



**CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY**

Name(s) Andrew W. Troxell	Project Number 34259
Project Title Are Solar Angles Important? Analyzing Solar Panel Efficiency Related to the Angle of the Sun	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The sun produces enough solar energy on earth to make almost every household in the world energy independent. Current solar panels have inefficiencies present which causes the panel to be less effective. Solar inefficiencies are more prominent due to the rotation and orbit of the earth. To understand how this occurs, one must understand how to extrapolate the angle of the sun and how to derive solar noon. My science project objective is to determine at which angle of the sun, relative to earth, will a solar panel be most efficient.</p> <p>Methods/Materials The solar racer was built following step by step instructions provided. A race track was marked off on a clean, smooth surface at a distance of four meters going North to South and East to West. Solar car trials were completed every hour starting at 9:00am through 2:00pm. The angle of the sun was measured before each test by using a meter stick, string, and a large protractor. The time was recorded, in seconds, for the car to travel 4 meters. Four trials were completed for each different angle of the sun/ time of day, and in each of the two directions. The trials information was collected and data was extrapolated.</p> <p>Results The data collected from each trial demonstrates which angle of the sun produces maximum solar energy. The output of solar energy was clearly most productive when the sun was located at a 45° angle relative to a solar panel maintained at 0°. Because the earth is always moving, the 45° angle of the sun can occur at different times of the day. It was well worth noting that the direction the solar car traveled was relative to the optimal solar energy output. This is verified by how fast the solar car traveled during the trials going West to East and North to South.</p> <p>Conclusions/Discussion The conclusion reached is that the angle of the sun does affect the amount of energy produced by a solar panel. My hypothesis was correct. The solar panel generated 59% more speed at 33-45° of the sun's angle to the earth's surface compared to the other angles at different times of the day. One can conclude the faster speed indicates improved energy output.</p>	
Summary Statement "Are solar angles important?" The goal of this project is to determine the angle of the sun and time of day where a solar panel produces the best output of energy.	
Help Received My teachers helped by exploring ideas and allowing to borrow some materials such as a chalkboard protractor. My family helped me with typing and the graphs.	