

Categorizing Indian states based on operating condition of photovoltaic system

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Abstract

Electricity generation of a photovoltaic (PV) module is primarily affected by local weather conditions, which vary significantly across vast geographic areas. This work introduces an approach to categorize Indian states based on outdoor operating conditions of PV modules that influence performance and reliability. Module temperature and irradiance are the two most important parameters which affect PV performance. Relative humidity (RH), module temperature, and global horizontal irradiance (GHI) are the three most important parameters that affect PV reliability. In this work, the PV module's most frequent operating condition (MFOC) of temperature and irradiance corresponding to maximum energy production has been analyzed for dominant PV technology (multi-crystalline silicon). Data from various sites across India were analyzed and subsequently grouped by state as PV installation decisions are generally based on state-level factors, such as state business policies, incentives, availability of local human resources, state power policies, etc. The MFOC method used in this work was supported by experimental results. Based on estimated states' MFOC, PV module output power has been obtained and compared with its rated power. Further in this work, major stressors affecting PV modules namely average RH, module temperature, and total annual GHI have been analyzed for different Indian states. Based on these specific stressors, states with similar stressor patterns have been grouped by the k-means clustering method. Results of MFOC estimation show potential for additional standardization methods to estimate PV system performance accurately. Statistical analysis of stressors highlights the importance of selecting PV technology modules carefully.

Keywords: Pv module, India, MFOC, k-means

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