Sea Grant Oregon

# A Primer on Wave Energy

## *Wave Energy Devices*

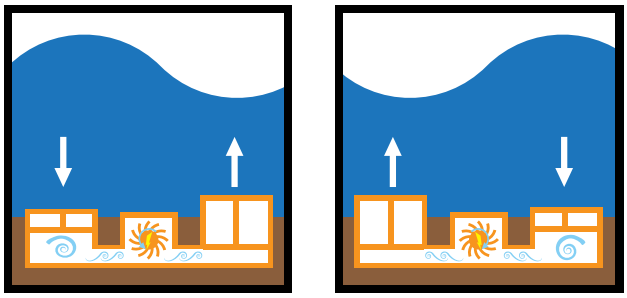
### Introduction

Today about 87 percent of the world's energy consumption relies on nonrenewable energy sources such as oil, natural gas, and coal. The burning of these fossil fuels releases pollutants into the atmosphere and can result in environmental damage. An abundant and promising source of renewable energy exists in the forms of wave, tidal, marine current, ocean thermal energy conversion, and salinity.

Wave energy began its march toward commercialization in the 1990s. Today several devices are nearing commercialization and many more are under development.

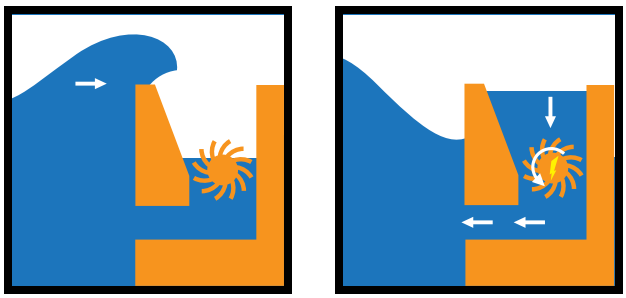
Many of the known wave-energy conversion devices can be grouped into nine categories, each with its own unique method of harnessing energy from ocean waves.

### 1.) Submerged Pressure Differential



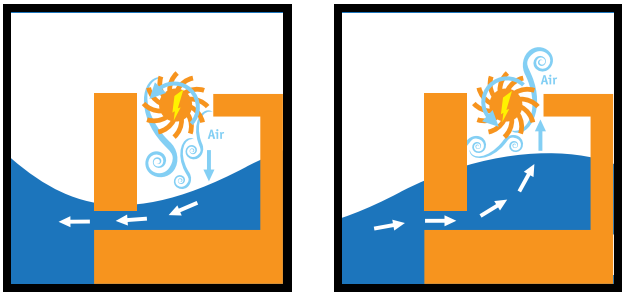
A pressure differential is created in the device as waves cause sea level to change as they pass. The vertical motion caused by the differential drives a fluid pump that creates mechanical energy.

### 2.) Overtopping Device



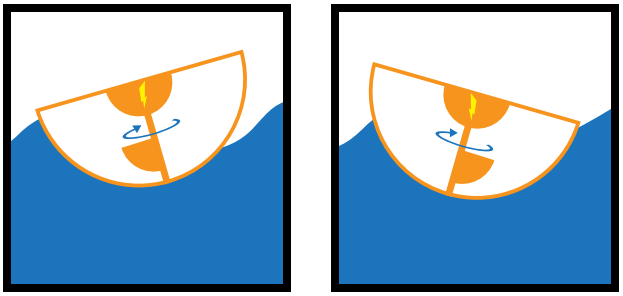
A collector funnels waves over the top of the structure and into one of the device's reservoirs, positioned below the waterline. The water is then run back out to sea through one or more turbines. As the water spins the turbine rotors, electric current is generated. This device can be found on shore or in open ocean.

### 3.) Oscillating Water Column



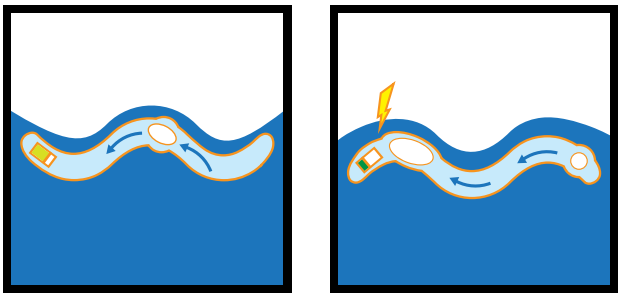

These are partially submerged structures that house a column of air above a column of water. Waves are funneled into the structure below the water line, forcing the water column to rise and fall like a piston. This movement both pressurizes and depressurizes the air column, moving a turbine with the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

### 4.) Rotating Mass



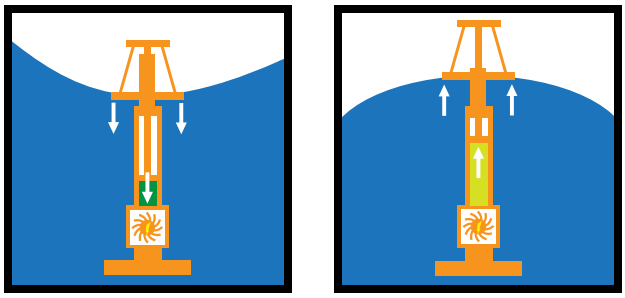
A rotating mass device heaves and sways in the waves, causing a gyroscope or weight to rotate within. The movement is attached to a generator inside the device, which produces energy.

### 5.) Bulge Wave



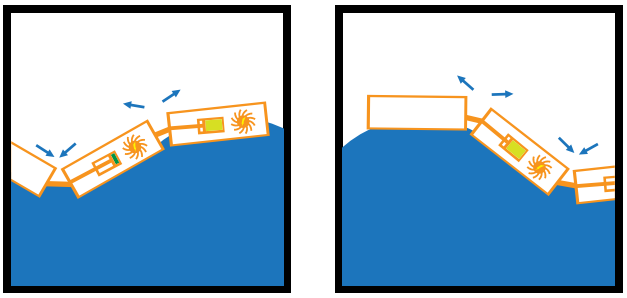
The bulge wave is a rubber tube filled with water. The passing wave causes pressure variations, which create a bulge within the tube. Energy is gathered as the bulge moves, along with the wave, toward a turbine in the bow of the tube.

## 6.) Point Absorber

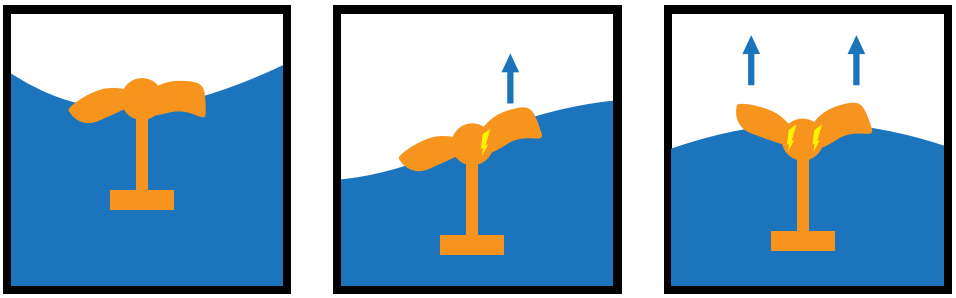


The point absorber is a floating structure that captures energy from the vertical motion of the waves. This up-and-down motion of the device drives generators that create an electric current.

## 7.) Wave Attenuator

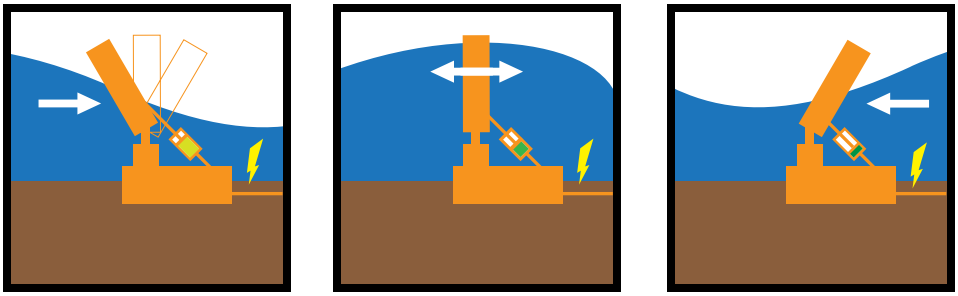


The wave attenuator is a multi-segmented device that captures energy as the motion of the wave causes it to flex where the segments connect. This movement then drives hydraulic pumps or generators.



## 8.) Hybrid Point Absorber /Attenuator

In this hybrid device, energy is generated by the vertical movement of segments attached to a central point. For example, the segments might be attached to drive shafts that turn a rotary generator.



## 9.) Surge Converter

This style of device harnesses wave energy directly from the surging and swelling motion of waves. The oscillation of the device creates mechanical energy.

## Conclusion

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 impacts to existing ocean users. The Northwest National Marine Renewable Energy Center (NNMREC), a project funded by the United States Department of Energy, is tasked with conducting a variety of studies relating to the advancement of understanding in wave energy. For more information on the wave energy research and testing being conducted in the Pacific Northwest, visit http://nnmrec.oregonstate.edu.

*Sources of text:*
*http://nnmrec.oregonstate.edu*
*http://www.emec.org.uk/marine-energy/wave-devices*
*http://www.iea.org*
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