



CALIFORNIA STATE SCIENCE FAIR 2005 PROJECT SUMMARY

Name(s) Ian R. Girard	Project Number S0705
Project Title Solar Hydrogen Fuel Cell Future	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals I designed and built a renewable hydrogen energy system. It consisted of a photovoltaic panel, an electrolyzer, a hydrogen storage system, and a proton exchange membrane fuel cell. I tested it to find its optimum operating conditions and energy conversion efficiency. The entire system was designed to be simple enough and cheap enough to build and test in a high school classroom for educational purposes.</p> <p>Methods/Materials I built almost all of the components in my garage from materials you can buy from a hardware store. I made changes in the design of the different parts of the system to try to make it work more efficiently. I manipulated air flow, cell compression, source of oxygen and type of proton exchange membrane to see how these variables affected the voltage and current output of the fuel cell. I also tested the electrolyzer to determine hydrogen and oxygen production rates.</p> <p>Results The efficiency of the solar panel averaged only 3% because it was operating at a low voltage and a high current which was very inefficient operating point for that particular panel. The energy efficiency of the electrolyzer was 41% which is about right when compared to industrial standards and considering the simplicity of the design. The maximum fuel cell efficiency was 10%. The source of oxygen and the compression had the most affect on the cell#s performance.</p> <p>Conclusions/Discussion Each stage of the system worked well, but at low efficiencies. I was able to optimize the output of the system by manipulating operating variables in the same way you would have to for commercial systems so this system would make a realistic teaching tool. If I was going to continue working on this I would use a different kind of photovoltaic panel that is designed to run an electrolyzer. This would have the most effect on the overall system efficiency. I would also change the design of the electrolyzer to prevent mixing of hydrogen and oxygen. I would also test to see the best way to keep the cell membrane moist so the fuel cell could run without constant care. This topic is very relevant because of the need to find an alternate energy source besides fossil fuels. Hydrogen is a likely candidate so it is important for students to at least have a basic knowledge of how a solar hydrogen energy system works.</p>	
Summary Statement I designed, built and tested a simple solar hydrogen fuel cell system that can be used for educational purposes.	
Help Received I got advice on design and testing from the Schatz Hydrogen Energy Research Center. My dad supervised me when I was testing the system especially with handling the electrolyte. A lot of businesses donated or loaned the materials and testing equipment I used.	