Performance evaluation of building-integrated photovoltaic systems for residential buildings in Southern India

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ABSTRACT
The integration of photovoltaic modules into the building structure is a challenging task with respect to power generation of PV module and the effect of incident solar radiation. The performance of building integrated photovoltaic (BIPV) modules varies depending upon the orientation and azimuth angle of the building. In this work, the year-round performance and economic feasibility analysis of grid-connected building-integrated photovoltaic (GBIPV) modules is reported for the hot and humid climatic regional condition at Kovilpatti (9°10'0''N, 77°52'0''E), Tamil Nadu, India. The appropriate mounting structures are provided, to experimentally simulate the performance of GBIPV modules at various orientations and inclination angles (0° to 90°). The result indicated that the optimum orientation for installation of BIPV modules in the façade and walls is found to be east while that for a pitched roof south orientation is recommended. The overall average annual performance ratio, capacity utilisation factor, array capture loss and system losses are found to be 0.83, 23%, 0.07 (h/day), and 0.17 (h/day), respectively. In addition, the economic feasibility of grid connected PV system for residential buildings in Tamil Nadu, India is analysed using HOMER by incorporating both a net metering process and electricity tariff. ***Practical application:*** Grid-connected building-integrated photovoltaic system has many benefits and barriers by being installed and integrated into the building structure. The application of GBIPV in building structures and its orientation of installation needs to be optimised before installing into buildings. This study will assist architects and wider community to design buildings facades and roofs with GBIPV system which are more aesthetic and account for noise protection and thermal insulation in the region of equatorial climate zones. By adding as shading devices, they can reduce the need for artificial lighting, and moderate heating or cooling load of the buildings.

KEYWORDS
Building integrated photovoltaic; BIPV, grid-connected; performance ratio, HOMER, net metering

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