Meteorological Effect on Exergetic and Exergoeconomics Parameters of a Wind Turbine

Authors : Muhammad Abid

Abstract : In this study, we performed the comparative exergetic and exergoeconomic analyses of a wind turbine over a period of twelve months from 1st January to 30th December 2011. The turbine is part of a wind-PV hybrid system with hydrogen storage, located on the roof of Mechanical Engineering Department, King Saud University, Riyadh, Saudi Arabia. The rated power output from this turbine is 1.7 W with a rated wind speed of 12 m/s and cut-in/cut-out wind speeds of 3/14 m/s. We utilize a wide range of experimental data in the analysis and assessment. We determine exergy efficiencies and their relation with meteorological variables, such as temperature and density. We also calculate exergoeconomic parameter R˙_ex and its dependence on the temperature, using the average values for twelve months of the year considered for comparison purposes. The exergy efficiency changes from 0.12 to 0.31 while the density varies between 1.31 and 1.2 kg/m3 for different temperature values. The R˙_ex has minimum and maximum values of 0.02 and 0.81, respectively, while the temperature is in the range of 8-24°C for various wind velocity values.

Keywords : exergy, efficiency, renewable energy, wind energy, meteorological variables
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