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Techno-economic evaluation of renewable energy systems combining PV-WT-HKT sources: Effects of energy management under Ecuadorian conditions (Article)

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Abstract

Sustainable development reached a new energy paradigm in recent decades, by promoting renewable generation technologies. The present study performs a techno-economic analysis of several hybrid energy systems that combine wind generators, photovoltaic systems, hydrokinetic turbines, lead acid batteries, and diesel generators in southern Ecuador. From real data, the sizing optimization of each renewable system was done under three proposed energy control algorithms. Then, the combinations of renewable systems are compared based on costs, energy, and environment. Additionally, this study includes several sensitivity analyzes varying the cost of the components and fuel, minimum state of charge in batteries, scaled electric load and time step to better understand the impact caused in each renewable hybrid system. The results show that a system composed of three renewable sources under load following and cycle charging energy controls, is cheaper and less polluting with respect to any combination of sources proposed. In addition to this, the systems that include photovoltaic systems and diesel generators present lower cost, 0.36 US\$/kWh in the best case. To reduce the operability of the diesel generator, load following energy control is recommended. However, if diesel generator is removed, the resulting cost of 100% renewable systems increases considerably, reaching 0.88 US\$/kWh. The results also show that, the variation in the capital cost of the components is directly proportional to the net present cost and cost of energy variation. Moreover, it is possible to reduce the cost of the system by discharging the batteries below their minimum state of charge. Finally, the results are more accurate when using a time step of 5 minutes. © 2020 John Wiley & Sons Ltd

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- Renewable energy resources
- Sustainable development

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
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