CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1813

Project Title

Improving Solar Panel Efficiency: The Effects of a Liquid Cooling System on Energy Production

Abstract

Objectives/Goals

Solar is one of the primary sources of clean energy, with photovoltaic (PV) technology as the dominant source. Current PV panels have an efficiency of 15-20%, which demonstrates the need for additional technical advances and innovative solutions. Temperature is one of the main factors affecting PV cells. There is an inverse relationship between power output and temperature. As ambient temperatures increase, the power output of a PV cell decreases. This study investigated the ability to increase the efficiency of solar panels by decreasing the temperature using a liquid cooling system.

Methods/Materials

A system was designed to test the effects of reducing temperature on the power output of PV panels. A small solar panel was fitted with a cooling system. A piece of solid foam insulation with a coiled length of plastic tubing carved into it was applied to the bottom surface of the PV panel. This was hooked up to a pump which circulated cold water through the system. This test panel was compared with the same model PV panel (without cooling) in a closed system. Both panels were placed in a wooden box, separated by a divider, and sealed with a glass door. Each chamber contained identical temperature sensors to measure the ambient temperature and the temperature underneath each of the panels. Separate voltmeters measured the voltage and current generated by each panel. A halogen shop light was used as the light source.

Results

The results confirmed that, as ambient temperature increased, power output of both PV panels decreased. Readings also showed that the cooling system reduced the ambient and under-panel temperatures of the test PV cell. With respect to power output, although both panels showed a decrease as temperature increased, the test panel showed a significant improvement in power production over the control panel (approximately 50% efficiency increase).

Conclusions/Discussion

This study confirms that increased temperature does negatively affect solar panel efficiency, and that cooling the panel can counteract the decrease in power production. By designing a cooling system for the underside surface of a PV panel, it's efficiency can be significantly improved. Innovative solutions such as this can help the advancement of clean solar energy.

Summary Statement

This project investigated the ability to improve solar panel efficiency by reducing it's temperature using a liquid cooling system.

Help Received

None