The Proposed Swansea Bay Tidal Lagoon. Notes from a presentation to CPRE at Taunton on 13th January 2015.

Background

Tidal Lagoon Swansea Bay (TSLB)[1] was founded by its CEO Mark Shorrock in 2012. He has a long history of involvement in renewable energy (CEO of Shire Oak Energy, Low Carbon Group, Low Carbon Investors Ltd and Wind Energy Ltd).

Finance of the initial phase of tidal lagoon development is being funded by Mark Shorrock to the tune of about £20m. Thereafter it is expected that institutional investors would fund the construction and would become shareholders.

CPRE was invited to a presentation on the proposed Swansea Bay Tidal Lagoon on 13th January 2015 at Taunton. It was attended by the CPRE Senior Energy Campaigner from London and representatives from CPRE Devon, CPRE Somerset, CPRE Gloucestershire and CPRE Avonside. The interest of CPRE is not directly in the proposed Swansea Bay Tidal Lagoon, but on possible future tidal lagoons on the English side of the Bristol Channel.

The presentation was given by Eva Bishop of TLSB. We were promised a copy of the presentation, but after over 3 months, we were presented with a reduced set of slides because of "*the sensitivity over certain information and figures within the slides presented*" and the slides that we did receive were "*not for wider circulation*".

The Swansea Bay Tidal Lagoon

The proposed Swansea Bay Tidal Lagoon is intended to be the first of a series of much larger tidal lagoons. As an 'offshore generating station' and being of >100MW, a 'nationally significant infrastructure project' (NSIP), the planning process is managed by the Planning Inspectorate and the decision to grant a 'Development Consent Order' (DCO) is made by the Secretary of State for Energy and Climate Change following a

[1] http://www.tidallagoonswanseabay.com/default.aspx

recommendation by the Planning Inspectorate. The process requires an Environmental Impact Assessment, public consultation, public hearings and examination by the Planning Inspectorate leading to a recommendation to grant or refuse by the Planning Inspectorate. The process began in 2010. The decision will be made by Amber Rudd by 10th June 2015 and if a DCO is given, construction will start at the end of 2015 with completion and connection to the grid expected in 2019. A marine licence (to allow dredging and construction is required from the Marine Licensing Team of Natural Resources Wales (NRW) on behalf of the Welsh Government. Other permits, such as from the Crown Estate and Swansea Docks, are also required. The Planning Inspectorate issued a report of recommendation to the Secretary of State on 10 March 2015. The Secretary of State has 3 months in which to issue a decision. The decision letter of the Planning Inspectorate will not be made public until after the decision has been made by 10th June 2015. A 6 week period is available after the decision for any legal challenges to the decision..

All the documentation can be seen at the National Infrastructure Planning website[2].

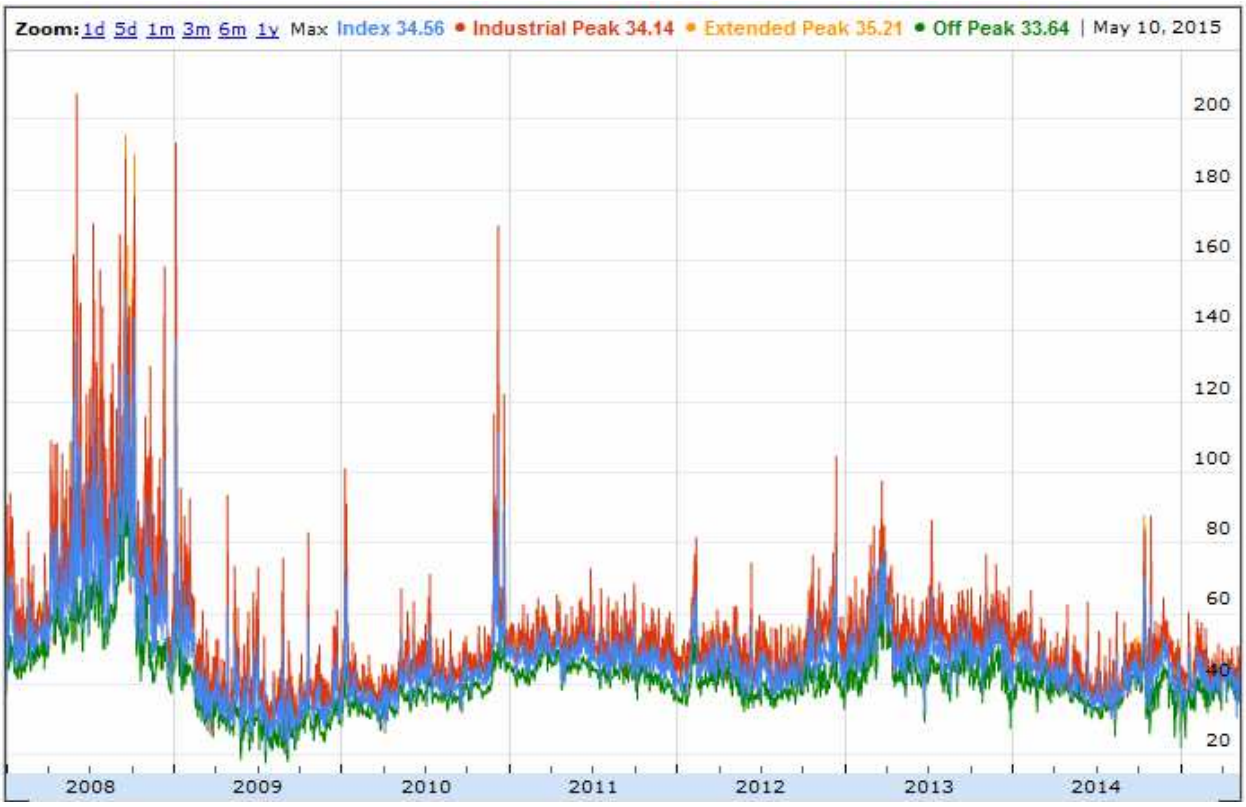
As is the norm with renewable energy schemes, there is a great deal of confusing, contradictory and misleading information given in the project description and application documents. Based on past experience, it is very unlikely that the Planning Inspectorate will realise this and will have taken the information provided by the TLSB as being factually correct. I will explain the most important of these below.

Project Description

The project would consist of a 9.5km long breakwater enclosing a lagoon of area about 11.5km² in the Swansea Bay area of the Bristol Channel, a location chosen because of the high tidal range. Two designs of breakwater are being examined, but both would include a considerable quantity of dredged material/rubble enclosed in rock armour and capped with concrete.

[2] http://infrastructure.planningportal.gov.uk/projects/wales/tidal-lagoon-swansea-bay/

Its lifetime of the Swansea Bay tidal lagoon is about 120 years and it will be funded for about 35 years at a strike price of about £168/MWh[3][4]. After that period it will produce unsubsidised electricity. If the scheme is permitted, it will be considered as a first-of-kind test bed for the concept of tidal lagoons. Note that £168/MWh is about 3 to 4 times the wholesale price of electricity (see chart below[5] which shows wholesale electricity prices fairly stable since 2009 at around £40 to £50/MWh) and would probably make the Swansea Bay tidal lagoon the most expensive generator in the UK, exceeding Hinkley C by 80% and offshore wind by 20%. Notwithstanding this fact, TLSB state that it is "*low cost*".



The electrical output is uncertain and TLSB don't like to use the term capacity factor. It will produce electricity four times a day during each ebb and flow tide, roughly 14 out of 24 hours. The installed capacity of the 16 x 20MW bi-directional turbines is 320MW, but the rated capacity at 4.5m head is 240MW. [Note the tidal range is between 4.1m (neap) and 8.5m (spring)] The actual output is optimised by operating for longer at lower

[3] 'Levelised cost of power from tidal lagoons'. Poyry, March 2014.
[4] http://www.telegraph.co.uk/finance/budget/11479698/Budget-2015-Government-to-begin-subsidy-negotiations-for-Swansea-Bay-tidal-lagoon.html
[5] http://www.energybrokers.co.uk/electricity/historic-price-data-graph.htm

output, based on the head difference between the water levels inside and outside the lagoon. Basically, the output is intermittent but predictable, being roughly 14 hours per day (3.5h per ebb and flood tide, with 2.5h between), with water flow controlled by sluice gates. Because the subsidy is a flat-rate, based on total MWh produced, not when it is produced or based on maximum demand, it is evident that the output profile will be managed to produce as much electricity as possible.

TLSB repeatedly state in the application documents that the scheme will produce baseload electricity, but that is clearly false. The total estimated annual output is variously given as 400GWh and 495GWh. Thus based on an installed capacity of 320MW, the load factor is 14.3% or 17.7% and based on the rated capacity of 240MW, the load factor is 19.0% or 23.5%. This is roughly equivalent in output to a conventional power station of about 60MW operating at a load factor of 90% (in other words, a tenth of the size of a typical 600MW turbogenerator).At a strike price of £168/MWh and a production of 495Gwh, the annual income would be £83m.

The capital cost of the scheme is obviously commercially sensitive, but has variously been estimated at between £750m and £1,000m. For this capital investment one could build a 600MW CCGT power station which would produce 10 times as much electricity and which would not need a subsidy.

TLSB variously claim that the scheme will produce enough electricity to power 120,000 to 155,000 homes and will reduce (or save) the emission of 236,000 te CO_2 per year. Based on these figures it can be deduced that TLSB assume an emissions displacement factor of 0.477 kg CO_2 /kWh. No reference is given for this figure of 0.477 kg CO_2 /kWh. The correct displacement factor to use is given by DECC. The Government approach to CO_2 emissions savings from renewable electricity is specified in its progress report to the EU 'First Progress on Promotion and Use of Energy from Renewable Sources for the United Kingdom'[6] where it is stated that the savings from renewable energy electricity deployment are "*calculated by multiplying the amount of renewable electricity generation by DECC's marginal emissions factor*". The marginal emissions factors are given in a joint HM Treasury/DECC report entitled 'Valuation of

[6] URN: 11D/943 First Progress Report on the Promotion and Use of Energy from Renewable Sources for the United Kingdom Article 22 of the Renewable Energy Directive 2009/28/EC

energy use and greenhouse gas emissions for appraisal and evaluation', June 2010. This report was updated in September 2013. The conversion factor for 2015 is 0.312 kg CO_2 /kWh and the figure falls with time as the UK electricity generation is de-carbonised such that by 2050 it is 0.030 kg CO_2 /kWh. Over a 35 year period beginning in 2019, the average factor is less than 0.175 kg CO_2 /kWh. TLSB have exaggerated the emissions of CO_2 displaced from other generating plant by a factor 2.7 over the 35 years that the scheme would be subsidised. The CO_2 emissions displaced over the 35 year period would be no more than 87,000 te per year. This exaggeration of displaced emissions is typical of renewable energy companies.

However, the CO_2 displaced is only part of the story. The 'carbon footprint' of the scheme has to be considered, together with the impact of the intermittent and variable output on the operating efficiency of other generators on the grid.

A 4-year payback time was stated (the carbon footprint). However, this figure would be based on the exaggerated CO_2 displacement ffigure, which is a factor 2.7 too high. Hence the payback time would be at least 10 years.

The impact of the intermittent production of up to 240MW of electricity upon the efficiency of despatchable fossil-fuel power stations required to balance supply with demand and maintain grid stability is not known. However, the ramping of power up and down to mirror the output of the tidal lagoon would reduce the efficiency of the despatchable power station(s) and would result in increased CO_2 emissions.

Taking account of the carbon footprint and the increased emissions of despatchable plant, the CO_2 emissions saved by the proposed tidal lagoon would be considerably less than 50,000 te per year. Compared to the UK 2025 target of an annual reduction of 296Mt of CO_2, the contribution of the proposed tidal lagoon would be less than 0.02% of the target, i.e. an insignificant amount. The Government has repeatedly made it clear that the renewable energy targets for 2020 will be met without any further renewable energy schemes and there are no renewable energy targets beyond 2020. CO_2 targets beyond 2020 should be met by the cheapest and most effective generators.

The breakwater/embankment will be built of millions of tons of gabbro rock from a re-opened Dean Quarry in the Lizard Peninsular in Cornwall. The quarry is now owned by Shire Oak Quarries, a sister company to TLSB. It has been selected due to its proximity (when compared with shipping from outside the UK), suitability (in terms of rock density and particle size) and volume of rock available. The site is consented to extract rock and the company is preparing a planning application to replace the existing jetty with two new jetties plus a protective breakwater to enable the transport of all rock by sea, avoiding rail or road traffic for construction. The proposed jetties and breakwater would be located within the Manacles Marine Conservation Zone (MCZ). This has understandably created controversy[7]. TLSB says that it considered alternative sources of rock from as far away as Norway, but it seems to have overlooked, for example, the suitable rock available from an existing and operational super-quarry at Glensanda in Scotland, where, subject to contract, the required particle size could be obtained.

A CPRE geologist raised the issue of silting, stating that he would expect rapid silt deposition such that it would become an issue within a few years of operation. Silting up of the lagoon received very little attention in the application documents. A brief search found this: "*Dredging works will also be carried out as part of the continued maintenance of the Project. During the Project's operation, limited siltation will occur within the impoundment, which will eventually affect the level of head that is able to build. When this occurs, TLSB will undertake maintenance dredging*". We have been subsequently informed that "*for Swansea Bay TLP will bring in a transportable dredger and place it into the lagoon. This will dredge while the lagoon is in operation and has no effect on power output. It will pump over the wall and into barges outside the lagoon. Then tug boats will take this to a disposal site 3 to 5km from Swansea (an existing site). Other lagoons are likely to have ship access, which is generally more efficient. This would enable TLP to bring in a dredging vessel e.g. a small hopper or a cutter so we do not have to pump over the wall*". It is not known whether dredging will be a continuous operation, 24 hours a day throughout the year and there is no indication of the amount of fossil fuel used in the dredging operation or the noise created. The benefits in terms of assumed tourism and recreational use could be seriously impacted by dredging operations.

[7] http://www.westernmorningnews.co.uk/Controversial-marine-zone-quarry-plans-marked/story-26267815-detail/story.html

Future tidal lagoons

The major CPRE concern is for possible future tidal lagoons along the English coast, with several large schemes being looked at which it is claimed could produce up to 8% of the UK electricity (in the Bristol Channel and between Colwyn Bay and Cumbria). Three of the schemes being examined are in the Bristol Channel, two on the Welsh side (Cardiff scheme and Newport scheme) and one on the English side (Bridgewater scheme). The Bridgewater scheme (stretching from possibly Minehead to Weston-Super-Mare and completed by 2027) was of huge concern to CPRE on the grounds of impact on tourism, landscape, wildlife, farming (Somerset levels) and on the natural processes of coastline erosion, beaches and mudflats. In particular it is noted that the Somerset coastline to the west of Hinckley Point is an erosional coastline. The land is gradually eroded to form the cliffs that produce the attractive coastline of significant tourism and recreational value. If the erosion was halted by the coast being enclosed within a lagoon, then the cliffs would become overgrown and degraded, and the coastline would become less attractive. Silt deposition and the need for dredging would also be an issue.

Conclusion

The proposed Swansea bay tidal lagoon is a nationally significant infrastructure to be decided by the Secretary of State for Energy and Climate Change. It is likely that the Secretary of State will have been given a recommendation by the Planning Inspectorate, based upon incorrect evidence because the application documents contain misleading and incorrect information.

The proposed tidal lagoon would produce an insignificantly small amount of very expensive (unaffordable) and intermittent electricity, it would have an insignificant effect on CO_2 emissions and it would adversely impact on the operation of despatchable power stations required to balance supply with demand and maintain grid stability.

Logically, the proposed tidal lagoon should not go ahead.

Post script

If the Secretary of State for Energy and Climate Change decides in favour of the Swansea Bay Tidal Lagoon it will indicate several things:

1. The Conservative Government is continuing with the Labour and LibDem energy policy of command and control, in which business decisions are taken by politicians.. It will signal that it is not in favour of a free market in electricity generation. It will indicate that it has not learnt the lessons of history showing that free and competitive markets picks winners and that Governments pick losers.
2. The Conservative Government is happy to see the continued destruction of the nuclear industry, the closure of the cheapest electricity generators (coal-fired power stations), the future unprofitability of gas-fired power stations, the construction of intermittent and unaffordable renewable energy schemes and the continued construction of dirty and expensive diesel generators.
3. The Conservative Government is not concerned about 'the lights going out' on its watch.
4. The Conservative Government is happy to continue to force electricity consumers to subsidise intermittent and inefficient renewable technologies that do not reduce CO_2 emissions.
5. The Conservative Government is happy to allow electricity prices to rise rapidly and thus increase fuel poverty and reduce industry's competitiveness.

The electricity industry will note these indicators and will not invest in much-needed new despatchable power stations to replace those closing down, unless they too are guaranteed massive subsidies.

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