Wave Energy, EDP’s Vision

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“Renewable energies will be the main driver of the company’s growth between 2007 and 2010”

António Mexia
(CEO)
Summary

1. EDP and EDP Inovação
2. Wave Energy – the opportunity
3. Wave Energy – technology
4. Wave Energy – EDP’s view
5. Conclusions
EDP Group

EDP is an integrated energy player with a strong focus in Clean Energy and...

Vision
An integrated energy company, leader in value creation in the markets where we can make a difference

Facts and Figures
• Third Iberian Energy player
• Owns more than 60% of Energias do Brasil
• Turnover of > 10 bi €
• ~13,000 people

Strategy
• Controlled Risk
• Superior Efficiency
• Focused Growth

• EDP is #4 in world ranking of wind installed capacity (~5 GW)
• EDP shows one of the highest growth rates among top world players

World Ranking - Installed Capacity
Geos GV 2007C

* Not updated
EDP Group
... with a global footprint, started in Iberia and presently spans over France, Belgium, Poland, Romania, Brazil and the United States
The global energy outlook is changing…

Global trends continue to support EDP’s clean energy focus

...making Renewables growth an unstoppable trend...

...in which EDP is uniquely positioned to create value

- Global consumption is growing
- Cost of fossil fuels and CO2 are rising
- Climate change: a global challenge
- Tremendous Renewable resources
  - Technological development makes Renewables cheaper
  - Growing regulatory support
- Located in geographies with high growth potential in renewables
- Proven track record in pipeline development and execution

Global trend supports EDP’s Renewable Strategy
EDP Inovação
Incorporated in 2007, EDP Inovação represents a stronger corporate commitment towards innovation. Innovation has a key role in the process of value creation in the EDP Group.

EDP Inovação’s main role is to promote value added innovation in the EDP Group, finding future growth vectors for the company and creating, today, options for the future.

- Identifying synergies between thematic R&D+I groups and across geographies
- Consolidating the R&D+I effort across the EDP Group
- Enabling an open innovation philosophy – leveraging the Innovation effort with meaningful partnerships
- Strong commitment from Top Management and strong link with business – value added innovation
- Strong alignment between EDPs Corporate Strategy and Innovation activities – Focused Growth, Superior Efficiency and Controlled Risk
EDP’s strategic innovation areas range from **clean energy** to **energy efficiency** (including transports), having at its core a new, more **intelligent electrical grid**.
EDP Inovação’s main goal is to explore future growth vectors. To achieve that EDP Inovação is actively looking for the newest technology and business trends.
Strategic Priorities and Innovation

EDP’s innovation activities are well aligned with the Group’s strategic priorities, positioning the Company towards the most likely growth vectors of the future.

<table>
<thead>
<tr>
<th>Strategic Pillar</th>
<th>Innovation Projects</th>
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<tbody>
<tr>
<td><strong>Focused Growth</strong></td>
<td>e.g. Clean Energy Projects</td>
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<td></td>
<td>Offshore Wind</td>
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<td>Wave</td>
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<td>Solar</td>
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<td>In Procurement – Global Supplyer Manag.</td>
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Wave Energy
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Wave Energy - Resource

Wave energy’s worldwide potential is vast. In particular the west coast of Europe is very suitable for wave energy development.

- Worldwide wave resource ranges 2 TW (15% in Europe)
- DTI / Carbon Trust estimate 200 GW of world installed capacity (feasible) until 2050
Wave Energy - Resource
Credible sources point to a worldwide wave energy potential in the range of 200 GW to 300 GW whereas in Portugal wave energy development could be in the range of 3 to 4.5 GW.

**Worldwide wave energy potential**
- 200 GW, feasible until 2050

**Portugal wave energy potential**
- 3 a 4.5 GW

* Installed capacity
Source: DTI / Carbon Trust, INETI / WavEC
Wave Energy – Portuguese Rational
Portugal brings together exceptional natural / logistics conditions with a strong government commitment

4 GW of potential capacity alongside Portuguese coast, to be installed over the years

* Wave Energy Center study

** Priority zones**

- Resource: 40 kW/m
- Electrical network along coast

** Exceptional sites**

** Government support**

1. **250 MW Capacity**
   - New Decree-Law defining 250 MW to be attributed through 3 phases:
     - Demonstration phase (20 MW)
     - Pre-Commercial phase (100 MW)

2. **15y feed-in tariff**
   - Feed-in-tariff, currently starting at €260 MWh, for 15y

3. **Simple licensing process**
   - Simple licensing process (envisaged one-stop-shop approach)
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Wave Energy - Technology

Comparing with other kinds of renewable energy technologies, wave energy, although very promising, is still getting from tank tests to significant sea trials.

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<th>Type</th>
<th>Commercial/mature</th>
<th>Pre-commercial</th>
<th>Demonstration Phase</th>
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<tr>
<td>Hydro</td>
<td>• Conventional Hydro</td>
<td></td>
<td>• Offshore Wind</td>
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<td></td>
<td>• Mini-Hydro</td>
<td></td>
<td>• Micro-Wind</td>
</tr>
<tr>
<td>Wind</td>
<td>• Onshore Wind</td>
<td>• Offshore Wind</td>
<td>• Offshore wind (floating)</td>
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<tr>
<td>Solar</td>
<td>• Solar PV – Cristaline silicon</td>
<td>• Concentrated Solar Power</td>
<td>• Solar PV – Nano thin films</td>
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<tr>
<td>Bio</td>
<td>• Biomass/waste combustion</td>
<td></td>
<td>• Tidal</td>
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<td>• Biomass cofiring</td>
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<td>• Ocean biomass</td>
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<td>• Biogas</td>
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<td>• Salinity gradient</td>
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<tr>
<td>Ocean</td>
<td>• Conventional geothermal</td>
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<td>• Ocean thermal</td>
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<tr>
<td>Geothermal</td>
<td>• Enhanced geothermal</td>
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Wave Energy - Technology
The first technology segmentation which is usually done takes into account water depth and proximity to coast.

- **Shoreline Devices**
  (Low depth)

- **Nearshore Devices**
  (Up to 20m depth)

- **Offshore Devices**
  (About 50m depth for floating devices)

**Trends?**

- The greatest potential is in offshore applications (more energy per meter, market is huge)
- Even onshore and nearshore devices are seen as development platforms for future offshore applications
Wave Energy - Technology

There are more or less four main groups of technologies: OWC, buoy type point absorber, articulated and overtopping.
Wave Energy - Technology

The main conclusion regarding technology is that the conversion principle is not yet stabilized and that technology maturity is still 5 to 10 years in the future.

- Energy conversion principle not yet stabilized – There is a large number of devices based in four or five conversion principles.
- First demonstration projects at sea ongoing.

How will technology evolve?

- Only one energy conversion principle, like in wind with horizontal axis turbines?
- Two or three conversion principles, segmented by resource characteristics, proximity to coast, etc.?
Wave Energy – Technology status

Wave energy is following a technology development cycle. At present, several projects have been tested in real sea conditions and are redesigning in order to meet operational criteria.

**Focus: Efficacy**
- Moving from R&D to first demonstration projects in the sea.
- Redesigning based on operational experience.
- Several wave energy demonstration projects in the sea.
- Beginning of a pre-commercial phase.

**Focus: Efficiency**
- First wave energy commercial deployments.
- Technology continuous improvement cycle.

Graph showing technology development over time with stages for Today/Short term, Medium term, and Medium/Long term.
Wave Energy - EDP
EDP is involved in wave energy since 2000 (Pico plant), but is actively following the market since mid 2005

- EDP has shortlisted a number of wave energy technologies as being the most promising (still not at a mature stage).

- EDP is promoting the “Ondas de Portugal” initiative with other promoters, industrial partners, research centers and technology developers in order to help grow a wave energy cluster in Portugal

- Several technological demonstration projects under preparation…

- EDP was involved in the development of the “European wave energy pilot plant” at the island of Pico (Azores, Portugal). The first wave power plant to be grid connected (y. 2000).

- EDP, together with WavEC is evaluating possibilities regarding the transformation of Pico plant into an OWC technology development platform.

- Following the cancelation of the breakwater integrated OWC project (BREAKWAVE), EDP is actively pursuing alternatives for the development of a demonstration project based in OWC technology.
Objective
To help grow an ocean energy cluster in Portugal, through the development of a multi-technology project backed by R&D and Industry.*

Main Milestones
• Wave energy technology demonstration projects
• Support infrastructure
• Industrial and R&D Cluster

Open Technology Strategy – the “Ondas de Portugal” initiative

Industrial
• Electronics
• Metallo-mechanics
• Shipyards
• Environmental area
• Etc.

R&D
• Anchorage
• Submarine cables
• Submarine connectors
• Advanced monitoring
• Resource estimation
• Farm configuration
• Etc.

* Articulated with Wave Energy Pilot zone being developed in Portugal
Wave Energy – Ondas de Portugal
OdP promotes Portuguese leadership in the wave energy sector, attracting investment, sharing knowledge and infrastructure and minimizing risk.

Enormous potential for value creation

- 3 to 5 GW of primary energy available, feasible
  400 MW until 2020 and 1 GW until 2025
- Business in the range of 1,5 Bi € in 2025 (80% exports)
- 7.700 jobs
- Opportunities in fabrication, engineering and O&M and environmental studies
- Leveraging on existing know-how, attracting more knowledge, in a R&D intensive area

Technology uncertainty (it is still not clear what concepts will materialize in real business)

OWC
Articulated

Point absorbers
Overtopping

Ondas de Portugal, OdP

Main renewable energy promoters and relevant industrial partners, in close relation with the scientific community, together to generate critical mass and share risk in the development of several promising wave energy and ancillary technologies.
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• EDP believes that Wave Energy, together with other emerging renewables, is one of the most important growth vectors for the company in the future.

• To support wave energy technology development is very much in line with EDP’s strategic pillar: focused growth.

• Resource and a favourable surrounding context positions well Portugal in a race for leadership in the wave energy sector... But action is “of the essence”!

• Wave energy technology is developing and several concepts are already extracting benefits from its “sea operational experience”.

• An open technology strategy, implemented through Ondas de Portugal will be key in sharing risk and providing a favourable framework for the creation of an ocean energy cluster in Portugal.
Thanks for listening!