# 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

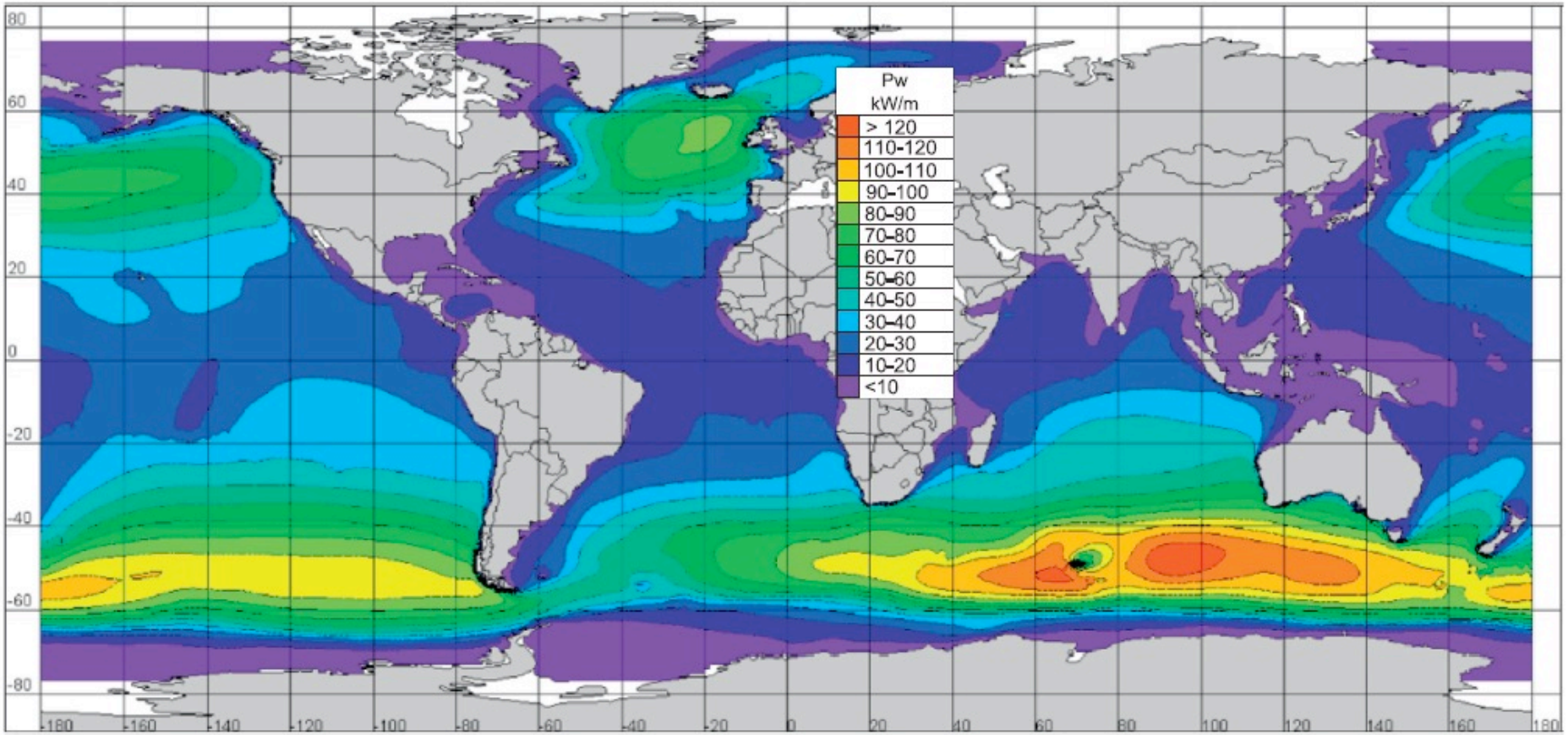
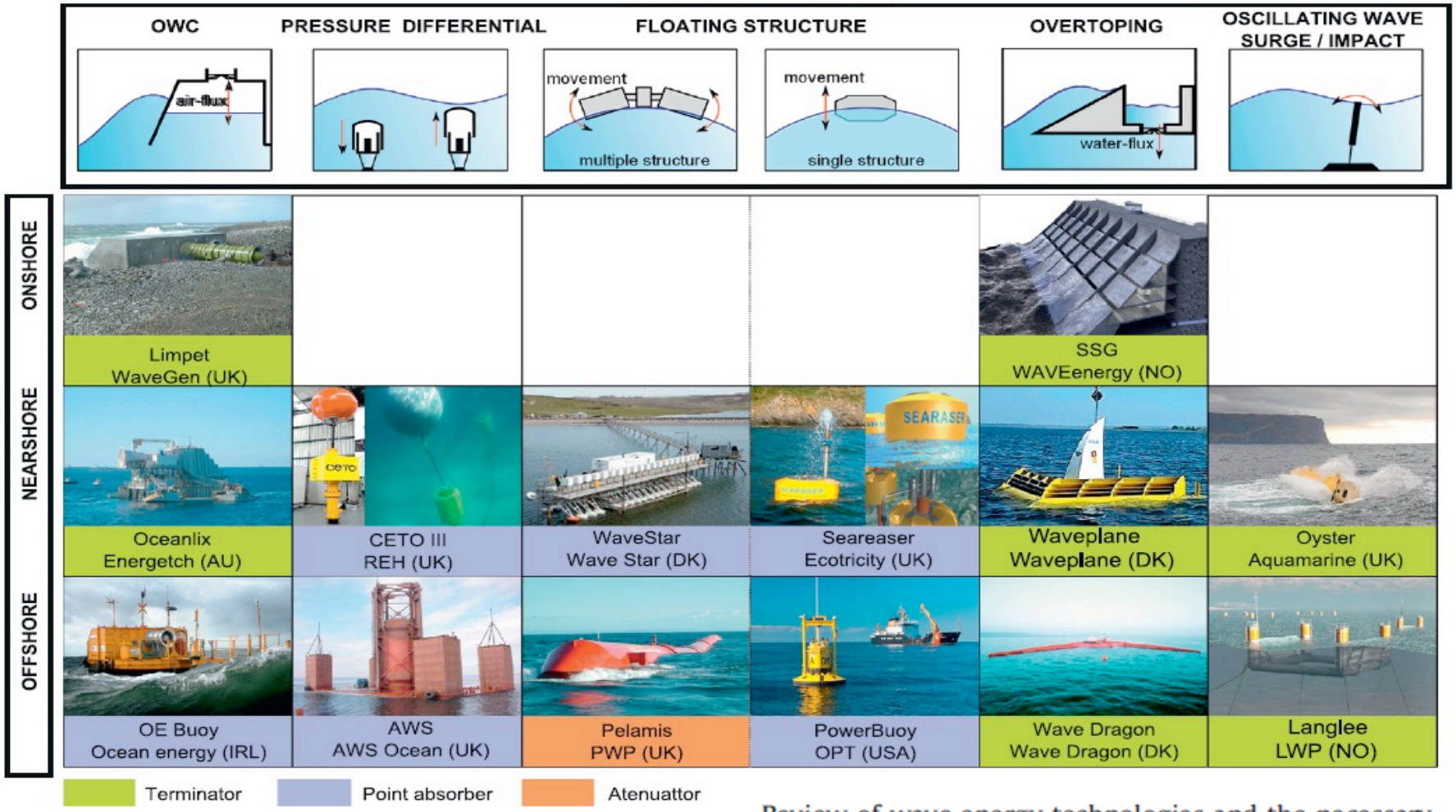



**Fig. 1.** Global annual mean wave power estimation in kW/m spanning 10 years period.

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

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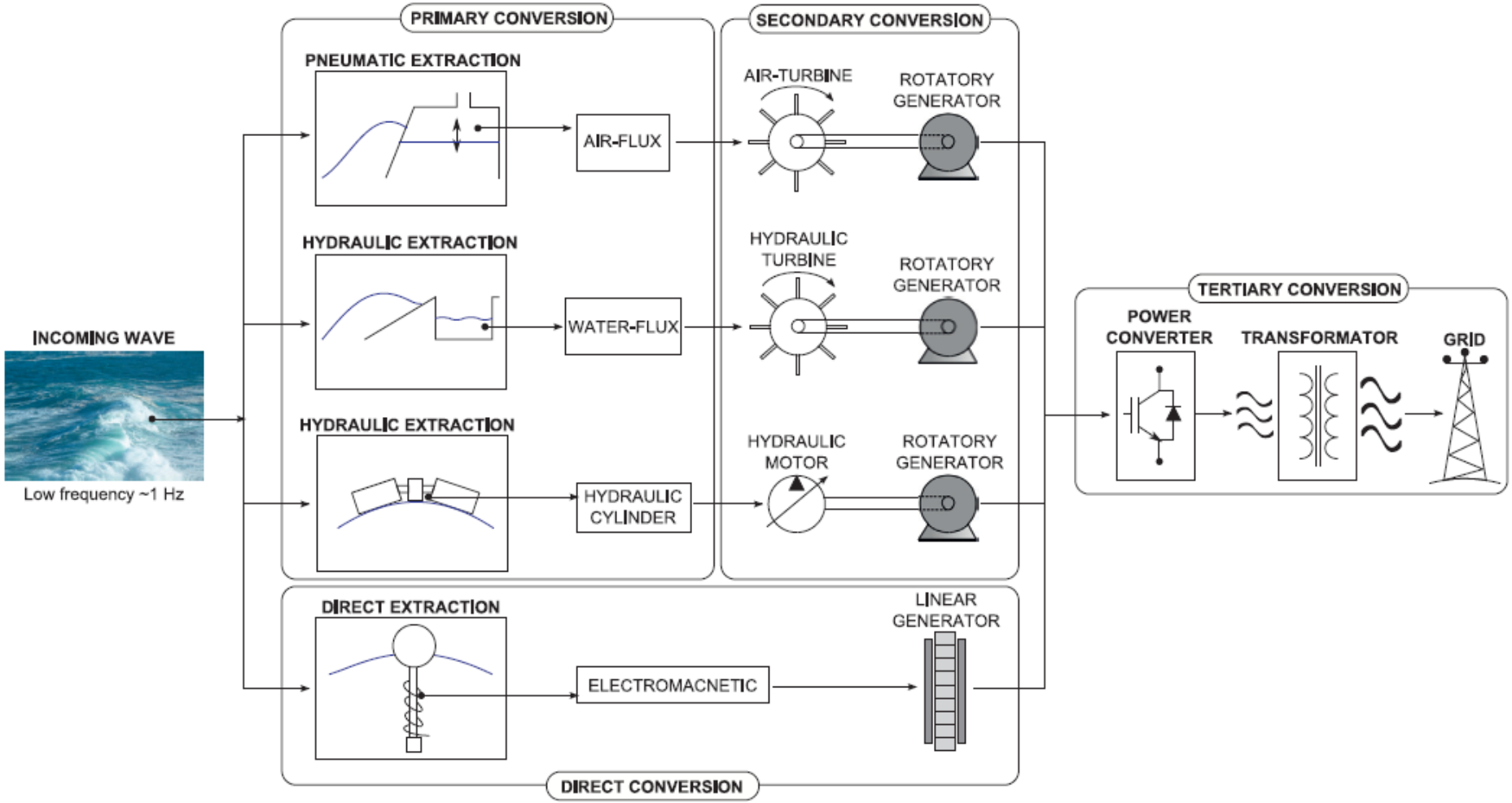
# Princípios de funcionamento




Review of wave energy technologies and the necessary power-equipment

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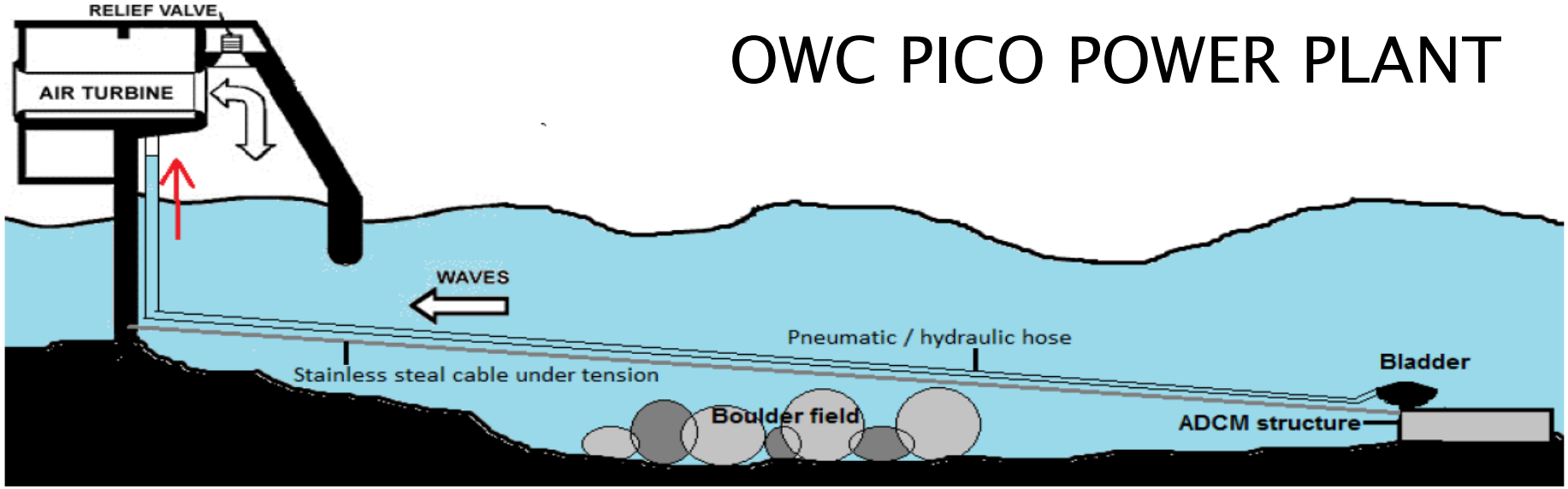
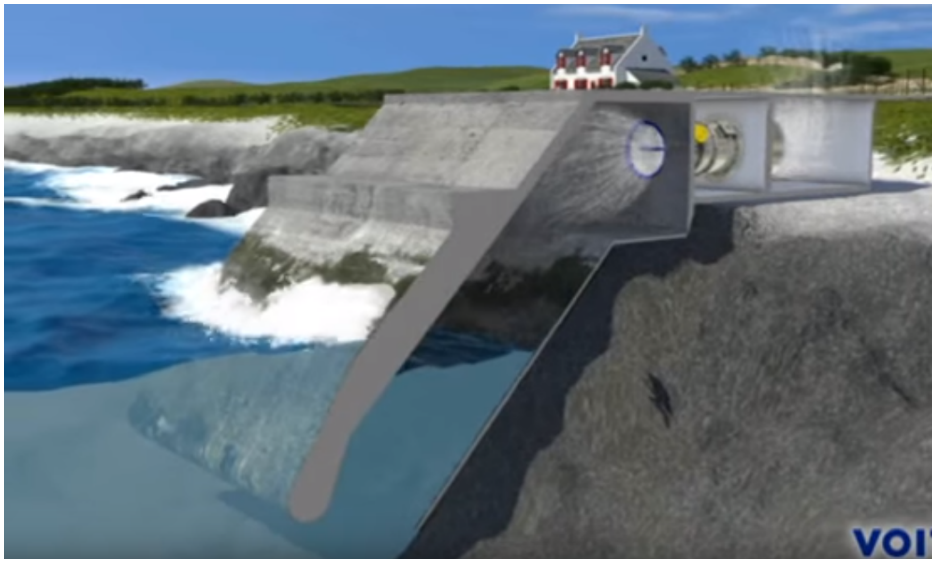
# Sistemas de Coluna Flutuante

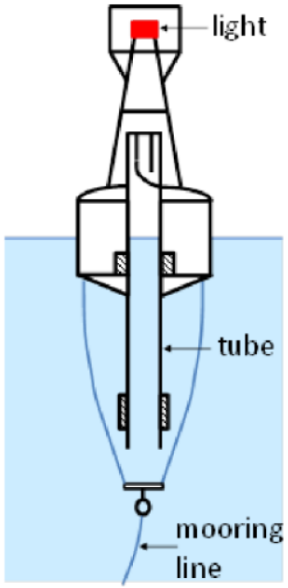
## OWC PICO POWER PLANT

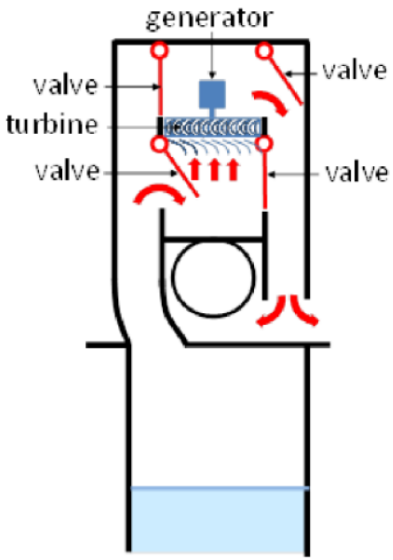


http://www.pico-owc.net/

# Sistemas de Coluna Flutuante




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

| A. F. O. Falcão, Modelling of Wave Energy Conversion, Lisboa: Instituto Superior Técnico, Universidade Técnica de Lisboa, 2014.

# Sistemas de Coluna Flutuante

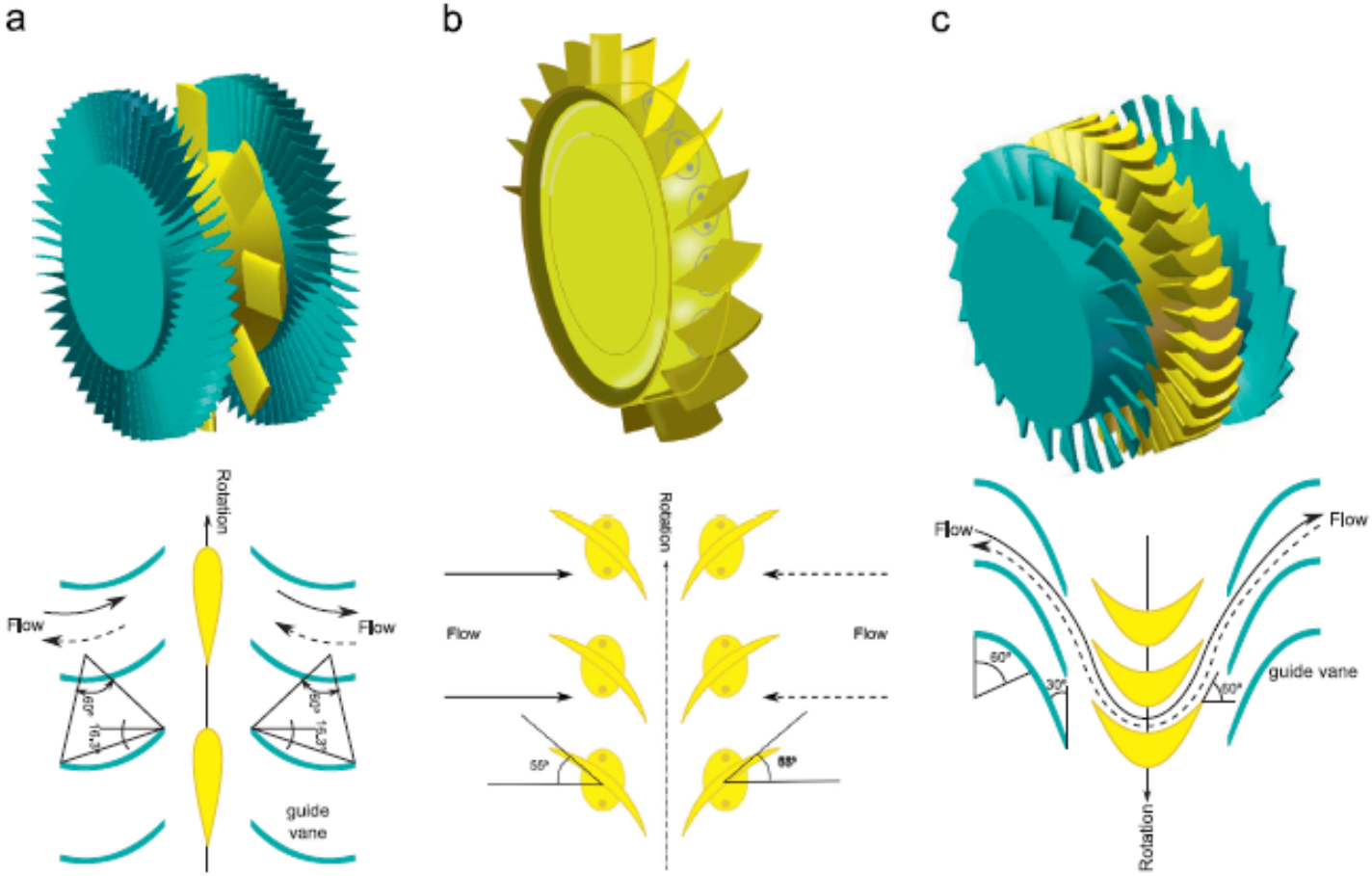



**Fig. 10.** Air turbines for WECs. (a) Wells turbine, (b) Denniss–Auld turbine and (c) impulse turbine.

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# Sistemas de geração de energia

## Coastal support


COPPE, UFRJ
Porto de Pecém, CE
Brazil

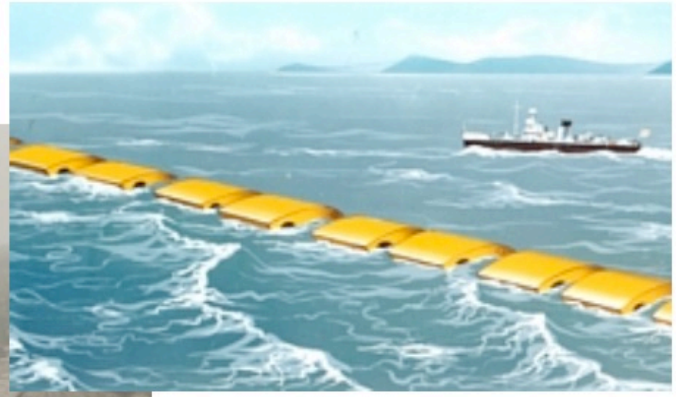
http://www.seahorseenergy.com.br/

# Sistemas de geração de energia

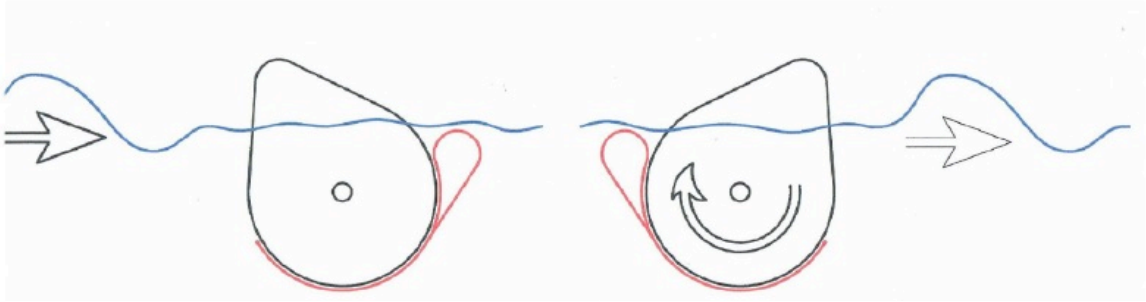
http://www.seahorseenergy.com.br/

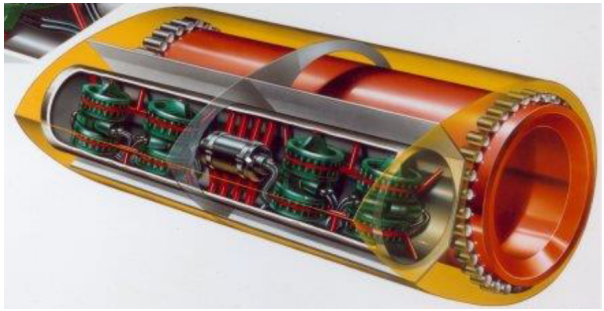
# Sistemas de geração de energia

## The Duck




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





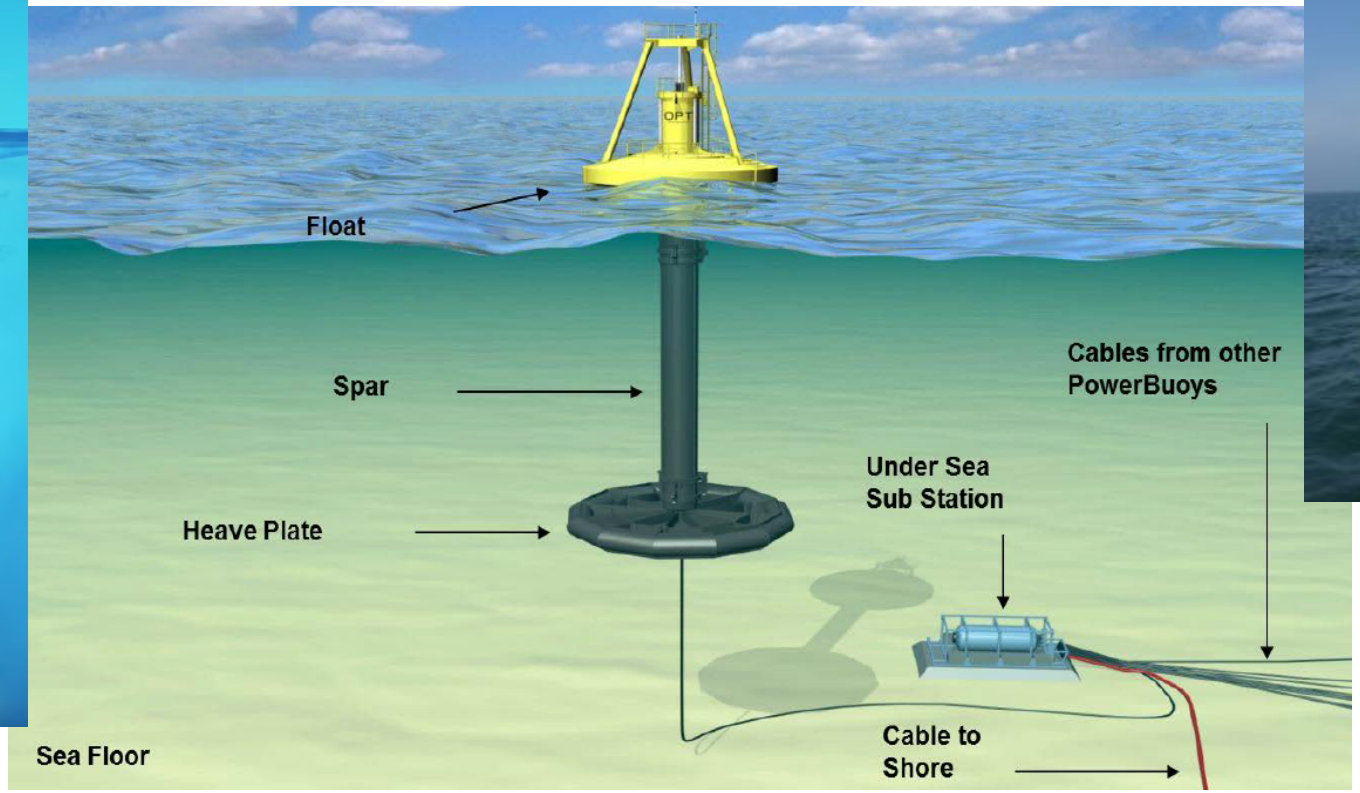
# Sistemas de geração de energia

## Pelamis

www.pelamiswave.com

# Sistemas de geração de energia

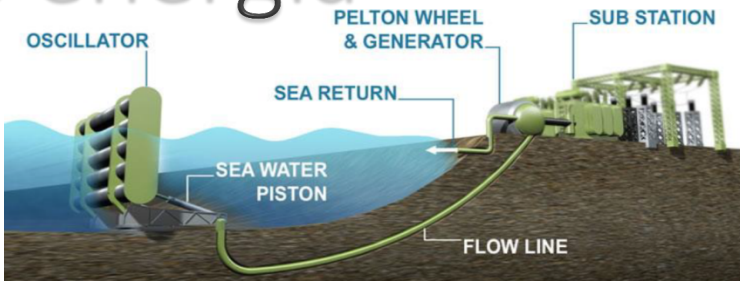
## POWER BUOY



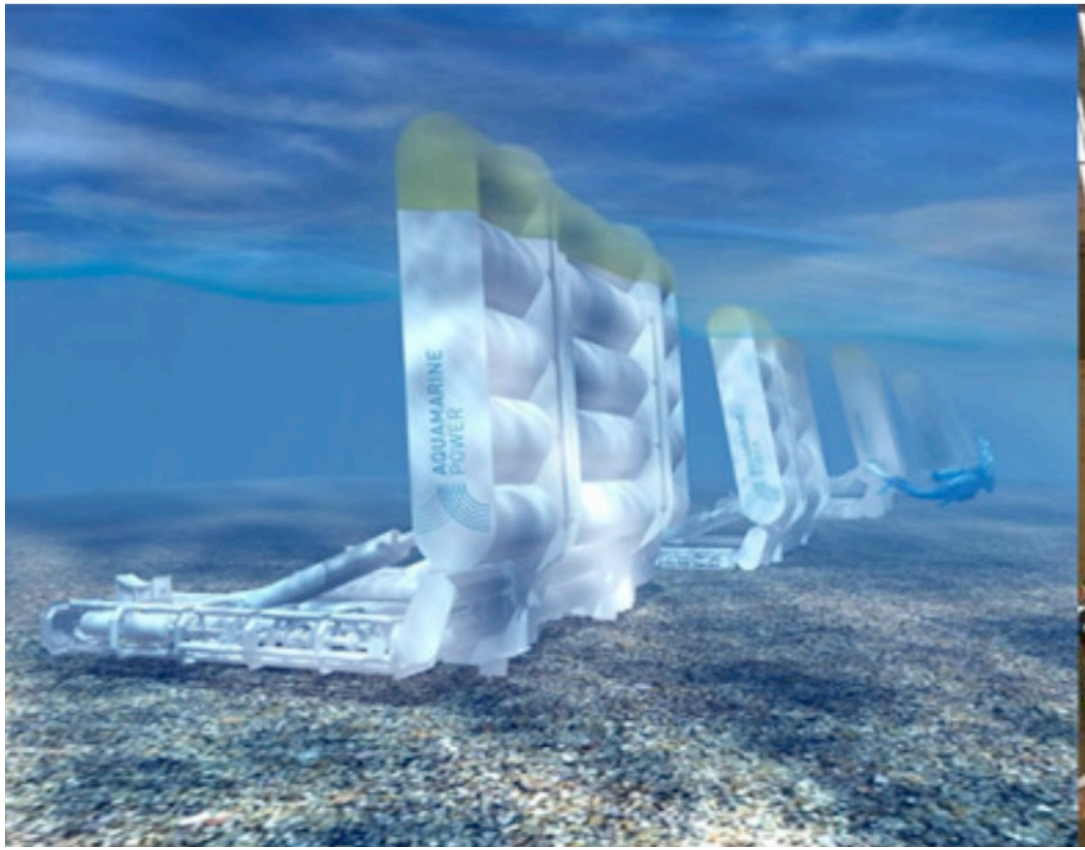

http://www.oceanpowertechnologies.com

# Sistemas de geração de energia

## The Oyster

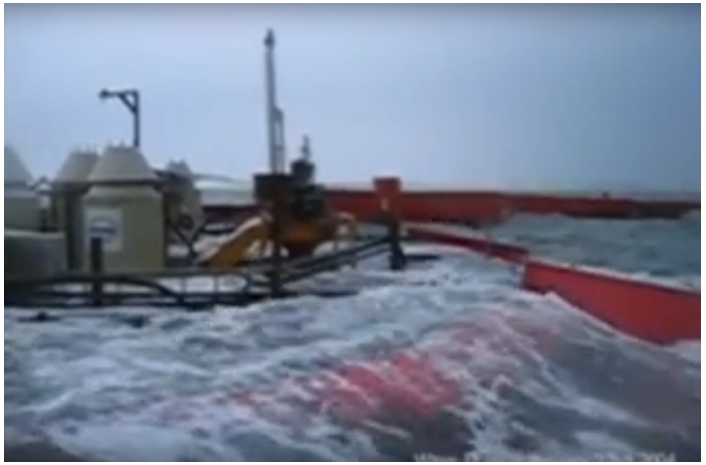


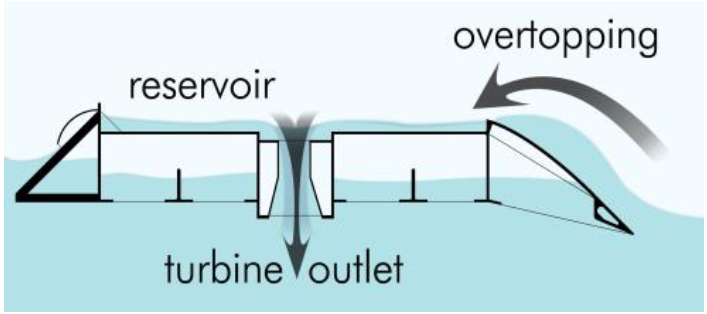

www.aquamarinepower.com

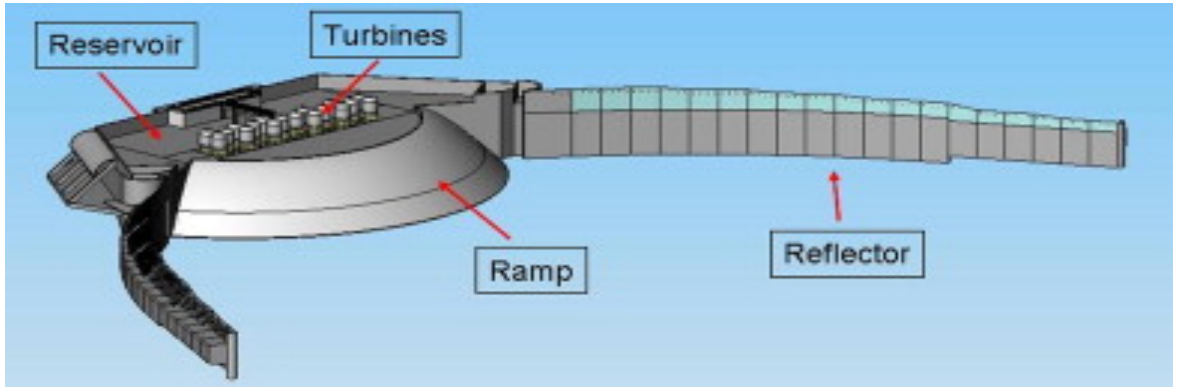



# Sistemas de geração de energia

## WAVE DRAGON



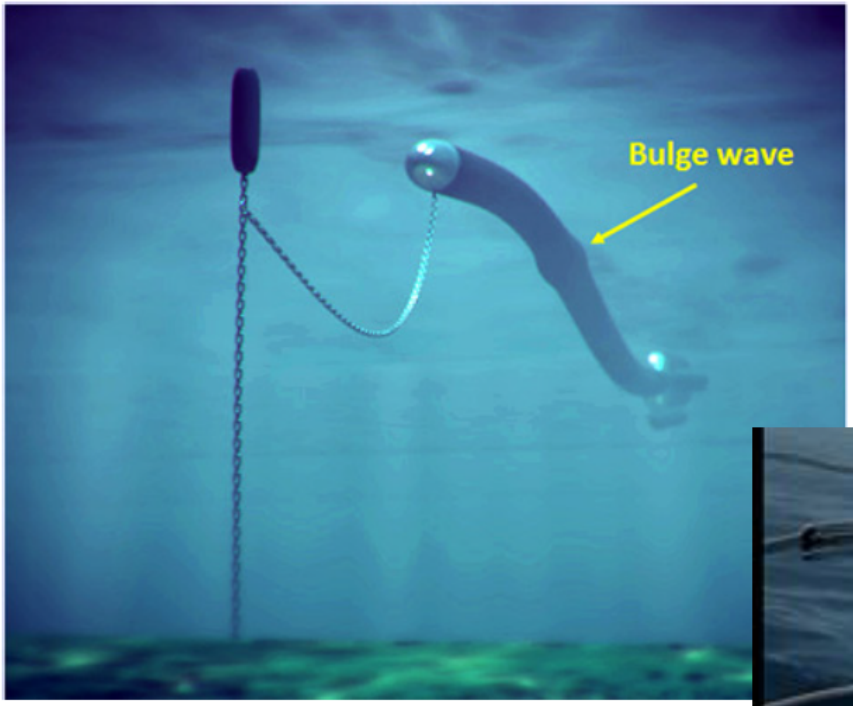


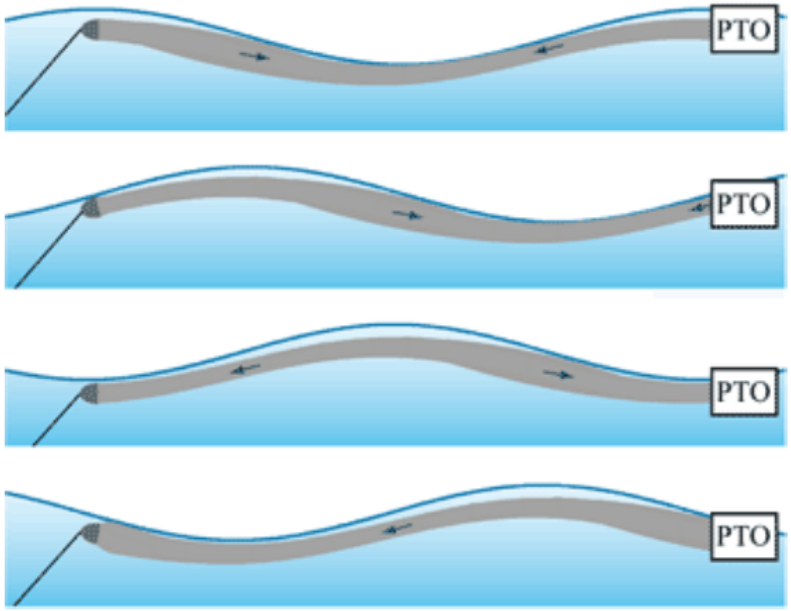



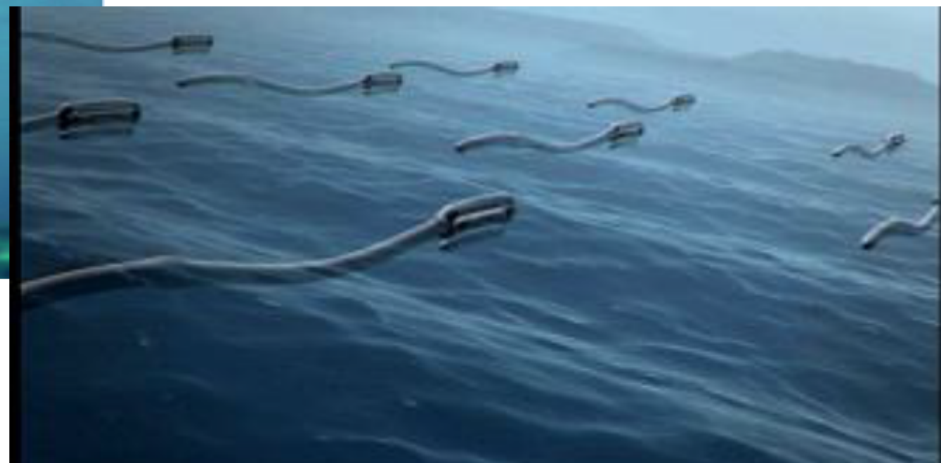

Wavedragon, [Online]. Available: http://www.wavedragon.net/.

# Sistemas de geração de energia

## Anaconda



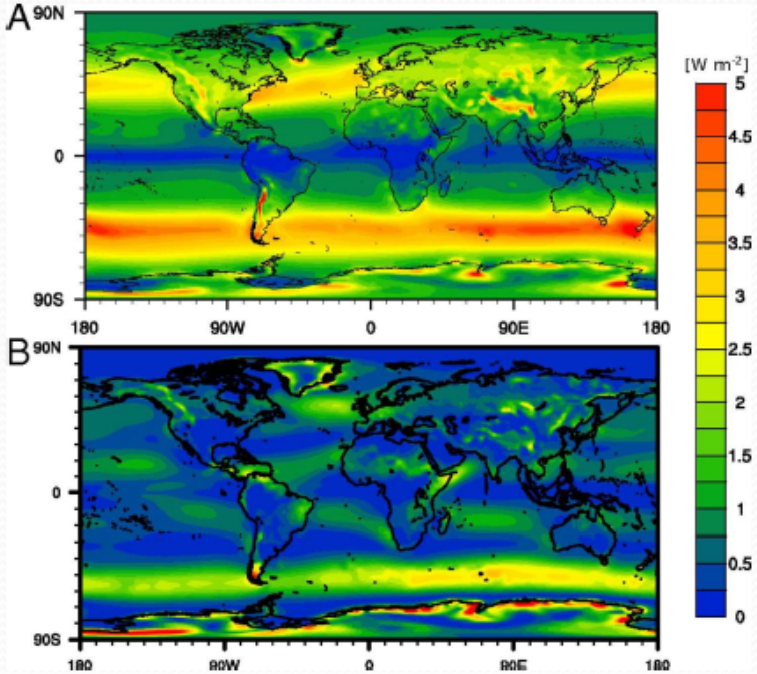



www.checkmateukseaenergy.com

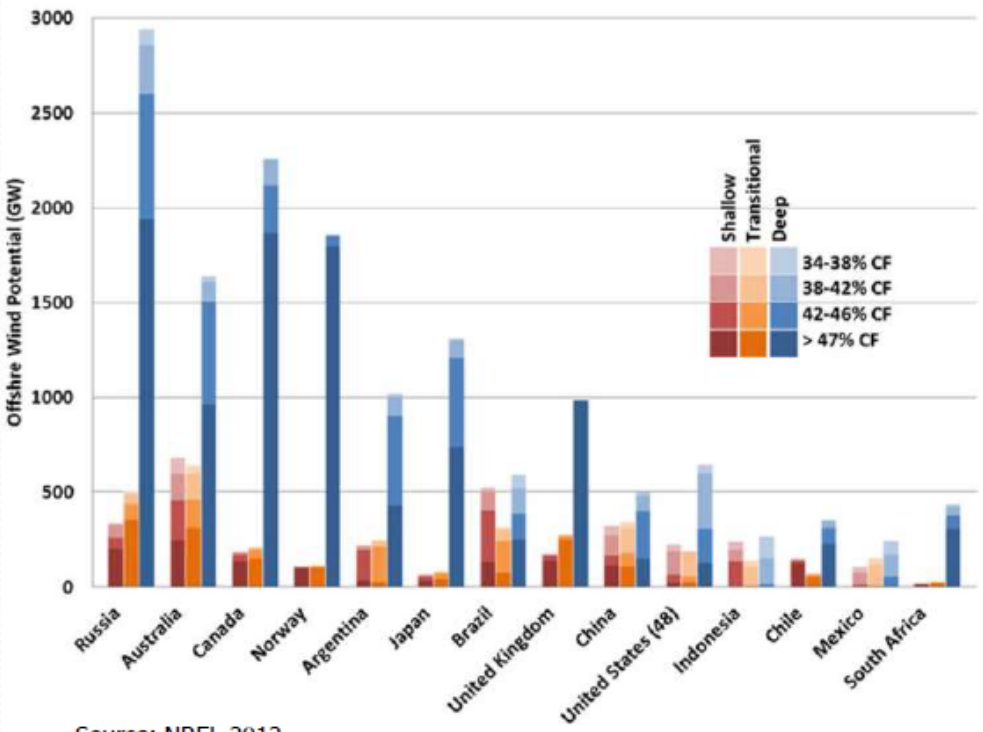
# Sistemas flutuantes de aerogeradores offshore


# Sistemas flutuantes de aerogeradores offshore

## Global Offshore Wind Kinetic Energy




Source: Possner & Caldera [PNAS] 2017




Source: NREL 2012

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

Shallow 0-30 m Transition 30-60 m
Deep > 60 m CF = Capacity Factor

Dr. C. R. Golightly GO-ELS Ltd. – Anchoring for Floating Wind Turbines
Future Offshore Foundations, Brussels, 8th November 2017

# 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

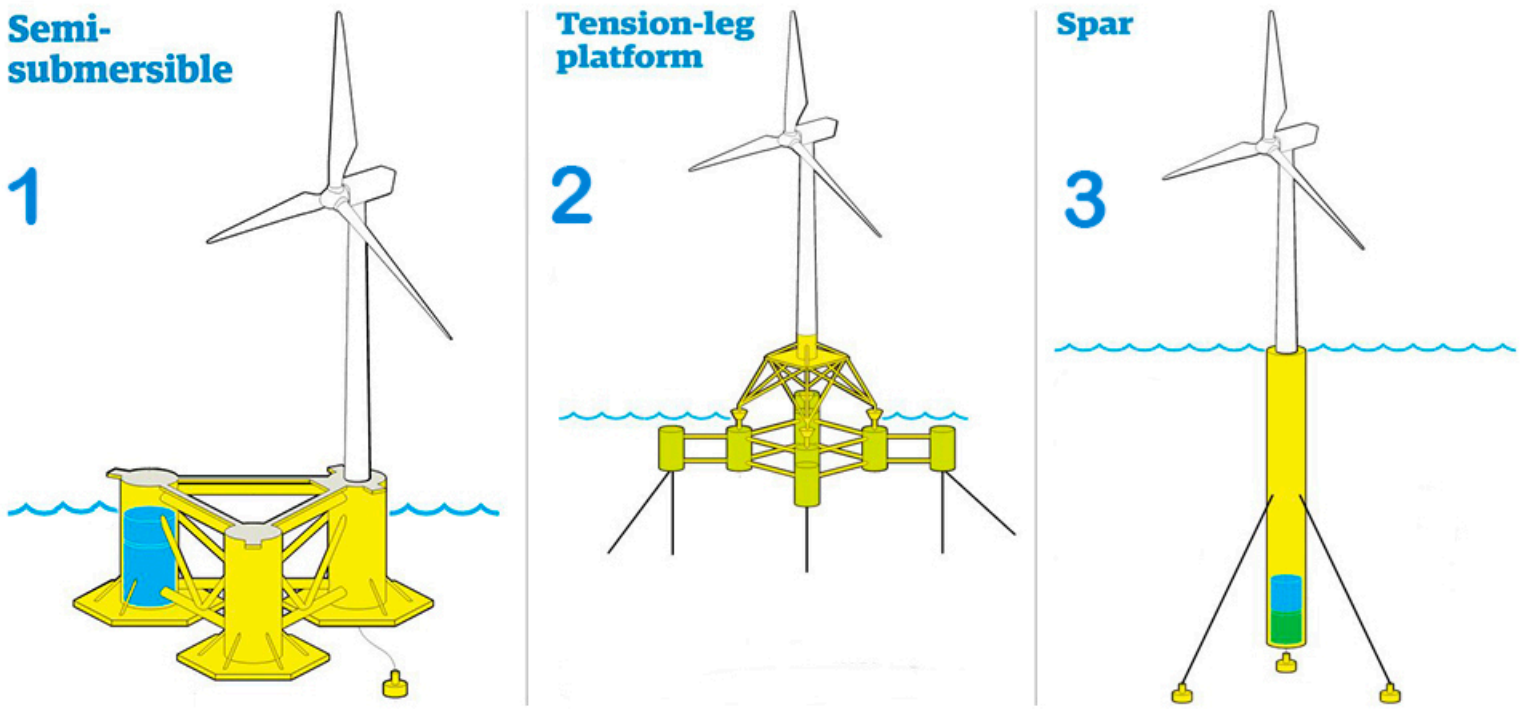
## Petrobras Starts UK Offshore Wind Tour

**A delegation from the Brazilian multi-national 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.

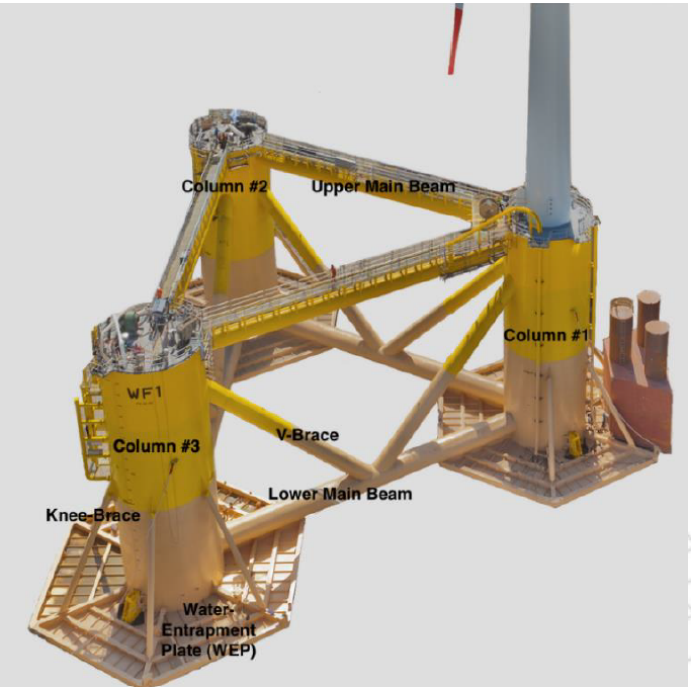
http://www.offshorewind.biz/2018/10/22/petrobras-starts-uk-offshore-wind-tour/

# Sistemas flutuantes de aerogeradores offshore



# Sistemas flutuantes de aerogeradores offshore

VolturnUS
http://en.wikipedia.org/wiki/VolturnUS_(floating_wind_turbine)




WINDFLOAT
http://www.principlepowerinc.com

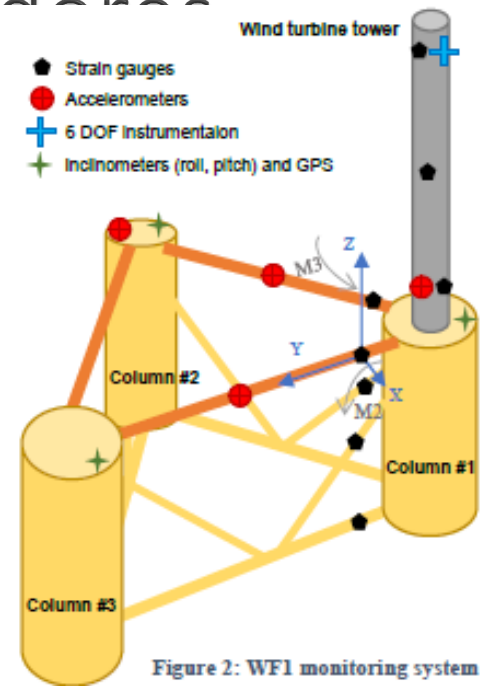
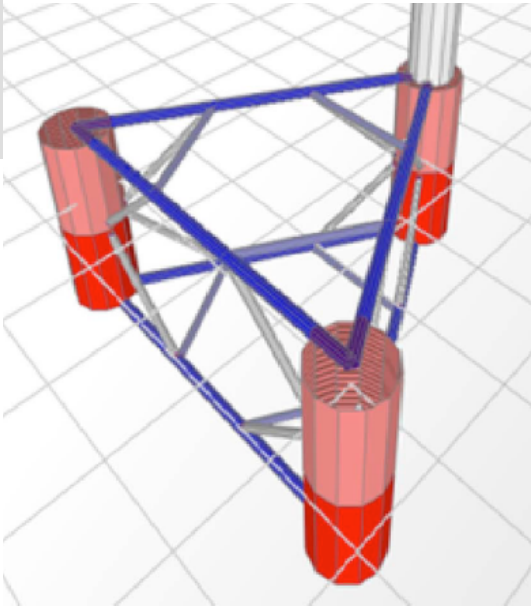


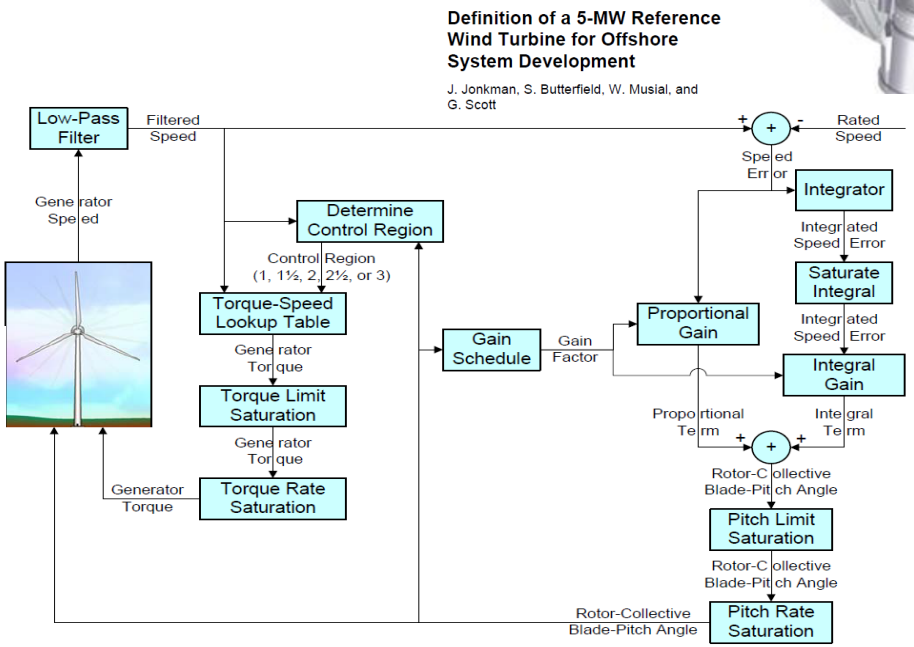

Figure 2: WF1 monitoring system



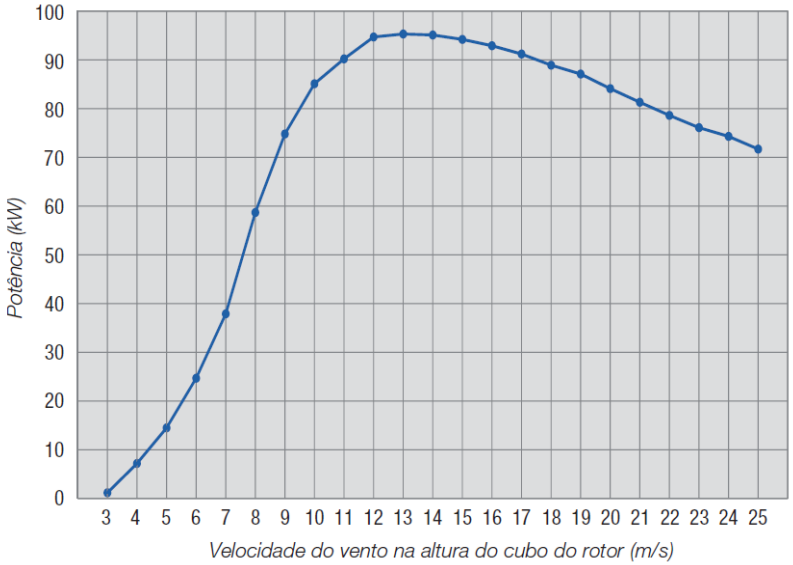
# Sistemas flutuantes de aerogeradores offshore

Desafios de projeto do sistema:

- Controle de pitch das pás.

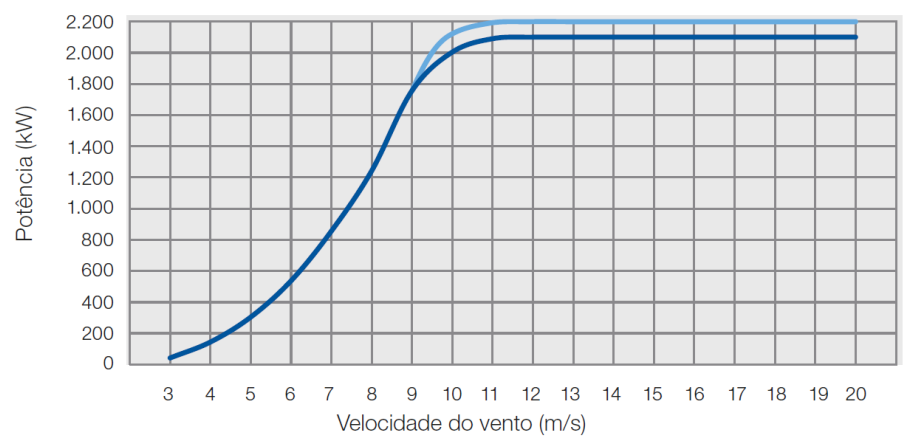



**Curva de Potência** [3]




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

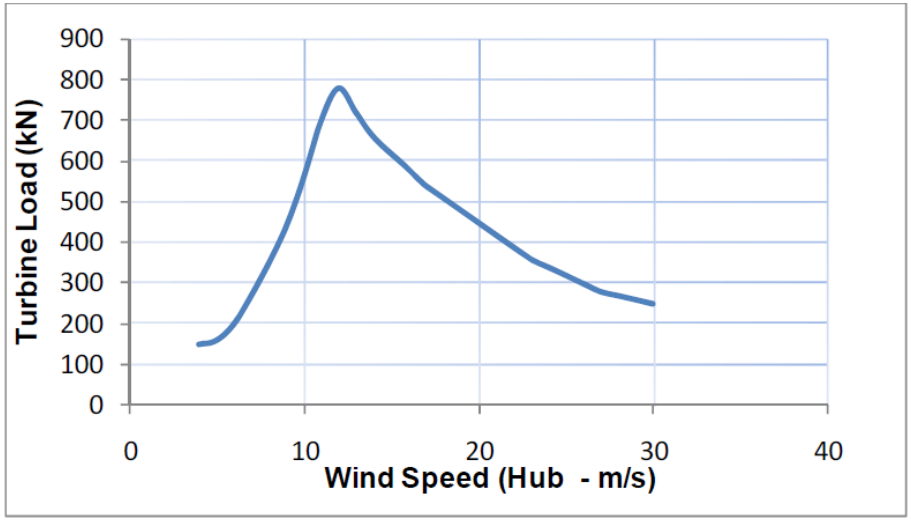



**Figure 5**: Turbine loading vs. Wind Speed.

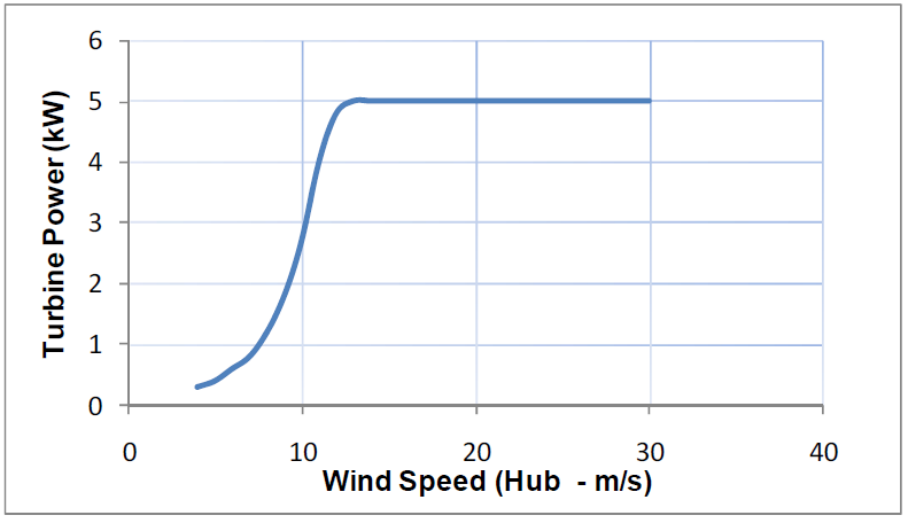
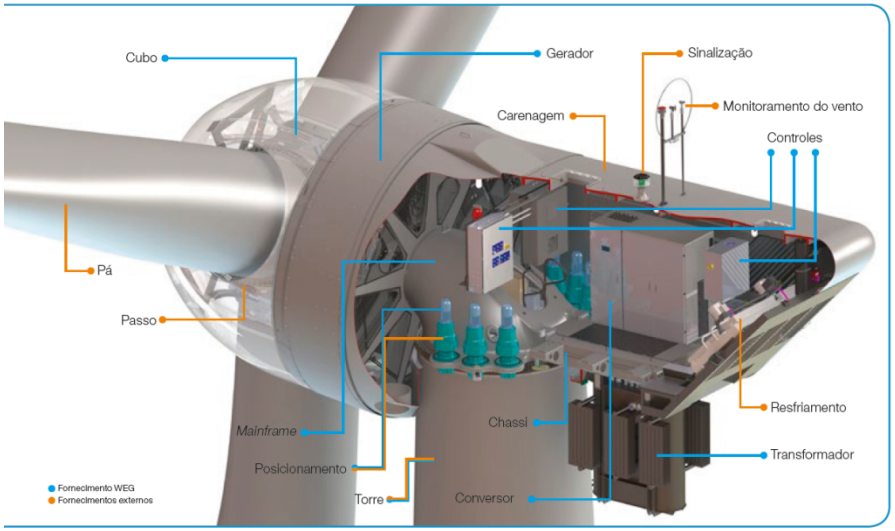



**Figure 6**: Turbine rated power vs. Wind Speed.

# Sistemas flutuantes de aerogeradores offshore

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

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VESTAS
www.vestas.com/

# Sistemas flutuantes de aerogeradores offshore

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