Optimal control of a fuel cell/wind/PV/grid hybrid system with thermal heat pump load

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Abstract

This paper presents an optimal energy management strategy for a grid-tied photovoltaic–wind-fuel cell hybrid power supply system. The hybrid system meets the load demand consisting of an electrical load and a heat pump water heater supplying thermal load. The objective is to minimize energy cost and maximize fuel cell output, taking into account the time-of-use electricity tariff. The optimal control problem is solved using a mixed binary and real linear programming. The supply switch to the heat pump water heater and the power from the grid, power to/from the inverter, electrolyzer hydrogen power and fuel cell power are the control variables. The temperature inside the water storage tank and the hydrogen in the storage tank are the state variables. The performance of the proposed control strategy is tested by simulating different operating scenarios, with and without renewable energy feed-in or rather export to the grid, and the results confirm its effectiveness, as it increases the supply reliability of the system.