World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:14, No:04, 2020

Fuel Cells and Offshore Wind Turbines Technology for Eco-Friendly Ports with a Case Study

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Abstract : Sea ports are considered one of the factors affecting the progress of economic globalization and the international trade; consequently, they are considered one of the sources involved in the deterioration of the maritime environment due to the excessive amount of exhaust gases emitted from their activities. The majority of sea ports depend on the national electric grid as a source of power for the domestic and ships' electric demands. This paper discusses the possibility of shifting ports from relying on the national grid electricity to green power-based ports. Offshore wind turbines and hydrogenic PEM fuel cell units appear as two typical promising clean energy sources for ports. As a case study, the paper investigates the prospect of converting Alexandria Port in Egypt to be an eco-friendly port with the study of technical, logistic, and financial requirements. The results show that the fuel cell, followed by a combined system of wind turbines and fuel cells, is the best choice regarding electricity production unit cost by 0.101 and 0.107 $/kWh, respectively. Furthermore, using of fuel cells and offshore wind turbine as green power concept will achieving emissions reduction quantity of CO_2, NOx, and CO emissions by 80,441, 20.814, and 133.025 ton per year, respectively. Finally, the paper highlights the role that renewable energy can play when supplying Alexandria Port with green energy to lift the burden on the government in supporting the electricity, with a possibility of achieving a profit of 3.85% to 22.31% of the annual electricity cost compared with the international prices.

Keywords : fuel cells, green ports, IMO, national electric grid, offshore wind turbines, port emissions, renewable energy
Conference Title : ICMTSD 2020 : International Conference on Maritime Transport and Ship Design
Conference Location : New York, United States
Conference Dates : April 23-24, 2020