
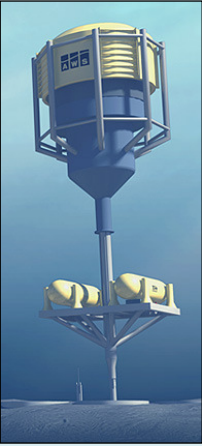

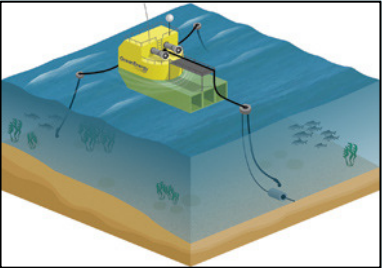









Device Name, Lead Organisation , Website, Country	Technology Type (from classifications i.e. point absorber)	Brief Description and picture	
OFFSHORE TECHNOLOGIES:			
AquaBuOY <i>Finavera Renewables</i> finavera.com/en/wave Ireland	Offshore; Point Absorber <i>Integrates 2 technologies originally from Sweden (IPS Buoy and Hosepump)</i>		<p>The 'AquaBuOY' point absorber integrates aspects of two previous device designs (the IPS Offshore Wave Energy Converter (OWEC) and the Hosepump) both of Sweden. The device comprises a slack-moored float (buoy) and a submerged vertical tube, which is open to sea at both its top and bottom. Incident waves cause the device to heave up and down creating a damping force that acts on a piston attached to two hose pumps, which contract and expand to provide a pumping effect. The hose pumps and separate water masses contained within them react against the heaving motion and convert the oscillatory motion into a high-pressure water flow to drive a turbine and generator.</p>

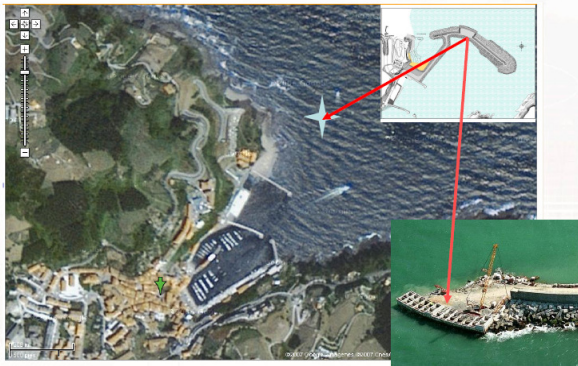

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<p>AWS (Archimedes Wave Swing)</p> <p><i>AWS Ocean Energy Ltd (invented and developed towards pilot plant by Teamwork Technology)</i></p> <p>www.awsoccean.com</p> <p>UK (Scotland) <i>(originally Netherlands)</i></p>	<p>Offshore; Submerged pressure differential</p>	 <p>The AWS (Archimedes Wave Swing) consists of a large air-filled cylinder which is submerged beneath the waves. As a wave crest approaches, the water pressure on the top of the cylinder increases and the upper part or 'float' compresses the air within the cylinder to balance the pressures. The reverse happens as the wave trough passes and the cylinder expands. The relative movement between the float and the fixed lower part or basement is converted directly to electricity by means of an innovative hydraulic system; in the pilot plant in Portugal, 2004, a linear generator was successfully tested. Variable frequency output is converted to utility grade power using an IGBT converter.</p>
<p>FO3</p> <p><i>Fobox AS</i></p> <p>No website</p> <p>Norway</p>	<p>Offshore</p>	 <p>The FO3 has 21 point absorbers mounted in vertical hydraulic cylinders which work in both directions. The vertical movements of the floating point absorbers will be transformed to hydraulic pressure. The hydraulic pressure is used to generate power by generators and numerical calculations.</p>

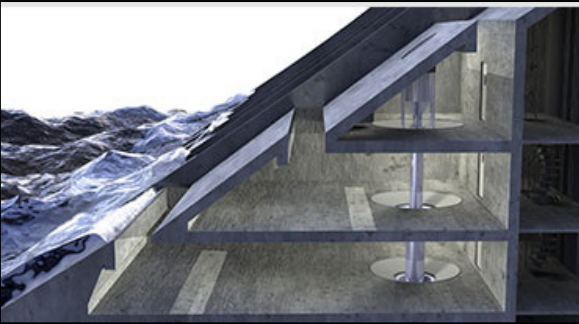

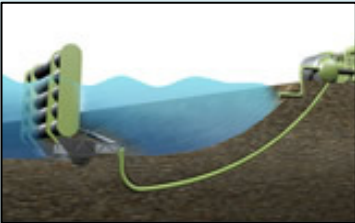
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<p>OE Buoy (Ocean Energy Buoy)</p> <p><i>Ocean Energy Ltd.</i></p> <p>www.oceanenergy.ie</p> <p>Ireland</p>	<p>Offshore; Oscillating water column</p>	 <p>The OE Buoy is an oscillating water column device, where the air in the chamber is pumped out and drawn in through the turbine duct by the movement of the water free surface within the device. Motions of the hull enhance the relative surface movement and increase the air flow.</p> <p>The power take-off system is an air turbine which converts the flowing air into rotational energy which drives the generator. All of the power take-off is above the waterline and not in direct contact with the seawater.</p>
<p>Pelamis</p> <p><i>Pelamis Wave Power Ltd</i></p> <p>www.pelamiswave.com</p> <p>UK (Scotland)</p>	<p>Offshore; Attenuator</p>	 <p>The Pelamis Wave Energy Converter is a semi-submerged, articulated structure composed of cylindrical sections linked by hinged joints. The wave-induced motion of these joints is resisted by hydraulic rams, which pump high-pressure oil through hydraulic motors. The hydraulic motors drive electrical generators to produce electricity. The Pelamis is designed to be flexibly moored in waters approximately 50-70m in depth.</p>


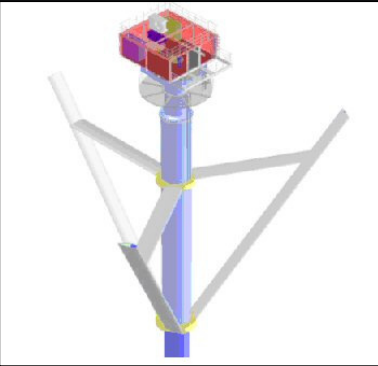
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<p>PowerBuoyTM</p> <p><i>Ocean Power Technologies Inc. (OPT)</i></p> <p>www.oceanpowertechnologies.com/</p> <p>USA</p>	<p>Offshore; Point Absorber</p>	 <p>The PowerBuoy is a free-floating point absorber wave energy converter that is loosely moored to the seabed; the buoy's float moves up and down on the central spar as the waves pass. This mechanical movement drives a hydraulic pump that forces hydraulic fluid through a rotary motor connected to an electrical generator.</p>
<p>SperBOY</p> <p><i>Embley Energy</i></p> <p>www.sperboy.com</p> <p>UK (Cornwall)</p>	<p>Offshore; Point Absorber</p>	 <p>The Sperboy is a floating buoy Oscillating Water Column (OWC) device consisting of a buoyant structure with a submerged & enclosed column. Housed above the OWC on top of the buoy is all the plant, turbines, generators and associated system facilities. The principle of operation is similar to that of fixed OWC's designed for shoreline and fixed installations. Except that a) the device is capable of deployment in deep water to maximize greatest energy source and, b) the entire body floats and maintains optimum hydrodynamic interactions for the prevailing and changing wave spectrum producing high energy capture at minimal cost.</p>

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<p>Wave Dragon</p> <p><i>Wave Dragon Aps</i></p> <p>www.wavedragon.net</p> <p>Denmark</p>	<p>Offshore; Overtopping device</p>	 <p>The Wave Dragon is a slack-moored, overtopping wave energy converter. Two curved arms focus waves onto a central ramp which the waves travel up and 'overtop' into a reservoir. At the bottom of the reservoir is a set of low-head hydro turbines, through which the collected water flows back out to sea. The reservoir has a smoothing effect on the water flow, and the turbines are coupled directly to variable speed generators. Since the head of water in the reservoir accounts for the energy, the concept is similar to a hydroelectric power plant.</p>
<p>Wavebob</p> <p><i>Wavebob Ltd.</i></p> <p>www.wavebob.com</p> <p>Ireland</p>	<p>Offshore; Point Absorber</p>	 <p>Wavebob is a freely floating axi-symmetric point absorber capable of resonating across any pre-determined range of wave frequencies and band widths. It may then be tuned to the prevailing wave climate using a proprietary system to change the device's natural resonance frequencies without changing draught. This may be set seasonally or much more frequently as may be justified economically. The instantaneous response of the Wavebob is adjusted rapidly and in real time (during each wave) via the hydraulic PTO by an on-board autonomous control system so that useful power output is maximised.</p>

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COASTAL & NEARSHORE TECHNOLOGIES		
<p>Energetech OWC</p> <p><i>Oceanlinx</i></p> <p>www.oceanlinx.com/</p> <p>Australia</p>	<p>Coastal/near shore Oscillating Water Column</p>	 <p>The Energetech OWC device is a near-shore bottom-standing oscillating water column rated 500 kW, developed by the Australian start-up company Energetech. The device has two particularities, namely the especially developed Denniss-Ault turbine and the structure that was made entirely of steel, including the parabolic-shaped steel arms forming a harbor for tuning the device better to incident waves.</p> <p>The device was placed on the sea bottom in front of the breakwater of Port Kembla, Eastern Australia, where a reef prevents high extreme loads due to wave impacts.</p> <p>The company was re-named into Oxeanlinx and is presently working on the development of an offshore version, apparently resembling a tension-leg platform principle.</p>
<p>LIMPET OWC</p> <p><i>Wavegen Ltd (owned by Voith Siemens,)</i></p> <p>www.wavegen.co.uk</p> <p>UK</p>	<p>Onshore; Oscillating water column</p>	 <p>The LIMPET OWC is a 250kW onshore oscillating water column device, which was developed as a follow-up for the successful Islay plant at the same location. LIMPET was installed between 1998 and 2000 on the Isle of Islay off the west coast of Scotland. It was initially designed for 2*250kW=500kW. An interesting lesson learnt for OWC operation in general was that in the beginning of operation, the developers were obliged to introduce a sound muffler, as nearby population complained about the noise.</p>

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<p>Mutriku Breakwater MOWC</p> <p><i>EVE (Ente Vasco de la Energia)</i></p> <p>www.fedarene.org/publications/Projects/NEREIDA/NEREIDA - 1st e-Newsletter/Nereida - e-Newsletter 1.htm</p> <p>Spain (Bask Country)</p>	<p>Coastal/near shore Multi Oscillating Water Column</p>	 <p>The MOWC project wants to demonstrate the successful incorporation of OWC technology with Wells turbine power take-off into a newly constructed rubble mound breakwater in Mutriku, in the North coast of Spain.</p>
<p>Pico OWC</p> <p><i>Wave Energy Centre</i></p> <p>www.pico-owc.net</p> <p>Portugal (Azores)</p>	<p>Coastal Oscillating Water Column</p>	 <p>The PICO OWC is a European Pilot Plant based in the oscillating water column principle. The Pico Plant is located in the Pico island, Azores, Portugal. Its construction was concluded in 1999.</p> <p>This plant consists of a hollow reinforced concrete structure – a pneumatic chamber - above the water free surface that communicates with the sea and the incident waves by a submerged opening in its front wall, and with the atmosphere by a fiber duct with a Wells turbine.</p> <p>Up-and down- movement of water column inside chamber makes air flow to and from the atmosphere. The turbine is symmetric and is driven indifferently in which direction the air flows.</p>
<p>SSG</p> <p><i>Waveenergy AS</i></p> <p>www.waveenergy.no</p>	<p>Coastal or near-shore Overtopping Device</p>	<p>The SSG (sea Slot-cone Generator) is an overtopping wave energy converter. It consists of three reservoirs on top of each other where the overtopping water from the incoming waves is temporarily stored at a higher level than the sea water level.</p>

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Norway		 <p>The potential power of the water in the reservoirs is then transformed in electricity by low-head turbines.</p>
Wave Star <i>Wave Star Energy</i> www.wavestarenergy.dk Denmark	Near-shore; multi- Point Absorber	 <p>Wave Star Energy's wave machine is a so-called multi point absorber. That means a machine equipped with a number of floats which are moved by the waves to activate cylinders, which press oil into a common transmission system, the pressure of which drives a hydraulic motor. The motor, in turn, drives the generator of the wave machine.</p> <p>In the event of a storm the floats are lifted to a safe position – on the large-scale machine they will hang 20 metres above the surface. A sensor on the seabed ahead of the machine measures the waves and ensures that the storm security system is automatically activated. The machine can be remotely controlled via the Internet (VPN connection).</p>
Oyster <i>Aquamarine .</i> www.aquamarinepower.com Northern Ireland	Near shore; Oscillating Wave Surge Converter	 <p>Oyster is a near-shore bottom-mounted device designed to interact efficiently with the dominant surge forces in shallow water waves.</p> <p>The principle consists of an oscillating module fixed to the seabed in depths of 12m at the mean water level. The module extracts the energy from passing waves and transmits it as seawater hydraulic</p>

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		power to a hydro-electric power conversion unit, located onshore.
Waveroller <i>AW Energy Oy.</i> www.aw-energy.com Finland	Near shore; Oscillating Wave Surge Converter	 <p>A WaveRoller device is a plate anchored on the sea bottom by its lower part. The back and forth movement of bottom waves moves the plate, and the kinetic energy produced is collected by a piston pump. This energy can be converted to electricity either by a generator linked to the WaveRoller unit, or by a closed hydraulic system in combination with a generator/hydraulic motor system. A WaveRoller plant is composed by a number of production modules. Each production module consists of 3 wave elements.</p>
Waverotor <i>Ecofys.</i> www.ecofys.nl Denmark	Submerged Pressure Differential	 <p>The Wave Rotor captures wave energy from the circulating water particles in the waves and also tidal currents. The circular currents can directly drive the rotor. The waves turn the rotor with sufficient torque for power to be taken off by a conventional generator coupled via a gearbox to the vertical shaft. This requires the waves to exert forces on the blades and the combination of blades shown (both a Darrieus arrangement and blades perpendicular to the shaft) is intended to optimise these forces. The power is transferred to the rotating shaft directly, albeit at slow speed. Two types of rotors are combined: a Darrieus rotor and a Wells rotor. These are respectively omni- and bi-directional rotors, which can operate in currents of changing directions.</p>