ABSTRACT

The Performance Characteristics of Commercially Available Photovoltaic Technologies under Jamaica's Climatic Conditions

Darlene Anesha Field

Photovoltaics (PVs) are direct converters of sunlight into electricity. PV manufacturers implement various procedures and use different materials so as to reduce production costs and increase cell efficiency. Performance parameters are quoted under standard test conditions (STC) however normal operating conditions rarely resemble STC. PV performance can therefore be as much as 30% less than the quoted values (Bucher 1997, 85).

With relatively high irradiance within the Caribbean, PVs could make a significant contribution to reducing electricity costs. However, previous studies have indicated that irradiance, temperature and load mis-matching are the major factors affecting PV performance in Jamaica (Williams 2001).

This study investigates the effects of temperature and irradiance on the performance of eight PV modules encompassing seven technologies. An evaluation of the effects of the two parameters, irradiance and temperature, is done to determine the circumstances under which each parameter becomes dominant. This revealed that the reduction in performance becomes marked at ambient temperatures above 29°C.

Since Jamaica's weather patterns do not include extreme variation, data collected over the first three months was used along with archival data of temperature and irradiance to predict the typical annual energy yields of the modules. This predicted energy was used to obtain the modules' costs per kWh over their warranted lifetimes. This revealed that even though the polycrystalline PVs generated the most energy amorphous silicon was most cost effective. In fact amorphous silicon attained grid parity for grid connected PV systems.

The data collected over the year were then made portable by obtaining a function to represent the effects of temperature and irradiance on module voltage. PV performance can therefore be predicted in regions with similar climatology once temperature, be it ambient temperature or module temperature, and irradiance, be it planar or horizontal irradiance are known.

Keywords: Darlene A. Field, Photovoltaic Performance; Performance Ratio; Temperature; Irradiance; Climate of Jamaica