CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

31936

Project Title

The Solar Solution

Abstract

Objectives/Goals

The objective of our project is to create a three-dimensional solar collector that will be more efficient and versatile than the commonly used flat panel.

Methods/Materials

We performed a computer simulation using 3 software applications: called Autodesk Ecotect, Google SketchUp & Autodesk 3DStudio. We ran a three-dimensional virtual solar analysis on the shapes we modeled and measured for incident Wh/m2. We built a solar flat panel and a dome-shaped solar collector. We measured volts produced by each prototype. Materials used: 1 inch x 2 inch silicon photovoltaic cells, tabbing wire, solder, Plexiglas, glass & LEGO Technic parts. We used a Vernier LabPro multimeter & the Logger Pro application to measure & graph the volts produced by our prototype models.

Results

Through our south facing computer simulation tests, we determined the 3 best collectors were a flat panel at proper tilt, which collected 32,000, Wh/m2, a hemisphere/dome, which collected 20,500 Wh/m2, and a quarter sphere, which collected 26,000 Wh/m2. We ran more virtual tests with these best 3 shapes facing North, East, and West. The quarter sphere fluctuated greatly while facing different directions, and the dome data remained nearly identical in all directions. We discovered that the dome & flat panel were the most efficient shapes. South facing prototype tests were extremely close to Ecotect predictions that the panel would be approximately 59% more efficient than the dome. This was true on the first day of south testing. On the other three days the panel was 56%, 55%, and 55% more efficient than the dome. However, west facing test results differed from the computer simulation predictions. Ecotect stated that the dome was 273% more efficient than the flat panel when both were facing west; in the prototype test the panel was 1%-2% more efficient than the dome.

Conclusions/Discussion

After analyzing our data, our team determined that the solar dome is a viable replacement for the panel in instances where the panel is not able to face south at an optimal tilt. Unlike a flat panel, the solar dome can also be placed on moving vehicles, trains and ships to collect solar energy more efficiently than flat panels, as these moving conveyances do not always allow flat panels to face south at a proper latitude angle.

Summary Statement

To build a three dimensional solar collector panel that performs more efficiently and has fewer limitations than the commonly used flat panel.

Help Received

A mother helped us acquire the PV cells. Architect Eric Carbonnier taught us how to operate Ecotect software. A father taught us how to solder.