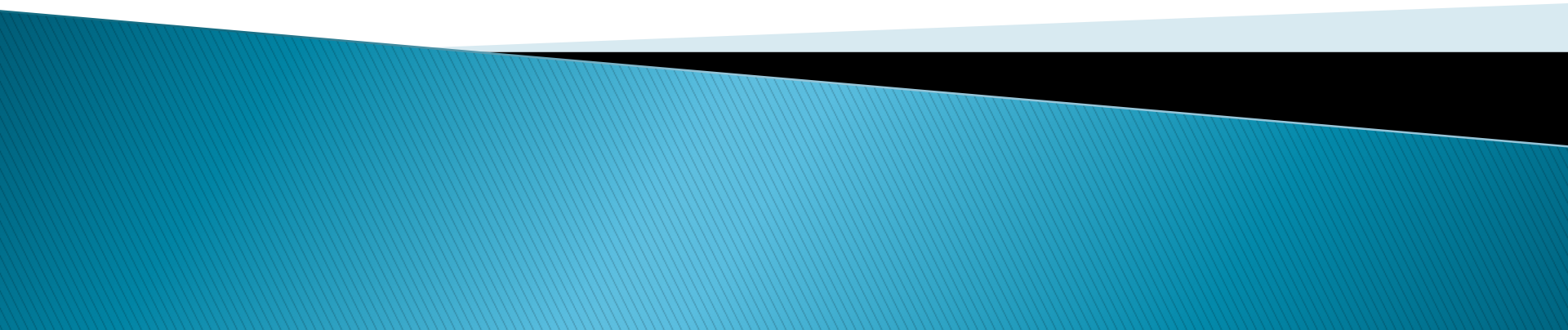


Sistemas de geração de energia com ondas

Sistemas flutuantes de aerogeradores offshore

PNV3523 Energia Renovável do Oceano



Sumário

- ▶ **Sistemas de conversão de energia a partir de ondas**
 - Potencial global
 - Princípios de funcionamento
 - Tipos de sistemas em desenvolvimento
- ▶ **Sistemas flutuantes de aerogeradores offshore**

Potencial global

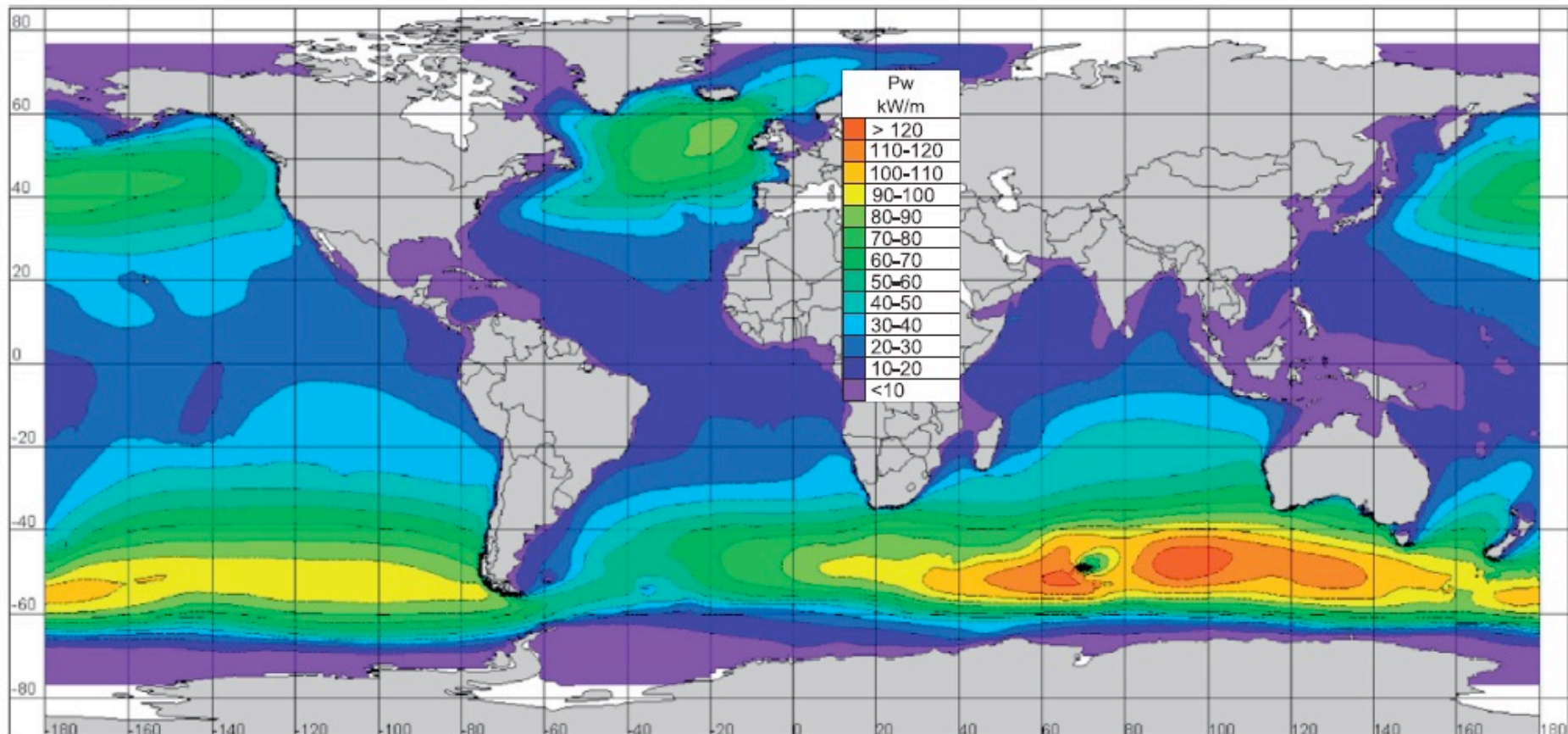
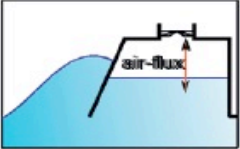
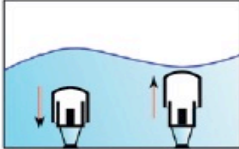
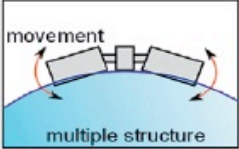
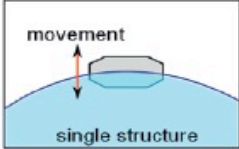
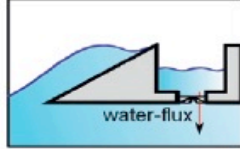
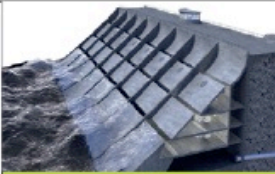


Fig. 1. Global annual mean wave power estimation in kW/m spanning 10 years period.

Review of wave energy technologies and the necessary power-equipment

Iraide López ^{a,*}, Jon Andreu ^a, Salvador Ceballos ^b, Iñigo Martínez de Alegría ^a,
Iñigo Kortabarria ^a

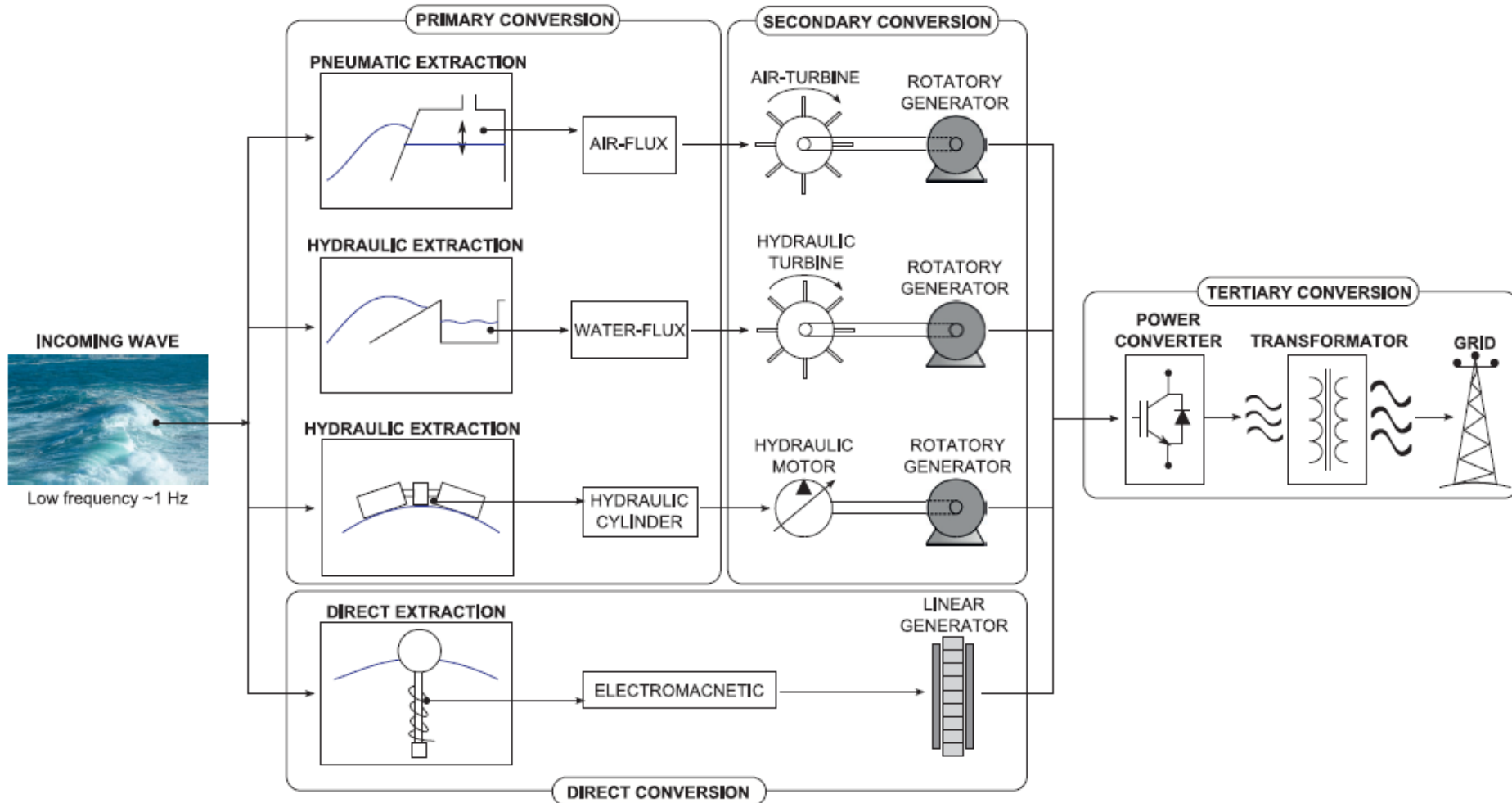
Princípios de funcionamento

		OWC	PRESSURE DIFFERENTIAL	FLOATING STRUCTURE		OVERTOPING	OSCILLATING WAVE SURGE / IMPACT
							
LOCATION	ONSHORE	 Limpet WaveGen (UK)				 SSG WAVEenergy (NO)	
	NEARSHORE	 Oceanlix Energetch (AU)	 CETO III REH (UK)	 WaveStar Wave Star (DK)	 Seareaser Ecotricity (UK)	 Waveplane Waveplane (DK)	 Oyster Aquamarine (UK)
	OFFSHORE	 OE Buoy Ocean energy (IRL)	 AWS AWS Ocean (UK)	 Pelamis PWP (UK)	 PowerBuoy OPT (USA)	 Wave Dragon Wave Dragon (DK)	 Langlee LWP (NO)
		 Terminator	 Point absorber	 Attenuator			

Review of wave energy technologies and the necessary power-equipment

Iraide López ^{a,*}, Jon Andreu ^a, Salvador Ceballos ^b, Iñigo Martínez de Alegría ^a, Iñigo Kortabarria ^a

Princípios de funcionamento

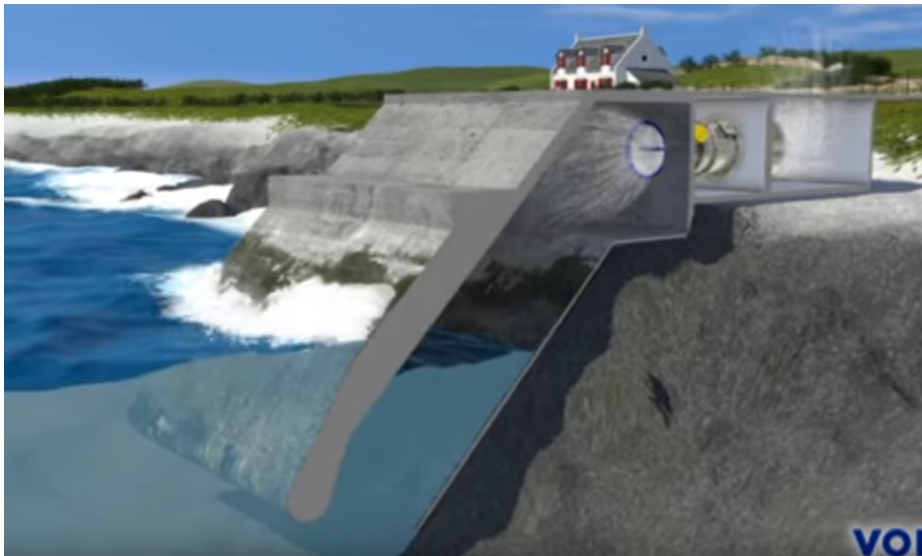
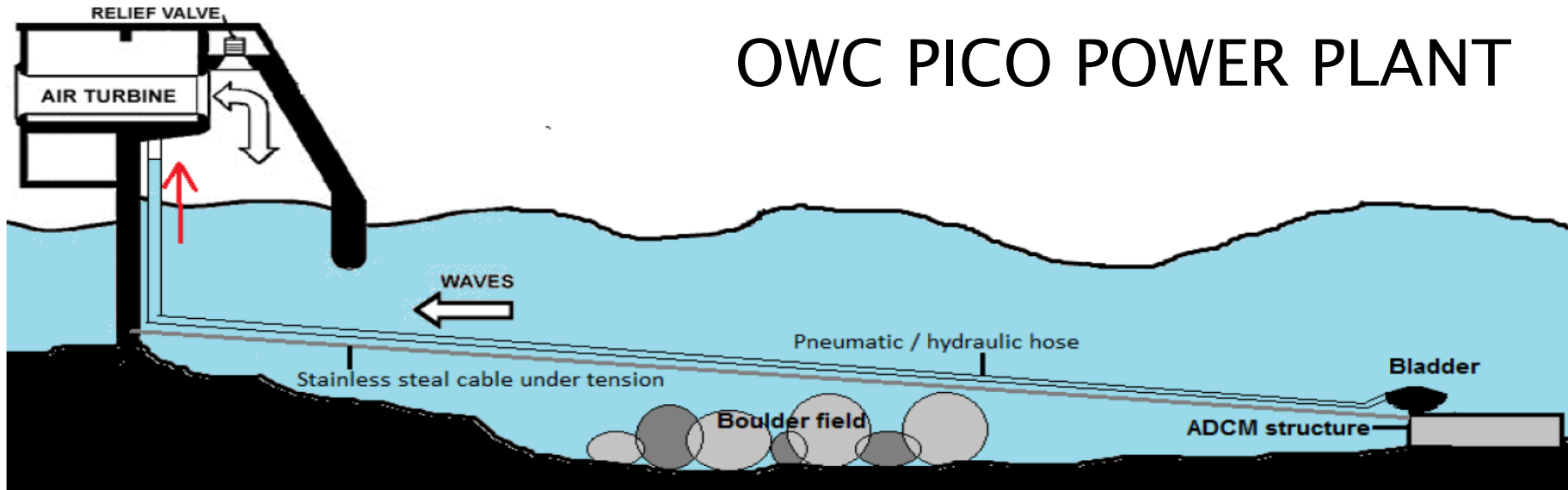


Review of wave energy technologies and the necessary power-equipment

Iraide López^{a,*}, Jon Andreu^a, Salvador Ceballos^b, Iñigo Martínez de Alegria^a, Iñigo Kortabarria^a

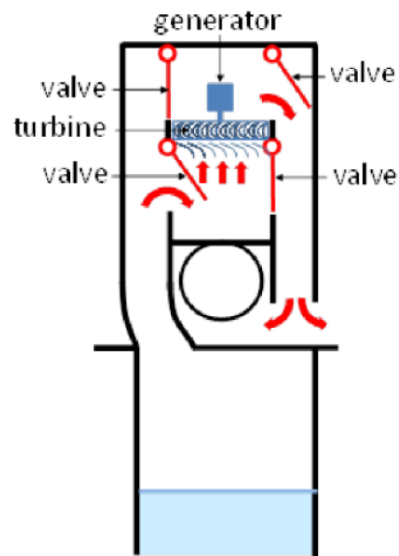
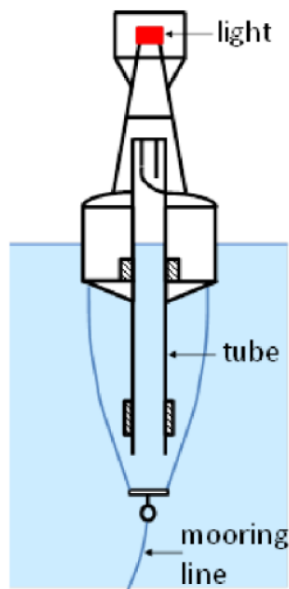
Sistemas de Coluna Flutuante

OWC PICO POWER PLANT



<http://www.pico-owc.net/>

Sistemas de Coluna Flutuante



Ocean Energy, 2015, available at: <http://oceanenergy.ie/>

Sistemas de Coluna Flutuante

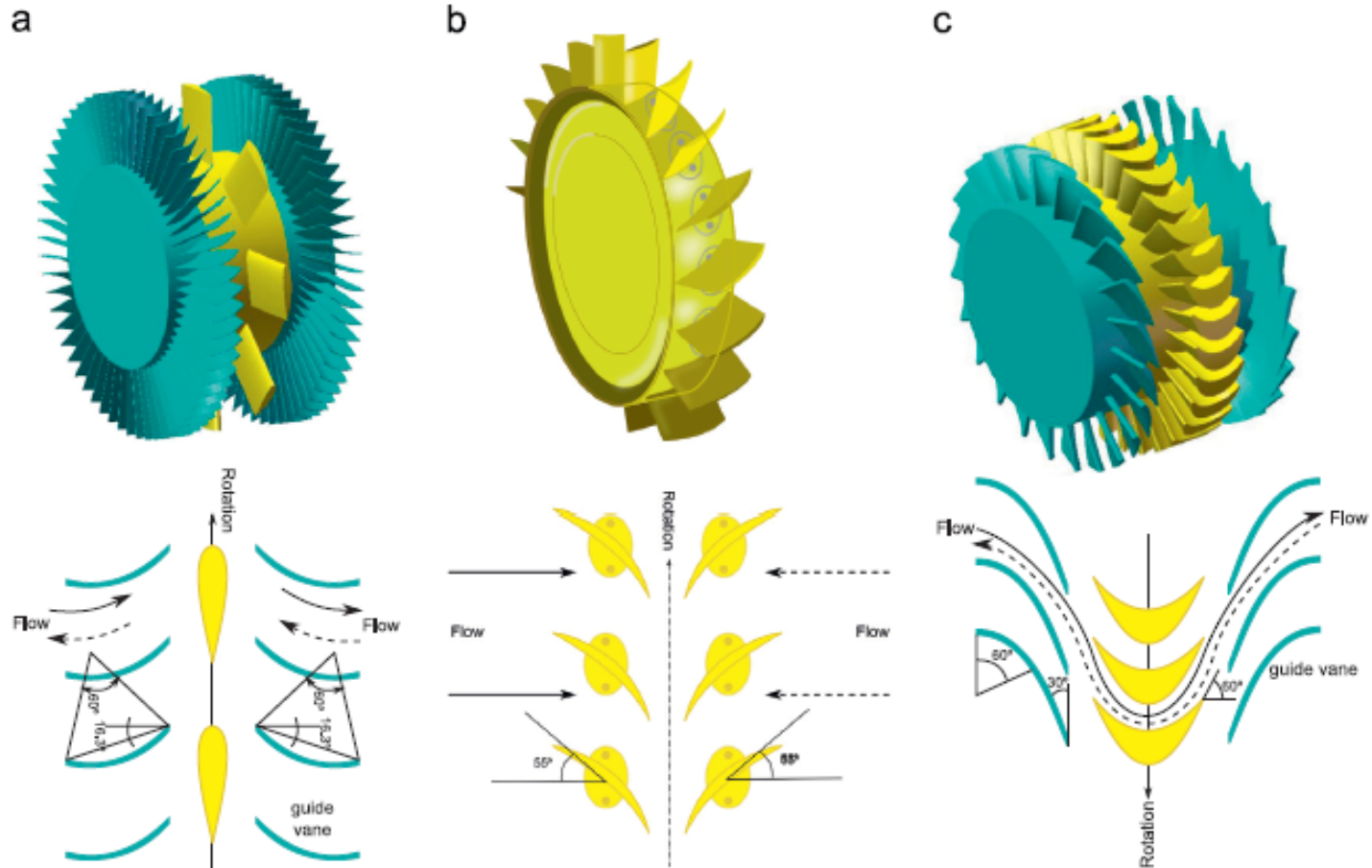


Fig. 10. Air turbines for WECs. (a) Wells turbine, (b) Denniss-Auld turbine and (c) impulse turbine.

Review of wave energy technologies and the necessary power-equipment

Iraide López ^{a,*}, Jon Andreu ^a, Salvador Ceballos ^b, Iñigo Martínez de Alegría ^a, Iñigo Kortabarria ^a

Sistemas de geração de energia

Coastal support



COPPE, UFRJ
Porto de Pecém, CE
Brazil

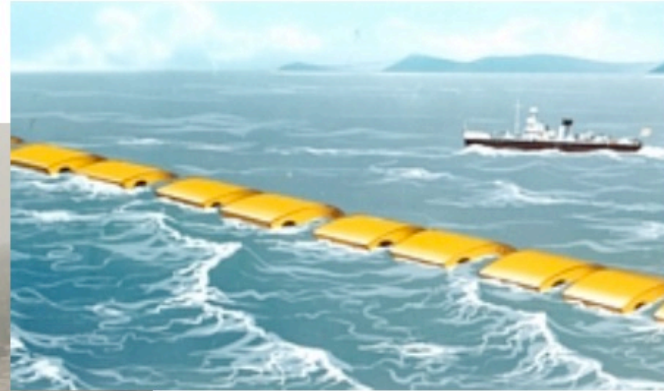
<http://www.seahorseenergy.com.br/>

Sistemas de geração de energia

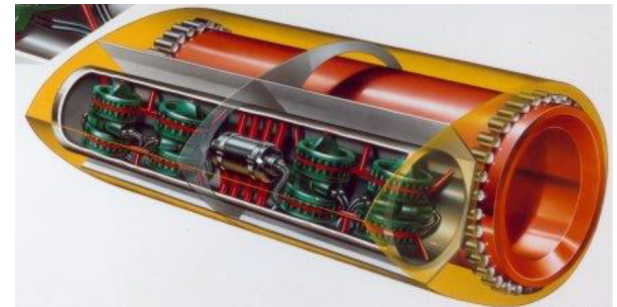
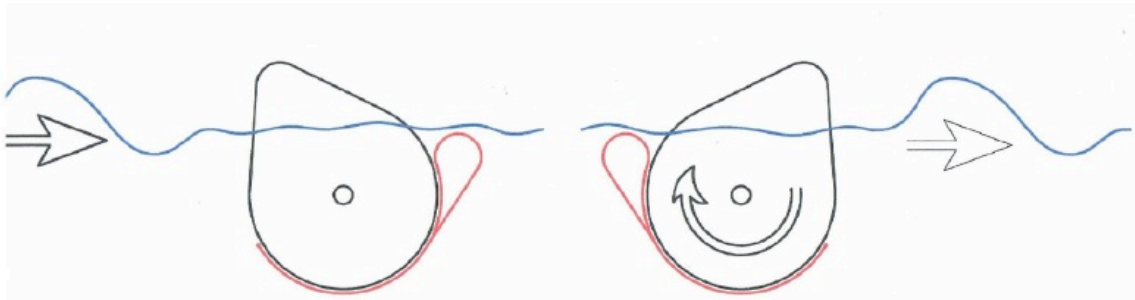


Sistemas de geração de energia

The Duck



Prof. S. Salter,
Univ. of Edinburgh, UK



Sistemas de geração de energia

Pelamis

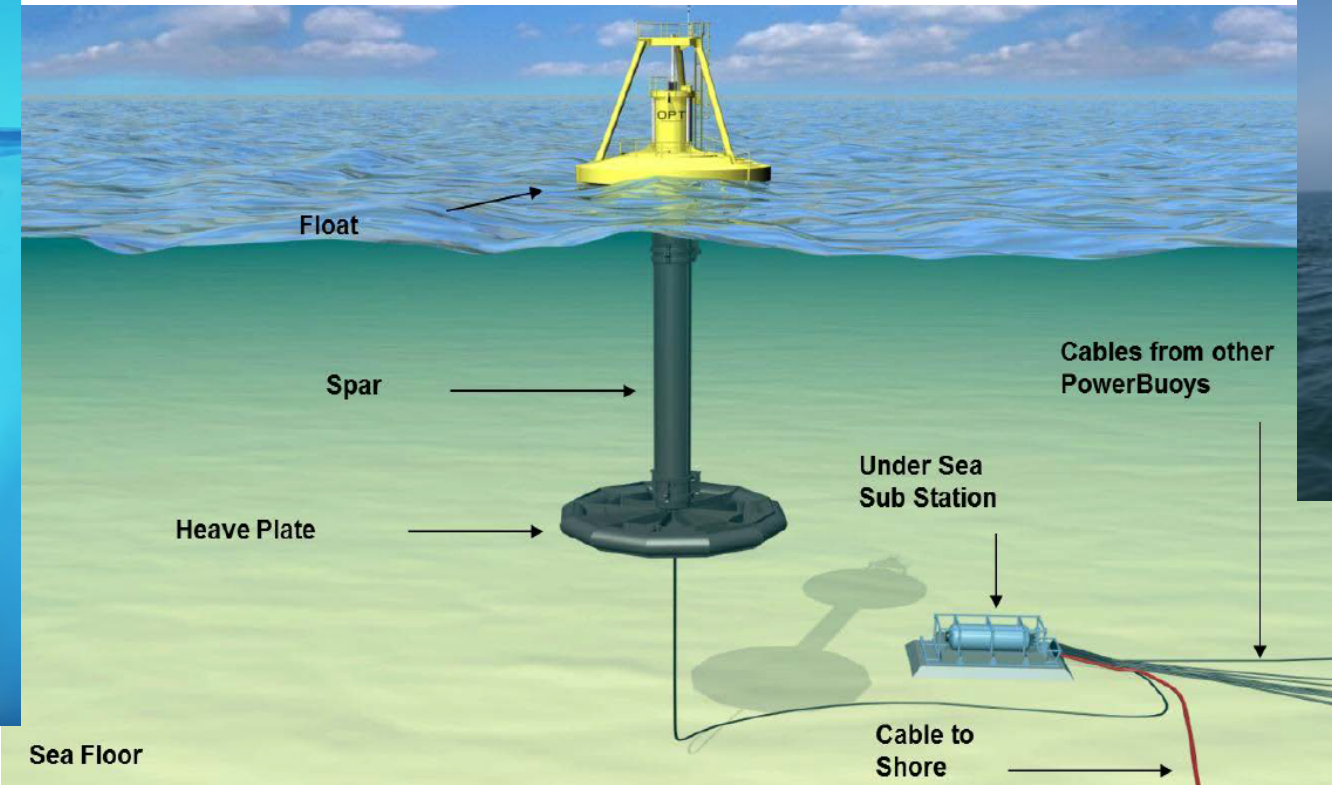


www.pelamiswave.com



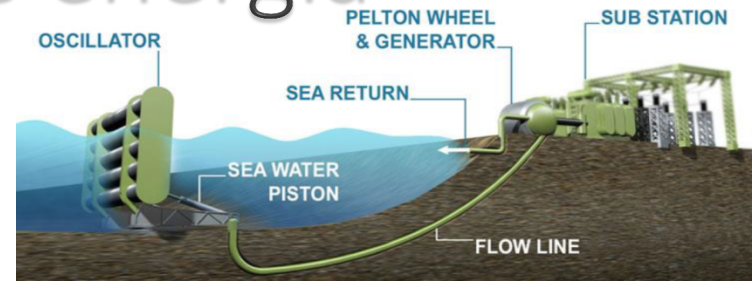
Sistemas de geração de energia

POWER BUOY

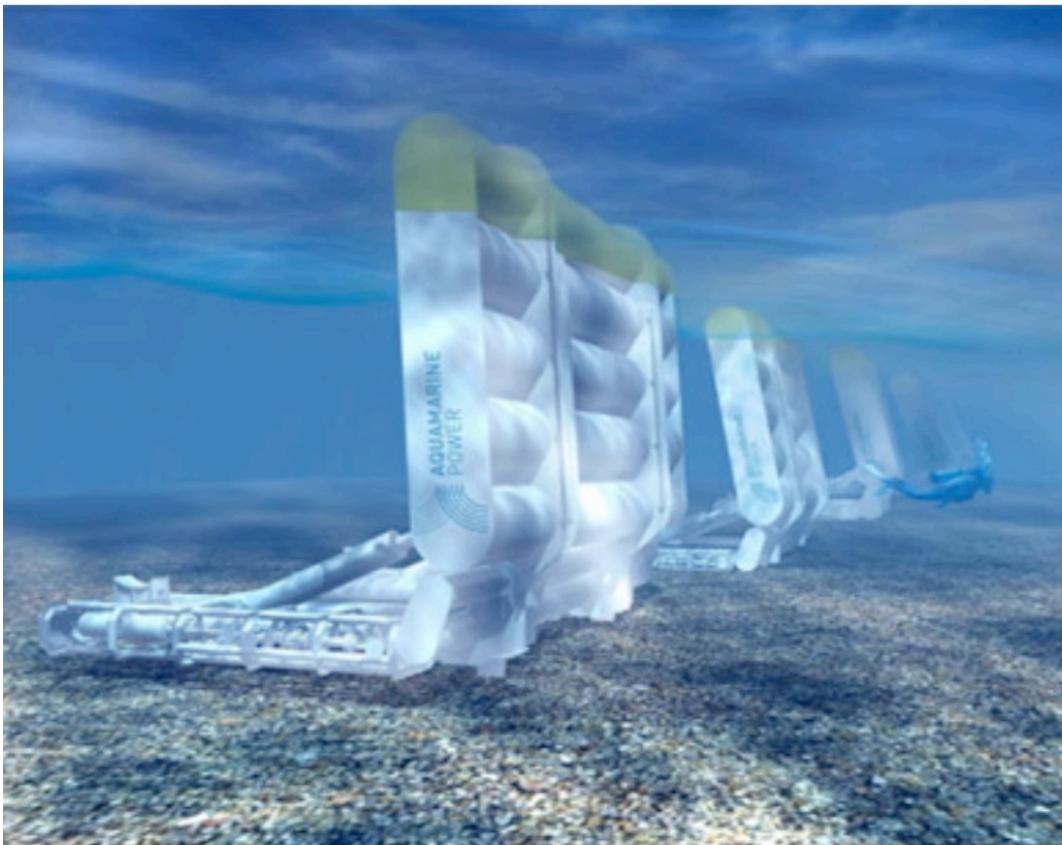


Sistemas de geração de energia

The Oyster

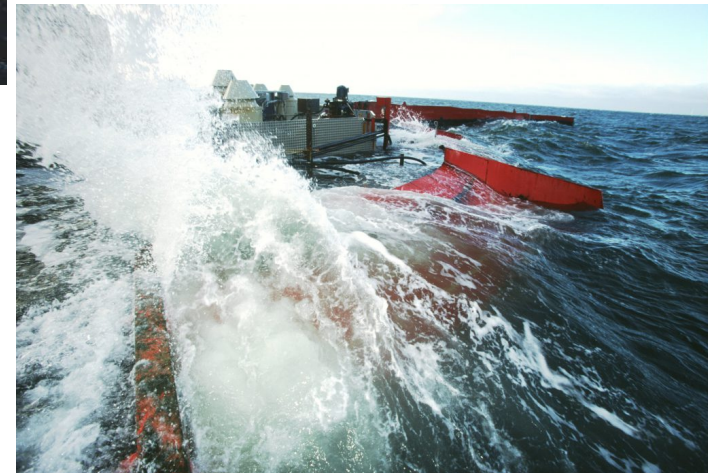
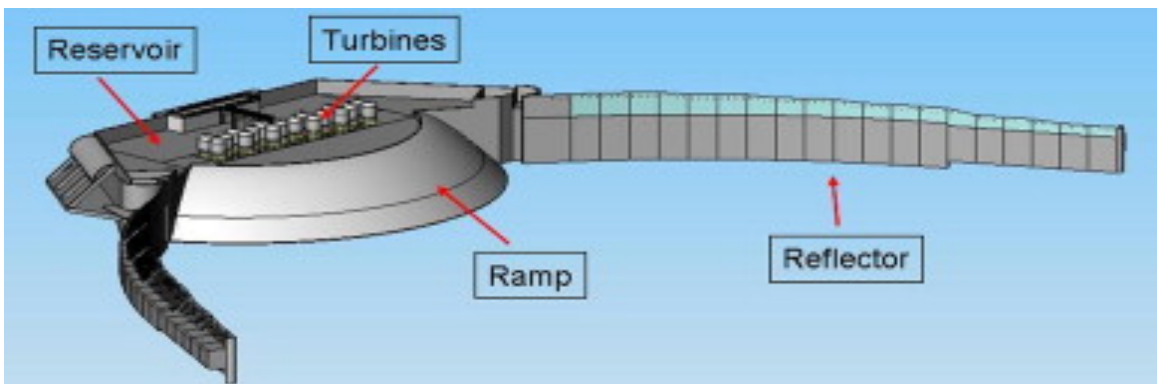
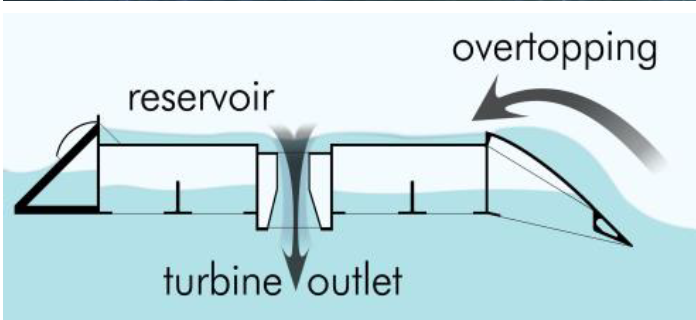
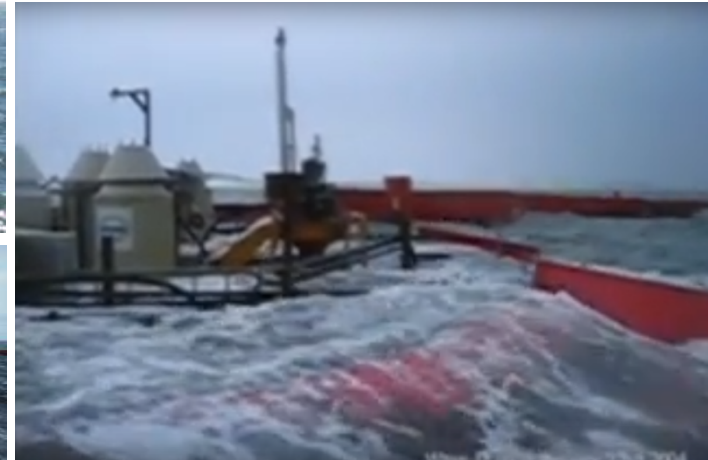


www.aquamarinepower.com



Sistemas de geração de energia

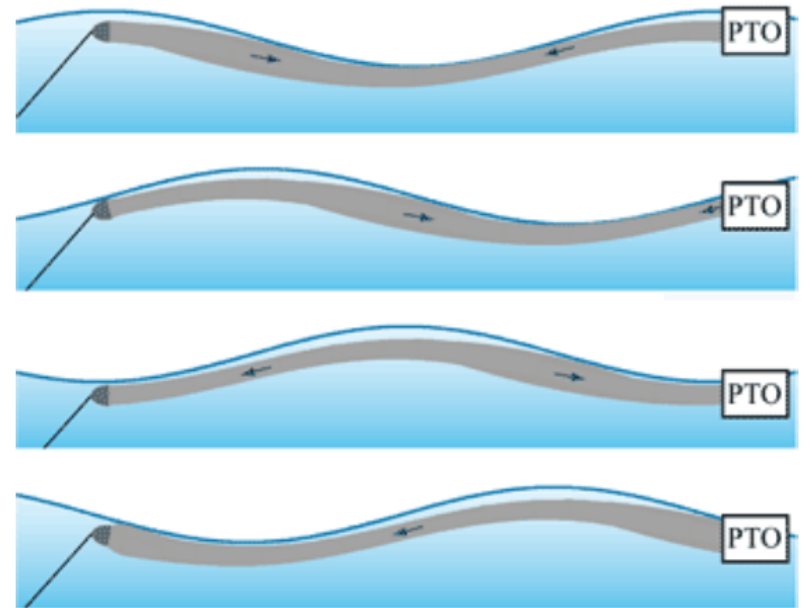
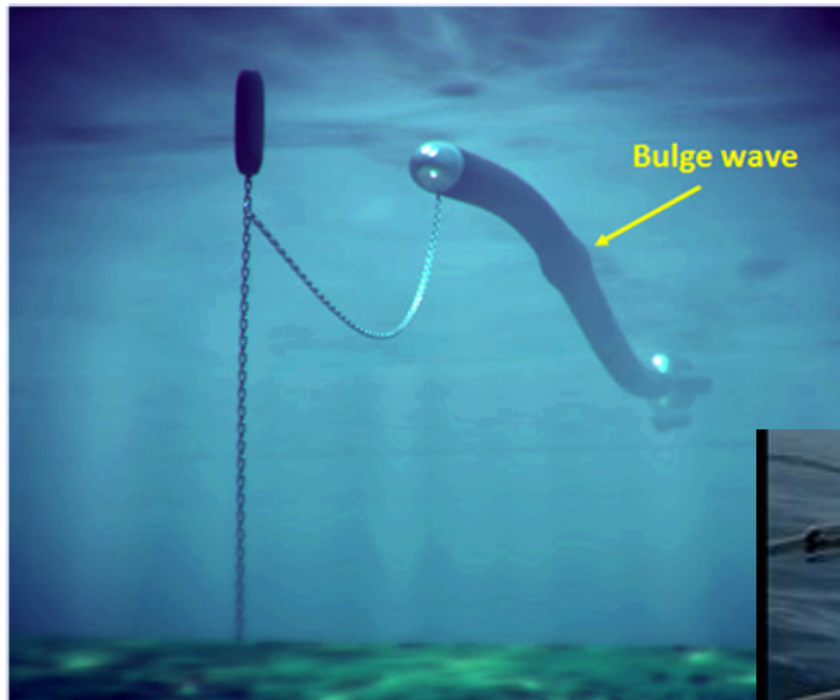
WAVE DRAGON



Wavedragon, [Online]. Available: <http://www.wavedragon.net/>.

Sistemas de geração de energia

Anaconda

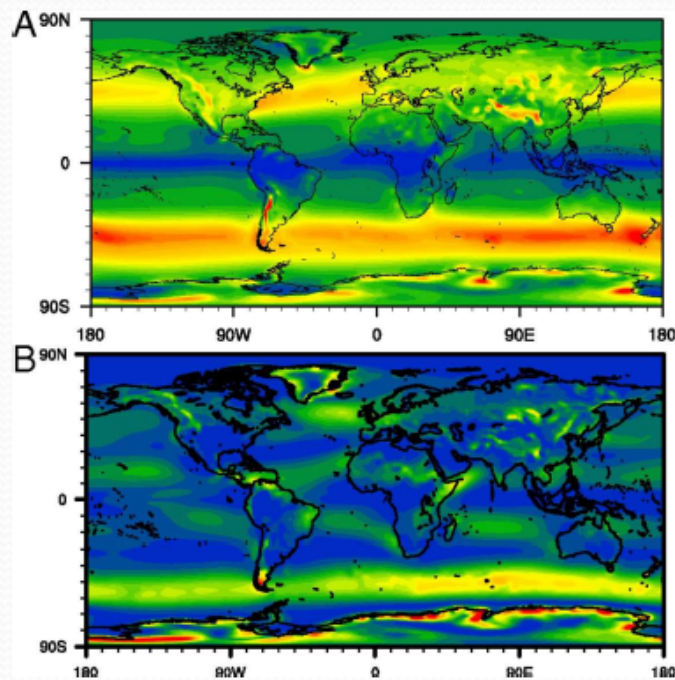


Sistemas flutuantes de aerogeneradores offshore



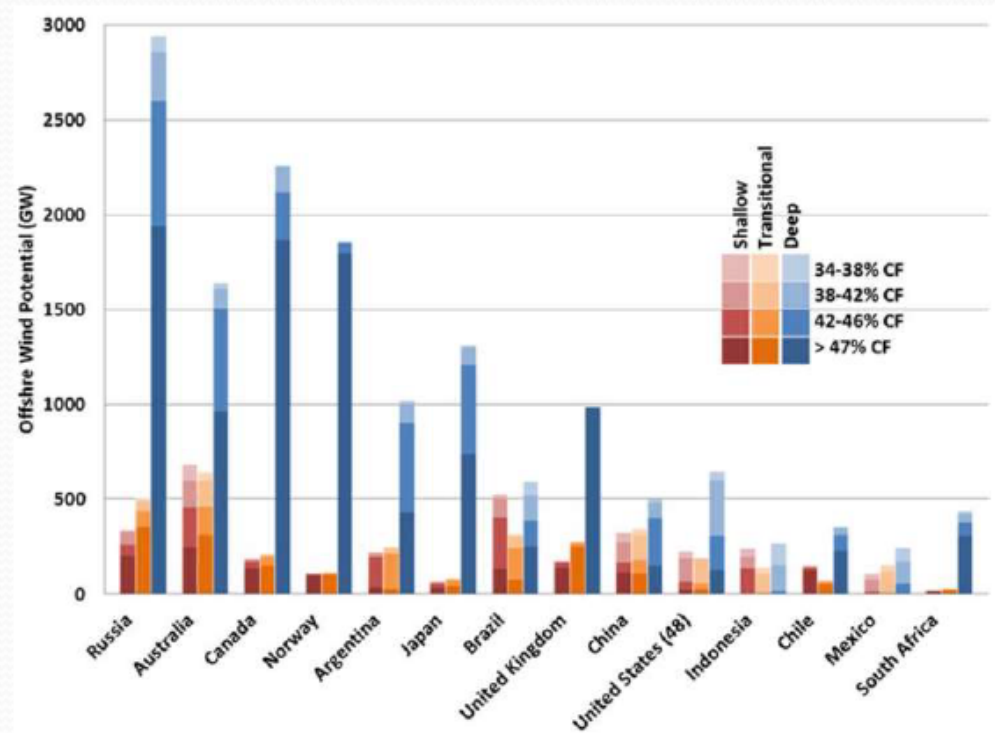
Sistemas flutuantes de aerogeneradores offshore

Global Offshore Wind Kinetic Energy



Source: Possner & Caldera [PNAS] 2017

A: Climatology of Kinetic Energy Extraction (KEE) B: Annual Mean Kinetic Energy (KE) Dissipation into Boundary Layer.



Source: NREL 2012

Shallow
Deep

0-30 m
> 60 m

Transition 30-60 m
CF = Capacity Factor

Sistemas flutuantes de aerogeradores offshore

BUSINESS GUIDE

Petrobras and Equinor Sign Offshore Wind MoU in Brazil



Image source: ANDRÉ RIBEIRO / AGÊNCIA PETROBRAS

Brazilian oil & gas major Petrobras has signed a Memorandum of Understanding (MoU) with the Norwegian energy company Equinor to jointly develop the offshore wind energy segment in Brazil.

Under the strategic partnership already entered into between the two companies, Petrobras and Equinor have been investigating other potential areas of cooperation, including the development of renewable energy initiatives.

<http://www.offshorewind.biz/2018/09/27/petrobras-and-equinor-sign-offshore-wind-mou-in-brazil/>

BUSINESS GUIDE

Petrobras Starts UK Offshore Wind Tour



A delegation from the Brazilian multinational oil and gas company Petrobras is visiting the North East England to meet with major supply chain companies in the offshore wind sector.

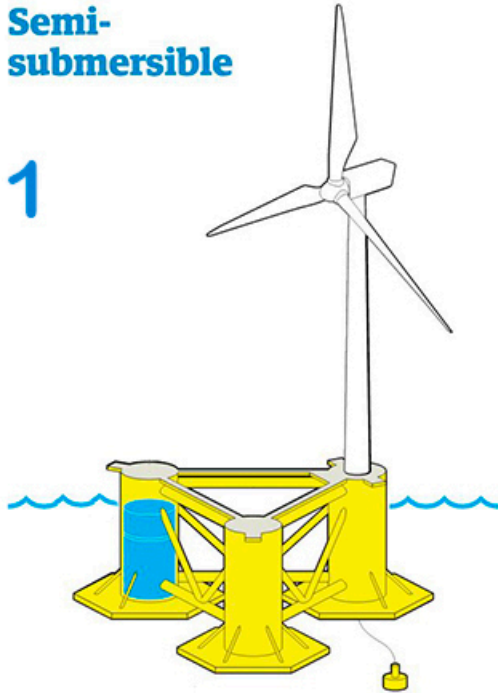
During the visit, the delegates – accompanied by members of the Department for International Trade Brazil – will take part in three days of activities hosted by Durham-based NOF Energy.

<http://www.offshorewind.biz/2018/10/22/petrobras-starts-uk-offshore-wind-tour/>

Sistemas flutuantes de aerogeneradores offshore

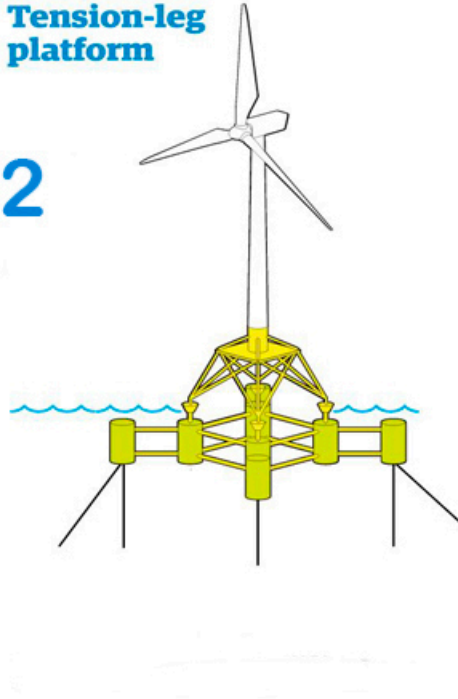
Semi-submersible

1



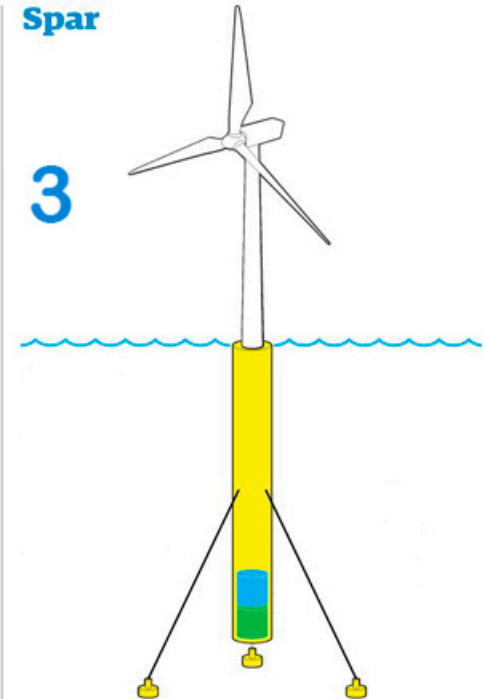
Tension-leg platform

2



Spar

3



Sistemas flutuantes de aerogeneradores offshore



VoltturnUS

[http://en.wikipedia.org/wiki/VoltturnUS_\(floating_wind_turbine\)](http://en.wikipedia.org/wiki/VoltturnUS_(floating_wind_turbine))



WINDFLOAT

<http://www.principlepowerinc.com>

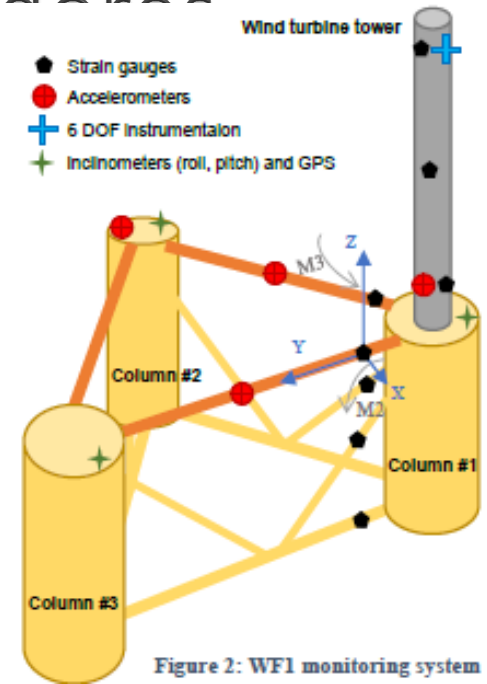
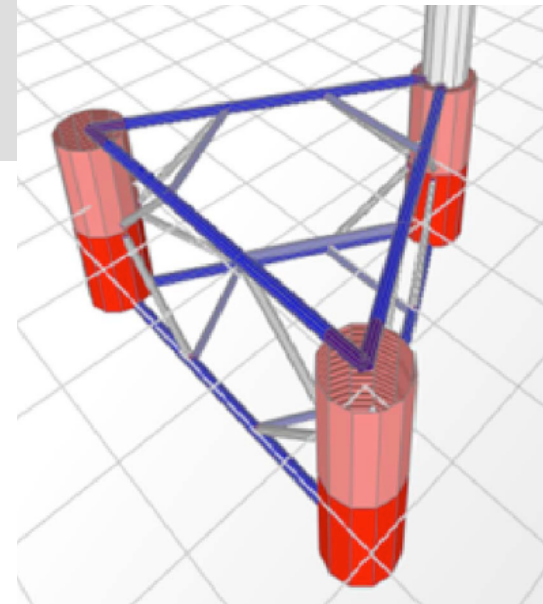


Figure 2: WF1 monitoring system



Sistemas flutuantes de aerogeradores offshore

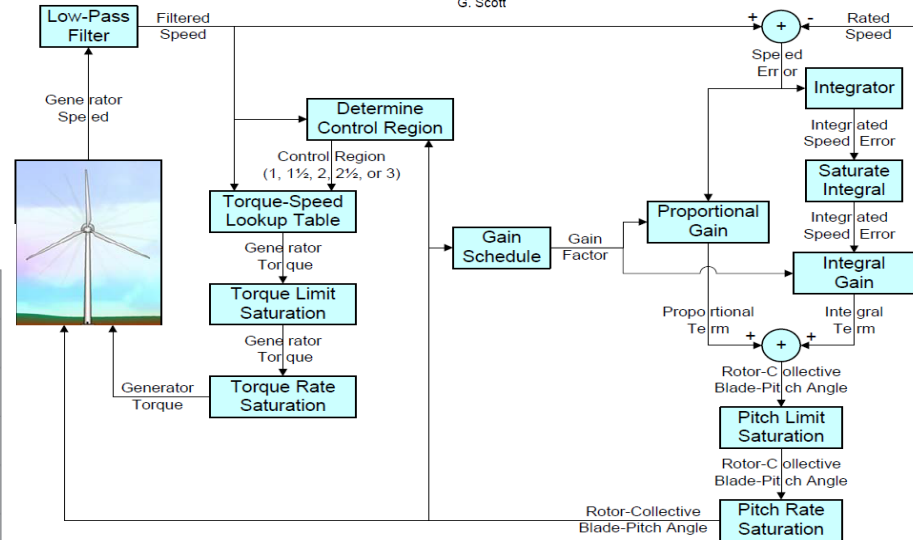


Desafios de projeto do sistema:

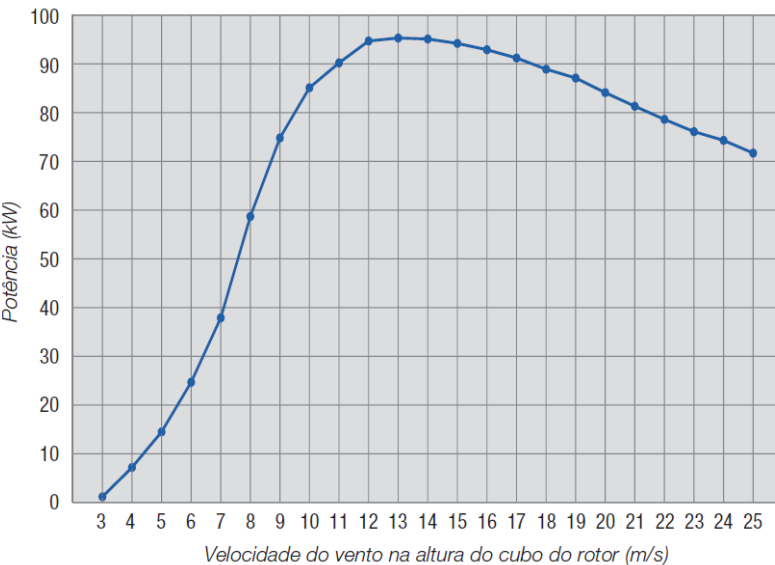
- Controle de pitch das pás.

Definition of a 5-MW Reference Wind Turbine for Offshore System Development

J. Jonkman, S. Butterfield, W. Musial, and G. Scott

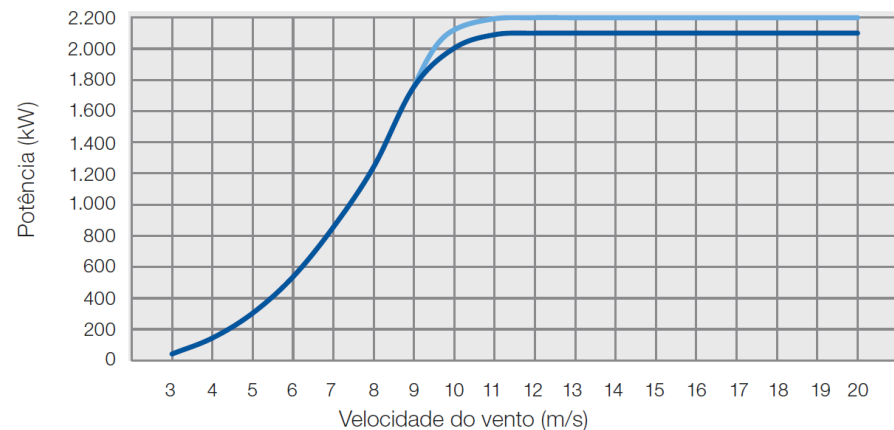


Curva de Potência³



WEG S.A.
www.weg.net

Curva de Potência



Sistemas flutuantes de aerogeradores offshore

Desafios de projeto do sistema:

- Efeito dinâmicos entre Aerogerador e Plataforma
 - Esforços
 - Acelerações
 - Estabilidade
 - Fadiga

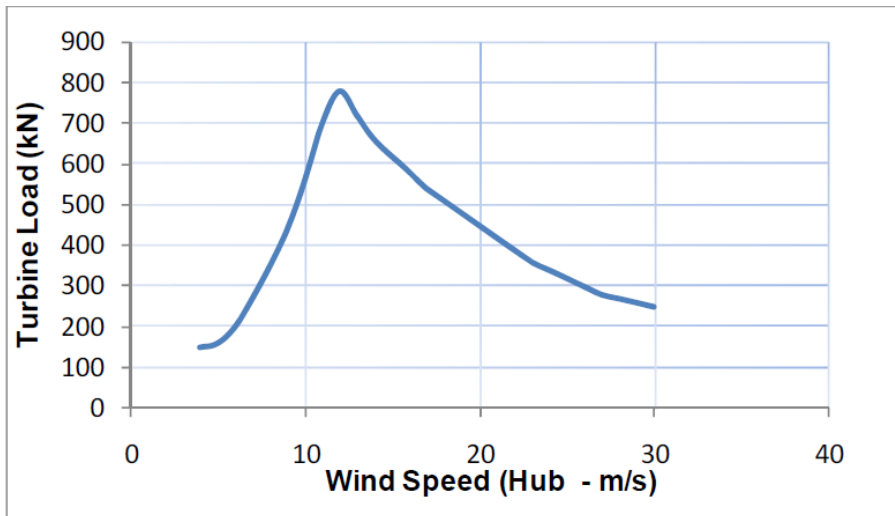


Figure 5: Turbine loading vs. Wind Speed.

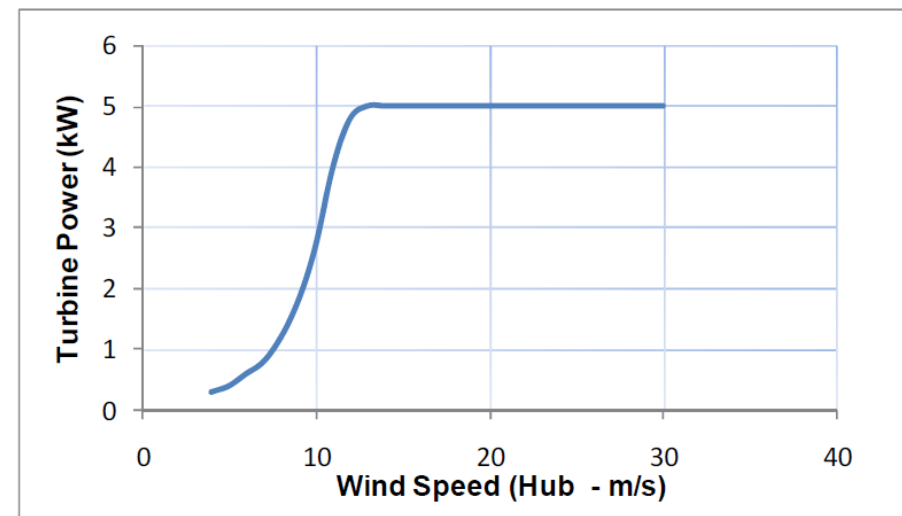
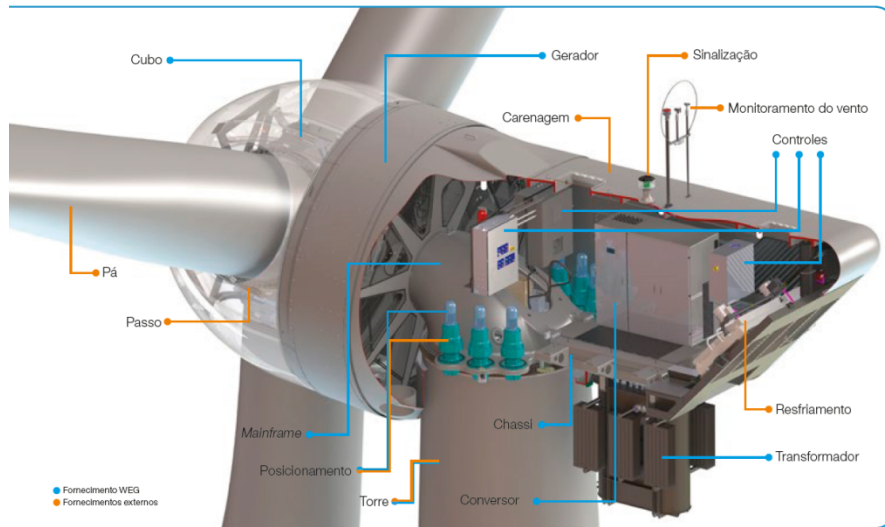


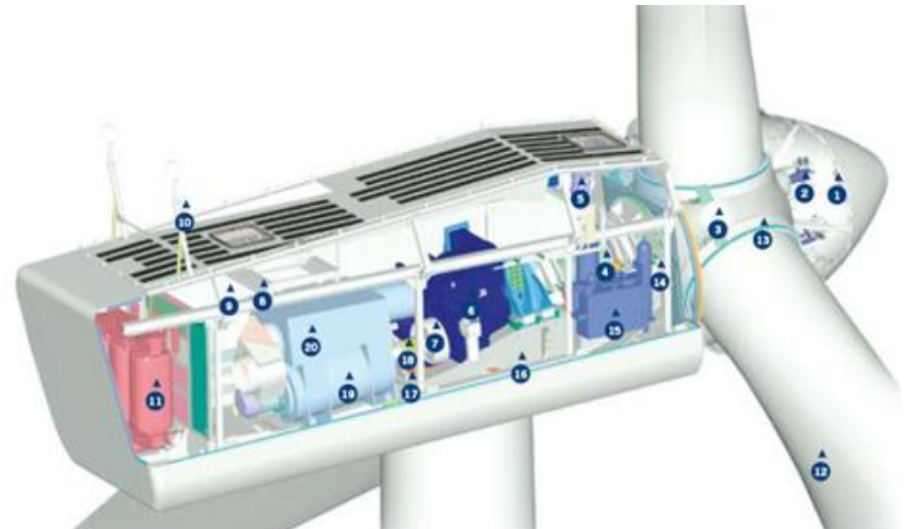
Figure 6: Turbine rated power vs. Wind Speed.

Sistemas flutuantes de aerogeradores offshore

Desafios de projeto do sistema: Disponibilidade de aerogerador para aplicação offshore???



WEG S.A.
www.weg.net



VESTAS
www.vestas.com/

Sistemas flutuantes de aerogeradores offshore

Desafios de projeto do sistema: Transmissão e distribuição de energia para consumo

66kV Floating Substation “Fukushima Kizuna”

turbines will be installed before 2015.

This project will establish the business-model of the floating wind farm and contribute to future commercial projects. The consortium members are also expected to learn know-how of floating offshore wind farm, which will be one of the major export industries in Japan.

The Fukushima FORWARD project believes to help Fukushima to become the center of new industry which will create new employment in this region to recover from the damage of the Great East Japan Earthquake in 2011.



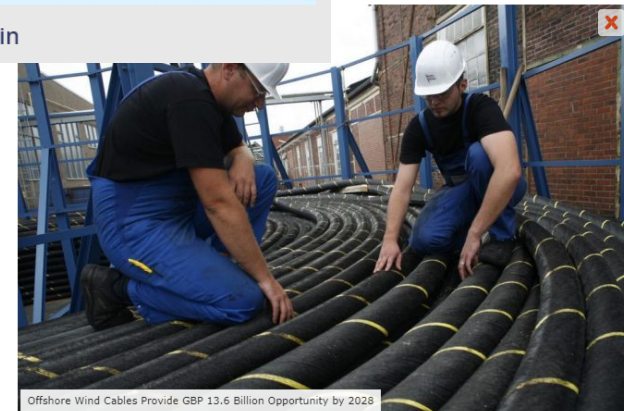
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News by topic

Grid Connection



Nexans Details Borssele 1 & 2 Win



Offshore Wind Cables Provide GBP 13.6 Billion Opportunity by 2028