Emerging Wave Energy Research and Technologies

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Waves are a concentrated form of solar energy.

Technology to convert wave energy to electrical energy is in its beginning phase.

> 1000 Patents

< 2 MW Installed
Introduction to Wave Energy

New forms of Energy are required!

It is estimated that if 0.2% of the ocean’s untapped energy could be harnessed, it could provide power sufficient for the entire world.

Compared to wind, wave energy has higher energy density, availability (80 – 90%) and predictability.
Power From Ocean Waves

kW/m crest length

Northwest National Marine Renewable Energy Center
Power from Ocean Waves
Available Resource off Oregon Coast

Seasonal variation
Good match for the NW load demand

Data buoys are 2-200 miles off shore, with waves traveling 15-20mph, gives 10+ hours forecast time for wave energy generators located 2 miles out

(wave data From National Data Buoy Center, Power estimated from 5 buoys off the Oregon coast over past 10 years)
Technology

Power-Take-Off
- Air
- Fluid
- Mechanical

Overtopping

Direct Drive
OPT Powerbuoy

Relative motion between a float and spar is mechanically converted to rotary motion, driving a conventional electrical generator.

Previous version used a hydraulic power-take-off, hydraulic cylinders driving a hydraulic motor.
Finavera AquaBuOY

Moving piston pressurizes seawater, water is fed through a hydraulic motor, driving a conventional electrical generator.
Pelamis

Hydraulic cylinders at joints pressurize hydraulic fluid, fluid is fed through a hydraulic motor, driving a conventional electrical generator.
Oceanlinx

Oscillating water column drives air turbine
Wave Dragon

Overtopping device: captures waves and feeds a low pressure hydraulic turbine
OSU’s multidisciplinary wave energy team is pursuing Wave Energy innovation in four thrust areas:

1) Researching novel direct-drive wave energy generators (6th prototype was ocean tested Sept. 2008)

2) Establishment of the National Marine Renewable Energy Center

3) Working closely with the Oregon Wave Energy Trust (OWET) and a variety of stakeholders to promote Oregon as the optimal location for the nation’s first wave energy test and demonstration site

4) Examining the potential biological and ecosystem effects of wave energy systems (HMSC Workshop)
OSU Direct-Drive Wave Generator Development

• Focus on simplification of processes: direct-drive approaches to allow generators to respond directly to the movement of the ocean.

• "Direct" drive describes the direct coupling of the buoy's velocity and force to the generator without the use of hydraulic fluid or air.

• The direct drive approach could either employ magnetic fields for contact-less mechanical energy transmission (flux-linkage), or use a form of mechanical linkage.

• Funding from Columbia Power Technologies, BPA, ONR
Oregon State University
Conceptual Wave Park

Magnetic Shaft
anchored to sea floor

Electric Coil
secured to heaving buoy

Permanent Magnet Linear Generator Buoy
Sea-Beav I off Oregon Coast, October 2007
OSU/CPT Blue Ray off Oregon Coast, September 2008
Oregon’s Leadership Opportunity

- Unique ocean resource
- Established marine community
- Established utility infrastructure
- Excellent reputation for renewable energy and green industry support
- Positive political climate (both state & federal)
- Potential environmental, social and economic impacts must be determined