SUSTAINABLE CAPSTONE PROJECTS（SCAP）
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SOLAR PANELS RELATED TESTING AND MEASUREMENT

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INTRODUCTION

The viability of solar energy from an economic standpoint depends on the solar panels' efficiency, which might decline with age and exposure to environmental factors. The installation angle of the panels is one of these factors that significantly affects energy production. This experiment considers a number of elements that affect the efficiency of aged solar panels and investigates how different tilt angles affect their performance.

FINAL PRODUCT

Experimental Setup 1. Panel Selection: Two aging Monocrystalline solar panels of model S190M from Solaris Photovoltaic were selected based on similar degradation levels. 2. Tilt Angle Variation: Panels were set at tilt angles: 20° , 25° and 30° . 3. Data Collection: - Electrical Measurements: Voltage and current were measured using multimeters at each angle. - Temperature: Solar panel temperature, hot spot temperature, and surrounding temperature were recorded. - Environmental Conditions: Wind speed, humidity, and solar radiation were measured using appropriate sensors. 4. Data Analysis: Collected data was analyzed to assess the correlation between tilt angles and the aforementioned variables on panel efficiency.

RESULTS AND DISCUSSION

The findings demonstrated a complex interaction between several factors and tilt angles. Panels oriented at a 30° angle showed higher current values than tilt angles at 25° and 20° were applied. Furthermore, climatic factors and temperature changes have a significant impact on efficiency at various tilt angles. We also noticed that the voltages remained pretty much the same throughout the measurements. In series the voltages added up to a higher value while the current mostly seemed to assume the value of the higher current between the two panels.

MATERIALS USED IN CONSTRUCTION

Re-Used/Recycled Materials:

- Used Metals from junkyard.
- Used Air conditioner mounting bases.
- Used iron bars.
- Used water pipes
- Screws and bolts.

Other Materials:

- Solar Panels: Two aging Monocrystaline solar panels of model S190M from Solaris Photovoltaic exhibiting similar degradation levels.
- Equipment: Tilt angle adjustment Panel stand, multimeters, temperature sensors, thermal camera and a laptop.

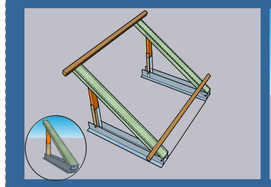

Figure 1. A view of the Design of Tilt angle adjustment Panel stand.

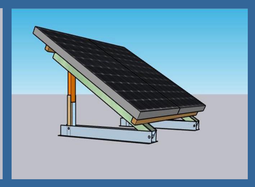

Figure 2. A view of the Design of Tilt angle adjustment Panel stand.

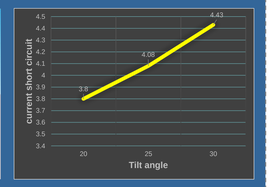

Table 1. The relationship of current with inclination angle

Figure 3. A view of the stand structure.

Figure 4. A view of Solar Panel System.

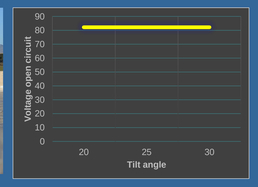

Table 2. The relationship of voltage with inclination angle.

CONCLUSIONS

This experiment highlights how crucial it is to take into account a variety of factors when evaluating the efficiency of aging solar panels, such as voltage, current, temperature fluctuations, ambient circumstances, and solar radiation. Considering the multifactorial factors, optimal tilt angles, particularly around 30° , were connected with increased energy production..

REFERENCES

• Steinhüser, A., et al. "Effect of Tilt Angle on the Performance of Photovoltaic Panels." Solar Energy, vol. 132, 2020, pp. 123-135.

• Chowdhury, S., et al. "Influence of Environmental Factors on the Performance of Solar Panels." Renewable Energy, vol. 98, 2016, pp. 64-75.