Marine Energy

Marine Energy Potential

Oregon has been identified as an ideal location for wave energy conversion based primarily on its wave resource and coastline transmission capacity. According to a 2011 study by the Electric Policy Research Institute, Oregon's total annual available wave energy in the inner shelf alone is equal to 143 terawatt-hours per year (TWh/yr), or 143 billion kilowatt-hours per year (KWh/yr) which is enough energy to power 28 million homes. State laws, such as our Renewable Portfolio Standard, recognize ocean energy as an eligible resource and as a part of Oregon's community-scale renewable energy future. In 2007, the Oregon Innovation Council (OIC) selected wave energy as an economic innovation focus. As a result of funding from the OIC, the Oregon Wave Energy Trust, a non-profit, public-private partnership was established with the goal of responsible development of wave energy projects in Oregon.

Energy and Transmission Needs

Most of Oregon's electricity demand is west of the Cascades, while electricity generation is east of the Cascades. Transmission lines that cross the Coast Range are all owned by Bonneville Power Administration and transfer power east-to-west. There is no significant power generation on the coast to bolster those lines. Local generating resources can safeguard a system against problems such as outages and overloads and preserve a local utility's ability to deliver electricity to its customers. Marine renewable energy projects can provide a more constant power production than solar or wind because they are relatively constant and change seasonally. The potential for generating wave energy off of Oregon's coast is strongest during the winter months, which coincides with peak electricity demand when coastal electricity load increases to 900 megawatts versus 500 megawatts needed in the summer.

Regulation

Within three nautical miles of the state coastline is the Oregon Territorial Sea which is under the jurisdiction of the state. Beyond the Territorial Sea boundary is the Outer Continental Shelf, which is under federal jurisdiction. If a marine energy project is located in Oregon's Territorial Sea, it must follow the regulatory structure laid out in Part 5 of the Territorial Sea Plan, adopted by the state in January 2013 in addition to other state permits and standards. If a project is in federal waters, it must receive a lease from the Bureau of Ocean Energy Management. In either federal or state waters, a water-driven power plant energy project must receive a license from the Federal Energy Regulatory Commission **(FERC)**; an offshore wind power project is not required to receive a FERC license.

Industry Activity

While wave energy holds substantial potential, both off the northwest coast of the United States and worldwide, the wave energy industry is only in early stages of development. Industry challenges include difficulty in capturing the energy in a usable form, the harsh marine environment, deployment costs, and competing uses of sea space. Oregon State University's Northwest National Marine Renewable Energy Center has become the primary testing center for wave energy device development in the United States. In January 2013, the center selected Newport as the "South Energy Test Site" (SETS) of the Pacific Marine Energy Center. SETS will be located about five miles from shore and will be the second facility in the world where full-scale devices can plug into the electricity grid.

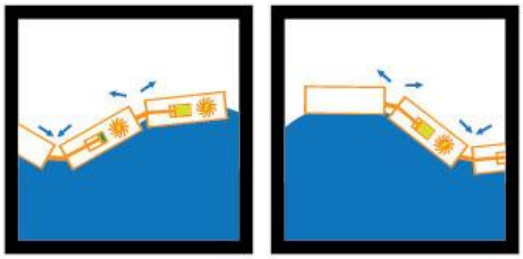
In early 2014, Ocean Power Technology **(OPT)** decided to suspend its Oregon effort to deploy wave buoys at Reedsport. In 2010, 11 state and federal agencies had signed a settlement agreement with OPT. The settlement agreement documented protection, mitigation, and enhancement measures for wave energy development, some of which included burying subsea cables to minimize navigation and fishing hazards, and implementing a spill prevention control plan. The Bureau of Ocean Energy Management **(BOEM)** has given

Principle Power, Inc. approval to submit a formal plan to build five, 6-megawatt floating wind turbine devices about 13 miles off the shore of Coos Bay. Known as the WindFloat Pacific project, this 15-square mile proposed lease area is one of a series of leasing efforts being pursued by BOEM. The Bureau is also conducting research into the renewable energy potential off the Oregon Coast. One study to be completed the summer of 2015 is the Pacific Regional Ocean Uses Atlas www.boem.gov/pr-12-pra/

The Oregon Army National Guard has been exploring options of using marine energy to become energy independent at Camp Rilea near Warrenton.

Examples of Marine Energy Devices

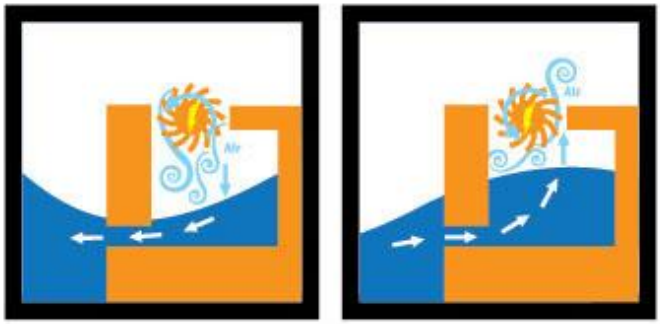
There have been over a hundred conceptual designs of marine energy conversion devices developed but only a few have been built as full-scale prototypes or tested. Currently, oscillating water column, attenuator, overtopping, and point absorbers are the main types of devices that generate or convert energy from waves. Because Oregon's seafloor is much deeper than states like New Jersey, Rhode Island, and Massachusetts, offshore wind installations will likely need to be platform-based. Examples of the different technologies are below.



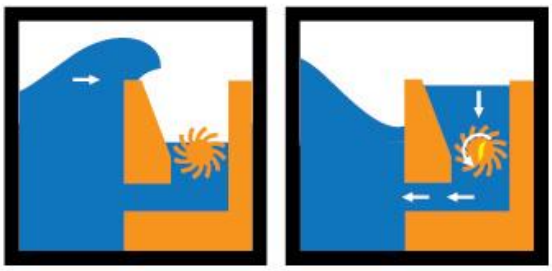
(Northwest National Marine Renewable Energy Center)

Attenuator: These devices are oriented in the direction of incoming waves that cause articulated components to bend and drive generators. Appearing somewhat like semi-submerged "train cars," they are typically moored to the ocean floor on one end. An example of the size of this device is around 390 feet long and 11 feet wide, with about 7 feet above the surface of the water.

Oscillating Water Column: These devices generate power when waves push against a horizontally hinged flap, or are funneled into a structure that causes a water column to rise and fall. These devices may be fixed to the ocean floor, hang from a floating or shoreline structure, or built into harbor jetties. An example size would be put into 20 - 100 foot depths, and be 65 feet wide.



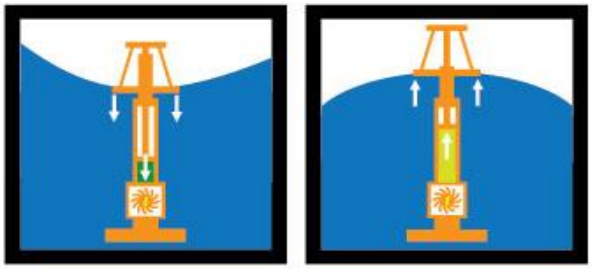
(Northwest National Marine Renewable Energy Center)



(Northwest National Marine Renewable Energy Center)

Overtopping: These devices have a partially submerged structure that funnels the wave over the top of the structure into a reservoir. The water runs back to the sea powering a low-head hydropower turbine. An example prototype is roughly 100 by 200 feet, but may be scalable as large as 700 by 1,200 feet and 65 feet wide.

Point Absorber: A device that captures energy from the vertical motion of the waves; can be floating on surface or attached to the bottom.



(Northwest National Marine Renewable Energy Center)

(Principle Power)

Platform-based offshore wind turbine: Offshore wind turbines are placed on a floating support structure to dampen wave and turbine induced motion, enabling wind turbines to be sited in previously inaccessible locations where water depth exceeds 50m.