CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S0812

Project Title
Ocean Wave Energy: Potential and Kinetic to Electrical

Abstract

Objectives/Goals
Ocean waves have huge amounts of energy that can be converted to electrical energy. We wanted to find the best method of converting this energy to electricity and determine the cost of building such a power plant, the amount of power it can convert, and the length of time it takes for it to pay for itself.

Methods/Materials
1. We theorized two concepts for converting ocean wave energy to electrical energy:
a. Globe generator is a floating ball that has 18 coils and magnets. The magnets are attached to a metal weight suspended in the middle with springs. The kinetic energy of the waves makes the metal weight push/pull the magnets in/out of coils. Our prototype had one coil and magnet. We scaled the energy converted up to 18 electromagnets (to represent one globe generator).
b. Reservoir power plant uses two wave collectors to focus the kinetic energy of waves leading the water into a reservoir. The reservoir is built above water level, so all water stored inside has potential energy. The reservoir water is drained onto an electric generator similar to Hoover Dam. We built a prototype of the wave collectors and reservoir plant. Then we built two prototypes of electric generators using coils, magnets, and turbine to measure the amount of electricity converted.
2. Each prototype was simulated using a 70,000L pool. The amount of energy converted was measured using two techniques:
a. Generator charges a capacitor using a diode bridge. Voltage measured and converted to joules.
b. A home-made joules meter built with a sensitive DC motor, and calibrated by discharging a capacitor with known number of joules, and marking the rotation angle of DC motor. A video camera was used to record the motor rotation. We analyzed the rotation by looking at the video frame-by-frame.

Results
The reservoir prototype converted the most amount of energy from the pool waves. A full-scale version would cost about $3.8 million dollars, and would convert 456 kwh. We used PG&E electricity rate of $0.20/kwh to conclude that it takes about five years for the reservoir to pay for itself.

Conclusions/Discussion
Capturing the energy from the ocean is a practical and affordable alternate energy source. The reservoir was more efficient than the globe generator. Going further, we would test our methods using real ocean waves, then with a better generator. We would also test a new method, and see how it compares to the reservoir method.

Summary Statement
We wanted to find a device that efficiently converts ocean wave energy to electricity so the world has an alternative, eco-friendly energy source.

Help Received
Mr. Simon Zarrin helped with the dangerous aspects of the project (using power tools).