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Performance investigation of a PV system connected to the grid

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Abstract

Recently, solar is considered as the most attractive renewable energy source, due to the development and the progress of the technologies. This paper presents a comparative and performance analysis of three PV technologies mono-crystalline (2.04 KWp), polycrystalline (2.04 KWp) and amorphous (1.86 KWp). These technologies are linked together and formed a grid connected station of total capacity 5.94 KWp, that is located on the roof of the faculty of science of Tetouan-Morocco. The performance of the three technologies are simulated, in term of final yield, using PV syst and the energy injected from the three technologies are compared together based on the data collected during the year 2016. The results obtained showed that the simulated final yield of each technology follows closely its reference yield for all the months of the year, and the mono-crystalline technology injects more energy compared to the others.

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Keywords: Grid connected-photovoltaic; PV syst software; solar radiation.

1. Introduction

Renewable energy is the future of humanity. Due to the high consumption and the reducing availability of fossil fuel resources, renewable energies (solar, wind, hydro… etc.) are subject to a great interest over the last decades. PV solar energy has genuinely developed and has increasingly become as a promising energy option due to many advantages such as abundance, absence of any pollution and availability in greater or lesser amounts at any point of the terrestrial globe. In the past decade, Morocco has implemented a favorable national energy strategy for

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development the renewable energies, with the aim of securing its energy supply in a context of strong growth in energy demand, in order to control the future costs of energy services compared with the upward trend in oil products prices and lastly to preserve the environment by mitigating greenhouse gas emissions. In this context there is a good opportunity for the country to develop the renewable energies sector in order to reduce its dependence on foreign countries and to meet its energy demand in a sustainable and autonomous way. Morocco has plenty of potential for renewable energy, including solar energy with 5.5 kWh / m^2 / day; with a sunshine of 3,000 hours per year [1].

There are several types of PV generating systems, where the differences between each technology reside in the yield, the price as well as the material used. The performance of a PV system depends strongly on meteorological conditions, such as solar radiation and temperature. To provide continuously energy during the year, a PV system must be correctly dimensioned. This requires a rigorous study in order to make the best choice, the most efficient and at the lowest cost [2,3]. In fact, the PV system is characterized with different performance parameters including: Reference yield, ambient temperature, final yield, system losses, capacity factor, and performance ratio.

Various studies have been conducted in literature on PV system performance investigation [3–11]. In Ref.[12], a performance investigation of a grid connected PV system composed of poly-and mono-crystalline silicon in dry climates conditions is conducted. The authors in [5], perform a comparison, energy analysis and economic performance of grid connected PV systems composed of polycrystalline and mono-crystalline. Ref.[13], performs a comparative performance of PV panels of different technologies micro-morph silicon, mono-crystalline silicon, amorphous silicon and polycrystalline silicon. Ref.[8] presents a monitoring and performance analysis study of grid connected PV under different climatic conditions in south Algeria. In [14], the authors present the performance analysis and investigation of a grid connected PV system composed of polycrystalline silicon is conducted. In [15], a comparative performance investigation between photovoltaic systems from two different cities is done.

The main objective of this work consists of estimating the production, in terms of energy and then validating the results obtained by a monitoring station. The PV system is a grid connected of three PV technologies, of 5.94 KW_p capacity. The monitoring station provides and manages real data such, irradiation, temperature; energy output daily, currents, voltages and efficiency of each technologies, and others; to be treated later in order to validate the simulation results. Therefore, an estimation of the production of any photovoltaic system is required before installation, which is the objective of the present paper.

Nomenclature

T_a	ambient average temperature (°C)
Glob Hor	global irradiation in the horizontal plane (KWh/m^2)
STC	Standard Test Condition
G_{STC}	total solar radiation under STC (KW/m^2)
G_{opt}	total in-plane solar insolation (KWh/m^2)
E_{AC}	AC energy output (KWh)
$E_{(AC,d)}$	total daily total AC energy output (KWh)
$E_{(AC,m)}$	total monthly AC energy output (KWh)
E_{DC}	total DC energy output
Y_f	final yield (KWh/KWp)
Y_r	reference yield (KWh/KWp)
a-Si	amorphous
p-Si	polycrystalline
m-Si	monocrystalline
PV	photovoltaic