CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

J0206

Project Title

Some Like It Cold: How Does Temperature Affect a Solar Panel's Efficiency?

Abstract

Objectives/Goals

There is an increasing need for power sources that do not pollute the planet. Silicon based solar cells have a lot of promise, but are not very efficient. In this project the relative power output of three different sets of solar panels was examined under different load and temperature conditions.

Methods/Materials

Three different sets of solar panels: four 11.4 cm x 33 cm, solar panels, Junior Solar Sprint, Solarmade (3 volts @ 3 Watts), two 19.1 cm x 29.2 cm solar panels, LiteFuze, (20 volts @ 5 Watts) and four 6.35 cm x 12.7 cm solar panels, (6 volts @ 3 Watts) were tested. The panels were connected to various loads resistances (R): 33, 100, 200, 233, 300, 600 and 900 Ohm resistors at 10 Watts, to complete the electrical circuit. A halogen light (1000 Watts) was suspended at a fixed distance above the panel. The panels were placed in the kitchen freezer to cool to below freezing. Each panel was taken quickly to the garage and the temperature was taken across the panel. The voltage (V) at that temperature was recorded when the light was turned on repeatedly as the panel warmed. The power (P) was calculated using P=V^2/R.

Results

The panels were first tested for consistent temperature measurements at 3-6 points across each panel. The panels were then tested for the optimal load for power output. The Junior Solar Sprint panels (set A), the LiteFuze (set B) and the smaller panels (set C) were tested and had optimal loads of 33Ohm, 300Ohm and 233Ohm resistors respectively. The panels were tested across temperature gradients at 33Ohm (peak) and at 100Ohm (approximate load for about 50% peak power) for set A, 300Ohm (peak) and 900Ohm resistors for set B and 233Ohm (peak) and 600Ohm resistors for set C respectively. With load resistance at or above the optimum the power output decreased linearly with temperature. When the load resistance was below the optimum then the power output did not follow the linear curve.

Conclusions/Discussion

The relative efficiency of silicon based solar panels increases with lower temperatures. The temperature and power relationship was linear at or above the optimal load resistance. The load resistance is critical to the performance of these solar panels in predicting their efficiency under different temperatures.

Summary Statement

The power output of solar panels increases linearly with decreasing temperature only at or above optimal load resistances.

Help Received

My parents purchased the supplies and my father helped me take measurements. Mrs. Gillum reviewed the project and provided solar panels. They also reviewed the write up.