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By

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Development of integrated maintenance strategies maximizing the availability of renewable energy sources with a comparative study between theoretical approaches and artificial intelligence: Case study of (photovoltaic, wind) in Nigeria.

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ABSTRACT

The development of renewable energy especially solar and wind energy over the recent years has gained global attention as an alternative method of generating energy experiencing exceptional growth in its production. In the Global Energy report, global solar energy is expected to have reached a cumulative capacity of 1TW while the wind energy is expected to have multiplied up to 3 to 4 times from mega production in the year 2020. This increase in the solar and wind power implies very significant financial investments. However, with this huge investment potential and significant increase in generation capacity, there is an additional, often overlooked responsibility: managing the power plants to ensure the lowest total life cycle cost (Life Cycle Cost). Like any standard production system, renewable energy (solar and wind energy in our case) generation components are subject to random failure which interrupts production and supply of demand.

Maintenance is identified as a major cause of accidents, lack of technical know-how of an equipment and the absence of a good maintenance routine plan. As part of the efforts to improve the efficiency and performance of renewable energy power plants, we propose models to optimize the power production and maintenance of our selected case studies (Sokoto solar plant and Katsina wind farm). In this regard, we developed new integrated maintenance policies integrated with production of the energy production from solar and wind energy systems. The preventive maintenance strategy adopted in this thesis is perfect maintenance strategy on the selected components for maintenance and an imperfect selective maintenance on the system (solar PV and wind turbine). Battery shortage in case of under-production and maintenance losses are challenges considered in this study. The methodology we developed entails solving the problem of energy production and maintenance optimization by using the theoretical method as well as machine learning method (ANN and SVM) in order to satisfy a random demand of energy during a finite horizon. We also studied the influence of environmental and operational condition of the systems and then validated the models by numerical examples and sensitivity studies proving the robustness of the developed models

Keywords: production, maintenance, renewable energy, artificial neural network (ANN), support vector regression (SVR), energy production, integrated maintenance.