PECC Noumea Seminar

Energy transition: A challenging perspective for the Pacific Islands and Coastal Areas

Noumea 26-28 November 2014

Renewable Energy in the Pacific Islands
An overview of available technologies

Henri Boyé

French Ministry of Ecology, Sustainable Development and Energy

Energetic transition

European Community commitments declined in 2020 ... ambitious national targets

20% reduction of GHG emissions
23% renewable energy
20% energy efficiency

A long-term commitment: the "factor 4"
A indicative European "roadmap" :
minus 40% GHG by 2030
minus 60% in 2040

Pacific islands

Islands Facing significant challenges

Dependence on oil

Missing interconnections

Islands as an opportunity for demonstrating energy solutions

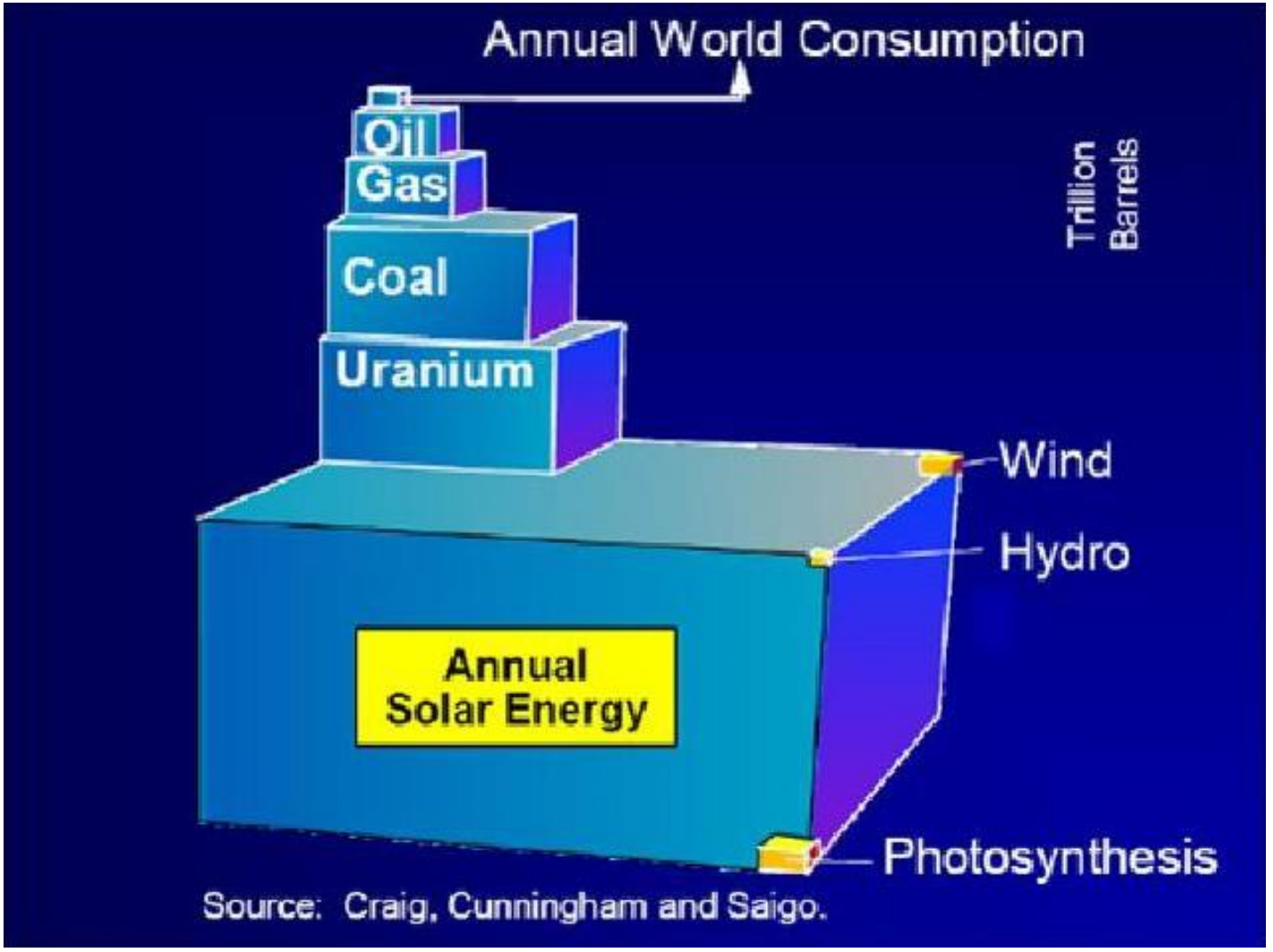
Towards an island action plan 2020-2030

Improve security of supply through diversified power generation technologies

Use islands as a priority test-bed, for innovative technologies, such as RES, storage, smart grids.

Foster R&D on islands,

Annual Solar Energy



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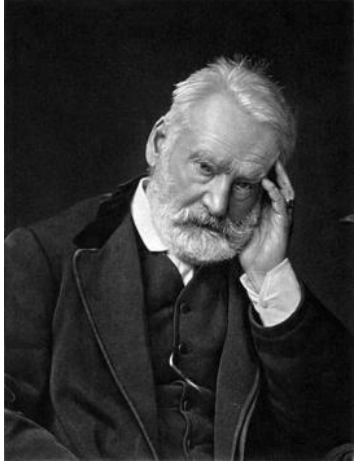
Earth is mostly ocean

Marine Energies



19th century Victor Hugo

"Use nature, this huge scorned auxiliary. Think of
the movement of waves, the ebb and flow, the comings and goings of tides.
What is the ocean? a huge lost force.
How the earth is stupid! not to use the ocean!
Victor Hugo, Quatre-vingt-treize, 1874

Jules Verne

"... I could, in fact, have established a circuit between wires immersed at different depths to generate electricity by the diversity of temperatures they experienced ..."
Jules Verne. 20000 Lieues sous les Mers, 1869
www.clubdesargonautes.org/energie/thermique.php

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The marine renewable energy innovation policies

State of the art in tidal energy, wave energy and floating windmills

Few mature technologies,
a large number of concepts at disparate stages of development

Case study of the hydrokinetic and tidal current public project in France, compared to UK development strategy.

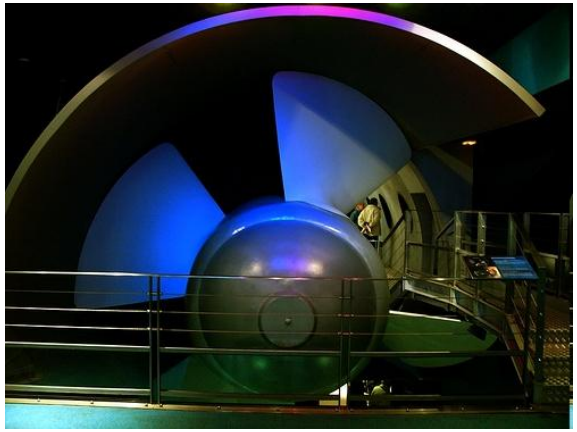
What are the main criteria for the regulator and the government?
Risks, barriers and opportunities;
Financial mechanisms for R&D.

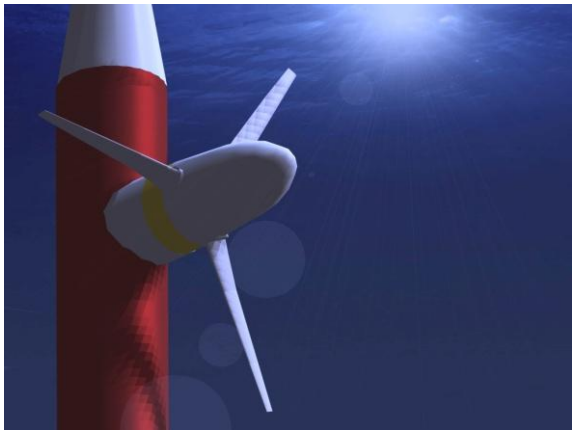
Some examples of public aids for a good cooperation and innovation development, incentives, public grants and feed-in tariffs, France Energies Marines, EMACOP…

Natural resource and Marine energy

Marine energy resources: a major challenge for the XXI century?

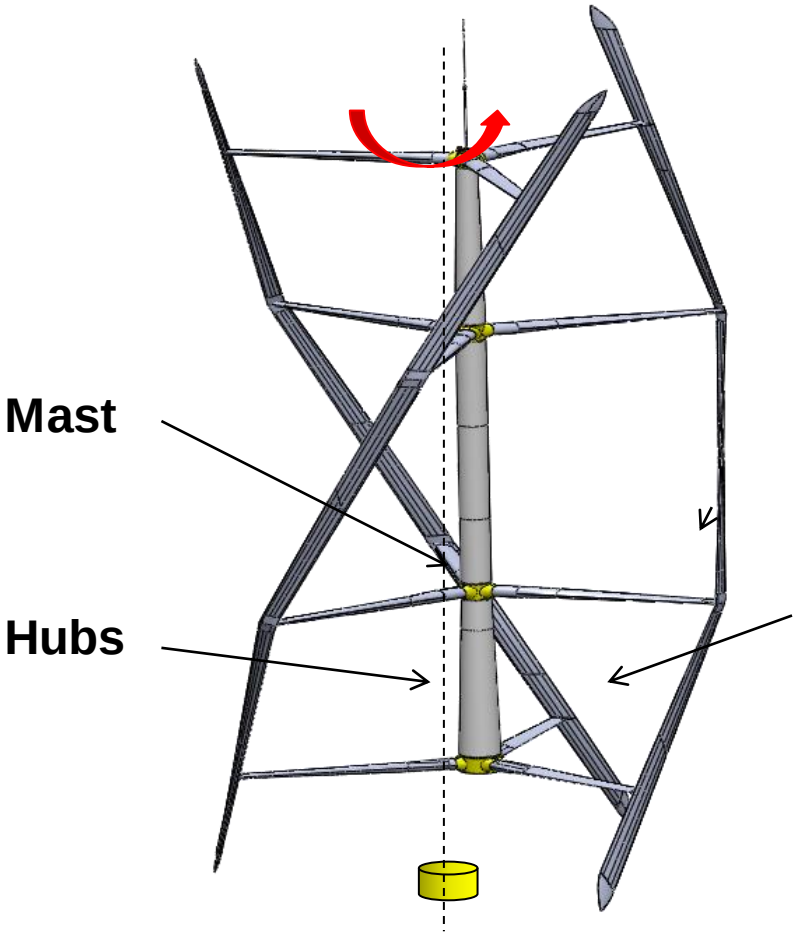
- Ocean accumulates thermal energy, and returns it in many forms
- Kinetic energy, potential energy, chemical energy, thermal energy ...
- Many types of marine energy
- Wind
- Waves and swell
- Currents
- thermal energy
- osmotic power



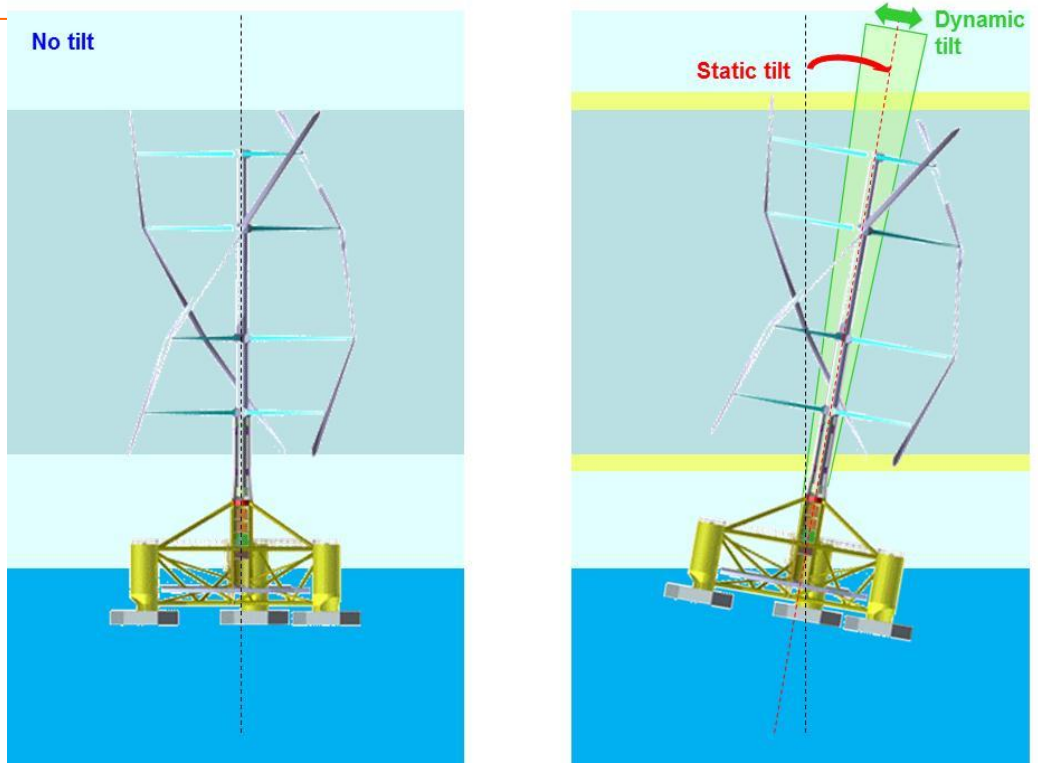


The Wind Floating windmill vertical axis

Nenuphar Wind Vertimed Project



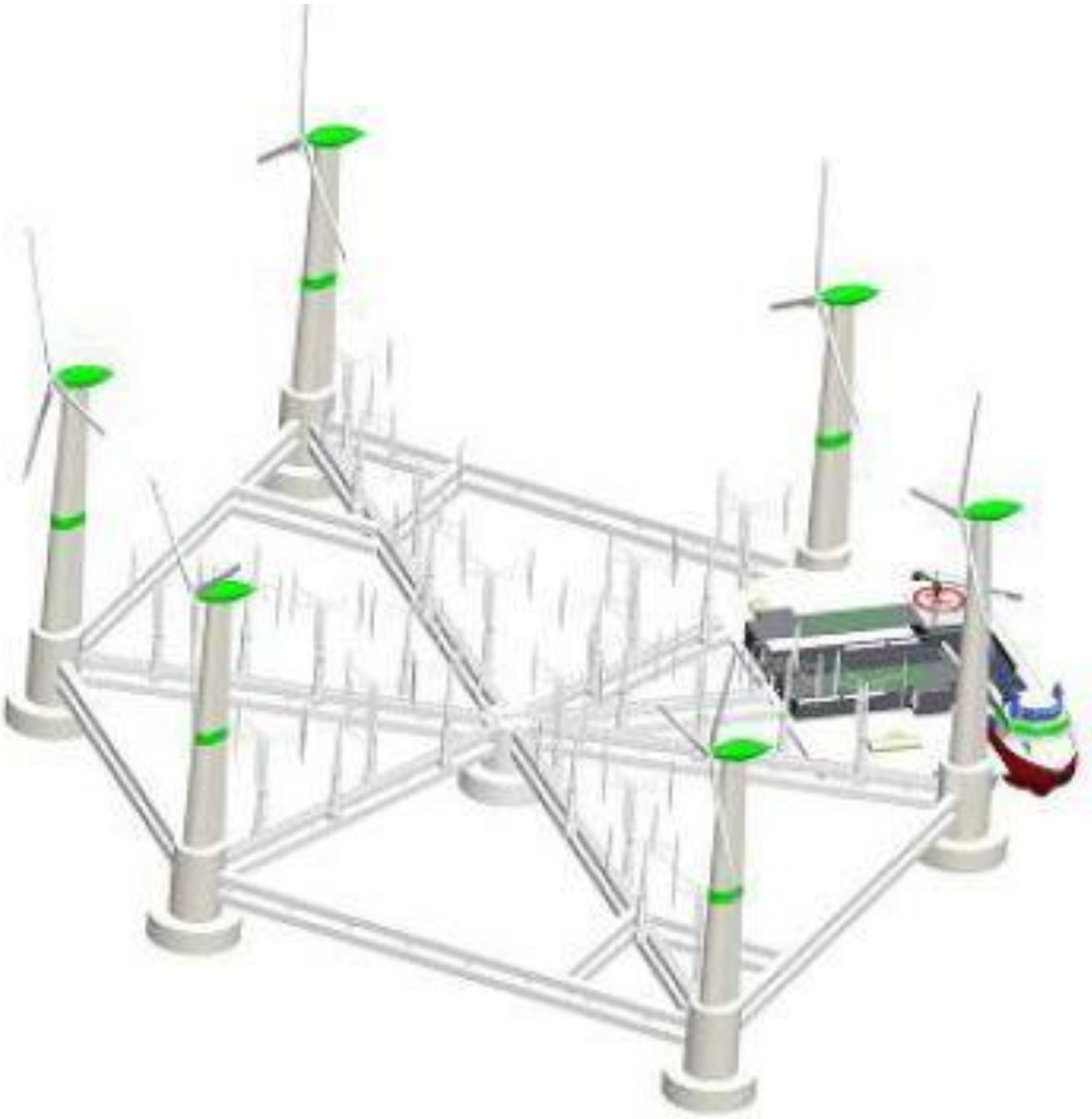
A wind turbine that can operate inclined



Winner European NER 300 funding

Other Wind floating Project IDEOL GAMESA DCNS Tested on the site SEM-REV Croisic in 2015

Floating offshore wind Malta



Floating deep offshore wind farm concept, Malta

Wave Energy

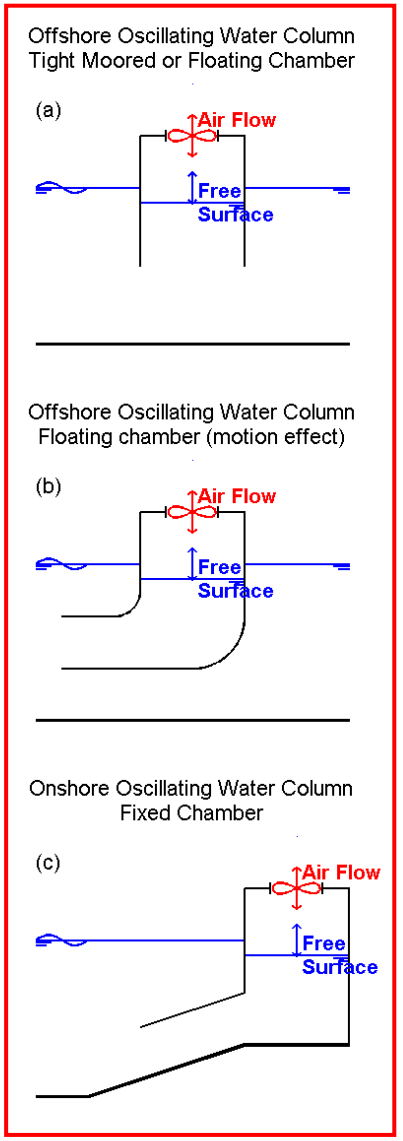
Wave energy modern technology

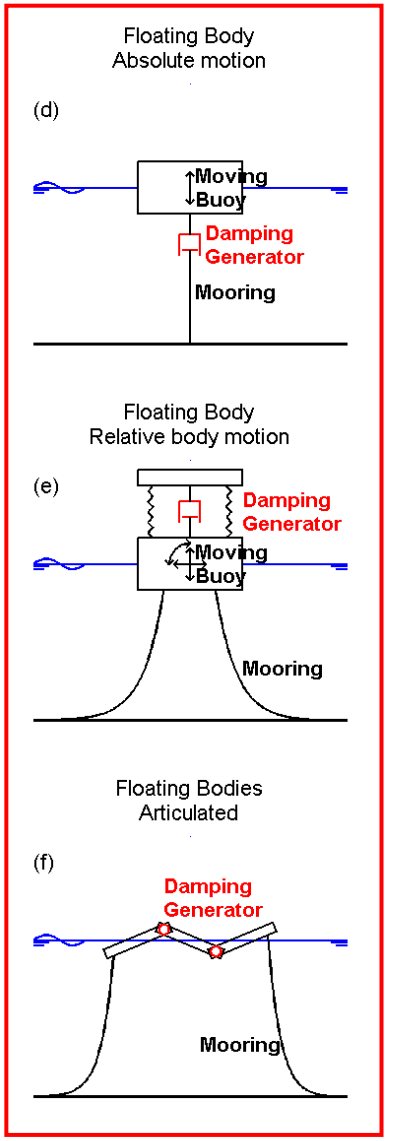
- Wave power devices are generally categorized by the method used to capture the energy of the waves, by location and by the power take-off system.
- Method types are point absorber or buoy ; surfacing following or attenuator oriented parallel to the direction of wave propagation ; terminator, oriented perpendicular to the direction of wave propagation ; oscillating water column ; and overtopping.
- Locations are shoreline, nearshore and offshore.
- Types of power take-off include : hydraulic ram, elastomeric hose pump, pump-to-shore, hydroelectric turbine, air turbine, and linear electrical generators.
- **There are hundreds of patents !!**

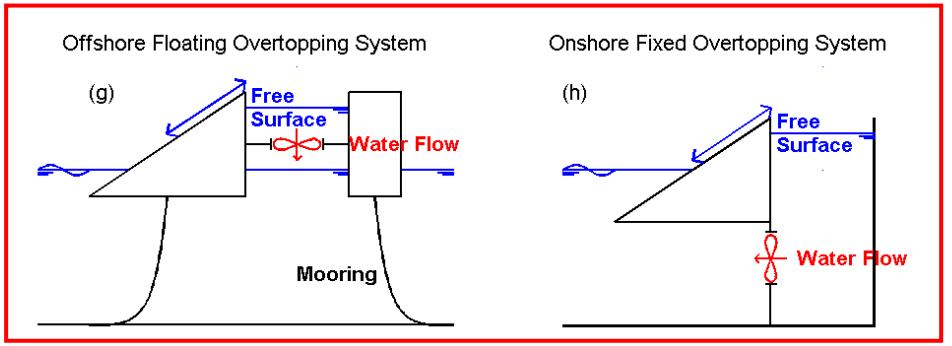
Wave energy

The basic principles of wave energy capture are :

- oscillating water columns
- moving bodies
- overtopping systems
- other (membranes,…)



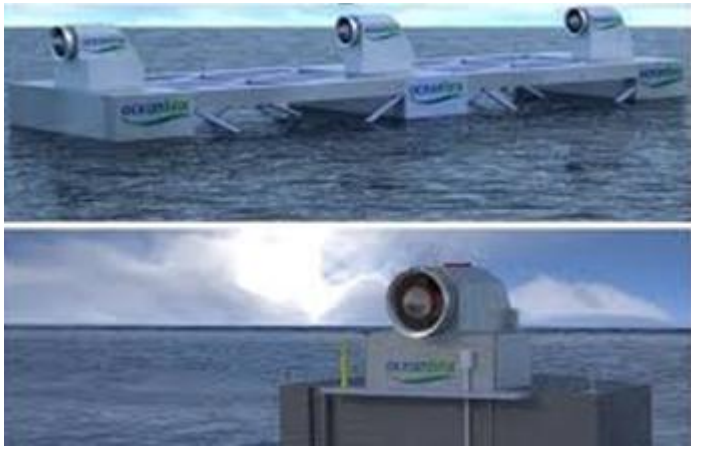




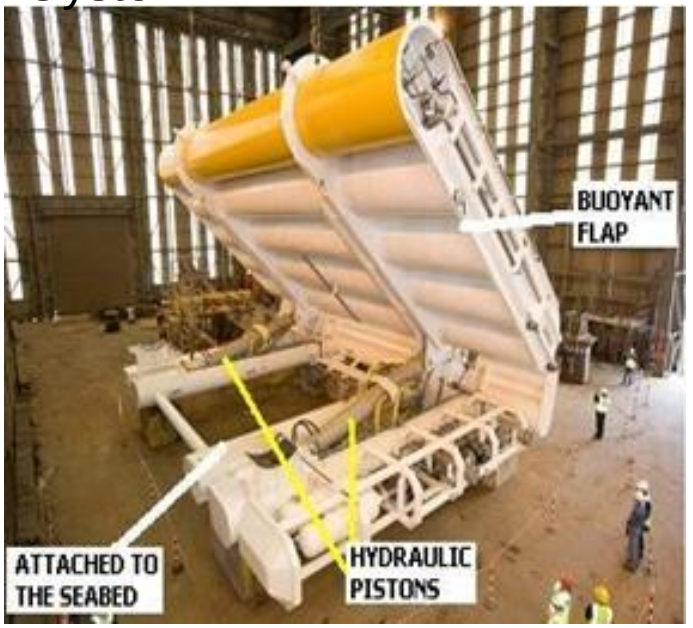
Wave energy converter (WEC)

Pelamis

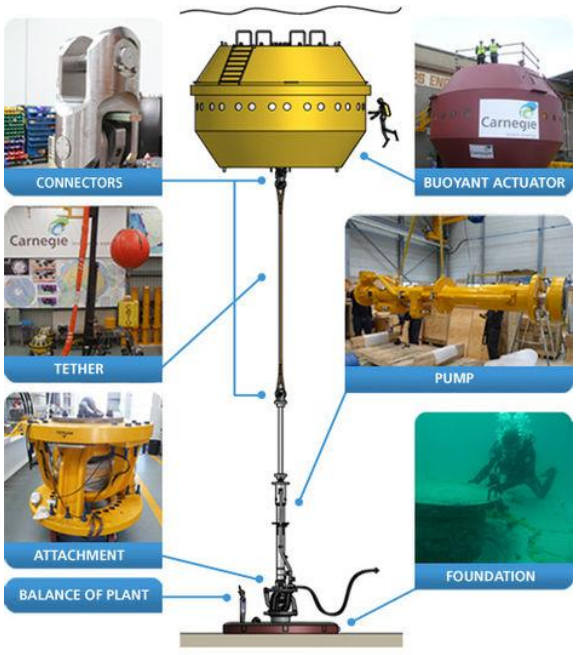
OWC OceanLink



Oyster



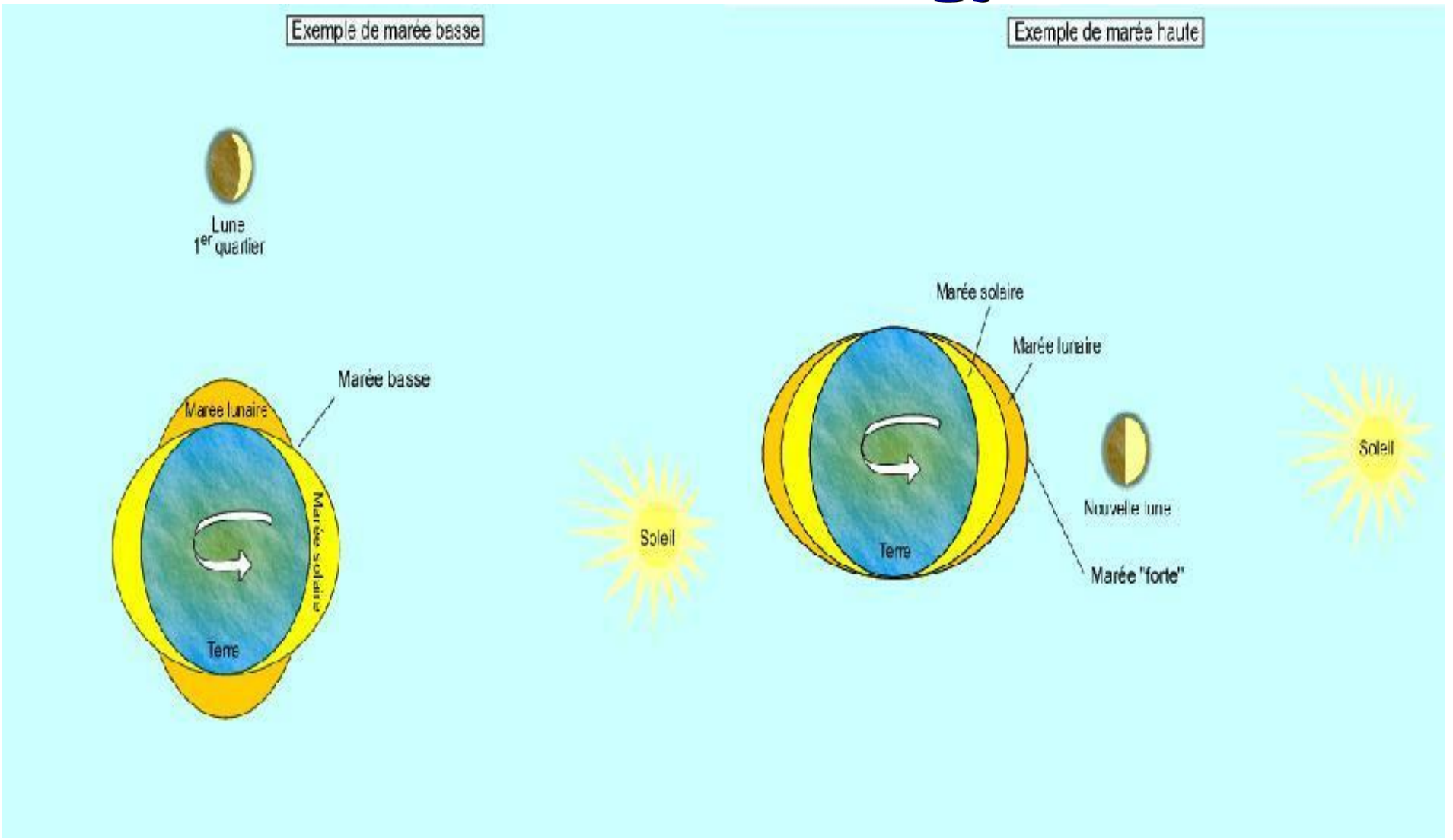
CETO Australia Freemantle with EDF-En



Some practical lessons learned in wave energy

- Increase demonstration at sea (only real sea operation will allow to identify the best solutions – reliability and costs)
- Test Centers
- Improve materials, components and power take-off equipment (failures to date are related to components and not the basic concept)
- Improve design, monitoring and control methods and tools for single devices and farms (Demonstration at sea is very expensive and risky)
- Improve fabrication, deployment, O&M methods and tools, including support vessels (cost reductions by a factor of 3 are to be attained)

Tidal Energy



Tidal and current energy The resource is predictable. The tidal height and current speed can be computed at a given place and at a given time.

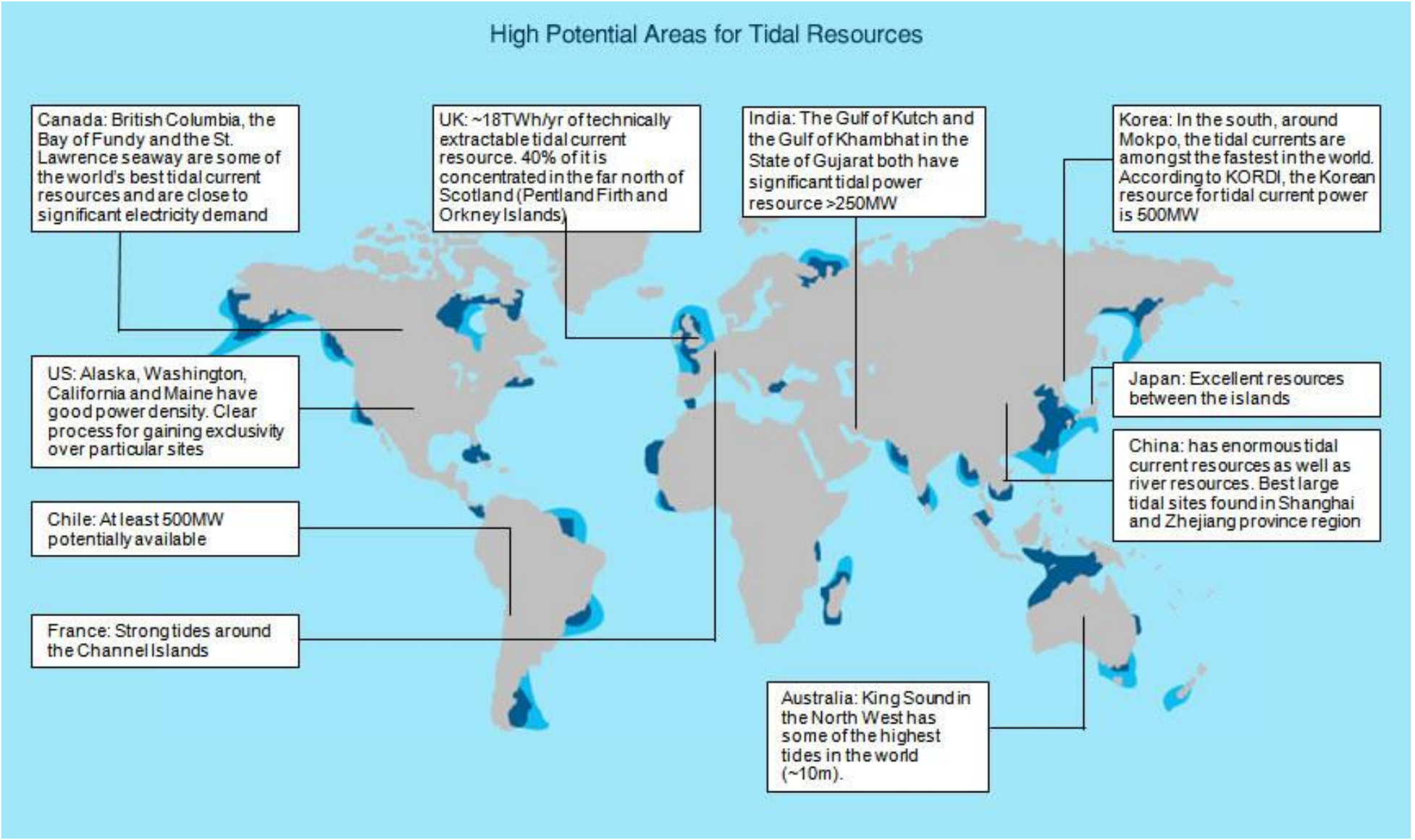
La Rance

the tidal plant of La Rance in Brittany inaugurated in 1966 by Général de Gaulle 240MW,

Lake Shiwa Korea

inaugurated 29 august 2011 by President of Korea republic, LeeMyung-bak. 254MW

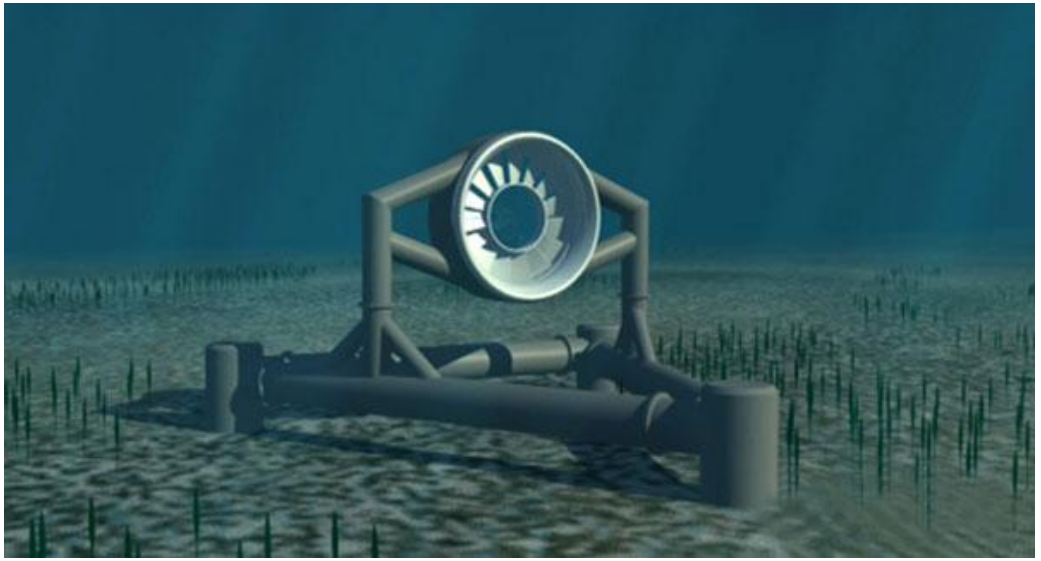
High Potential areas for tidal resources



Tidal stream power

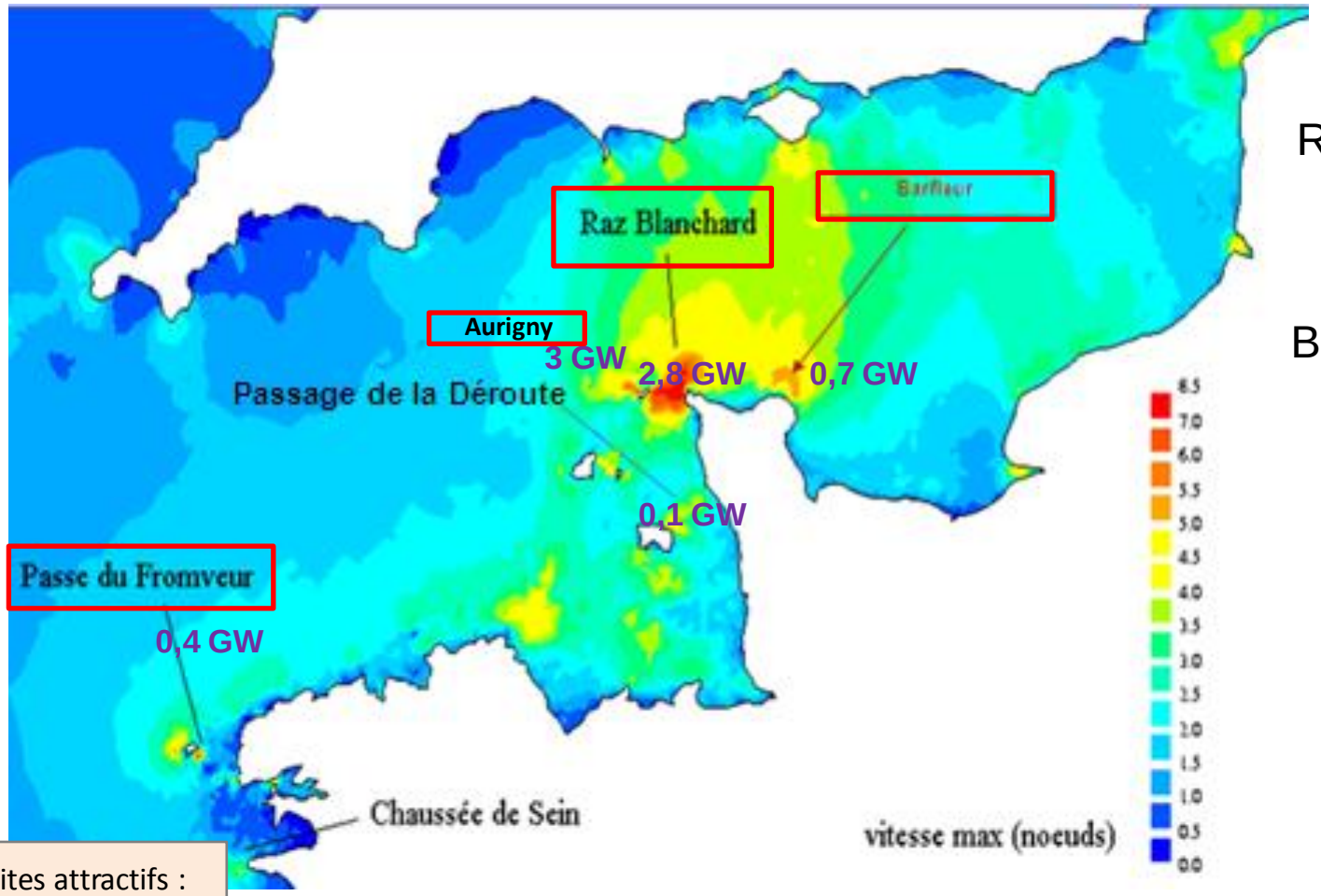
DCNS has bought 60 % of OpenHydro

Bréhat Paimpol (with EDF)
and Raz Blanchard



Tidal stream power Alstom

The potential tidal field

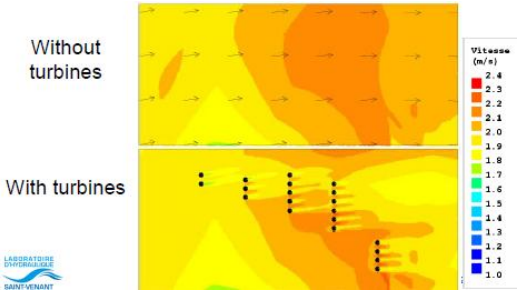


Sites attractifs :
>2m/s

Survey EDF-DCNS :
Raz Blanchard = 1-1,5 GW
3GW with Alberney

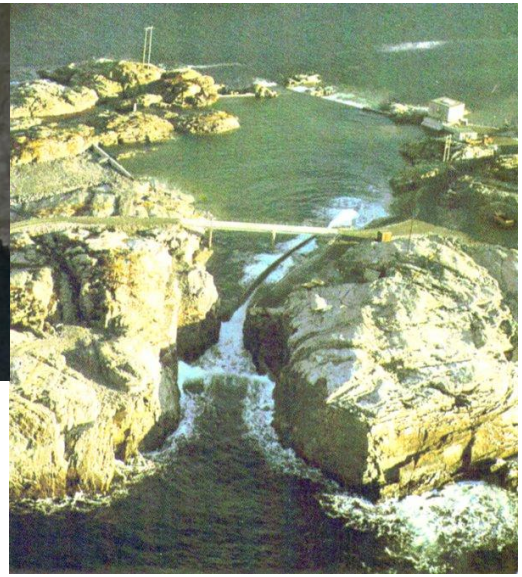
Survey DGEC:
Barfleur > 0,7 GW ?

Conditions:
currentology
bathymetry
Wake effects



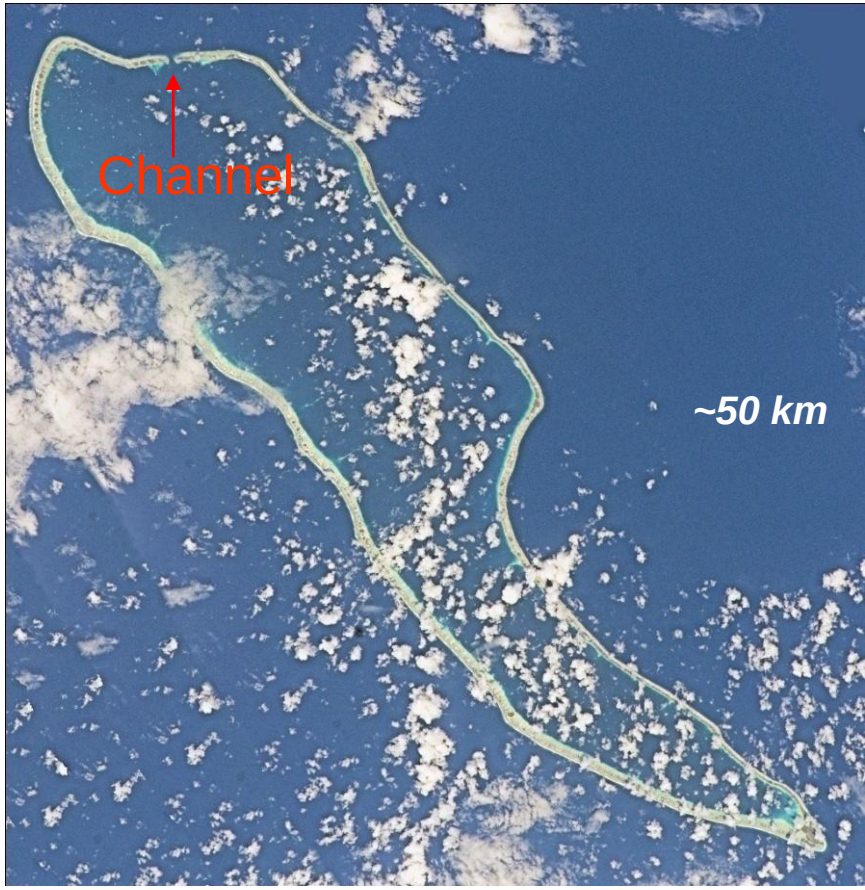
Tidal and current energy

Particular aspects of kinetic energy from currents



Tapchan site
(Tapered Channel)
near Bergen, Norway

Hao atoll, Tuoamotu archipelago
(not exploited)



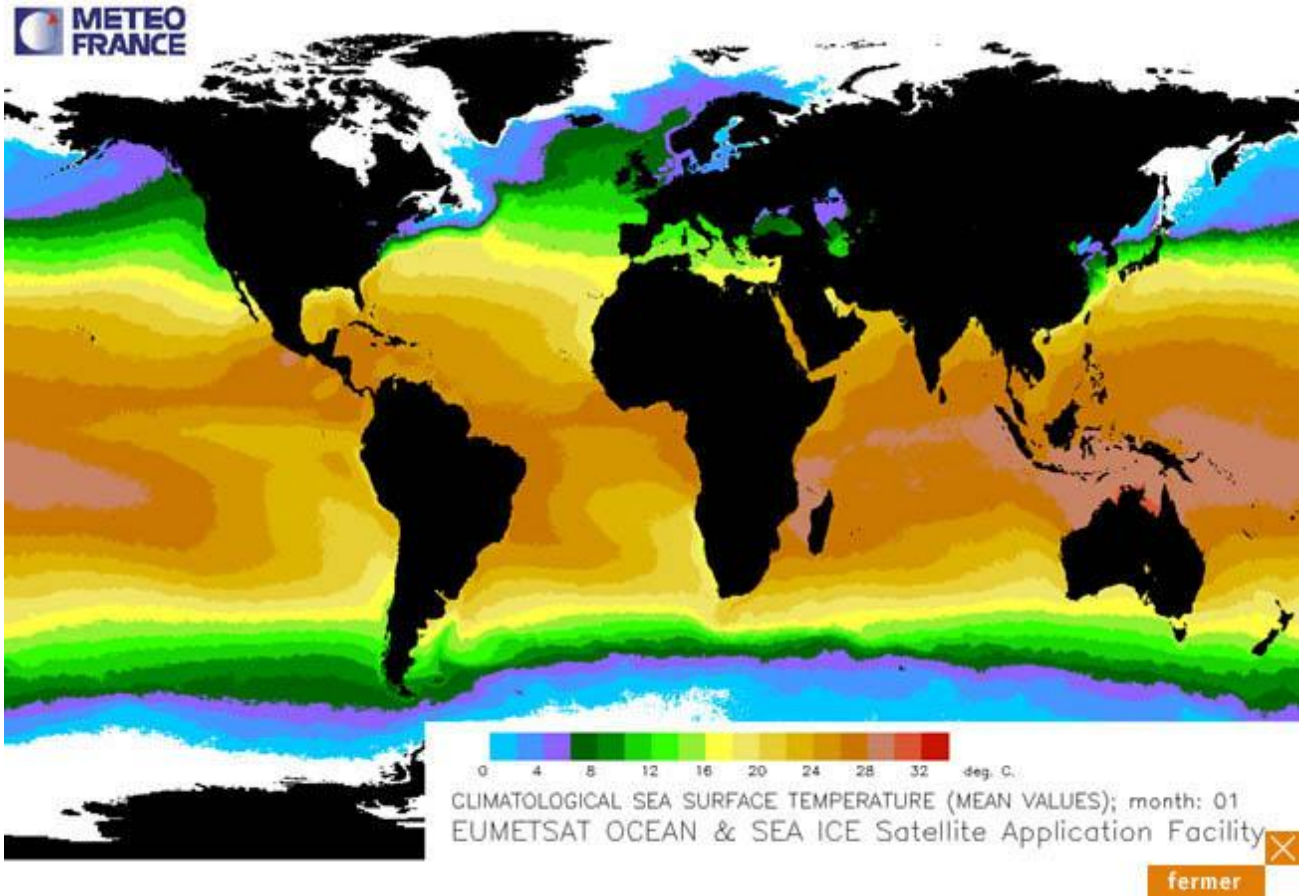
Natural site on Maré island, Loyauté islands
(not exploited)

Ocean thermal energy

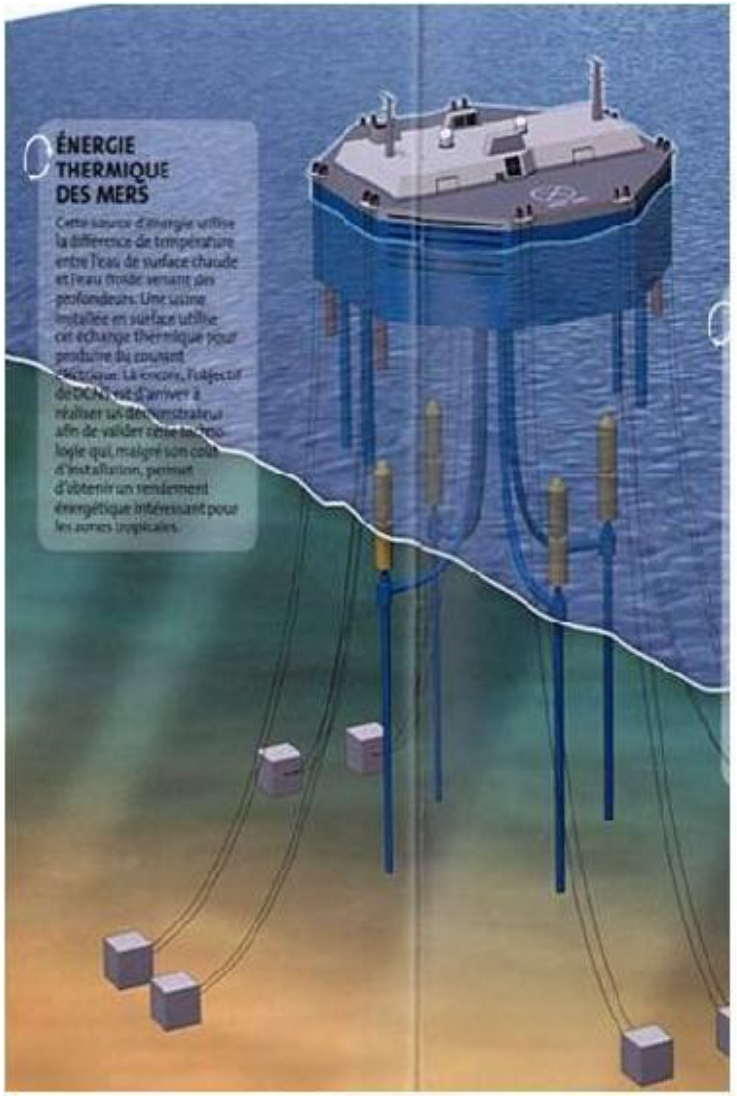
The principle :

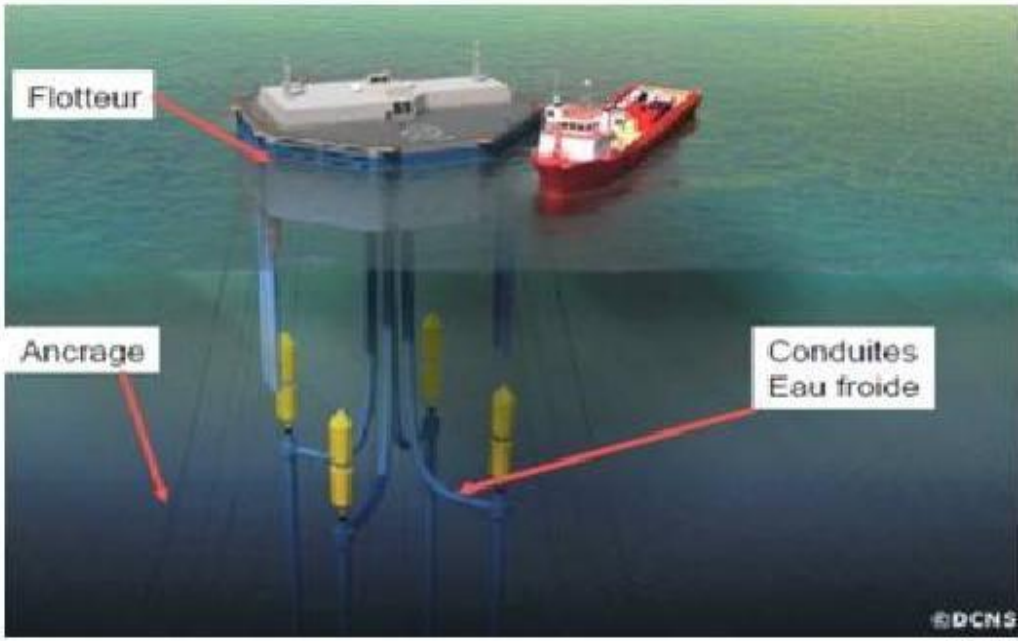
In the tropics, use the temperature difference between the bottom and the surface for the production of electricity

In metropole : resource of water at stable temperature for installations such as "heat pump”



OTEC Ocean thermal Energy Conversion





A difficulty : the cold water pipe

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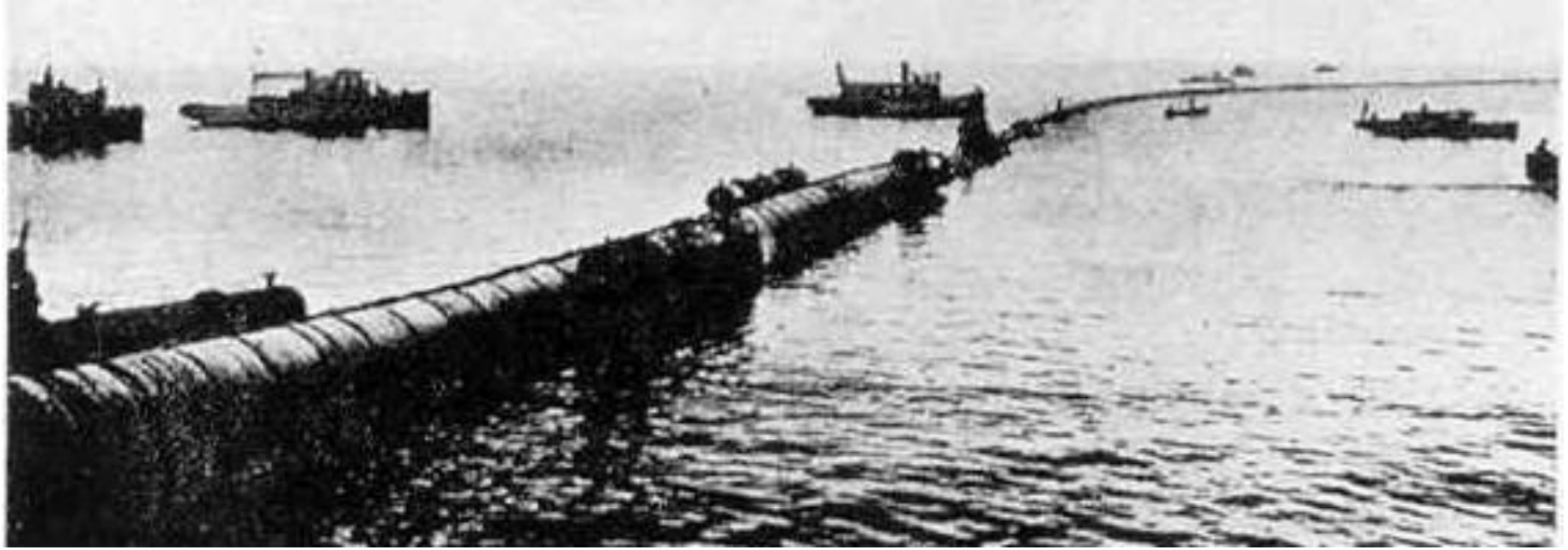


Georges Claude, Cuba (1929)

Georges Claude was a French chemist who invented the neon light. He passed an electrical current through a sealed tube of neon gas and got a light that was visible even during the daytime.

He also designed and built ocean thermal energy electrical plant prototypes in Cuba and Brazil attempting to generate electricity from the difference in temperature between deep and shallow water.

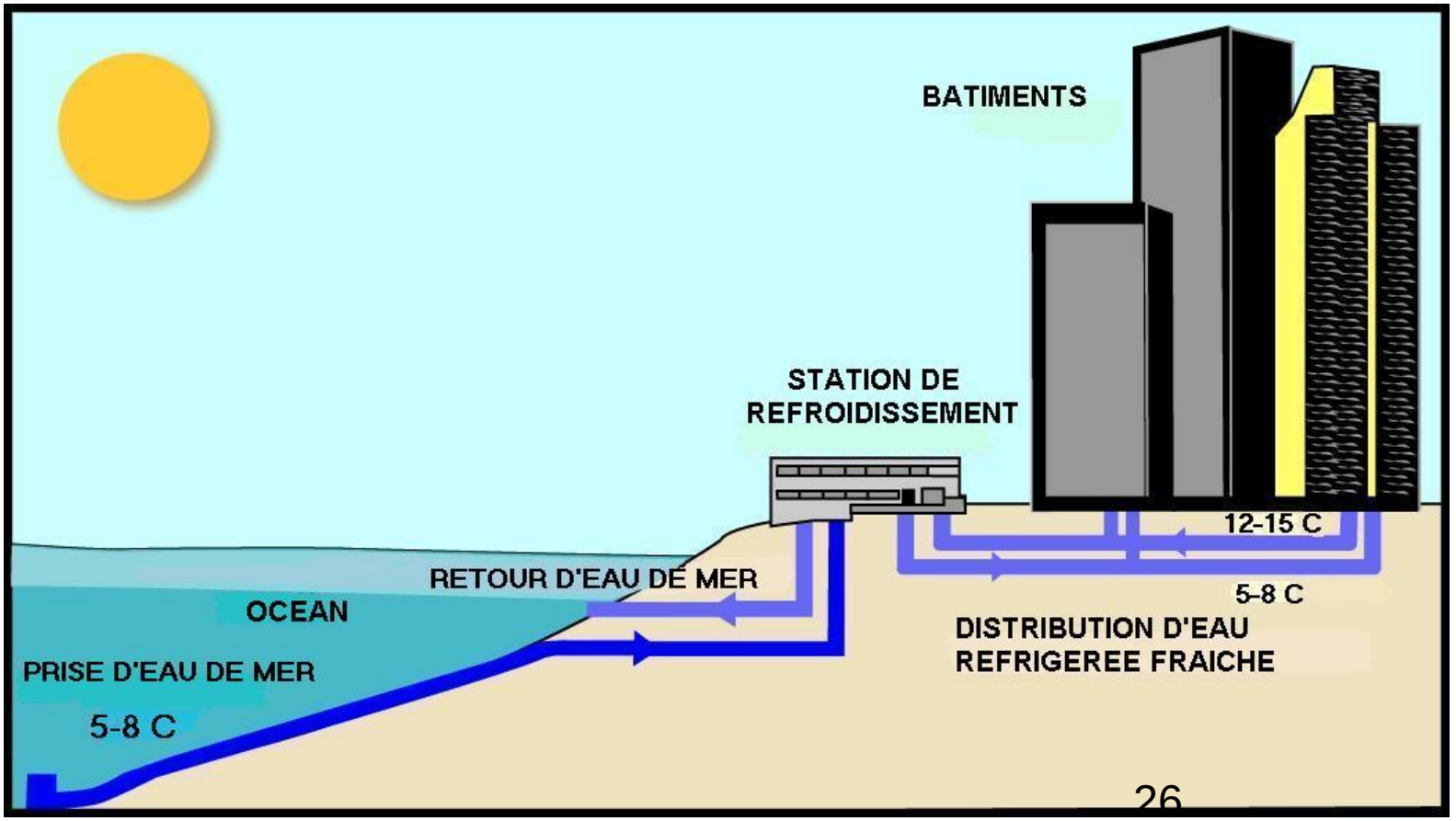
SWAC Sea Water Air Conditioning

Production and distribution of cold water

Reunion Island Communes of Saint Denis and Sainte Marie

Tahiti NEW HOSPITAL OF POLYNESIA

Operation of a SWAC system



A profusion of technologies: a selection is necessary

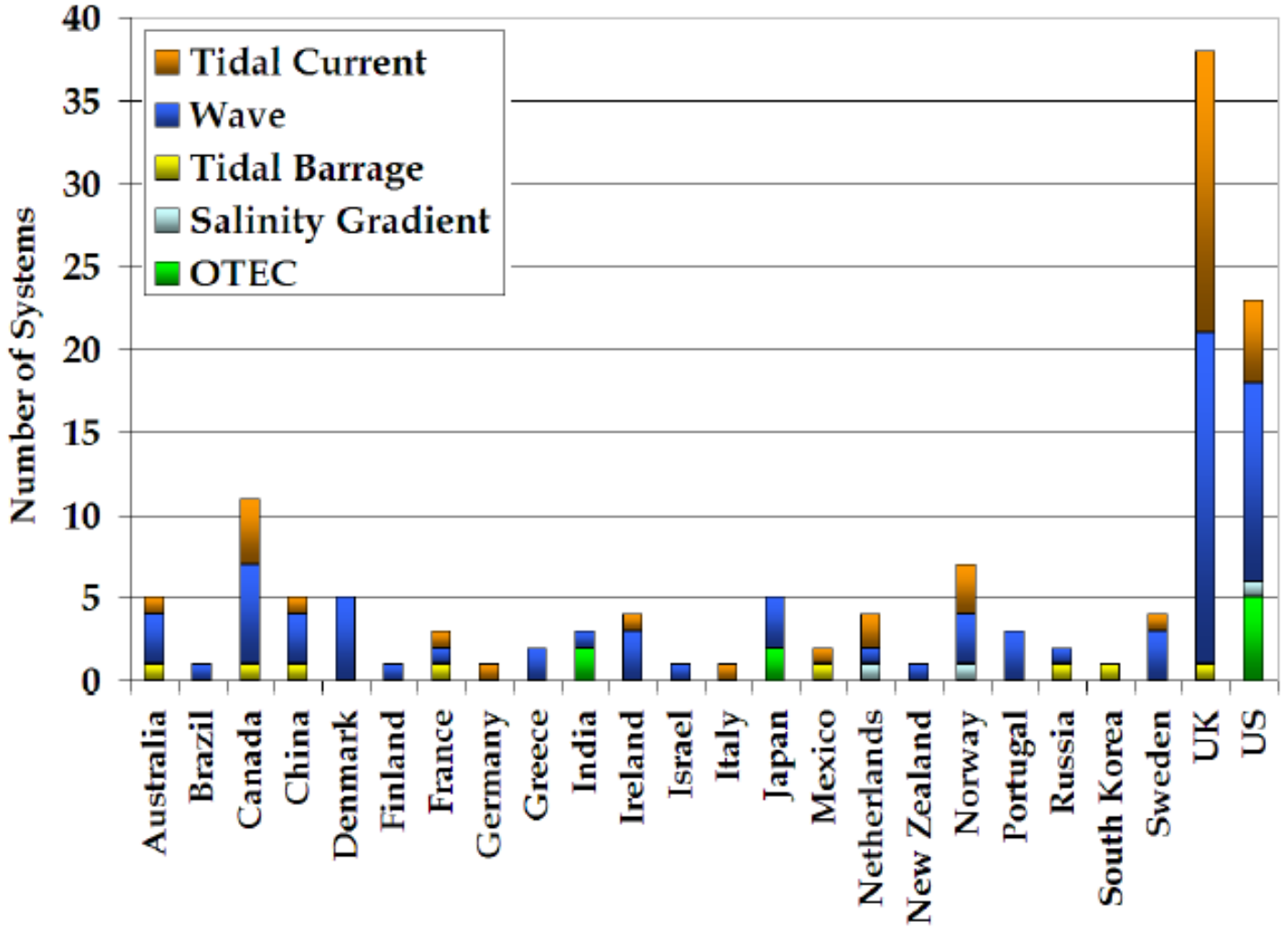


Figure 5: Ocean energy-related research, demonstration and commercial activities, as of December 2007

Stakes for development of MRE

Industrial Challenge of Marine Energies
Reduced Cost by Economy of scale **?**

Building an Industry
Industrial Policy, Manufacturing

Financing and Incentive

Mechanical Marine Renewable Energy
Technological barriers

Construction of large scale and fine mesh metocean database

Development of numerical tools: seakeeping, energy conversion

Design of mooring systems

Materials: reliability, fatigue, corrosion, bio-fouling, life cycle

Operations at sea: deployment, inspection, maintenance, reparation, dismantling

Connexion to the grid: underwater connectors, umbilicals

Energy storage: batteries, hydraulic, hydrogen?

Non technical Barriers for MRE
Public Policies and barriers

- Simplification of licensing procedures for projects and entrepreneurs
- Access to the electrical grid
- Access to field data
- Promote internal market : •Feed-in tariffs ,
- Define internal market (% of energy mix)
- In spite of the very high expectations on wave energy, present costs are high and no operational experience is still available.
- A large number of barriers can be identified, most of which may be removed or significantly reduced with proper public policies

Sea trials : test sites

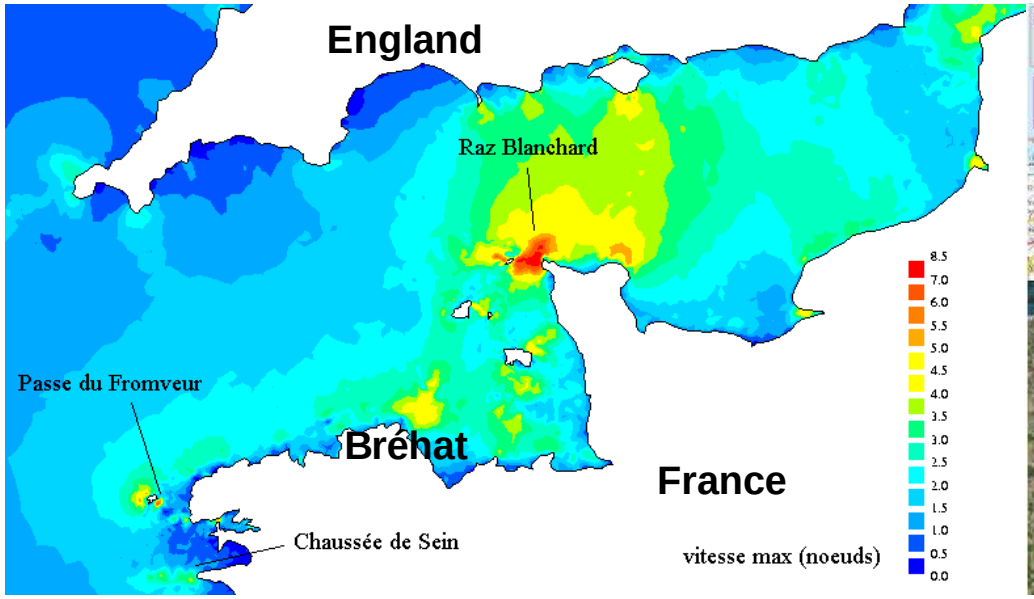
Large scale testing

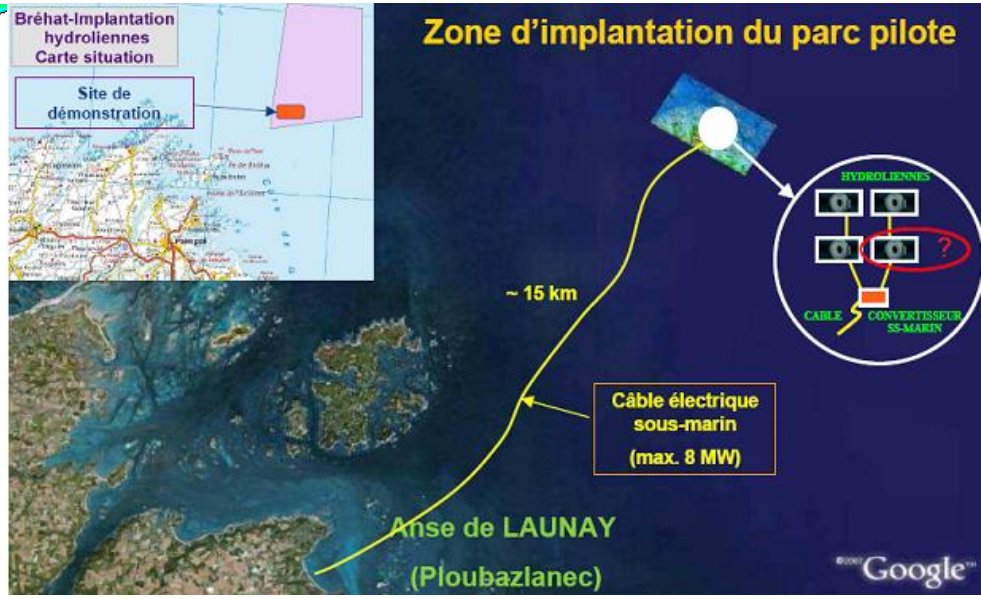
EMEC site, Orkney islands, Scotland
www.emec.org.uk

Marine current turbines

Wave energy converters

Island of Bréhat, France, for marine current turbines





France Energies Marines

Mapping members and associated partners

Public-private partnership

Privés

Publics

The test sites : Advantages of a national coordination

- Teams and equipment shared between sites
  Optimization of the different steps related to sea trials

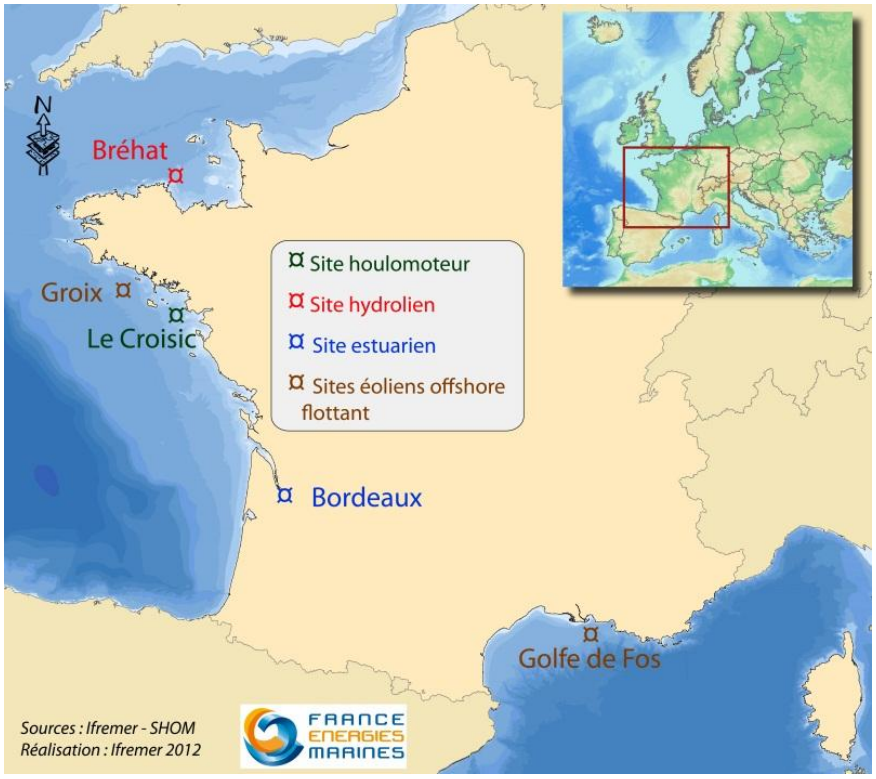
SEENEOH
Bordeaux
Tidal
Estuarine
Test site

SEM-REV
Floating
Marine
Converters
Test Site

Paimpol
Bréhat
Tidal
Energy
Test site

Groix
Test
site

Gulf
of Fos
Test site
(MISTRAL)



- Development of a database linked to the resource and the environment on a wide range of conditions
- A collective approach in interactions and positioning related to the regulatory framework, insurance, etc. certification

EMACOP

(Energies MArines, COtières et Portuaires)

EMACOP is a French national research project on renewable marine energies in coastal and port areas

- EMACOP is an acronym for Marine Renewable Coastal and Portuary Energy Many French partners: technical, engineering, research, ports, companies, local municipalities…
- Cooperative financing

Thank you for your attention

hboye@free.fr

Henri.boye@developpement-durable.gouv.fr

http://www.emacop.fr/