

## Weather data analysis and optimal design of hybrid PV-wind-diesel power system for a village in Chlef, Algeria

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### ABSTRACT

This study considered the ability of a hybrid power system Photovoltaic-Wind-Diesel with storage (batteries) to meet the demand for electric charge of 54 kWh/day in an isolated site of 10 inhabitants, not connected to the electrical grid, within the Chlef region, Algeria. Meteorological data (such as: global solar radiation, Wind speed, Wind direction, air temperature and relative humidity) was measured at Ouled Fares site in Chlef, between 1st January 2015 and 31st December 2015. The monthly average global solar radiation measured at the Ouled Fares site during this period ranged from 2.387 kWh/m<sup>2</sup>/d to 7.322 kWh/m<sup>2</sup>/d. The monthly average Wind speeds ranged between 1.328 m/s and 3.404 m/s. The objective of this study was the optimization of a hybrid Photovoltaic-Wind-Diesel power system. Simulation software HOMER was used to find out if the hybrid system performed comparably in terms of technical and economic feasibility to a conventional system connected to the grid. The study found that the Photovoltaic-Diesel-Battery system was the most economic power system, it produced 30,472 kWh/y with COE 0.224 \$/kWh. The proposed system comprised of 20 kW of PV panels, one Diesel generating 2.5 kW rated power and 36 batteries of nominal capacity 4 kWh. It was noted that 96% (29,144 kWh/y) of energy was produced by the Photovoltaic generator and 4% (1,328 kWh/y) was produced by the generator, which worked 586 h/y with a consumption of 449 L/y. The Diesel price of 0.70 US\$ per liter was considered fixed and without fluctuations. The hybrid system was able to meet energy requirements (load of 19,781 kWh/y) of the village with 15.1% energy in excess (4,593 kWh/y). The proposed system avoided over 28.39 kg/y of CO<sub>2</sub> less emissions for the local atmosphere of the site and would save 22.59 barrel/y of fossil fuel. Moreover, the comparison showed that the autonomous hybrid system is the best choice compared to the conventional grid connection with COE 0.047\$/kWh when the connection distance exceeds 1.35 km.

*Keywords:* Sizing; PV/wind/diesel system; Solar radiation; Wind speed; HOMER

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