

WAVE ENERGY UTILIZATION IN PORTUGAL

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WAVE ENERGY IN PORTUGAL

Research & Development 1978 - 1986

- R&D started with scientific background after 1973 oil crises
- Portugal - R&D driven by governmental institutions (university, laboratories) since 1978
- Governmental funding
- Technology: OWCs, Wells turbines
- Resource assessment (since 1983)

WAVE ENERGY IN PORTUGAL

1987 - 2000

Activities Shoreline OWC wave energy pilot plant (Pico plant)
Resource mapping (national & European)

European R&D Programme on Wave Energy & Tidal Currents

Started in 1991

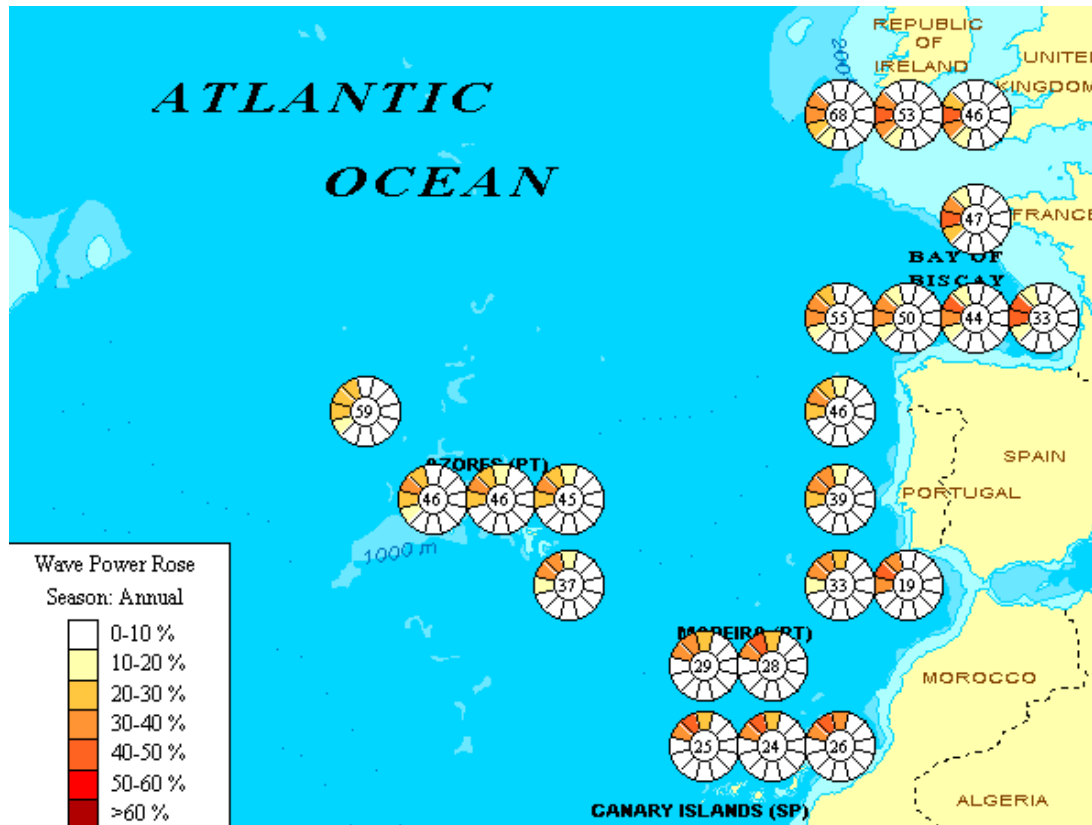
Portugal: coordinated 6 EC contracts

OWC Pico Power Plant (4)

Resource Methodology & WERATLAS (2)

WERATLAS - European Wave Energy Atlas

EC Contract



www.ineti.pt/proj/weratlas

- 6 countries (coord. INETI)
- Electronic atlas
85 points off Atlantic & Med Sea coasts
- ECMWF - WAM model selected after verification against buoy data
- Comprehensive set of statistics
- 1994 - 1996

OWC Pico Plant

Objectives

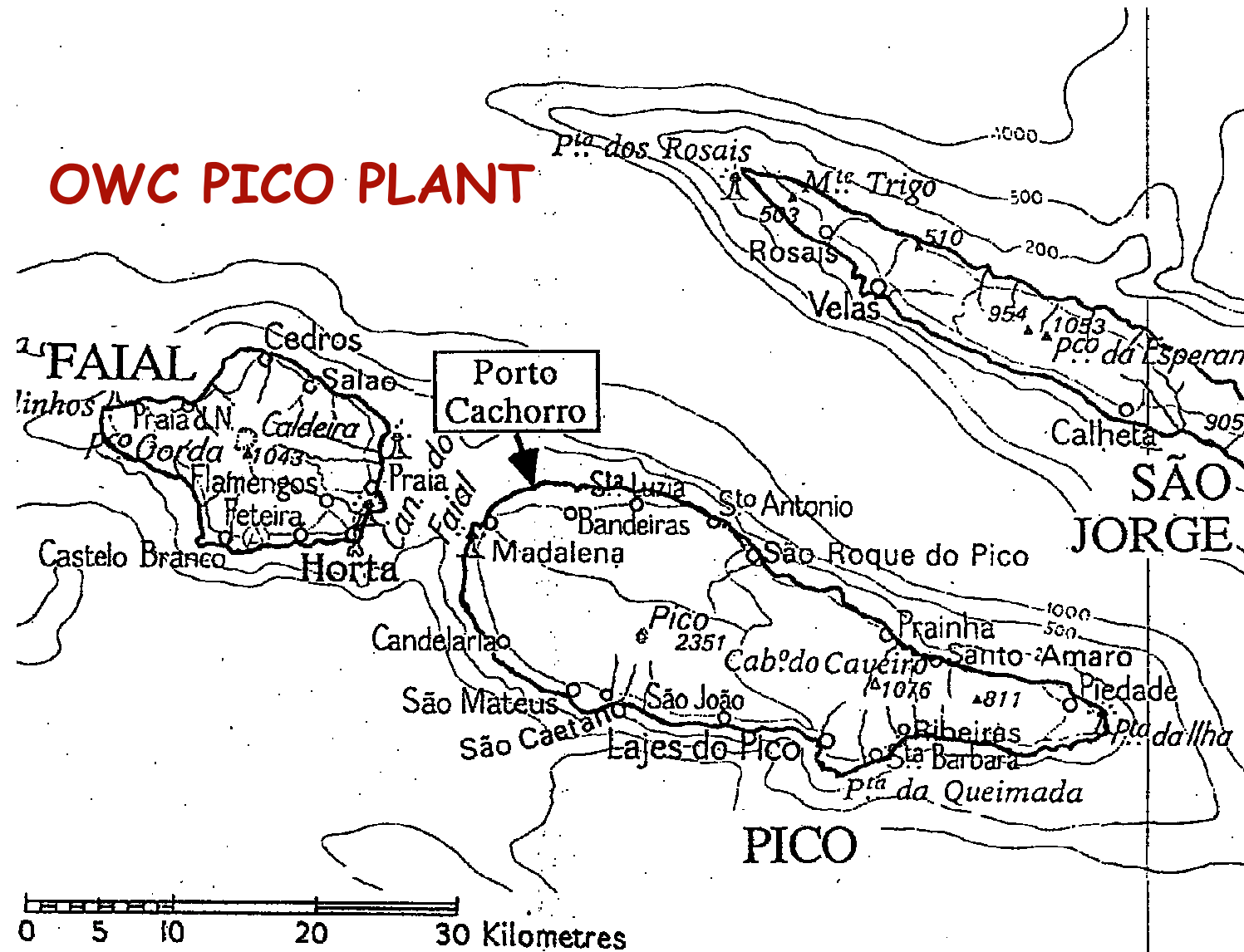
- To demonstrate & assess the technical & economical viability of OWCs.
- To provide a facility for testing equipment (turbines, valves, electrical).
To supply energy to the local grid (about 1 GWh/year).
- It was not designed to be (only) a commercial plant.

Driven by R&D institutions supported by companies

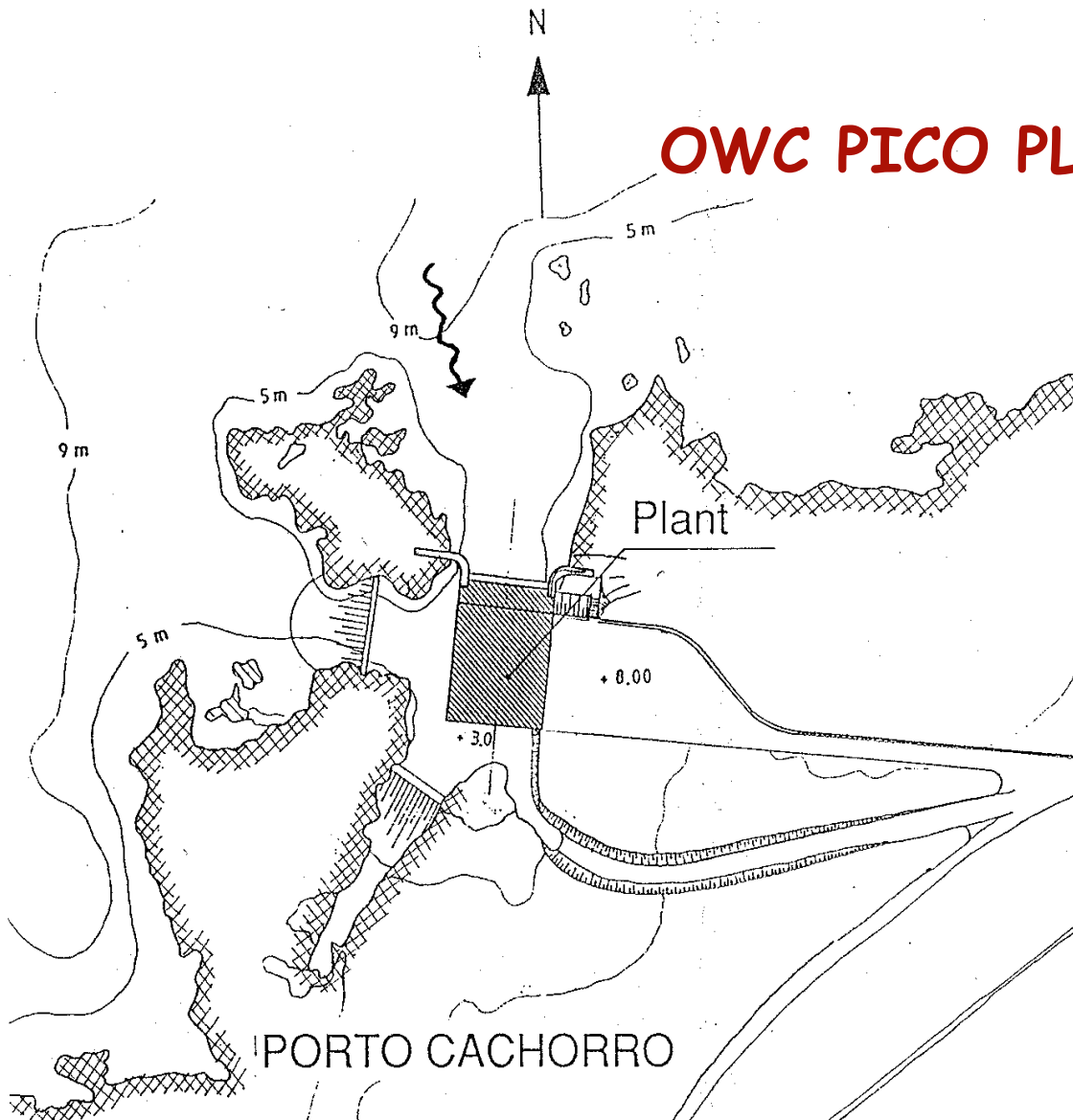
OWC PICO PLANT

Azores Archipelago

- 1700 km W Lisbon
- (2h fligth)
- 9 islands
- Population 250000
- Pico island 15000
- Independent grids



OWC PICO PLANT



- NW coast facing
- dominating waves
- Indented coastline
- Water depth 8m
- Natural energy concentration

- $P_{year} = 14 \text{ kW/m}$

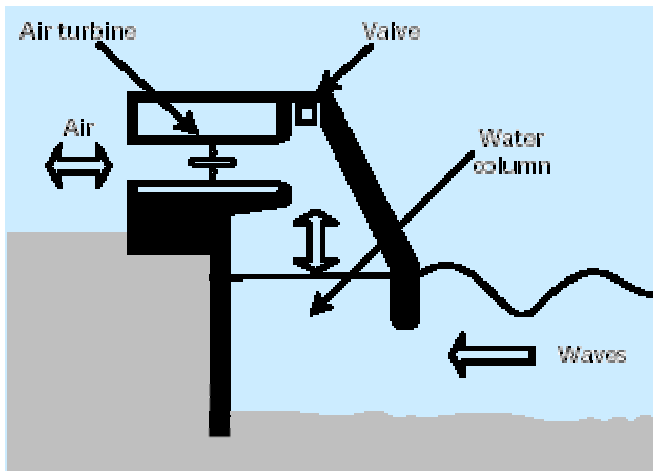
OWC Pico Plant

Pico Island

Azores

400 kW

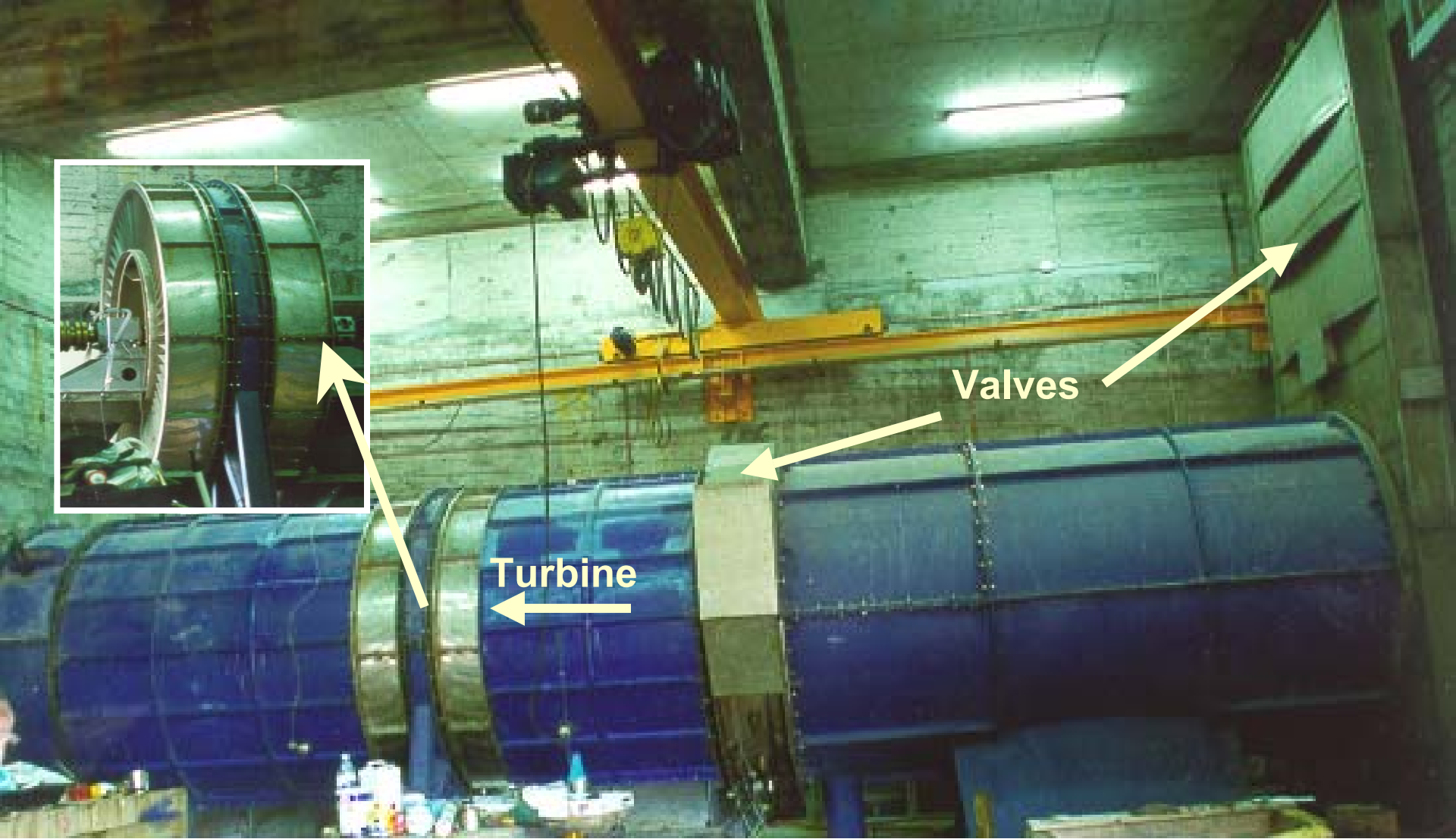
1999



Pico OWC Plant

Exposed to strong sea states





Pico Plant: turbine and ducts, during initial tests in 1999

REs POLICY 2000 -

39% electricity from REs by 2010 (EC Directive for electricity)

Wave Energy

- Target : 50 MW
- One-stop shop
 - . Permitting
 - . Grid Connection
 - . Power Purchase Agreement Feed-in Tarif: 23 c€/ kWh
- Funding for R&D and Demo Projects
- Testing site for prototypes (2006 - planned)

WAVE ENERGY IN PORTUGAL 2000

Resource & Site Selection

Nearshore resource – ONDATLAS (mainland & Madeira islands)

- PEMAP – GIS on resource; bathymetry, seabed coverage; grid;
- Guidelines for resource assessment (IEA & other)

R&D

- Offshore systems (MARTIFER; IST & INETI)

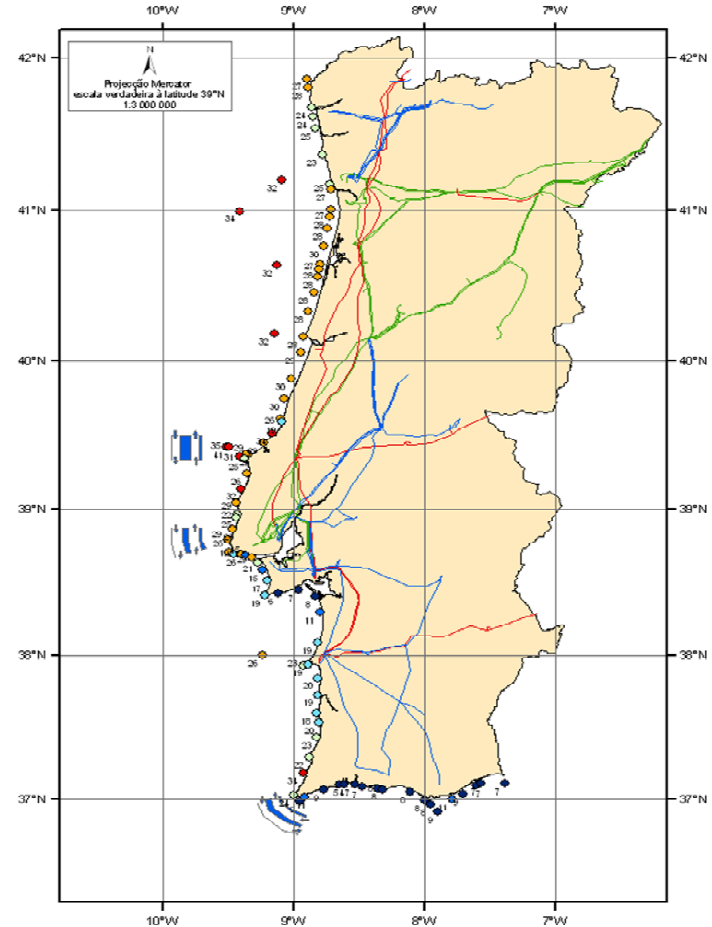
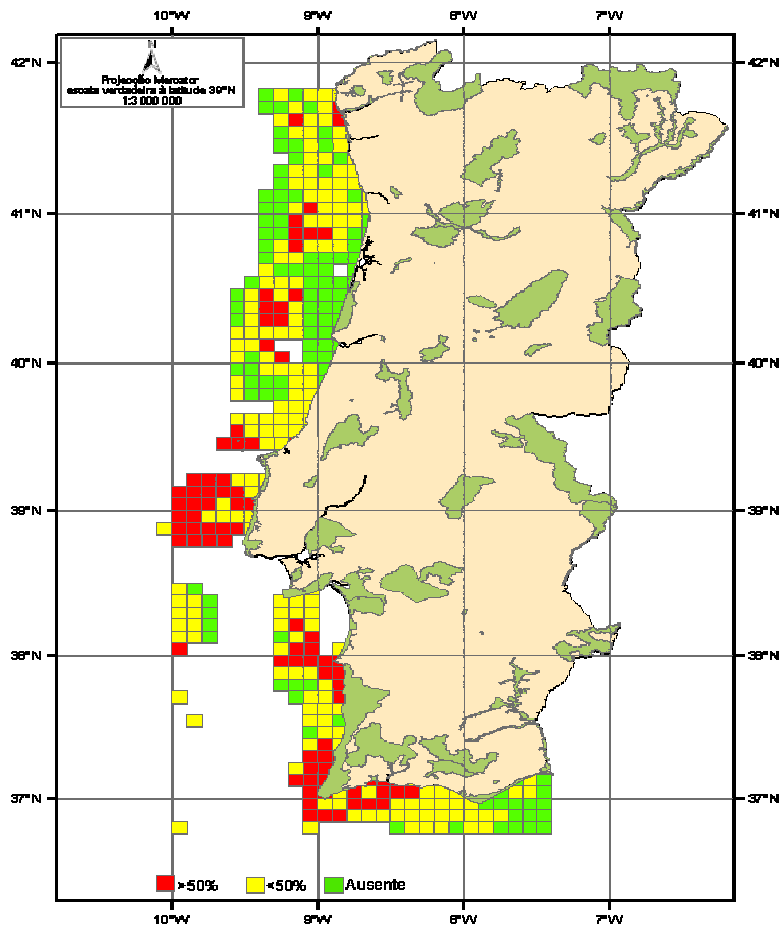
WAVE ENERGY IN PORTUGAL

Prototypes

- Refurbishment & test of Pico Plant (2005 - 2006)
- Breakwater OWC – Mouth of Douro River - 0.5 MW (2007 - 2008)
- Pelamis – 2.25 MW (2006 - 2007)
- Aquabuoy – 2MW (2007 – 2009)

SITE SELECTION

PEMAP 1.0 SIG Database: resource, bathymetry, seabed coverage, grid, protected areas





FOZ DO DOURO

PORTO

**Breakwater OWC
at Mouth of Douro River,
Porto**

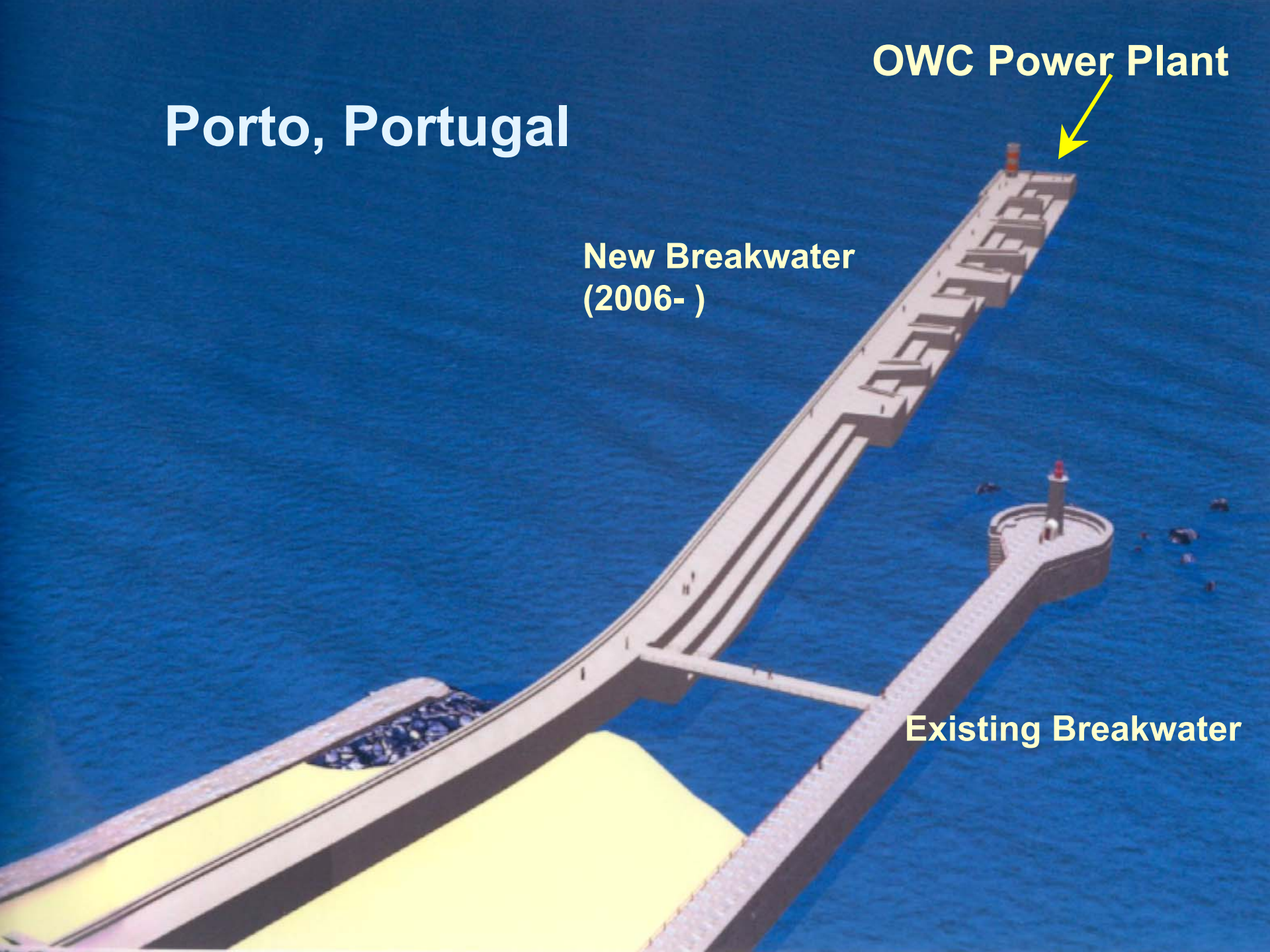
Porto, Portugal

OWC Power Plant



New Breakwater
(2006-)

Existing Breakwater



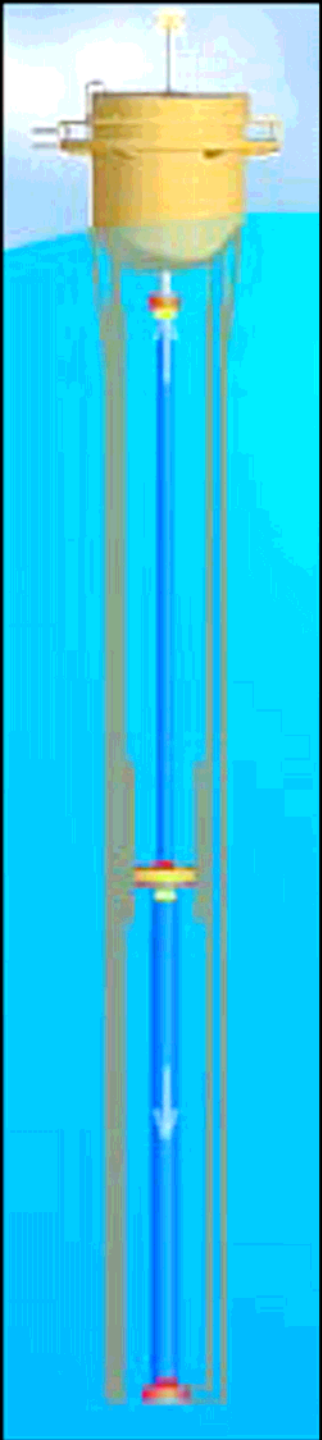
PELAMIS 2007



Developer: ENERSIS

Rated capacity: 2,25 MW

Plans for 20 MW



AQUABUOY

- AquaEnergy Portugal (to be registered soon)
(EDP – mainland utility)
- EC Contract for a 2MW prototype



Thank you !