would help control a tidal surge upstream of the barrage, though it might exacerbate it to seaward. It could also prevent the consequences of long-term sea level rise, though neither of these appear to be part of the design brief. Inside the basin it would reduce the power of storm waves, and by reducing the maximum tide height it would in effect strengthen existing defences. However it could also weaken them by concentrating wave pressure on a narrower section of the sea wall and for longer periods each tide, and, as there would be no low tide, it would prevent future easy access to sea wall foundations.

ii) From the land. 800km² of low level land would be affected by the barrage. This area is drained by the many rivers large and small, and there are at least 100 tidal flap schemes by which the excess land water drains out at low tide by gravity. The change in sea level would create the necessity to change all these schemes to pumping system because they would either not be able to drain because of the new low tide level, or they would not have enough time to drain because of the short period at low tide level. The cost of uprating was estimated by the SDC as £62m. No estimate was made of the annual cost of pumping. It might be necessary to divert the River Axe to south of Brean Down to ensure adequate drainage of its basin, which would create substantial landscape changes between Weston and Brean Down.

f) Biodiversity. It is clear that the tidal basin as a habitat would be different from the existing estuary, but quite unclear what the difference would be.

Birds. At present some 50,000 birds of 15 species are present in nationally or internationally significant numbers either on passage or in winter (SDC figures). They feed largely on mud-dwelling invertebrates which occupy a small proportion of the total existing inter-tidal area. It is quite unclear whether the post-barrage tidal regime would provide enough rich inter-tidal mud for long enough for these populations to be sustained. The birds come from the whole arctic region, and we have an international responsibility for them. It is of course also possible that the changed tidal regime would lead to an increase in invertebrate biomass, and thus enable larger numbers of birds to be supported. It is not possible to know whether this would be the case.

Fish. Salmon and Eels are the most important fish species commercially. It is quite unclear whether they would survive a journey through the turbines, and at other sites up to half fish suffer damage.

Mammals. Seals are seen in the estuary, and probably would fail to gain entrance in future, or would be trapped if they did.

g) Landscape. The landscape impact of the barrage itself, which would be seen as a low lying line across the horizon, would be slight. Its impact on both Flat Holm and the Reserve of Steep Holm, both now very remote and isolated islands, would be very considerable, even if neither were actually linked to the barrage. The impact of the project on coastal habitats both upstream and downstream would be very substantial, including the possibility of much increased deposition in Bridgewater Bay, but also the possibility of higher tides there, and hence less efficient drainage of the Somerset Levels. Like so much about the proposal these changes cannot be predicted.

h) Environmental Legislation. The Estuary is protected under national and European law which could only be overridden by “overriding public interest” which would require compensation. There is no possible mitigation for the loss of an estuary, but there could be a very substantial package negotiated to provide different environmental gains in other places.

i) Transport links. The ship dock would prevent a rail line. There is no demand for another road link across the estuary, and the existence of the ship dock would either require a substantial viaduct or a road switching system at either side of the lock. Either would increase costs without benefit. There would need to be a service road from both ends, and maintenance of the system would require very substantial gantries to remove turbine and sluice units.

j) Tourism. The barrage itself would be a tourist draw, and the altered tidal regime would make the estuary attractive to boat owners. The total basin areas would be the same size as the Solent, and could in theory support a similar scale of sailing activity. SDC suggests an increase of between 5% and 20% in tourism. Weston is at present the prime tourist destination, but to remain so it would have to ensure its beach remained clean. The impact of the barrage and dredging on beaches is quite unknown.

4 Conclusion by SDC.

SDC believes that there is a case to be made for a full investigation of a Severn Barrage as part of a Sustainable Energy package. However compliance with the Natura 2000 directive is a central condition of a sustainable scheme and much wider and stronger action on climate change is a pre-requisite for the SDC’s support. There may be an ‘environmental opportunity’ available by linking a compensatory habitats package to climate change adaptation. A Severn Barrage must be publicly-led as a project and publicly-owned as an asset to ensure long-term sustainability. Government should consider a range of innovative financing mechanisms that would maintain overall public control and ownership of the project.

My Conclusion. There are far better ways of spending £15bn which would reduce CO2 emissions by far more than 0.9%. The highly intermittent power provision that bears no relation to power demand, and the need to distribute the power generated over long distances would ensure that the Barrage’s actual contribution to national requirement would be minimal, and would help to perpetuate the reliance on cheap centralized power that is the main cause of high emissions. The future must lie with micro-generation and high electrical prices which would help to minimize wastage. The environmental damage the scheme would certainly cause, together with the very wide range of unknown and unknowable consequences, renders the scheme unsupportable.

28/10/2007