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Photovoltaic performance prediction in Northern Nigeria using generated typical meteorological year dataset

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Abstract

Relevant meteorological files are needed by simulation software to assess the energy performances of buildings or efficiency of renewable energy systems. This paper adopts the Sandia method to generate typical meteorological year (TMY), using a 35-year hourly measured meteorological dataset from four stations in the northern region of Nigeria. The cumulative distribution function (CDF) for each year was compared with that of the long-term composite of all the years in the period for the seven major weather indices made up of relative humidity, wind speed, minimum temperature, global solar radiation, precipitation, mean temperature and maximum temperature. The 12 typical meteorological months (TMMs) selected from the different years were used for formulation of a TMY for the zone. In addition, performance assessment of a 72-cell polycrystalline solar PV module using the generated TMY and long-term (LT) values was also conducted. Two statistical indicators, the mean percentage error and the root mean square error, were adopted to evaluate the performance of each TMY with the LT mean, and also that of the PV energy system. Findings show that the TMMs are evenly spread within the data periods across the sites while closest fit between the long-term mean and TMY are obtained with the global solar radiation followed by the mean temperature in all the sites especially in Bida and Minna. From the energy system analysis carried out, it was found that TMY data are able to predict the performance of the PV system to within 5% of the LT data.

Keywords:

NigeriaSandia methodFinkelstein-Schafer statisticstypical meteorological yearbuilding energy simulationPV system

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