A Decision Support Model for Site Selection of Offshore Wind Farms

Ms Afrokomi-Afroula STEFANAKOU [1]
PhD Candidate of Dept. of Shipping Trade and Transport, University of the Aegean

Dr. Nikitas NIKITAKOS
Professor of Dept. of Shipping Trade and Transport, University of the Aegean
[1] *Contact details of corresponding author*

Tel: +30-22710-35286
Fax: +30-22710-35299
e-mail: sttm10028@stt.aegean.gr

Address: University of the Aegean, Department of Shipping Trade and Transport.2A Korai Street, 82100, Chios, Greece.

Abstract

The environmental problems that developed around the production of energy from fossil fuels have forced the whole planet to take thoroughly in consideration the renewable energy sources. The wind energy this time ranks in the first row of exploitation due to economic attractiveness and technological maturity. However, (offshore) wind farms may as well cause various socio-economic and environmental problems, which are mostly related with the geographic locations of these facilities. The topic of proper location of wind farms is considered a very complex process, in which a number of criteria must be analysed often hardly comparable with each other and even contradictory.

This paper presents a theoretical framework of selecting an (offshore) wind farm location based on a spatial cost-revenue optimization which combines multi-criteria analysis (MCA) with geographic information system (GIS). The proposed framework consists of three stages. The first stages excludes sites that are infeasible for wind farms based on criteria were defined by responsible authorities. The second stage identifies the best suitable sites based on social environmental and economic criteria. The economic criteria are based on the expected Net Present Value (NPV), Internal Rate of Return (IRR), Debt Service Cover Ratio (DSCR) and Loan Life Cover Ratio (LLCR), from three major cost and revenue categories that are spatially dependent: revenue from generated electricity, and costs that are generated due to distance of wind farm from the electricity grid and coastal facilities (e.g. port, shipyard). The third stage includes the sensitivity analysis, as a means of checking the stability of the results against the subjectivity of the expert judgments.

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