

Solar irradiance forecasting and energy optimization for achieving nearly net zero energy building

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ABSTRACT

Solar energy and the concept of passive solar architecture are being increased in several areas to attain the net-zero energy concept. This paved the way for an increase in the need of solar irradiance forecasting for both solar PV applications and Passive Solar Architectural buildings. First, solar irradiance forecasting was done with 131 400 data sets (1-h data for 15 years) which was split into monthly mean for every year. This model was evaluated by forecasting the post-consecutive years one by one with the pre-consecutive years which includes the pre-forecasted years. This model was shown to have RMSE values of 11% to 24% for various seasonal forecasting using the Random Forest Algorithm in WEKA, which gave the annual irradiance results nearer to the PV Sol energy forecasting results. The R-value was in the range of 0.8 to 0.9 for various seasons which is good. Building Energy Optimization was carried out using BEopt 2.8 software designed by NREL. The chosen building was set to the standard parameters in India, and then, the optimization was done with various customized parameters and systems available in India to reduce the energy consumption from 192.2 MMBtu/yr to 109.1 MMBtu/yr with a 7 kW Solar PV System to attain the net-zero energy concept.

KEYWORDS:

Decision trees; Energy utilization; Forecasting; Intelligent buildings; Solar energy; Solar radiation; Sols