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European Business and Technology Centre

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Policy Regulation, Technology & Finance

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The multi-chamber oscillating wave column Seabreath technology and the *e-pier* idea to produce electricity from sea waves

seabreath® wave energy

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Who we are

seabreath®
wave energy

Startup Company
Dr. Luigi Rubino **CEO & Inventor**

University of Padua
Department IMAGE

Marine Applications

University of Parma
Department of Information Engineering

Power electronics

e-pier
University spin-off

Contents

- Energy from the seas and wave resource
- Wave energy converters classification
- Design challenges in wave energy
- The Seabreath
- A case study: e-pier
- The way forward

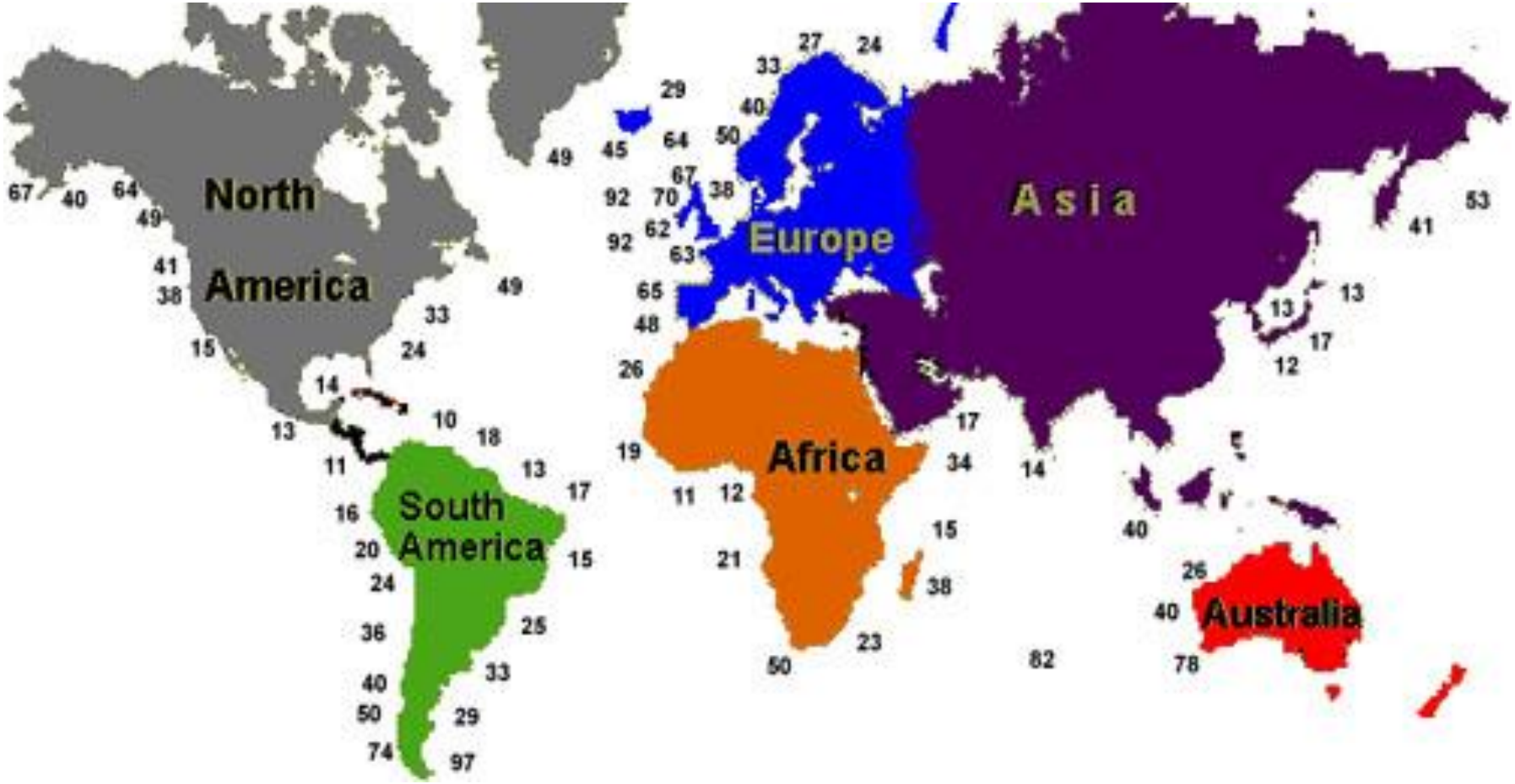
Energy extraction from the seas

Energy can be extracted from the seas using a range of procedures depending on how it has been stored:

- tides
- temperature gradients
- ocean currents
- waves

Apart from the tidal energy, the other kinds of sea energies have being tested obtaining different results, some of them closed to the theoretical calculations and other ones rather different.

Global wave resources



Average annual wave resource kW/m deep water

It is estimated that the potential worldwide wave power resource is 2 TW.

Wave Energy Converters (WECs) classification

Although the large variation in designs and concepts, WECs can be classified into three main types:

- Attenuator
- point absorber
- terminator

Within the categories identified above, there is a further level of classification of devices, determined by their mode of operation, e.g:

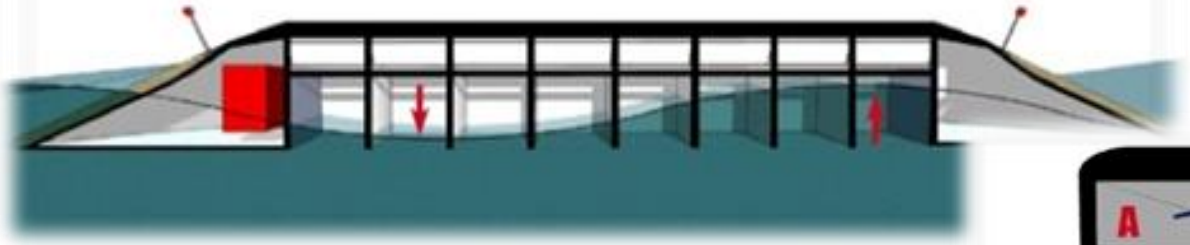
- *Submerged pressure differential*
- *Oscillating wave surge converter*
- *Overtopping device*
- *Oscillating water column (OWC)*

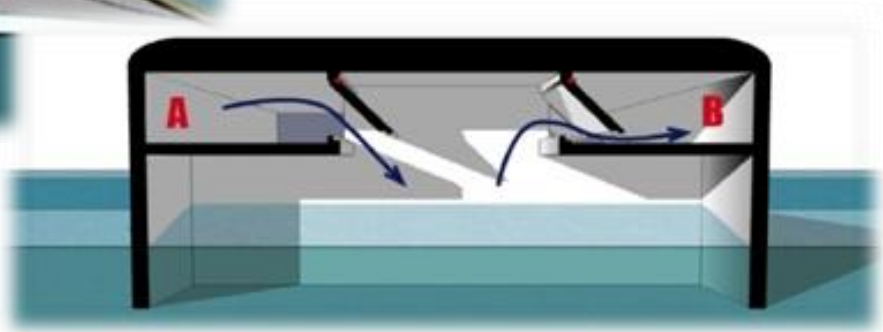
Design challenges in wave energy

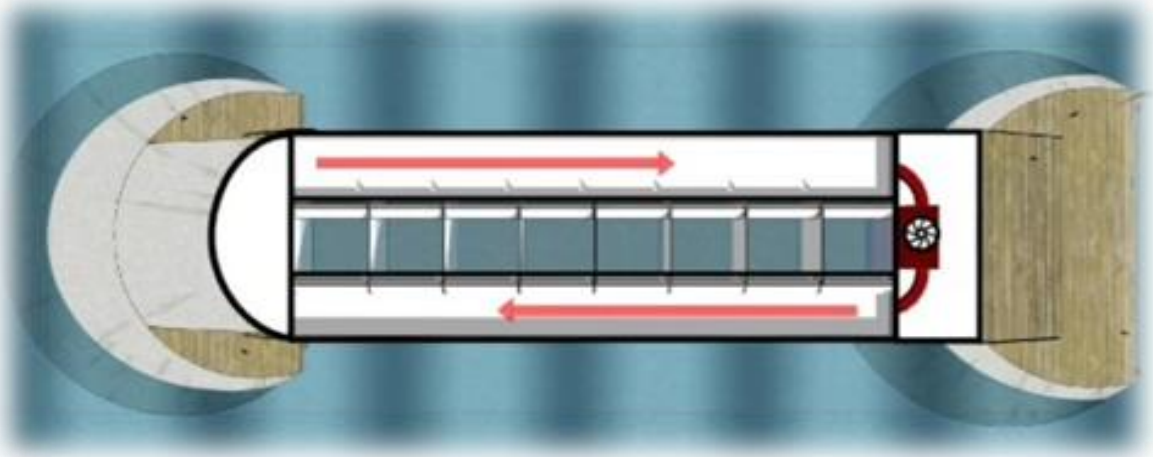
- Convert energy in waves to useable form
  - Elliptic fluid particle motion – large cyclic forces
  - Irregular frequency, amplitude, direction
  - Extreme loads can be > 100 × average working
- Wave power converters must
  - Survive extremes
  - Produce a predictable defined output
  - Compete with other forms of generators
  - Have a substantial positive energy balance

Multi-chamber OWC

The *Seabreath* WEC







Further details at www.seabreath.it

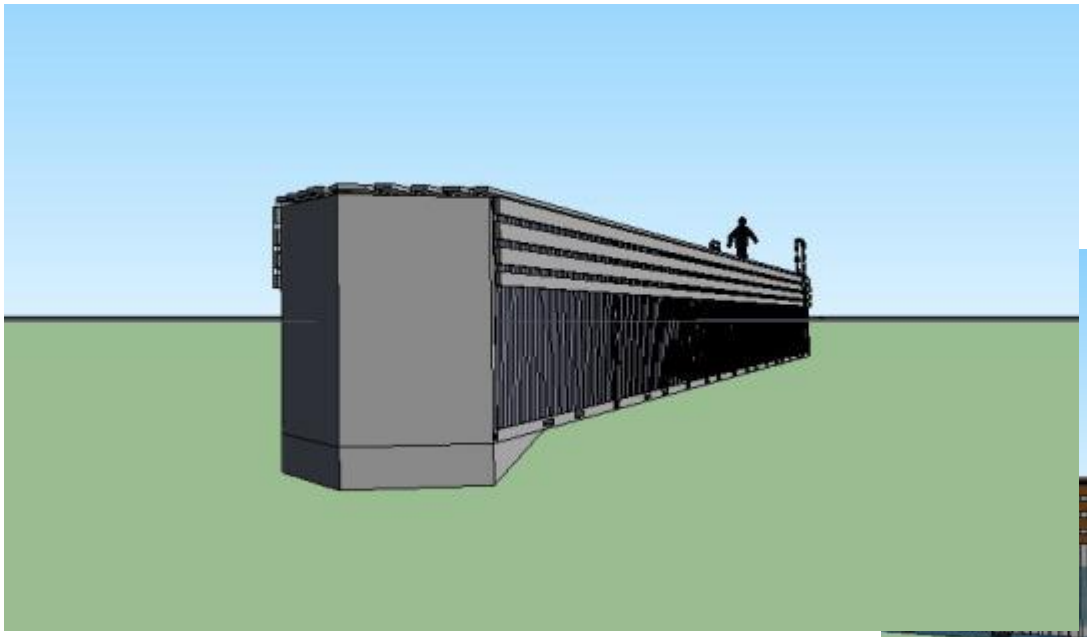
Advantages of Seabreath

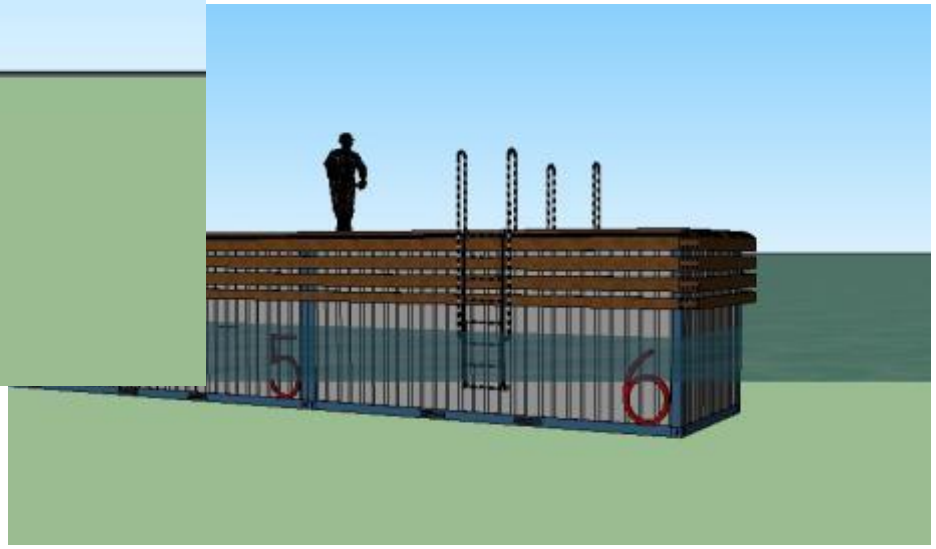
- limited use of inland areas;
- relatively uniform distribution of the exploitable energy source – sea waves;
- Components made by re-using and/or re-cycling items and materials (e.g. freight containers)
- simplicity in the installation and replacement of components of WEC due to their modular features;

Advantages of Seabreath

- limited number of under-water or wetted mechanical elements;
- suitable for a lot of sea wave conditions;
- multipurpose features (energy production, costal protection, boat docking,…);
- readiness in the dismantling and recycling of components;
- payback time similar to those of other standard renewable energy systems.

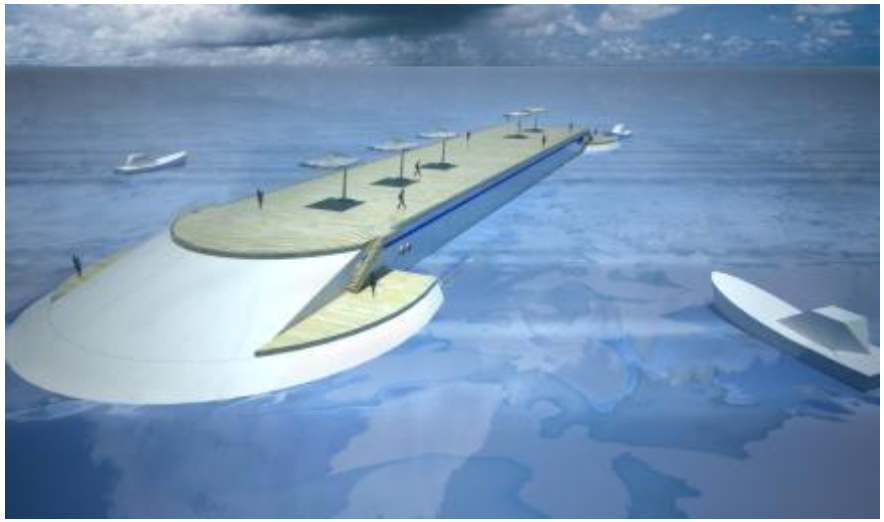
Seabreath made by using old freight containers

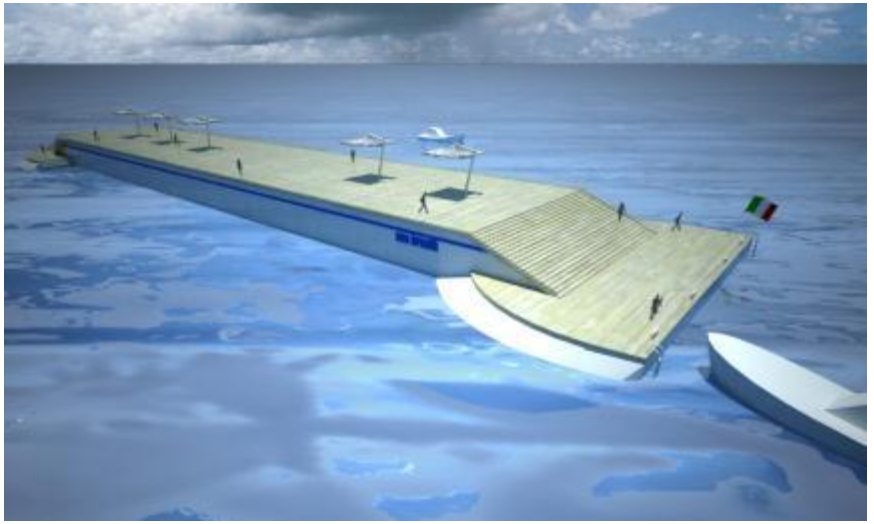




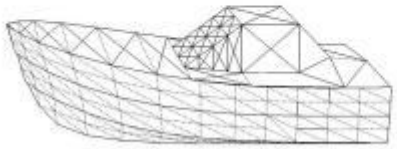
- 30-100 m long
- Suitable for high energy production

Seabreath for bath-house



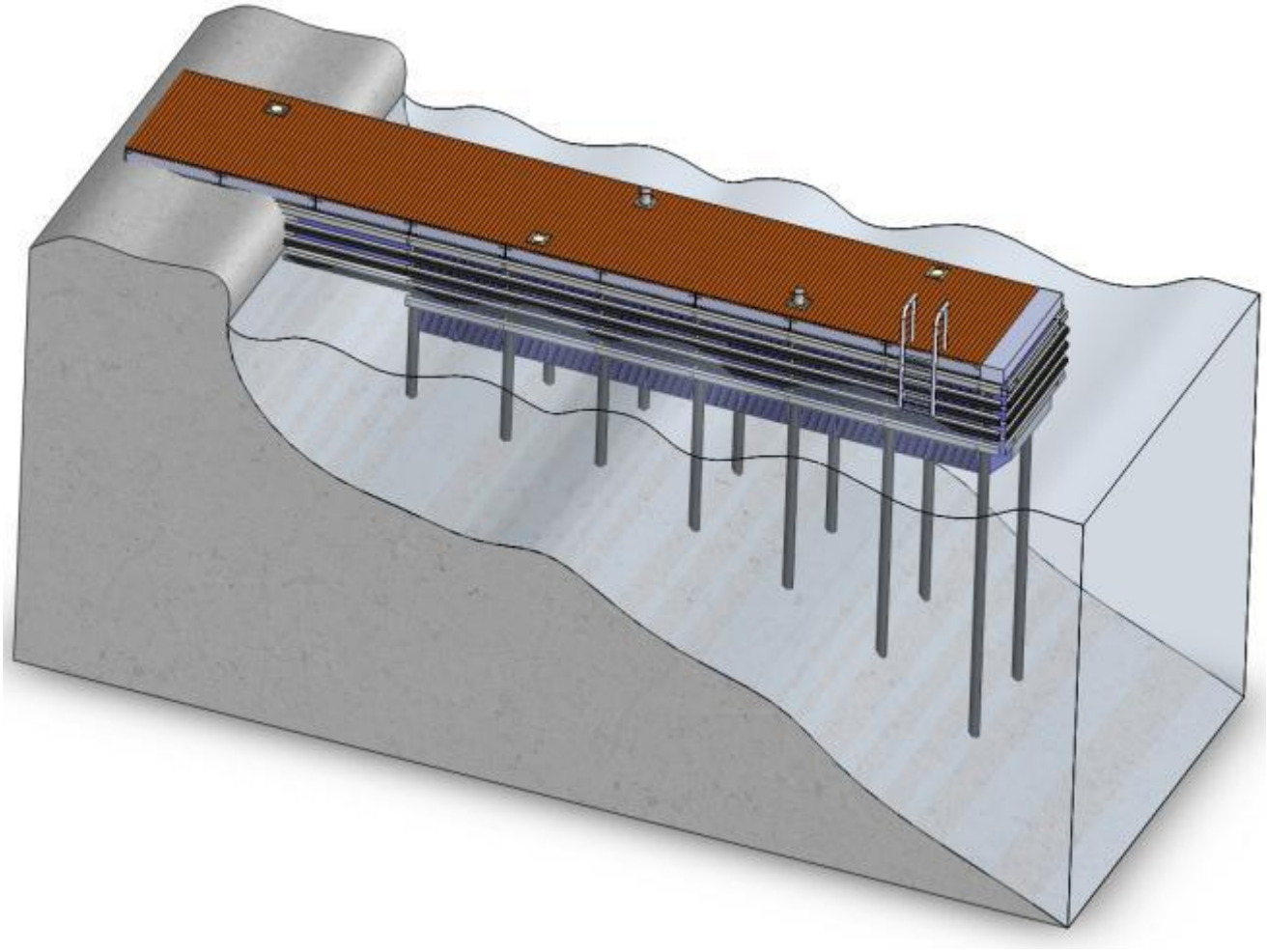


seabreath®
wave energy



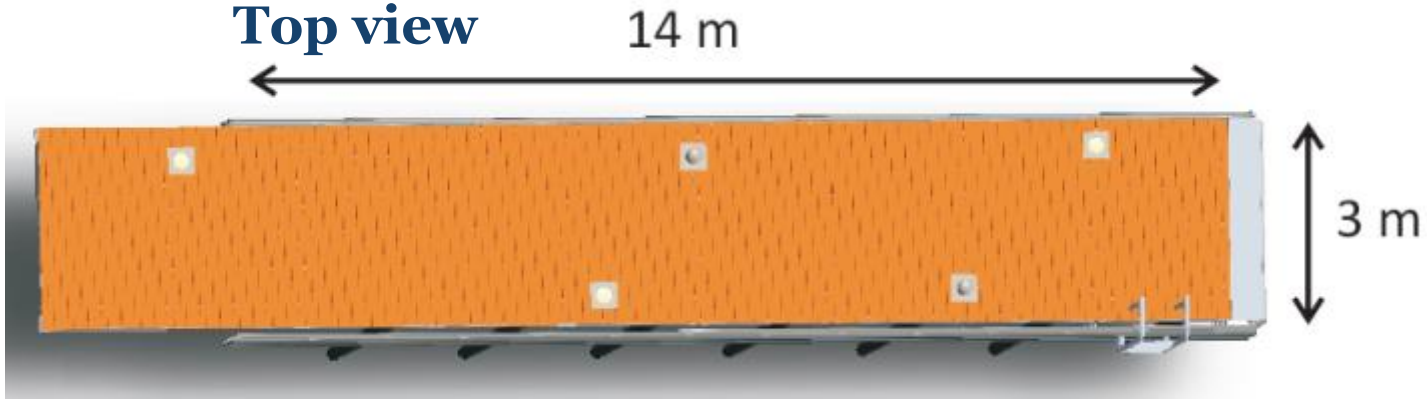
The e-pier design

Perspective

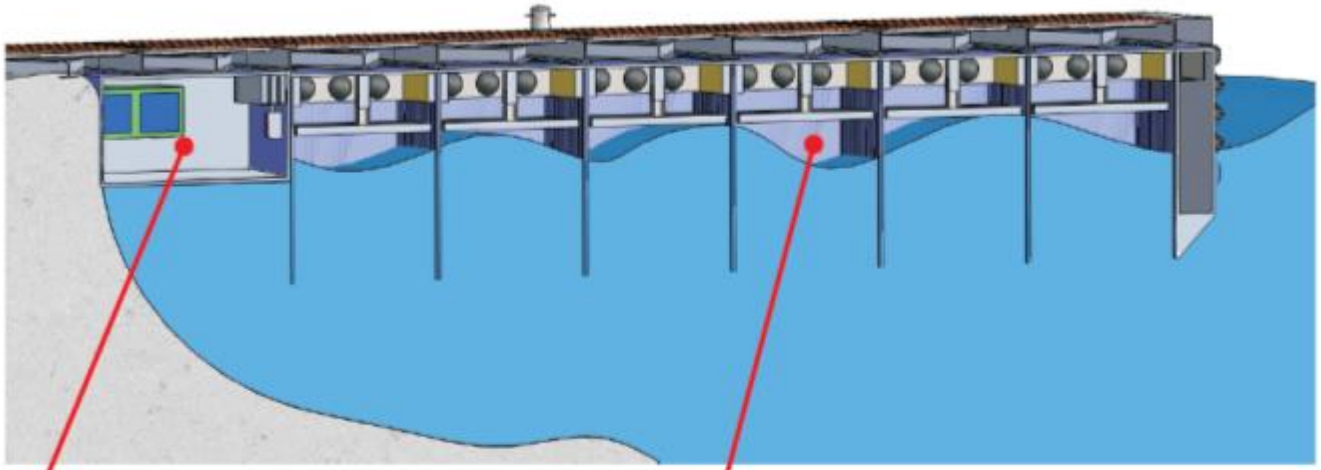


The e-pier design

Top view



Longitudinal vertical section

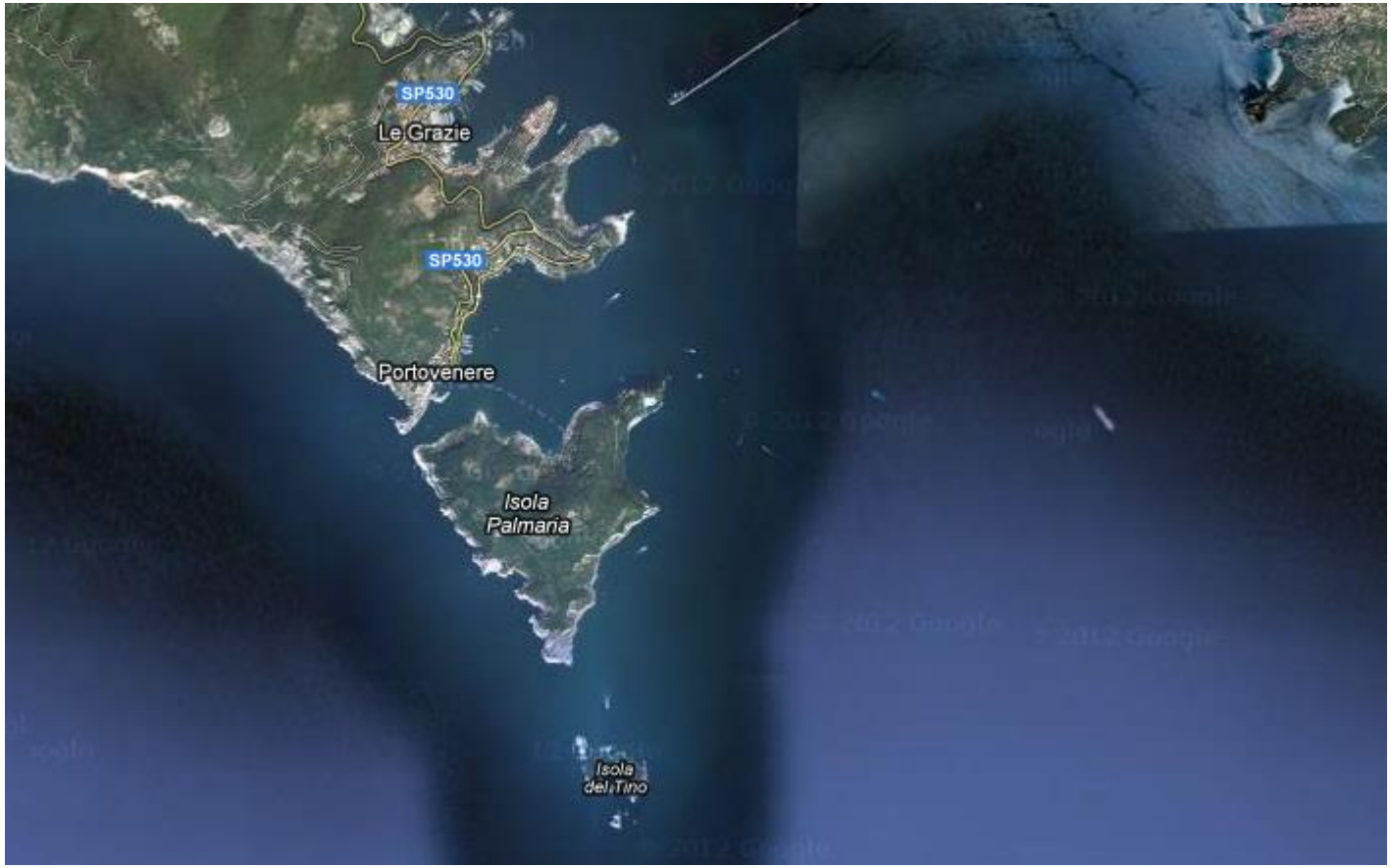


Cabinet for wind turbine and power electronics

OWC chamber

An example of design with Seabreath: the *e-pier*

The site



Cala del Pozzale – Palmaria Island
Porto Venere Regional Park

An example of multi-chamber OWC: the e-pier

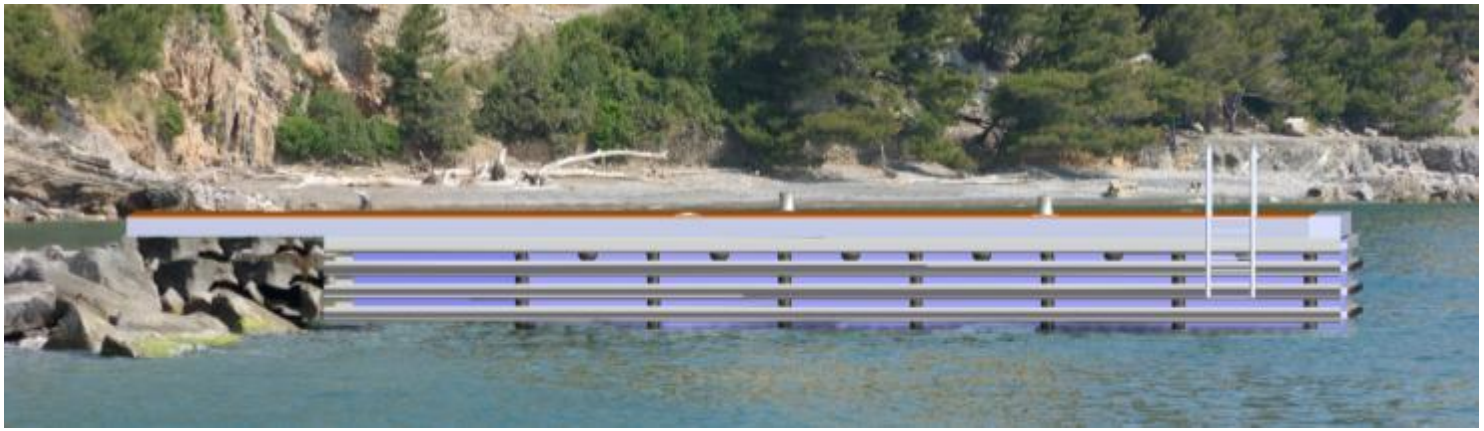
The piers

Cala del Pozzale – Palmaria Island
Porto Venere Regional Park

The e-pier design

As it is

After refurbishment



The e-pier design

- Two piers: each with one embedded multi-chamber oscillating wave column converter, replacing the existing languishing in a state of decay
- Features:
  - boats mooring
  - Pedestrian crossing
  - Coastline erosion reduction
  - **Electric energy production (WEC)**

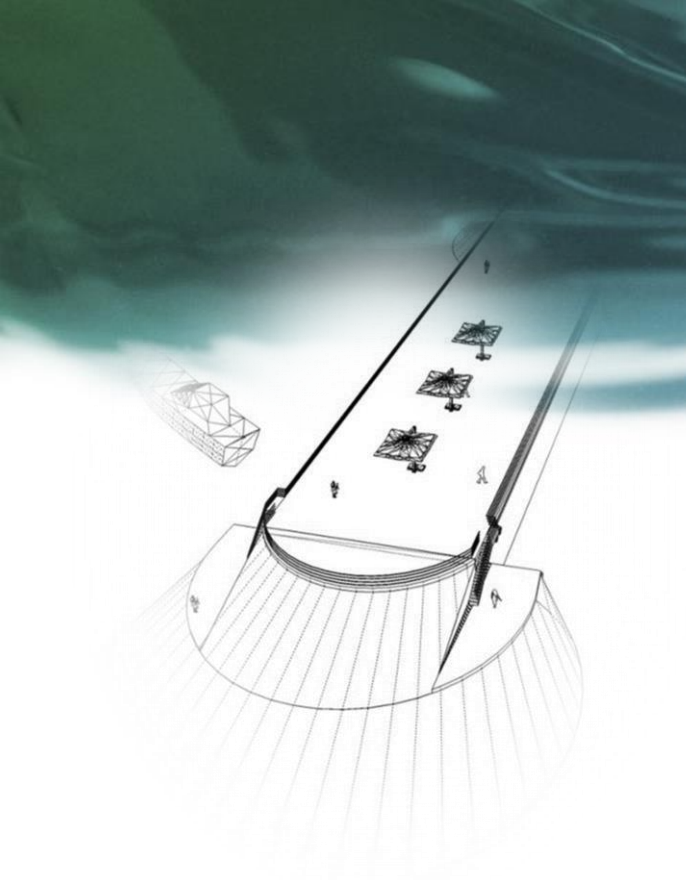
The e-pier design

- Users: houses, restaurants, others touristic facilities and public lights
- by the buoy for wave measurement of La Spezia and some calculations considering the sea bed profile at the coastline:

Direzione / T_s	2.0 s	3.5 s	4.5 s	5.3 s	6.0 s	6.6 s	7.2 s	7.7 s	8.2 s
30°N	1.14	13.42	11.99	5.14	2.99	4.39	4.16	2.38	4.89
45°N	0.74	7.97	7.41	3.37	2.66	3.29	4.16	5.95	1.63
60°N	0.54	7.24	7.41	5.32	3.32	3.84	4.16	2.38	1.63
75°N	0.58	6.56	6.26	3.37	2.32	4.39	3.33	4.76	4.89
90°N	0.52	6.39	6.57	4.43	2.99	2.74	4.16	3.57	6.51
105°N	0.55	6.65	6.72	5.85	6.31	3.84	4.16	4.76	4.89
120°N	0.54	7.75	10.62	7.44	6.64	8.23	5.00	7.15	11.40
135°N	0.67	12.23	12.99	8.50	7.97	9.87	12.49	11.91	14.66
150°N	0.97	18.13	17.95	10.99	9.96	20.29	15.82	10.72	11.40
165°N	1.29	22.07	33.54	23.03	14.28	13.16	22.48	33.35	14.66
Somma	8.00	108.00	121.00	77.00	59.00	74.00	80.00	87.00	77.00

TOTALE: 692 W/m/y (incidente la spiaggia)

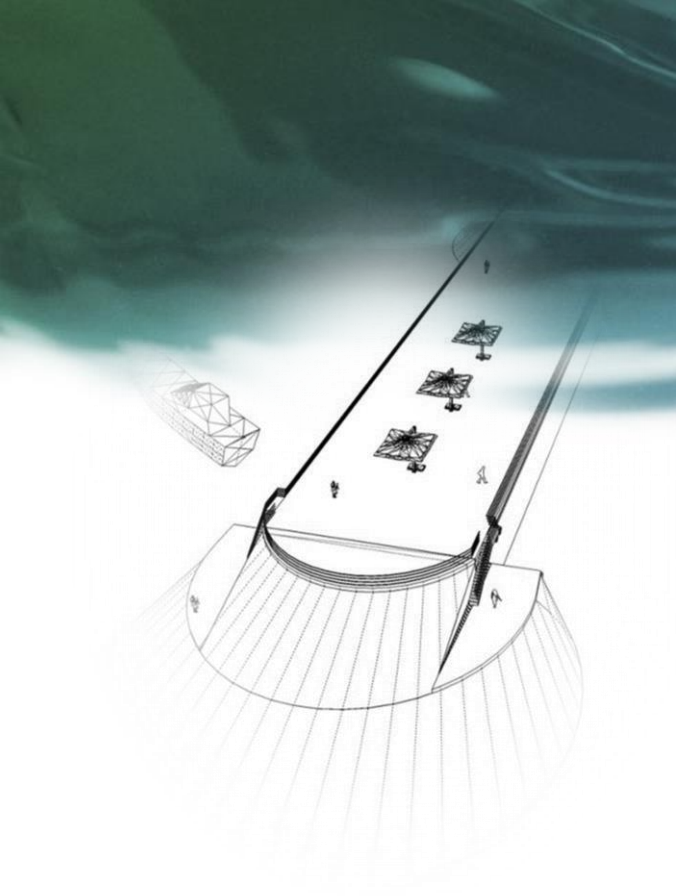
- Energy production (2 WEC): 18 MWh/y



Seabreath and e-pier the way forward

We are looking for partners to start international R&D project about the Seabreath applied to piers.

We wish to find organizations or group interested in:
- Research
- Development
- Financing & Business



Thank you