

# BULLETIN

As the authoritative international voice on ocean energy we collaborate internationally to accelerate the viability, uptake and acceptance of ocean energy systems in an environmentally acceptable manner.



OCTOBER 2011

## Introduction

The Implementing Agreement on Ocean Energy Systems (OES) of the International Energy Agency (IEA) will complete its second five-year mandate on 28 February 2012. Thus a request for a new 5-year term was submitted to the IEA Committee on Energy Research and Technology (CERT) during 2011. The Strategic Plan for OES for 2012-2017 has been developed according to the founding objectives of the IEA and the need for a globally accepted Vision for Ocean Energy.

The OES brochure on the "International Vision for Ocean Energy" published in September 2011, sets out the opportunities, benefits and policies for ocean energy and barriers to the uptake of ocean energy surrounding the Vision, and being influenced by the organisational values of OES.

**Task I - Information Collation and Dissemination** is the central task of the OES work programme on the technical, economic, environmental and social aspects of ocean energy systems. During 2011, a Communications Plan for the OES has been prepared and as a result a new website will soon be launched. As part of the new strategy, OES branding has been updated with a focus on increasing awareness and understanding of the public in general.

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**This bulletin highlights recent achievements and prospects in 14 member countries of the Implementing Agreement on Ocean Energy Systems (OES).**



Sihwa Tidal Power Plant (254MW) inaugurated in July 2011, Korea

## Republic of Korea

Keyyong Hong, Korea Ocean Research and Development Institute (KORDI)

Sihwa Tidal Power Plant of 254MW was inaugurated in July 2011. The construction of this plant was initiated in December 2004. It consists of 10 turbines of 25.4 MW rated power, with annual forecast generation capacity of 552.7 GWh. The project cost was US\$462.5 million. In Korea three other tidal power plants are being considered: Ganghwa (838.2 MW), Incheon (1440 MW) and Garorim (520 MW).

A 500 kW oscillating water column (OWC) pilot plant will be installed in intermediate waters on Jeju Island, in 2012. It is formed by two air chambers, equipped with the impulse turbine. This project, managed by KORDI, is funded by the government with a total budget of US\$ 24 million (R&D: US\$ 8.5 million; pilot plant: US\$ 15.5 million).

## Japan

Yasuyuki Ikegami, Institute of Ocean Energy, Saga University (IOES)

The New Energy and Industrial Technology Development Organization (NEDO) has concluded a study on the ocean renewable energy potential in the country. The available ocean energy resources have been mapped (wave, OTEC, current, tidal current and tidal range power) and favourable places for the development of ocean energy projects have been identified.

## China

Dengwen Xia, National Ocean Technology Center

China plans to release, by end of this year, its five-year Plan (2011-2015) for Marine Renewable Energy, prepared by the State Oceanic Administration (SOA) and by the National Energy Administration (NEA). SOA has also been preparing a national strategy for Marine Renewable Energy which will set up a target for installed capacity with 2020 horizon. This document shall also be released until the end of the year.

Since 2010, SOA had in place a Special Fund for Marine Renewable Energy covering several specific areas from R&D to demonstration of grid connected projects. In 2010, the total amount of financial support from this funding programme was US\$ 44 million for 26 projects. This year, it has been US\$ 31 million for 39 projects.

In 2011 a new project on Daguang Island started operation, which demonstrates, on a remote island, the combination of a 30 kW wave energy system with a 60 kW wind turbine and a 15 kW solar power system. This combination of renewable energy sources is the focus of other projects in China: a 500kW project on Zhaitang Island and a 500 kW on Danwanshan Island are under development.

Plans have been initiated for the creation of a grid-connected wave and tidal test site in Rongcheng, Shandong, China.

## New Zealand

John Huckerby, AWATEA

On 30 August 2011 the New Zealand Government released its Energy Strategy. The document retains an aspirational target of achieving 90% renewable electricity generation but does not make specific references to marine energy. Since late 2007 the NZ Government has offered funds for deployment projects, through the Marine Energy Deployment Fund (MEDF). Grants have been allocated in four rounds from 2008 to 2011, with the 4th Round closing in for bids in November 2010. As a result of the grants, several projects are in development:

**Crest Energy** have secured resource consents for a 200 MW tidal current project in the outer part of the Kaipara Harbour north of Auckland.

**Chatham Islands Marine Energy Limited** plan to deploy a 220 kW Wavegen LIMPET device on the main Chatham Island (800 km east of NZ).

**Tangaroa Energy** has established a relationship with Norwegian company Langlee Wave Power to deploy a 20 kW device off Stewart Island.

## Australia

John Wright, CSIRO

There are about 12 companies active in Australia looking at demonstration to commercial developments. OPT Australia received, at the end of 2009, a \$66 million grant from the federal government for a 19 MW commercial development off the coast of Victoria.

The government has set up the \$126 million Emerging Renewables Program to support new renewable energies. This fund will be administered by a relatively new body, the Australian Centre for Renewable Energy (ACRE) which will in turn be superseded by the formation of the Australian Renewable Energy Agency (ARENA). ARENA will administer \$3.2 billion budget from the Australian government to promote R&D, commercialization and deployment of renewable energy projects to improve the sector's competitiveness. Applicants may apply for funding at any time and there are no funding limits for projects

The Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia's national science agency is continuing to map the ocean energy resources in Australia. A new industry association called 'Ocean Energy Australia' is under formation with already 9 industry members.



WET-NZ scale device being deployed off Akaroa Heads, New Zealand

**Wave Energy Technology – New Zealand (WET-NZ)** was granted funds to deploy a 1/2-scale, 20 kW point absorber device off the Wellington coast in 2009 and was again awarded funds to install an export cable to connect this device to the shore in the final round of funding. The WET-NZ 1/2-scale device is currently undergoing preliminary sea trials off Banks Peninsula (near Christchurch) before being shipped to the consented deployment location in Wellington.

## Canada

Tracey Kutney, Natural Resources

The Marine Renewable Energy Technology Roadmap, in collaboration with industry and supported by Natural Resources Canada, set up a target of 75 MW installed by Canadian industry by 2016 and 2 GW by 2030 expected to represent \$2 billion annual economic value in 2030.

Four in-stream tidal projects are planned to be tested in the Fundy Ocean Research Center for Energy (FORCE): NS Power/OpenHydro, Alstom/Clean Current, Minas Basin/MCT and Atlantis Resource Corporation/Lockheed Martin/Irving Equipment. Particular effort is being put towards the development of environmental research, community consultation, and a research and monitoring advisory groups. Several wave, marine and river current developers are active in Canada.

### In-stream Tidal current:

**Alstom** - now owns the Clean Current tidal technology and is working on deploying at FORCE in the next couple years

**New Energy Corp** - planning testing in Canoe Pas (British Columbia), Grand Passage (Nova Scotia) during 2012-2013

**Mavi Innovations Inc** - currently testing a ducted vertical axis  $\frac{1}{4}$  scale device, at NRC.

### Wave energy:

**Surf Power** - completing model testing at the Offshore Engineering wave basin in IOT (West Coast)

**College of North Atlantic** - developing a project off the southern part of Newfoundland, East Coast

### River in-stream:

**New Energy Corp** - testing in Alaska (U.S.), Manitoba, and British Columbia

**RER** (formerly RSW) - deployed a 250 kW machine in St. Lawrence river, near Montreal, Quebec

**Sabella Energy** - planning to install a unit in St. Lawrence river, 2011-2012

**Clean Current** - currently testing river-current device  
Verdant Power Canada - work is continuing on the proposed project for the St. Lawrence river, near Cornwall, Ontario

**Instream Energy** - performing tests in British Columbia

## Mexico

Gerardo Hiriart, Energias Alternas, Estudios y Proyectos (ENAL)

Mexico is becoming more interested in quantifying its ocean energy resources. There is no special support mechanism to stimulate private investment in ocean energy. Government R&D funding has been quite limited but it is expected to increase, mainly for detailed resource assessment studies.

## United States of America

Michael C. Reed, U.S. Department of Energy

The United States has a goal of achieving 23-38 GW by 2030 from ocean energy sources. Through the U.S. Department of Energy, the U.S. is undertaking a rigorous assessment of available U.S. marine resources (wave, ocean and tidal current, and ocean thermal), and evaluating the wide range of technologies available to tap these resources, while simultaneously seeking to address and resolve associated environmental challenges. It is also aiming to simplify the licensing of ocean energy projects. These efforts will support the issuance of a comprehensive technical and economic assessment of U.S. marine and hydrokinetic resources and technologies. This report will serve to inform and guide future U.S. investments in marine and hydrokinetic technologies. By the end of the calendar year, the U.S. will complete several of its ocean energy resource assessments. In July 2011, a tidal resource map was made available. Resource assessments and maps for wave and ocean thermal energy will be released by the end of the year. The U.S. is also supporting numerous in-water demonstrations of MHK technologies. Current and planned U.S. demonstration projects for 2011-2013 include:

**Free Flow Power** deployed a 40 kW river in-stream turbine in the Mississippi River in July 2011.

**Columbia Power Technologies** deployed its "Sea Ray" wave energy converter in March 2011 in Puget Sound, WA.

**Ocean Renewable Power Company** will deploy the first of five 150 kW "TidGen" tidal turbines in March 2012 in Cobscook Bay.

**Ocean Power Technologies** will deploy the first 150kW "PowerBuoy" in the U.S. in January 2012 in Reedsport, OR.

**Snohomish Public Utility District** plans to deploy two grid connected 6-meter "OpenHydro" turbines in Admiralty Inlet in 2013.

The U.S. Department of Energy is also funding a variety of work through national labs, universities, and industry partners aimed at developing tools and conducting research to accelerate the deployment of ocean energy technologies. Some of these projects include:

**Sandia National Laboratory** has developed a new tool and training course to improve array optimization and near-field wake characterization for tidal energy devices, based on their efforts to update EFDC (Environmental Fluid Dynamics Code).

**The Northwest National Marine Renewable Energy Center** (Oregon State University and the University of Washington) has developed a modular and scalable instrumentation package for cost-effective environmental and performance monitoring of tidal turbines.

**Pacific Northwest National Laboratory** works with DOE under Annex IV of the OES-IA to develop an international environmental impacts database.

## Spain

José Luis Villate, Tecnalia



Turbine room of Mutriku OWC, Basque Region  
Source: EVE

Spain's first grid connected wave power plant was inaugurated in July 2011, in the Basque region promoted by Ente Vasco de Energia (EVE), the Basque energy agency. It consists of a new breakwater in Mutriku harbor with 16 oscillating water column (OWC) chambers each one equipped with a 18.5 kW Voith Hydro Wavegen turbine.

The test facility for floating wave energy converters bimep, also promoted by EVE, is progressing and it's expected that the cables will be laid in 2012. Spain recently announced targets for ocean energy (wave and tidal): the first 10 MW are expected by 2016 and an annual growth rate of 20-25 MW between 2016 and 2020 is expected to accumulate to 100 MW by 2020. A detailed Wave Atlas developed along the whole Spanish coastline by "Instituto de Hidráulica Ambiental" (Cantabria University), funded by IDAE (Spanish Energy Agency - Industry Ministry), is now available at:

[www.ihcantabria.com/enola](http://www.ihcantabria.com/enola)

A new test infrastructure, the **Cantabria Coastal and Ocean Basin**, was inaugurated in March. The basin is aimed at research on maritime engineering (offshore and coastal) that requires physical and/or numerical modeling and it combines wind, waves and current generation.

## Portugal

Ana Brito e Melo, Wave Energy Centre



300 kW WaveRoller – Machine room  
Source: AW-Energy

ENONDAS, a fully owned subsidiary of Portuguese National Grid (REN), is carrying out the site survey and the engineering tasks for the Portuguese Pilot Zone, recently named **Ocean Plug** (offshore São Pedro de Moel).

The 400kW experimental **oscillating water column (OWC) plant on Pico Island**, Azores, demonstrated autonomous and continuous operation for 3 months in 2010. In the beginning of 2011, a serious generator failure occurred, which could only be solved towards August. By Autumn, autonomous operation was successfully resumed through several tests, and a proposal was submitted to the regional funding agencies to renovate parts of the structure and refit half of the plant's space with a second turbine duct, designed as a modular test bed. Pico OWC integrates in a selection of European infrastructures highly relevant for ocean energy development through the EC-funded MARiNET project.

The **300 kW WaveRoller** demonstrator project is expected to be installed in January 2012, offshore Peniche (central region of Portugal). This project is conducted by the Finish company, AW-Energy, in partnership with the Portuguese Eneólica, with EU funding.

**WindFloat Prototype** a floating platform with a Vestas 2.0 MW wind turbine, was successfully installed offshore Northern Portugal in the beginning of October 2011, at Aguçadora, an EDP grid connected site.

## United Kingdom

Trevor Raggatt, DECC

Currently, in England and Wales marine energy technologies receive 2 ROCs (Renewables Obligation Certificates) for each MWh generated to the grid. The Department of Energy and Climate Change (DECC) propose increasing this to 5 ROCs/MWh for both wave and tidal stream energy (subject to a 30MW project capacity) for devices installed by 31st March 2017. After this date, support will be through the new Feed-in-Tariff with Contracts for Difference, which is being developed by the UK as a part of its Electricity Markets Reform (EMR) process.

More info is available here:

[http://www.decc.gov.uk/en/content/cms/news/pn11\\_85/pn11\\_85.aspx](http://www.decc.gov.uk/en/content/cms/news/pn11_85/pn11_85.aspx)

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**The proposed banding levels for wave and tidal energy under the UK Renewables Obligation, currently the main UK market-based revenue support mechanism, were announced.**

## Denmark

Kim Nielsen, Ramboll



Source: Danish Energy Agency

A Danish “Partnership” project lead by Aalborg University and funded by the Danish Energy Technology Development and Demonstration Programme (EUDP) was initiated in 2011 with the objective to provide a revised and updated strategy for wave energy development in the country.

There are several companies active in wave energy in Denmark: during 2011, **DEXA-WAVE** has installed a 1:5 scaled prototype at DanWEC, Hanstholm and entered into an agreement with Government of Malta to develop three full-scale wave energy converters (ca. 250 kW) followed by additional 24 converters. The 1:10 model tested at Nissum Bredning was transported and installed in Malta in July 2011 as a show case.

**Floating Power Plant** announced, in April 2011, a co-operation with Bridgewater Capital, Oregon, US the joint creation of a US company, Floating Power Inc., to com-

mercialize the Danish company’s Poseidon Wave/Wind Energy Platform.

**Wave Dragon** has received funding from EUDP, in 2011, to develop phase 1 of a full-scale 1.5 MW demonstrator project at the test centre DanWEC, Hanstholm.

**Leancon** is working on the 1:10 prototype which is expected to be installed in Nissum Bredning, in the spring of 2012.

**CrestWing** will be testing a 1:5 scale model in open sea offshore Frederikshavn, for a 6-month period, planned to start in October 2011.

**Weptos** is a new approach integrating two strings of “Salters Ducks” each driving a common shaft, which is presently being tested at the new and large Spanish facility Cantabria Coastal and Ocean Basin (CCOB).

**Wave Star** has been operating in the sea for more than 2 years providing power to the grid at the test site DanWEC.

## Sweden

Maja Wänström, Swedish Energy Agency

The Swedish Government launched a programme for large scale demonstration plants with a total budget of €85 million. One of the six projects funded is a 10 MW wave farm developed by Seabased AB & Fortum AB, a €28 million project, with €15 million grant from the Swedish government.

Ocean Harvesting Technology AB is developing a 1:4 wave energy prototype with Fred Olsen AS for testing in the ocean. Minesto AB awarded €0.4 million Carbon Trust grant to test its marine current prototype at Strangford Lough, UK, considered by Carbon Trust to represent the third generation of tidal technology concepts



Seabased testing at Runde Environmental Centre (Norway)

## Norway

Harald Rikheim, Statkraft

There has been a significant increase in R&D and Demonstration funding for renewable energy over the last years, which has led to more funding on ocean energy in Norway. Several Norwegian wave and tidal current technologies are progressing:

**SEAHORSE POWER, LLC**, a patented wave energy concept was launched for testing in September at the Runde Environmental Centre.

**Fred Olsen BOLT**, a wave energy device is operating since 2009. BOLT 2, with 225 kW rated power (16 m diameter), is now under construction to be launched at Fabtest, a new test facility in the UK operated by Exeter University.

**Langlee Wave Power** has secured £700,000 (6 million NOK) funding from Färna Invest AB and has recently presented a new mooring system.

A new **OWC wave energy system** is now under development based on experiences from the Kværner concept in the 1980’s.

**Hammerfest Strøm UK**, originally from Norway, is now pre-commissioning/testing their 1 MW pre-commercial tidal current unit (HS1000) at The European Marine Energy Centre (EMEC), with Carbon Trust funding.

The **Hydra Tidal device** is being modified after a testing period, last year, in Lofoten islands.

## Ireland

Eoin Sweeney, Sustainable Energy Authority of Ireland (SEAI)

Ireland's target of 500 MW of installed ocean energy capacity by 2020 is underpinned by national work to accelerate technology progress. A detailed report on "Assessment of the Irish Ports & Shipping Requirements for the Marine Renewable Energy Industry" was published in June 2011, prepared on behalf of SEAI. This is an example of the preparatory work to the industrial supply chain in Ireland, essential to maximising the economic benefit for utilisation of marine energy resources. It begins by establishing the distribution of the ocean energy resource around the Irish coast, necessary to determine the appropriate port resources needed for developments at the various coastal locations. The Department of Communications, Energy and Natural Resources, with input from SEAI and in parallel with the development of the Strategic Environmental Assessment (SEA) have prepared a draft **Offshore Renewable Energy Development Plan** (OREDP) which describes the policy context for development of offshore wind, wave and tidal stream energy in Irish waters up to 2030. Following the public consultation, a post-consultation report will be soon published.

SEAI is further coordinating a study on the viability and cost benefit analysis for Ireland exporting renewable electricity (RES-E) using the Co-operation Mechanisms in Directive 2009/28/EC. A previous report "Offshore Grid Study: Analysis of the Appropriate Architecture" was prepared by Elgrid, in August this year.

The development of the fully open-ocean grid-connected wave test facility in west of Belmullet in County Mayo is underway.

The **Marine Renewables Industry Association (MRIA)** representing all of the main interests on Ireland engaged in the wave and tidal energy sector was established. The Association includes developers (e.g. Wavebob, Ocean Energy, OpenHydro, Aquamarine and others), utilities and site developers, consultants, R&D businesses, supply chain activities and academic researchers.

WestWave, a consortium led by ESB International Limited, has potential to secure support under wave energy category of EU NER300. This consortium includes 4 of the leading technologies developers: Aquamarine, Pelamis Wave Power, Ocean Energy and Wavebob and aims to develop a 5 MW wave energy project off the west coast of Ireland by 2015.

## OES Collaborative Research Projects

### Task 1

**Review, Exchange and Dissemination of Information on Ocean Energy Systems - ACTIVE**

Operating Agent: Wave Energy Centre - Portugal  
Duration: From 2001

### Task 2

**Development of Recommended Practices for Testing and Evaluating Ocean Energy Systems - CONCLUDED**

Operating Agent: Ramboll - Denmark  
Duration: 2002-2009

### Task 3

**Integration of Ocean Energy Plants into Distribution and Transmission Electrical Grids - CONCLUDED**

Operating Agent: Powertech Labs - Canada  
Duration: 2007 - 2010

### Task 4

**Assessment of Environmental Effects and Monitoring Efforts for Ocean Wave, Tidal and Current Energy Systems - ACTIVE**

Operating Agent: Department of Energy - USA  
Duration: 2009 - 2011

### Task 5

**The Exchange and Assessment of Ocean Energy Device Project Information and Experience - NEW**

Operating Agent: Department of Energy - USA  
Duration: 2012 - 2014

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## OES Members

2001	Denmark Portugal United Kingdom
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2007	Germany Mexico Norway
2008	Spain Italy New Zealand Sweden
2009	Australia
2010	Korea South Africa
2011	China

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