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Analysis of cost estimation and wind energy evaluation using wind energy conversion systems (WECS) for electricity generation in six selected high altitude locations in Nigeria

S. Olayinka Ohunakin [a,*], S. Joshua Ojolo [b], S. Babatunde Ogunsina [c], R. Rufus Dinrifo [d]

[a] Mechanical Engineering Department, Covenant University, Ota 112101, Nigeria

HIGHLIGHTS

- All the locations considered have mean wind speeds above 4.8 m/s.
- Economical wind applications are possible in Kano and Katsina.
- Highest capacity factor and energy output are obtained using AN Bonus 1 MW in Kano.
- Specific cost of unit energy per kW h is cheaper using AN Bonus 1 MW.

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ABSTRACT

Two commercial wind turbines namely AN Bonus 300 kW/33 and AN Bonus 1 MW/54 were technically assessed for electricity generation in six selected high altitude sites spreading across the North-West and North-East geopolitical regions of Nigeria by computing their capacity factors, annual power and energy outputs. The economic evaluation of using the two wind energy conversion systems (medium and large) for electric power generation in the selected locations were also estimated using the present value cost method. The results showed that capacity factors of the two turbines in the selected sites ranged between 4.6 and 43%. Average minimum cost per kW h was obtained in Kano as $0.0222/kW h with AN Bonus 1 MW while the highest average cost is $0.2074/kW h with AN Bonus 300 kW in Kaduna. The highest cost in each of the location was obtained with the medium WECs (AN Bonus 300 kW). In addition, Kano and Katsina were also found to be very economical for any of the adopted wind turbine models. Gusau and Kaduna, at cost of unit energy of about $0.30/kW h were found to be more profitable for non-connected electrical and mechanical applications (water pumping, battery charging) than diesel generator.