REF
RENEWABLE ENERGY FOUNDATION
21 JOHN ADAM STREET, LONDON, WC2N 6JG
TEL: 020 7930 3636. FAX: 020 7930 3637
EMAIL: research@ref.org.uk
WEB: http://www.ref.org.uk

# *IPA Energy + Water Economics* on the Severn Barrage

The UK tidal resource is a predictable, carbon-free renewable energy that could meet a minimum of 10% of the UK's electricity demand. The Government's current Feasibility Study on determining the best option for the Severn Estuary has heralded a new era of tidal range and tidal stream technology nationwide options. REF acknowledges that all large-scale renewable technologies raise physical, economic and environmental issues.

Tidal stream in particular is a nascent industry where thorough, multi-disciplined, UK-wide research is urgently required if this new technology is to be universally adopted within a useful timescale. REF thus welcomes all parties to broaden the debate and contribute to the knowledge base for what prove to be a vital component of a balanced, low carbon energy portfolio for the UK.

As part of its general research program REF commissioned *IPA Energy + Water Economics*, a leading economic consultancy to prepare two studies to inform our views on the Severn Barrage.

We are now publishing these studies as contributions to general public debate. The studies are not statements of REF's views on any of the proposals for generating electricity in the Severn estuary.

## *Study 1: Severn Barrage Costing Exercise* (March 2008)

Three aspects of the Severn Barrage, the generic term for the Cardiff-Weston Barrage scheme, are explored in this March 2008 report from IPA. It leads with a comparison of levelised energy costs between the Severn Barrage, onshore and offshore wind and other large-scale conventional generation technologies. The amount of energy that could be generated from each technology for the same cost as developing the Severn Barrage is investigated. Two sensitivities are applied; varying discount rates and varying carbon prices. IPA identifies that due to the high CAPEX of onshore, offshore and the Severn Barrage, their generation costs are the most sensitive to variations in the discount rate. It suggests that unlike coal and gas, the economics of renewable energy projects are independent of the carbon price although as the carbon price increases so does the competitiveness of renewables compared with fossil fuels. It could be argued that attributing a load factor of 33% to onshore wind and an offshore capital cost of £1-£1.5m per installed MW (at the time £2-£2.5m p/MW and now £3m p/MW) is rather generous but there is no doubt that the Severn Barrage has the highest capital cost of any alternative generation plant. However, identifying the Severn Barrage to have the lowest operational and maintenance costs of all the technology investigated is significant given its longevity (120 years). The conclusion that out of all the technologies compared the most energy produced for the same cost would be from nuclear generation is not surprising.

IPA then discusses the contribution that a Severn Barrage Scheme would have to security of supply. While the tide is predictable, the conversion to electricity does not always synchronise with times of peak demand. Variation also occurs due to the differential between spring and neap tides. The positive effect of varying the timing of generation is briefly contemplated with interesting results for spring tides.

This leads onto the possible effects of a Severn Barrage scheme entering 8.6 GW into the national electricity system with the subsequent flexibility needed from conventional plant. It demonstrates how combining flexible barrage generation and pumped storage capacity could alleviate fluctuations.

IPA have, by their own admittance, had to apply their own assumptions to figures calculated using different cost components and operating parameters from a selection of documents. It is thus unclear to what extent balancing costs have been taken into account. IPA concludes that with the exception of offshore wind, the other technologies could provide at least twice the amount of energy as the Severn Barrage for the same cost.

## ***Study 2: Severn Barrage Costing, Follow-on Analysis*** **(December 2008)**

This follow-on report seeks to compare costs of electricity generation and potential $CO_2$ reduction of the Severn Barrage compared with other technologies. The year 2025 is chosen to allow for stabilisation of the generation market after the retirement of known plant in the next decade and the construction of the Severn Barrage. Utilising an analysis of IPA's own data of market trends and wholesale electricity price developments from April 2009 to March 2033, a new generation stack is assumed. On this construct, a number of base, low and high scenarios are explored to determine the cost of carbon abatement for each technology.

It is noted that the under-estimation of offshore wind capital costs in the previous report are updated. However, there are a number of other unusual modelling assumptions. For example, the assumed generation stack differs considerably from current Government expectations. It can be noted also that the Severn Barrage is allocated a 50 year lifetime instead of the widely accepted 120 (La Rance has operated now continually for 42 years of out its 75 year lease) and rather than the 20 years given to offshore turbines empirical evidence suggests that 12 years is more realistic.

IPA concludes that the Severn Barrage is not quite as effective as renewables and nuclear because of its unique daily generation profile: the timings of maximum generation do not quite match the times of peak demand and hence the Barrage does not displace as much of the high intensity coal-fired generation as the baseload (assumed flat daily profiles) renewables and nuclear plants. Onshore and offshore wind and biomass can achieve slightly better $CO_2$ and variable cost reductions than the Severn Barrage because of their more evenly distributed (on average) operation, and with lower capital costs thus have a lower abatement cost.

02.11.09