

# Progress in the Development of OCEANTEC Wave Energy Converter

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# Overview

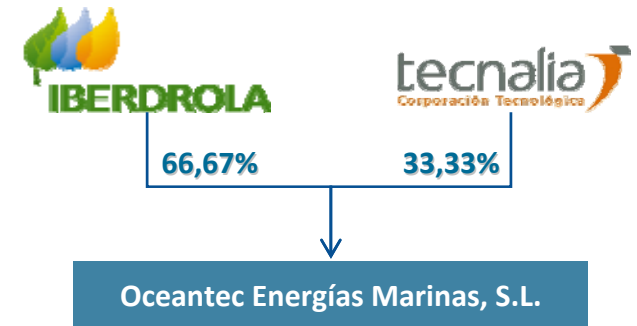
1. The Company
2. The Technology
3. Laboratory Work
4. Sea Trials in the Basque Coast
5. Conclusions and Lessons Learnt

# 1. The Company: presentation

## Oceantec Energías Marinas, S.L.

- **Basque company founded in May 2008** with the aim of developing the OCEANTEC Wave Energy Converter: A device to generate renewable electricity from Ocean Waves.

- The Company is a Joint Venture between:
  - **IBERDROLA**: Spanish utility, leader in Renewable Energies.
  - **TECNALIA**: Main Spanish private Technology Corporation.



- This initiative will involve a joint investment of around **€4.5 million**.
- OCEANTEC works closely with research institutions and industrial companies to **leverage significant expertise** in wave energy conversion, hydrodynamics and engineering.

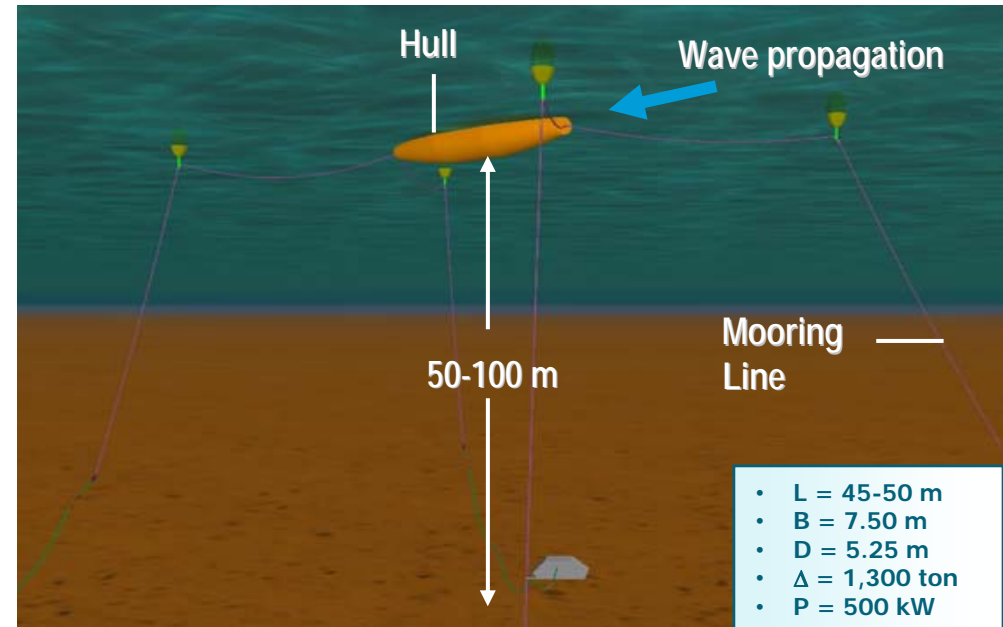
# 1. The Company: key milestones



- 2012:** Multi-device Pilot Plant (Phase 4)
- 2011:** Full scale prototype tested (Phase 3)
- 2009:** Power train manufacture & integration. 2nd round of sea trials
- 2008:** Sea trials of a quarter scale prototype (Phase 2)
- 2008:** €4.5m Investment led by IBERDROLA. Technology entirely transferred to OCEANTEC ENERGÍAS MARINAS, SL
- 2007:** Technology validated through Numerical Simulations and Laboratory Tests (Phase 1). Search for investors
- 2006:** International Patent of the OCEANTEC WEC was filed
- 2005:** Identification of the WEC Concept & start of Conceptual design
- 2004:** Assignment of a Multidisciplinary Team in TECNALIA

## 2. The Technology (I)

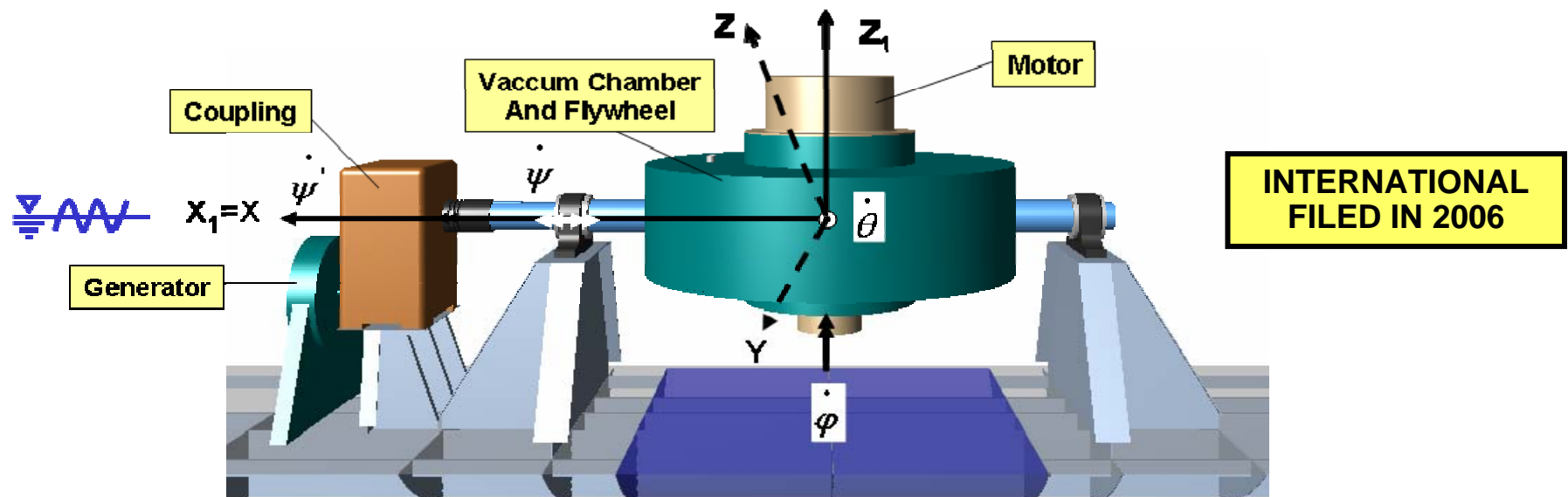
Main Features	
Location	<ul style="list-style-type: none"><li>● Offshore</li><li>● Floating structure</li></ul>
Shape & orientation	<ul style="list-style-type: none"><li>● Attenuator or lineal absorber</li><li>● Slender hull shaped body</li></ul>
Capture principle	<ul style="list-style-type: none"><li>● Relative inertial motion</li><li>● Based on a gyroscopic device</li></ul>



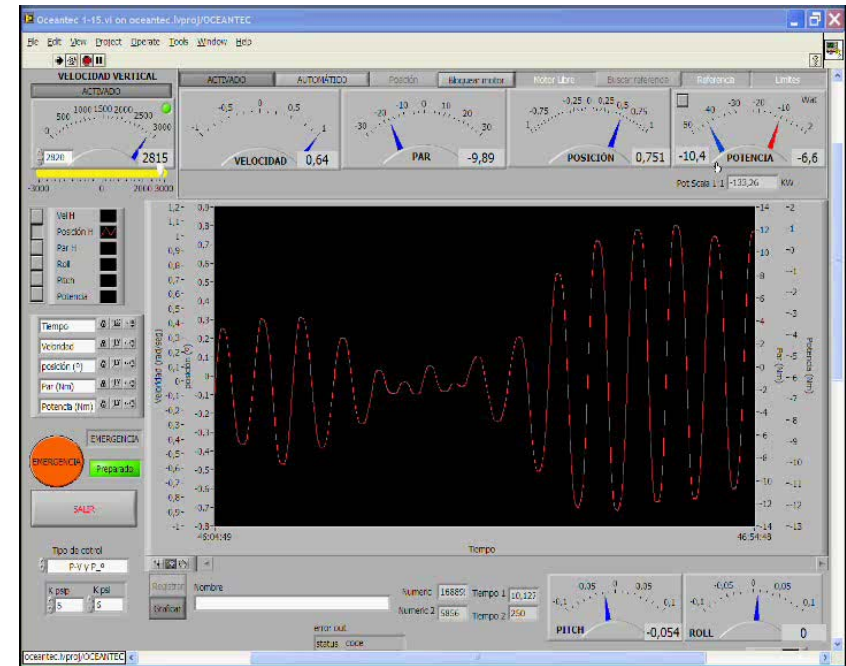
- **Floating body** oscillates due to wave excitation in its main DOF: pitch.
- **Mooring system** allows the body to weathervane so that it is faced to the predominant wave propagation direction.
- Main advantage: capture system **completely encapsulated** & free of contact with sea water.

## 2. The Technology (II)

- A flywheel continuously spins under the action of an electric motor (Z).
- The pitching motion of the WEC caused by wave action is transformed into an alternating precession in the longitudinal hull axis (X).
- A coupling device transforms this precession into an unidirectional rotation of higher frequency that is used to feed a conventional electric generator.



# 3. Laboratory Work: PTO workbench



## Workbench tests (2007, 2008, 2009)

- Design Model of the Power Take-off, 1:15 → Model used for 2nd round of Wave Tank Tests
- Goal: Validation of Advanced Control Strategies.
- Oscillating plate can reproduce Hull interaction with Ocean Waves (both Regular and Irregular Waves)
- Compact Field Point + Labview for Data Acquisition, Monitoring & Control

# 3. Laboratory Work: wave tank tests



## 1st round of Wave Tank Tests (2007)

- Validation model, 1:37,5
- Goal : Characterise hydrodynamic behaviour
- Azimuth fans to simulate wind & current forces
- Regular Waves & Survival tests

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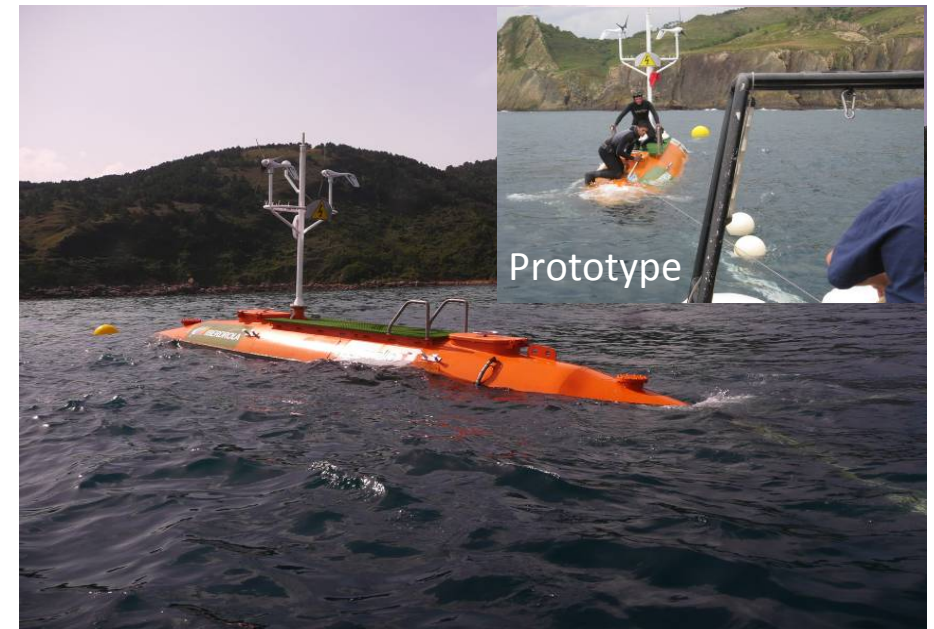
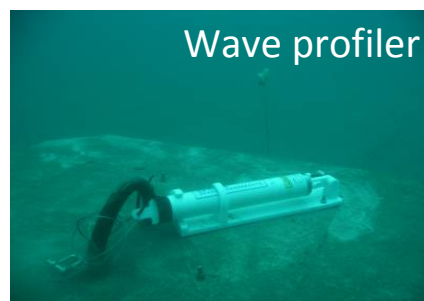
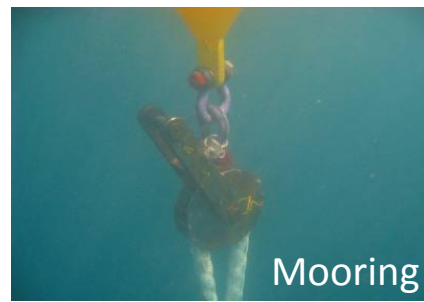
## 2nd round of Wave Tank Tests (2008)

- Design model with Power Take-off, 1:15
- Goal: Assess power performance & refine hydrodynamic data
- Regular & Irregular Waves
- Additional Drift and decaying tests

# 4. Sea Trials in the Basque Coast (I)

## Preparation of Sea Trials:

- Authorisation granted – Cala Murgita, July 2008
- Installation of marking buoys - July 2008
- Installation of deadweights, mooring lines and wave & tide recorder - August 2008
- Commissioning of 1:4 prototype – Sept 2008



## 4. Sea Trials in the Basque Coast (II)



### 1st round of Sea Trials (2008)

- Process model, 1:4
- Goals: Structural and Mooring System reliability;  
Improvement of installation and monitoring procedures
- Deployment: start September 2008 to mid October 2008
- Fully sensorised: Environmental conditions, Motions & Loads
- Data analysis: good correlation with simulations, robustness, valuable input to improve WEC design.

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### 2nd round of Sea Trials (2009)

- Goal: Further structural tests & WEC Performance

# 5. Conclusions and Lessons Learnt

## **GET WET!**

- OCEANTEC is the first Spanish wave power device tested in open sea.
- Sea trials provide invaluable experience to understand key issues & real challenges (e.g. manufacture, installation, O&M, ...).

## **BE HUMBLE!**

- A young company in an emerging sector cannot provide solutions for every issue.
- Rely on leader research and industrial companies as far as possible to reduce errors.

## **ONE STEP AT A TIME!**

- A phased-based development approach has proved to be paramount to reduce risk, produce useful results and build confidence in potential investors.

## **BE FLEXIBLE, KEEP FOCUSED!**

- Impossible to scale environmental conditions: when & where is best to perform Sea Trials?
- Dynamically equivalent behaviour may imply no material in the market fulfilling all requirements.

## **NOT EVERYTHING IS TECHNOLOGY!**

- Early planning to anticipate difficulties.
- Fairly straightforward process for temporary permits. Many uncertainties for commercial plants permits.

# Thank you very much for your attention!

## Further Information:

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