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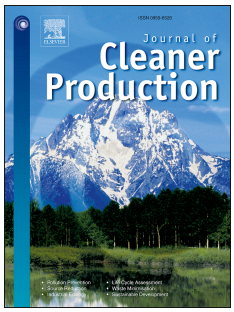

An optimal configuration for a solid oxide fuel cell-gas turbine (SOFC-GT) hybrid system based on thermo-economic modelling

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ABSTRACT

The aim of this research is to present an optimal configuration for solid oxide fuel cell-gas turbine hybrid systems based on thermo-economic modeling. To this end, four different designs of direct hybrid systems with pressurized and atmospheric fuel cells have been presented. In the first two designs, one stack fuel cells has been used in the hybrid system, and in the other designs, two stack fuel cells have been utilized. By examining four hybrid system, it was found that hybrid system with one pressurized fuel cell hybrid system is better than the other. The advantages of this system include its lower irreversibility rate, low purchase, low installation and startup costs, and the adequate price of its generated electricity. Results show that the hybrid system with one atmospheric fuel cell has a low electrical efficiency, high irreversibility rate; and also the price of its generated electricity is higher than that of the other proposed systems. Conversely, the hybrid systems with two fuel cells, in spite of enjoying a high efficiency, are not cost-effective and economical. The findings indicate that the total efficiency of 64% and electrical efficiency of 51% was achieved for optimal hybrid system. Also, the thermo-economic analyses show that the generated electricity price is about USD 11.6 cents/kWh based on the Lazareto's model and USD 18.5 cents/kWh based on the total revenue requirement model. The purchase, installation and startup cost of this hybrid system is about $1692/kW; which is almost twice the cost of a gas turbine unit.

Keywords: Hybrid system; Solid oxide fuel cell; Gas turbine; Optimal configuration;Thermo-economic model