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DIFFERENT METRICS FOR ESTIMATING THE TIDAL STREAM ENERGY RESOURCE

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ABSTRACT

Tidal stream turbines are a promising technology for generating clean and predictable energy. At the time of writing there are a few prototype devices installed. There is, however, no consensus as to the best device and even less is known about the cost of routinely building and maintaining devices. Until these factors are better understood it is not possible to accurately quantify the resource of candidate sites. Nevertheless, it is important to quantify the magnitude of the resource before the technology reaches maturity.

For a small scale deployment of tidal turbines it may be acceptable to determine the resource from the magnitude of the naturally occurring kinetic energy flux by multiplying this by the turbine's power coefficient. However, if tidal stream turbines are going to generate power which is significant at a national scale they will need to be deployed at a level where there is a significant change to the flow. In this case it is no longer satisfactory to use the kinetic flux approach.

An alternative approach to quantifying the resource is to consider the maximum power which can be extracted from a particular site. This provides an upper bound on the magnitude of the resource, however, in general it will not be feasible to generate this much power due to turbine inefficiencies, environmental concerns and competing uses of the water (i.e. shipping and marine life).

Extracting the upper bound would also would require a very large number of turbines and this may be uneconomic for the amount of power they would generate. This is because as rows of turbines are added to a tidal channel, for example, there is a diminishing return of power generation and therefore the power produced by each newly added turbine reduces. At some point this produced power may become sufficiently low so that adding new turbines can therefore become uneconomic.

One approach to determining how low the power must become for a turbine to become uneconomic, without a detailed knowledge of the cost per turbine, is to compare the power per swept area of turbines with that of offshore wind turbines [1]. Other metrics may also be considered in a preliminary analysis of a candidate site. For example the ratio between power and thrust on the turbine is important both as an alternative proxy for power per cost, but also because it implicitly includes information on power per environmental change. It is also important to look at the intermitency of the power generated, not only over the daily cycle but also over the spring/neap tidal cycle [2].

REFERENCES

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