The purpose of this project was to develop a portable modular solar power system to provide electricity and hot water. The system has been designed to be easily transported and quickly deployed with little to no assembly required. Although the system was sized to provide enough power to run essential devices in the average home, a smaller scale model was built in order to test and demonstrate the system.

Introduction

The goal of testing was to determine the effect of incorporating a thin reflective film. The time needed to heat the evacuated tube was measured after using solar PV panels with and without a thin reflective film. The goal of reflecting some of the higher wavelengths, to heat the water within the evacuated tube, was reached by measuring the reduction in time to heat the tube. A drop in power output from the solar panels was recorded (and expected) because some of the solar energy was reflected away. The voltage was measured across several, discrete, resistor values. Using the power law, \( P = \frac{V^2}{R} \), the voltage and resistor values were used to calculate the solar PV output power.

Testing the Reflective Film

The difference in time to heat the tube to 70° C was about 8 minutes. Cloud cover prevented heating the tube in both cases to 100° C, but there was a clear reduction in time to heat the tube to the same temperature. Because the trend was linear, the temperature gradient was expected to follow the same trend.

The power output was reduced as a result of the ITO film. By plotting the power output and comparing the maximum power, there was a 25% drop in power. This was expected.

This system was able to take solar energy, unused by the solar PV panels, and convert it to thermal energy within an evacuated tube.

Conclusion

Objectives

<table>
<thead>
<tr>
<th>Portability</th>
<th>Yes</th>
<th>The arms fold down to the side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate Electricity</td>
<td>Yes</td>
<td>Generates .6 W per panel</td>
</tr>
<tr>
<td>Generate Hot Water</td>
<td>Yes</td>
<td>Reduces time to heat water by 8 minutes</td>
</tr>
</tbody>
</table>

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Future

- Other films might provide better transmissivity and reflectivity
- Higher quality PV panels will increase power output