A PRIMER ON

Wave Energy Devices

Today about 93 percent of the world's energy consumption relies on nonrenewable energy sources such as oil and coal. The burning of these fossil fuels releases pollutants into the atmosphere and can result in environmental damage. Renewable energy sources, such as wind, solar, and wave, are possible alternatives to fossil fuels.

An abundant and promising source of energy exists in the forms of wave, tidal, marine current, ocean thermal energy conversion, and salinity.* The U.S. has committed $200 million toward wave-energy technology from 2008 to 2012, under the Marine Renewable Energy Research and Development Act. The U.S. Department of Energy has also provided $55 million over the past three years for the development, research, and application of ocean energy.

Patents for harnessing wave energy date back to 1799, and some early applications for wave power were constructed in France around 1910. The pursuit of wave energy became more heavily researched in the 1940s and has since grown in interest. Wave energy began its march toward commercialization in the 1990s. Today several devices are nearing commercialization and many more are under development. The goal of these technologies is to turn mechanical energy, obtained from an outside source (waves), into electric current. Many of the known wave-energy conversion devices can be grouped into five categories, each with its own unique method of harnessing energy from the waves.

Wave Attenuator

This device is long and multi-segmented and floats on the surface. The attenuator is anchored in place with a mooring line and positioned perpendicularly to incoming waves. Some attenuators tap only the heave (vertical motion); others tap both heave and surge. The device captures energy as the motion of the wave causes it to flex where the segments connect. This movement then drives hydraulic pumps or generators.

Point Absorber

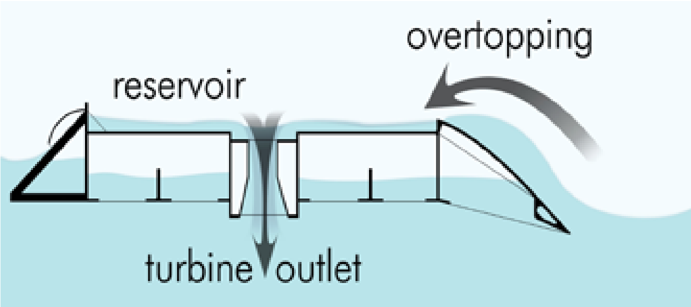
The point absorber is a floating structure that captures energy from the vertical motion of the waves. This up-and-down motion of the device drives generators that create an electric current.

Surge Converter

This style of device harnesses wave energy directly from the surging and swelling motion of waves. It uses the oscillation between a float, flap, or membrane and a fixed point. That movement creates a usable form of mechanical energy. Similar devices are also being developed that utilize pitching, heaving, and swaying motions.

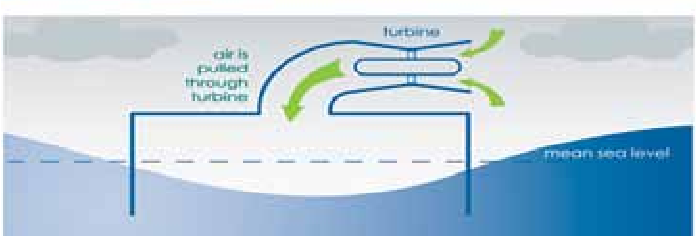
**Tidal systems include both barrages and turbines for tidal currents, while marine current systems employ turbines in non-tidal ocean flows.*

Overtopping Device



The overtopping device generally is constructed on shore or on a levee. There is a collector that funnels waves over the top of the structure and into one of the device's reservoirs positioned below the waterline. The water is then run back out to sea through one or more turbines. As the water spins the turbine rotors, electric current is generated.

Oscillating Water Columns



These are partially submerged structures that house a column of air above a column of water. Waves are then funneled into the structure below the waterline, forcing the water column to rise and fall like a piston. This movement both pressurizes and depressurizes the air column, moving a bidirectional turbine with the resulting "push/pull" force.

Development of wave energy requires an interdisciplinary approach. Harnessing energy from ocean waves is not simply about which device creates the most power, but also requires considering anchoring and mooring systems, potential environmental effects, and socioeconomic effects, such as "view sheds" and impacts to existing ocean users. There are also shore-side issues to consider such as connecting to the grid, storing the power, and transporting it to where the power is needed. Development of any new energy industry requires a multitude of investigations and considerations. The Northwest National Marine Renewable Energy Center (NNMREC) is a project funded by the United States Department of Energy and is tasked with conducting a variety of studies relating to the advancement of understanding in wave energy. For more information on research and testing happening on wave energy in the Pacific Northwest, visit http://nnmrec.oregonstate.edu.

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Sources of text and photos:

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