



ΑΡΙΣΤΟΤΕΛΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΟΝΙΚΗΣ
ΠΟΛΥΤΕΧΝΙΚΗ ΣΧΟΛΗ

ΤΜΗΜΑ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ ΔΙΟΙΚΗΣΗΣ ΚΑΙ ΔΙΑΧΕΙΡΙΣΗΣ ΤΕΧΝΙΚΩΝ ΕΡΓΩΝ

ACADEMIC YEAR 2017 - 2018

TITLE OF DIPLOMA THESIS

Offshore Wind Farms: Multi-criteria Selection of the Wind Turbines' Support Structure and Preliminary Evaluation of the Investment

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ABSTRACT

The installation and the operation of offshore wind farms has been a significant development of renewable energy sector. Up to now, most existing offshore wind farms have been installed and are operating near to shore by deploying fixed bottom support structures. However, offshore wind industry moves forwards the installation of offshore wind turbines at larger distances from the shore and, therefore, at deeper waters, where the winds are stronger, by taking advantage of the technology of floating support structures. Yet, technical and financial challenges should be overcome for the suitable realization of floating offshore wind farms.

This diploma thesis aims to develop tools for supporting decision making at the preliminary stage of the investment. Two tools have been developed. The first one enables the multi-criteria assessment of wind turbines' support structure among seven alternatives presenting currently the most dominant design solution. This tool aims to select the best alternative in order for the investors to reduce technical and economical risks that may arise during the implementation of the investment. The multi-criteria assessment consists of twelve technical, economical and environmental criteria, which are calculated for each alternative according to the water depth, the rated power of the wind turbine and the distance from the port (inputs to the tool).

The second tool evaluates at the preliminary stage the investment of offshore wind farms based on their lifecycle cost analysis. After estimating the lifecycle cost of the offshore wind farm, cash flows are calculated and the investment is evaluated based on six investment metrics such as the Levelised Cost of Energy and the Net Present Value of the Investment.

The two tools are applied for the case of the installation of two offshore wind farms in Greece. The first offshore wind farm is located at a marine area in South Limnos and the wind turbines have fixed bottom support structures, while the second one is located at a marine area close to Rhodes island and it consists of floating offshore wind turbines. The two investments are calculated and evaluated separately, the corresponding results are compared and the most profitable



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investment is chosen. This investment is, finally, further investigated by modifying the offshore wind turbines' capacity.

KEYWORDS

Offshore wind farm, Wind turbine's support structure, Multi-criteria assessment, Evaluation of Investment, Investment cost