



Investigation of effects of dust, wind and relative nutrients in solar power plants: Amasya example

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Accepted 23 Aug 2017

Abstract

Due to the developing technologies and needs, the energy demand is increasing day by day. The use of renewable energy sources is becoming increasingly widespread due to increased needs and environmental damage. Because solar is an endless resource, solar energy is the most important source of renewable energy resources. In this work, due to the pruning, the dust, wind and relative sensitivity of the solar photovoltaic technology of the 200 kW solar power plant established in the roof of Amasya University Faculty of Science, Literature was examined for the Amasya environment, and the results were reached on a regional basis.

Keywords: Powder; photovoltaic; solar energy; powder effect; temperature and relative humidity effect.

1. Introduction

The modern information societies that we are in are; The energy that is needed for every application that has become the most indispensable parts of life like technology, innovation, industry, transportation, communication has become the most important and hard to give up today. However, with today's methods, energy production can also cause irreparable damage to the world, which is the living space of the society. Hence, mankind has turned to renewable energy sources.

Two solar technologies are widely used today, namely "solar thermal" and "solar photovoltaic (PV)" and their use is likely to increase in the near future. For solar energy, several worldwide studies have proposed efficient installations (solar monitors, maximum power monitors, DC buckets and amplifier converters) to optimize solar energy capture (1, 2; 3). Nevertheless, the practicalities, such as dust accumulation, everywhere that may critically affect the reliability of PV installations are often overlooked. In addition, the harsh climate can further reduce its productivity, given the fact that solar PV materials have evolved in science and technology, and that photovoltaic cells have low internal

conversion efficiency (typically up to 20%).

In one of the world's top computing giants, Google California, examined the effect of 1.6MW solar energy on the solar sunspots (4). The company built two systems, flat and inclined panels. Theoretically, the dirt was removed from the sloped panes by the rain effect, while the dirt accumulated on the flat system. At the end of 15 months, it was observed that energy efficiency doubled as a result of cleaning flat panels. However, it was found that the difference for the oblique panels was relatively small. A different study of the dust effect on solar PV panels in California reported that it caused a 2% reduction in current compared to the clean PV panels in solar PV panels (5).

Hottel and Woertz were among the pioneers investigating the effect of the solar system on dust. They had a 4.7% reduction in collector performance when the average solar radiation loss was less than 1% (6). In a study by Salim et al., A solar village near Riyadh showed a 32% reduction in performance after eight months into dust accumulation in the PV system (7). Wakim stated that there was a 17% decrease in PV power due to the accumulation of

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sand in the panels in Kuwait after six days. In addition, the study also indicated that the effect on dust PV performance would be higher in spring and summer than in autumn and winter (8).

In this study, the productivity of the solar panel was compared with the effect of factors such as dust, temperature and relative humidity on the climate and environmental factors in the Amasya region.

1.1. Solar Data of Amasya

Amasya is located in the Central Black Sea Division between 34 ° 57 '06 " - 36 ° 31' 53" East Longitudes and 41 ° 04 '54 " - 40 ° 16' 16" North Latitudes. The average altitude of the city is 1150 m. and the

settlement angle that should be chosen to obtain the most efficient result from the photovoltaic panels is 290 C. A 1 square meter improvement parallel to the peak is 663 W/m² with the highest falling power. On a 290 sloped surface, it is 705 W/m². The average solar energy per square meter per day in the same month is 5.9 Kwh. A total of 1460 KWh/m² on a 290 sloped surface while the total energy decaying throughout the year is 1360 W/m². The total energy that can be produced with an average of 18% efficient solar panel of 1 square meter is more than 266 KWh. Amasya province average temperature data is shown in figure 1.

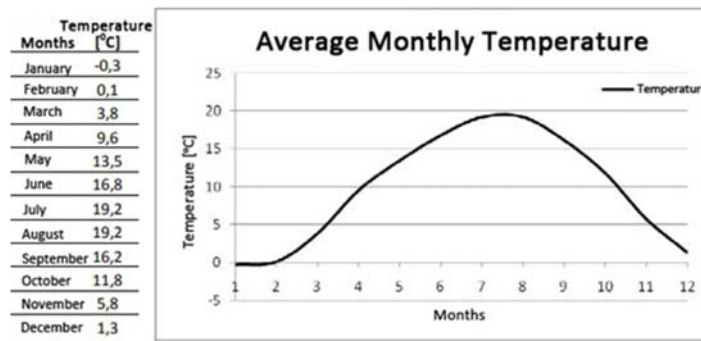


Figure 1. Amasya Province average temperature data.

Amasya is the average daily solar environment.

The highest sunshine and sunshine durations per square meter in Amasya province are seen in Figures 2 and 3 as per the month. While the highest power on

m² module installed as a yacht is calculated as 663W/m², the most suitable angle for geography is 290 the maximum power of 706 W/m² drops on the module placed.

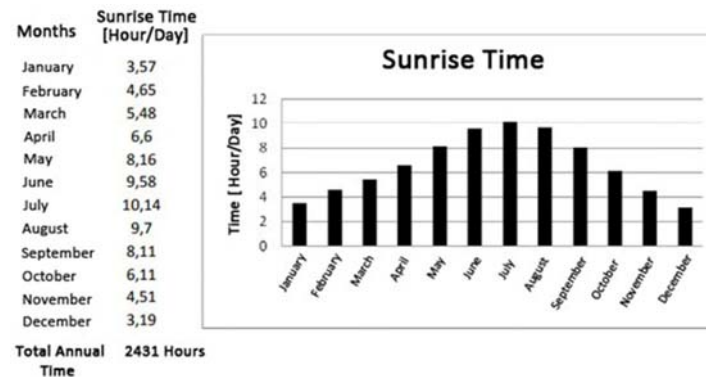


Figure 2. Amasya city sunrise time.

Amasya's average daily energy decreases for m² are shown in Fig. 4, with a horizontal correction from sunrise to sunset and a 320 deg. Despite the fact that

in the horizontal plane there is more energy collection in July, the total energy accumulated in the panel installed at an angle of 290 ° is higher.

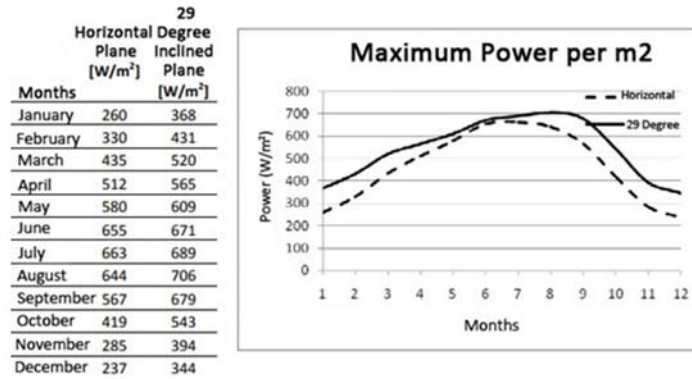


Figure 3. Amasya city sunrise power.

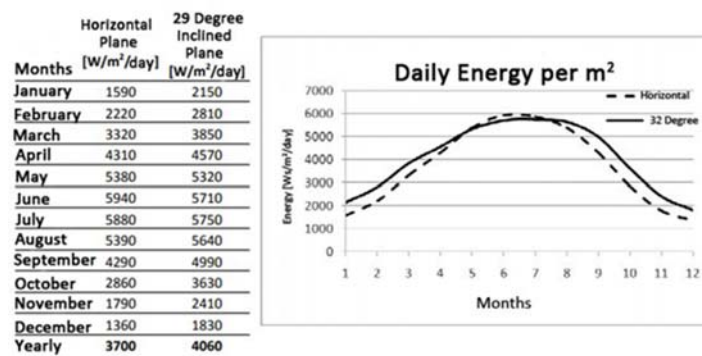


Figure 1. Daily energy per m².

2. Methodology

In this study, as shown in figure 5, a total of 800 250 watt panels were placed in the 200 kW power installed on the 4000 m² area of Amasya University

faculty of science and literature. The obtained DC voltages were converted to grid voltage by 10 units of 20 kW inverters and synchronized to ten grid.



Figure 2. Panel layout.

Hobolink and Also Energy's remote monitoring programs enabled the system to be monitored and

stored 24 hours a day.

3. Results and Discussions

Factors affecting energy efficiency, which have never been done before in our region, were examined

for the first time according to the data obtained from our study.

3.1. Humidity effect

In the Hoboling software, the effect of the nodule is shown in Fig. 6. The daily moisture effect and the daily yield are shown in Fig. 7 as the weekly moisture effect and the daily yield, and finally in Fig. 8 as the monthly moisture effect and the daily yield.

When the graphs are examined, the efficiency increases in the days when the nuance is high, as shown in Fig. 6'b, Fig. 7b and Fig. 8b This increase in yield is thought to have made a kind of washing effect that reduces the pollution on the ditch panels.

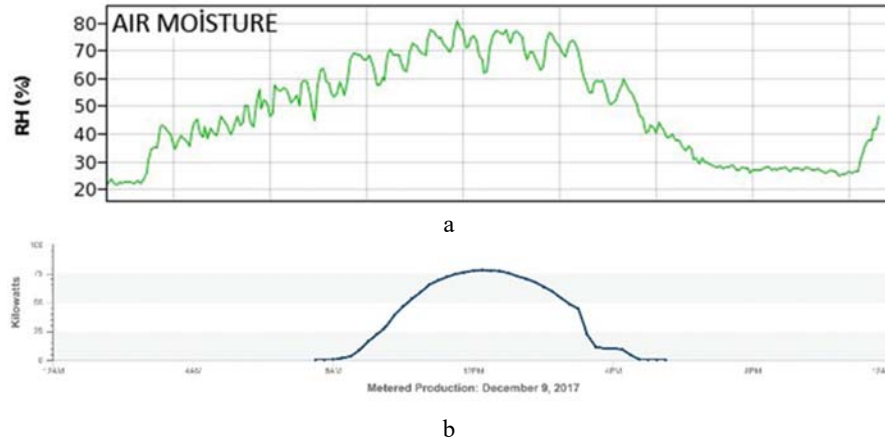


Figure 3. a) Daily moisture effect b) Daily yield.

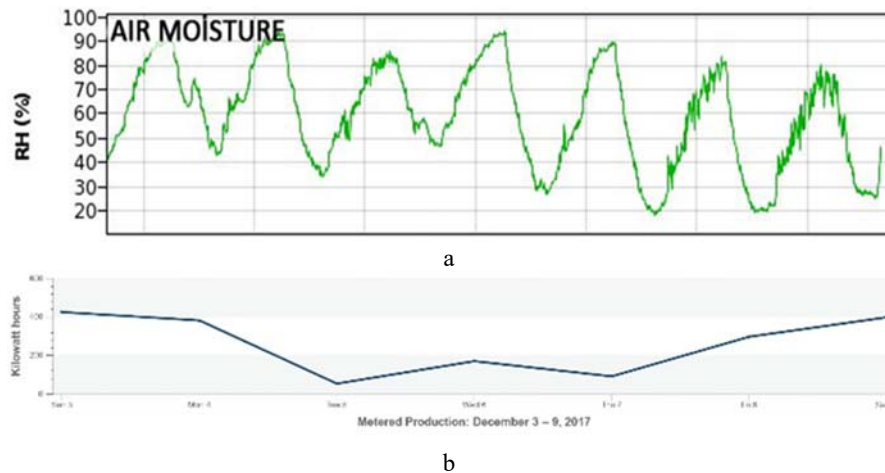


Figure 7. a) Weekly moisture effect b) Daily yield

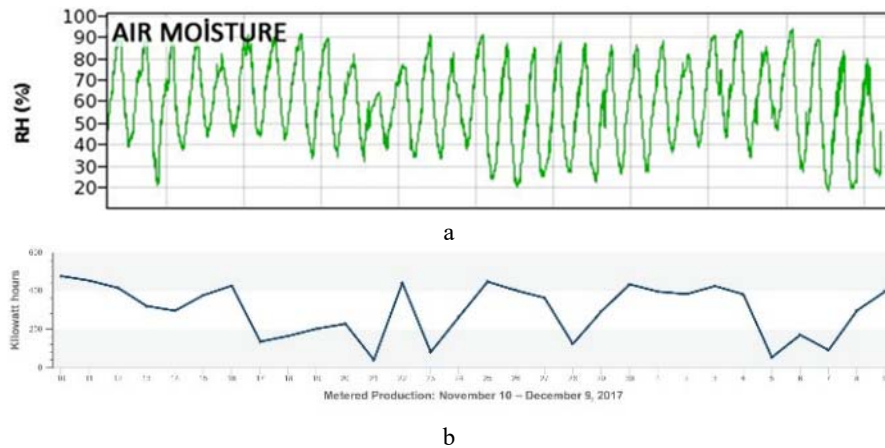


Figure 8 a) Monthly moisture effect b) Daily yield.

3.2. Wind Effect

When Figure 9 is examined, it is observed that the wind that flows in our region changes daily, weekly and monthly. Compared with the data obtained here, yield graphs in figures 6, 7 and 8 show that the wind increases and the efficiency increases. This increase is thought to be due to the cooling of the wind panels and their contribution to the removal of contamination on the panel surfaces.

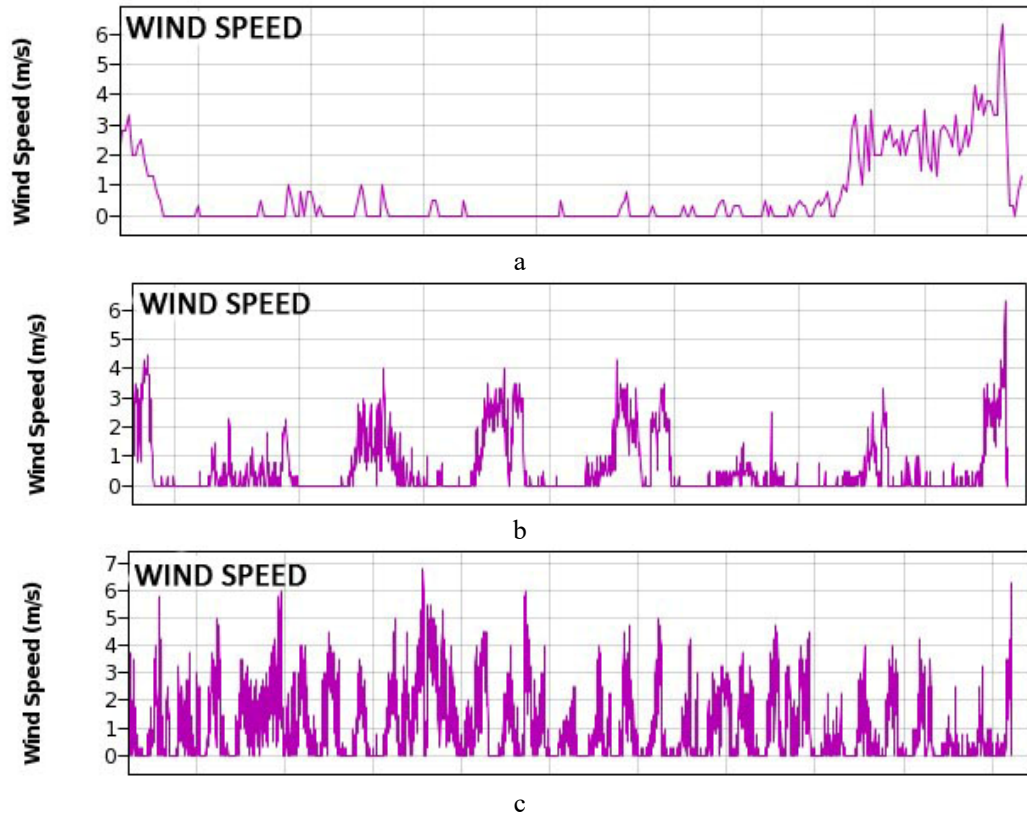


Figure 4. a) Daily wind effect b) Weekly wind effect c) Monthly wind effect.

3.3. Powder Effect

It is understood from the yield graphs that the Central Black Sea region is advantageous from air pollution and dust wool. In particular, it has been observed that

the continuity of wind and raw weather events reduces the negative effects of air pollution on panels.

4. Conclusion

The effects of dust, wind and relative humidity were studied for the Amasya region. It has been observed that there is not much negative effect on the performance of the PV panels due to the lack of dust for the Amasya region. Moreover, it was observed that the Central Black Sea region had an advantageous position in terms of pollution even if

the decrease in productivity was 1%, because it made a kind washing effect which reduced the pollution on the ditch panels coming into the water. It has been observed that the continuous winds in our region have a positive effect on the cooling of panels and the sweeping of pollution on panel surfaces.

References

- [1] Cemil, S. 2007. Sun-tracking system with PLC control for photo-voltaic panels. International Journal of Green Energy 4(6):635–43.

- [2] Abd El-Shafy, A.N. 2010. Novel maximum-power-point tracking algorithm for grid-connected photovoltaic system. *International Journal of Green Energy* 7(6): 600–14.
- [3] Amit, J., M. Rajeev, and K.M. Susheel. 2011. Modeling impact of solar radiation on site selection for solar PV power plants in India. *International Journal of Green Energy* 8(4):486–98.
- [4] www.goodcleantech.com/2009/08/google_studies_how_dirt_affect.php, M. Moon. (2009) Google Studies How Dirt Affects Solar Panel Efficiency. PC Magazine: Good Clean Tech. Available:.
- [5] Katz, G. B. (2008). Effect of dust on Solar Panels. [2006-10-01]. <http://www.gregorybkatz.com/Home/effect-of-dust-on-solar-panels>.
- [6] M. C. Hottel and B. B. Woertz, "Performance of flat plate solar heat collectors," *ASME Trans.*, vol. 64, pp. 91-104, 1942.
- [7] A. Salim, F. Huraib, and N. Eugenio, "PV power-study of system options and optimization," in *Proceedings of the 8th European PV Solar Energy Conference*, Florence, Italy, 1988.
- [8] F. Wakim, "Introduction of PV power generation to Kuwait," Kuwait Institute for Scientific Researchers, Kuwait City, 1981.