

Las transparencias son el material de apoyo del profesor para impartir la clase. No son apuntes de la asignatura. Al alumno le pueden servir como guía para recopilar información (libros, ...) y elaborar sus propios apuntes

Departamento: Ingeniería Eléctrica y Energética
 Área: Máquinas y Motores Térmicos

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 Tlfn: ETSN 942 20 13 44 / ETSIIT 942 20 13 82

- Introducción
- Panorama Energético Nacional
- Algunas “Curiosidades”
- Las EERR en la Unión Europea
- Visión de las Energías Renovables
- Búsqueda de Información Científica
- Energías de las Olas, Mareas y Corrientes
- **Tecnologías de Aprovechamiento**
- Turbinas Hidráulicas
- Energía Térmica Marina
- Velas
- Algas Marinas

Parte 1^a

Parte 2^a

Parte 3^a

Parte 4^a

Parte 5^a

Parte 6^a

Parte 7^a

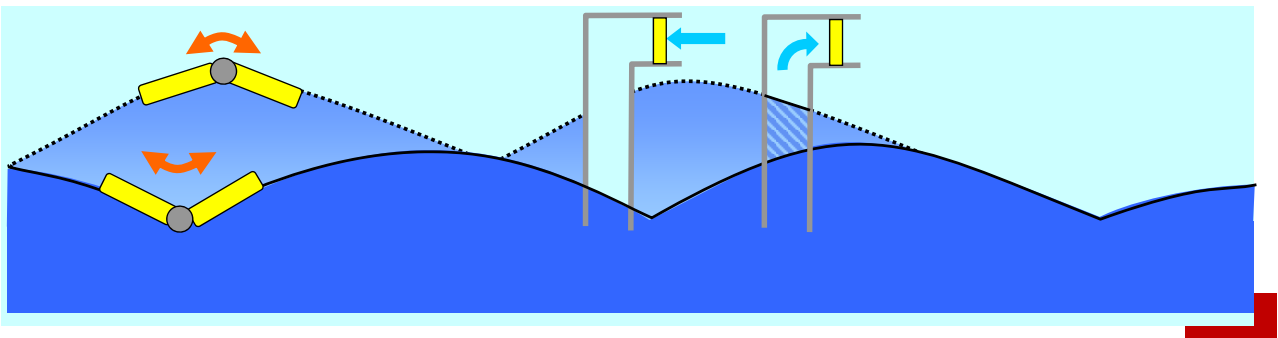
Parte 8^a

Virtual

Virtual

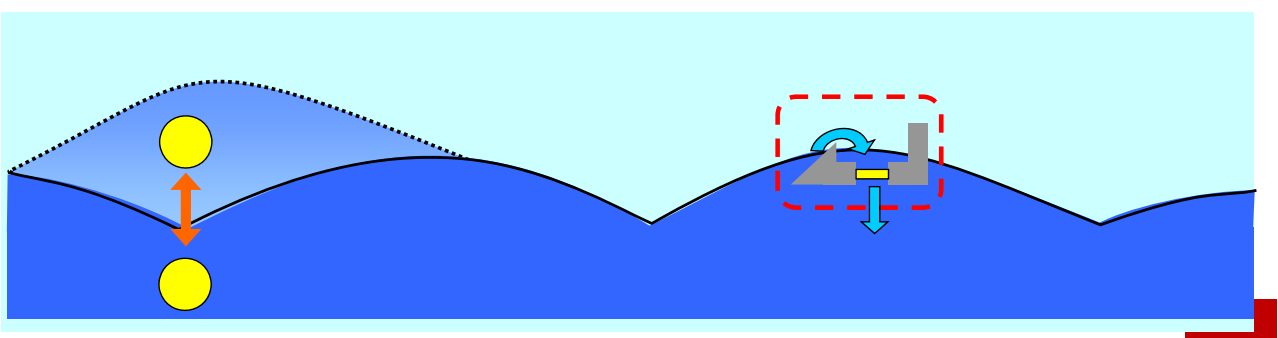
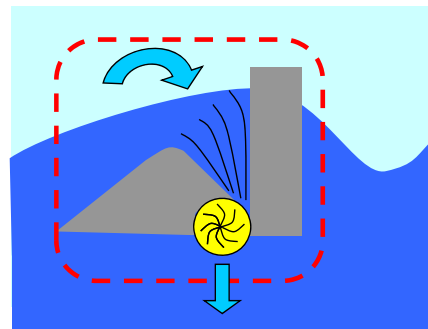
Tecnologías de Aprovechamiento de la Energía de las Olas

- Attenuators (surface following)
- Oscillating Water Columns (OWC)



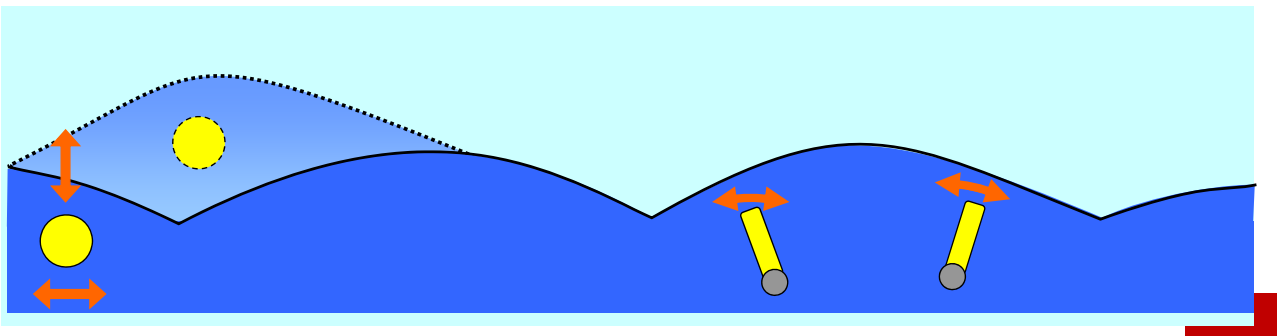
Tecnologías de Aprovechamiento de la Energía de las Olas

- Attenuators (surface following)
- Oscillating Water Columns (OWC)
- Oscillating Wave Surge Converter
- Overtopping Devices



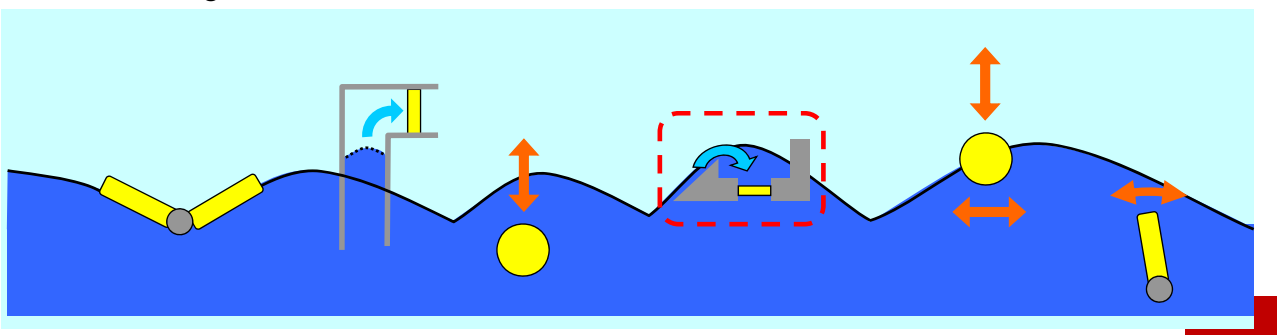
Tecnologías de Aprovechamiento de la Energía de las Olas

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- Point Absorbers
- Submerged Pressure Differential

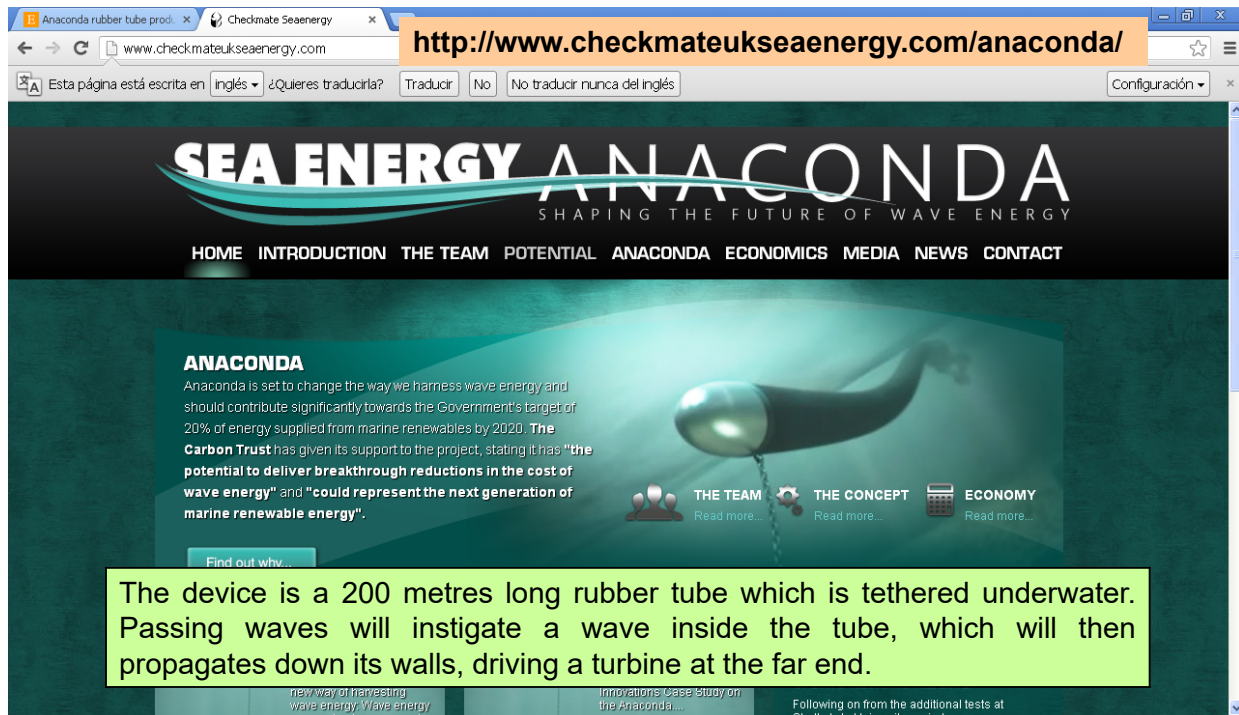


Tecnologías de Aprovechamiento de la Energía de las Olas

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- Submerged Pressure Differential



Anaconda Wave Energy Converter



http://www.checkmateukseaenergy.com/anaconda/

SEA ENERGY ANACONDA
SHAPING THE FUTURE OF WAVE ENERGY

HOME INTRODUCTION THE TEAM POTENTIAL ANACONDA ECONOMICS MEDIA NEWS CONTACT

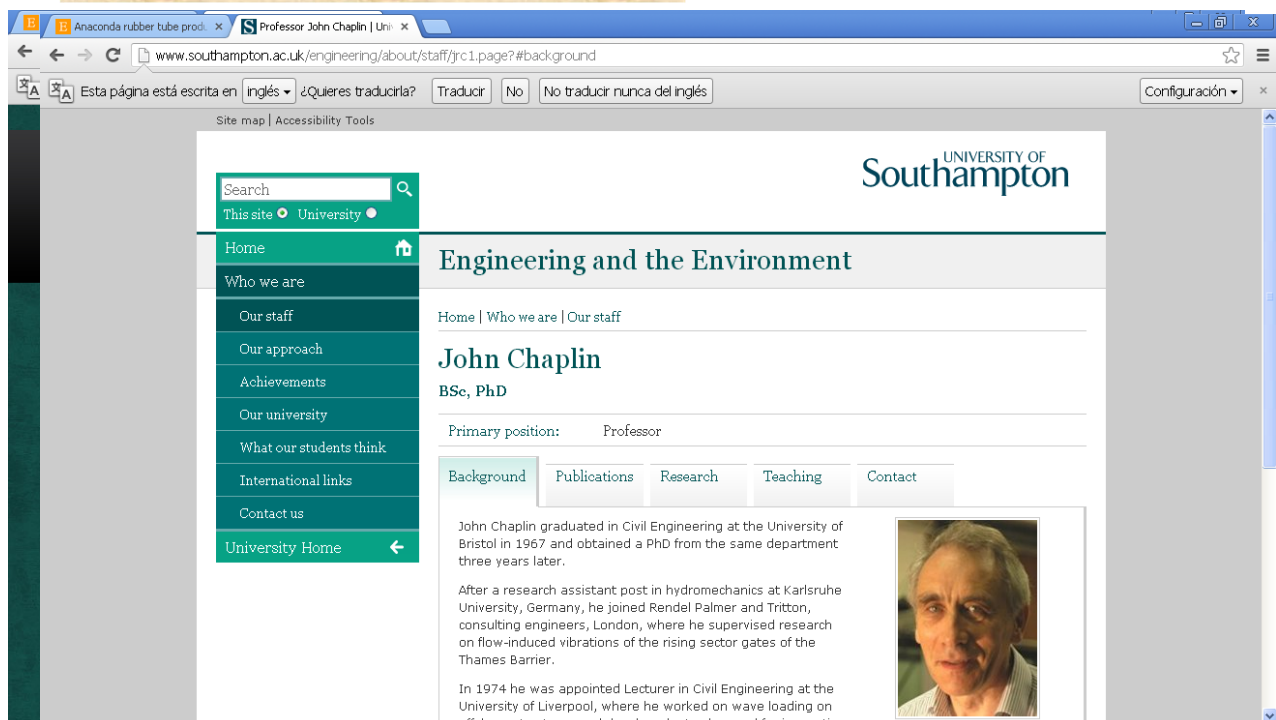
ANACONDA
Anaconda is set to change the way we harness wave energy and should contribute significantly towards the Government's target of 20% of energy supplied from marine renewables by 2020. **The Carbon Trust** has given its support to the project, stating it has "the potential to deliver breakthrough reductions in the cost of wave energy" and "could represent the next generation of marine renewable energy".

THE TEAM THE CONCEPT ECONOMY

Find out why...

The device is a 200 metres long rubber tube which is tethered underwater. Passing waves will instigate a wave inside the tube, which will then propagates down its walls, driving a turbine at the far end.

Anaconda Wave Energy Converter



www.southampton.ac.uk/engineering/about/staff/jrc1.page?#background

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UNIVERSITY OF
Southampton

Engineering and the Environment

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John Chaplin
BSc, PhD

Primary position: Professor

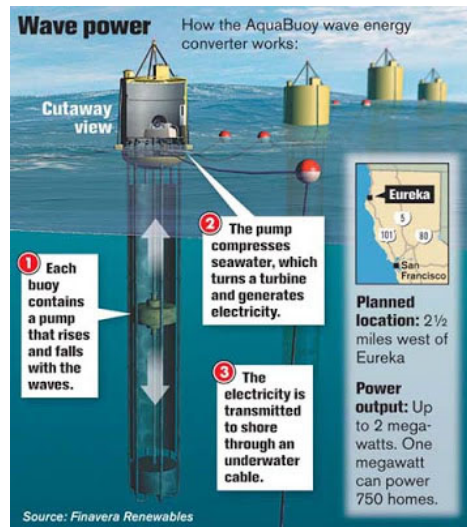
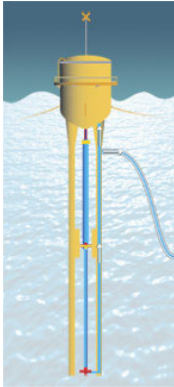
Background Publications Research Teaching Contact

John Chaplin graduated in Civil Engineering at the University of Bristol in 1967 and obtained a PhD from the same department three years later.

After a research assistant post in hydromechanics at Karlsruhe University, Germany, he joined Rendel Palmer and Tritton, consulting engineers, London, where he supervised research on flow-induced vibrations of the rising sector gates of the Thames Barrier.

In 1974 he was appointed Lecturer in Civil Engineering at the University of Liverpool, where he worked on wave loading on offshore structures and developed a track record for innovative

AquaBuoy

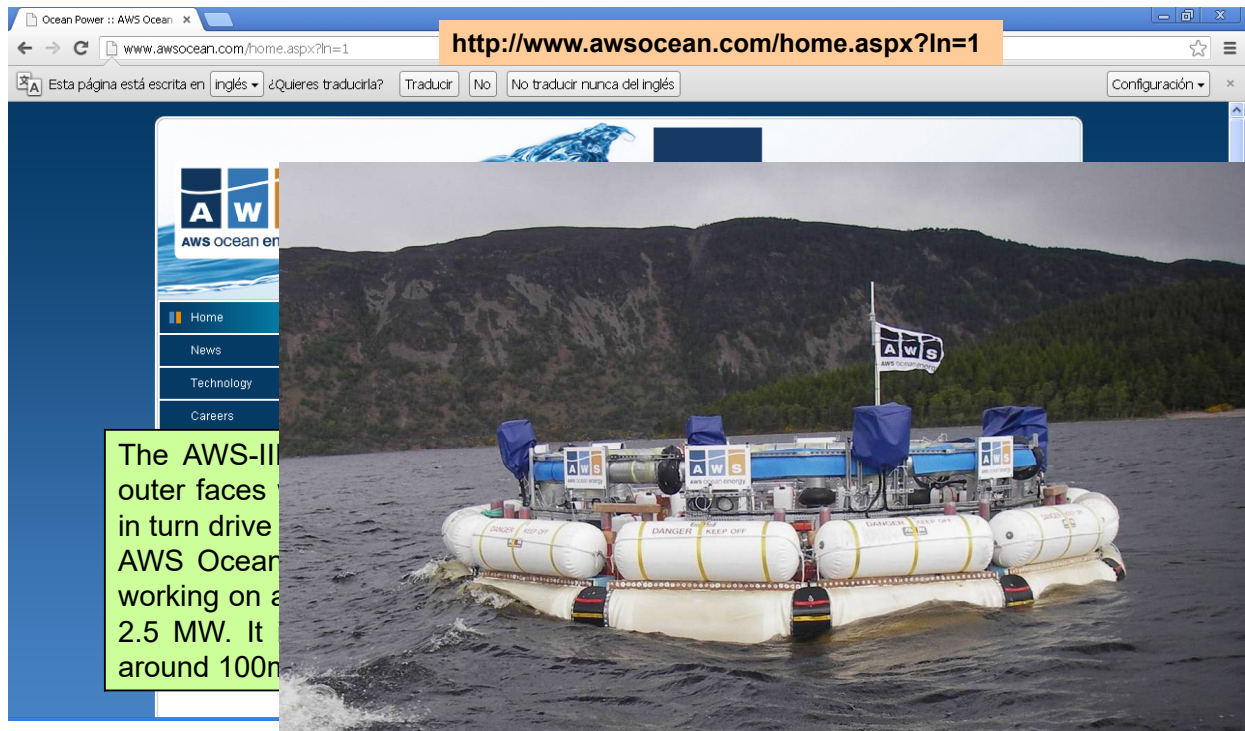


Energy transfer takes place by converting the vertical component of wave kinetic energy into pressurized seawater by means of two-stroke hose pumps. Pressurized seawater is directed into a conversion system consisting of a turbine driving an electrical generator. The power is transmitted to shore by means of an undersea transmission line

AWS-III

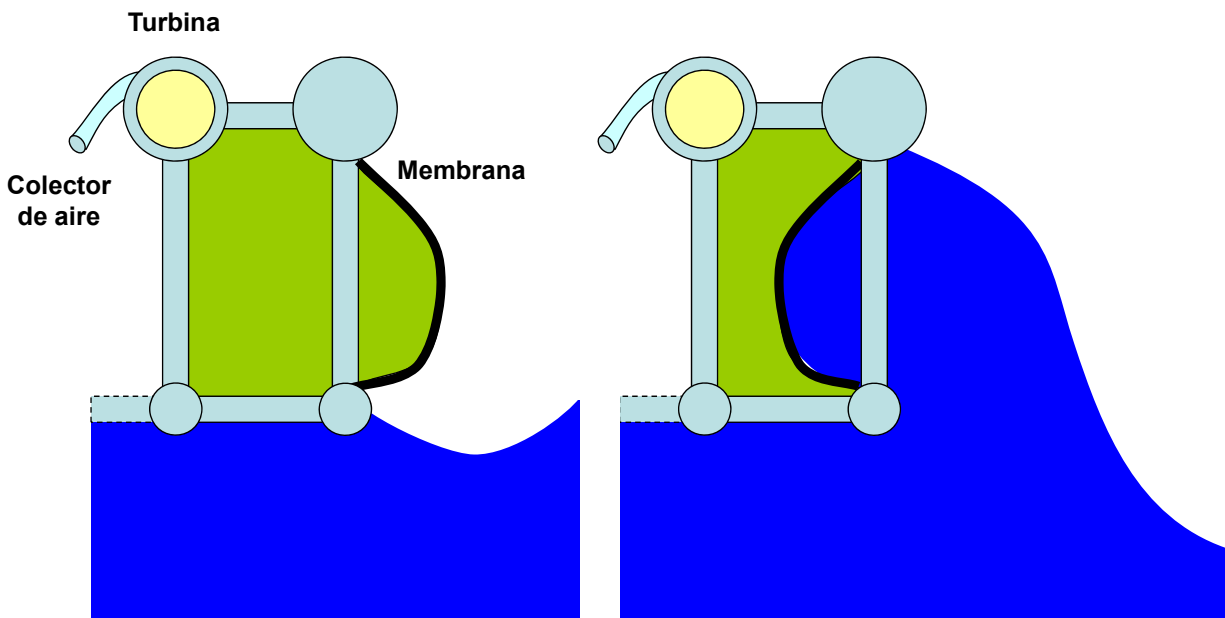
The AWS-III is a floating toroidal vessel. It has rubber membranes on the outer faces which deform as waves pass, moving air inside chambers which in turn drive air-turbines to generate electricity. AWS Ocean tested a 1/9 scale model in Loch Ness in 2010, and are now working on a full sized version which will be 60m across and should generate 2.5 MW. It is envisage these will be installed in offshore farms moored in around 100m depth of water.

AWS-III



AWS-III

Sistema Clam



CETO Wave Power

Renewable Power from the Ocean's Waves

Carnegie Wave Energy Limited (ASX:CWE) is focused on developing and commercialising its 100% owned CETO wave energy technology which is capable of producing zero-emission power and direct desalinated water.

People We Work With

Australian Government
Department of Defence

Announcements

[Carnegie Signs Cooperation Agreement with Water Corporation 27.08.2013](#)

You are invited to hear an

The device consists of a single piston pump attached to the sea floor with a float (buoy) tethered to the piston. Waves cause the float to rise and fall, generating pressurized water, which is piped to an onshore facility to drive hydraulic generators or run reverse osmosis water desalination.

\$193,905 grant payment from the Australian Federal Government for the Perth Wave Energy Project

CETO Wave Power

Buoyant Actuator
Captures wave energy using a floating buoyant actuator. The buoyant actuator is a large, spherical, inflatable structure that rises and falls with the waves. It is connected to the pump by a tether. The buoyant actuator is made of a high-strength, flexible material that can withstand the forces of the waves. It is also equipped with a pressure relief valve to prevent over-pressurization.

Connectors
SA Connector connects the tether to the Buoyant Actuator
Pump Connector connects the tether to the pump
Made of steel

Pump
High pressure rated stainless steel cylinder
Converts wave energy into useful and transportable hydraulic energy
Adapted from offshore oil and gas mooring applications

Attachment
Attaches the Pump to the Foundation
Provides the CETO unit the required flexibility to move with the wave motion and to operate equally well irrespective of wave direction
Adapted from offshore oil and gas mooring applications

Foundation
Anchors the CETO unit to the ocean floor
Drilled and grouted pile foundation
Utilises standard offshore design and construction techniques

Tether
Transfers energy from the Buoyant Actuator to the Pump
Adapted from offshore oil and gas mooring
The flexibility of the tether minimises unwanted loads on the system

The device consists of a single piston pump attached to the sea floor with a float (buoy) tethered to the piston. Waves cause the float to rise and fall, generating pressurized water, which is piped to an onshore facility to drive hydraulic generators or run reverse osmosis water desalination.

Federal Government for the Perth Wave Energy Project

CETO Wave Power

CONCEPT

Wave-driven pumps → Pipelines deliver high pressure water ashore → Driving proven hydroelectric generators

Buoys
Captures wave energy and by pulling on a flexible tether, raises the onshore mounted pumps.

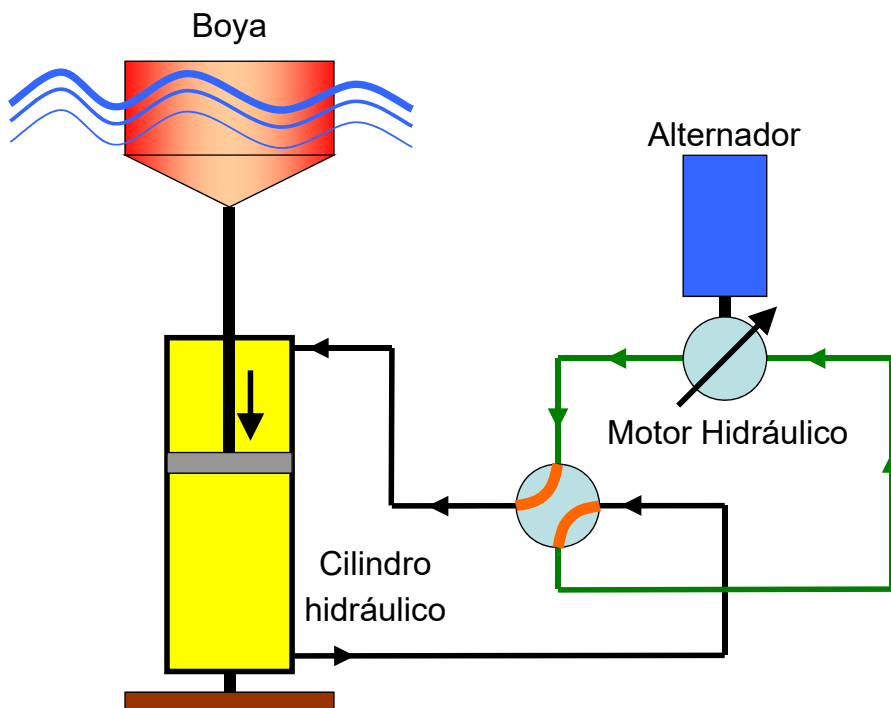
Connectors
Connects the buoys to the pump.

Pump
Used to raise high pressure water to the onshore power plant.

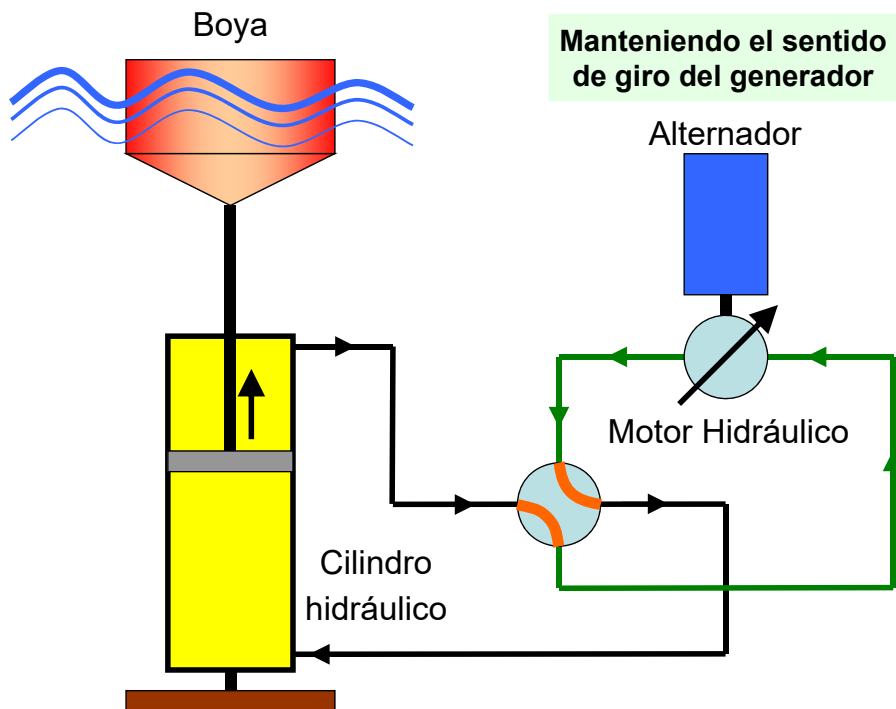
Attachment
Connects the pump to the foundation.

Not to scale
© Carnegie Wave Energy Limited

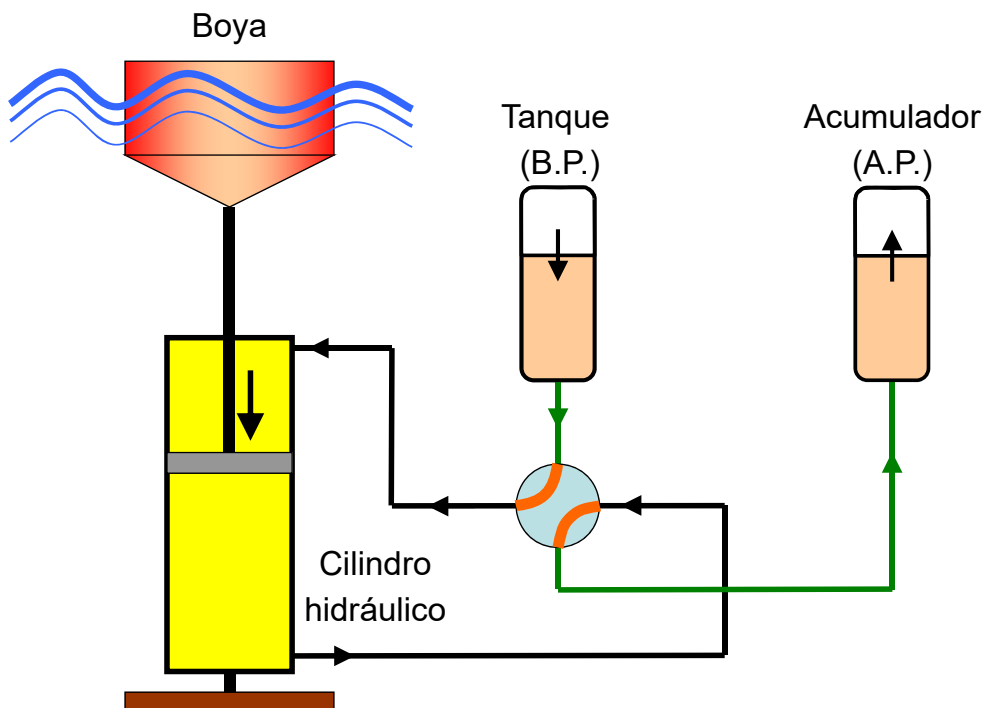
Producción de electricidad



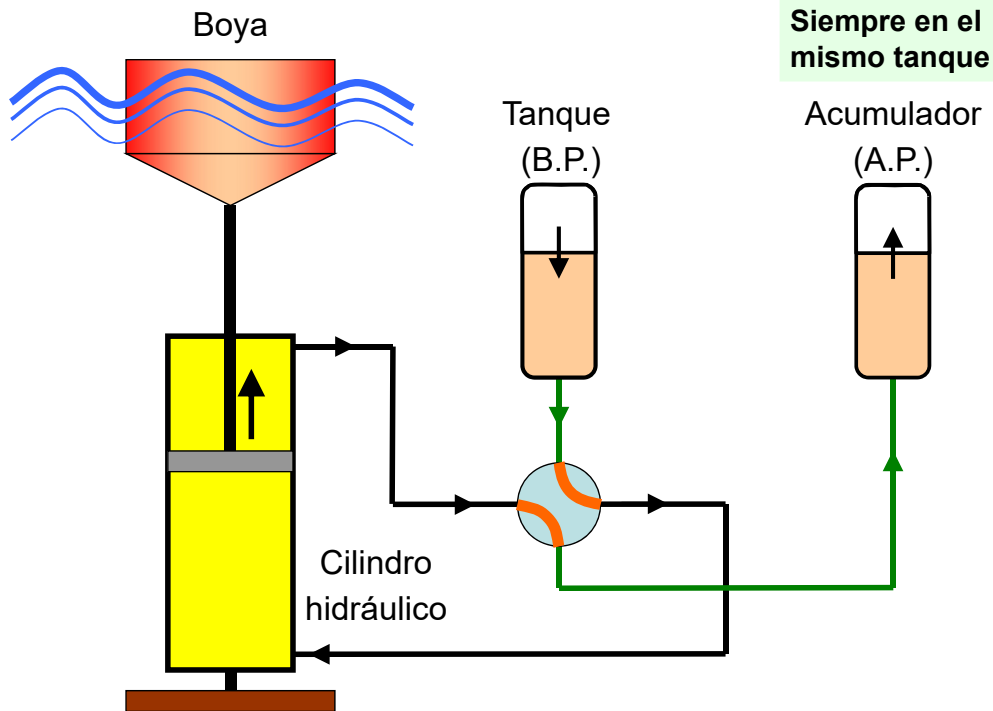
Producción de electricidad



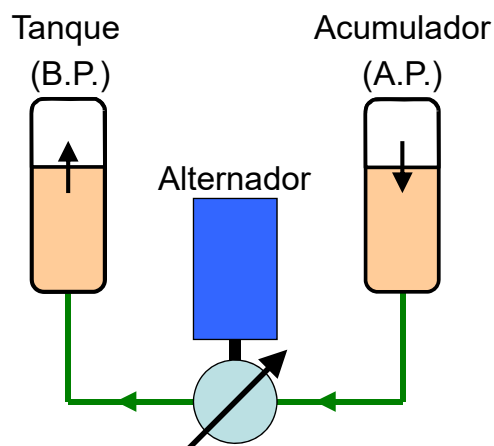
Acumular energía

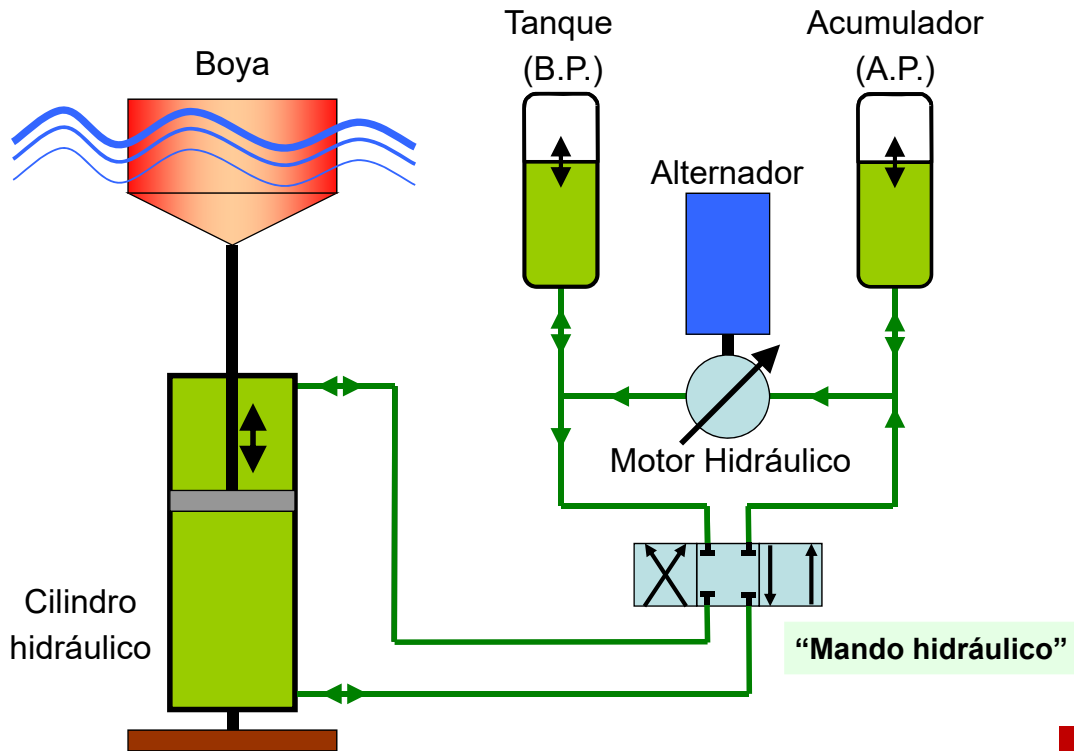


Acumular energía



Producir energía eléctrica





Cycloidal Wave Energy Converter

Atargis Energy Corporation

Ocean Wave Energy

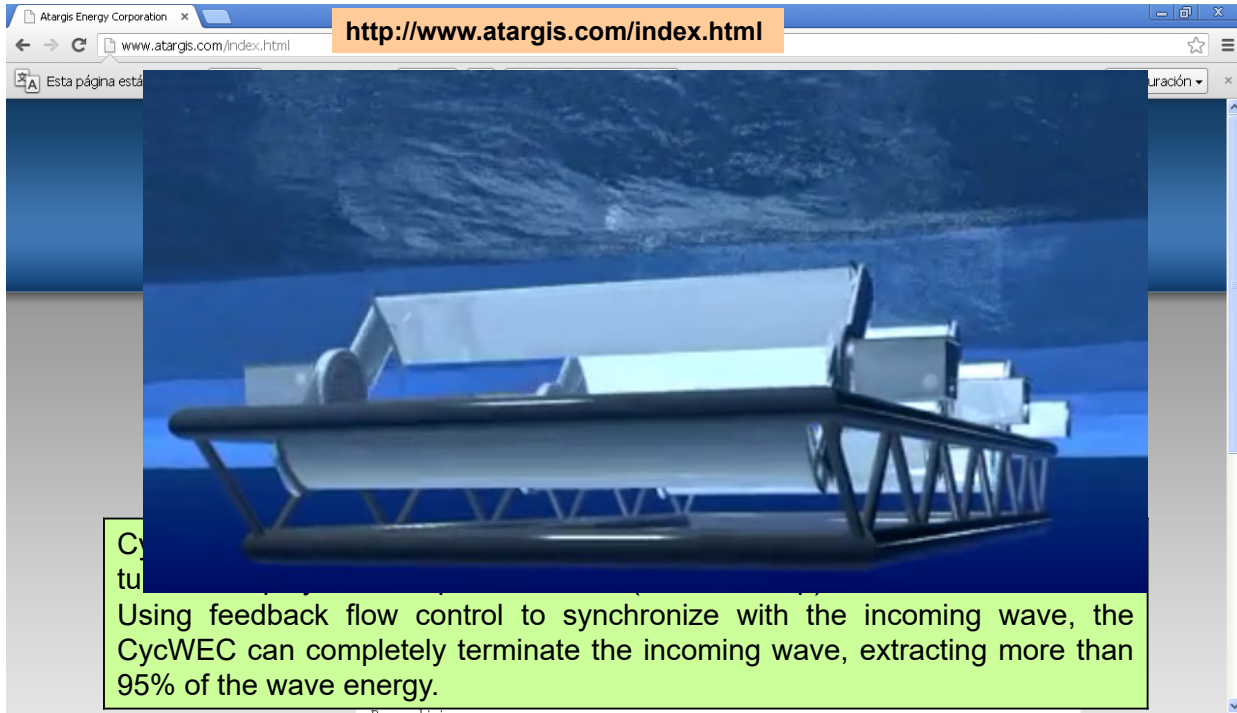
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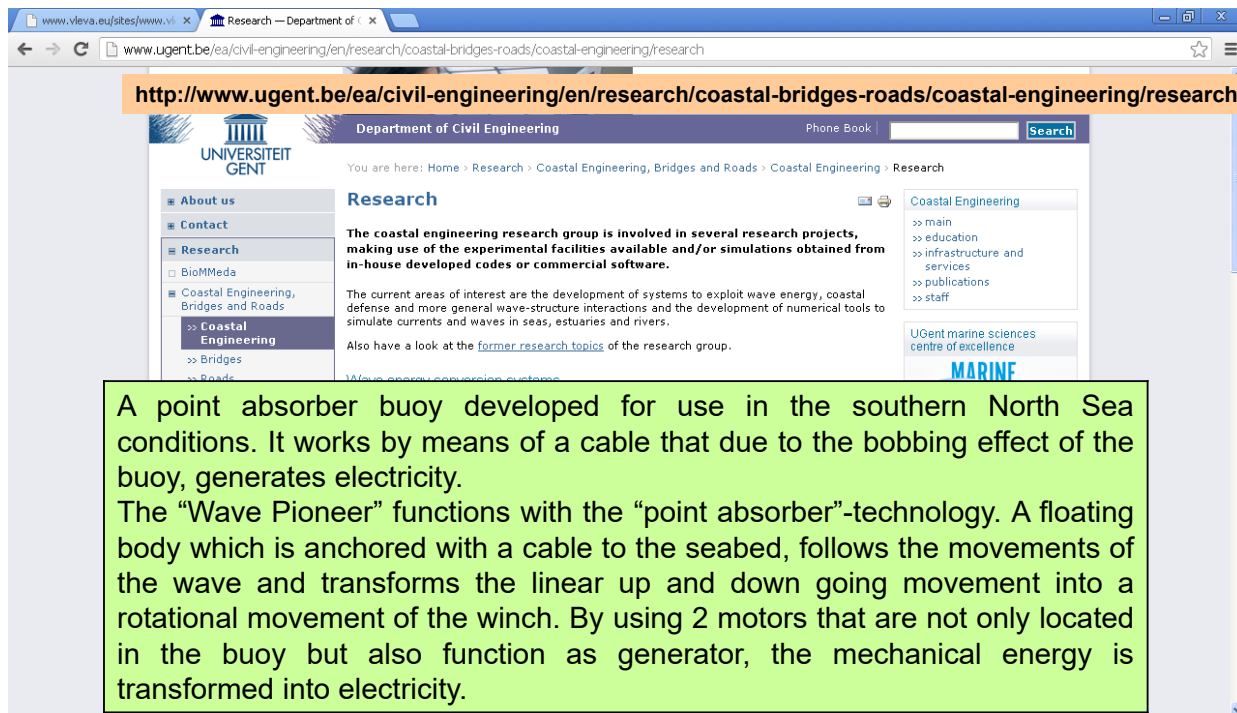
Cycloidal Wave Energy Converter (CycWEC) uses two-bladed, horizontal axis turbines deployed in deep ocean water (~100 m deep). Using feedback flow control to synchronize with the incoming wave, the CycWEC can completely terminate the incoming wave, extracting more than 95% of the wave energy.

Cycloidal Wave Energy Converter



Using feedback flow control to synchronize with the incoming wave, the CycWEC can completely terminate the incoming wave, extracting more than 95% of the wave energy.

FlanSea (Flanders Electricity from the Sea)



A point absorber buoy developed for use in the southern North Sea conditions. It works by means of a cable that due to the bobbing effect of the buoy, generates electricity.

The “Wave Pioneer” functions with the “point absorber”-technology. A floating body which is anchored with a cable to the seabed, follows the movements of the wave and transforms the linear up and down going movement into a rotational movement of the winch. By using 2 motors that are not only located in the buoy but also function as generator, the mechanical energy is transformed into electricity.

FlanSea (Flanders Electricity from the Sea)

<http://www.ugent.be/ea/civil-engineering/en/research/>

Department of Civil Engineering

You are here: Home > Research > Coastal Engineering, Bridges and Roads

Research

The coastal engineering research group is involved in making use of the experimental facilities available and in-house developed codes or commercial software.

The current areas of interest are the development of systems to defend and more general wave-structure interactions and the simulation of currents and waves in seas, estuaries and rivers.

Also have a look at the [former research topics](#) of the research group.

[Wave energy conversion systems](#)

A point absorber buoy developed for use in deep water conditions. It works by means of a cable that connects the buoy, generates electricity.

The “Wave Pioneer” functions with the “point absorber” body which is anchored with a cable to the seabed. The wave and transforms the linear up and down movement into a rotational movement of the winch. By using 2 turbines in the buoy but also function as generator. The energy is transformed into electricity.

Islay LIMPET

<http://voith.com/en/products-services/hydro-power/ocean-energies/wave-power-plants-590.html>

Group Insights Markets & Industries Products & Services Press

Wave power plants

Products & Services > Wave power plants

Overview
Video
Types of power plants

Technology: Oscillating water column

With this technology, sea water turbines do not come into contact with the water. Instead, a column of air is set in motion which drives the turbine. The power plant works in the following manner: The waves spill into a hollow chamber. This compresses and calms the air column in a similar way to how an air pump works. The power plant then uses the pressure difference is then turned into rotary energy in a turbine (named after its inventor). This is in turn passed to a generator to produce electricity.

This means that the turbine has the air periodically flow through it from both sides, depending on whether the device is “breathing” in or out. Because of the special design of the turbine, it can generate power in both directions.

ISLAY WAVE POWER STATION

- 1 Wave capture chamber set into rock face
- 2 Tidal power forces water into chamber
- 3 Air alternately compressed and decompressed by “oscillating water column”
- 4 Rushes of air drive the Wells Turbine, creating power

500 kW shoreline device uses an oscillating water column to drive air in and out of a pressure chamber through a Wells turbine.

Islay LIMPET

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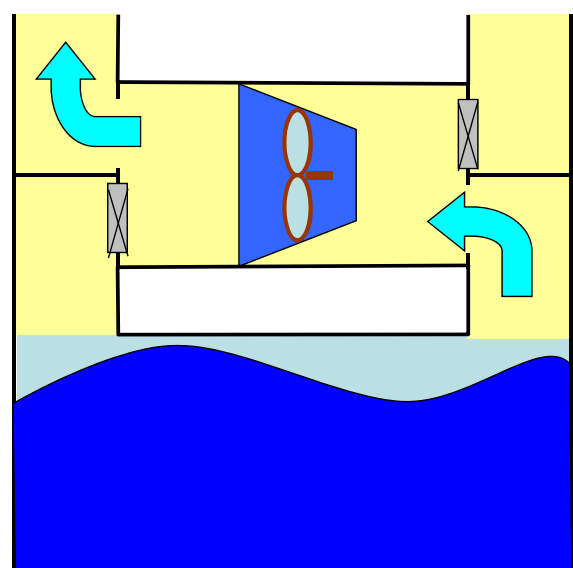
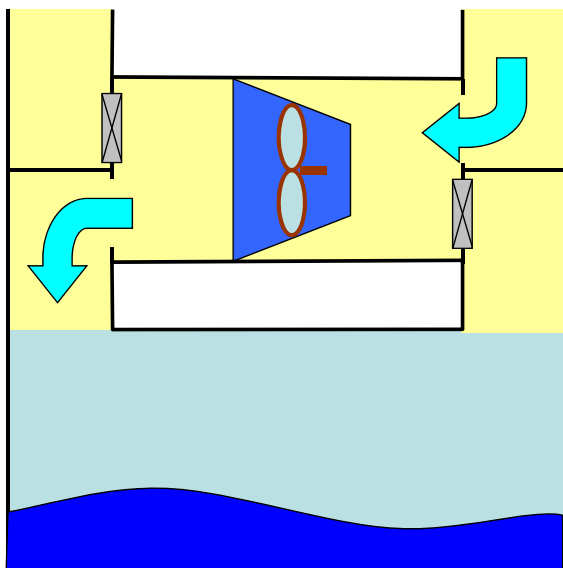
LIMPET

LIMPET is a fixed structure shoreline Oscillating Water Column (OWC) wave power plant that operates with a pneumatic turbine. A 500 kW prototype unit was installed at Isle of Islay, Scotland in 2000, and this has been extensively researched, publicised and internationally recognized. For further information about LIMPET click [here](#).

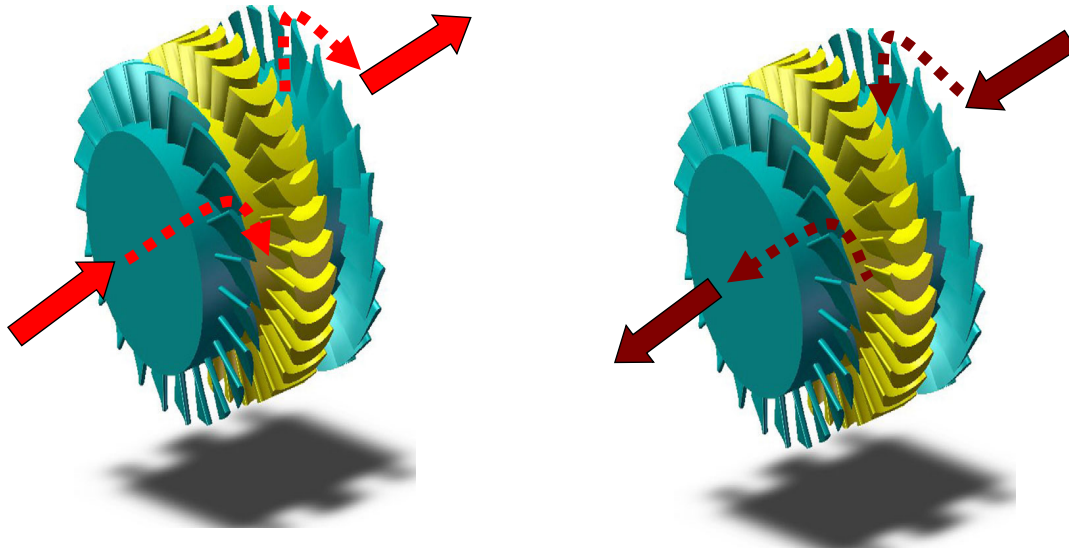
For further information, please contact:
Prof Trevor Whittaker
Environmental Engineering Research Centre (EERC)
School of Planning, Architecture and Civil Engineering
Tel: +44 (0) 28 9097 4031
E-mail: twhittaker@qub.ac.uk

500 kW shoreline device uses an oscillating water column to drive air in and out of a pressure chamber through a Wells turbine.

Mantenimiento del sentido de giro Compuertas en el aire

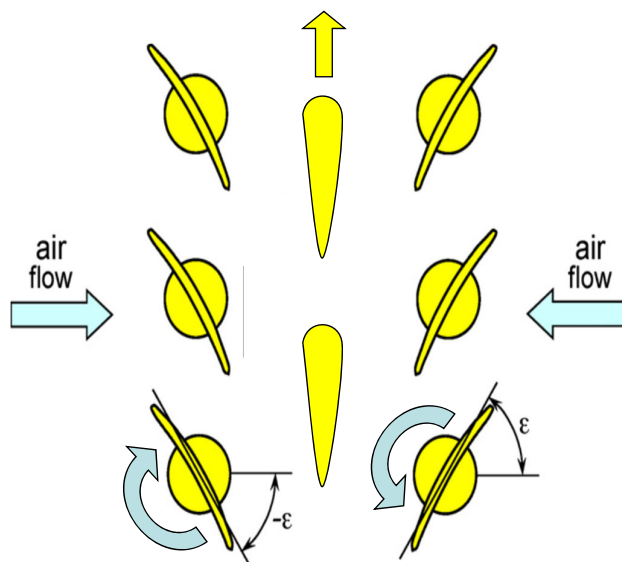


Mantenimiento del sentido de giro Alabes directores



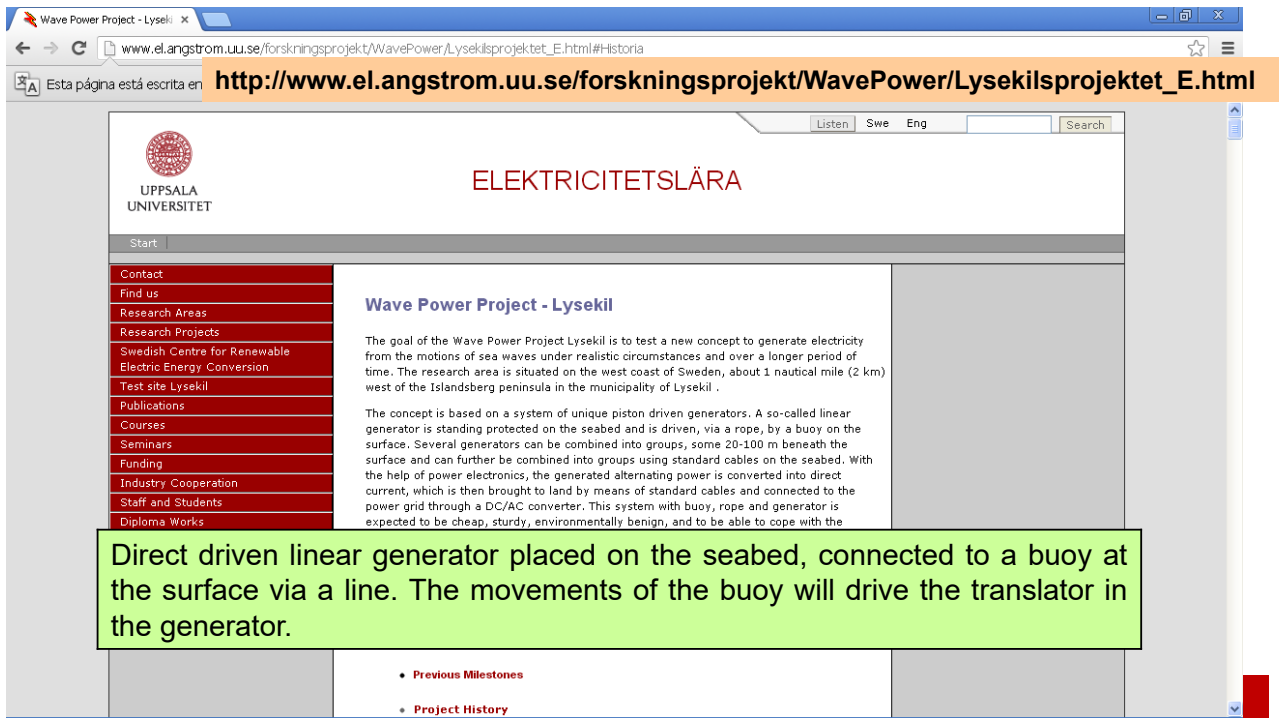
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Mantenimiento del sentido de giro Con giro de los alabes directores



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Lysekil Project



Uppsala Universitet
ELEKTRICITETSLÄRA

Start

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- Publications
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Wave Power Project - Lysekil

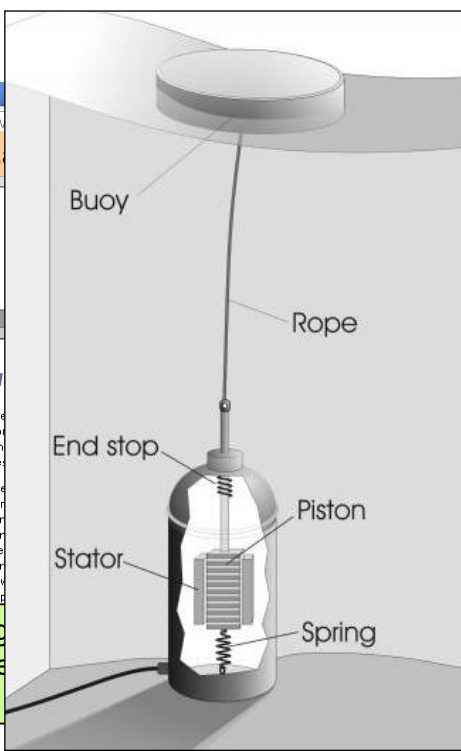
The goal of the Wave Power Project Lysekil is to test a new concept to generate electricity from the motions of sea waves under realistic circumstances and over a longer period of time. The research area is situated on the west coast of Sweden, about 1 nautical mile (2 km) west of the Islandsberg peninsula in the municipality of Lysekil.

The concept is based on a system of unique piston driven generators. A so-called linear generator is standing protected on the seabed and is driven, via a rope, by a buoy on the surface. Several generators can be combined into groups, some 20-100 m beneath the surface and can further be combined into groups using standard cables on the seabed. With the help of power electronics, the generated alternating power is converted into direct current, which is then brought to land by means of standard cables and connected to the power grid through a DC/AC converter. This system with buoy, rope and generator is expected to be cheap, sturdy, environmentally benign, and to be able to cope with the

Direct driven linear generator placed on the seabed, connected to a buoy at the surface via a line. The movements of the buoy will drive the translator in the generator.

- Previous Milestones
- Project History

Lysekil Project



Buoy

Rope

End stop

Piston

Stator

Spring

Direct driven linear generator placed on the seabed, connected to a buoy at the surface via a line. The movements of the buoy will drive the translator in the generator.

Direct driven linear generator placed on the seabed, connected to a buoy at the surface via a line. The movements of the buoy will drive the translator in the generator.

- Project History

Oceanlinx

<http://oceanlinx.com/>

OUR PRODUCTS
2013

Learn about our diverse product range

For the last 15 years Oceanlinx have developed, deployed and are one of the very few companies to generate 2 prototypes of our technology in the ocean.

To generate electricity from long-wavelength ocean swell oscillations. The third and final demonstration-scale, grid-connected unit near Port Kembla, near Sydney, Australia, a 2.5 MW_e system that went online in early 2010. In May 2010, the wave energy generator snapped from its mooring lines and wrecked on Port Kembla's eastern breakwater.

www.oceanlinx.com/technology/products/bluewave

VACANCIES

Oceanlinx

<http://oceanlinx.com/>

Generator and Transmission System

Bidirectional Reaction Turbine

Oscillating Water Column

01

02

To generate electricity from long-wavelength ocean swell oscillations. The third and final demonstration-scale, grid-connected unit near Port Kembla, near Sydney, Australia, a 2.5 MW_e system that went online in early 2010. In May 2010, the wave energy generator snapped from its mooring lines and wrecked on Port Kembla's eastern breakwater.

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VACANCIES

OE Buoy



http://www.oceanenergy.ie/oe-technology/platform.html

OCEANENERGY
A WORLD OF POWER

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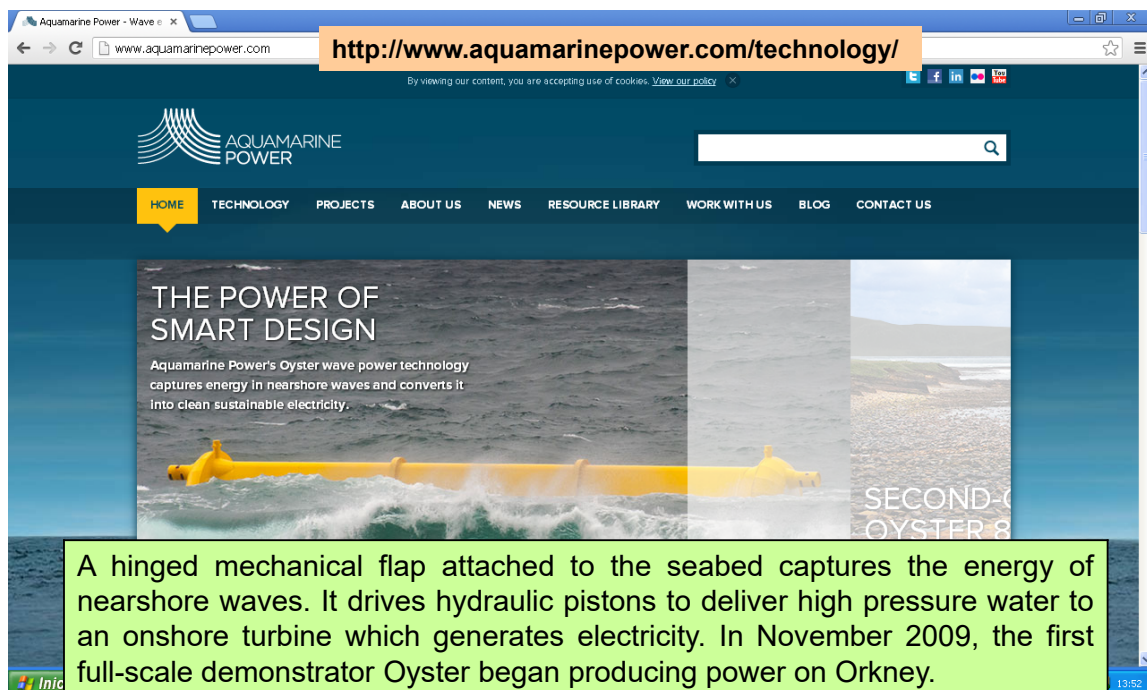
OceanEnergy is a world leader in Innovative Renewable Energy within the wave energy industry.

Wave technology is one of the most exciting areas of untapped energy potential and OceanEnergy have developed ground breaking technology to harness the power of the ocean.

In September 2009 completed a 2-year sea trial in one quarter scale form. The OE buoy has only one moving part.

energy commercially there are a number of key components required:

Oyster Wave Energy Converter



http://www.aquamarinepower.com/technology/

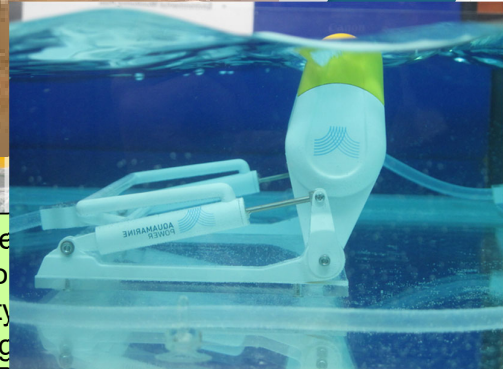
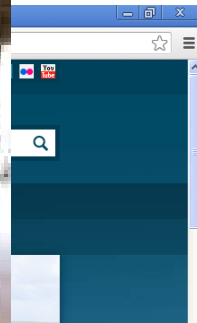
AQUAMARINE POWER

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THE POWER OF SMART DESIGN

Aquamarine Power's Oyster wave power technology captures energy in nearshore waves and converts it into clean sustainable electricity.

A hinged mechanical flap attached to the seabed captures the energy of nearshore waves. It drives hydraulic pistons to deliver high pressure water to an onshore turbine which generates electricity. In November 2009, the first full-scale demonstrator Oyster began producing power on Orkney.



A hinged mechanical flap attached to the seabed captures nearshore waves. It drives hydraulic pistons to an onshore turbine which generates electricity. The full-scale demonstrator Oyster began producing

Pelamis Wave Energy Converter

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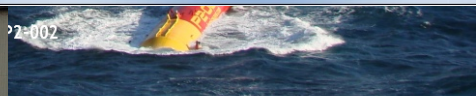
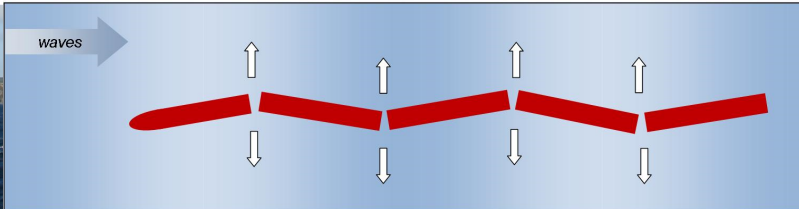
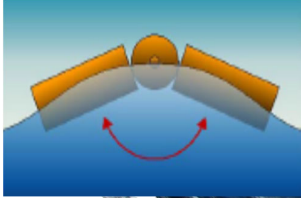
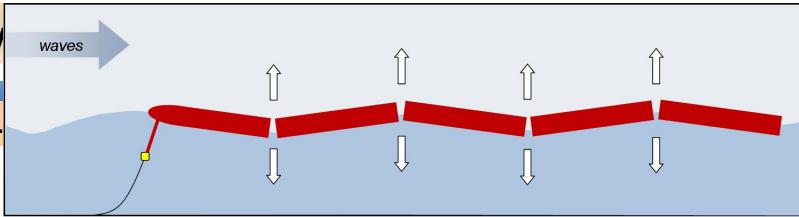
Posted 21.05.13

As waves pass along a series of semi-submerged cylindrical sections linked by hinged joints, the sections move relative to one another. This motion activates hydraulic cylinders which pump high pressure oil through hydraulic motors which drive electrical generators. The first working Pelamis machine in 2004 was at the European Marine Energy Center. The later P2, owned by E.ON, started grid connected tests off Orkney in 2010.

Pelamis Wave Energy



About us



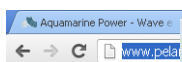
semi-submerged cylindrical sections linked together relative to one another. This motion pumps high pressure oil through hydraulic motors. The first working Pelamis machine in the world was installed at the European Marine Energy Center. The later P2, owned by the Scottish Government, was installed at Orkney in 2010.

www.pelamiswave.com/pelamis-technology read more

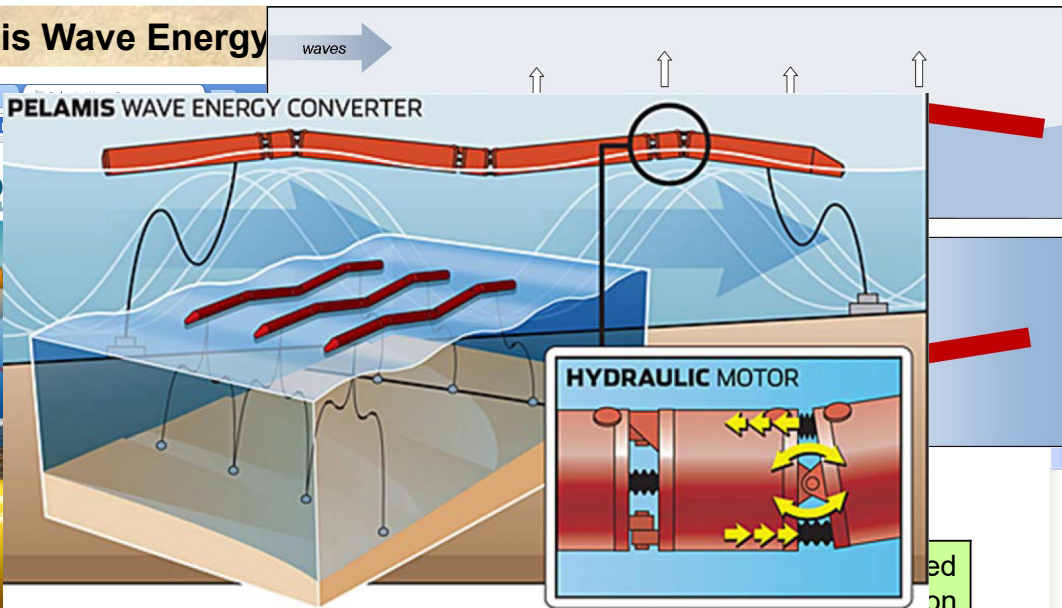
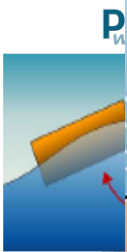
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Pelamis Wave Energy



PELAMIS WAVE ENERGY CONVERTER



semi-submerged cylindrical sections linked together relative to one another. This motion pumps high pressure oil through hydraulic motors. The first working Pelamis machine in the world was installed at the European Marine Energy Center. The later P2, owned by the Scottish Government, was installed at Orkney in 2010.

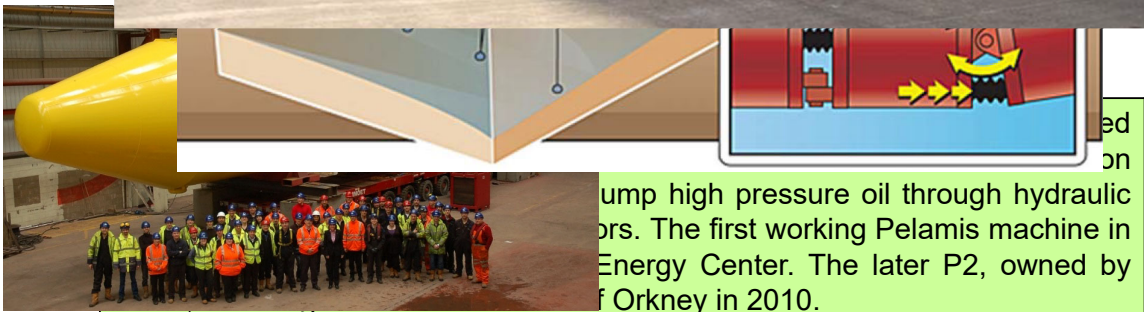
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Pelamis

Aquamarine Power



... pump high pressure oil through hydraulic cylinders. The first working Pelamis machine in the world was installed at the Energy Center. The later P2, owned by the Scottish Government, was installed at Orkney in 2010.

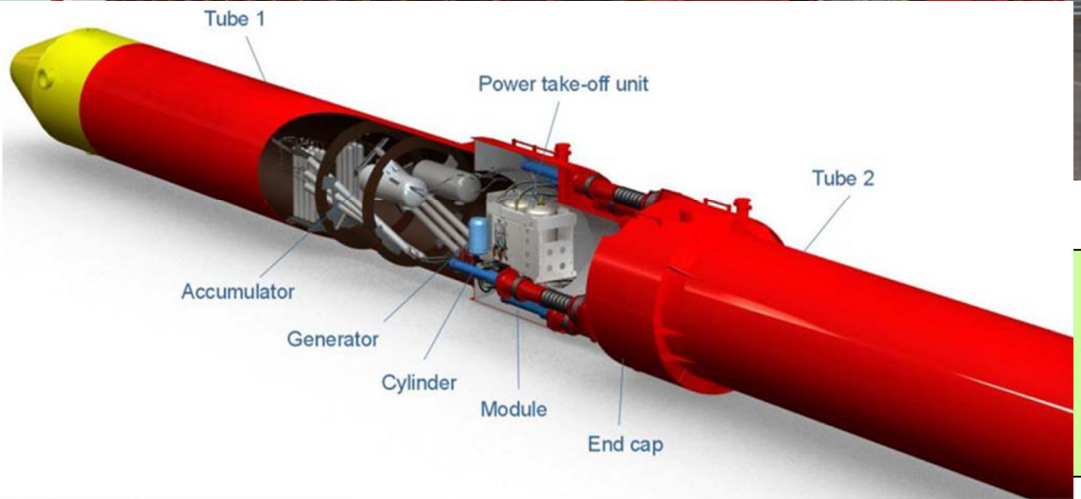
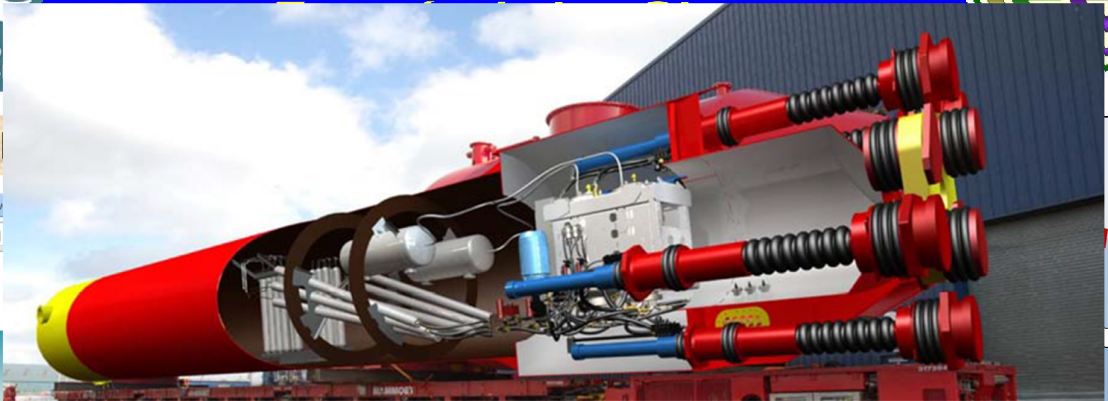
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PowerBuoy

Boya de Santoña

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OPT
OCEAN POWER TECHNOLOGIES

ABOUT TECHNOLOGY PRODUCTS PROJECTS INVESTORS FAQ CAREERS CONTACT

Technology

- Applications
- Benefits
- Technology Comparison
- Environmental
- Visual Impact
- Global Resources

TECHNOLOGY

OPT's PowerBuoy® wave generation system uses a "smart," oceangoing buoy to capture and convert wave energy into low-cost, clean electricity.

La parte móvil dibuja la ola sobre una estructura similar a un pistón, donde se instala una bomba hidráulica. El fluido entra y sale de la bomba con el movimiento e impulsa un generador eléctrica.
The electricity is transmitted by a submerged transmission line. The buoys are designed to be installed one to 8 km offshore in water 30 to 60m deep.

PowerBuoy

Boya de Santoña

<http://www.oceanpowertechnologies.com/technology.htm>

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PB150 kW

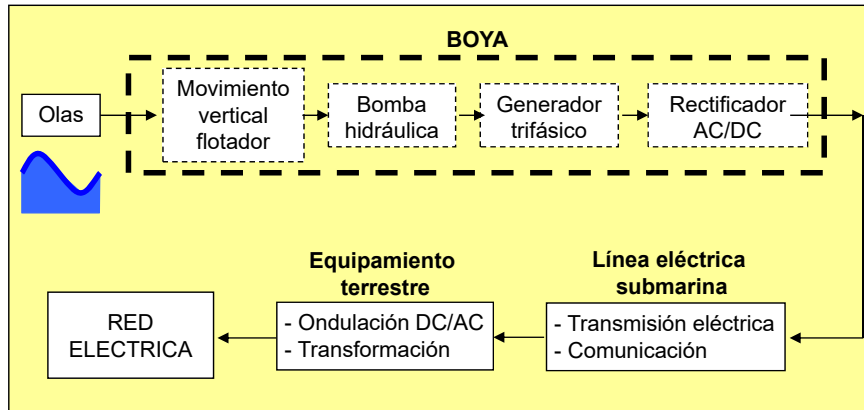
Dimensions: 36.1, 29.5, 9.8, 3.3, 114.8, 6.6, 45.9

PowerBuoy

Boya de Santoña

La **boya piloto**, del tipo PB40ES, tiene una altura de 38 metros,(3/4 Sumergidas), posee:

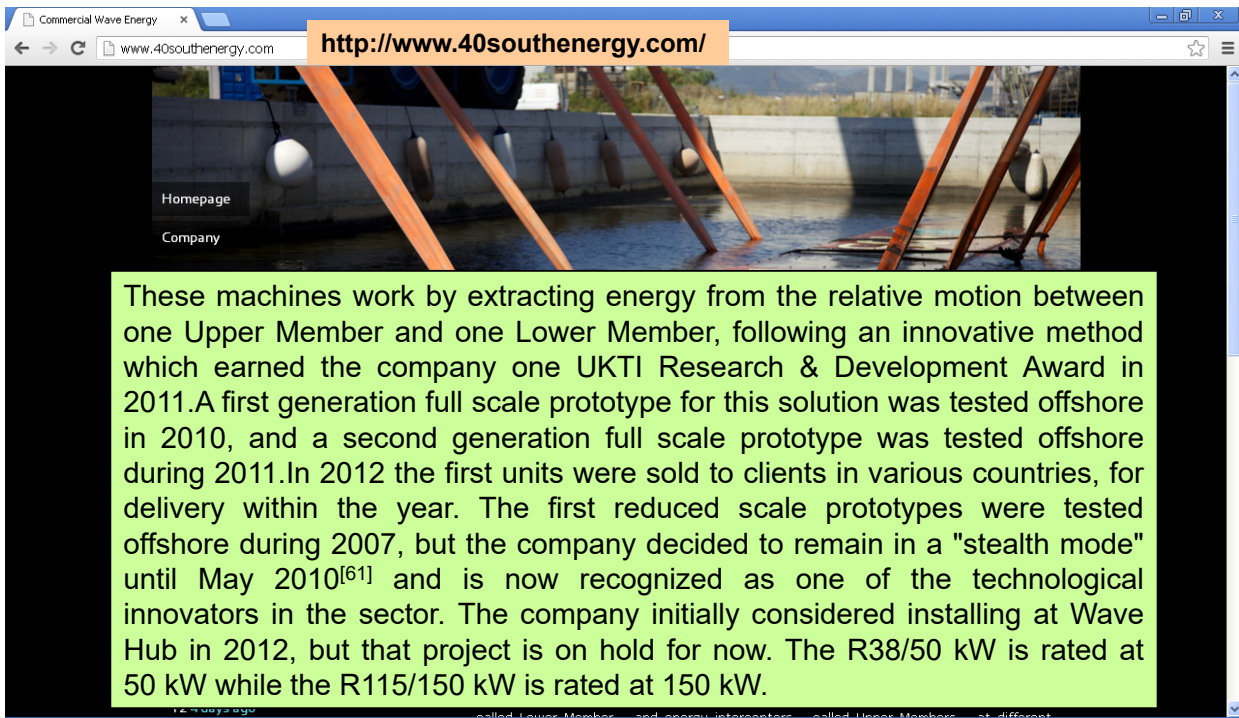
- Flotador de 7 m. de diámetro
- Estabilizador de 11 m. de diámetro



40South Energy Wave Energy Converters

The 40South Energy wave energy conversion system comprises two parts. The first part – called the “Lower Member” – is submerged at a depth of between 15 and 25 metres (depending on model type and the site of deployment). Above it, one or more “Upper Members” are submerged at a depth between 1 and 12 meters (depending on the sea and operating conditions). The relative motion between the Upper and Lower Members converts directly into electricity within the machine.

40South Energy Wave Energy Converters

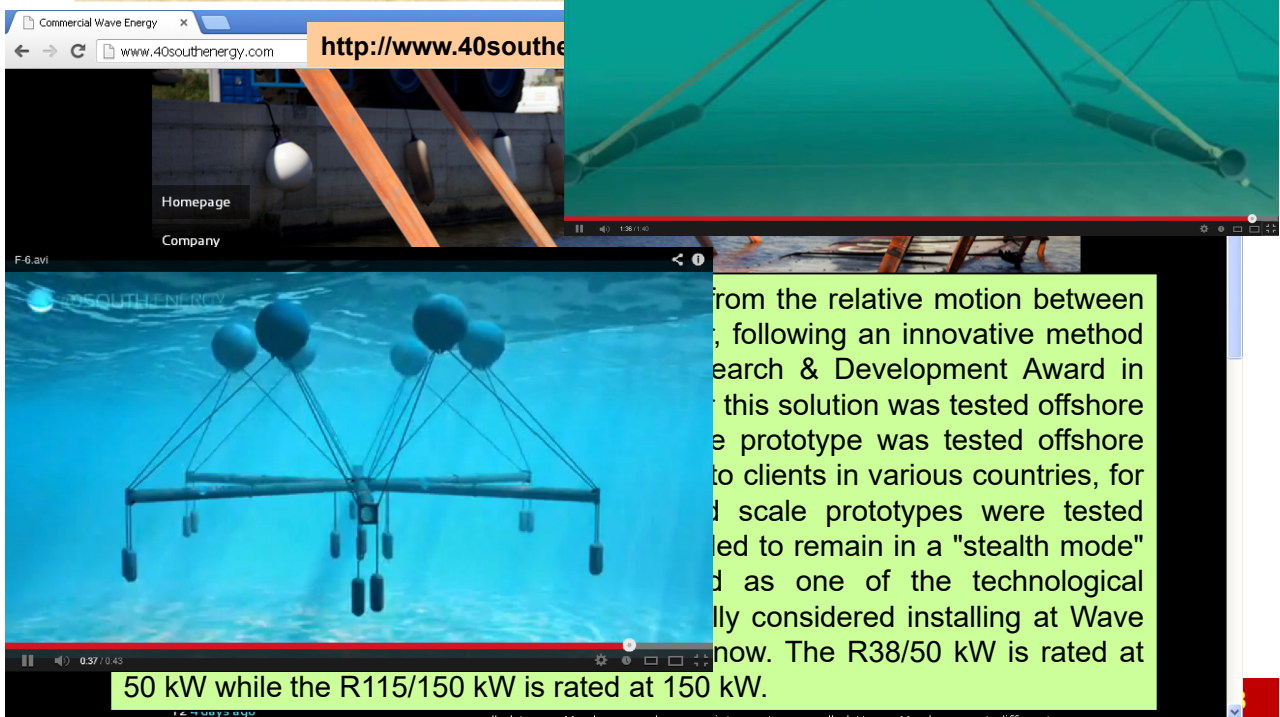


Commercial Wave Energy x
www.40southenergy.com <http://www.40southenergy.com/>

Homepage
Company

These machines work by extracting energy from the relative motion between one Upper Member and one Lower Member, following an innovative method which earned the company one UKTI Research & Development Award in 2011. A first generation full scale prototype for this solution was tested offshore in 2010, and a second generation full scale prototype was tested offshore during 2011. In 2012 the first units were sold to clients in various countries, for delivery within the year. The first reduced scale prototypes were tested offshore during 2007, but the company decided to remain in a "stealth mode" until May 2010^[61] and is now recognized as one of the technological innovators in the sector. The company initially considered installing at Wave Hub in 2012, but that project is on hold for now. The R38/50 kW is rated at 50 kW while the R115/150 kW is rated at 150 kW.

40South Energy Wave Ener



Commercial Wave Energy x
www.40southenergy.com <http://www.40southenergy.com/>

Homepage
Company

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earch & Development Award in
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SDE Sea Waves Power Plant

Wellcome

A breakwater-based wave energy converter, this device is built close to the shore and utilizes the vertical motion of buoys for creating hydraulic pressure which in turn operates the system's generators

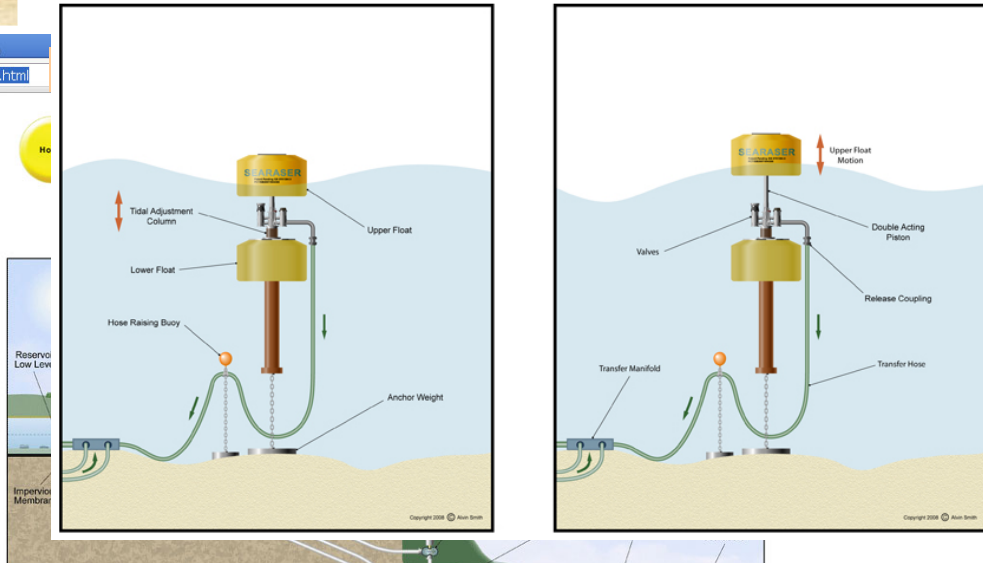
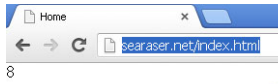
SeaRaser

Renewable on Demand Energy Pumped Storage Power Plant

The diagram shows a cross-section of the system. On the left, a 'Reservoir Low Level' is connected to 'Pumped Water Inlets' and a 'Screen'. A 'Surge Pond' is located on the right. A 'Penstock Pipe' runs from the surge pond down to a 'Turbine Generator' on the sea floor. 'Returning Sea Water' flows back up through the pipe. Other components include an 'Impervious Membrane', 'Water Retaining Sill', 'Manifold', and 'Searasers'.

Consisting of a piston pump attached to the sea floor with a float (buoy) tethered to the piston. Waves cause the float to rise and fall, generating pressurized water, which is piped to reservoirs onshore which then drive hydraulic generators

SeaRaser



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searaser.net/JAA OLD - sr_1280.html

Wavebob

<http://www.wavebob.com/wavepower/>

Wavebob have conducted some ocean trials, as well as extensive tank tests. It is an ocean-going heaving buoy, with a submerged tank which captures additional mass of seawater for added power and tunability, and as a safety feature (Tank "Venting")

Wave Dragon

<http://www.wavedragon.net/>

Wave Dragon ... for a better future

Home

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Wave Dragon
... is a pioneering large scale ocean energy solution for bulk electricity generation.

With the Wave Dragon wave energy converter large wing reflectors focus waves up a ramp into an offshore reservoir. The water returns to the ocean by the force of gravity via hydroelectric generators.
Wave Dragon seen from reflector, prototype 1:4½

Wave Dragon

<http://www.wavedragon.net/>

reservoir overtopping turbine outlet

Wave Dragon ... for a better future

the force of gravity via hydroelectric generators.
Wave Dragon seen from reflector, prototype 1:4½

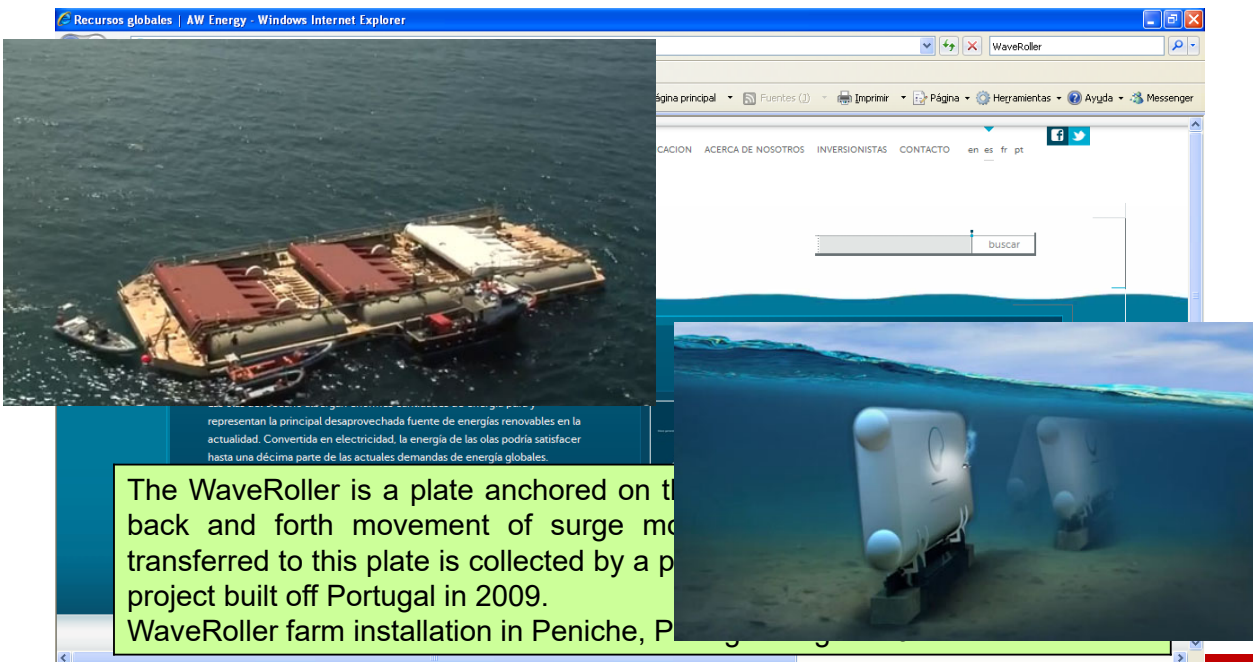
WaveRoller

<http://aw-energy.com/>



WaveRoller

<http://aw-energy.com/>



Wave Star

<http://wavestarenergy.com/>

UNLIMITED CLEAN ENERGY with The Wavestar machine

The Vision - Laurent Marquis

The Wavestar machine draws energy from wave power with floats that rise and fall with the up and down motion of waves. The floats are attached by arms to a platform that stands on legs secured to the sea floor. The motion of the floats is transferred via hydraulics into the rotation of a generator, producing electricity. Wave Star has been testing a 1:10 machine since 2005 in Nissum Bredning, Denmark, it was taken out of duty in November 2011. A 1:2 Wave Star machine is in place in Hanstholm which has produced electricity to the grid since September 2009.

Wave Star

<http://wavestarenergy.com/>

The diagram illustrates the mechanical components of the Wave Star machine. It shows two floats on the water surface, connected to a central structure supporting the wave power machine. The structure is anchored to the sea bed. The machine includes shafts and a one-way bearing. The 3D model shows the machine's legs and the platform supporting the floats.

ENER

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hydraulic
producing electricity. wave Star has been
in Nissum Bredning, Denmark, it was ta
1:2 Wave Star machine is in place
electricity to the grid since September 20

SRI Wave-Powered Generators

Renewable Energy | SRI Intl | X
<http://www.sri.com/research-development/renewable-energy>

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Renewable Energy

Jump to: Products + Solutions Press Releases

SRI research is leading to new ways to harvest energy from renewable resources, including the sun, biomass, waves, and other forms of kinetic energy. SRI is also developing technologies that enable the broader use of renewable resources. These technologies include new catalysts, separation technologies, materials, and energy storage technologies that will help bring renewable energy solutions to market.

Products + Solutions

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- Wave-Powered Generators for Clean Energy
- Integrated Biorefineries
- Hydrogen and Fuel Cell Research at SRI International
- Addressing the Dollar-Per-Watt Challenge in Solar

A type of wave buoys, built using special polymers, is being developed by SRI International.

Low-Cost Process for Solar-Grade Silicon
Demand for solar energy is growing rapidly due to concerns about energy independence and the by consumer interest and favorable public policy, there is a growing need for

Wave-Powered Generators for Clean Energy Production

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SRI Wave-Powered Generators

Renewable Energy | SRI Intl | X
<http://www.sri.com/research-development/renewable-energy>

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Products + Solutions

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Wave-Powered Generators for Clean Energy Production

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Mighty Whale

<http://www.jamstec.go.jp/e/>

JAMSTEC
JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY

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For a Better Future of Our Planet Earth
JAMSTEC'S Research and Development

Observation, analysis and prediction of global environmental change

Research Institute for Global Change | Institute for Research on Earth Evolution | Institute of Biogeosciences | Leading Project | Laboratory System | Research, Development and Promotion of Infrastructural Technologies

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JAMSTEC News
[2013/09/02][Press Release] Integrated Ocean Drilling Program (IODP) Deep-Sea Scientific Drilling Vessel *Chikyu* to Set Sail on Expedition 348 - NanTroSEIZE Stage 3: NanTroSEIZE plate boundary deep riser 3

Japan Agency for Marine-Earth Science and Technology

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Mighty Whale

<http://www.jamstec.go.jp/jamstec-e/30th/part6/page2.html>

The process of generating electricity from wave energy does not cause environmental pollution.

The MIGHTY WHALE has been carrying out the open sea tests since 1998 off the mouth of Gokasho Bay, Nansai-cho, Watarai-gun, Mie Prefecture. The MIGHTY WHALE, 50 meters long and 30 meters wide, is equipped with three generators. The MIGHTY WHALE is of the terminator type, which has an array of air chambers at right angle to the direction of waves entering the generator. By this design, the efficiency of conversion of wave energy to pneumatic energy is much higher than that of the KAIMEI, which was of the attenuator type.

Nonpolluting and renewable energy that can be obtained without discharging greenhouse gases, which contribute to global warming, includes solar power, wind power, and wave energy. Among them, wave energy is said to have an energy density 20 to 30 times larger than that of solar power, and five times larger than wind power, and therefore it is considered very promising as a new source of energy. The total wave energy of the world is estimated to be 1 to 10 Terawatts, an amount almost equivalent to the electric power consumed throughout the world.

JAMSTEC began open sea tests of the KAIMEI, a large floating-type wave power generator since 1978. The KAIMEI converts wave energy into pneumatic air energy (primary conversion), and then the pneumatic air rotates a turbine, to generate electricity (secondary conversion). In 1979, JAMSTEC transmitted, on an experimental basis, electricity generated by the KAIMEI to onshore via a submarine cable. This electricity was consumed as household electricity.

JAMSTEC went on constructing the MIGHTY WHALE, an offshore floating-type wave power device, as a prototype facility for open sea tests, drawing on the experience of the KAIMEI. The MIGHTY WHALE has been moored since September 1998 off the mouth of Gokasho Bay, Nansai-cho, Watarai-gun, Mie Prefecture, and it has been carrying out sea trials. The mechanism of power generation by the MIGHTY WHALE is the same as that of the KAIMEI, however, the efficiency of the primary conversion, or the conversion of wave energy to pneumatic energy, has been improved significantly, from 12 percent to 50 percent. The MIGHTY WHALE's electric power is expected not only to be transmitted onshore but also to be used for environmental remediation of the coastal area. There is a drawing of the MIGHTY WHALE around a megaload, to absorb wave energy rolling into the megaload, thereby preventing the megaload from pitching. The megaload, as a gigantic floating structure, is now drawing considerable attention for a floating airport. There would also be an additional advantage of helping the airport become self-sufficient in electric power, even without supply from onshore.

The MIGHTY WHALE, 50 meters long and 30 meters wide, is equipped with three generators driven by an Oscillating Water Column.

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Mighty Whale

<http://www.jamstec.go.jp/jamstec-e/30th/part6/page2.html>

The process

The MIGHTY Nansei-cho, with three generator units at an angle to the wave direction, to pneumatic...

Nonpolluting... to global warming... energy demand... therefore it is estimated to be the world's largest... JAMSTEC... KAIMEI... turbine, to generate electricity... household... JAMSTEC... facility for open sea tests... September 15... KAIMEI... has been important... not only to be a drawback... calm... One... provides more... The MIGHTY... it. Installation... used for aquaculture... WHALES... are from pitching... airport. There... even without... interest in...

The photo shows the KAIMEI, a large floating type wave power generator. The KAIMEI was 80 meters long and 12 meters wide. The open sea tests of KAIMEI were carried out from August 1978 to March 1986, three kilometers offshore of Yura, Tsuruoka city, Yamagata Prefecture. The photo shows the second-stage open sea tests for power generation. The wave hits the bow side of the ship-shaped device. Generating facility which is of the attenuator type, with air chambers aligned on the side of the wave entrance.

Electric power generated by the MIGHTY WHALE is used for environmental remediation of the coastal areas, in addition to other ordinary uses. The seacoast, whose waves have been made calm by the wave-dissipating effect of the MIGHTY WHALE, is used for aquaculture and marine recreational activities.

Operating principle of the MIGHTY WHALE

- 1 Incident waves cause the water level in the air chambers to rise and fall.
- 2 This creates a high-speed airflow through the air turbine passage, causing the turbines to rotate.
- 3 This causes generators coupled to the turbines to rotate, producing electric output.

Wave Plane

<http://www.waveplane.com/>

WavePlane

Welcome to WPP A/S - Wave Energy about WavePlane

"WavePlane Electric A/S" DK-CVR 34 57 95 98

WPP A/S owns all patents and is shareholder in WavePlane Electric A/S (WPE). WPE is licensee and have sole rights for sale and productions world wide for the electric WavePlane.

WavePlane - the only device in the world that converts pulsating waves directly into a fast and even rotation without any moving parts.

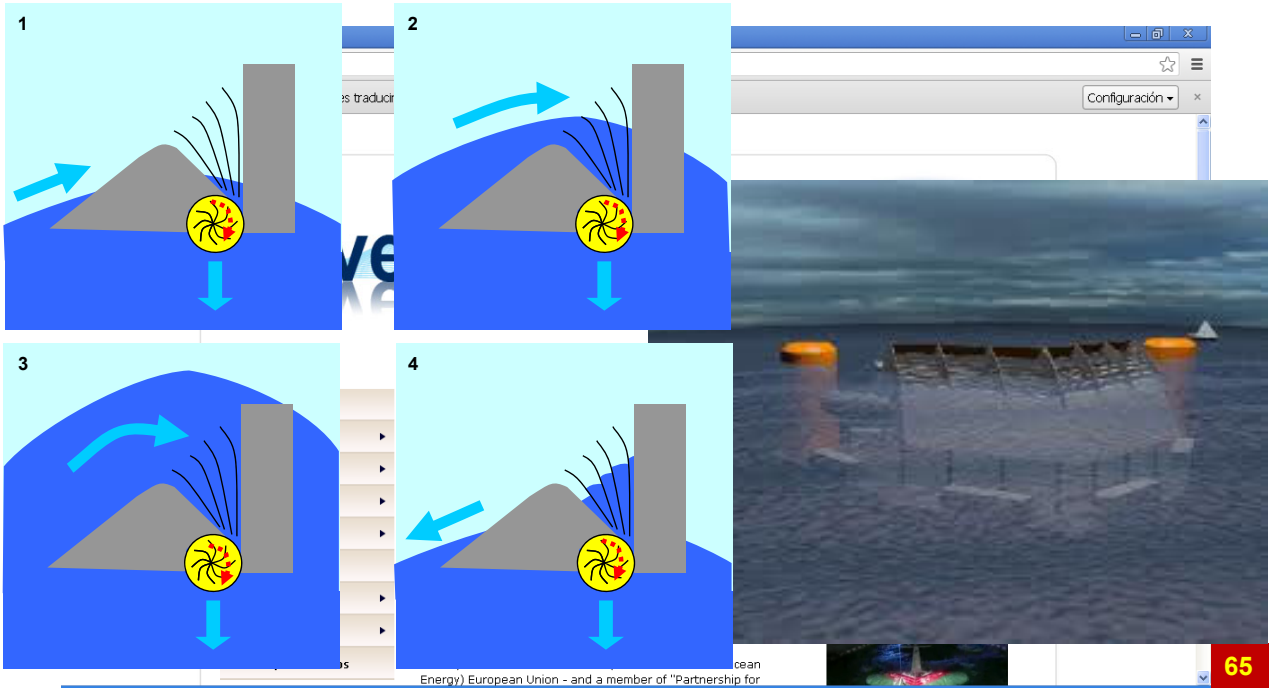
The director of WPP A/S - Erik Skaarup is the inventor of the device WavePlane

Erik Skaarup is also the chairman of Danish Wave Energy Association www.waveenergy.dk

WPP A/S is a member of "CA OE" (Coordinated Action Ocean Energy) European Union - and a member of "Partnership for..."

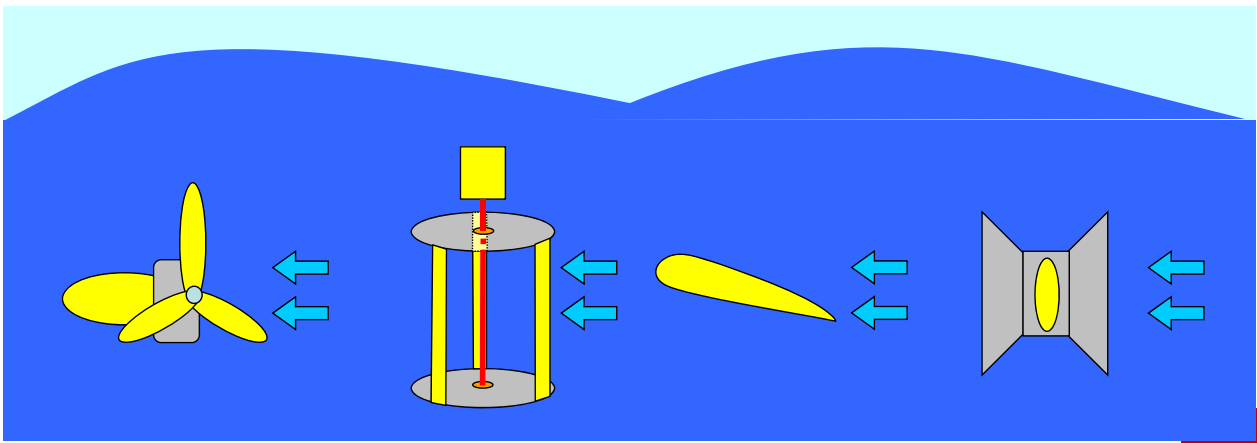
Wave Plane

<http://www.waveplane.com/>



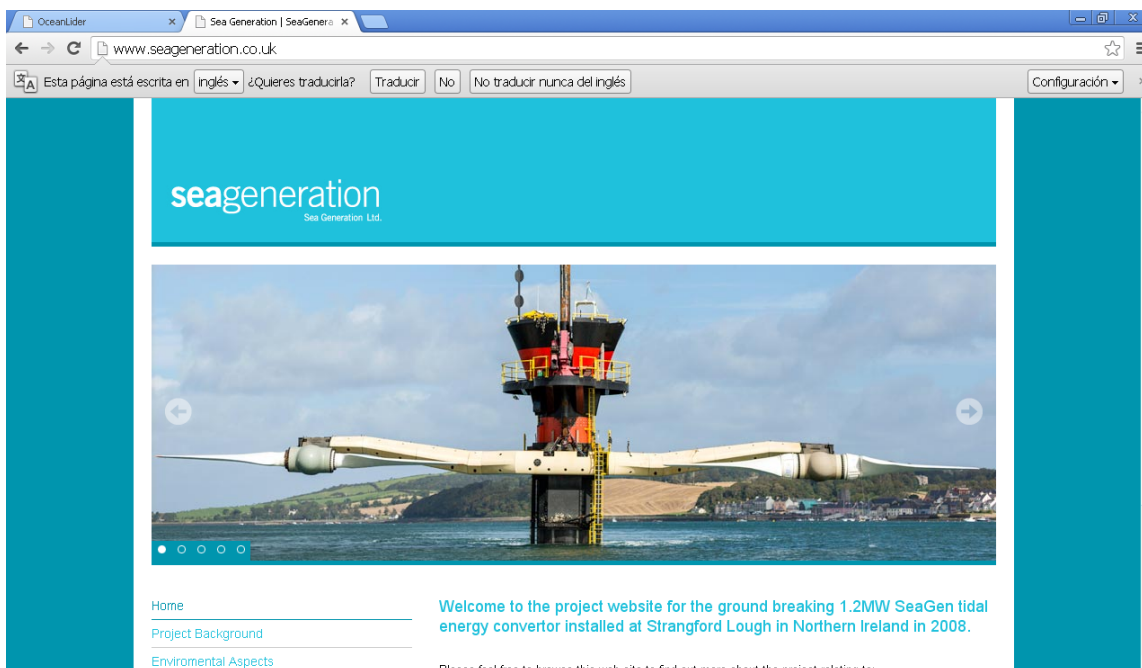
Tecnologías de Aprovechamiento de la Energía de las Corrientes

- Horizontal axis, or axial flow turbines
- Vertical axis or cross-flow turbines
- Reciprocating hydrofoils
- Venturis



Marine Current Turbines

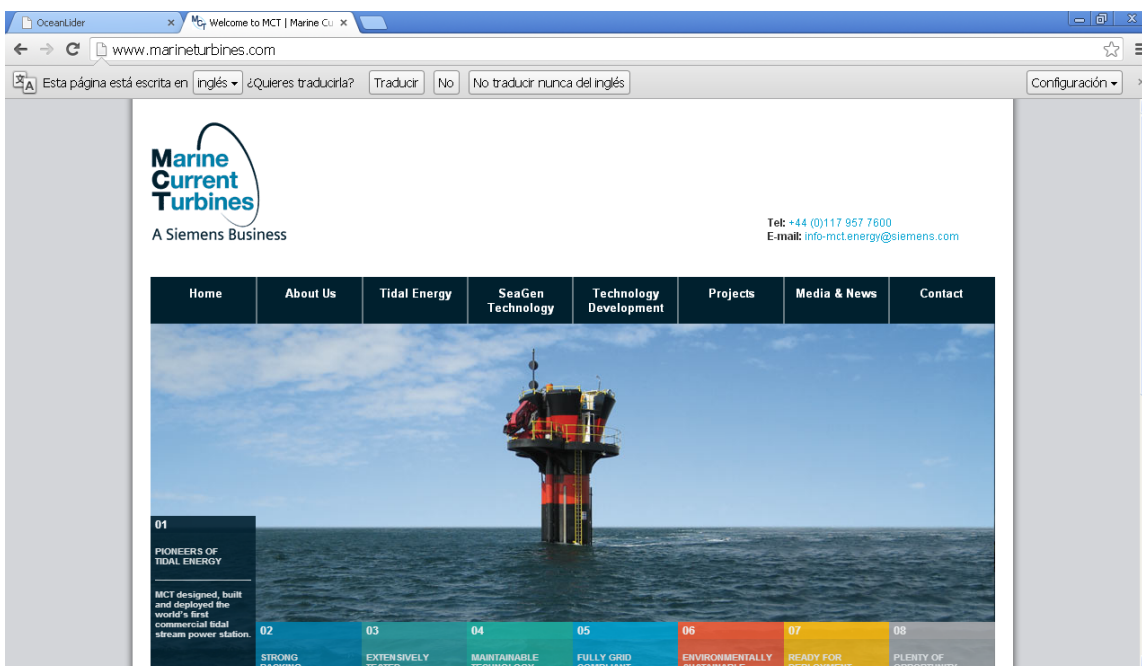
<http://www.seageneration.co.uk/>



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Marine Current Turbines

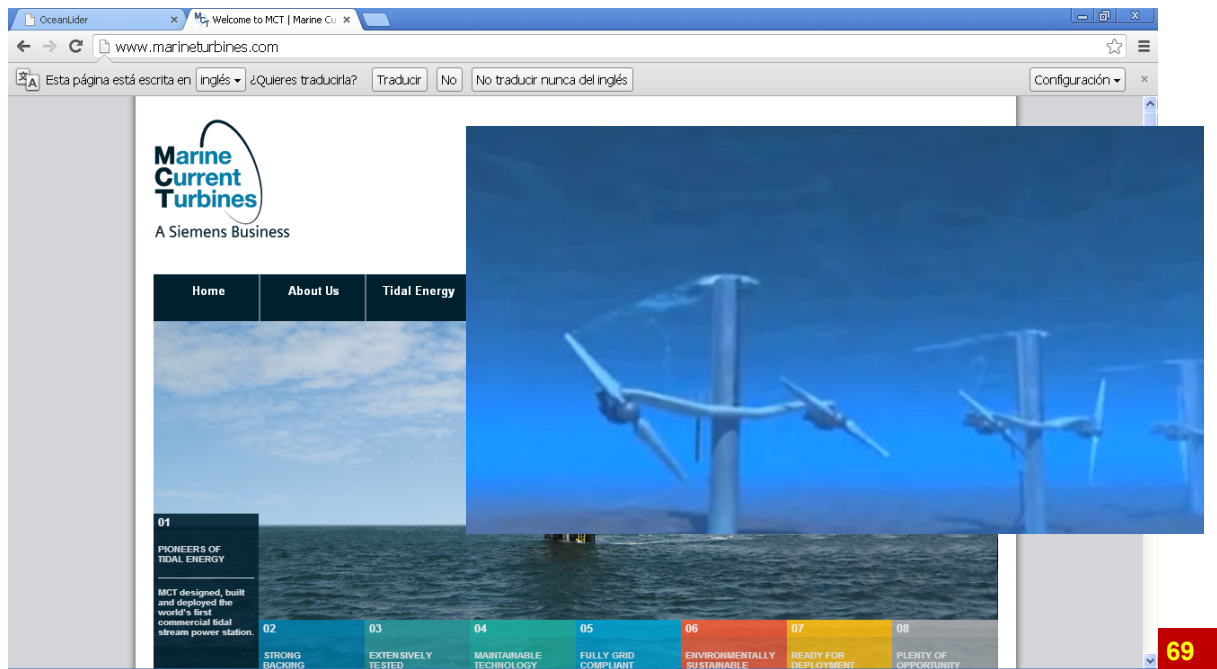
<http://www.marineturbines.com/>



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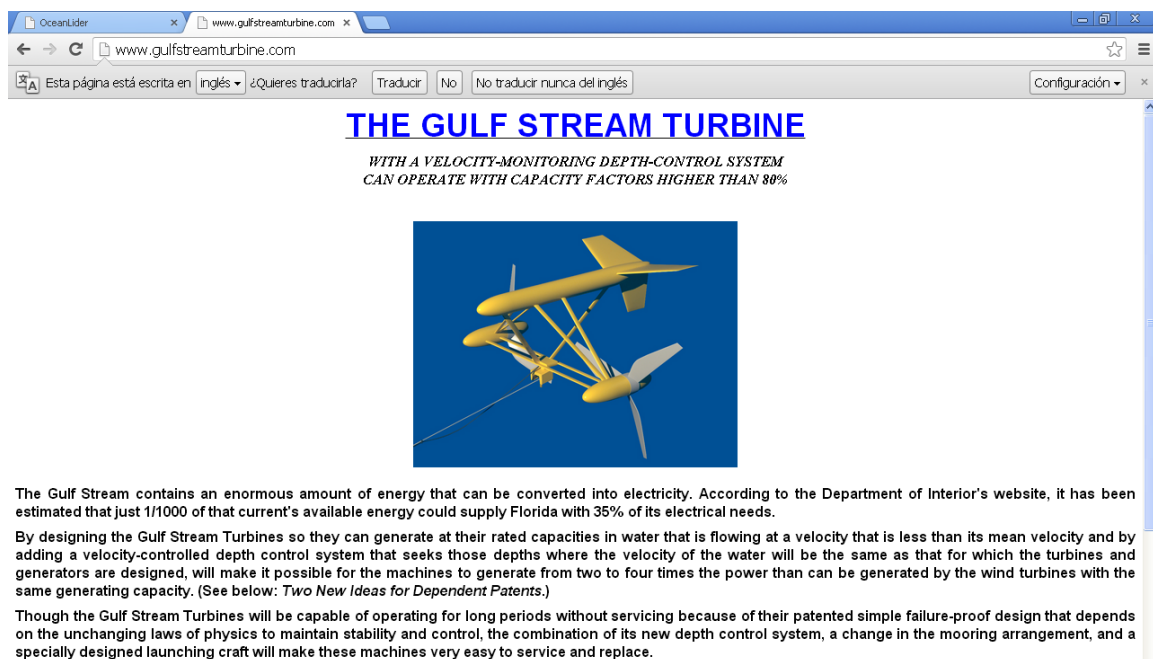
Marine Current Turbines

<http://www.marineturbines.com/>



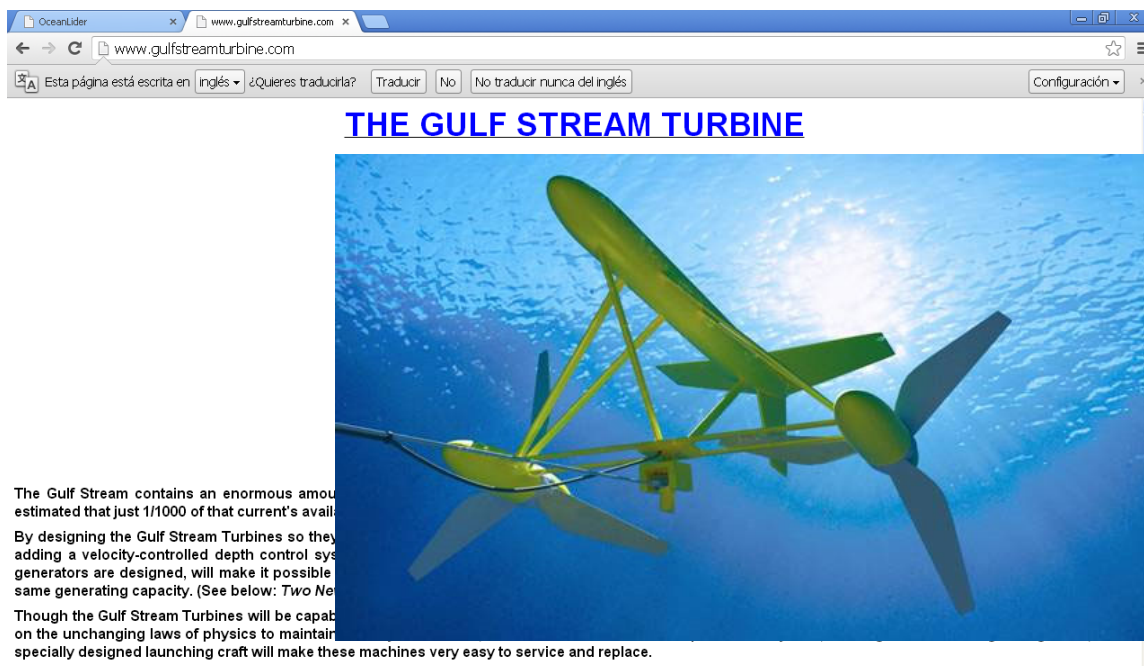
Gulf Stream Turbine

<http://www.gulfstreamturbine.com/>



Gulf Stream Turbine

<http://www.gulfstreamturbine.com/>



THE GULF STREAM TURBINE

The Gulf Stream contains an enormous amount of energy. It is estimated that just 1/1000 of that current's available energy can be harnessed.

By designing the Gulf Stream Turbines so they can operate in a velocity-controlled depth control system, the turbines and generators are designed, will make it possible to harness the same generating capacity. (See below: Two New Turbines)

Though the Gulf Stream Turbines will be capable of operating on the unchanging laws of physics to maintain their efficiency, specially designed launching craft will make these machines very easy to service and replace.

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Open Hydro

<http://www.openhydro.com/home.html>



openhydro
— a **DCNS** company

sea THE FUTURE™

company environment technology development images news careers home contact us legal and privacy

silent, invisible, predictable, renewable energy

OpenHydro, a **DCNS** company, is a technology business that designs, manufactures and installs tidal energy systems, enabling our customers to supply renewable energy that is silent, invisible, predictable, cost effective and in harmony with the environment.

To share information and discuss any topic related to the sea **blu@planet** the social network of the sea Follow us on:   

OpenHydro - Engineers Ireland Overall CPD Company of the Year 2011 - visit www.engineersireland.ie

IRELAND MEMBER OF THE TOP 1000 ACCREDITED ISO9001:2008

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Open Hydro

<http://www.openhydro.com/home.html>

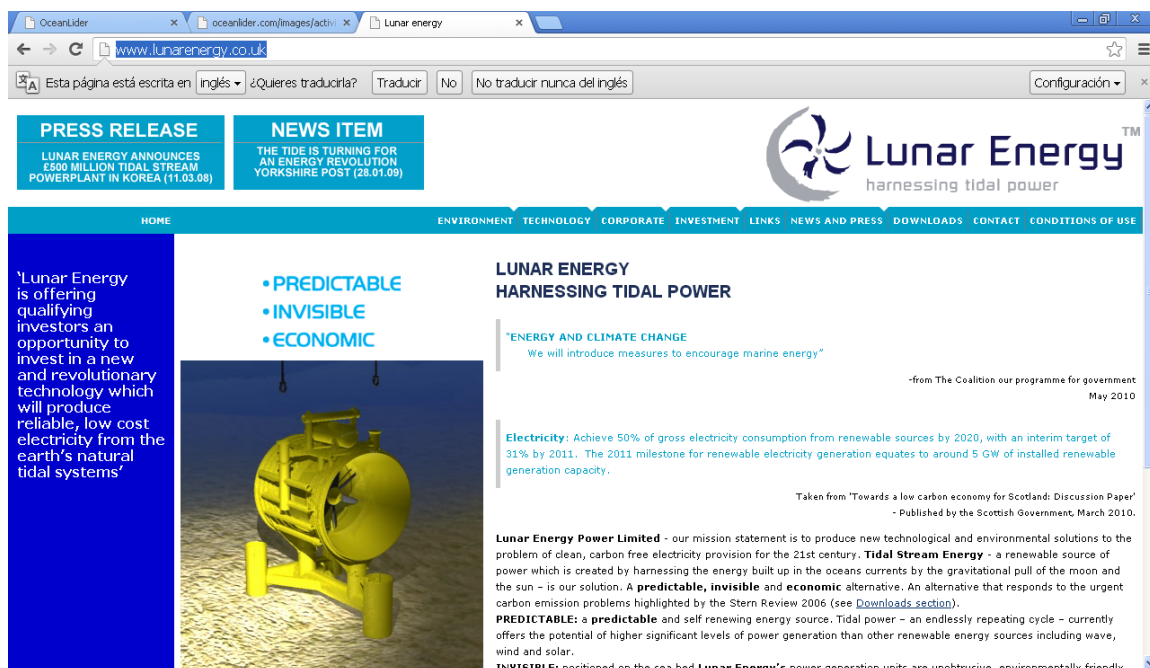


The screenshot shows the Open Hydro website interface. On the left, there's an underwater scene with two turbines. On the right, a large yellow and white turbine structure is shown in the ocean. The text on the page includes 'openhydro a DCNS company', 'predictable, invisible, renewable', and 'is a technology business that designs, manufactures enabling our customers to supply renewable energy that is cost effective and in harmony with the environment.' At the bottom, there are social media links for 'bloopplanet' and accreditation logos for 'IRELAND' and 'CPD'.

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Lunar Energy

<http://www.lunarenergy.co.uk>

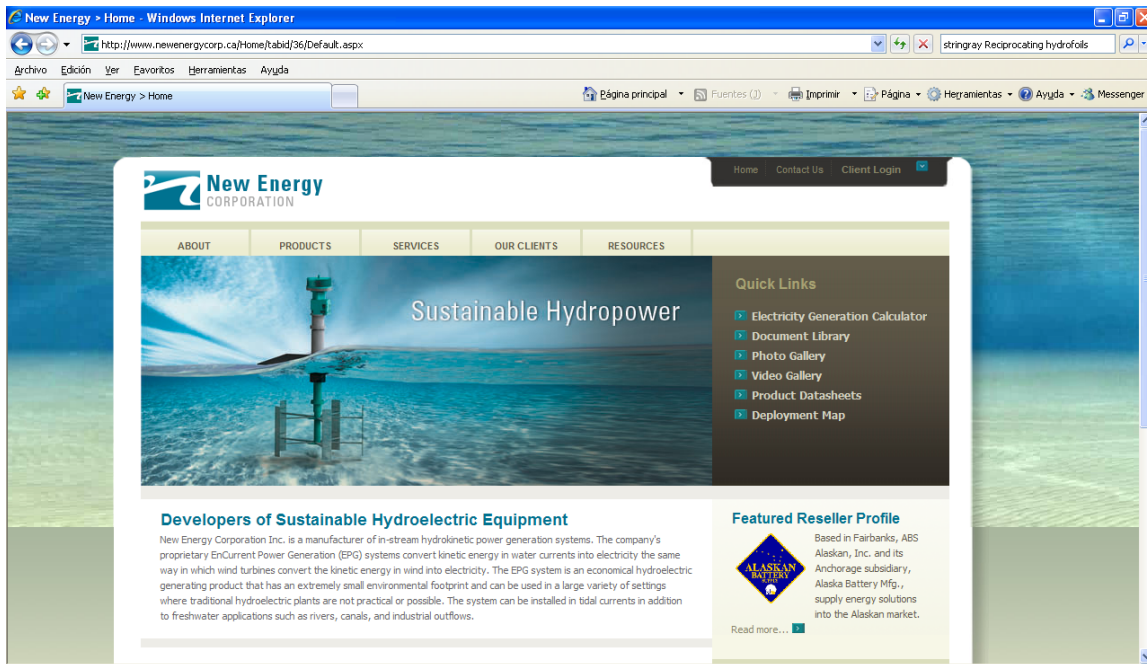


The screenshot shows the Lunar Energy website. At the top, there are navigation tabs for 'HOME', 'ENVIRONMENT', 'TECHNOLOGY', 'CORPORATE', 'INVESTMENT', 'LINKS', 'NEWS AND PRESS', 'DOWNLOADS', 'CONTACT', and 'CONDITIONS OF USE'. The main content area features a yellow turbine image and text: 'LUNAR ENERGY HARNESING TIDAL POWER', 'ENERGY AND CLIMATE CHANGE', and 'We will introduce measures to encourage marine energy'. A quote from 'The Coalition our programme for government' is also visible. The footer contains the company's mission statement and contact information.

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NEW ENERGY

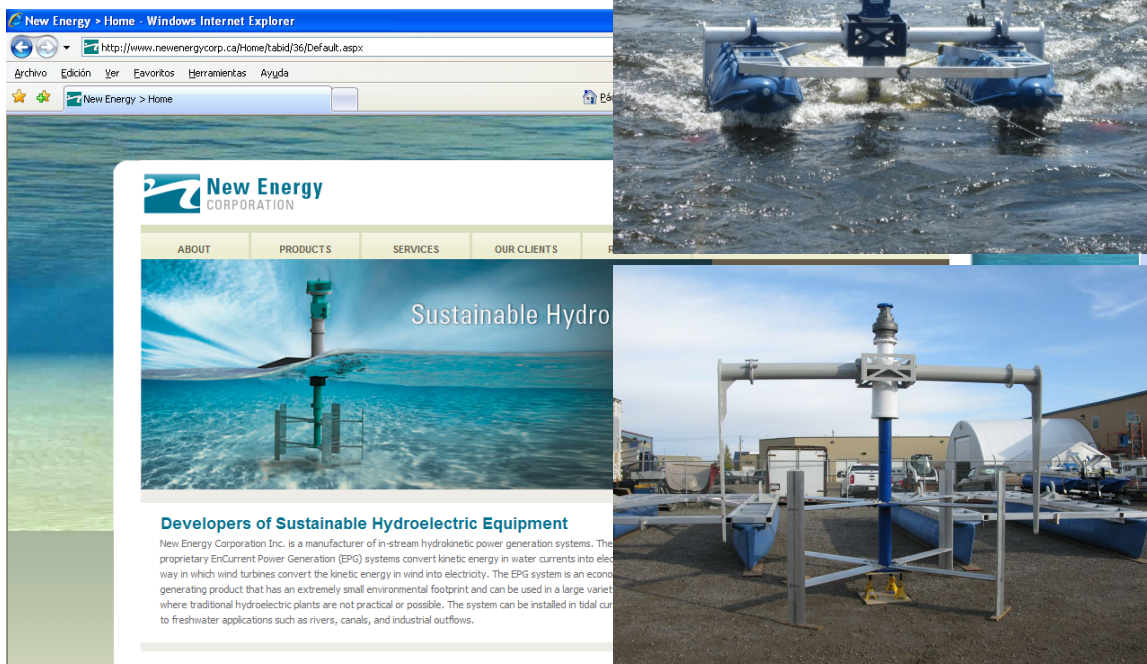
<http://www.newenergycorp.ca/Home/tabid/36/Default.aspx>



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NEW ENERGY

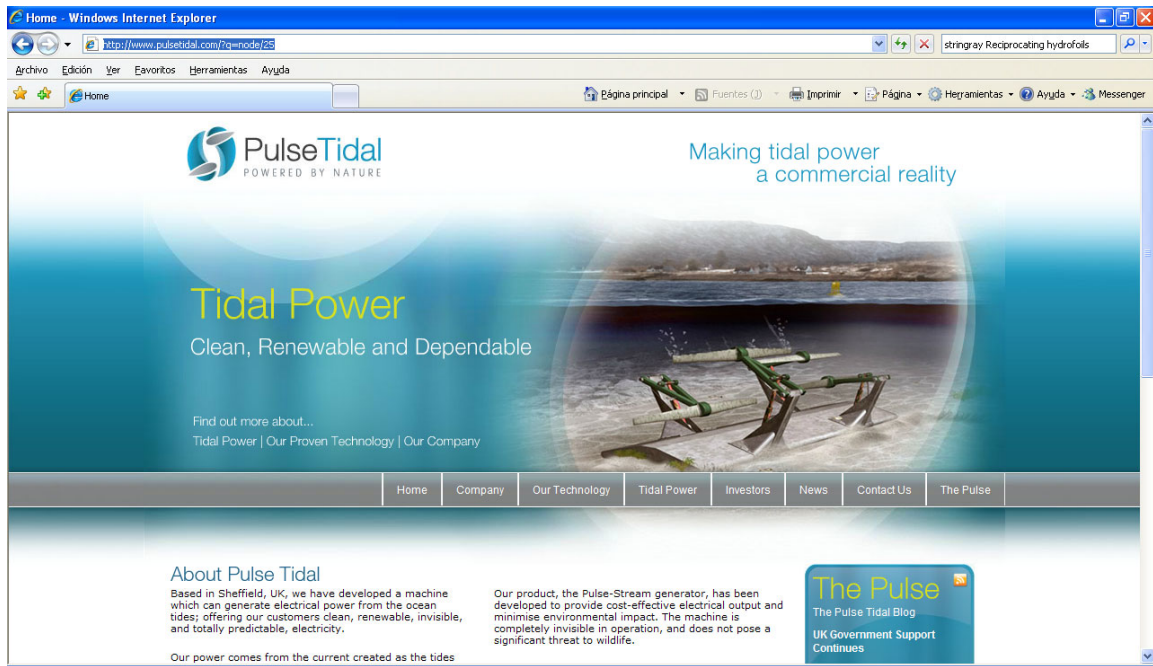
<http://www>



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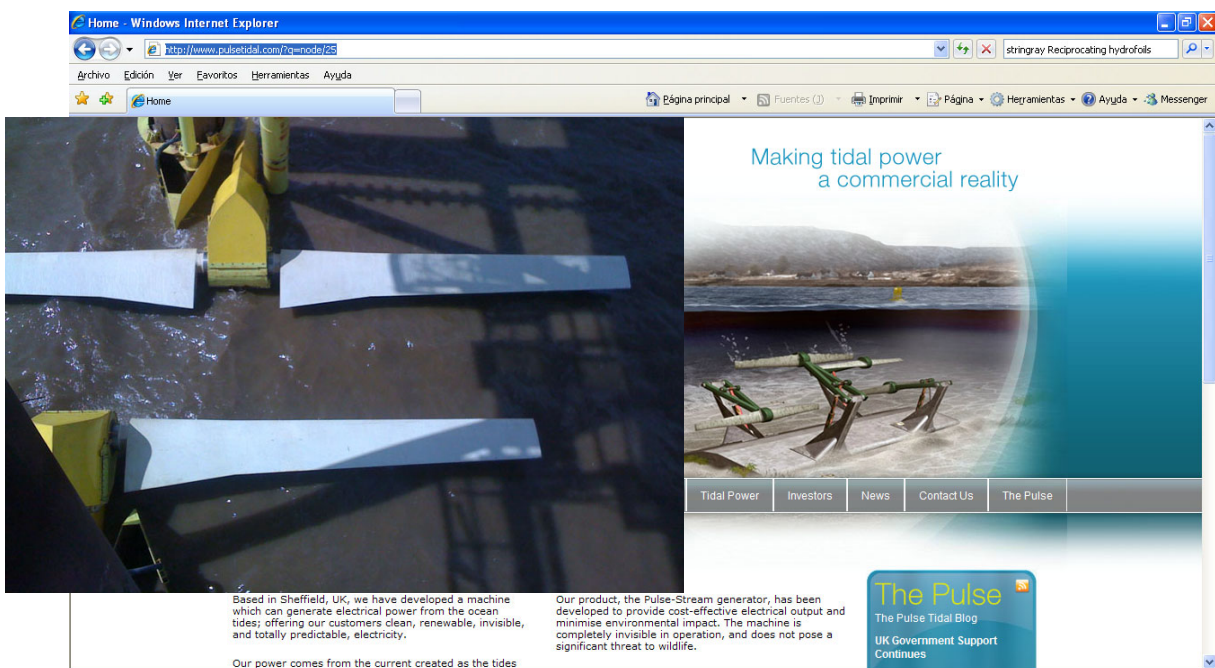
PULSE TIDAL

<http://www.pulsetidal.com/?q=node/25>



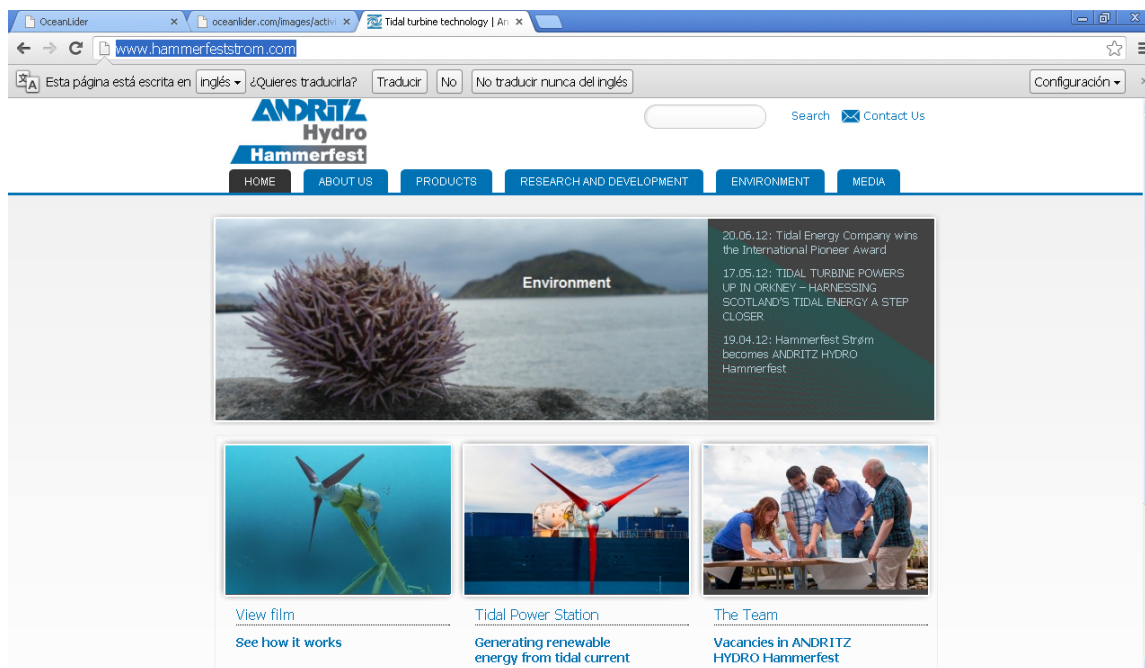
PULSE TIDAL

<http://www.pulsetidal.com/?q=node/25>



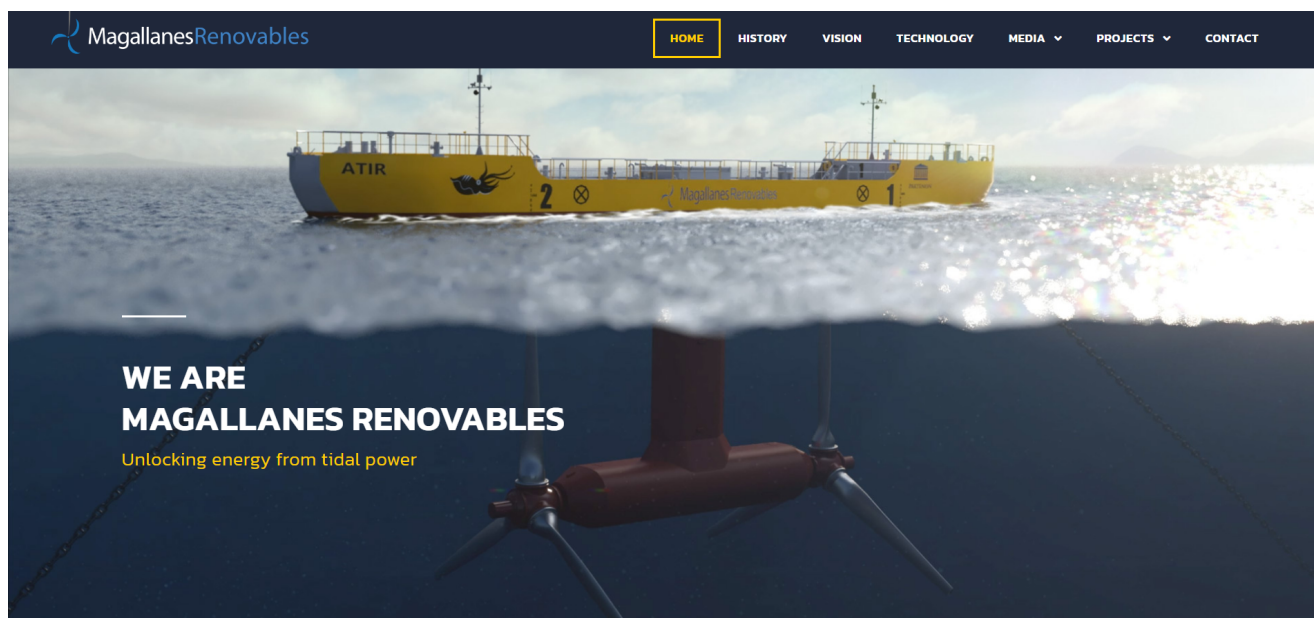
Hidro Hammerfest

<http://www.hammerfeststrom.com/>



Magallanes Renovables

<https://www.magallanesrenovables.com/>



EU RESEARCH

http://cordis.europa.eu/projects/home_en.html

Wave energy

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EU RESEARCH

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EU RESEARCH

European Commission / CORDIS

CORDIS
Community Research and Development Information Service

European Commission > CORDIS > Projects > Home

Home | News | Funding | **Projects** | Results | Partners | Go local

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- FP6 (10078)
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Supramolecular polymers - a possible biomaterial for artificial human parts

Progress in stem cell research could advance Muscular Dystrophy treatment

A large scale scientific collaboration led by France's Pierre and Marie Curie University and national institute of health and medical research has generated significant ...

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EU RESEARCH

European Commission / CORDIS

CORDIS
Community Research and Development Information Service

European Commission > CORDIS > Projects > Search

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EU Research Projects

Your search: for "tydal energy"

Results 1 - 10 of 17628

- GASTONE** - New powertrain concept based on the integration of energy recovery, storage and re-use system with engine system and control strategies
[Start Date: 2013-11-01 End Date: 2017-04-30]
- GENIC** - Globally optimized eNERgy efficient data Centres - GENiC
[Start Date: 2013-10-01 End Date: 2016-09-30]
Data Centre (DC) energy consumption has doubled between 2000 and 2005 and grew by 50% from 2005 to 2010 consuming 1.5% of global energy with continued rapid growth. On average, computing consumes 60%...

Related services

research*eu results magazine

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Participant Portal

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EU RESEARCH

The screenshot shows the CORDIS website interface. The search bar contains the text "ocean energy". The results list includes:

- 1. **CA-OE** - Co-ordinated Action on Ocean Energy [Start Date: 2004-10-01 End Date: 2007-12-31]
Ocean energy industries and research organisations are at present small and scattered. Nevertheless between 5 and 10 different large scale Ocean Energy systems including new and unproven technology ar...
- 2. **DTOCEAN** - Optimal Design Tools for Ocean Energy Arrays [Start Date: 2013-10-28 End Date: 2016-10-27]
The DTOcean project is aimed at accelerating the industrial development of ocean energy power generation knowledge, and providing design tools for deploying the first generation of wave and tidal ener...
- 3. **Upper ocean structure and circulation and its response to atmospheric forcing**

On the right side, there is a "Related services" section with a "research*eu results magazine" cover image and a "wired" logo with the text "Send your own news". A "Participant Portal" logo is also visible. A red box with the number "85" is located in the bottom right corner of the screenshot.

Ocean energy

85

EU RESEARCH

The screenshot shows the CORDIS website interface. The search bar contains the text "sea energy". The results list includes:

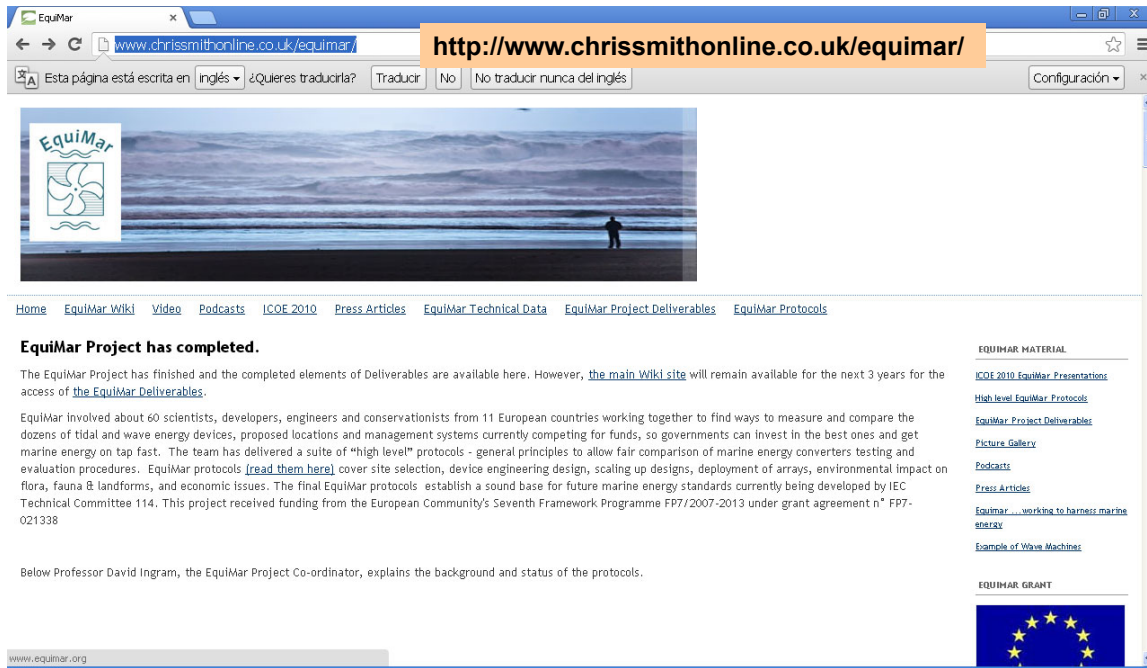
- 1. **ENSEA** - European North Sea Energy Alliance [Start Date: 2012-10-01 End Date: 2015-09-30]
The European North Sea Energy Alliance (ENSEA) aims to increase the competitiveness of research-driven energy clusters through better coordination and exploitation of research. A key driver for cluste...
- 2. **Global Change, 1992-1994** [Start Date: 1992-01-01 End Date: 1994-12-31]
Progress to end 1991 Two main activities have been undertaken : a) Terrestrial Biosphere : The processing of the AVHRR GAC time series for West Africa has been completed. Temporal series analysis has been performed in view of i...
- 3. **FTP-SC** - A European Technology Platform for Sustainable Chemistry

On the right side, there is a "Related services" section with a "research*eu results magazine" cover image and a "wired" logo with the text "Send your own news". A "Participant Portal" logo is also visible. A red box with the number "86" is located in the bottom right corner of the screenshot.

Sea energy

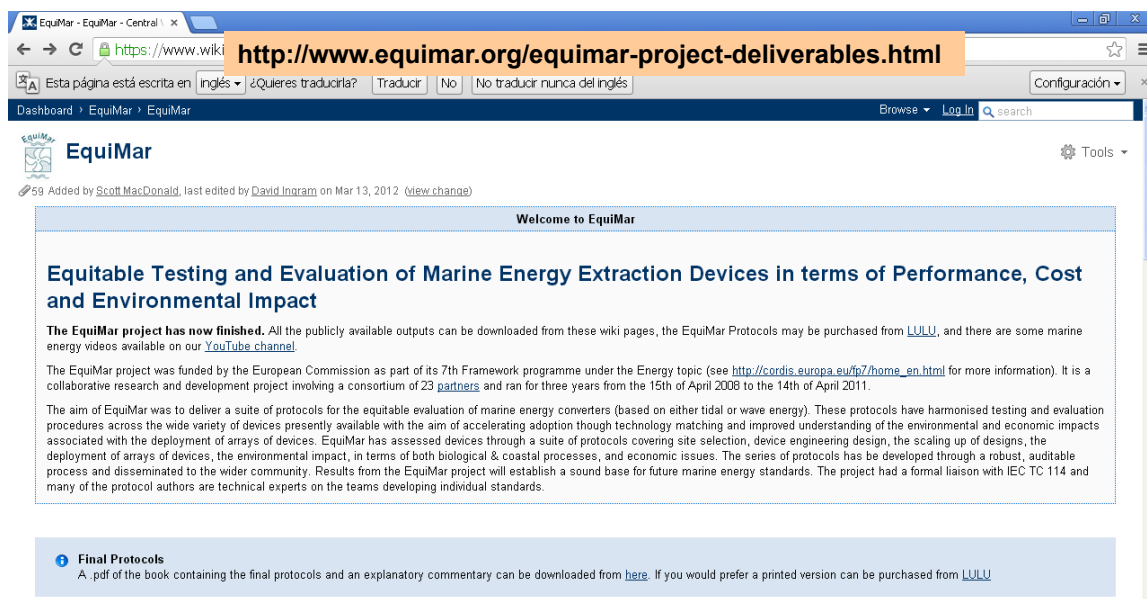
86

EquiMar



The screenshot shows a web browser window with the URL <http://www.chrissmithonline.co.uk/equimar/>. The page features a navigation menu with links to Home, EquiMar Wiki, Video, Podcasts, ICOE 2010, Press Articles, EquiMar Technical Data, EquiMar Project Deliverables, and EquiMar Protocols. The main content area is titled "EquiMar Project has completed." and contains text about the project's completion and the availability of deliverables. A sidebar on the right lists "EQUIMAR MATERIAL" and "EQUIMAR GRANT" with various links. A red box with the number "87" is visible in the bottom right corner of the screenshot.

EquiMar



The screenshot shows a web browser window with the URL <http://www.equimar.org/equimar-project-deliverables.html>. The page is titled "Welcome to EquiMar" and features a main heading: "Equitable Testing and Evaluation of Marine Energy Extraction Devices in terms of Performance, Cost and Environmental Impact". Below this, there is text stating "The EquiMar project has now finished." and providing information about the project's funding and goals. A red box with the number "88" is visible in the bottom right corner of the screenshot.

EquiMar

EquiMar - EquiMar - Central | x

Estz <https://www.wiki.ed.ac.uk/display/EquiMar/wiki/EquiMar;jsessionid=E74D286B9C35837A252BD33B4836D848>

Dashboard Esta página está escrita en **inglés** ¿Quieres traducirla? Traducir No No traducir nunca del inglés Configuración

Project Deliverables

- D1.1 Global Analysis of Pre-normative Research Activities for Marine Energy
- D1.2 Recommendations from Other Sectors
- D2.2 Wave and Tidal Resource Characterisation
- D2.3 Application of Numerical Models
- D2.4 Wave Model Intercomparison
- D2.5 Tidal Model Intercomparison
- D2.6 Extremes and Long Term Extrapolation
- D2.7 Protocols for Wave and Tidal Site Assessment
- D3.1 Identification of Limitations of the Current Practices Adopted for Early Stage Tidal Device Assessment
- D3.2 Concept Appraisal and Tank Testing Practices for 1st Stage Prototype Devices
- D3.3 Limitations of Current Practices adopted for Tank Testing of Small Marine Energy Devices
- D3.4 Best Practice for Tank Testing of Small Prototype Wave and Tidal Devices
- D4.1 Sea Trial Manual
- D4.2 Data Analysis and Presentation
- D4.3 Test Sites Catalogue
- D5.1 Guidance Protocols on Choosing of Electrical Connection Configurations Equimar WP5_D2_v09.pdf
- D5.2 Device Classification Templates
- D5.3 Protocols and Guidance for Device Specification and Quantification of Performance
- D5.4 Tested Version of Site/Device Matching Database Including Initial Analysis of Interaction Effects Within Arrays
- D5.5 Pre-deployment and operational actions associated with marine energy arrays
- D5.6 Assessment, reporting and remediation of risk associated with marine energy arrays
- D5.7 Assessment of the present status and future scenarios of the supply chain for marine energy arrays
- D5.8 Impacts Upon Marine Energy Stakeholders
- D6.1.1 Existing Legislation, perspectives and evolution of other similar technologies
- D6.1.2 Technical Criteria for a Common Legislation
- D6.2.1 Draft Scientific Guidelines
- D6.2.2 Scientific Guidelines
- D6.3.1 Uncertainties Regarding Environmental Impacts
- D6.3.2 Uncertainties and Road Map
- D6.4.1 Draft Protocol on Life Cycle Analysis Approach
- D6.4.2 Life Cycle Analysis Protocol
- D6.5.1 Analysis of Case Studies and Useful Tools
- Equimar_D6-5-2-1.pdf D6.5.2 Analysis of Case Studies and Useful Tools
- D7.1 Summary of Mitigation of Cost Measures by Different Stakeholders

OCEAN-Lider

OceanLider

<http://www.oceanlider.com/>

OceanLider **LÍDeres en Energías Renovables Oceánicas**

Español English

Inicio Proyecto Consorcio Resultados Documentación Noticias Contactar

Distribución, transporte, transformación, calidad de las energías renovables marinas
Gestión, mantenimiento y comunicación inteligentes para explotaciones oceánicas

21 / 10 / 2013 20:01:15

Bienvenidos a la web del proyecto CENIT-E OCEAN LÍDER

El proyecto CENIT-E OCEAN LÍDER, Líderes en Energías Renovables Oceánicas es una ambiciosa iniciativa tecnológica promovida por un consorcio de empresas con una alta capacidad en Investigación, que afronta el desafío de generar y crear el conocimiento y las tecnologías necesarias para el aprovechamiento eficiente e integral de las energías oceánicas renovables.

Conocimiento y Tecnologías que permitirán el desarrollo de nuevas instalaciones; dispositivos; estructuras; vehículos; buques y sistemas de caracterización de emplazamientos; y generación, distribución y transporte de la energía eléctrica captada de los océanos, que permitan su aprovechamiento sostenible y la implantación de novedosos modelos inteligentes de gestión y explotación de dichas fuentes energéticas preservando el medio ambiente marino y la seguridad de la vida humana en la mar.

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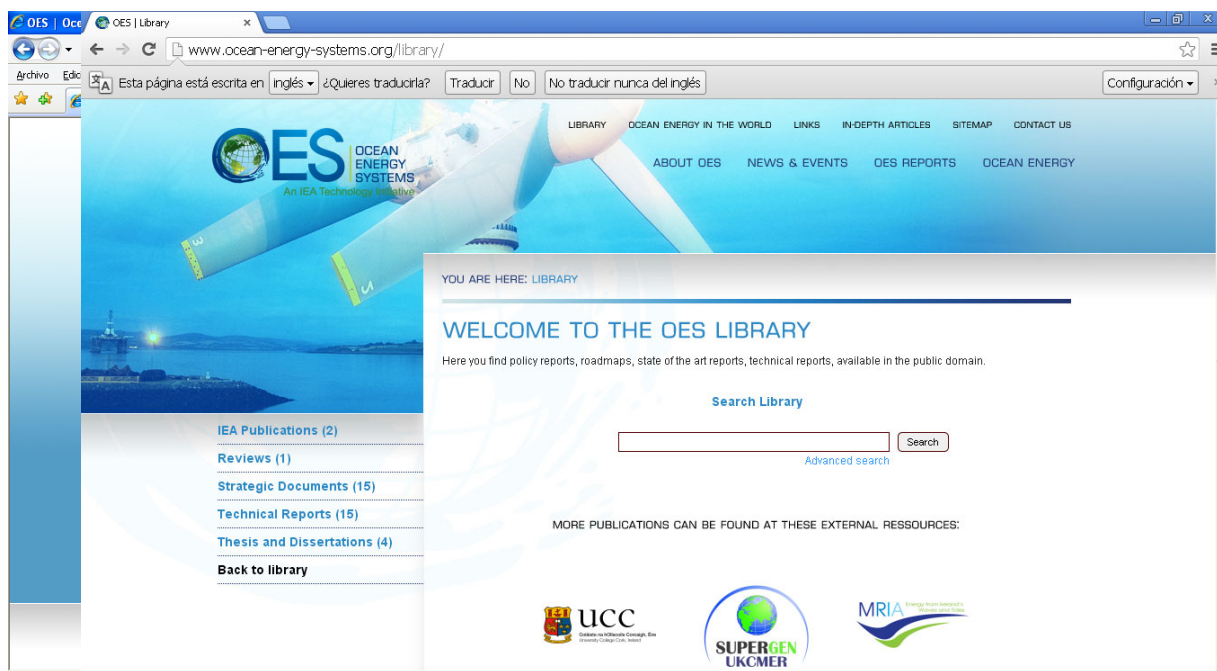
OCEAN ENERGY SYSTEMS

<http://www.ocean-energy-systems.org/>

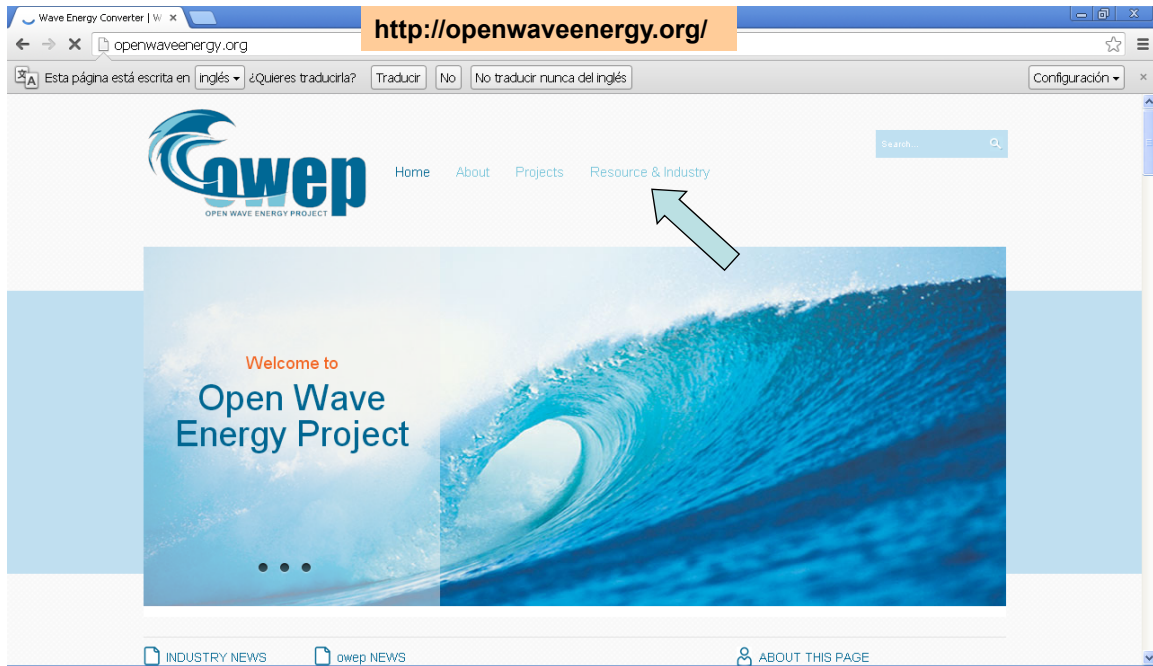


OCEAN ENERGY SYSTEMS

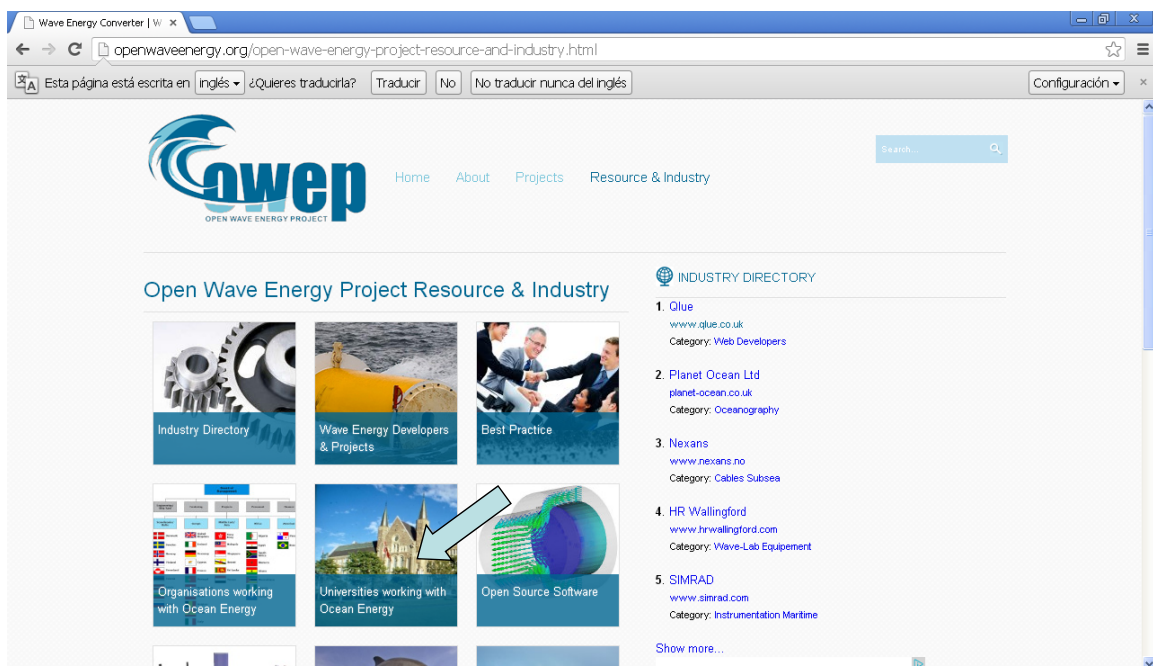
<http://www.ocean-energy-systems.org/>



OCEAN WAVE ENERGY PROJECT



OCEAN WAVE ENERGY PROJECT



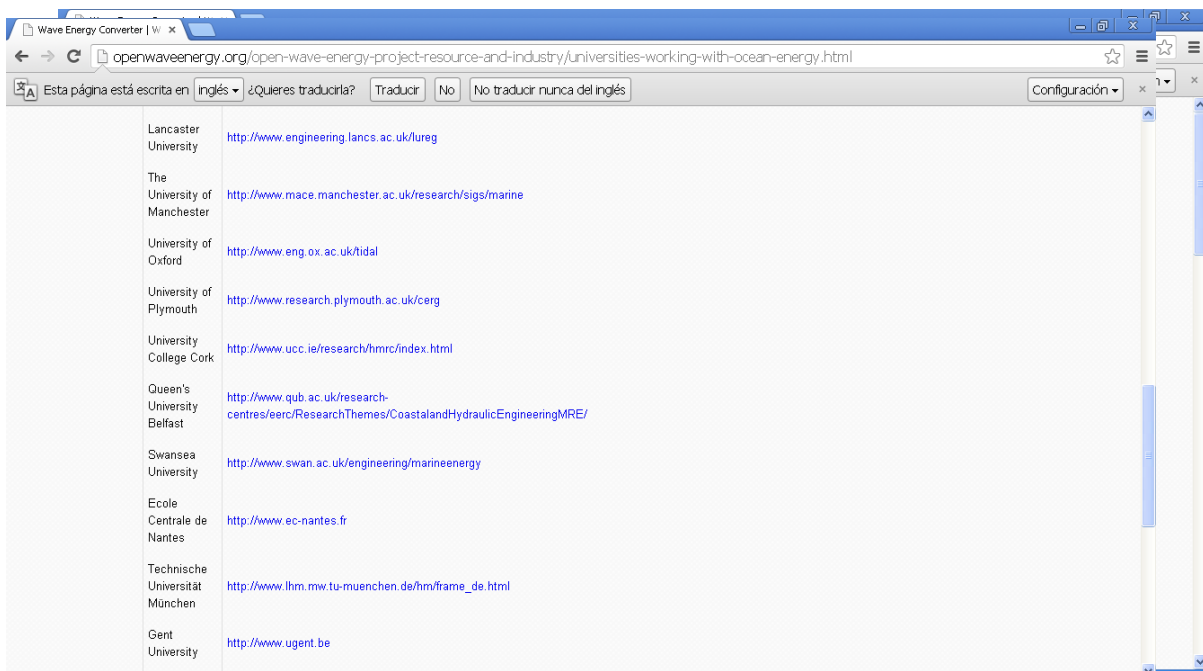
OCEAN WAVE ENERGY PROJECT



The screenshot shows the website openwaveenergy.org/open-wave-energy-project-resource-and-industry/universities-working-with-ocean-energy.html. The page features the OWEP logo and navigation links (Home, About, Projects, Resource & Industry). The main content area is titled "Universities working with Ocean Energy" and includes a photograph of four people in a meeting. To the right, there is an "Industry Directory" section with links to "Wave Energy Developers & Projects", "Best Practice", "Organisations working with Ocean Energy", "Universities working with Ocean Energy", "Open Source Software", "Proprietary Software for Ocean Energy", and "Environment". A vertical double-headed arrow on the right side of the browser window indicates scrolling.

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OCEAN WAVE ENERGY PROJECT



The screenshot shows the same website as above, but scrolled down to a list of universities. The list includes the following entries:

Lancaster University	http://www.engineering.lancs.ac.uk/lureg
The University of Manchester	http://www.mace.manchester.ac.uk/research/sigs/marine
University of Oxford	http://www.eng.ox.ac.uk/tidal
University of Plymouth	http://www.research.plymouth.ac.uk/cerg
University College Cork	http://www.ucc.ie/research/hmrc/index.html
Queen's University Belfast	http://www.qub.ac.uk/research-centres/eerc/ResearchThemes/CoastalandHydraulicEngineeringMRE/
Swansea University	http://www.swan.ac.uk/engineering/marineenergy
Ecole Centrale de Nantes	http://www.ec-nantes.fr
Technische Universität München	http://www.lhm.mw.tu-muenchen.de/hm/frame_de.html
Gent University	http://www.ugent.be

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OCEAN WAVE ENERGY PROJ

openwaveenergy.org/open-wave-energy-project-resource-and-industry/universities-working-with-ocean-energy.html

Lancaster University	http://www.engineering.lancs.ac.uk/lureg
The University of Manchester	http://www.mace.manchester.ac.uk/research/sigs/marine
University of Oxford	http://www.eng.ox.ac.uk/tidal
University of Plymouth	http://www.research.plymouth.ac.uk/cegr
University College Cork	http://www.ucc.ie/research/hmrc/index.html
Queen's University Belfast	http://www.qub.ac.uk/research-centres/eerc/ResearchThemes/CoastalandHydraulicEngineeringMRE/
Swansea University	http://www.swan.ac.uk/engineering/marineenergy
Ecole Centrale de Nantes	http://www.ec-nantes.fr
Technische Universität München	http://www.lhm.mw.tu-muenchen.de/hm/frame_de.html
Gent University	http://www.ugent.be
Gent University	http://www.ugent.be
Instituto Superior Técnico.	http://www.ist.utl.pt
Delft University of Technology	http://tudelft.nl
Universidad de La Laguna, Tenerife	http://www ull.es
Oregon State University	http://wave.oregonstate.edu/Facilities
The University of Texas at Austin	http://www.utexas.edu
The University of Iowa	http://www.ihr.uiowa.edu/facilities/annexes-labs-and-shops/hydraulics-wave-b-facility

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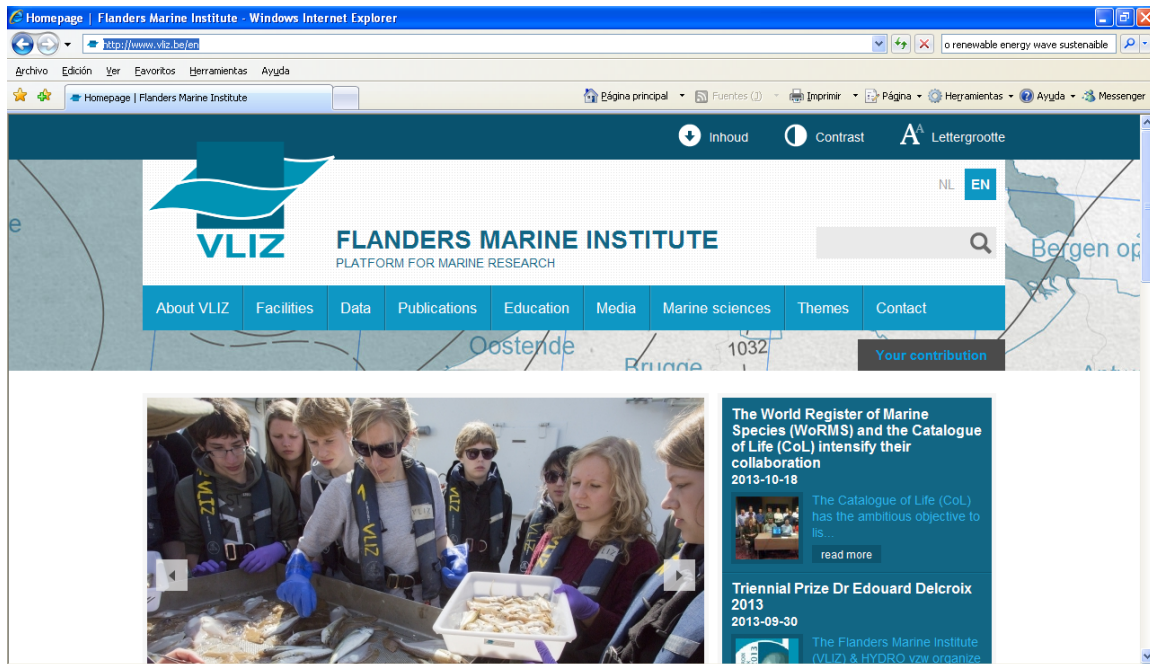
openwaveenergy.org/open-wave-energy-project-resource-and-industry/universities-working-with-ocean-energy.html

Gent University	http://www.ugent.be
Instituto Superior Técnico.	http://www.ist.utl.pt
Delft University of Technology	http://tudelft.nl
Universidad de La Laguna, Tenerife	http://www ull.es
Oregon State University	http://wave.oregonstate.edu/Facilities
The University of Texas at Austin	http://www.utexas.edu
The University of Iowa	http://www.ihr.uiowa.edu/facilities/annexes-labs-and-shops/hydraulics-wave-b-facility

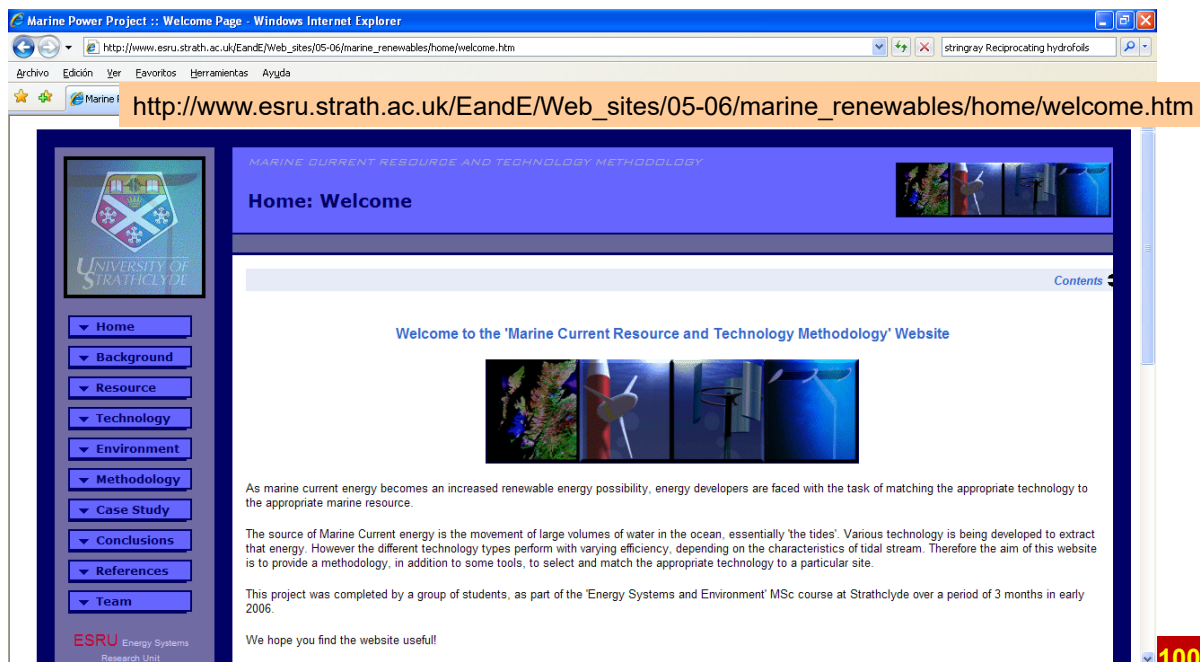
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3ª edición
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Ed: Pearson

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