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Introducing and assessment of a new wind and solar-based diversified energy production system intergrading single-effect absorption refrigeration, ORC, and SRC cycles

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ABSTRACT

This paper proposes and evaluates an integrated energy production system using two forms of renewable energy, solar and wind, in order to deliver cooling, heating, electricity, and water desalination. Along with organic Rankine cycle components (ORC), this diversified energy system includes an absorption refrigeration system, steam Rankine cycle (SRC), thermoelectrics, reverse osmosis, wind turbines, and parabolic-linear solar collectors. This study contains several innovations, including using thermoelectrics in the Rankine organic cycle instead of a condenser that gives the system a high capacity, utilizing parabolic solar collectors, and implementing wind energy as the direct source of electricity for such system. Energy, Exergy, and Exergoeconomic analysis approach is performed for the evaluation approach. EES software is used to model and analyze the data. As part of the validation process, the results are compared with those published previously and are found to be relatively consistent. The research results revealed four points. First, with the increase in solar radiation, the amount of freshwater produced for the system increased from 69.15 to 75.23 m^3/h. Second, the total exergy efficiency increased from 54.24 to 77.27% when the steam turbine's inlet pressure was increased. Third, the system's total cost decreased from 77.27 to 28.30 $/h with increasing ambient temperature. Fourth, the highest exergy loss is associated with solar energy with a central receiver. Based on exergy losses, it was determined that a solar system with 60% and a wind turbine with 17% have the highest losses.

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