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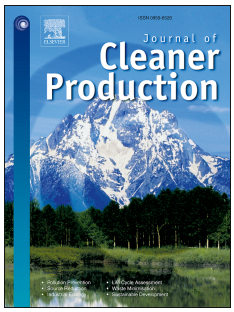

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Techno-economic comparative analysis of off-grid hybrid photovoltaic/diesel/battery and photovoltaic/battery power systems for a household in Urumqi, China

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Abstract:

Photovoltaic (PV) Hybrid power systems are an emerging energy technology that promises to create great opportunities and challenges for developing and developed countries. The current study analyzes the techno-economic feasibility of different PV hybrid power systems using the RETScreen Clean Energy Project Analysis Software for a typical household in Urumqi, China. The solar radiation data of Urumqi is taken from the National Aeronautics and Space Administrative (NASA) database. In Urumqi, the global solar radiation ranges from 1.93 to 5.92 kWh/m^2/day, and the annual average scale is predicted to be 4.2 kWh/m^2/day. Furthermore, the electrical load consumed by a household in this region is 10.275kWh/day with 5.7kW peak demand. In this paper, the electricity generation, financial viability, greenhouse gas (GHG) emission reductions, and sensitivity analyses are discussed. Three solar tracking models (fixed, one-axis and two-axis) for the off-grid residential PV power systems have been considered. The considered off-grid PV power systems are projected to annually produce approximately 3.68 MWh (fixed tilt arrays), 3.79 MWh (one-axis), and 3.83 MWh (two-axis) of alternating current electricity delivered for a typical household in Urumqi. The PV/diesel/battery power system is the most economic feasible scenario, whereas the diesel power system is the most expensive for a household in Urumqi. In addition, the minimum value of the GHG emission reduction is 5.5 tCO_2/year for an off-grid PV system with fixed tilt arrays, while the maximum value of GHG emission reduction is 5.6 tCO_2/year for an off-grid PV system with a one-axis or two-axis tracking module. The off-grid PV/battery power system with a one-axis or two-axis tracking module can offer the best performance in terms of GHG reduction. In addition, the NPV and GHG reduction cost values increase with the increases of the fuel cost escalation rate, inflation rate, and project life, whereas the two values decrease with the increase of the discount rate. Therefore, the

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