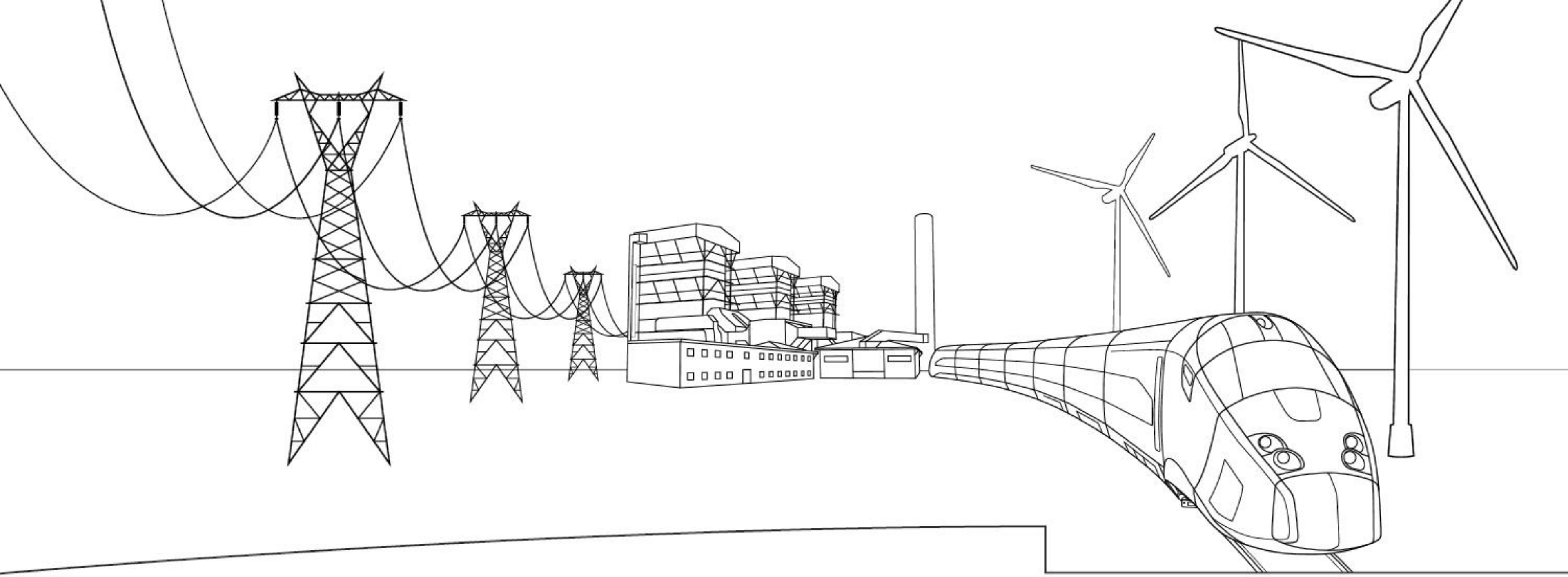


LE RENDEZ-VOUS DE L'ASSURANCE TRANSPORTS
PARIS - 2014

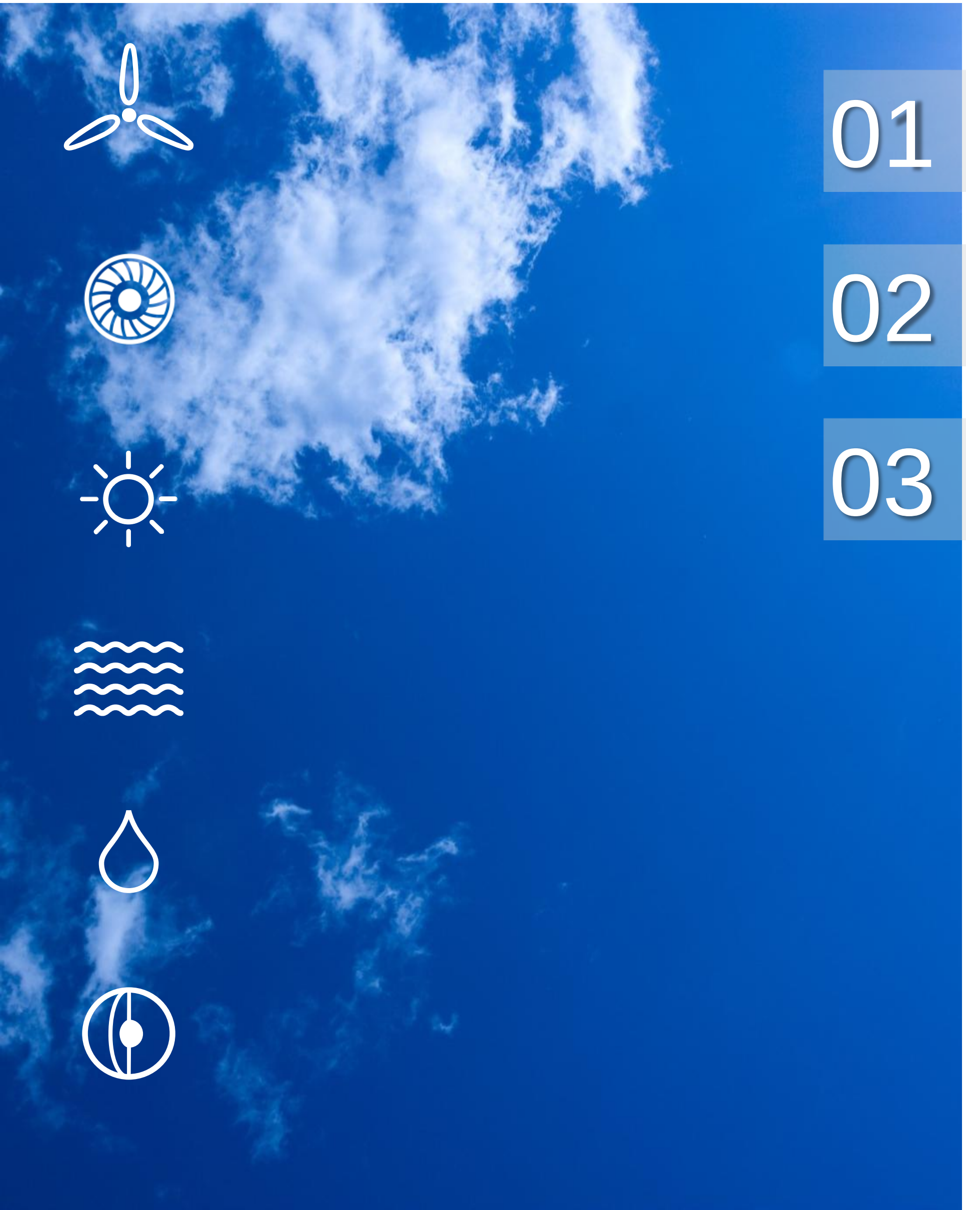
Marine Energies

Jérôme PECRESSE

May 12th, 2014

ALSTOM
Shaping the future

Agenda

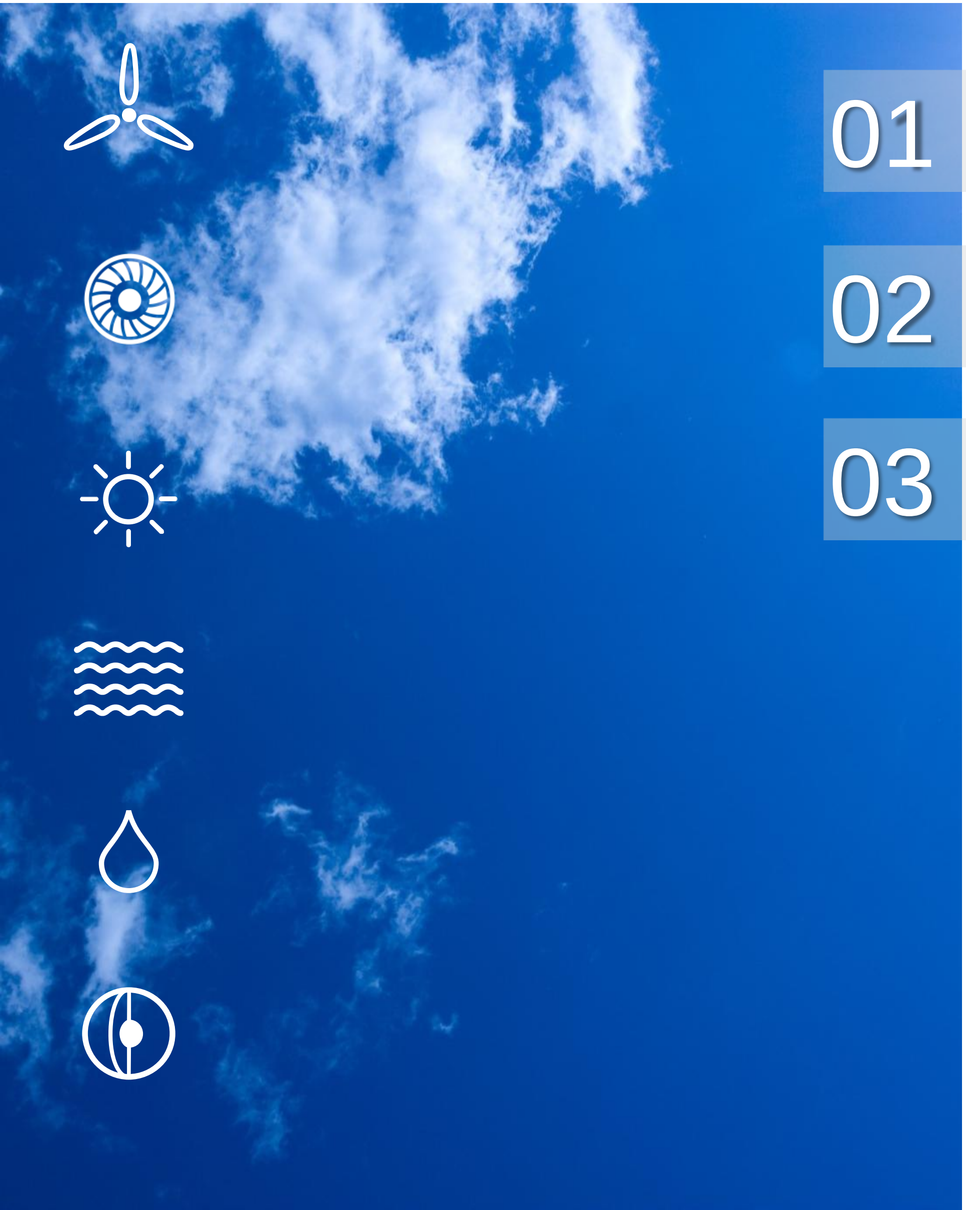


01 Overview of Marine Energies

02 Focus on Main Marine Energies

03 Alstom’s Strategy

Agenda



01	Overview of Marine Energies
02	Focus on Main Marine Energies
03	Alstom's Strategy

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Overview of Marine Energies
A large range of technologies

Alstom scope

Offshore Wind

Wind

Floating Offshore Wind

Tidal Stream

Current

Wave

Wave

MARINE ENERGY

Tidal Impoundment

Thermal

Temperature

Osmotic Pressure

Salinity

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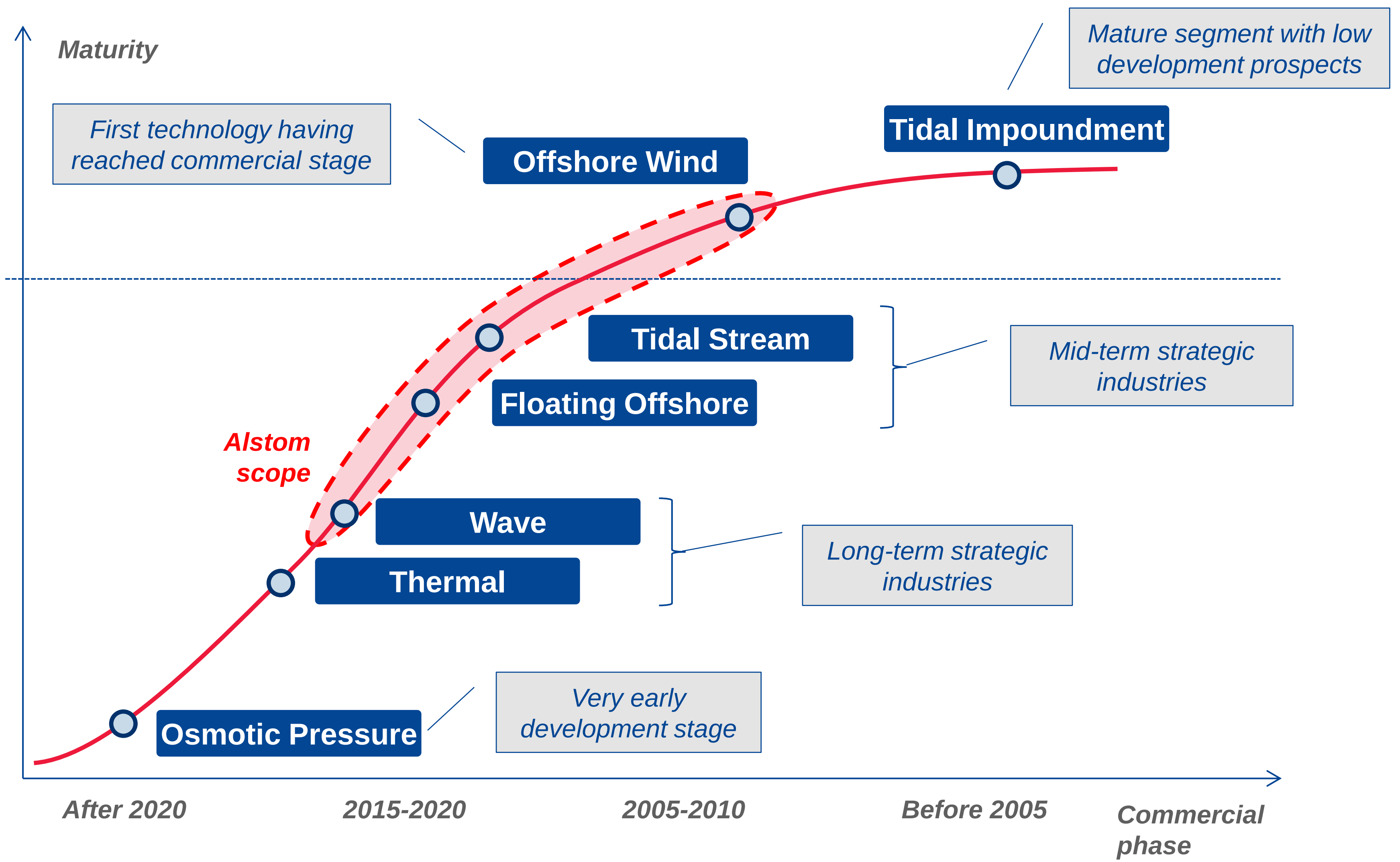
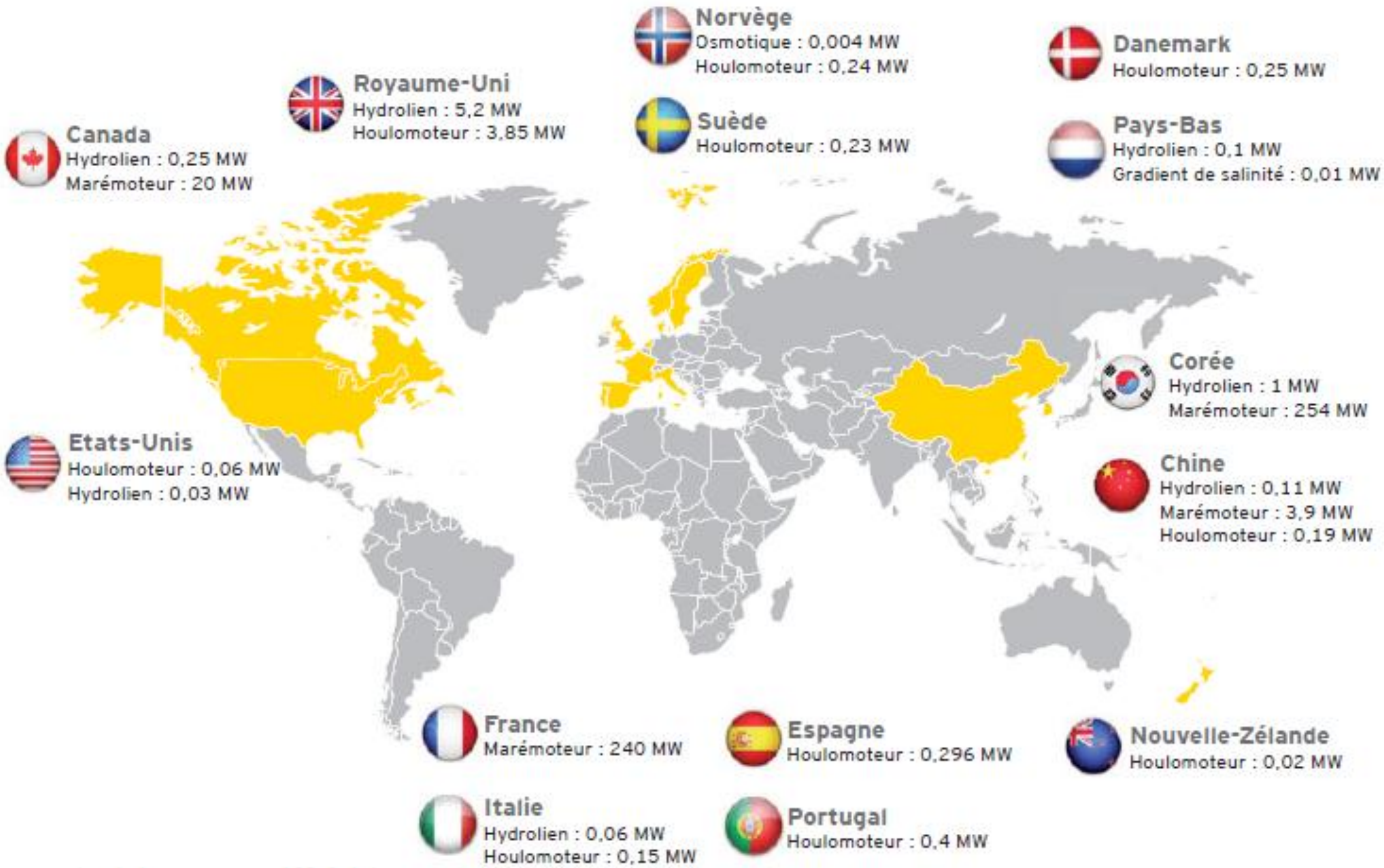
Overview of Marine Energies
Various Stages of Development



Source: INDICTA

Overview of Marine Energies
Dynamics in the World

World Installed Base in Marine Energies[1] (2013)

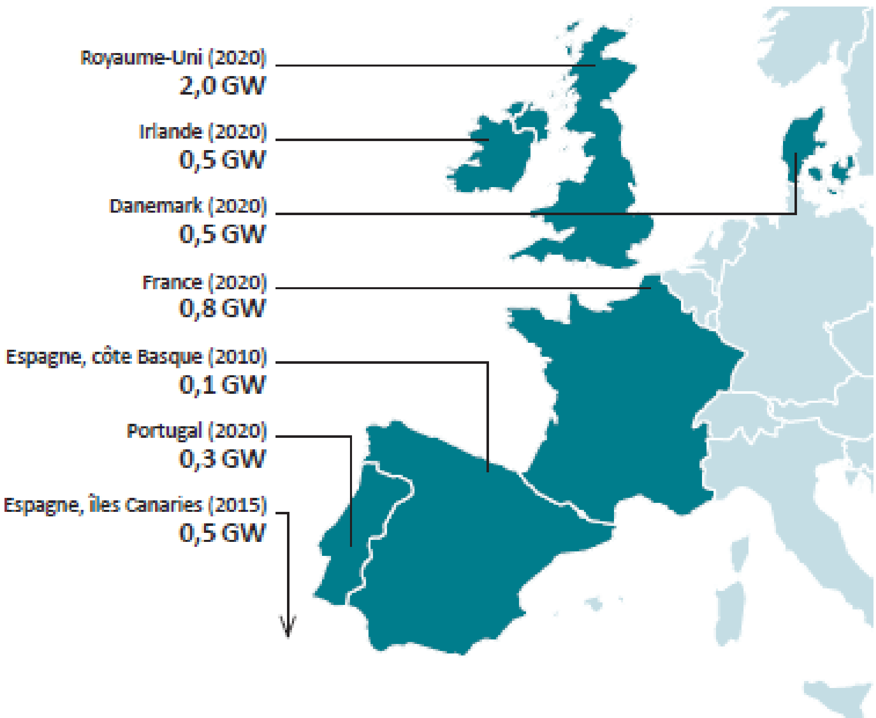


World installed base in Marine Energies[1] totalled 530 MW in 2013 (517 MW from Tidal)
IEA estimates a worldwide potential of up to 748 GW of Marine Energy capacity by 2050

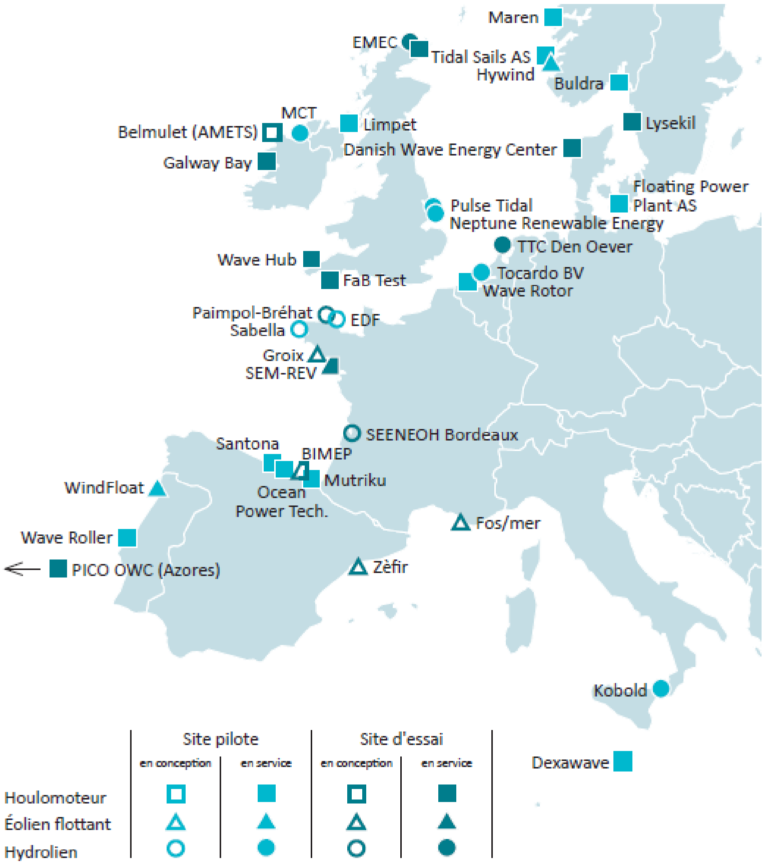
1. Excluding Offshore Wind
Source: Ocean Energy Systems

Overview of Marine Energies Dynamics in Europe

European Targets for Marine Energies[1]



European Pilot Sites for Marine Energies[1]

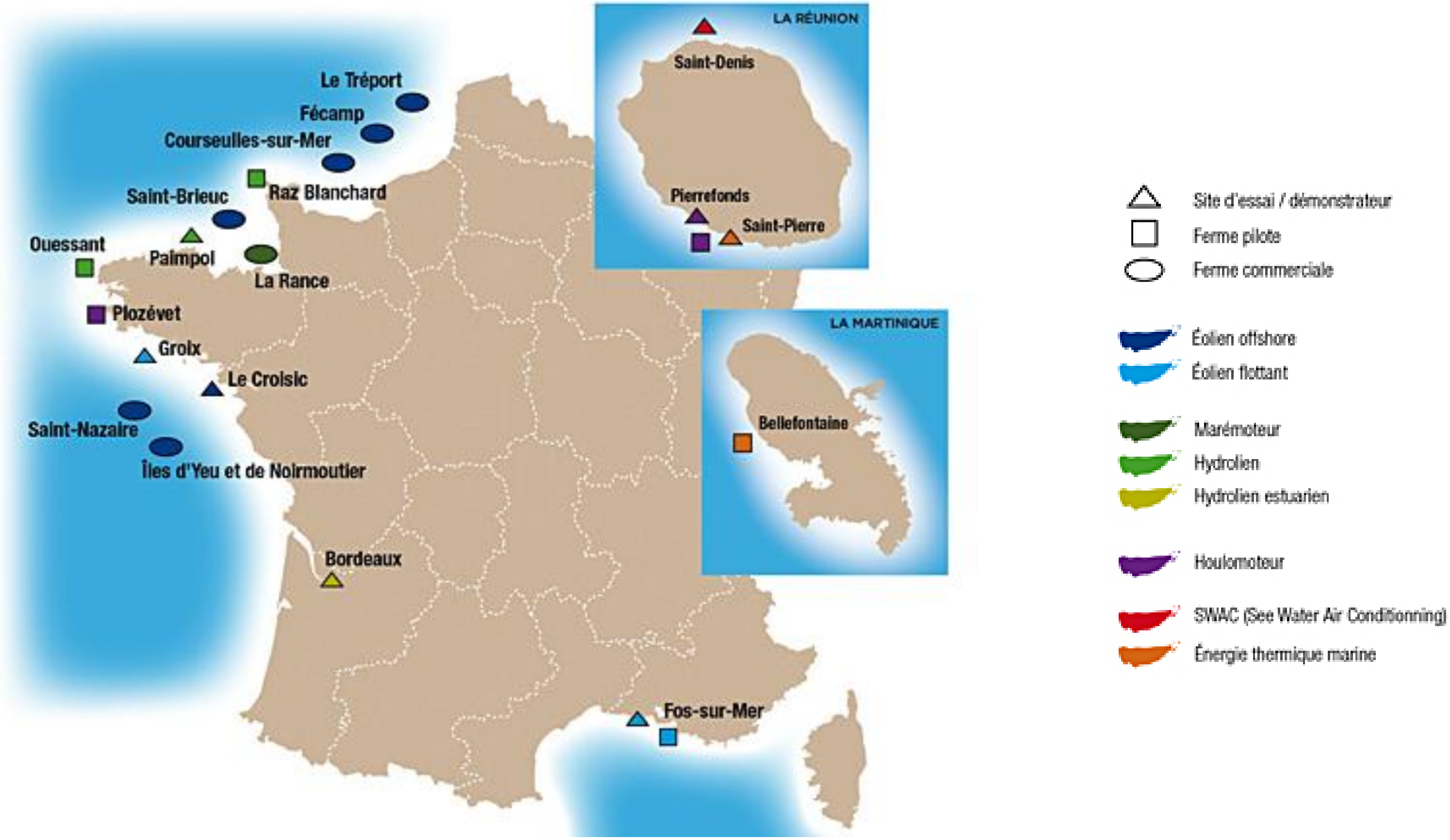


European installed base in Marine Energies[1] totalled 250 MW in 2012 (239 MW from Tidal)
IEA estimates a potential of 188 GW by 2050, satisfying 15% of European electricity demand

1. Excluding Offshore Wind
Source: Ocean Energy Systems, EU

Overview of Marine Energies
Dynamics in France

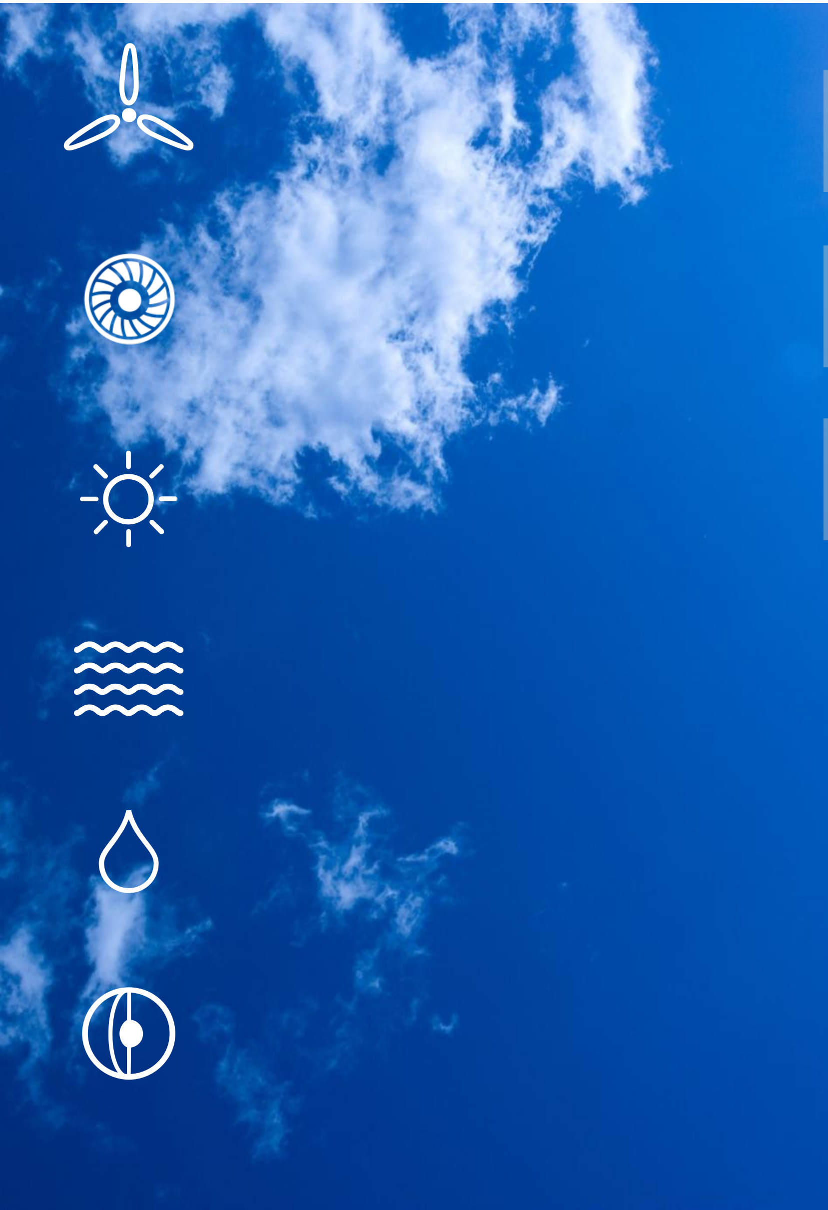
Main French Projects in Marine Energies (2013)



France is endowed with major natural potential in Marine Energy, encompassing Wind Offshore, Wave, Tidal and Thermal gradient

Source: Comité National des Energies Marines, Nov 2013

Agenda



01 Overview of Marine Energies

02 Focus on Main Marine Energies

03 Alstom’s Strategy

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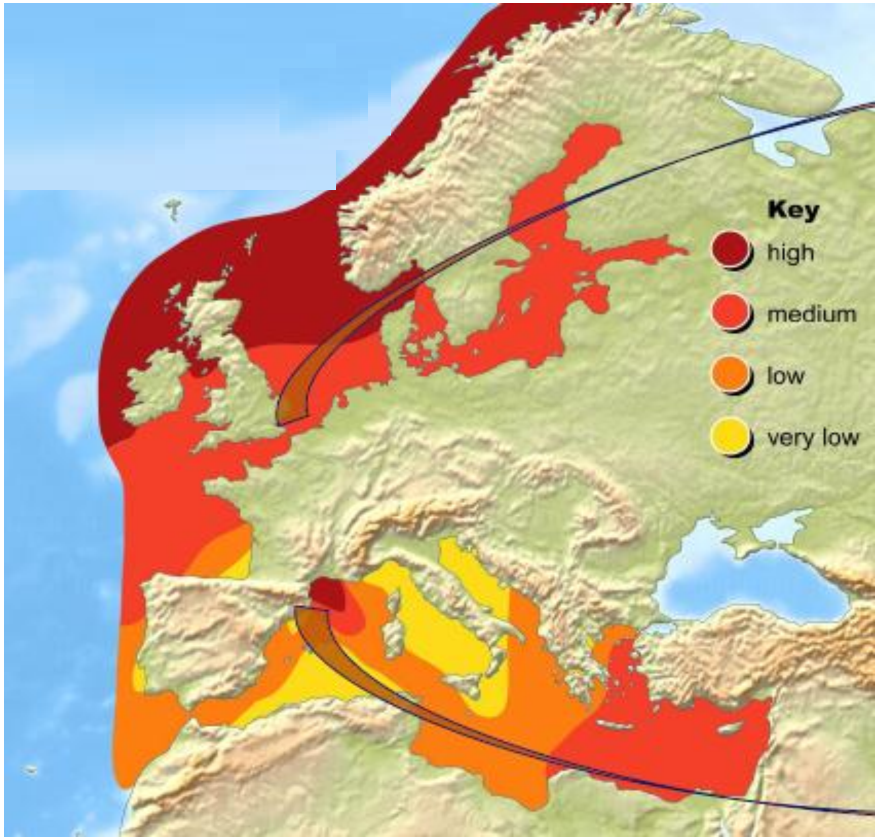
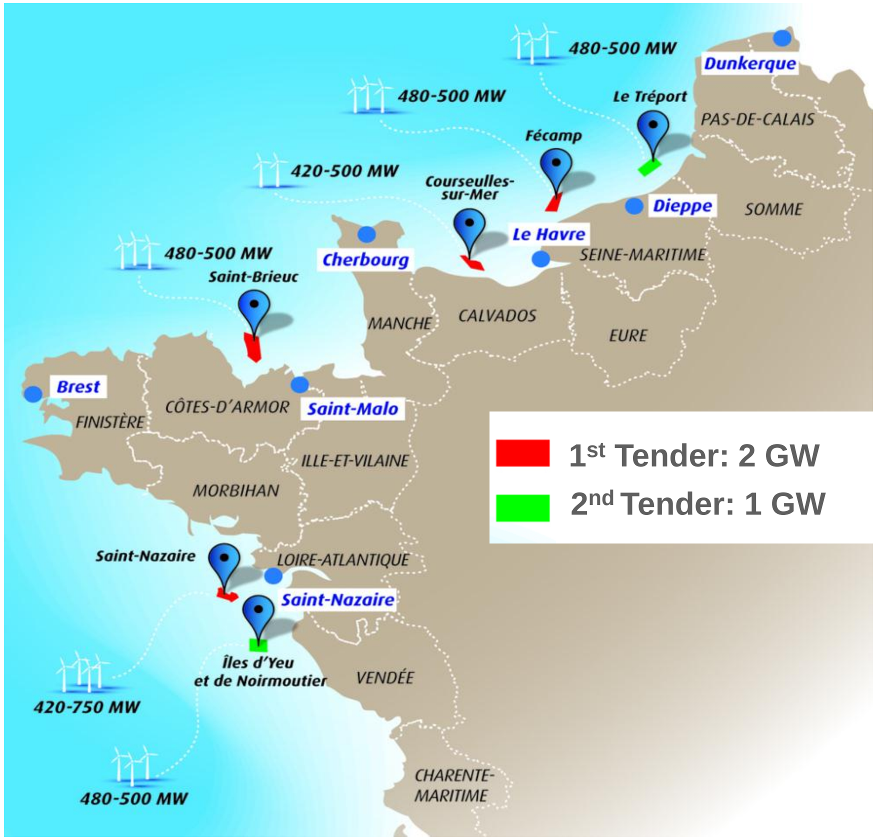
Focus on Main Marine Energies
Offshore Wind (1/3)

Offshore Wind

Wind Resource Distribution in Europe



French Tenders in Offshore Wind

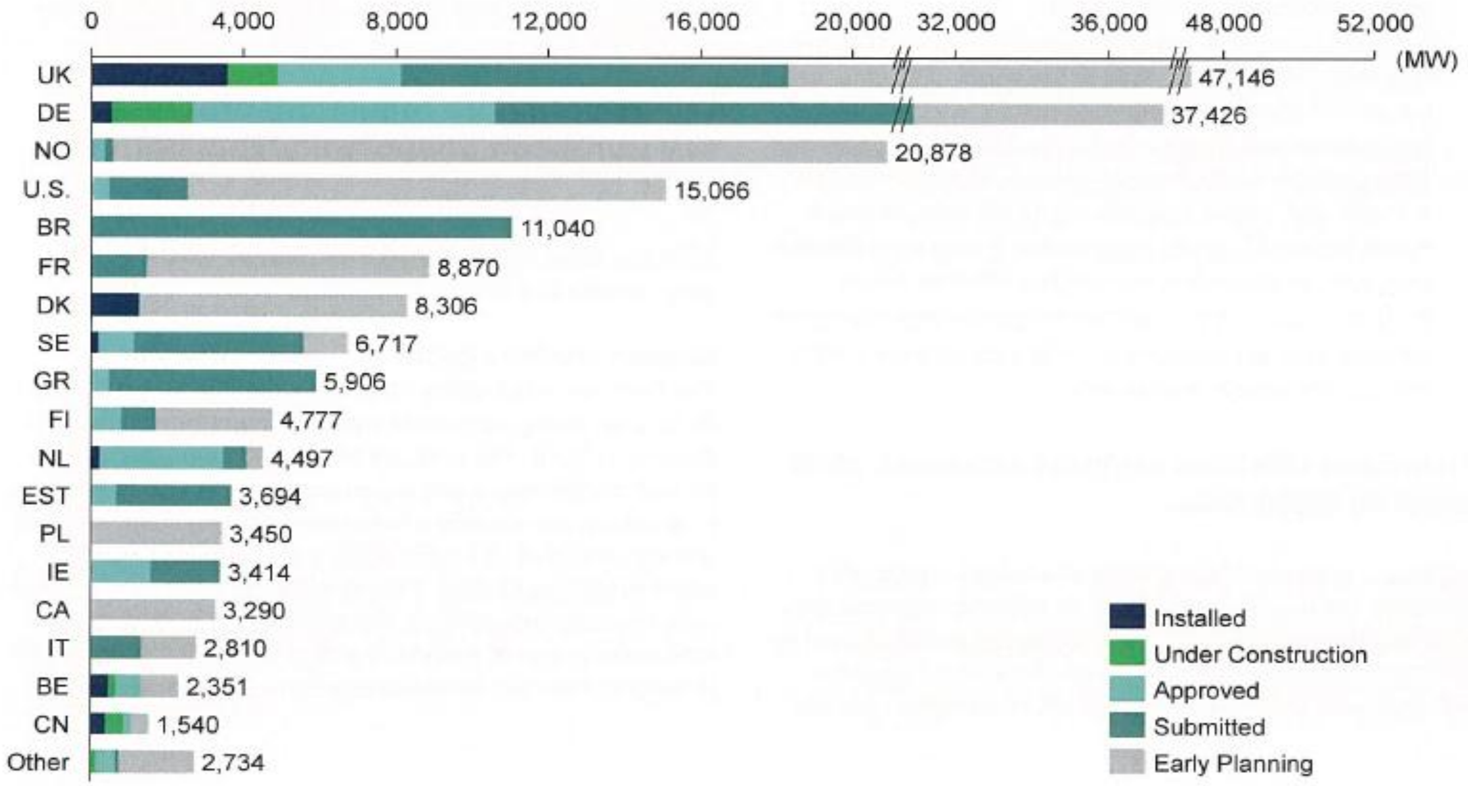


25 GW of Offshore Wind new capacity will be added in Europe throughout 2013-2020

Focus on Main Marine Energies
Offshore Wind (2/3)

Offshore Wind

Largest Offshore Pipelines by Country (Sep 2013, MW)



A large majority of projects are based in Europe

Source: Make Consulting

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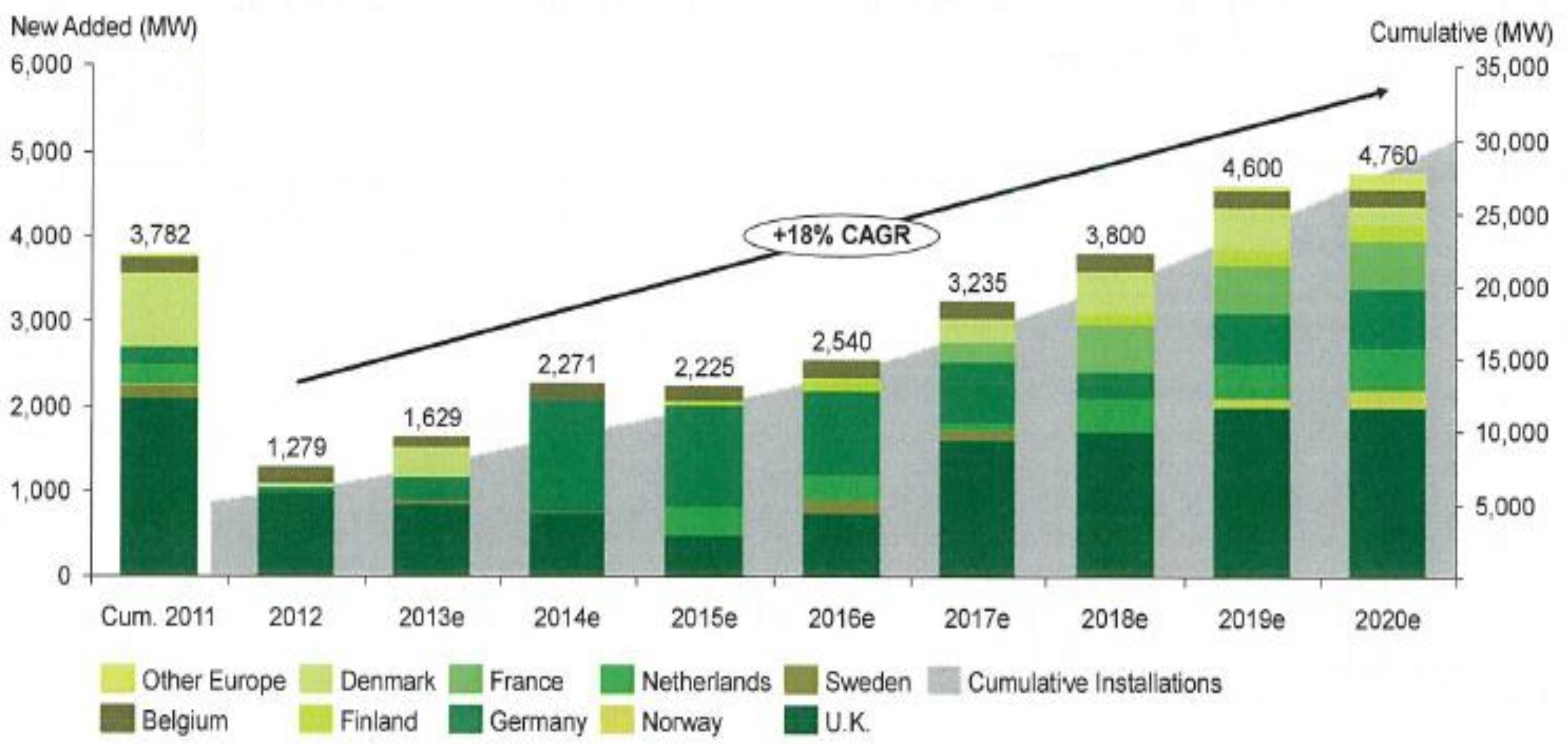
Focus on Main Marine Energies
Offshore Wind (3/3)

European Offshore Wind Power Market Outlook (2012-2020, MW)



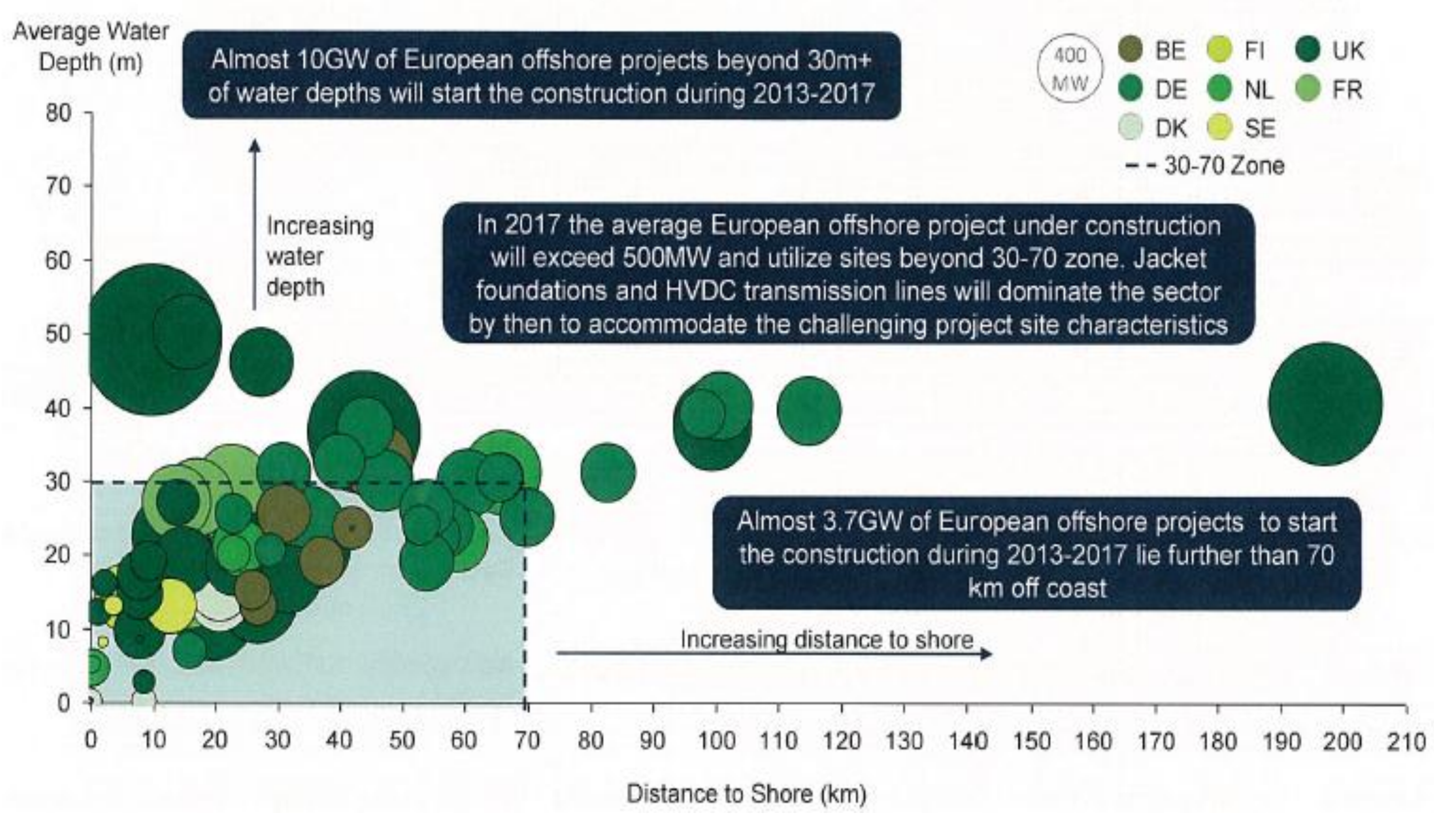
Offshore Wind installed base to reach 30 GW by 2020

Source: Make Consulting

Focus on Main Marine Energies
Floating Offshore Wind (1/3)

Floating Offshore Wind

European Offshore Project Pipeline (2012-2017e, average water depth vs. distance to shore)



Development of Offshore Wind projects at increasing distance to shore and water depth, paving the way for Floating Offshore Wind

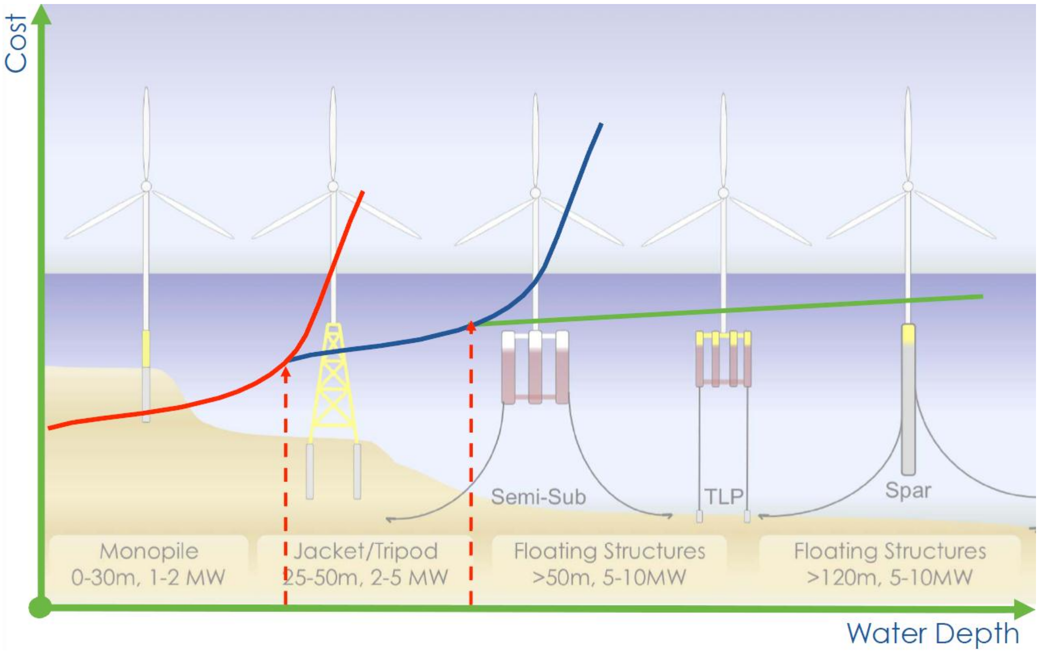
Source: Make Consulting

Focus on Main Marine Energies
Floating Offshore Wind (2/3)

Floating Offshore Wind

Floating offshore wind turbines are mounted on a floating structure, so they are not constrained by the same depth limitations as fixed-base turbines. They can be towed into deep water well away from the shore, where winds are stronger and steadier. Undersea cables are used to take the electricity onshore. Floating wind turbines can be towed far out to sea, minimizing their impact on landscapes.

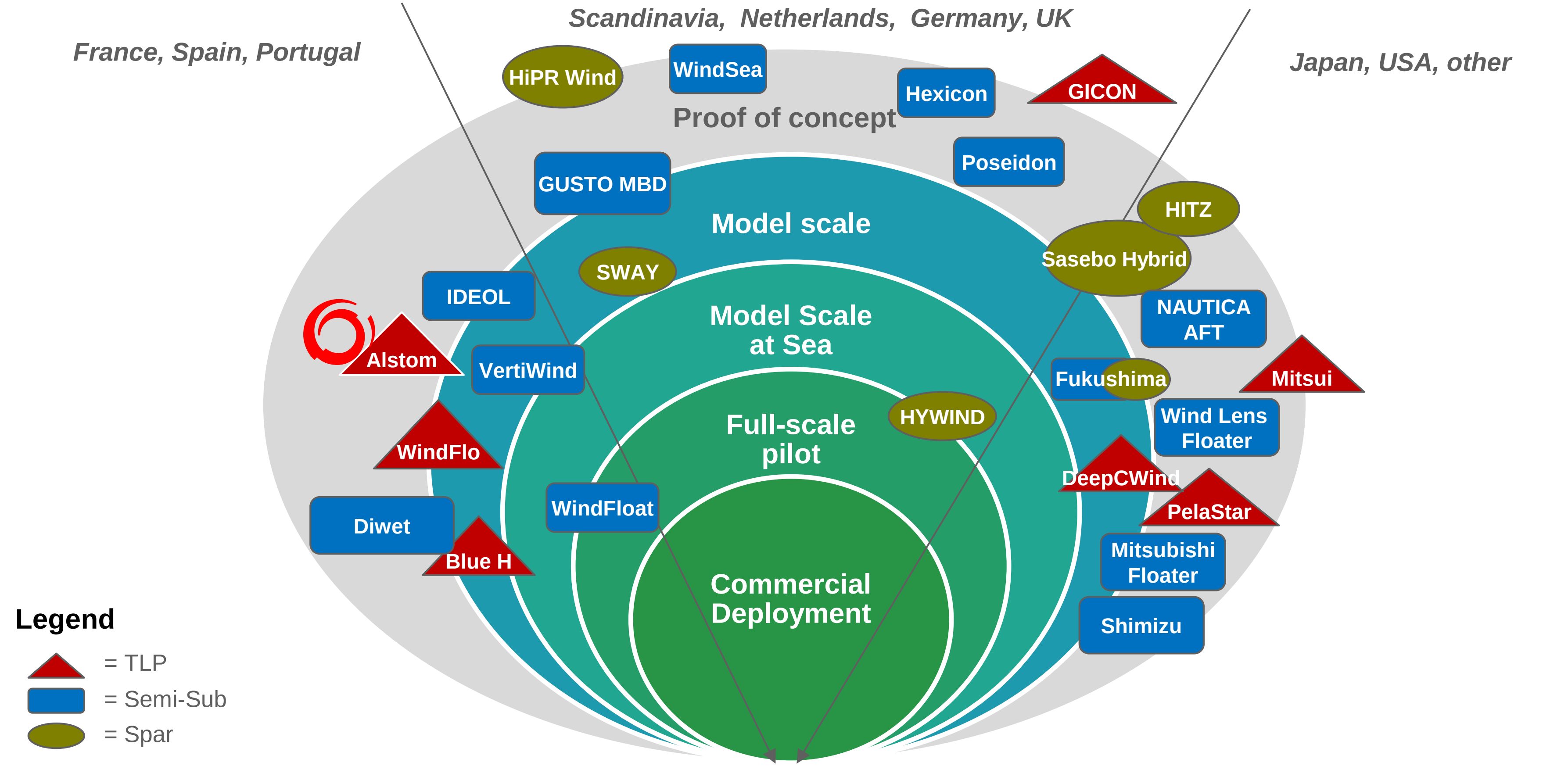
Overview of Main Technical Solutions for Offshore Wind



Water depth is the main criteria to differentiate a technological solution from another
Fixed Offshore expensive and depth-correlated, ~50% of costs from foundation & installation

Focus on Main Marine Energies
Floating Offshore Wind (3/3)

Floating Platforms Under Development

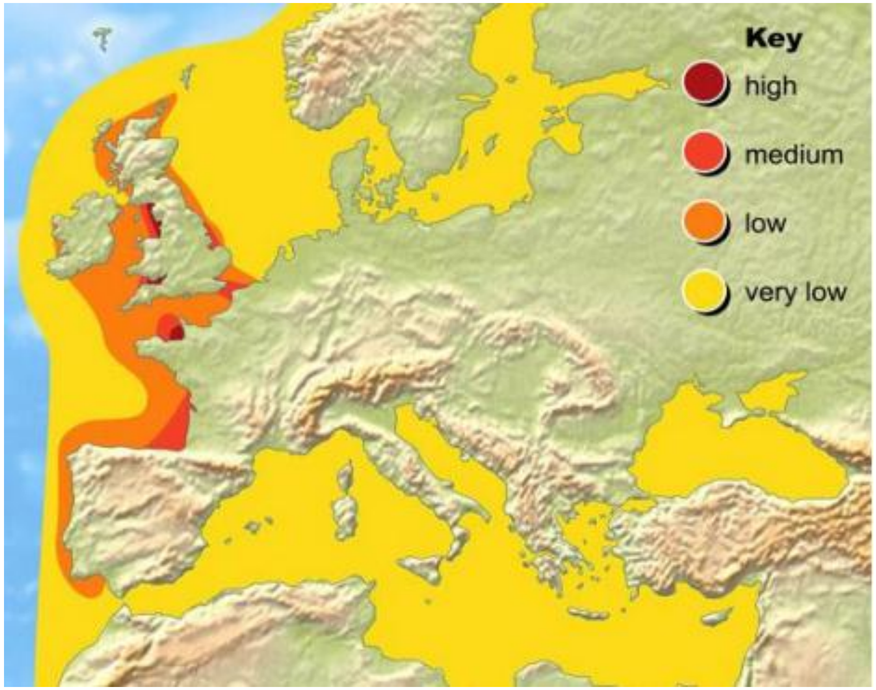


A number of floating platforms are developed across geographies and technological solutions, with very differentiated stages of completion

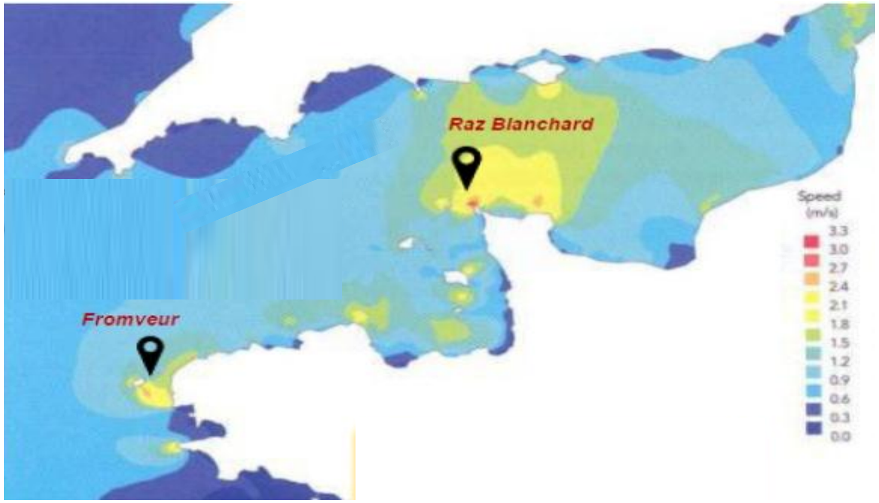
Focus on Main Marine Energies
Tidal Stream (1/2)

Tidal turbines are designed to convert the kinetic energy of ocean and tidal currents into electricity or into a second pressurized fluid. The energy of tides is highly predictable but also highly localized, the most suitable sites being those where ocean currents are particularly strong

Tidal Stream Resource Distribution in Europe



French Sites in Tidal Stream



Early markets in UK and France,
with Tidal potential estimated to respectively 6 GW and 3 GW

Sources: Aquaret, EDF/DRD

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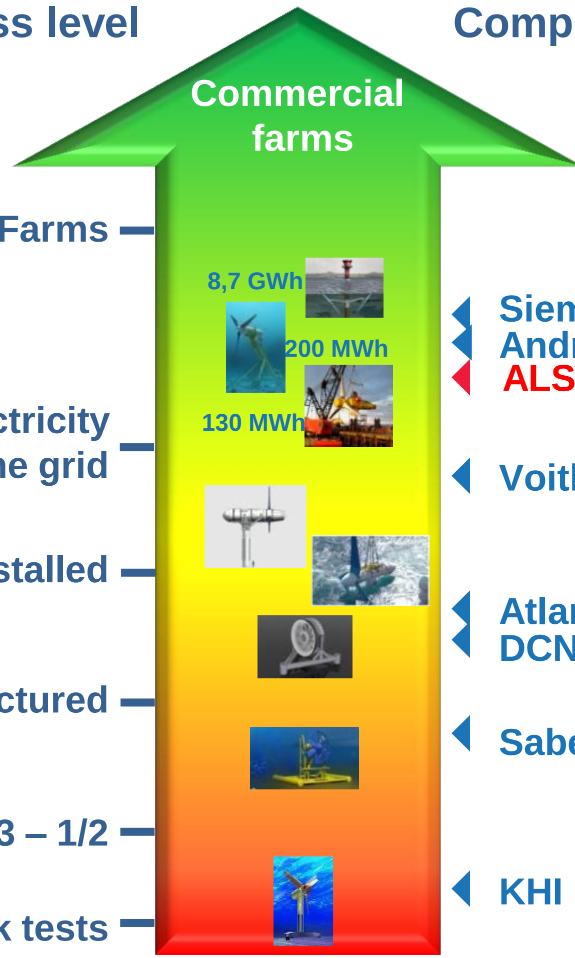
Focus on Main Marine Energies
Tidal Stream (2/2)

Tidal Stream

Competition Maturity

Technology readiness level	Competitors
Pilot Farms	
	Siemens
	Andritz
	ALSTOM
1MW prototype generating electricity to the grid	
	Voith Hydro
0,5-1MW prototype installed	
	Atlantis
	DCNS
0,5-1MW prototype manufactured	
	Sabella
Prototype 1/3 – 1/2	
Concept, model and tank tests	KHI



Source: Alstom

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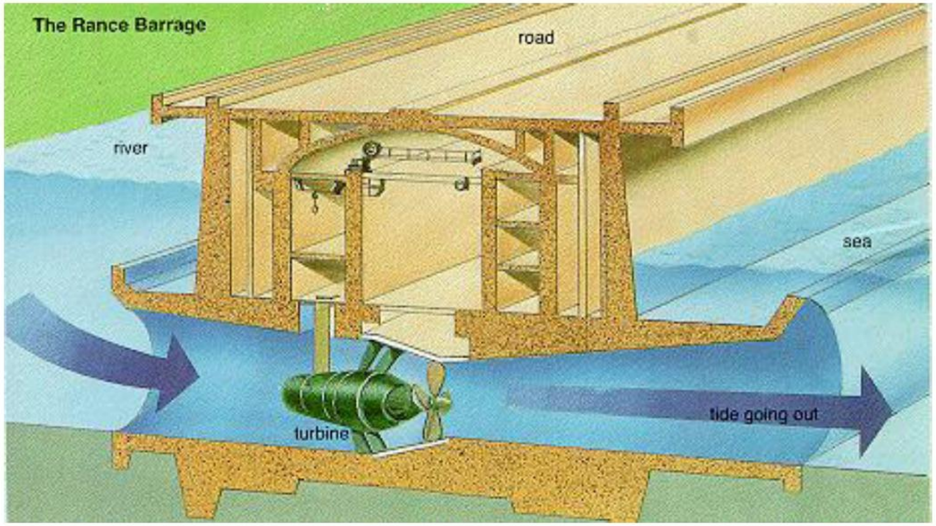
Focus on Main Marine Energies
Tidal Impoundment

Tidal Impoundment

Tidal barrages make use of the potential energy in the difference in height (or head) between high and low tides

La Rance (France) power plant of 240 MW, installed since 1967



Main other sites in the world:

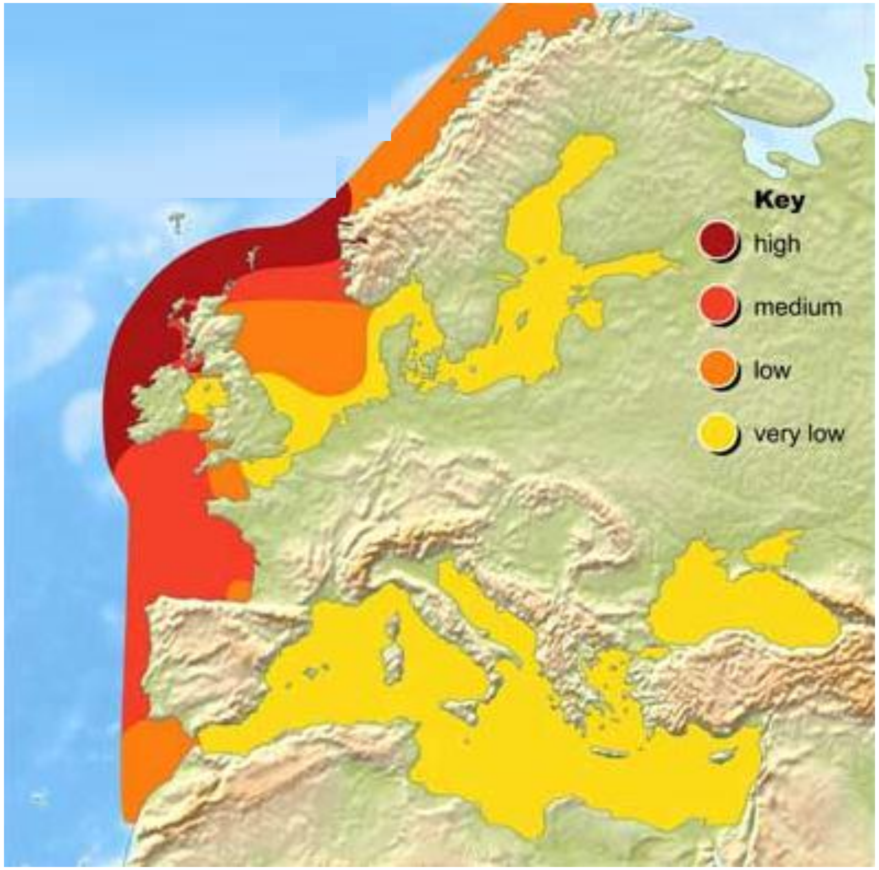
- *Sihwa (254 MW, South Korea)*
- *Annapolis (20 MW, Canada)*
- *Jiangxia (5 MW, China)*

Focus on Main Marine Energies Wave

Wave

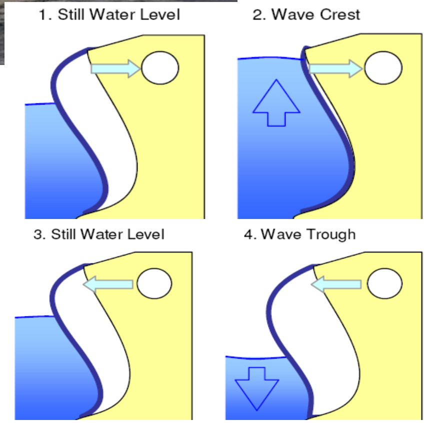
Waves offer a large source of energy that can be converted into electricity. Several principles for converting wave energy exist, using either fixed onshore devices or mobile devices at sea

Wave Resource Distribution in Europe



Alstom Wave Prototype: AWS

1/9^{e} Power unit, Scotland



Diaphragm converting wave into pneumatic energy with generators converting it into electricity

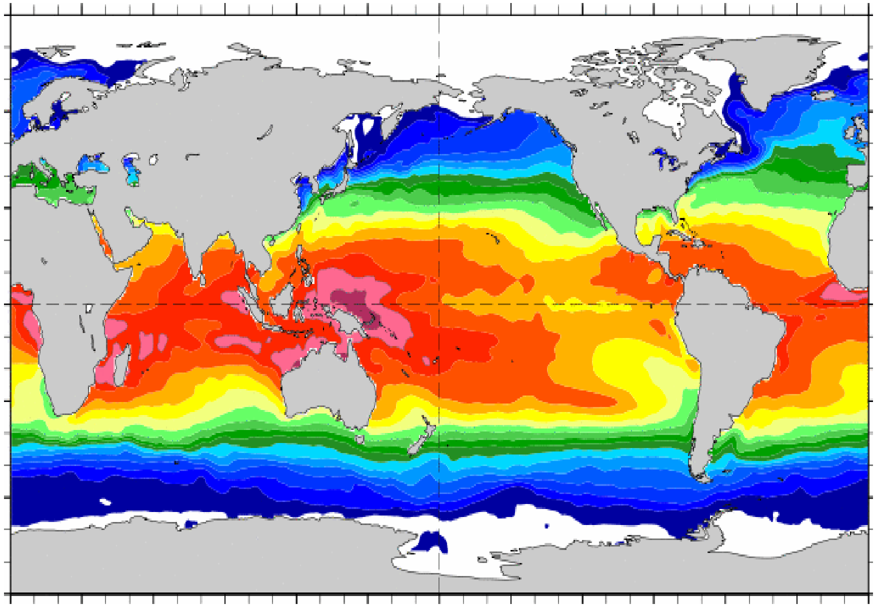
Sources: Aquaret, Alstom

Focus on Main Marine Energies
Thermal

Thermal

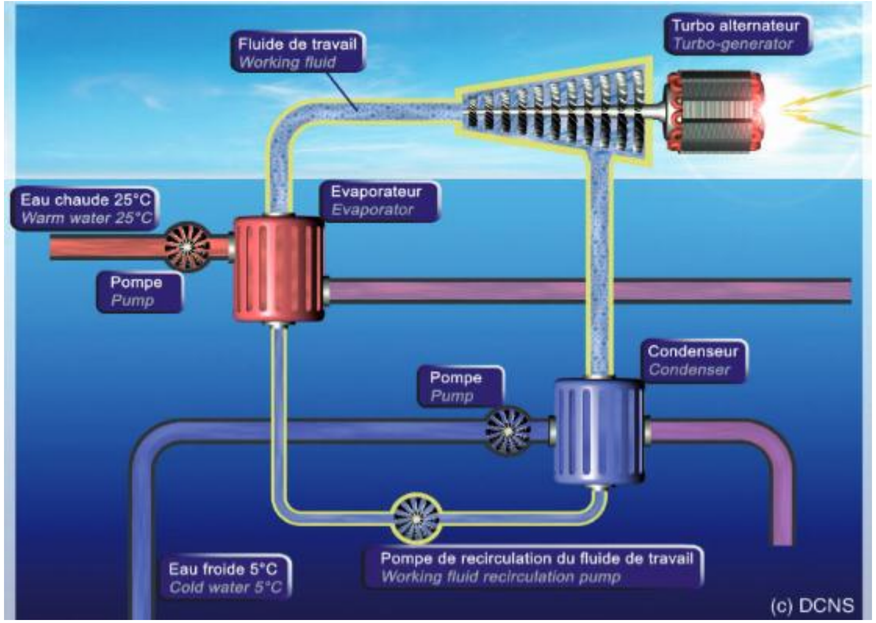
Ocean thermal energy conversion (OTEC) technology relies on a temperature difference of at least 20°C between warm surface water and cold deep water. OTEC has the advantage of producing renewable energy on a continuous basis

OTEC Potential



Operating principle - DCNS OTEC Design

10 MW Power unit, Martinique



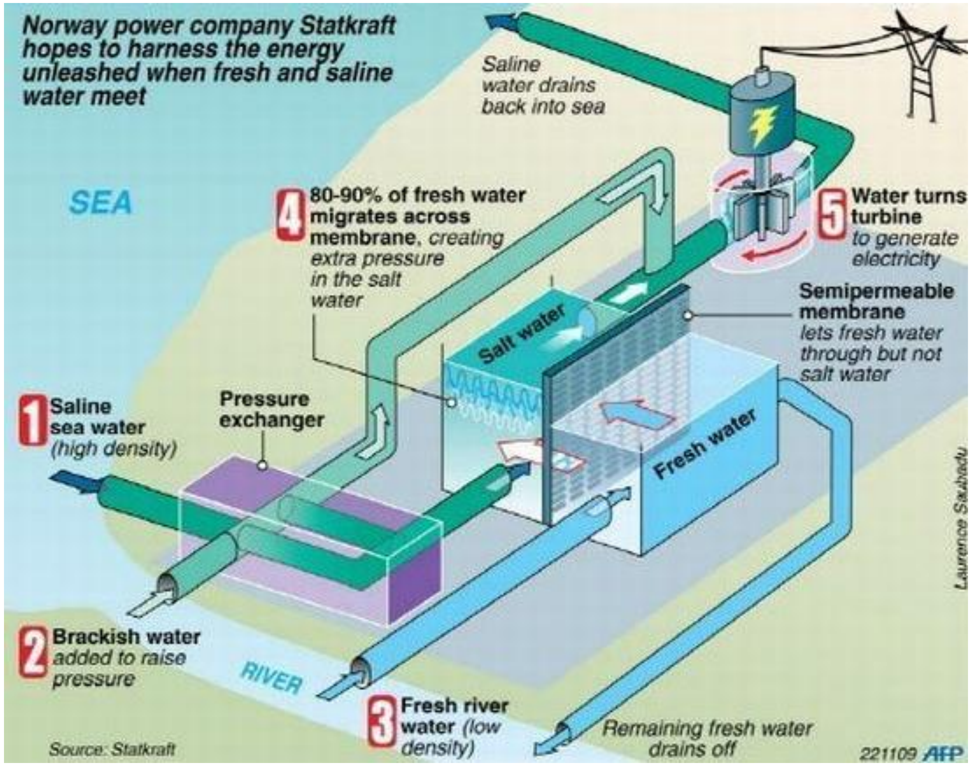
Sources: OES, DCNS

Osmotic Pressure

Focus on Main Marine Energies
Osmotic Pressure

Osmotic energy technology uses the energy available from the difference in salt concentrations between seawater and freshwater. Such resources are found in large river estuaries and fjords. The system uses a semi-permeable membrane that allows the salt concentrations to equalize, thus increasing pressure in the seawater compartment

Operating Principle – Statkraft Design



Source: Statkraft

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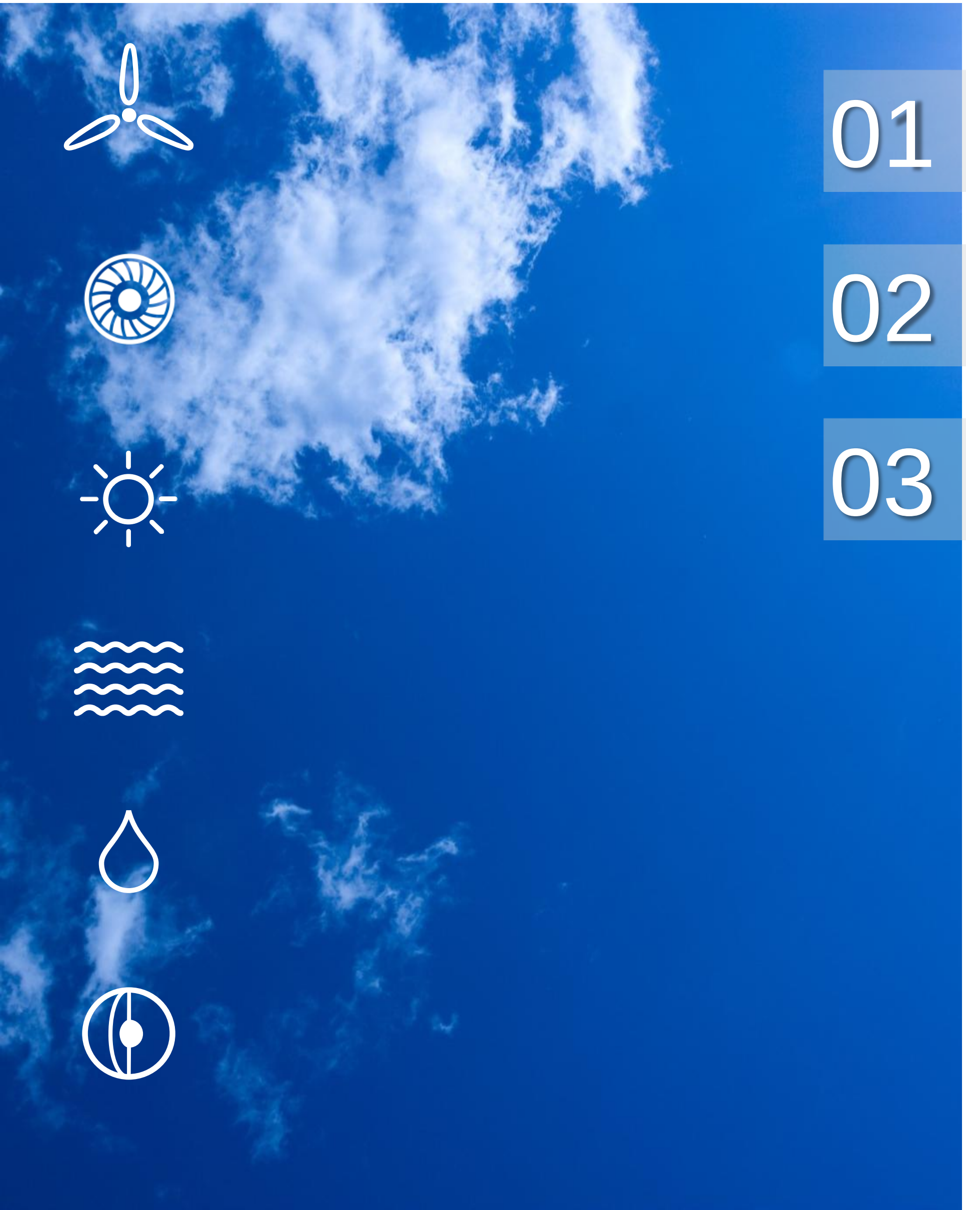
Agenda



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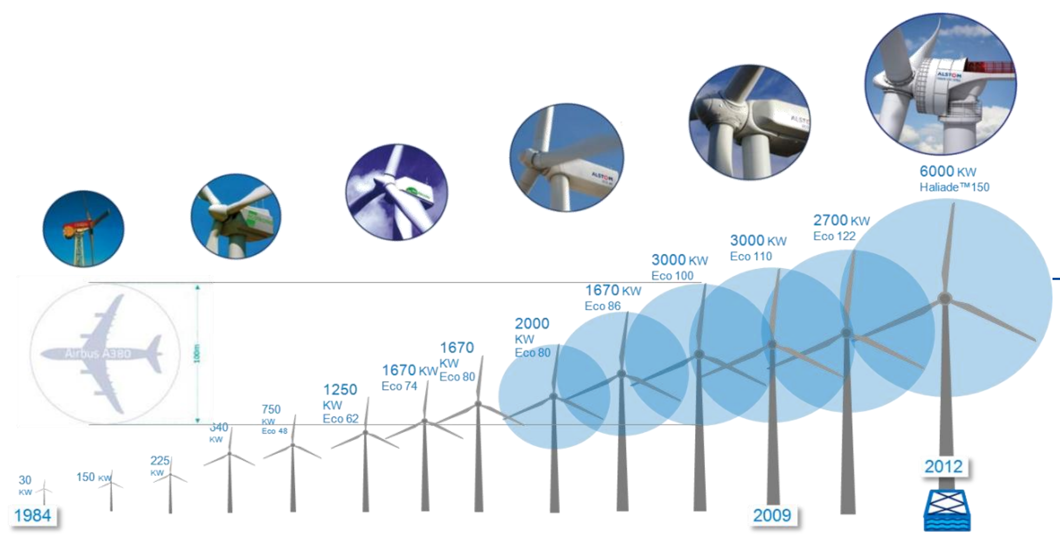
Alstom's Strategy
Offshore Wind – Haliade 150-6 MW

Offshore Wind

Evolution of Alstom Wind Turbines



Haliade 150-6 MW Prototypes

Onshore prototype at Le Carnet (France)

Offshore prototype at Ostend (Belgium)

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Alstom's Strategy
Offshore Wind – Haliade Installation at Ostend

Offshore Wind

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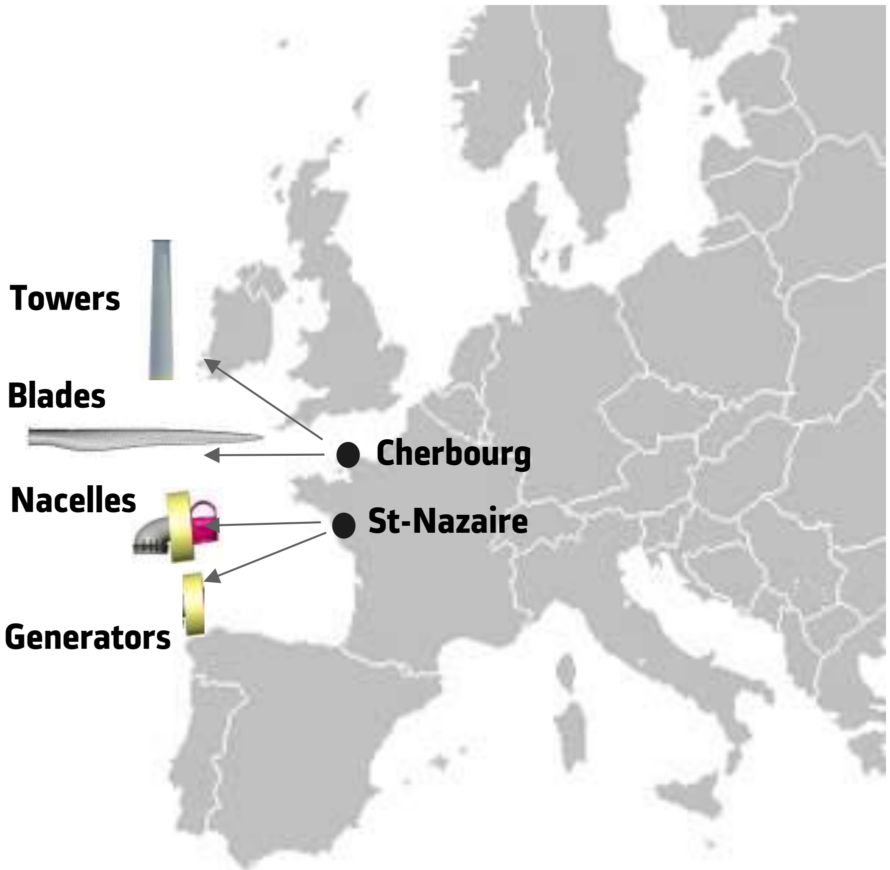
Alstom's Strategy
Offshore Wind – Industrial Plan in France



- **4 factories in 2 sites:**
  - **Generators** and **Nacelles** at Saint-Nazaire (the first stone of the nacelles factory was laid in early 2013)
  - **Blades** and **Towers** at Cherbourg
- **1 R&D / Engineering center for Marine Energies at Nantes**
- **Social impact:**
  - 1 000 direct & qualified jobs
  - 4 000 indirect jobs

Alstom's Strategy
Tidal Stream

1-MW Alstom Tidal Turbine

Tidal Pilot Farms - Industrial Plan in France

First Tidal pilot farm in France to be installed in 2017/2018, expected commercial farm by 2018/2019

Source: Alstom

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Alstom's Strategy
Key Achievements & Objectives

" Become one of the 3 world leaders in Marine Energies "

Offshore Wind

- **Exclusive turbine supplier of 3 wind offshore farms** at Saint-Nazaire, Courseulles-sur-Mer and Fécamp, for a total of around 240 wind turbines
- **4 facilities under construction** in Saint-Nazaire (nacelles, generators) and Cherbourg (blades, towers)
- Successfully erected **Haliade™ 150-6 MW prototypes**, both onshore at Le Carnet (France), and offshore at Ostend (Belgium)
- Targeting also other large offshore wind markets in Europe (Germany, UK) and the United States, where it has signed a contract with US offshore wind developer **Deepwater Wind** to supply five Haliade

Floating Offshore

- Glosten Associates selected the Haliade 150 for its **PelaStar Floating Tensio-Leg Platform** currently under construction in the UK, under ETI (Energy Technologies Institute) financing
- Alstom is contributing **engineering work** for the ETI project and discussions currently ongoing to form consortium with Glosten for further developments in Floating Offshore

Tidal Stream

- **Alstom is one of the very few companies to have produced energy on the grid** with a full-scale tidal turbine, immerged since January 2013 in Orkney (Scotland)
- **Full solution in development**, which will be ready for pilot farm projects in 2016-2017, including modular turbine platform, optimized foundation, interconnection solution, competitive installation process and Operation & Maintenance offering
- **AMI (Appel à Manifestation d'Intérêt) on Tidal pilot farms in progress**, involving 2 utilities (one of them being GDF-Suez)

R&D / Engineering center for Marine Energies to be built in Nantes, for Fixed & Floating Offshore Wind, as well as Tidal Stream technologies

Alstom's Strategy
Focus on Insurance

- **New technologies induce new risks; as a consequence, insurers are prudent while owners and financiers require more protection**
  - Owner and Contractor have to assume larger share of risk than for land based projects
  - Marine Energy projects have both land-based and offshore components, insurance market historically handles both differently
  - Large number of subcontractors each bearing significant risks, these have to be apportioned between contractor and subcontractor. Contractual arrangement sometimes do not match traditional insurance (Knock-for-Knock)
  - Significant serial risk, traditionally not well covered by insurance market
  - Duration of projects requires commitment of insurer in long term, which they are not accustomed to give

Marine Energies will present challenges to insurers (as they do to Contractors and Owners) which will require innovation and creativity on their part

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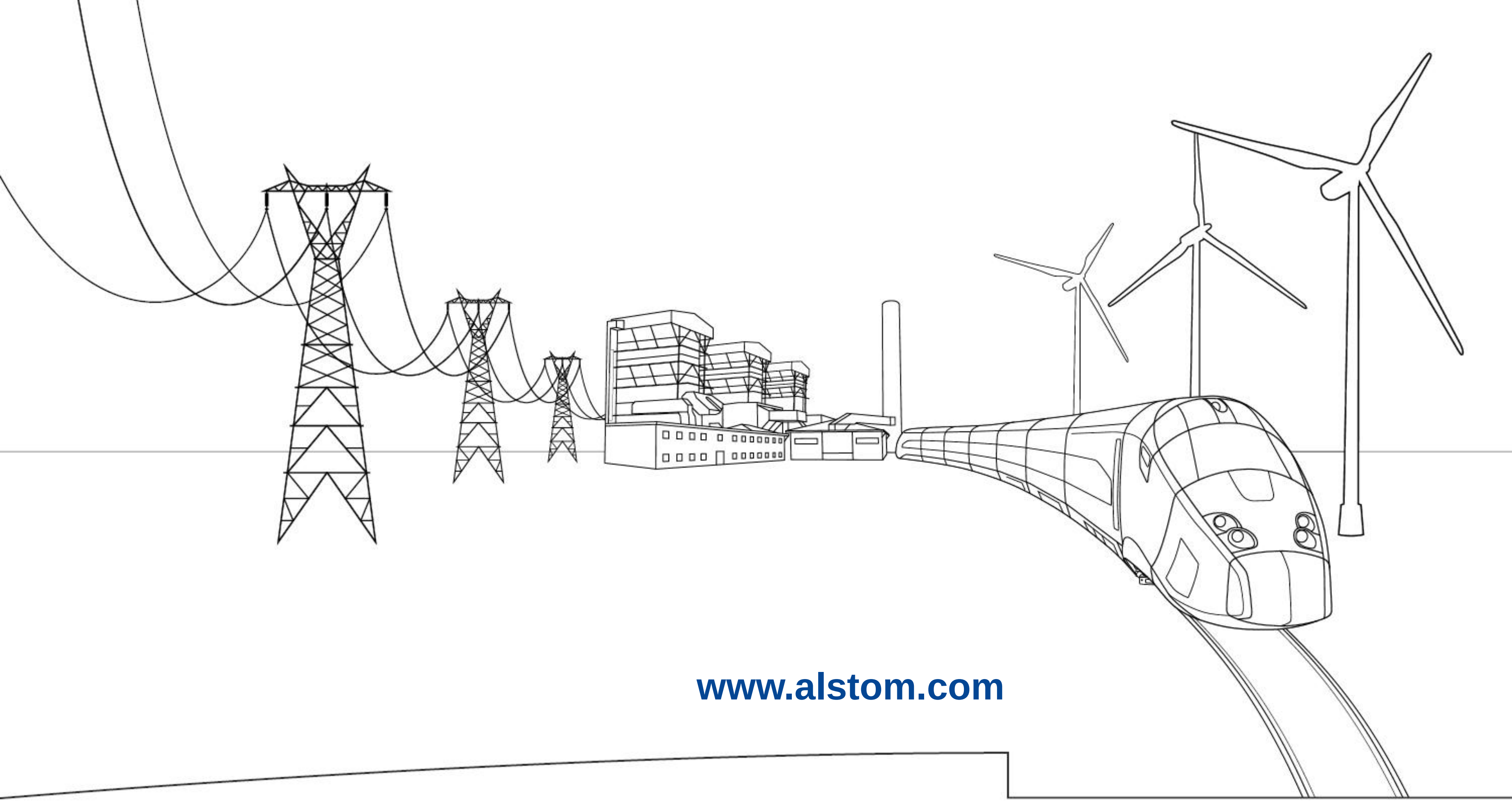

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