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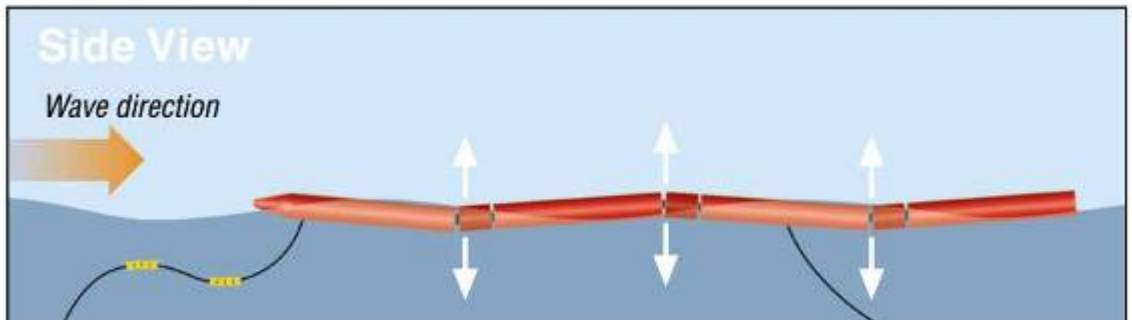
The Pelamis Wave Energy Converter

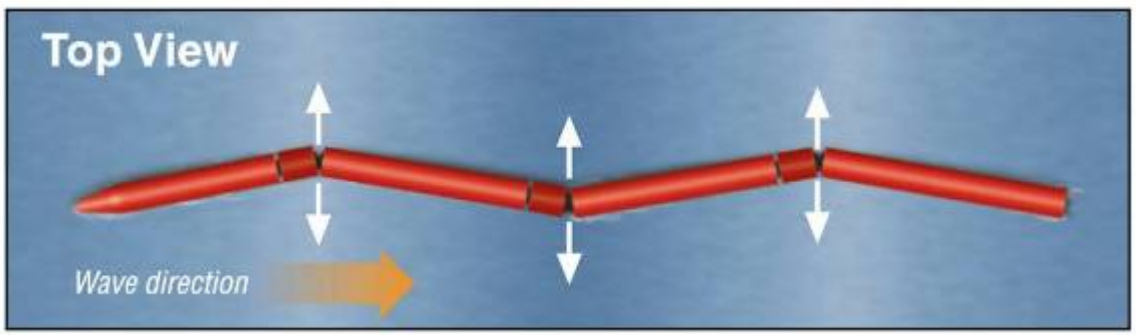
A phased array of heave + surge point absorbers

Max Carcas, Business Development Director

Pelamis WEC technology - *CONCEPT*

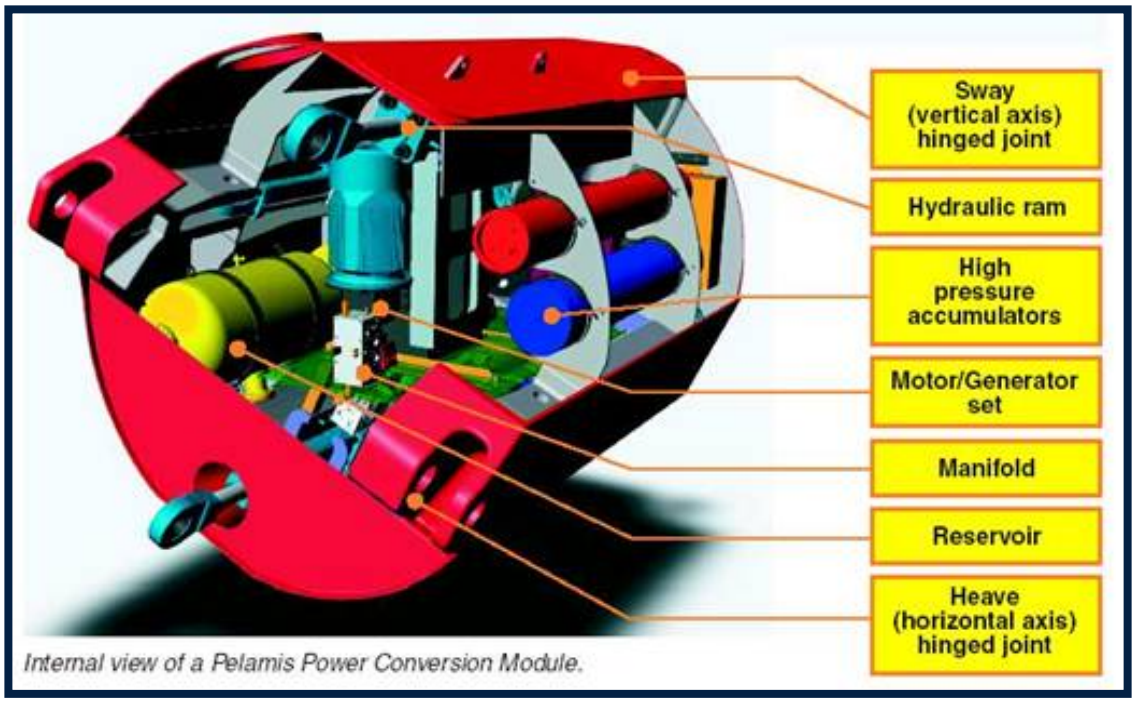
- Articulated cylinder
- Swings head-on to incident waves
- 4 x main segments, 3 x joints
- Wave induced joint motion resisted to absorb power





- 140m long, 3.5m diameter
- 750kW rated power
- Capacity factor 0.25-0.4

Pelamis WEC technology – *POWER TRAIN*



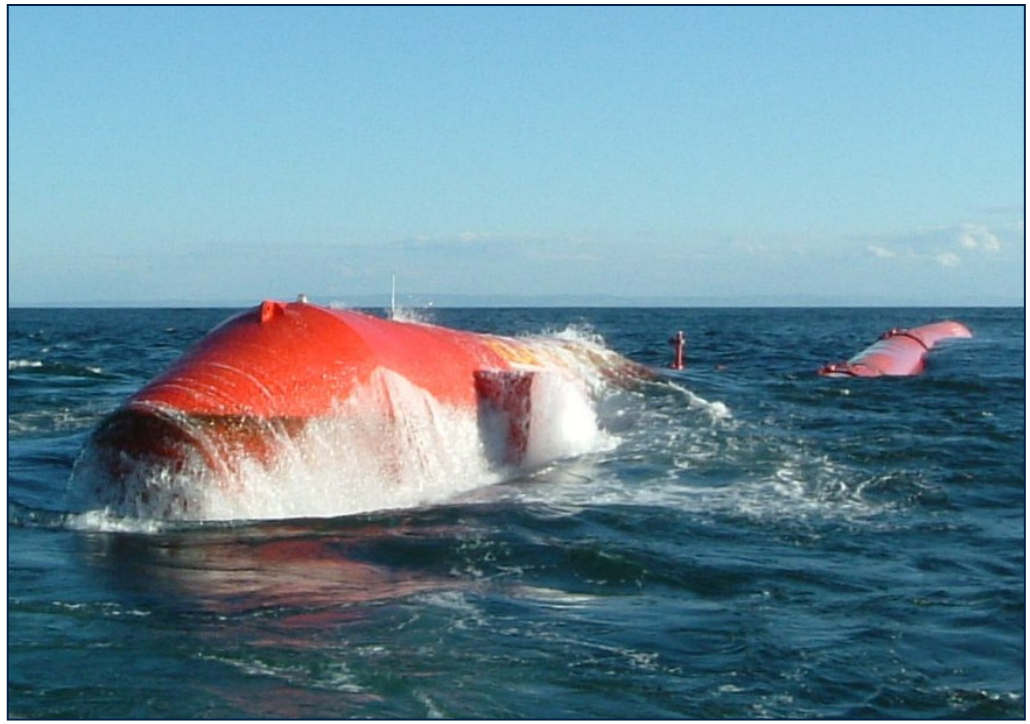
Internal view of a Pelamis Power Conversion Module.

- 3 x 2-axis, 250kW rated *'POWER CONVERSION MODULES'*
- Hydraulic rams pump fluid into smoothing accumulators
- Hydraulic motors drive induction generators to generate *STEADY OUTPUT*
- *PROVEN, AVAILABLE & EFFICIENT TECHNOLOGY & COMPONENTS*

Pelamis WEC technology - *Features*

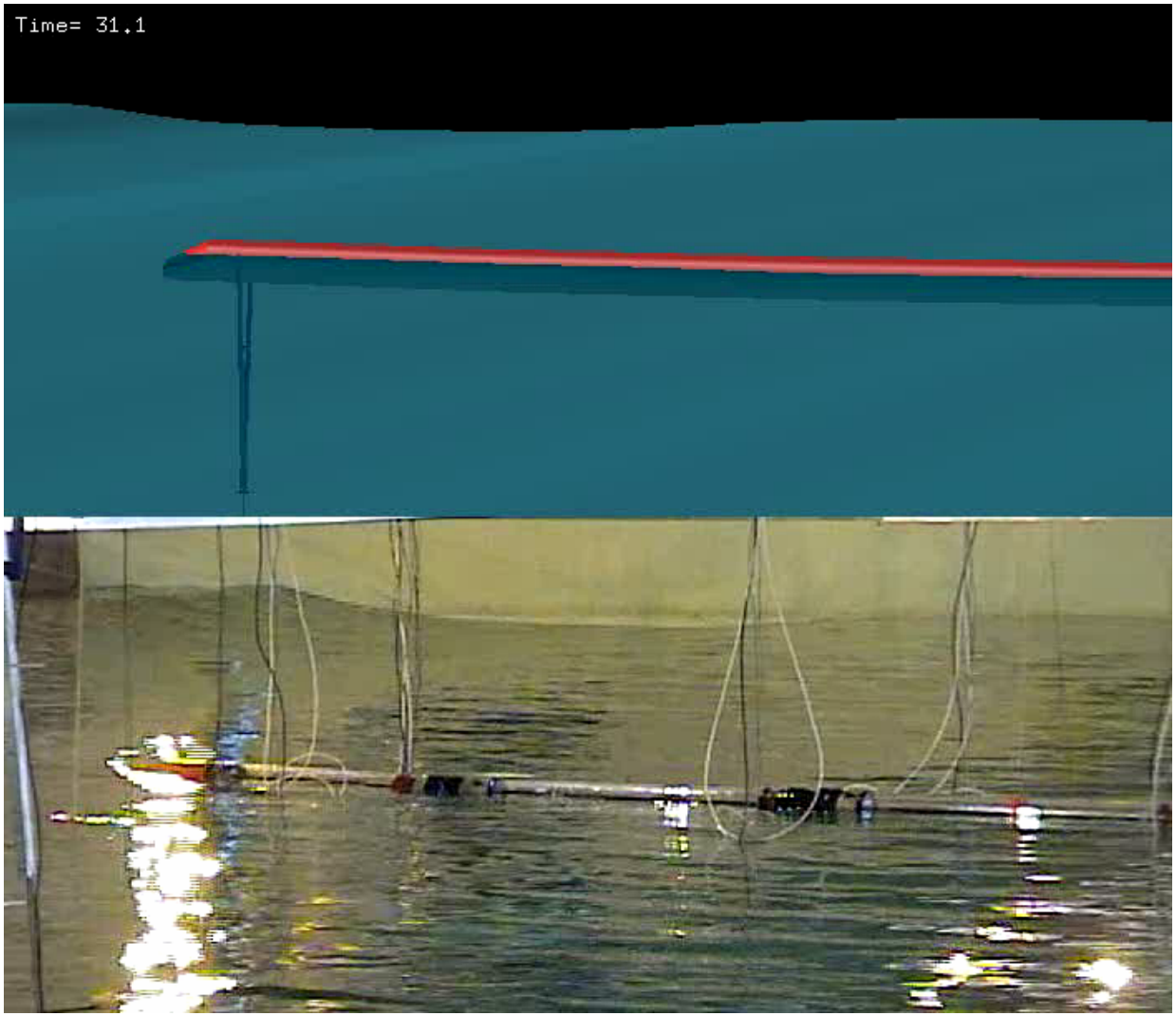
PELAMIS Features

- Offshore deployment
- Inherent survivability
- Highest power capture/unit weight
- Available technology
- INDEPENDENTLY VERIFIED

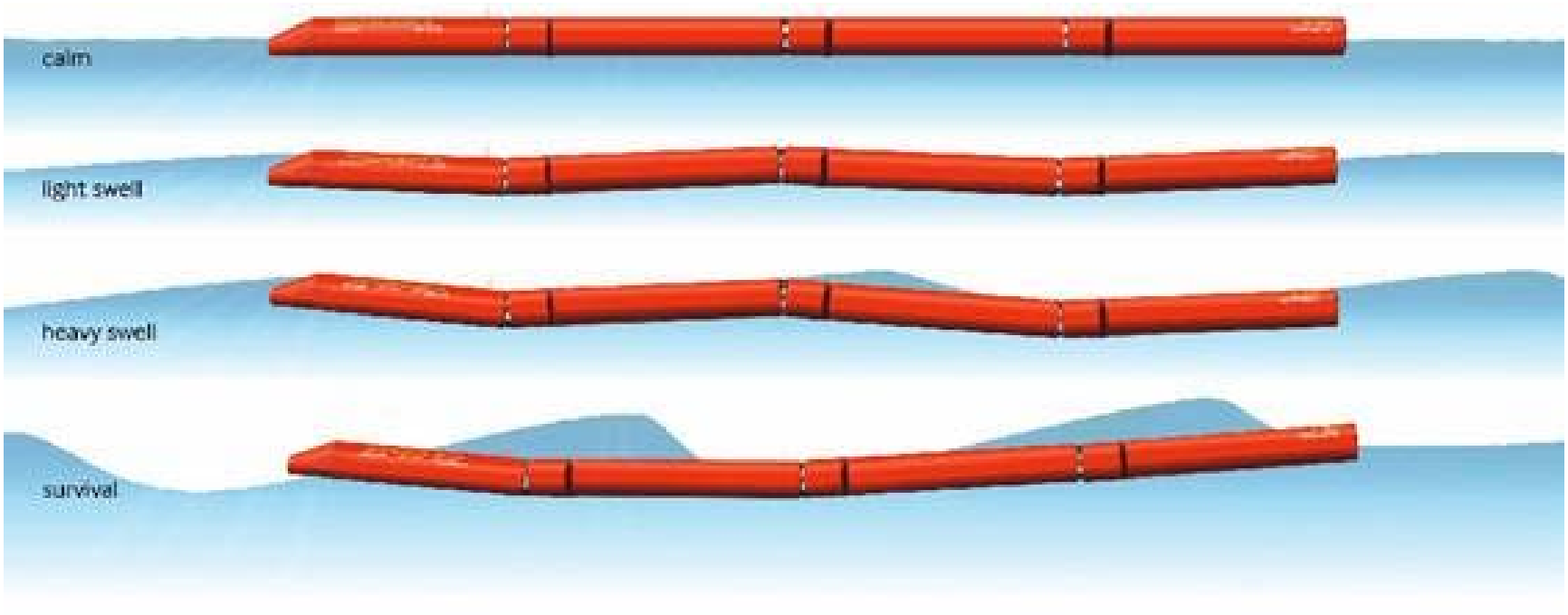


- Forecastable output
- Negligible visual intrusion
- Minimal environmental impact
- Minimum on-site construction work
- Off-site maintenance

Experimental and numerical modelling



Pelamis WEC technology – *SURVIVABILITY*



- Small cross-section, finite length, streamlined form, compliant moorings
- Self-limiting '*hydrostatic loading*' => limits absorbed power in large waves
- Almost invisible to '*hydrodynamic loading*' in large seas
- Too short to react against extreme storm waves

Extreme ‘100 year’ wave – 28m wave height

Full-scale production prototype - Development

1999	2000	2001	2002	2003	2004	Onwards

Concept development

Primary R&D & modelling

7th-Scale prototype

Full-scale R&D & design

Full-scale joint test

Production prototype

Cost reduction & performance enhancement

Rigorous, staged & efficient R&D

Full-scale operation

Production prototype – Specifics

- 750kW production prototype
- Outsourced fabrication with assembly and operation undertaken by OPD
- Proven company processes – have successfully *'prototyped OPD'*
- Launched and tested April 2004
- 4 sets of sea trials
- Installed at EMEC August 2004
- 1,000 hours operation recorded
- Concept, handling, operation and control confirmed
- Initial teething problems resolved
- Power capture and conversion in line with prediction

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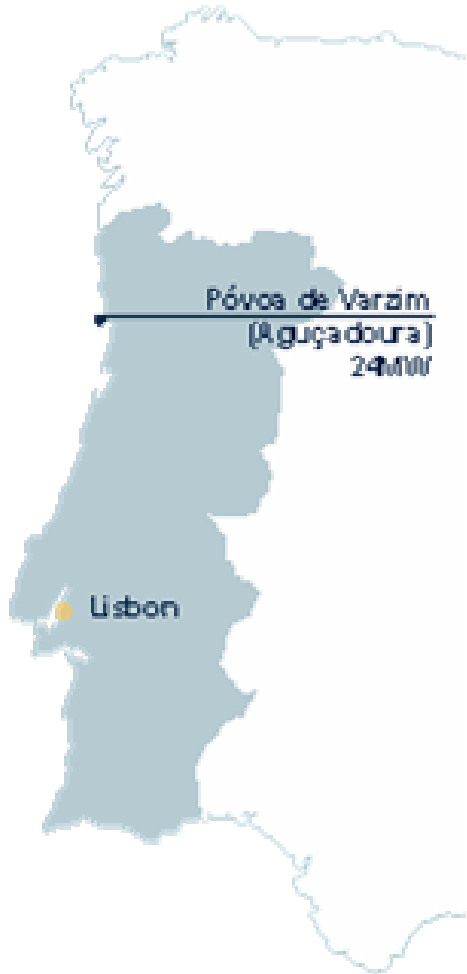
PROJECTS

Enersis – Project #1



Enersis

- Portugal's largest developer of renewable projects
- Subsidiary of Semapa
- Aim to be Portugal's leading wave developer

Project phase 1:

- Three Pelamis P1A machines
- 2.25 MW
- 5km off Aguçadoura
- 50m water depth
- Cable + substation in place

Enersis – Project expansion

Phase 1

- Three Pelamis P1A 750KW machines
- Production underway
- Permitting and consents secured

Phase 2

- Letter of intent
- Expand project to 24MW
- Grid connection rights secured

Phase 3

- Multi-site deployment

Production for Portugal

Order – 3 x P-1A 750kW machines

Main tube fabricator:	Camcal
Main tube castings:	Goodwins
Power module fabricator:	RDI
Hydraulic rams:	Hystat
Accumulators:	FCH
Generator Pack:	Hytec
Assembly/commissioning:	OPD

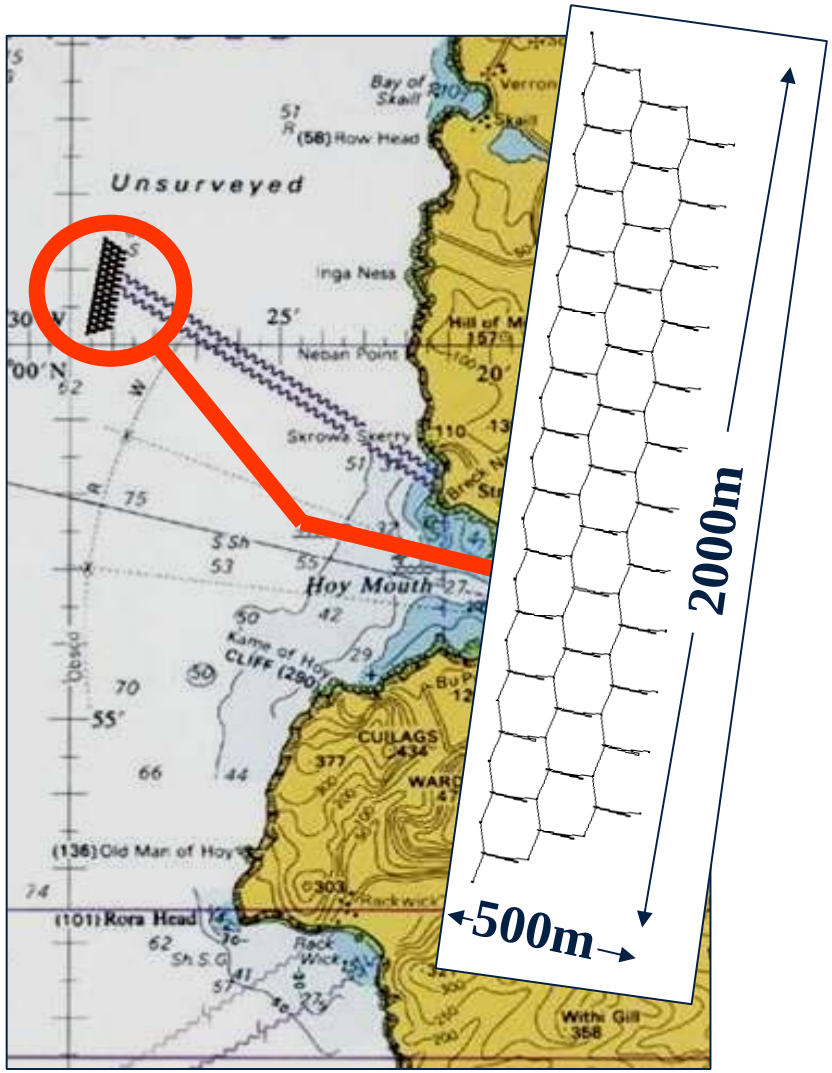
Production of 3 machines progressing to cost and schedule

Ross Deeptech - Stonehaven

Fife energy park - Methil

Camcal - Lewis

Scotland



ScottishPower

Major international utility
UK's largest wind developer

amec

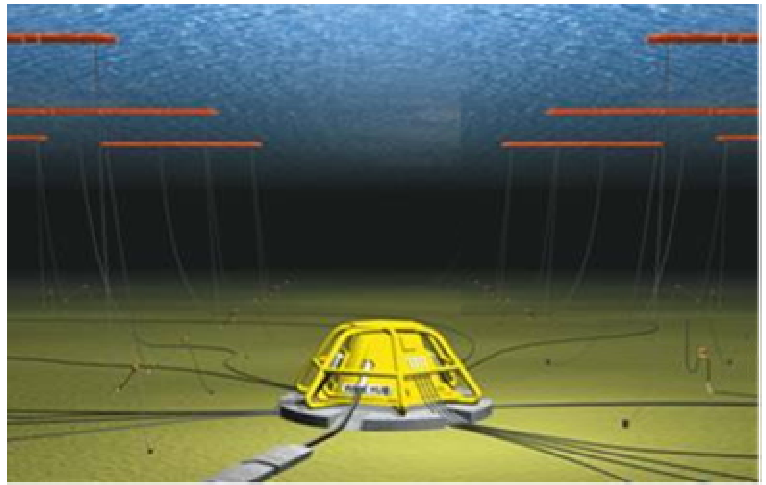
Developer of UK's first offshore and Europe's largest wind-farm (700MW) in Western Isles

- Consortium development
- Plan: phased 22.5MW wave farm
- Grid connection applied for
- Target: first stage 2005/6
- Key DTI/Scottish Executive market enablement mechanisms

South West England

Wave Hub

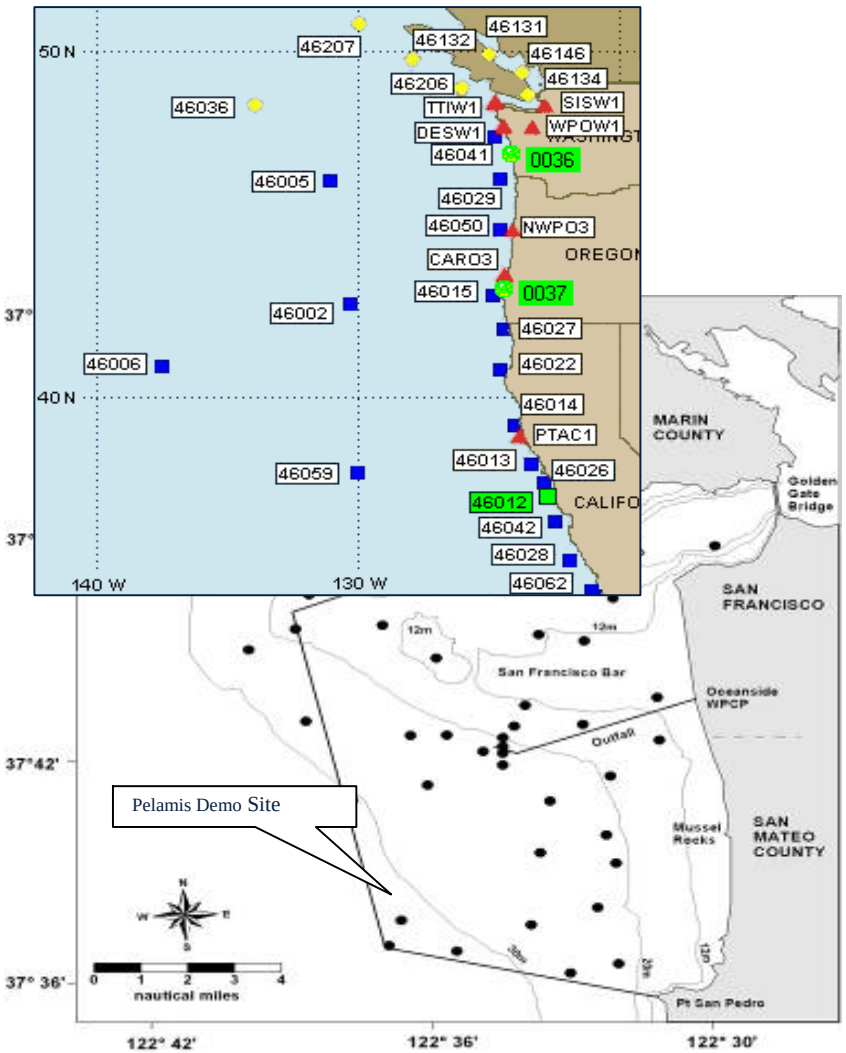
- Cornwall
- £1.5m Consenting and permitting
- 20MW (30MW ultimately)
- Initially allocated in 5MW tranches
- Anticipated 2007



Ocean Prospect

- Expression of interest for 5MW at Wave Hub
- In discussion about larger UK project
- Overseas opportunities

United States



EPRI

Electricity Innovation Institute

Electrical Power Research Institute

- Public/private project part funded by DOE, NREL and individual states
- Project: five state wave energy sites in Maine, Oregon, Washington, Hawaii, Massachusetts + city of San Francisco
- Pelamis selected by EPRI as system currently recommended for deployment.
- Target installation 2007
- Funding for ocean energy approved in recent Energy bill

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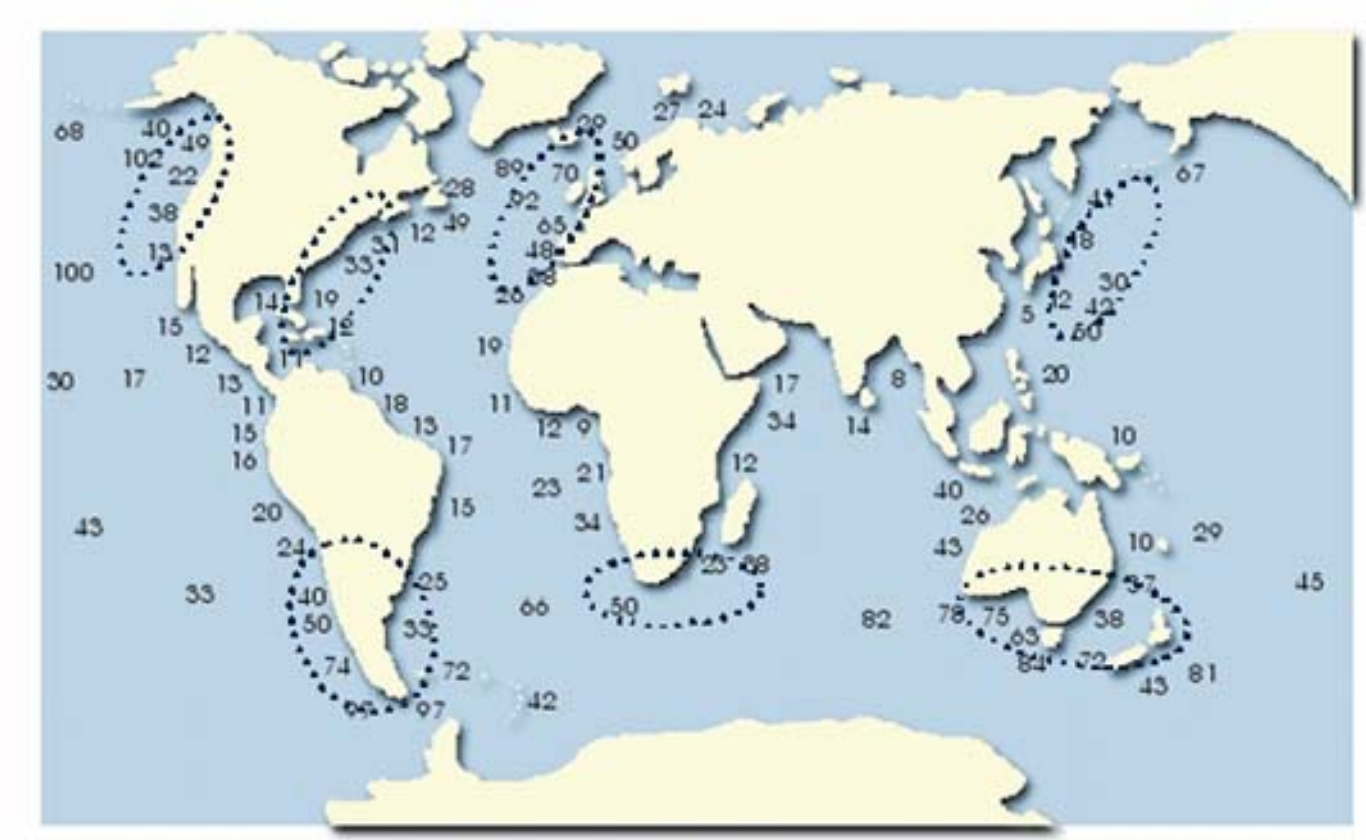
MARKET POTENTIAL

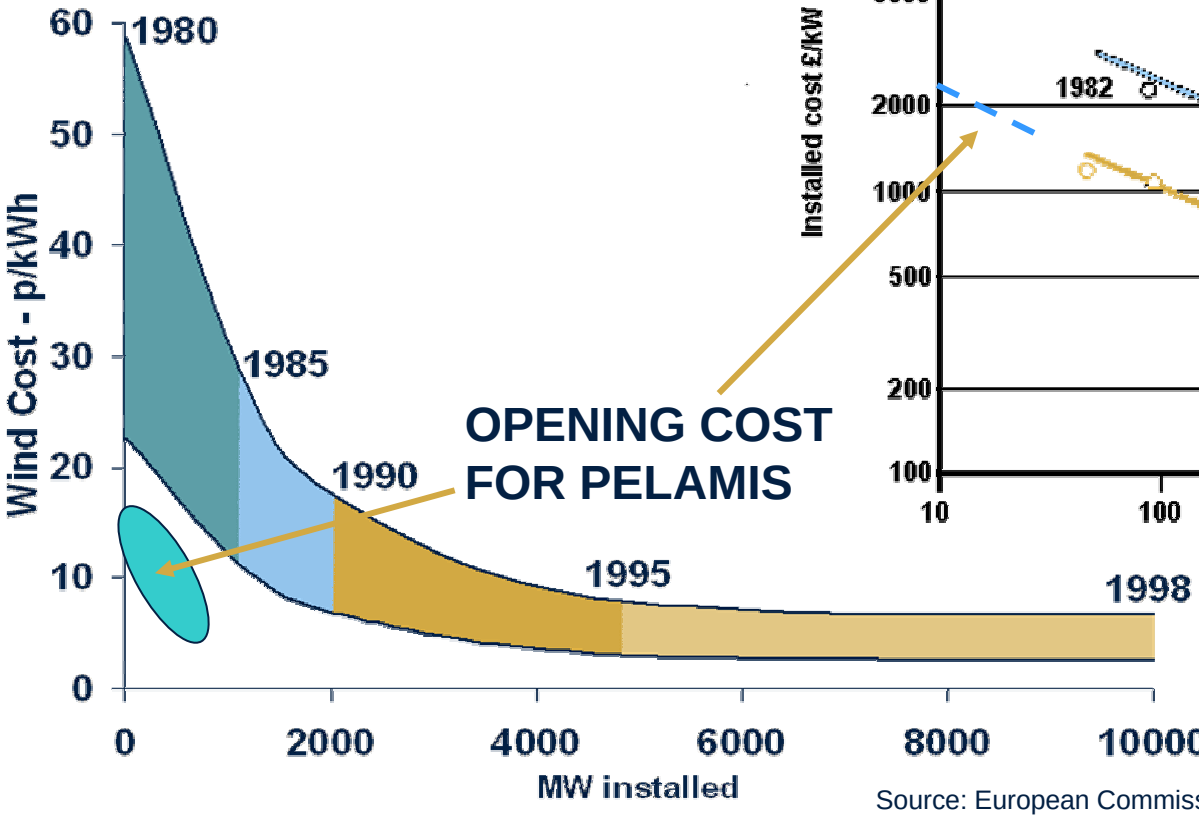
Global market

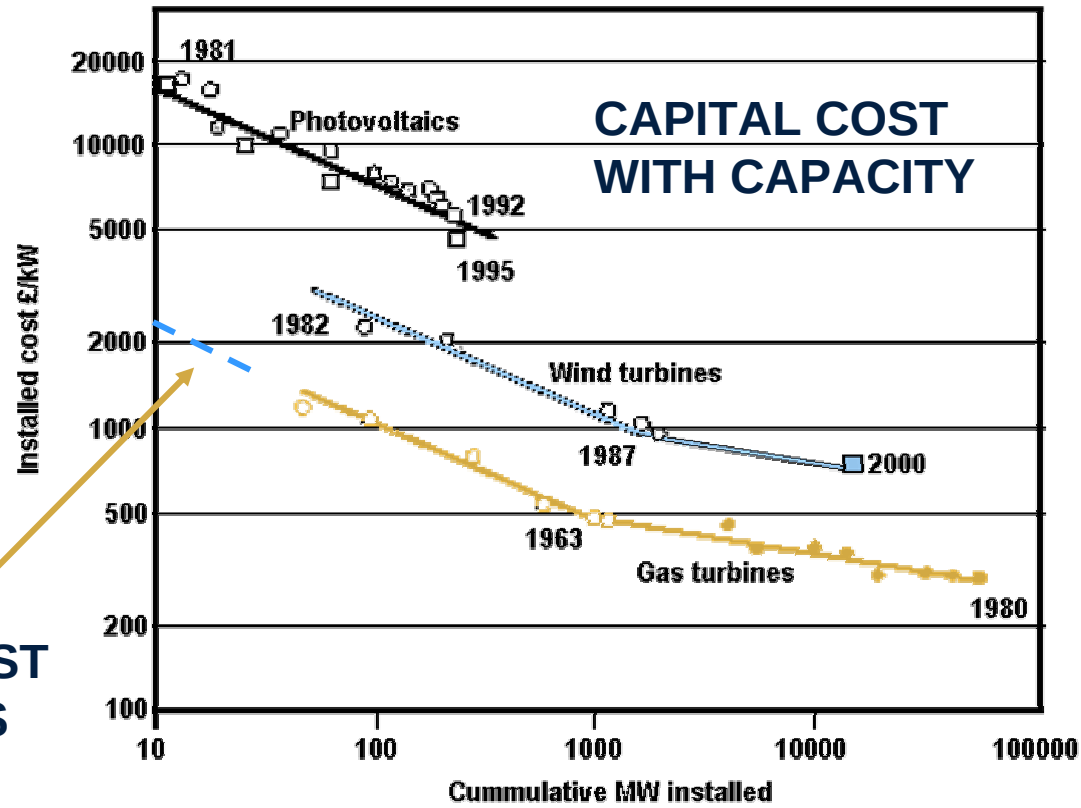


- WORLD > 2000 TWh/yr, £500bn CAPEX (c.f. existing hydro & nuclear)
- eg UK > 80 TWh/yr (~20%), >£20bn CAPEX
- eg Portugal > 12 TWh/yr (~25%), >£5bn CAPEX

Cost barriers

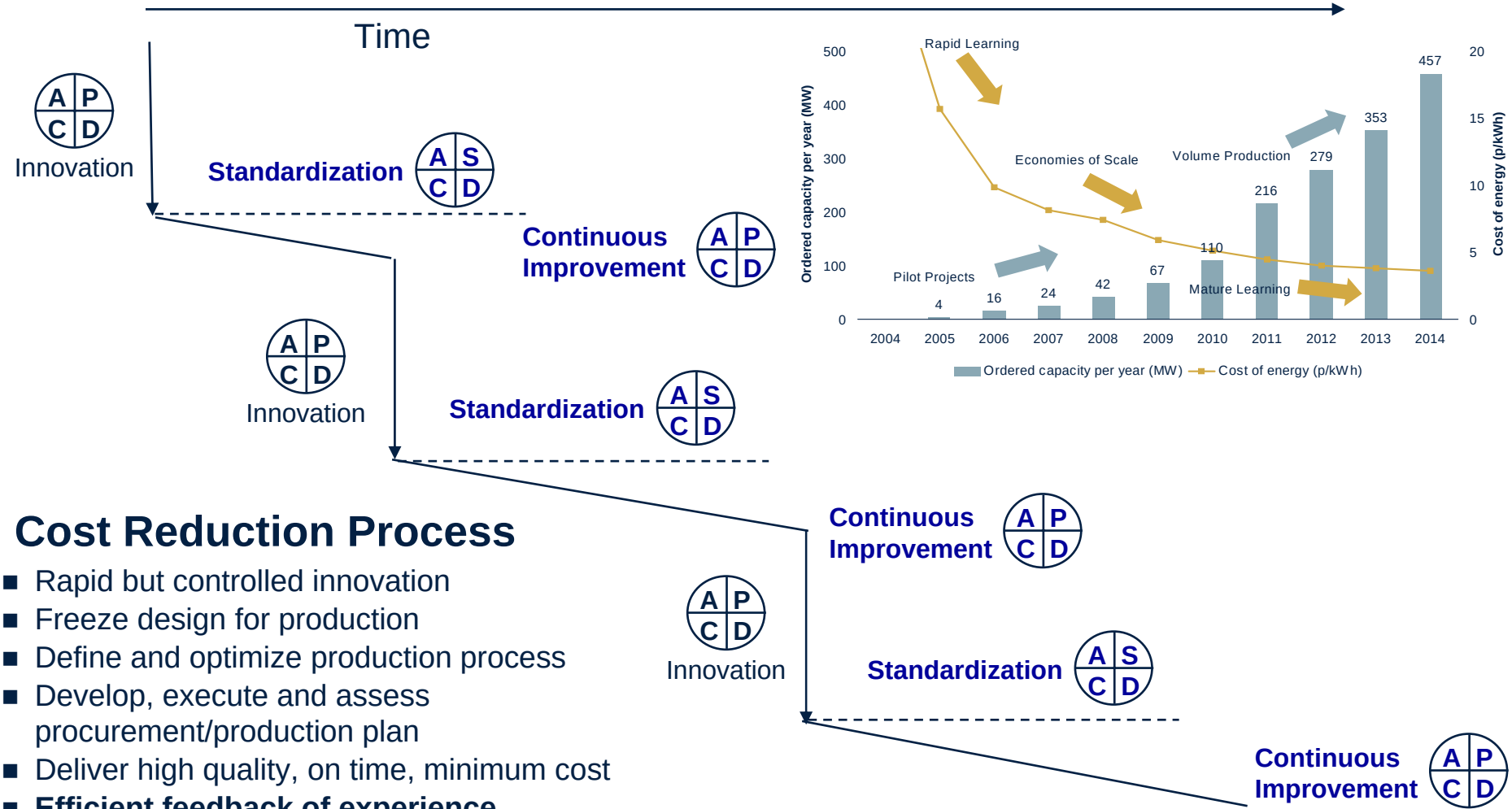
Cost reduction drivers:
- Technological advances
- Cost of capital
- Economies of scale





Source: European Commission ATLAS

Cost reduction – Driving down the costs

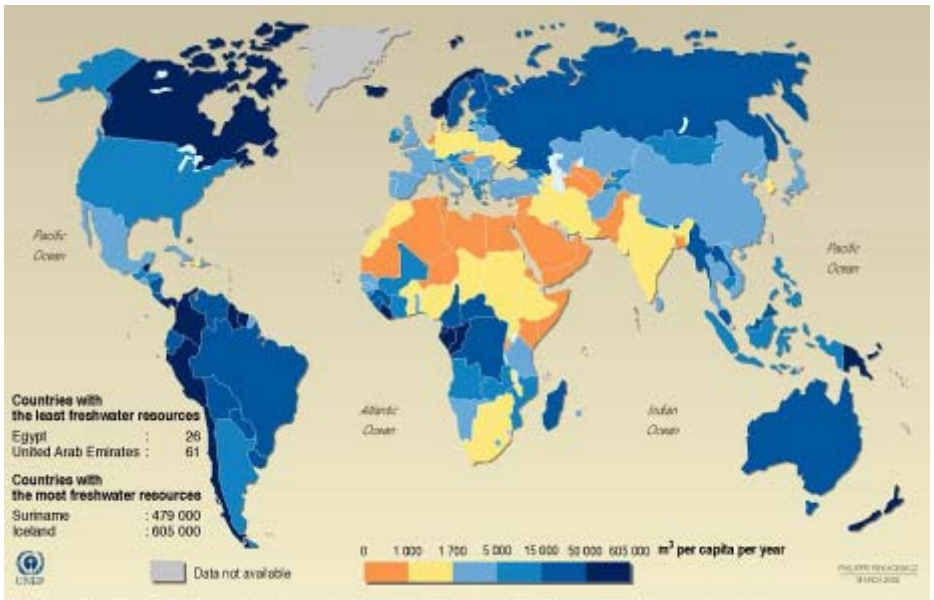


Cost Reduction Process

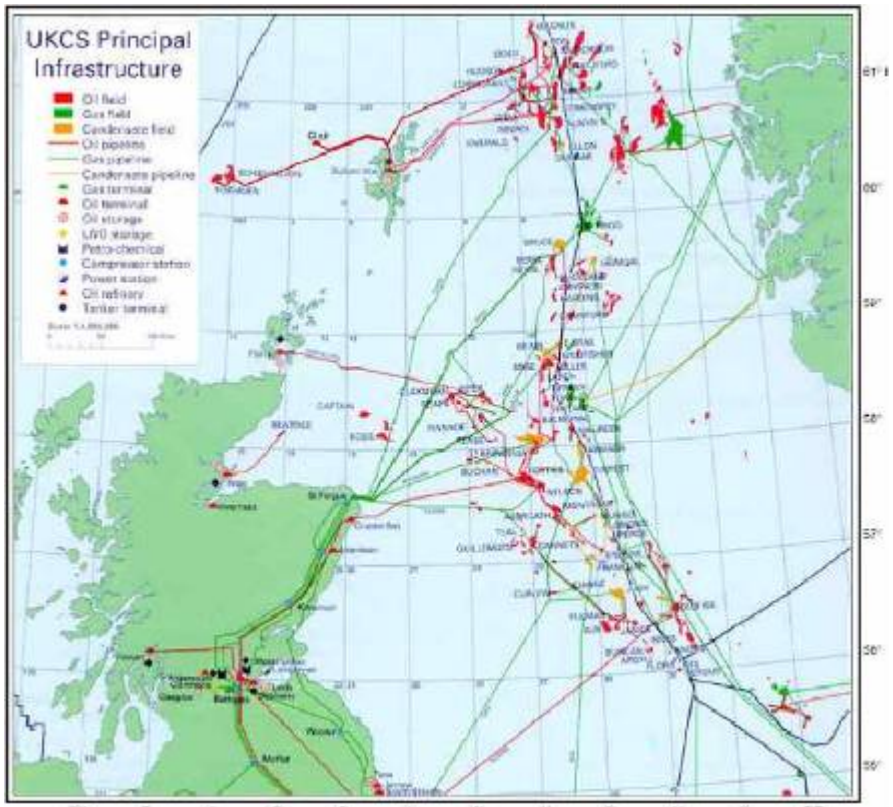
- Rapid but controlled innovation
- Freeze design for production
- Define and optimize production process
- Develop, execute and assess procurement/production plan
- Deliver high quality, on time, minimum cost
- **Efficient feedback of experience**

Other potential market opportunities

- Off grid
- Oil and gas – generation
- Oil and gas – pumping
- Desalination



Source: World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life, World Resources Institute (WRI), Washington DC, 2000



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