ANALYSIS OF POSSIBILITIES OF USING BIFACIAL SOLAR PANELS

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Abstract. *The purpose of our experimental experiment was to test 550W simple and bifacial solar panels with the same power. In our experiment, both panels were installed in the same stationary position and measurements were made at 15-minute intervals. Graphs were drawn for both panel indicators and analysis was carried out. Our article provides a comparative analysis of power, short circuit current and open circuit voltages.*

Keywords: *bifacial panel, simple panel, efficiency, albedo, power.*

1. INTRODUCTION

Today, the use of renewable energy sources in our republic is supported at the government level. In this regard, in a very large part of our republic, the installation of solar plants on the roofs of buildings and structures is being achieved, thereby increasing the efficiency of energy production. The goal here is to encourage each energy user to produce a certain part of his needs, both to save energy and to produce energy. Of course, against the background of these changes, it is very important to perfectly teach students about energy ideas from the school course [1,2]. It is significant that the amount of energy obtained through renewable energy sources will exceed 316GW by 2023, and the largest share of these energies will belong to photovoltaics (PVs) [3]. The use of solar energy is much more convenient than the use of other types of renewable energy sources. It can be assumed that the basis of renewable energy in the future will be PVs. The purpose of our research is to analyze the best PV panels above 400W that are the most widely sold in marketing today. This guarantees a better product for consumers in practice. Taking into account the great influence of world marketing on Uzbekistan, it is possible to return a sharp increase in the trade of bifacial solar panels in the following years Figure 1.

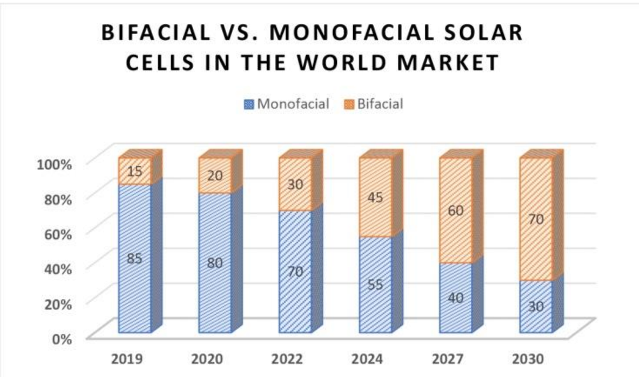

Figure 1. Forecast of the worldwide market shared for bifacial solar cell technology according to the International Technology Roadmap for Photovoltaic (ITRPV) – 11th Ed., April 2020.

This is the basis for practical testing of these two types of panels in different conditions. For this purpose, two panels of the same power were taken and practical tests were carried out. High temperature and pollution strongly affect the energy efficiency of PV panels [4-7]. In addition, solar radiation falling on the PV panel surface is the most important indicator for energy efficiency [8-9]. This means that solar radiation returned from the ground can also be effectively used for bifacial PVs (Fig. 2).

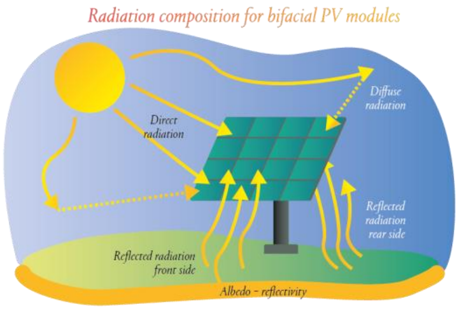

Figure 2. Radiation composition for bifacial PV modules [10].

Studies from around the world show that bifacial PV panels are more efficient than conventional PV panels [11-12].

2. MATERIAL AND METHODS

In our study, simple and bifacial panels with a power of 550 W were selected for comparison of electrical parameters and produced power. Their electrical parameters were measured during the day. Our research was conducted on April 19, 2023 at the Institute of Physics and Technology. Our experiment was measured between 8:45 a.m. and 5:00 p.m. and graphs were drawn based on the results. Our PV panels were installed in the same stationary position at an angle of $\theta=33^0$ (for the month of April), when the sun is at the zenith point so that solar radiation falls on the panels in a perpendicular position Figure 3.

Figure 3. The general arrangement of solar panels.

Table 1 shows the general electrical parameters and dimensions of our panels. During the experiment, external parameters such as solar radiation, ambient temperature, wind speed and humidity were also measured at the same time.

Table 1

Model Type	**SN550-144MB**	**YH550W-36MH**
Peak Power (Pmax)	550W	550W
Module Efficiency	21.28%	21.28%
Maximum Power Voltage (Vmp)	41.33V	42.13V
Maximum Power Current (Imp)	13.31A	13.06A
Open Circuit (Voc)	49.83V	50.1V

Short Circuit Current (Isc)	13.79A	13.9A
Power Tolerance	± 5W	± 3 %
Maximum System Voltage Nominal	1500V	1500V
Maximum Series Fuse Rating	25A	25A
Size	2279*1134*35 mm	2279*1134*35 mm

Taking into account that the panels are in a stationary state in many solar stations (SSs) being installed today, the stationary state was analyzed in our work.

3. RESULTS

In our experiment, short circuit current, open circuit voltage and solar radiation falling on the panel surface of PV panels were measured every 15 minutes. On April 19, the air temperature rose from 12^0C to a maximum of 21^0C. The average wind speed varied from 0.5 m/s to 5 m/s. Our panels were stationary during the measurement. Figure 4 presents graphs of short circuit current and open circuit voltages of both panels over time. As can be seen from the graphs, bifacial PV has recorded better results in terms of both electrical parameters, and it can be concluded that the electricity produced by it during the day is also high. Open circuit voltage drops due to increase in panel temperature [13-15]. In this case, in a simple PV panel, this process happened quickly due to a sharp increase in temperature, and this caused a large part of the energy loss. In the bifacial panel, this fall was relatively slower, and the sharp fall occurred between 12:00 and 1:00 pm. During the rest of the day, the open circuit voltage of the bifacial panel was on average 0.5V higher than that of the normal panel. The difference in short circuit currents is also clearly visible in the graph. For most of the day until 14:45 pm, the bifacial PV panel current was larger than the normal panel. In the subsequent process, the short circuit current of the normal panel was increased by a very small value.

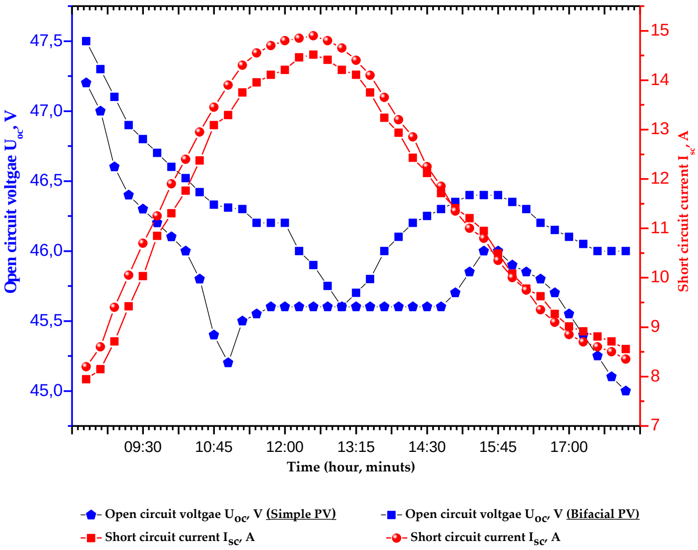

Figure 4. Time dependence of I_{sc} and U_{oc} in simple and bifacial PV panel.

The time dependence of the solar radiation falling on the surface of the panels is shown in Figure 5. At 12:30 p.m., the highest value of almost $800 \frac{W}{m^2}$ was recorded.

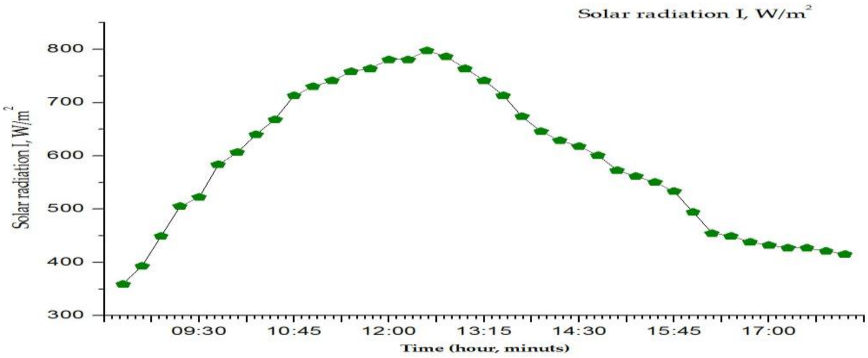

Figure 5. Time dependence of solar radiation.

Of course, power is one of the most important quantities. It can be easily calculated using the obtained parameters.

$$P = FF \cdot I_{sc} U_{oc} \quad (1)$$

Figure 6 shows the power values of both panels, and we can see that the power value produced by the bifacial panel was always greater. The maximum values reached at 12:30 were 547.5W for the bifacial panel and 503.3W for the simple panel. This means that the bifacial panel has 8.7% more power at the peak value.

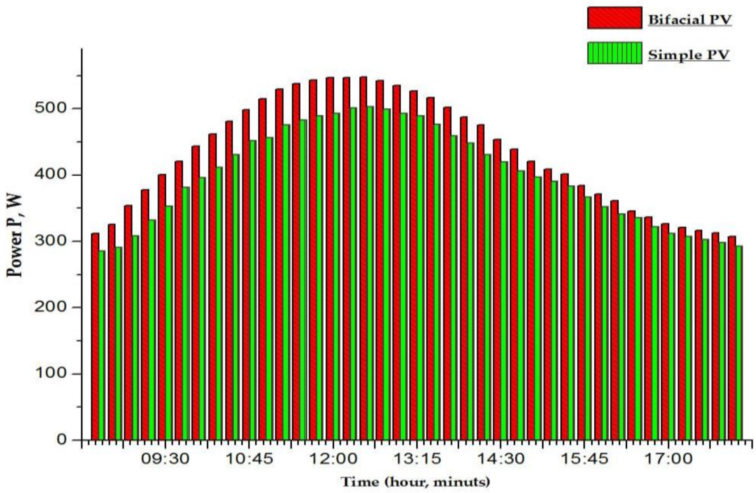

Figure 6. Time dependence of the power of simple and bifacial panels.

Of course, it is better to give information about the average value in questions about variable values. So, it was determined through calculations that the bifacial panel gives an average of 434.3W, and the normal panel gives 399.3W. In this case, it was determined that the efficiency of the bifacial panel is 8.76% higher.

4. CONCLUSION

From the experimental results in natural conditions, we can conclude that the bifacial panel is able to provide more power by almost 9% compared to the normal panel. In addition, bifacial panel electric indicators are superior to ordinary panels. Of course, we will be able to learn that the influence of albedo plays a very important role here. However, it is definitely more effective to use a simple panel in the implementation of heat collectors.

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