TITLE OF DIPLOMA THESIS:

Multi-criteria Decision Analysis combined with Geographic Information Systems for Site Selection and Cost Estimation of Hybrid Offshore Wind and Wave Energy Systems in Greece.

AUTHOR: Margarita Vasileiou

ABSTRACT

Offshore wind and wave energy correspond to inexhaustible clean energy sources. The simultaneous exploitation of the corresponding energy potentials, through the installation and operation of Hybrid Offshore Wind and Wave Energy Systems (HOWiWaES), may lead to multiple advantages (e.g. increase of renewable energy yield per km^2 in the ocean space, cost reduction through the design and operation of synergetic systems, reduction of grid integration requirements for renewable systems that are effective during different time periods). Consequently, a HOWiWaES may contribute to the sustainable development of countries, the saving of energy resources, the protection of the environment and to the mitigation of climate change effects.

A prerequisite for the efficient implementation of all the above is the appropriate site selection of HOWiWaES in the ocean environment. This site selection corresponds to a complex, multi-dimensional decision-making process, which is characterized by the existence of multiple conflicting criteria; at the same time, it requires the collection, the analysis and the accurate space representation of data related to the criteria required for the site selection process. The combined use of Multi-criteria Decision Making (MCDM) methods with Geographic Information Systems (GIS) enables the site selection of HOWiWaES through a geographic accurate, systematic, efficient and integrated manner.

The objective of the present thesis is the site selection of HOWiWaES in Greece, through the combined use of a MCDM method and GIS. The corresponding methodology that is proposed and applied includes two distinctive, successive phases. The 1st phase includes the formation of thematic maps, through the application of a GIS software, taking into account the various examined site selection criteria (available offshore wind and wave potential, morphology-geography, local infrastructure, environmental criteria, activities). In this phase, specific areas in the examined marine environment are excluded, based on specific exclusion criteria, while areas eligible for the sitting of HOWiWaES are determined. The latter areas represent the candidate areas for evaluation (alternatives). In the 2nd phase, the analytic hierarchy process, consisting of the objective, the selection criteria and the various alternatives, is applied. The eligible areas, as obtained from the 1st phase of the site selection process, are evaluated and are ranked. Based on this ranking, the "optimum" area for the sitting of HOWiWaES in the Greek marine environment is defined and proposed. Finally, for this area the levelized cost of energy is estimated, considering two different, appropriately selected floating HOWiWaES (Semi-submersible Flap Combination hybrid system and Spar - Torus Combination hybrid system).

KEYWORDS : Analytic hierarchy process, Geographic information systems, Site selection, Hybrid Offshore Wind and Wave Energy Systems, Levelized cost of energy