

# Comparative study of three photovoltaic technologies (Monocrystalline – Polycrystalline – Amorphous)

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**Abstract**—This work aims to do a comparative study of three photovoltaic technologies, in terms of electric power produced and the calculation of the photovoltaic (PV) efficiency, the results show that the photovoltaic technologies monocrystalline and polycrystalline have a good photovoltaic efficiency than amorphous technologie, in the weather conditions of Safi, so we can say that these photovoltaic technologies, are the applicable in Safi.

## I. INTRODUCTION

The Moroccan energy situation has become very critical, the Morocco imports 95% of its energy needs, which makes it dependent the exporting countries, to cope with this problematic, the Morocco has launched the law n°13-06, [7] relative to the renewable energies, this project of law allows to fill in the legal gaps, in the field of renewable energies, and to encourage the investments, and ride up many challenges, it also contributes to the reduction of energy dependence. In this perspective and in the framework of national project name's "Propre.ma"[2], an installation of photovoltaic panels has been set up within the National School of Applied Sciences, Safi (ENSAS). The global objective of this project "Propre.ma" is to establish the photovoltaic productivity maps on the scale of Morocco Using a terrestrial calibration by measures on many sites and technologies [3]. The object of this work is to do a comparative study of three photovoltaic technologies within the ENSA of Safi.

## II. DESCRIPTION OF THE PHOTOVOLTAIC INSTALLATION

In the framework of project (propre.ma), the ENSA of Safi installed photovoltaic panels on the roofs of the establishment since the year 11-12-2014. Indeed the installation is composed of three different technologies : 8 polycrystalline silicon modules, 8 monocrystalline silicon modules, 12 amorphous silicon modules, figure 1. These panels are connected to the power grid of the establishment, for provide electricity, and reduce the energy bill.

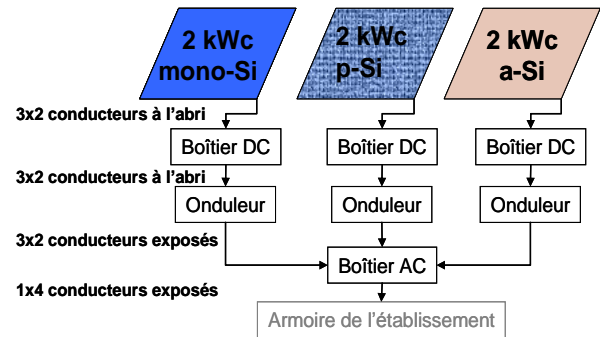


Figure 1: Photovoltaic modules

## III. ANALYSIS WEATHER CONDITIONS OF SAFI

### A. Irradiation solar inclined and horizontal

The figure 2 represent the variation of solar irradiance measured the 09/06/2016 by two photovoltaic modules, one is placed horizontally, and the other is inclined by 30 degree.

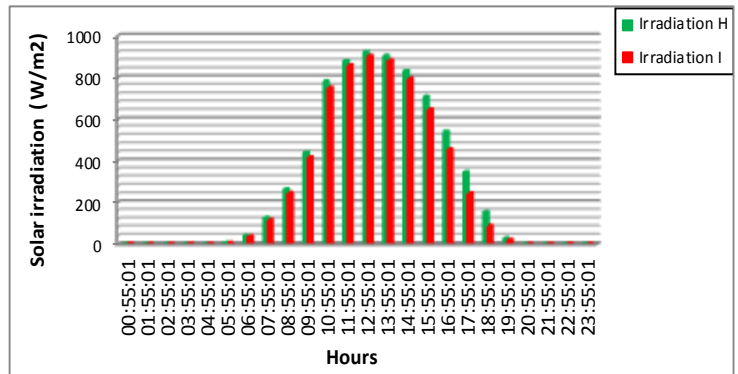


Figure 2 : Variation of irradiation solar on the inclined and horizontal plane during the day 09/06/2016

We can notice that the horizontal module captures more solar energy than the inclined module. The maximum of solar irradiance for both modules inclined and horizontal are respectively 904,17W/m<sup>2</sup> and 920, 122 W/m<sup>2</sup> and are registered at 12h55.

### B. Ambient temperature ( $T_a$ ) and module temperature ( $T_{mod}$ ) of the three PV technologies

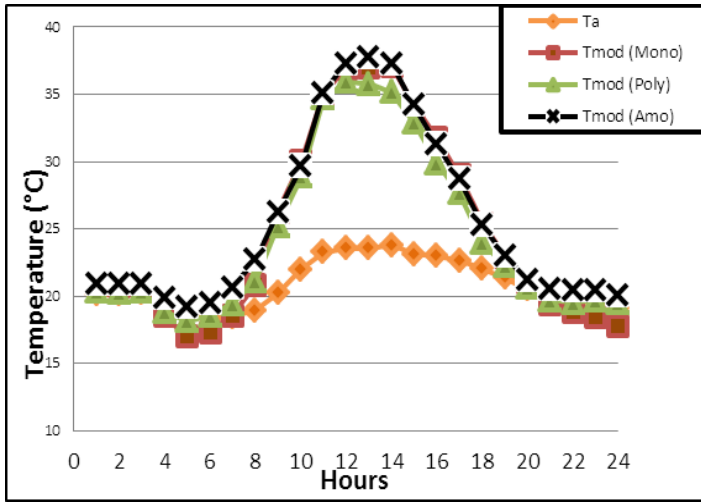


Figure 3: Variation of  $T_{mod}$  and  $T_a$  during the day 26/06/2016

The figure 3, represent the variation of module temperature ( $T_{mod}$ ) and ambient temperature ( $T_a$ ) during the day 26/06/2016, for the three photovoltaic generators. The curves show that the  $T_{mod}$  is bigger than  $T_a$  in the period 8h00 at 19h00. This difference between the two temperatures is due to heating the photovoltaic module by the solar radiation. Otherwise, the pic of  $T_{mod}$  registered between 12h00 and 14h00 is explained by the maximum intensity of radiations during this period. Concerning the night time, from 19h00 at 6h00 we observe that the temperatures of three modules are almost equal and relative of  $T_a$ . This is due to no-heating of modules by solar radiation.

## IV. COMPARATIVE STUDY OF THREE PV TECHNOLOGIES

### A. Electric power of the PV installation

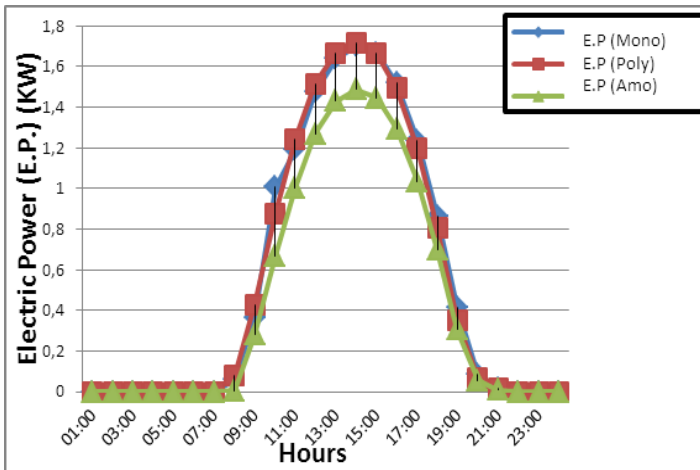


Figure 4: Daily electric power of the three PV technologies of the PV installation, during the day 20/06/2016

From the figure 4, we notice that the daily power for the three photovoltaic technologies evolves in the form of a Gaussian curve, the pics of 1,702 KW, 1,714 KW and 1,488 KW, have been registered at 14h, respectively for the monocrystalline, polycrystalline, and amorphous technology. This figure also shows that the monocrystalline, polycrystalline generators have a good electric energy production than the amorphous. This is due to the crystallographic structure specific of each photovoltaic technology.

### B. Photovoltaic efficiency of three PV modules

TABLE I. PHOTOVOLTAIC EFFICIENCY ( $\eta_{PV}$ ) OF THREE PV MODULES

$\eta_{PV}$ Monocrystalline	$\eta_{PV}$ Poly crystalline	$\eta_{PV}$ Amorphous
12%	13%	5%

From these results, we notice that the monocrystalline, polycrystalline generators, have a better photovoltaic efficiency than amorphous generator. These results correspond perfectly to the values found in the literature.

## V. CONCLUSION

During of this work, we found that the monocrystalline, polycrystalline generators, have a better photovoltaic efficiency and good electric power production in the weather of Safi, so we can say that these photovoltaic technologies, are the most applicable in Safi.

## VI. REFERENCES

- [1]-<http://www.mem.gov.ma/>
- [2]-<http://propre.ma/>
- [3]-N.Aarich, N. Erraïssi, M. Akhsassi, A. Lhannaoui, M. Raoufi and A. Bennouna, "Propre.Ma" project: roadmap & preliminary results for grid-connected PV yields maps in Morocco, IRSEC'2014, Ouarzazate, October 17-19, 2014.

