CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

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Project Number

J0716

Project Title

Maximizing Solar Panel Power by Tilting Its Angle towards the Sun

Abstract

Objectives/Goals

Our objective is to determine the effect of tilting a photovoltaic solar panel in order to maximize its output power for designing an efficient solar energy system.

Methods/Materials

Two photovoltaic solar panels were juxtaposed in an open space almost free from shadows. One panel was tilted at 34-degrees and the other was at 57-degrees. We chose these two angles because during the two equinoxes in September and March, the earth axis is parallel to the sun axis. Therefore, we placed one panel to the latitude of Agoura, at 34-degrees, which was where the experiment was taken place. However, during the two solstices in December and June, the earth axis tilts 23.5-degrees away from the sun axis. Therefore, we tilted the second panel at 57.5-degrees by adding 23.5-degrees to the latitude of Agoura, 34-degrees. In our experiment, we collected the short circuit current (Isc) from the two solar panels for six hours in each of the five days. This was recorded in 60-second time intervals from a current meter to a laptop computer using data acquisition software that was commercially available. The Isc was then converted to the maximum power (Pmax) by multiplying it to the open circuit voltage and fill factor for both panels. We then plotted the Pmax as a function of time to compare the panel performance on each day. We also calculated each panel#s total power from the Pmax versus the time plots by integrating the area under the curves. We then converted the total power to kWh for a day-to-day energy comparison.

Results

Our results showed that on clear days, the 57-degree panel received about 20% more total power per day than the 34-degree panel. This proved our hypothesis because the 57-degree panel was more perpendicular to the incoming rays from the sun, since we experimented during the winter when the earth tilts 23.5-degrees away from the sun. However, on raining days, there was very little power received from the sun, so the total power was about the same for both panels.

Conclusions/Discussion

Our conclusion is that the panel needs to be perpendicular to the sun to receive the most power. Designing a solar system by tilting its angle to maximize the output power can actually save the system cost by using fewer panels and using less panel area. Our experiment shows that this improvement can be possible by 20% when we tilt the angle from 34-degrees to 57-degrees in areas around Los Angeles during the winter.

Summary Statement

We measured and compared the output power of two photovoltaic solar panels tilted at two different angles to see which one yielded more power to design an efficient solar panel system.

Help Received

Father explained how solar cells work, data analysis and helped purchase solar panels; Mother bought board supplies; The teacher and school science fair gave helpful comments