

**Greater San Diego Science and Engineering Fair  
2018 PROJECT SUMMARY**

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**Project Title:  
An Alternative Choice for Alternative Energy**

**Abstract**

**Objectives/Goals**

Renewable energy sources may be able to prevent pollution during energy production, but do not always work reliably. The objective is to create an efficient scale model of a new renewable energy source, comprising of a wind production unit and a hydroelectric unit.

**Hypothesis**

It is hypothesized that the hydroelectric unit will perform at a 60% efficiency and the vertical axis wind turbine (VAWT) unit will perform at a 55% efficiency. It is further hypothesized that the overall scale model consisting of each unit will perform at a 70% efficiency.

**Methods/Materials**

The experiment required a frame to be built in order to hold the upper reservoir and the VAWTs. Each unit was tested separately, while the voltage and current was collected by a voltmeter every five seconds over a thirty second time frame. The hydroelectric unit used the equation  $(\text{net head} \times \text{flow}) \div 10 = P$  was used based on the dimensions of the frame. The VAWT unit used the equation  $P = 1/2 \rho a v^3$  based on the conditions of the testing environment. Once the data was collected from each unit, the efficiency of the scale model was determined by using the amount of energy produced and the equations for the potential amount of energy.

**Results**

Based on the collected data, the VAWT unit outperformed the hydroelectric unit, allowing the hydroelectric unit to use less energy for pumping. Despite this observation, the hydroelectric unit performed at a 54.52% efficiency, the VAWT unit performed at a 46.52% efficiency, and the overall scale unit performed at a 73.62% efficiency. The lower efficiency of the hydroelectric unit may have been caused from the lack of water at the end of each thirty second time frame, while the lower efficiency of the VAWT unit may have been caused by the inability of the generator to reliably relay the voltages and currents from each trial.

**Conclusions/Discussion**

The data supported the hypothesis, and the overall scale model outperformed the hypothesized efficiency. On a line graph, it was visible that the amount of energy produced had a trend of decreasing the amount of energy produced in the last five seconds. Yet, the overall scale model was able to perform at a higher efficiency than expected because the a small portion of the energy produced by the VAWT unit was used in pumping. Therefore, a conclusion can be made that combining renewable energy sources increases the efficiency.

**Summary Statement**

Renewable energy sources are on the rise but are not reliable enough to constantly produce energy, and this project proposes a method to satisfy the everyday demands for energy.

**Help Received**

Father provided materials and helped build model, and Elaine Gillum helped to edit the notebook.

