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Performance of different photovoltaic module types under low irradiation climatic conditions: A case of Chengdu

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ABSTRACT

The power output of a photovoltaic (PV) module depends on the specific climate conditions of each location and on the spectral response of each technology. The impact of solar radiation duration?, temperature, humidity, dust can strongly affect the energy production of a PV system. Chengdu, in Southwest of China (Latitude 30.34^o North, Longitude 105.55^o East), with a typical low irradiation weather condition, was considered not feasible to install PV systems. However, the performance of PV module of different technologies in Chengdu is seldom reported. This paper presents an energy performance analysis of six different PV modules under outdoor conditions at Sichuan University in Chengdu. For this purpose, by using p-Mono crystalline, p-Multi crystalline, amorphous silicon, CdTe, CuInGaSe and bifacial modules, six 1 kWp on-grid photovoltaic power systems (PPS) were installed on the rooftop of the Institute of New Energy and Low-Carbon Technology at Sichuan University. These PPSs were monitored from January to December, 2019. It was found that the p-Mono crystalline PV module showed the most excellent energy output of 830.9kWh, while the CuInGaSe only produced 758.1 kWh. The energy output order is p-Mono > amorphous silicon > CdTe > p-Multi > bifacial > CuInGaSe. On total 33 sunny days in 2019, amorphous silicon module performs best, followed by p-Mono and CdTe. However, on the cloudy and rainy days, power generation of p-Mono is the most, then p-Multi and bifacial module, while CuInGaSe generates the minimum. It can be found that PV panels with p-Mono modules have the best power generation capacity in Chengdu, for the good performance both in sunny days and in cloudy days. The second component is amorphous silicon module, which also have good power generation capacity in sunny days and cloudy days. CdTe is suitable for sunny days, while p-Multi and bifacial have more advantages and stability in cloudy days. CuInGaSe has the worst power generation capacity, which is backward in all kinds of weather with poorest stability, so it is not suitable to be installed in low irradiated area, like Chengdu. This work provides a precise evaluation of outdoor power generation capacity for different PV modules under low irradiation weather conditions. The results can provide important indications for the PV users and suppliers to install proper solar modules at areas with similar climate conditions as that of Chengdu.

Keywords: photovoltaic module, low irradiation climatic conditions, power generation

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