Free flow turbines and their efficiency

Research and Industry Workshop
Mathematics Department
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A commercial future?

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The objective - a commercial future

Whilst the aim of the workshop is to discuss the efficiencies achieved from free flow turbines, the overall objective must surely be to choose a suitable design which could generate electricity at a commercially viable price. The design of the Gorlov Helical Turbine appears to be best suited to marine applications for electricity generation.

A recent report by the UK-based engineering consultant Parsons Brinckerhoff revealed that tidal power generation is currently the most expensive source of electricity in Britain, with costs likely to be in a 16 -38p/kWh range.

Typical cost ranges include:

Tidal generation - between 16 and 38p/kWh

Offshore wind - between 15 end 21p/kWh

Onshore wind - between 8 and 11p/kWh

Combined cycle gas turbine - between 6 and 11p/kWh

Nuclear - between 6 and 8p/kWh

Parsons Brinckerhoff utilises a sophisticated analysis model, which takes account of multiple factors for each generation type including predicted costs for fuel, carbon, operation and maintenance. It also includes factors reflecting optimum plant life and construction scheduling. The cost breakdown of generation technologies emphasises the large variations in capital and fuel price contributions. However, it does not take account of the costs of transmission on the national grid, which reflects current uncertainty relating to the treatment of costs by the transmission system operators for offshore wind and other geographically distributed generation types.

(Figures taken from *tidaltoday* March 2010)

From these figures, tidal generation would currently appear to be a commercially non-viable option. However, there are undoubtedly major disadvantages to wind, gas and nuclear energy production, so that if the cost effectiveness of tidal generation could be improved, it could provide a reliable and environmentally acceptable alternative.

How, where and who could design and build a prototype unit?
On the assumption that this workshop feels there is a commercial future for the GHT design in relation to marine applications, how could we take forward these ideas to the next stage? As further development of the design may be needed to improve efficiency, the involvement of a university research department would be crucial in order to build a working prototype. Design issues which might be considered in trials would include:-
- ratio of diameter to length
- angle/profile of helix
- casting versus fabrication

Currently, all the prototype free flow turbines appear to be fabricated. When building my model, the fabrication process resulted in 2/3 of the shell being wasted. For small test units this is still probably the most economic way of making them. However, for larger turbines, I believe that casting the turbine would be the way forward. Although the initial pattern costs for castings are high, the advantages are:-
- minimum wastage of metal
- increased rigidity and strength
- wide choice of suitable metals
- changes to the pattern can easily be made, allowing for easy data comparison
- castings would be able to withstand damage from modest sized debris
- engineers and designers are free to profile the casting to optimise power outputs

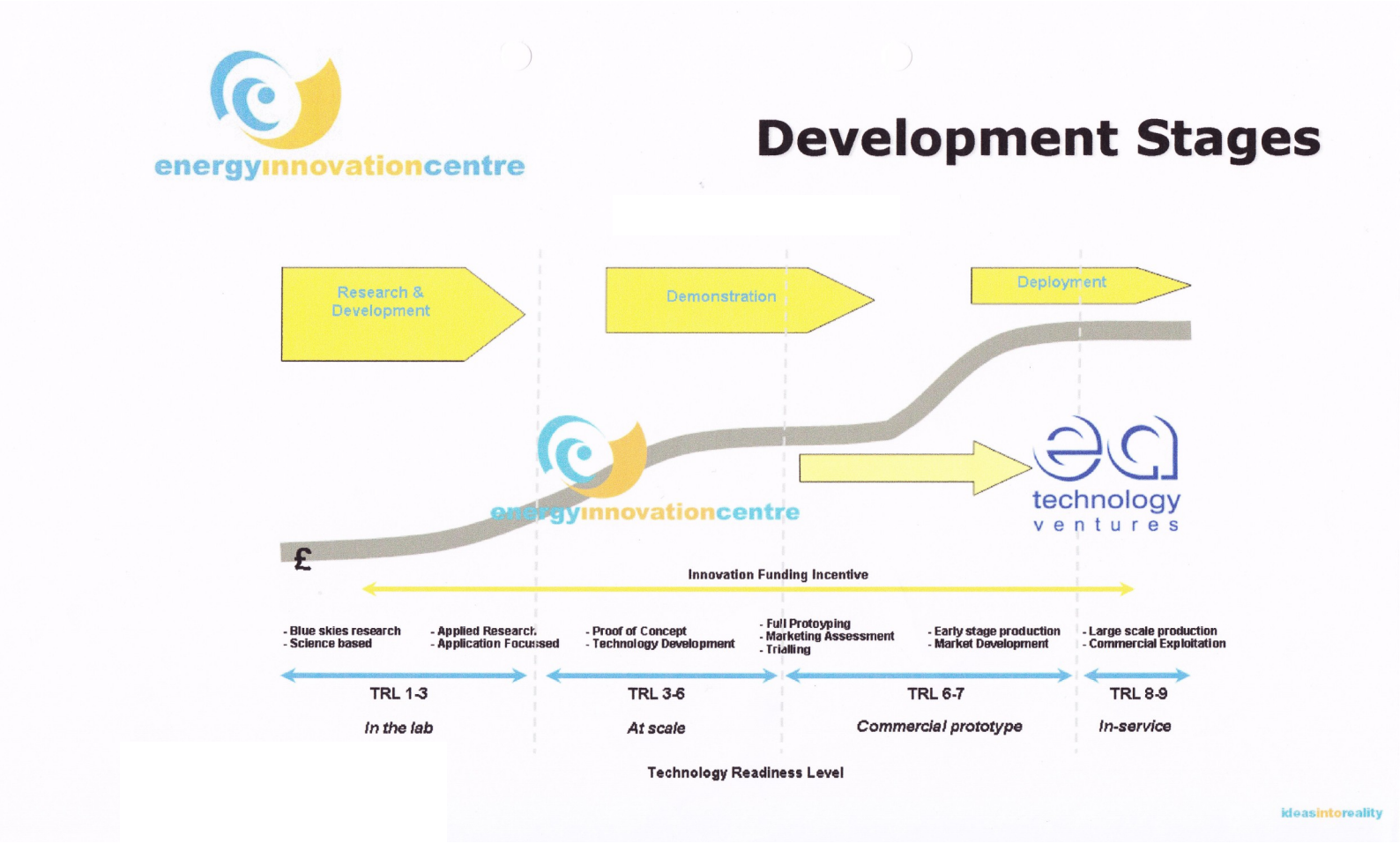
Legal considerations
As Lucid Energy Technologies, USA, have certain rights for the GHT design, would this restrict a UK development project?

Sponsorship options
To do any form of practical testing which would produce worthwhile data requires major capital investment – that means sponsorship. Possible sponsors are likely to be already involved in the generation and/or distribution of electricity. Major electrical generators/distributors include - E.ON, EDF Energy, npower, International Power, Scottish & Southern Electricity, Green Energy, Western Power , SP Manweb.

Alternatively, sponsorship might come from:
- one of the large UK based engineering companies
- the Carbon Trust
- the Government-backed Technology Strategy Board

So far the TSB has helped to finance research and development projects focusing on supporting and underpinning the development of pre-commercial full scale devices. Beneficiaries of their £9m grants are Bauer Renewables Ltd, Palemis Wave Power Ltd and Marine Current Turbines Ltd. The following diagram is from the Energy Innovation Centre, Capenhurst, Wirral. It shows the 4 stages of development, with the TSB supporting TRL 6-7.

(see diagram over page)



As the development of free flow turbines has reached TRL 6-7 in other parts of the world, would the TSB be the most likely sponsor of a UK trial of a GHT?

Summary

In my opinion, there are four major issues to be resolved:-

- the research department able to design the most efficient prototype
- the sponsorship to fund it
- the engineering company to build it
- the most appropriate site to trial it

Unless we are able to solve these issues, there is unlikely to be any commercial future for a GHT in the UK.