Contribution ID: **23** Type: **Contributed Oral Presentation**

Performance of a Bifacial Solar Module Under Different Backgrounds

Thursday, September 28, 2023 4:45 PM (13 minutes)

Bifacial Photovoltaic (BPV) is a rapidly growing technology that has the potential to increase electricity production while taking up less space compared to conventional modules and due to this, they have attracted significant attention in recent years. Apparently, little study has been conducted on these types of modules, notably on the use of reflecting surfaces to improve backside production, which in this case receives low irradiance. This paper reports on a section of my research conducted on the rooftop of the Department of Physics at the University of Nairobi's Chiromo Campus in Kenya. This study examines the influence of various backgrounds on the performance of a bifacial solar module. Two solar modules were mounted back-to-back to create a double-sided solar module (bifacial solar cell configuration), with one module facing the sky (front side) and the other facing the ground (back side). The module was kept at about 1.2 m and inclined at about 300 to the horizontal facing north orientation. Beneath the module, various backgrounds were used in turns while parameters like solar irradiance, module temperature, current, and voltage values were recorded. Solar irradiance was measured using an HT304N reference cell fixed alongside the back module and connected to an irradiance meter. Current-Voltage values of the solar module were obtained using a current-voltage (I-V) solar analyzer. The effect of a reflective background on the module's performance was investigated using Metallized polyethylene terephthalate, (MPET), normal galvanized iron sheet, and mylar windshield sunshade as reflectors. Data collection was done daily between 12 pm and 1 pm East African Time, EAT at an interval of 2 minutes. Data analysis and visualization were done using Python and Origin software. The results confirmed that using reflective backgrounds greatly increases the power output of the bifacial solar module. Metalized polyethylene terephthalate, MPET reflectors produced the most irradiance of the tested three reflector samples, followed by the Mylar sunshade and finally iron sheet. MPET increased irradiance by 84.62%, Mylar by 77.21%, and iron sheets by 22.95%. Moreover, due to its high reflectivity, the MPET reflector was recommended for usage as a reflecting surface.

Keywords: Bifacial, solar module, background irradiance, performance

Reference

[1] H. Wu, Y. A. Huang, F. Xu, Y. Duan, and Z. Yin, "Energy Harvesters for Wearable and Stretchable Electronics: From Flexibility to Stretchability,"Adv. Mater., vol. 28, no. 45, pp. 9881–9919, 2016, doi: 10.1002/adma.201602251.
[2] A. Kahan and EIA, "EIA projects nearly 50% increase in world energy usage by 2050, led by growth in Asia - Today in Energy - U.S. Energy Information Administration (EIA),"24.09.2019, vol. 2019. pp. 2018–2021, 2019. [Online]. Available: https://www.eia.gov/todayinenergy/detail.php?id=41433
[3] E. Stephens et al., "Future prospects of microalgal biofuel production systems,"Trends Plant Sci., vol. 15, no. 10, pp. 554–564, 2010, doi: 10.1016/j.tplants.2010.06.003.
[4] J. S. Stein et al., Bifacial PV modules & systems Experience and Results from International Research and Pilot Applications. 2021.
[5] C. Deline, S. Macalpine, B. Marion, F. Toor, A. Asgharzadeh, and J. S. Stein, "Evaluation and field assessment of bifacial photovoltaic module power rating methodologies,"2017 IEEE 44th Photovolt. Spec. Conf. PVSC 2017, pp. 1–6, 2017, doi: 10.1109/PVSC.2017.8366887.
[6] A. Asgharzadeh et al., "Analysis of the Impact of Installation Parameters and System Size on Bifacial Gain and Energy Yield of PV Systems,"no. i, pp. 3333–3338, 2018, doi: 10.1109/pvsc.2017.8366690.
[7] R. Guerrero-Lemus, R. Vega, T. Kim, A. Kimm, and L. E. Shephard, "Bifacial solar photovoltaics - A technology review,"Renew. Sustain. Energy Rev., vol. 60, pp. 1533–1549, 2016, doi: 10.1016/j.rser.2016.03.041.
[8] N. Riedel-Lyngskær, P. B. Poulsen, M. L. Jakobsen, P. Nørgaard, and J. Vedde, "Value of bifacial photovoltaics used with highly reflective ground materials on single-axis trackers and fixed-tilt systems: A danish case study,"IET Renew. Power Gener., vol. 14, no. 19, pp. 3946–3953, 2020, doi: 10.1049/iet-rpg.2020.0580.
[9] M. Rueter, M. Dobosz, and R. D. Wilk, "A Study of Reflector-Enhanced Bifacial PV,"Am. Sol. Energy Soc. Natl. Sol. Conf. 2021 Proceedings, Sol. 2021, no. 2018, pp. 103–114, 2021, doi: 10.18086/solar.2021.01.05.
[10] C. K. Lo, Y. S. Lim, and S. Y. Kee, "Improvement of bifacial solar panel efficiency using passive concentrator and reflector system,"Proc. 2013 Int. Conf. Renew. Energy Res. Appl. ICRERA 2013, no. October, pp. 42–45, 2013, doi: 10.1109/ICRERA.2013.6749723.
[11] M. T. Patel, M. R. Khan, X. Sun, and M. A. Alam, "A worldwide cost-based design and optimization of tilted bifacial solar farms,"Appl. Energy, vol. 247, no. March, pp. 467–479, 2019, doi: 10.1016/j.apenergy.2019.03.150.

[12] H. L. Cha, B. G. Bhang, S. Y. Park, J. H. Choi, and H. K. Ahn, "Power prediction of bifacial Si PV module with different reflection conditions on rooftop,"Appl. Sci., vol. 8, no. 10, 2018, doi: 10.3390/app8101752.

Abstract Category

Energy

Primary author: Dr WAITA, Sebastian (University of Nairobi)

Presenter: Ms KATUNGE, Gloria (University of Nairobi)

Session Classification: Parallel Session 1

Track Classification: Physics Research