Wave power resource assessment

Introduction

Oceans are an enormous source of energy. The overall resource (approximately 2 TW) is of the same order of magnitude as the world's electricity consumption [2]. The large density and the favourable seasonal variation of ocean energy make technologies for wave energy conversion worthwhile to be investigated and developed. Till now the resource is studied in detail for regions with a high wave energy density. As Wave Energy Converters (WECs) still contend with problems regarding the survivability (structural strength and mooring) in a severe and energetic wave climate, the prospects of wave energy conversion in a less aggressive wave climate should be investigated, certainly in this stage of technology.
The Belgian Continental Shelf (BCS) is a rather sheltered area in the southern part of the North Sea. The wave climate is less aggressive as compared to open seas and therefore more likely to assure the survivability of Wave Energy Converters (WECs). A study of the wave climate on the BCS is needed to identify the possibilities for wave energy conversion.

Wave power resource

The characterization of the wave power resource on the BCS is based on wave data from wave measurement buoys. On six locations on the Belgian Continental Shelf (Westhinder, ZW-Akkaert, Trapegeer, Oostende, Wandelaar, and Bol van Heist, Figure 1) scatter diagrams, based on buoy measurements between 1984 and 2004, were provided by the Flemish Ministry of Transport and Public Works (Agency for Maritime and Coastal Services – Coastal Division) for different wave directions. The scatter diagrams show the average occurrence frequency (in %) of different sea states (a combination of wave height and wave period) for one year (or one specific month) and a given wave direction.
The theoretical wave power for each sea state is multiplied with its occurrence frequency given in the scatter diagram. Summation leads to the average available wave power (per meter of wave crest) [1].
Figure 1 shows the obtained yearly average wave power for the selected locations on the Belgian Continental Shelf The resource increases from approximately 1.5 kW/m near the coast till 4.5 kW/m 30 km offshore.

Multi-criteria decision analysis

Once the wave power resource is known, an optimal site for wave power conversion can be selected. A comparative assessment between minimal cost and maximal production of a farm of wave energy converters should be made while considering other use of the oceans. In general a geo-spatial multi-criteria analysis, in which several factors are weighed against each other, is performed to obtain the best location for wave energy conversion.

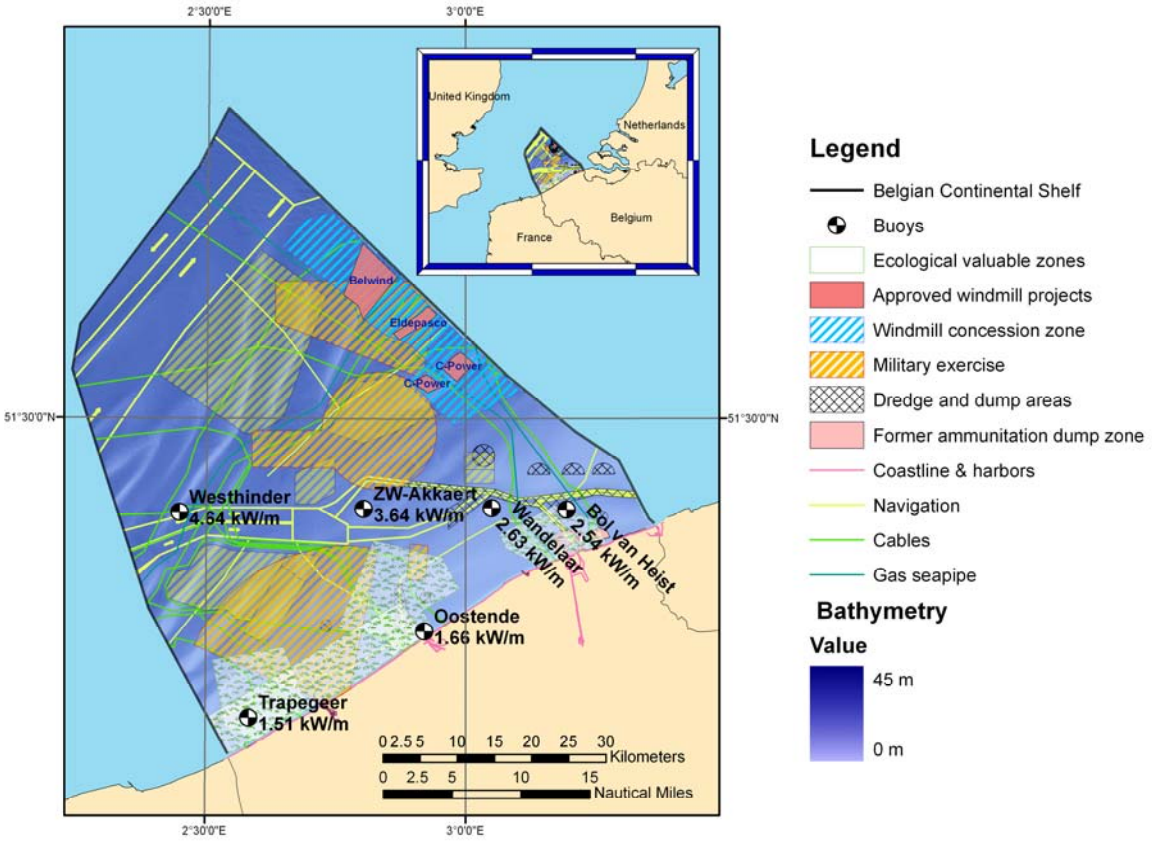

Figure 1 Average annual available wave power in kilowatt per meter of wave crest ([1]) and current activities on the Belgian Continental Shelf (Sources: MUMM, Kustatlas, Marebasse [3]).

References

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