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Predicting Photovoltaic Energy Profile of Birzeit University Campus Based on Weather Forecast

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Abstract : This paper presents a study to provide sufficient and reliable information about constructing a Photovoltaic energy profile of the Birzeit University campus (BZU) based on the weather forecast. The developed Photovoltaic energy profile helps to predict the energy yield of the Photovoltaic systems based on the weather forecast and hence helps planning energy production and consumption. Two models will be developed in this paper; a Clear Sky Irradiance model and a Cloud-Cover Radiation model to predict the irradiance for a clear sky day and a cloudy day, respectively. The adopted procedure for developing such models takes into consideration two levels of abstraction. First, irradiance and weather data were acquired by a sensory (measurement) system installed on the rooftop of the Information Technology College building at Birzeit University campus. Second, power readings of a fully operational 51kW commercial Photovoltaic system installed in the University at the rooftop of the adjacent College of Pharmacy-Nursing and Health Professions building are used to validate the output of a simulation model and to help refine its structure. Based on a comparison between a mathematical model, which calculates Clear Sky Irradiance for the University location and two sets of accumulated measured data, it is found that the simulation system offers an accurate resemblance to the installed PV power station on clear sky days. However, these comparisons show a divergence between the expected energy yield and actual energy yield in extreme weather conditions, including clouding and soiling effects. Therefore, a more accurate prediction model for irradiance that takes into consideration weather factors, such as relative humidity and cloudiness, which affect irradiance, was developed; Cloud-Cover Radiation Model (CRM). The equivalent mathematical formulas implement corrections to provide more accurate inputs to the simulation system. The results of the CRM show a very good match with the actual measured irradiance during a cloudy day. The developed Photovoltaic profile helps in predicting the output energy yield of the Photovoltaic system installed at the University campus based on the predicted weather conditions. The simulation and practical results for both models are in a very good match.

Keywords : clear-sky irradiance model, cloud-cover radiation model, photovoltaic, weather forecast
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