OCEANTEC OWC

Figure 1. OCEANTEC WEC and BiMEP

Summary description

This project consists in the installation of the OCEANTEC WEC into the sea at the BiMEP platform (an offshore infrastructure for the demonstration and proving of wave energy generation devices over a sustained period of time).
The OCEANTEC WEC is is a point absorber device based on the Oscillating Water Column (OWC) principle, which was found as the most effective technology for its simplicity, minimum number of components, scalability and low generation cost. The development has materialized in a sensor able to take advantage of the energy of the waves and based on the principle of the oscillating water column (OWC). The device uses a large volume of moving water as a piston in a cylinder. Air is forced out of the column as a wave rises and fresh air is drawn in as the wave falls. This movement of air drives turbine at the top of the column.
After an initial numerical modeling and a preliminary design of the collector, tests were carried out in a channel with a first prototype at 1: 25 scale. The design has been validated by DNV. At this stage, a full prototype has been developed in the North Coast of Spain.
The technology development has been supported by the Basque Energy Agency under a Pre-commercial Procurement Contract. The testing activities of the WEC are also part of the European project OPERA ('Open Sea Operating Experience to Reduce Wave Energy Cost'), which has received funding from the EU Horizon 2020 research and innovation programme under the grant agreement No. 654444.

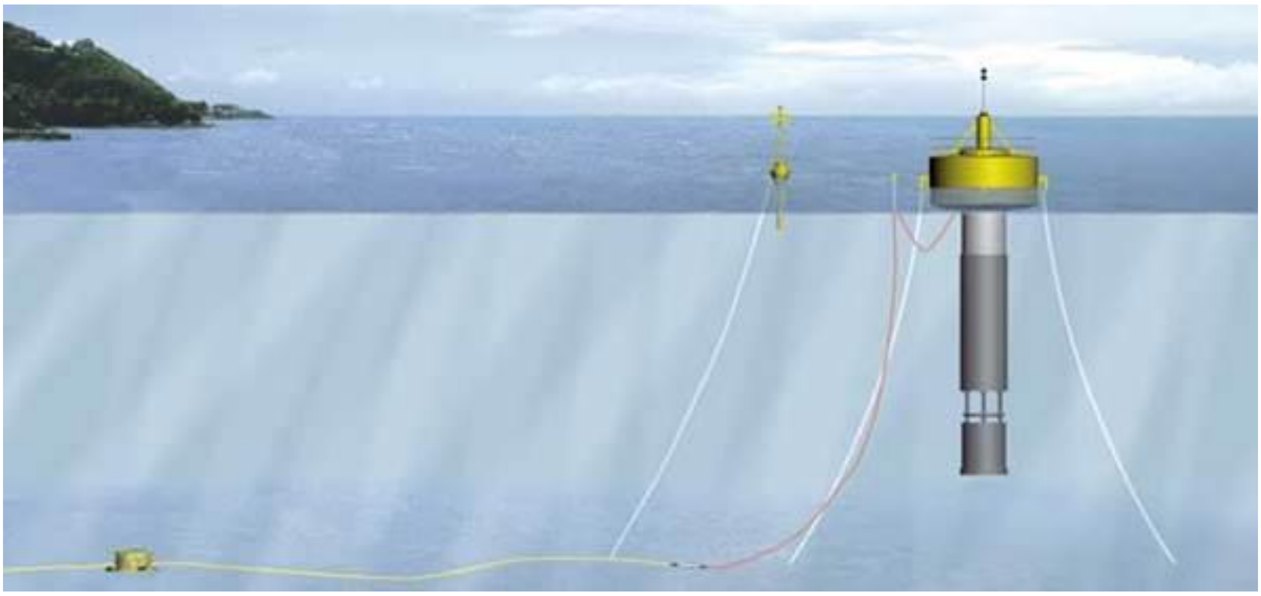

Figure 2. OCEANTEC system

Reason of interest for MAESTRALE

The OCEANTEC concept has interesting advantages applicable to the Mediterranean Sea. Its main feature is a cylindrical buoy, whose survivability has been proven for many years to open sea conditions. Its low maintenance cost is associated to its simplicity. The converter is easily accessible for maintenance increasing reliability and reducing costs. As an overall it offers low energy costs obtaining it from the waves.

GENERAL INFORMATION	
Type of Blue energy source	**Wave energy**
Type of energy output	**Electricity**
Type of project/plant	**Prototype**
Status	**Operational**
Location	***43.469 N , -2.860 E*** ***Cantabrian Sea*** ***Spain, Armintza***
Involved actors	***Oceantec – Developer***

	Tecnalia - technology leader *Iberdrola - Market*
Nominal power	*30 kW of nominal power, in terms of energy: 262.8 MWh/year*
Annual productivity	*The performance of the device is not available at this stage*
Size	*20 m2*
Year	*2016 - BIMEP site launch* *2017 -Re-launching after reworks*
Implementation cost	*Not applicable at this stage: prototype development*
Payback period	*Not applicable for this project, but for any offshore project around a decade is foreseen*
Key words	*floating device, Oscillating Water Column (OWC), bouy, wave energy, wave energy converter, point absorber, turbines*
Web link	**http://www.oceantecenergy.com/**

7.3.1 BACKGROUND

Energy policies framework

Integrated Maritime Policy
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An Integrated Maritime Policy for the European Union. The Integrated Maritime Policy seeks to provide a more coherent approach to maritime issues, with increased coordination between different policy area
Blue Growth
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Blue Growth opportunities for marine and maritime sustainable growth. Blue Growth is the long term strategy to support sustainable growth in the marine and maritime sectors as a whole. Seas and oceans are drivers for the European economy and have great potential for innovation and growth. It is the maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth.
Blue Energy

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond. On 20 January 2014, the Commission set out an action plan to support the development of ocean energy, including that generated by waves, tidal power, thermal energy conversion and salinity gradient power in its communication entitled 'Blue Energy: Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond'.

Legal and administrative background

Recommendations
DNV-OSS-312 Offshore service specification: Certification of Tidal and Wave Energy Converters

EU Legislation
*** Regulation (EU) No 1255/2011 of the European Parliament and of the Council of 30 November 2011 establishing a Program to support the further development of an Integrated Maritime Policy**
*** Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. It seeks to contribute to ensuring biodiversity in the European Union by the conservation of natural habitats, and wild fauna and flora species.**

Links with spatial planning instrument

Maritime Spatial Planning
Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning
Competition for maritime space – for renewable energy equipment, aquaculture and other uses – has highlighted the need to manage our waters more coherently. Maritime spatial planning (MSP) works across borders and sectors to ensure human activities at sea take place in an efficient, safe and sustainable way. That is why the European Parliament and the Council have adopted legislation to create a common framework for maritime spatial planning in Europe.

This case study is a research project so just a device was deployed for its development, and therefore not a significant impact was found on the maritime spatial planning. If a full plant is installed, the definition of the deployment area must be agreed with the key players of the Mediterranean Sea, e.g. tranport companies, main sea routes; so as to reduce the impact on other sectors.

7.3.2 TECHNOLOGICAL ISSUES

Applied technology

The Oceantec point absorber oscillating water column (OWC) floating device consists of a simple and robust buoy that moves by the action of the waves. It consists basically of three parts: a float that moves by the effect of the waves, a hollow cylinder that contains the water column and a lower ballast that provides stability and inertia.
The air flow produced by the relative movement of the buoy and the water column is conducted through a bidirectional turbine located at the top of the float. The turbine rotates in a single direction regardless of the direction of the air flow, allowing the generator to be coupled to the turbine shaft.
Different control strategies are used to adjust and optimize the performance of the sensor for each sea state, as well as to protect it in the event of a storm.

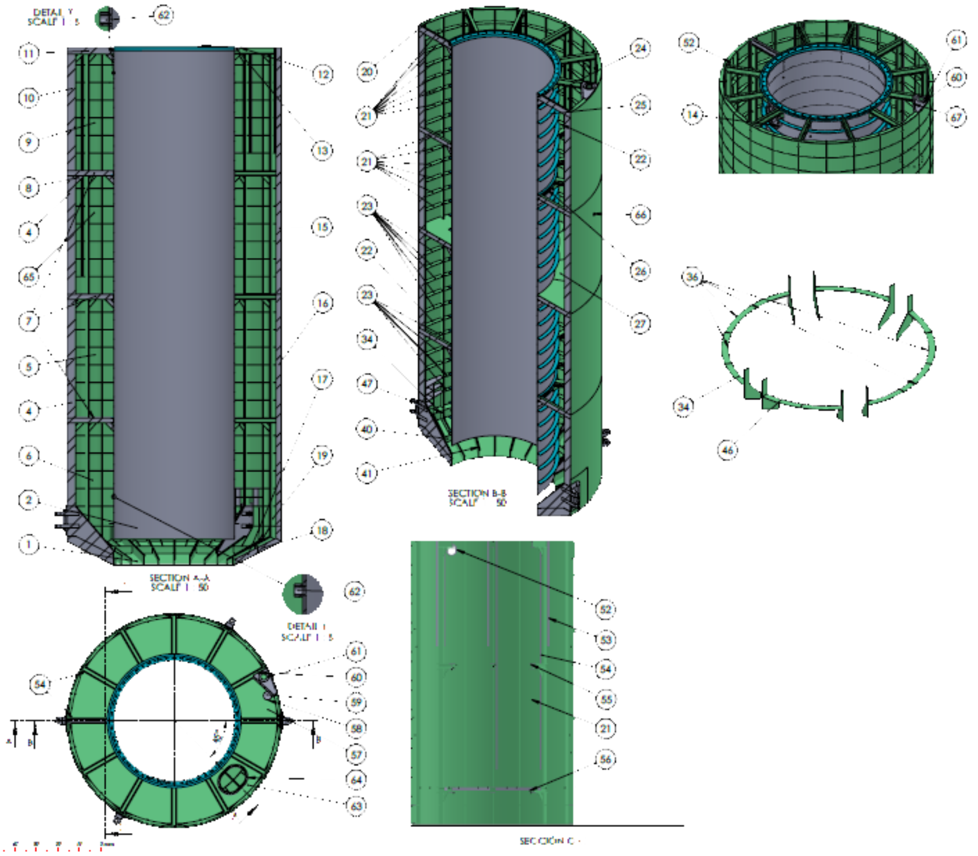

Figure 3. OCEANTEC oscillating water column floating device

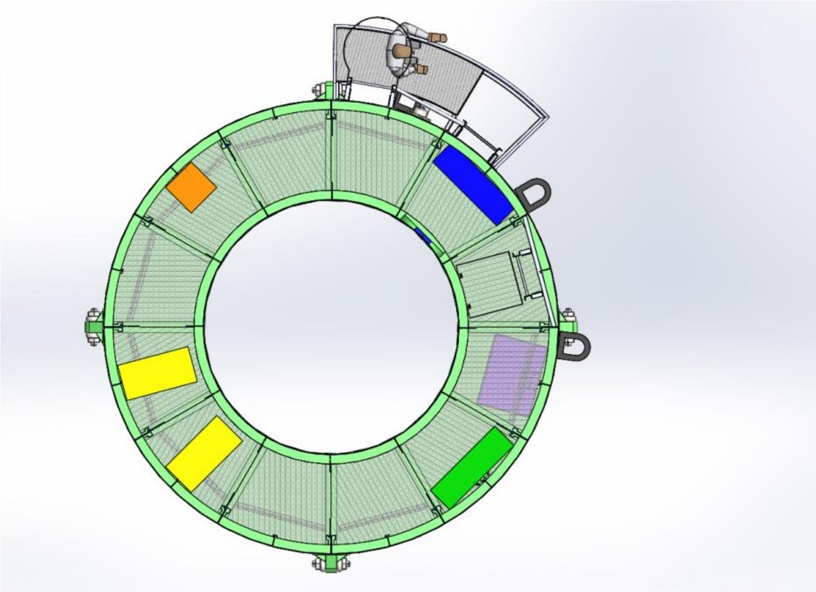

Figure 4. OCEANTEC oscillating water column floating device – top view

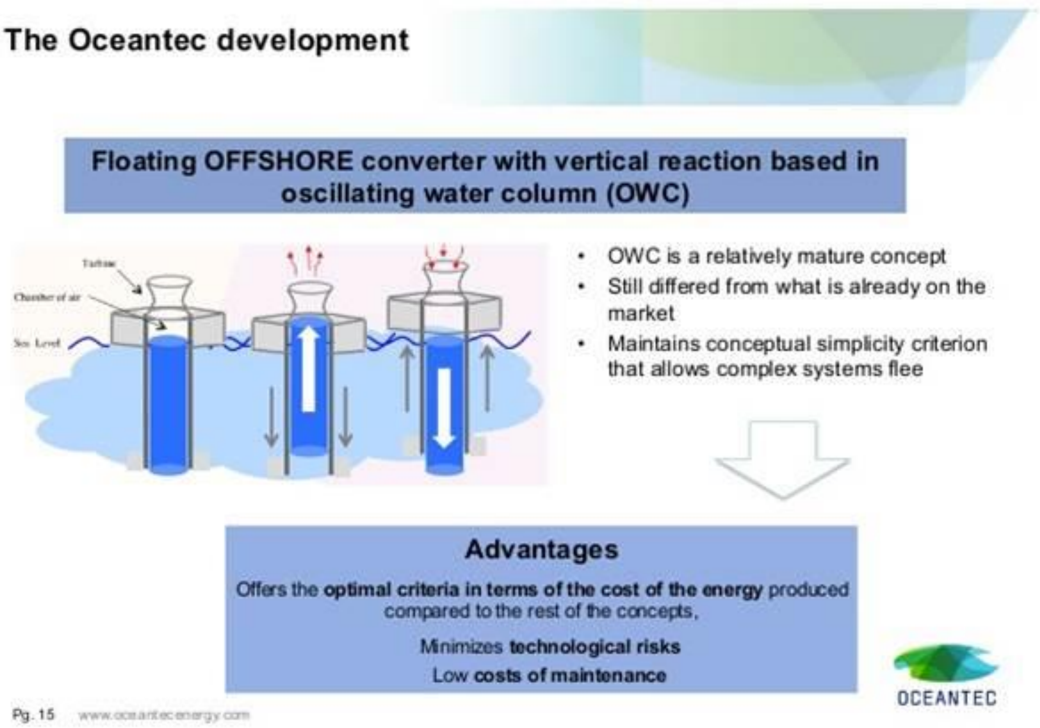

Figure 5. OCEANTEC working principle

Innovation aspects

The main advantages of the OCEANTEC buoy WEC are the following:
• Survivability: traditional concept which has demonstrated its survivability over the years.
• Low maintenance cost, simplicity: just one moving part, the turbine.
• Cost of the Energy: after this analysis, it can be said that offers the lowest energy cost for harvesting wave energy

Quantitative information

The OWC is shaped like a large buoy with 5 m in diameter, 40 m height and weight of around 70 tons..

Background information

Wave energy has long been considered as one of the most promising renewable energy sources. The typical parameter for estimating the wave resource is the mean annual wave energy flux, which provides the power of the waves per meter of wave length.
The greatest resource (over 100 kW/m) is found in the South Hemisphere, but in areas remote from the population. The coastal areas with the highest values of resource (over 30 kW/m) are the following: (i) the Atlantic façade of Europe, (ii) the Patagonia Coast (south of Chile); and (iii) the south of Australia Coast and New Zealand. While a significant proportion of the population lives near the Atlantic Coast in Europe, the population density of the other two areas is very low, particularly in the Patagonia, which is practically uninhabited. To a less extent, with a mean value of the annual resource between 40-70 kW/m, the areas of South Africa and North Pacific Coast (United States and Canada) could be included.
For this reason, the characterization of the resource is very important for the establishment of the wave farm location. Furthermore, during the propagation of the waves to the coast their properties change as a result of the bottom friction experiencing refraction and shoaling. In the presence of irregular bottoms this interaction increases and results in areas of high energy concentration (hot spots) and, on the other side, areas of relatively low energy (cold spots).
Generally annual mean wave power values higher than 15-20 kW/m are considered optimum for the deployment of a wave farm.

Assessment tools & methods

As this was a research project that was installed for a year, it was not necessary to conduct such studies. However, the potential impacts on the environment brought about by the device were considered and mitigated, as will be described in the following section.

Figure 6. Towing of the OCEANTEC vertical floating device

Environmental & Landscape impacts

Oscillating Water Columns have no moving parts in the water, and therefore pose little danger to sea life. Offshore OWCs may even support sea life by creating an artificial reef. The biggest concern is that OWCs cause too much noise pollution, and could damage the natural beauty of a seascape. Both these problems could be fixed by moving OWCs farther off shore

Socio-economic impacts

The technology would positive contribute to the decarburization goals of the country. Local economic regeneration would improve.
Spanish economic opportunity where its technology could become worldwide known and expanded and will allow the developing of business activities in emerging energy fields. Construction and manufacturing jobs sustained by the project. It will take advantage of the energy of the sea, an immense and inexhaustible resource. If 0.1% of the available energy at sea could be converted into electricity, it could serve 5 times the current world energy demand.
The contract award goes in line with Basque energy strategy which targets 14% contribution of renewable energy to total energy demand by 2020.

7.3.3 IMPLEMENTATION ISSUES

Implementation cost

n/a

Financial sources

It will be deployed as part of EU-funded OPERA project whose goal is to halve the cost of wave energy generation, with an EU investment of €8 M.
Previously, several agents invested in the development of the concept such as IBERDORLA with a €4.5M investment or the local Ente Vasco de la Energia with a 2.5 million €

Problems and obstacles

Regarding the environmental effects, the main issues are related to the visual impact and the noise emanating from the air outlet of the turbine at higher speed peaks affecting sea life and inhabitants, which prevents these converters from being located near residential areas.
From the point of view of the technology, the main drawbacks are concerned to the low power generation as a result of the variability and intermittency of the wave conditions and air pressure in the OWC. The Oceantec Project will work on a future design of 300 kW per floating OWC (instead of 30 kW). With this, the viability of the farm can be achieved with a lower number of devices.
Possible side effects on navigation could appear depending on the installation location. In addition, saltwater particles will inevitably have an impact on turbine blades, resulting in possible adverse effects such as corrosion and fouling.

Success factors

Wave energy is a resource of very high availability, energy-dense, stable over time, concentrated and predictable around the world. The project has only one moving part, the turbine. Its low maintenance cost associated with simplicity turns it into a competitive energy project compared to other wave technologies.
An important advantage to comment it also its little environmental effect and damage.

Transferability in the MAESTRALE area

The Oceantec OWC Project is a very adaptable project to the Mediterranean Sea. Due to its simplicity, scalability and low environmental impacts, it can be easily installed in any part of the world. OWC devices work generating energy form wave energy; therefore the best location for this type of energy resource technology is areas with high wave energy resource. In the case of the Mediterranean Sea we find the most energetic area in the Western basin in between the Balearic Islands, Sardinia and Corsica and the Northern coast of Algeria with an annual mean power around 10kW/m, while the central and Eastern Mediterranean present moderate wave energy potential with mean figures around 6 - 7kW/m.
It can be observed that these values do not reach the 20 kW/m found in the Europe Atlantic façade but can assure the viability of this kind of devices. Furthermore, the local analysis can show that in certain areas can reach these values thanks to the concentration of energy (generally induced by irregular bathymetries)

Notes/Comments

1) **http://www.oceantecenergy.com/**
2) **Salcedo, F., et al. "Oceantec: sea trials of a quarter scale prototype." Proceedings of 8th European Wave Tidal Energy Conference. 2009.**
3) **Ruiz-Minguela, J. P., et al. "Design and testing of the mooring system for a new offshore wave energy converter." Proc. 2nd International Conference on Ocean Energy. 2008.**
4) **Lasa, J., Antolin, J. C., Angulo, C., Estensoro, P., Santos, M., & Ricci, P. (2012). Design, construction and testing of a hydraulic power take-off for wave energy converters. Energies, 5(6), 2030-2052.**