

MORGAN HORNE'S 'OPEN COAST TIDAL ENERGY' REPORT

Revised Response to Prof David Mackay: Cllr Stuart Anderson, Conwy CBC, 7.4.14

This report was printed in 1993 but never published. Though written by a consultant engineering company it makes no reference to a client readership, leaving questions as to which other agencies and departments besides DECC may harbour archived copies (DEFRA? The Crown Estate?).

The study is broad-brush and of its time as regards lack of computer modelling support. Its ideas on coastally attached impoundments, or 'lagoons', contrast with the former Severn Tidal Power Group's (STPG) emphasis on barrages, but may also be taken to complement this. Its background study work, said to have taken six years, must have run concurrently with the second DoE Severn Barrage study, published in 1989, which decided not to revisit the earlier 1981 DoE (Bondi) Report's alternative idea of coastally attached lagoons on the Severn. But Morgan Horne, in giving the 1981 DoE lagoon idea a wider, more strategic airing must surely have known about the precedent. It is remarked that parallel development of Open Coast schemes would help the STPG by offering more overall continuity of tidal grid outputs. In ranking order based on useful tidal range and moderately shallow coastal shelf areas fit for enclosure, the best locations were reckoned to be off the NW of England and N Wales, followed by the E coast of England from Humber to Wash. SE Sussex and Kent, and parts of the SW Wales coast, are also cited. Bridgwater Bay is ignored, one suspects out of deference to STPG work. But strategically important locations also omitted include St Andrews Bay/Tayside in E Scotland, Tremadog Bay in NW Wales, and the Thames Estuary.

The study precedes the notion of Integrated Coastal Zone Management. Yet despite longstanding pre-existence of UK shoreline management, coastal processes and future climate change adaptation needs are glossed over - coastal defence being called an 'incidental benefit' four years after the first IPCC Report. The attached patent multiplies sluice numbers in a way that is hard to see being scaled up manageably, costs are sketchy, alternative alignments appear as one-off project options rather than in staged form, and both text and diagrams seem to overlook the dependence of bulb turbines on deep submergence to prevent cavitation. By arbitrarily doubling 'DoE scaling' of through-flow capacity and outputs the report does challenge STPG and DoE assumptions in the lagoon context, although a tripling of through-flow capacity would be needed to naturalise basin excursion during spring tides. Still, it is claimed that Open Coast schemes could together put an average 7.5 GW into the grid, or 25% of UK electricity demand at the time. (By comparison, the accepted average output of 2 GW from a 1989 DoE Severn Barrage was rated then as having been 6% of UK demand.)

In summary, despite its limitations this study deserves praise for its ambition to open up a UK-wide perspective on hitherto neglected aspects of tidal range potential. As such it sheds some new light on what still amounts overall to an extraordinarily unappreciated elephant-in-the-room. Politically, fear of such boldness may explain the report's suppression from public view. In turn, rather than of openness the background impression is left of a conspiracy of silence that, however unintentional, now surely merits both practical and strategic correction. To that end, and to add relevant context, the following table places the report alongside six more recent studies.

TABLE SHOWING MORGAN HORNE STUDY ALONGSIDE SIX MORE RECENT STUDY REVIEWS

| | 1. Morgan Horne (1993) | 2. STPG Definition Study (2002) | 3. Lempérière & Paul (2007) | 4. Anderson* (2008) | 5. Burrows (2009) | 6. Mackay (2009) | 7. Atkins/Rolls- Royce (2010) |
|--|-------------------------------|--|--------------------------------------|---------------------------------|-------------------------------|-----------------------------|--|
| TYPE(S) OF TIDAL RANGE SCHEMES CONSIDERED: Barrage(s) Coastal Impoundment(s) Offshore lagoon(s) | No Yes (Yes) | Yes No No | Yes Yes Yes | Yes Yes Yes | Yes Yes No | No No Yes | Yes No No |
| OPERATIONAL MODE(S) CONSIDERED: One-way Two-way (1x DoE flow) Two-way (3x DoE flow) 'High head' lagoon-pair | Yes Yes No No | Yes No No No | (Yes) Yes Yes Yes | (Yes) Yes Yes No | Yes Yes Yes No | Yes No No Yes | No Yes Yes No |
| EMPHASIS ON NEED FOR PLANT INNOVATION TO (i) INCREASE CAPACITY & (ii) ELIMINATE SLUICING | No No | No No | Yes Yes | Yes Yes | No No | No No | Yes Yes |
| PRIMARY STANCE(S) ON SUSTAINABILITY ARE: Economic Environmental Social | Yes Yes No | Yes No No | Yes Yes No | No Yes Yes | Yes No Yes | No Yes Yes | Yes Yes No |
| STUDIES' REGIONAL MARKET SIGNPOSTING: Severn E Irish Sea UK's Eastern Coast UK-wide/British Isles Worldwide | No Yes Yes Yes No | Yes No No No No | Yes Yes Yes Yes Yes | Yes Yes Yes Yes Yes | No Yes No Yes Yes | No No Yes No No | Yes No No No No |

*This & the other five post-1992 references are accessible via a 2012 paper headed 'Impounding the Tides' on www.marenproject.eu/eng/contact/

Each of the following paragraphs sets out some issues identified by one of the above study reviews, alongside opportunities that - whether or not originally identified - remain to be usefully explored.

1. Morgan Horne (1993)

- 1.1 **New issues identified:** previous preoccupation with barrages may have overshadowed other shallow coastal zones' potential, which could well be considerably greater overall.
- 1.2 **Outstanding opportunities:** the company (Boving) here advising on bulb turbines seems to have never had experience in this field. This suggests potential for an up-to-date, 'strategic market potential study' for tidal range weaving together key strands currently left hanging loose by both Open Coast and Atkins/Rolls-Royce 'SETS' studies (qv. Para 7).

2. STPG Definition Study (2002)

- 2.1 **New issues identified:** none, as this study merely updates costs from the 1989 DoE work
- 2.2 **Outstanding opportunities:** failure to seek new ideas or turbine formats for a Severn Barrage eventually paved a way for Severn Embryonic Technology Studies (qv. Para 7).

3. Lempérière and Paul (2007)

- 3.1 **New issues identified:** this review in English by two seasoned French engineers blasts several myths about La Rance that have long obstructed fresh thinking in the UK – e.g. that its installed capacity is an optimal ‘given’, and its dependency on supplementary sluices makes these a necessary feature for future projects. An alternative higher head twin-lagoon idea is also put forward, with potential to yield continuous grid inputs.
- 3.2 **Outstanding opportunities:** improved design formats are hinted at but not shown. The twin lagoon idea may suit France’s less populated coastlines more than the UK’s. In all the paper suggests a tidal range world market $2/3^{\text{rds}}$ the size of conventional hydro’s.

4. Anderson (2008)

- 4.1 **New issues identified:** non-dimensional comparator method set out for flat-basin study of up to 6x installed capacity over DoE for two-way generation. Using this, a design brief was suggested for 2-way Severn Barrage ‘naturalising’ through-flows during spring tides by deployment of 3x DoE capacity with a counter-positioned, contra-rotating (CPCR) twin pump-turbine format and a deeper, curved barrage alignment. A UK-wide strategy for barrages and impoundments must anticipate longer term coastal defence needs.
- 4.2 **Outstanding opportunities:** the CPCR format - though later agreed in the Atkins/Rolls-Royce SETS work to be potentially the best, and probably the only fully fit-for-purpose, generic tidal range format – has yet to be accorded a practical proof-of-concept venue. This is an essential first step and unique proposals are in hand that could secure honest public engagement alongside genuinely useful business and academic advancement.

5. Burrows (2009)

- 5.1 **New issues identified:** applied non-dimensional method suggested by Anderson mainly to barrage schemes in E Irish Sea, suggesting its potential may exceeds that of Severn
- 5.2 **Outstanding opportunities:** felt inhibited from modelling two-way generation because of lack of established Hill Chart data. Future study opportunities therefore left open.

6. Mackay (2009)

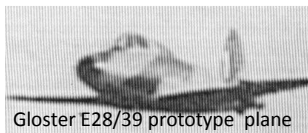
- 6.1 **New issues identified:** excellent all-round introduction to four 2050 UK ‘sustainable energy scenarios’, each featuring demand management & minimum 2x increase in low carbon grid electricity supply – e.g. half from nuclear, half from assorted renewables.
- 6.2 **Outstanding opportunities:** tidal range appears in none of the scenarios. Surely there must be an opportunity for a new, fearless edition of this book where it **does** appear.

7. Atkins and Rolls-Royce (2010)

- 7.1 **New issues identified:** CPCR pump/turbine format confirmed as the best/only practical one for a future Severn Barrage, out of over 20 looked at, but modelling showed the standing wave effect would here limit working head to 3M. Agreed with Anderson’s hunch that 3x increase in through-flow was possible on a new, curved alignment. Timed pumping calculated to yield an average extra 23% net output, 59% during neap tides.
- 7.2 **Outstanding opportunities:** because of the heading ‘Severn Estuary Embryonic Studies’ a quite false impression has been left that the CPCR format’s main or only application is for a Severn Barrage. But with an operating head understood to be up to 5 M, no obligatory submergence requirement, and pumping efficiency up to 70% without significant loss of generating efficiency it would be just as suitable for impoundments – and for tidal river-mouths with combined tidal and fluvial flood risk, as in Somerset and Pwllheli. Such smaller schemes would strengthen market prospects by highlighting flood risk mitigation value and creating interim revenue streams (q.v. Para 1.2 above).

CONCLUSION: TRUE OPENNESS MEANS OPEN SHARING OF PRACTICAL & POLITICAL STRATEGIES

Every private detective, after excluding false leads, hopes to emulate Sherlock Holmes in showing how ‘whatever is left, however improbable, must be the solution’. So what’s left? What was it hoped to find anyway? Morgan Horne is not alone in offering partial answers, so a synthesis is needed. Much bigger and more smoothly effective two-way through-flow capacities remain a key issue for all forms of tidal range, as on this proviso UK net average tidal range potential may prove nearer 20GW than 2GW. To scan the table and comments above and read Sir John Houghton’s letter with attachments may help reveal much of the core bulk of Britain’s climate adaptation and mitigation strategy for the period 2020-50, to which the present wind and marine current agendas may soon be seen as akin to the proverbial elephant’s feet and appendages. The Welsh Government defines sustainable development (SD) positively as ‘long term investment in locally conceived and developed projects under a shared over-arching strategy’. But it is arguable that without openness of vision the people perish for **lack** of strategy, from which targets may divert attention and for which they are no useful substitute in the longer term referable to SD. It may help to put the SD idea into engineering terms using three graphic symbols, one for each component of essential political leadership strategy, viz:-

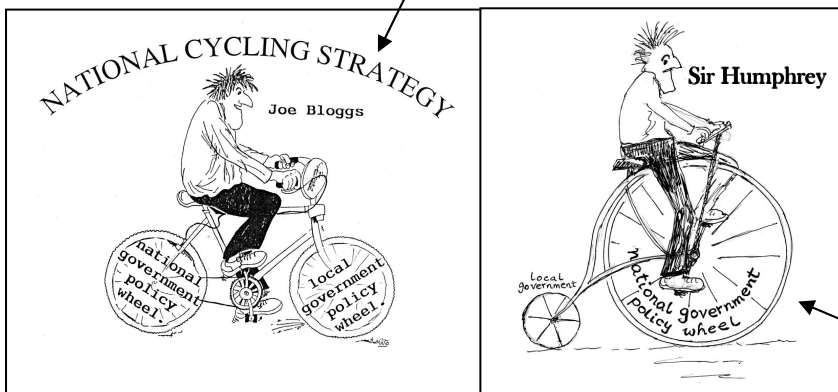


ECONOMIC: to avoid Bristol Brabazon /Concorde style dead-ends, a small proof-of-concept project is essential for a generically new plant solution aiming at energy extraction in the range 50-100%. The UK government should not duck its responsibility as it did with the jet engine pre-WW2.



ENVIRONMENTAL: an approach to Prince Charles is under way. The viaduct symbolises transport as a future use of renewable energy within the British ‘Energy Islands’. To get the North of Scotland Hydro schemes started Churchill told his Labour Secretary of State, Tom Johnston, he’d ‘look sympathetically upon anything about which Scotland was unanimous’

SOCIAL: the humble bicycle offers an excellent model for partnership in environmental awareness.



NB: regardless of chosen grade of political devolution this method of combining power and steering is less conducive to safe, steady progress.

FOUR RELEVANT REFERENCES - the first three by American authors, the last by a Scot:-

Economic: ‘The Wide Lens: a new strategy for Innovation’ Adner R, Penguin 2012. ISBN 978-0-670-92168-3

Environmental: ‘Good Strategy/Bad Strategy: the difference and why it matters’. Rumelt R, Profile 2011. ISBN 978-1-84668-480-7

Social: ‘Why Nations Fail: the origins of power, prosperity and poverty’. Acemoglu D & Robinson JA, Profile 2013. ISBN 978-1846684302

Project scoping & political leadership: ‘The Dam Builders: power from the glens’. Miller J, Birlinn 2002. ISBN 1-84158-225-5