Jose Luis Villate

Offshore Renewable Energy
TECNALIA

CONTENT

Introduction: Offshore Renewable Energy

BIMEP: test infrastructure operating in real marine conditions

OPERA: Open sea operating experience to reduce wave energy costs

HarshLab: A unique offshore laboratory

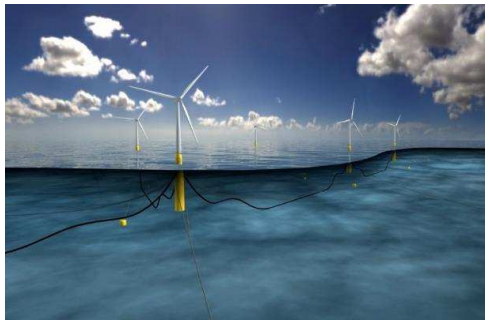
What is next?

Introduction: Offshore Renewable Technologies

Ocean Energy: Wave, Tidal Currents, Tide rise & fall, Ocean thermal gradient and Salinity gradient

Other renewables in the marine environment: Offshore wind, marine biomass, floating PV

Fixed Offshore Wind



Floating Offshore Wind

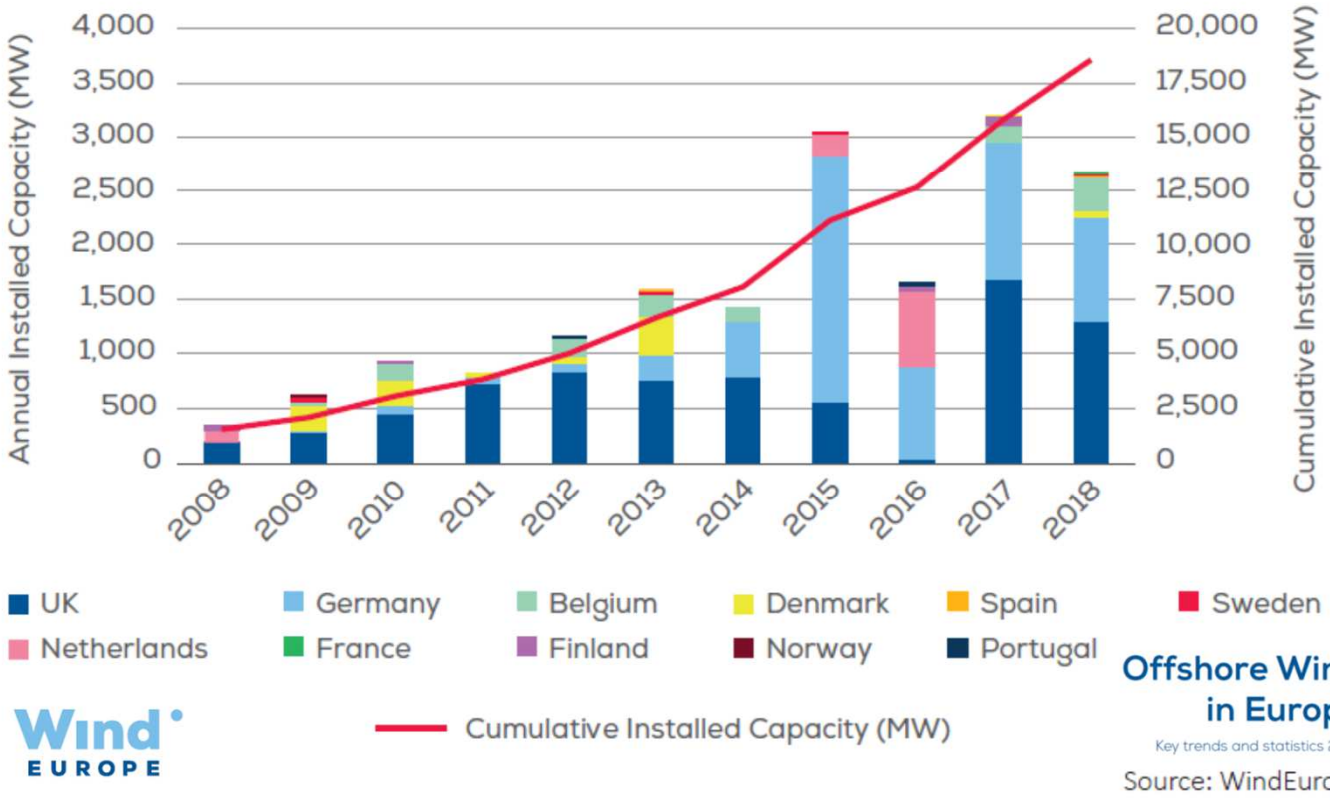
Wave Energy

Tidal currents

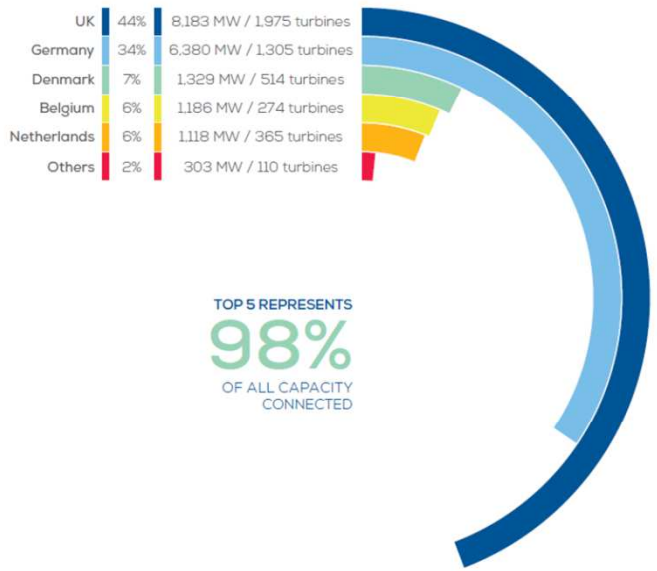
Introduction: Offshore Wind, a growing business

- 4,543 offshore turbines are now installed and grid-connected, making a cumulative total of 18,499 MW.

Annual offshore wind installations by country and cumulative capacity (MW)



Cumulative Installed capacity (MW) and number of turbines by country



Wind EUROPE

Offshore Wind in Europe

Key trends and statistics 2018

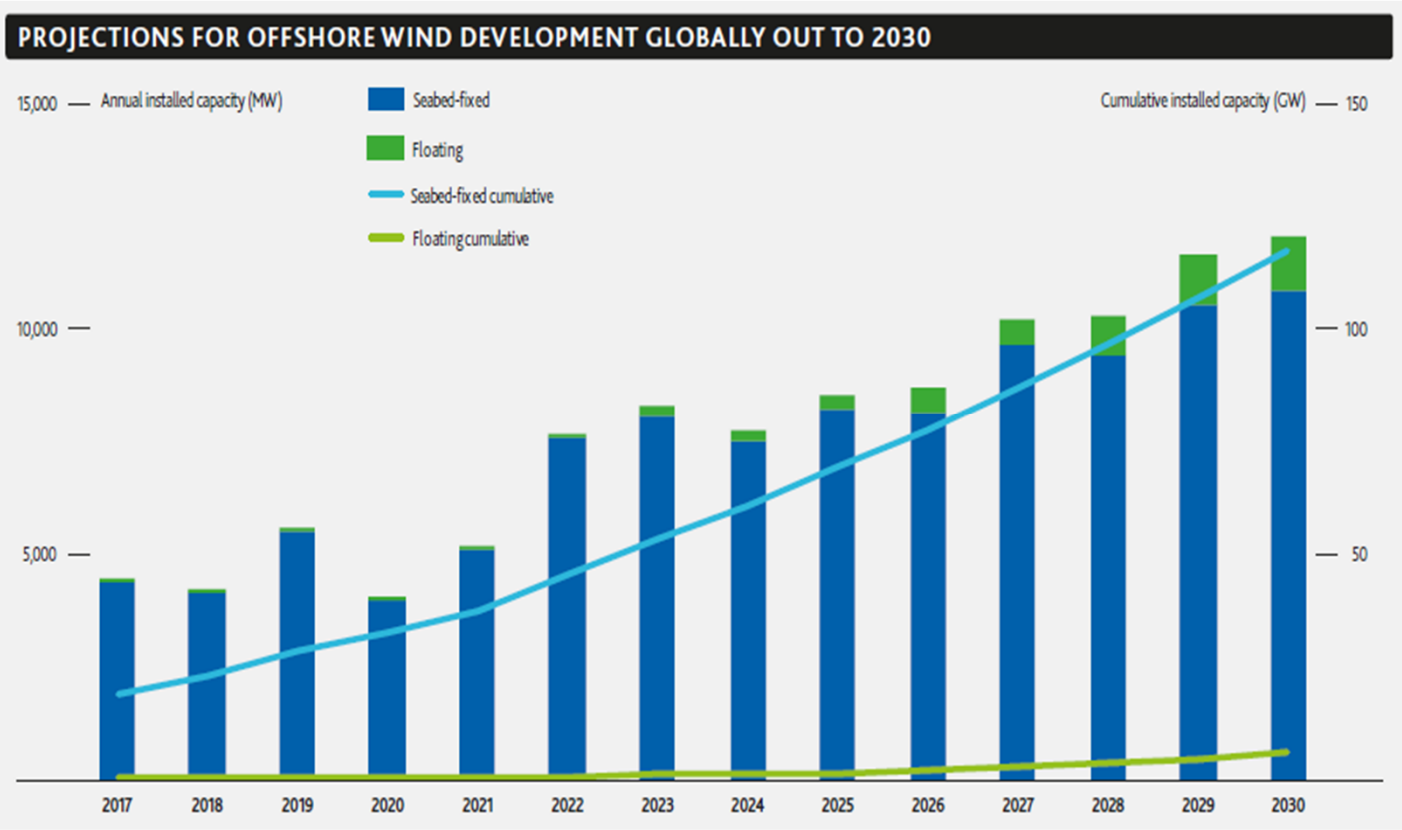
Source: WindEurope

Introduction: Floating Wind, emerging technology

Several solutions under development:
Semisubmersible, TLP, Spar…

First farm in operation,
several under construction

Introduction: Offshore wind, a global market

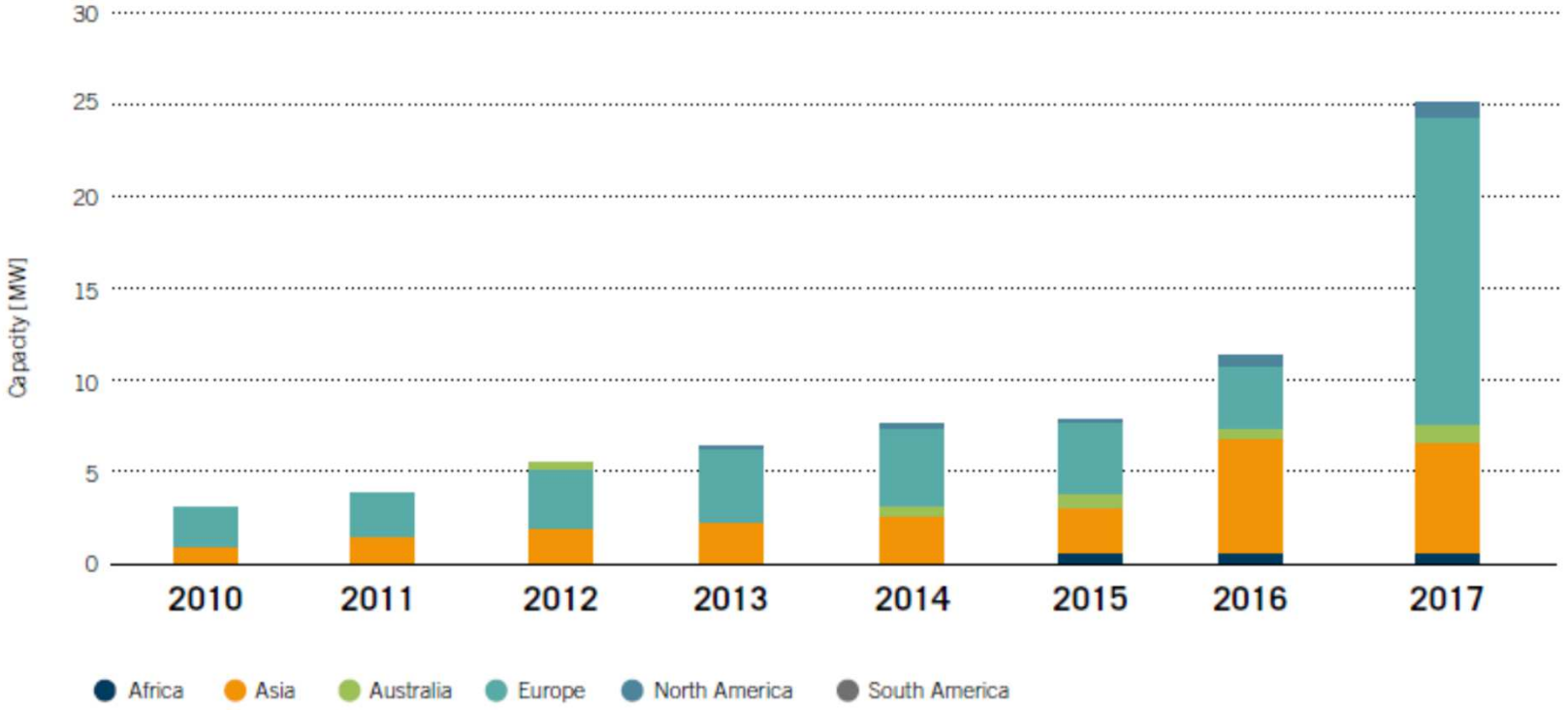


GWEC
GLOBAL WIND ENERGY COUNCIL

Global Wind Report

Annual Market Update 2017

Introduction: Wave and tidal, a few devices in the water



Cumulated ocean energy capacity by location in the period 2010 – 2017 (tidal barrage not included)
Source: OES WebGis Database - Fraunhofer IEE

Introduction: Wave and tidal, long term perspectives

iea Energy Technology Network | OES OCEAN ENERGY SYSTEMS

2017

INDUSTRIAL GOAL

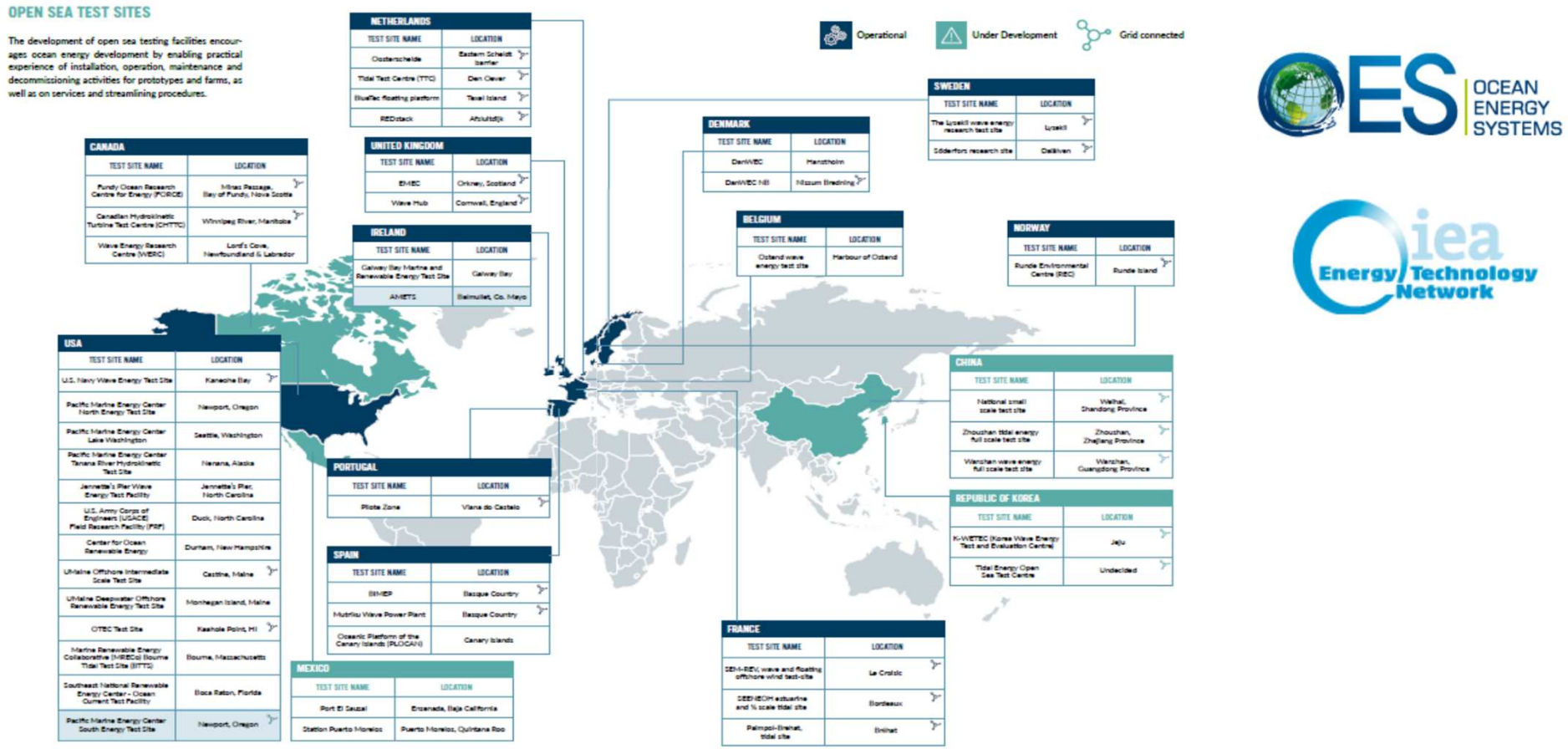
By 2050, ocean energy has the potential to have deployed over 300 GW of installed capacity.

Ocean Energy Forum

OCEAN ENERGY STRATEGIC ROADMAP
BUILDING OCEAN ENERGY FOR EUROPE

Under favourable regulatory and economic conditions, ocean energy could meet 10% of the European Union's (EU) power demand by 2050

Introduction: Open sea test sites for wave and tidal



OCEAN ENERGY SYSTEMS

iea Energy Technology Network

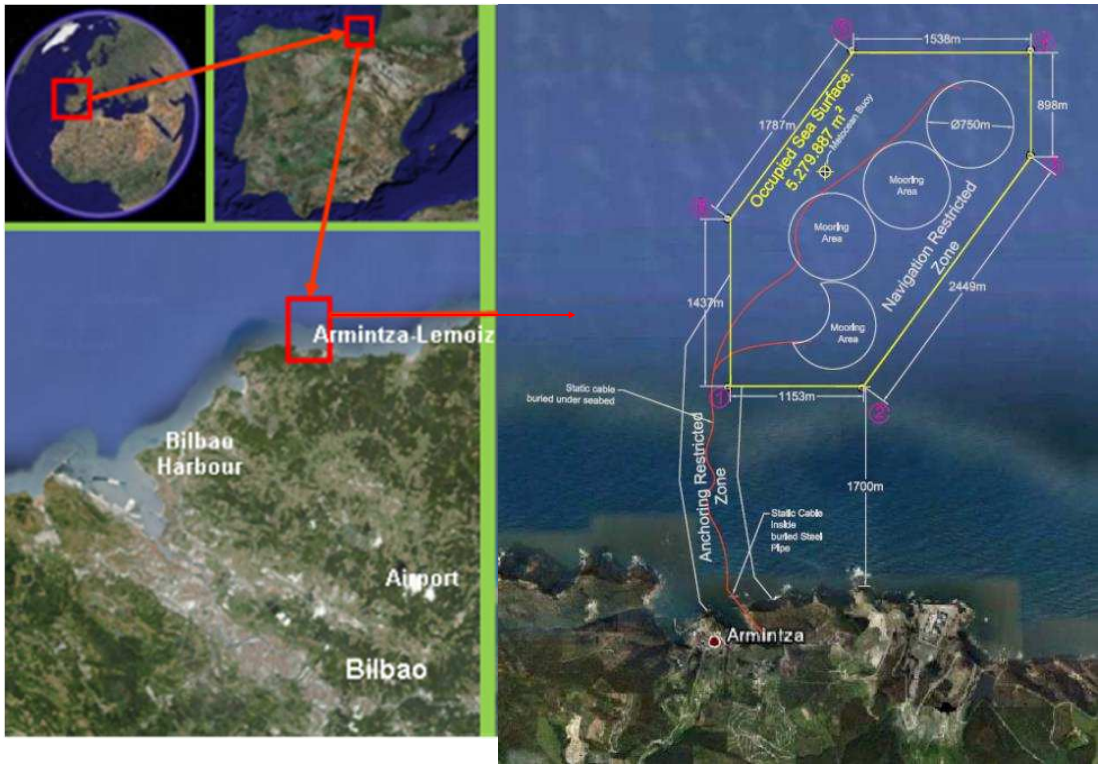
BIMEP: test infrastructure operating in real marine conditions

bimep

Biscay marine energy platform

https://bimep.com/

- An infrastructure for testing **prototypes of marine energy converters and auxiliary equipment** at open sea
- Located in the Gulf of Biscay, **1,6 nautical miles** away from the village of Armintza (Bizkaia, Spain)
- **5.3 km²** total surface area.
- Designed for **testing and demonstrating prototype devices** for harnessing marine energy prior to their full-scale commercial development.
- Fully equipped with **modern subsea infrastructure** for onshore grid connection:
  - 13,2 kV – 5 MW subsea export cables.
  - Research and Data Centre (Monitoring and control system)
  - **24/7 surveillance**



- Well communicated with Armintza's port, which allows a **quick access** to samples under trial while ensuring **100% offshore conditions**.

OPERA: Open sea operating experience to reduce wave energy costs

Key Challenges of Wave Energy

- Reduce COST of energy
- Improve overall PERFORMANCE
- Lower RISKS to attract investors

→ **Very limited EXPERIENCE of real open-sea operation**

OPERA: Open sea operating experience to reduce wave energy costs

Project Aims

Collect, analyse and share for the first time high-quality **open-sea operating data and experience**

Validate & de-risk **4 industrial innovations** for wave energy

Innovation	Target	LCOE impact
Novel biradial air turbine	50% higher annual efficiency compared to Wells turbine	33%
Advanced control strategies	30% increase in energy production	23%
Elastomeric mooring tether	Reduce peak loads by 70%	7-10%
Shared mooring configuration	50% reduction in overall mooring costs in arrays	5-8%

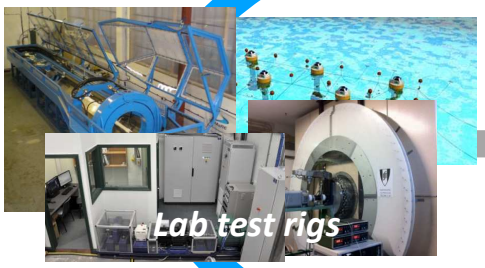
Reduce the **cost of wave energy** by 50% in the long term

OPERA: Open sea operating experience to reduce wave energy costs

Methodology

1 Baseline configuration
Nationally funded prototype (2.5 M€)

3 Benchmarking of new configuration
Global assessment



DATA COLLECTION
2 years

2 De-risking path
Innovations and procedures

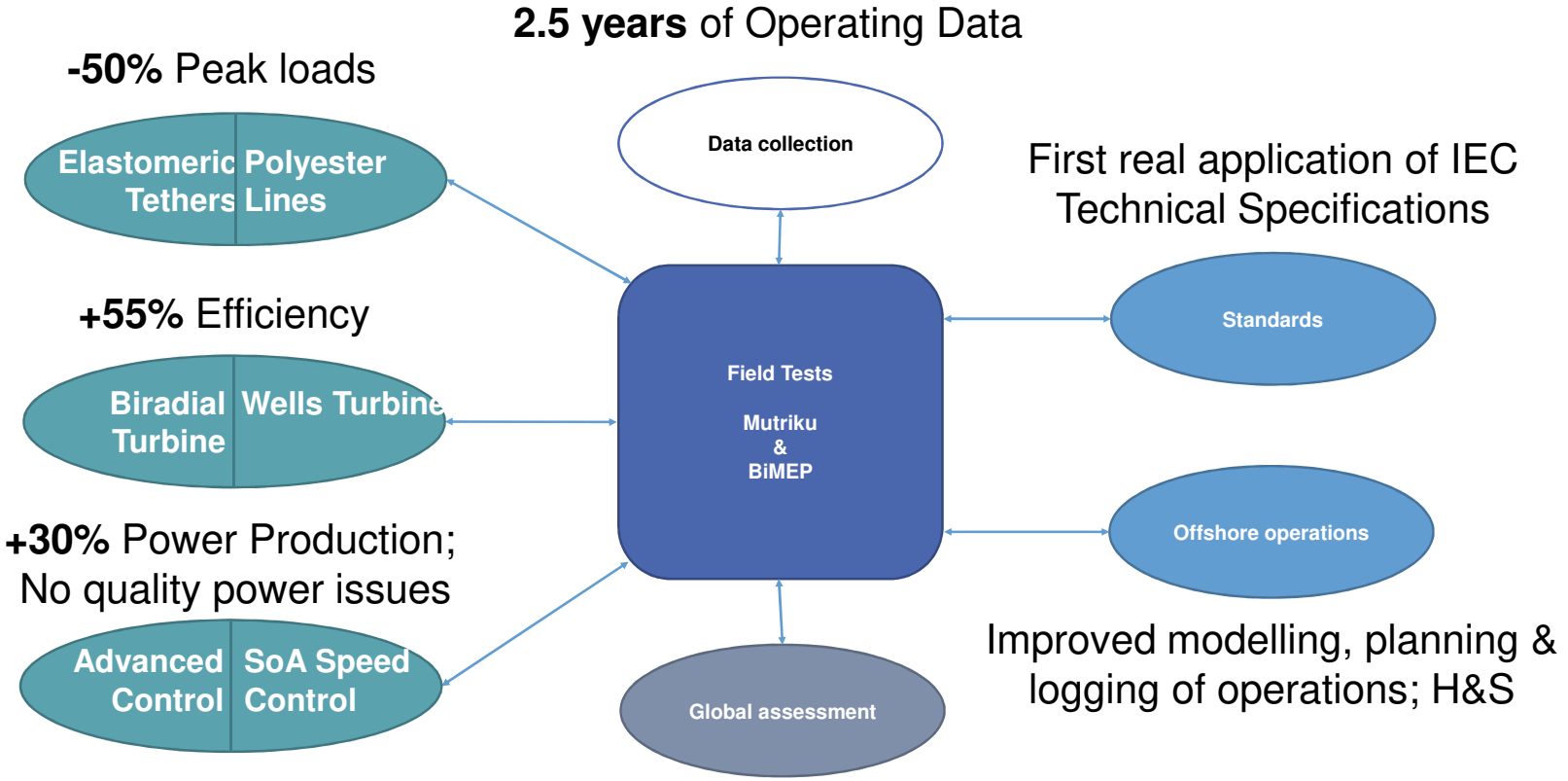
Feb 2016 • Jul 2019
www.opera-h2020.eu

OPERA: Open sea operating experience to reduce wave energy costs

Highlight of technical results

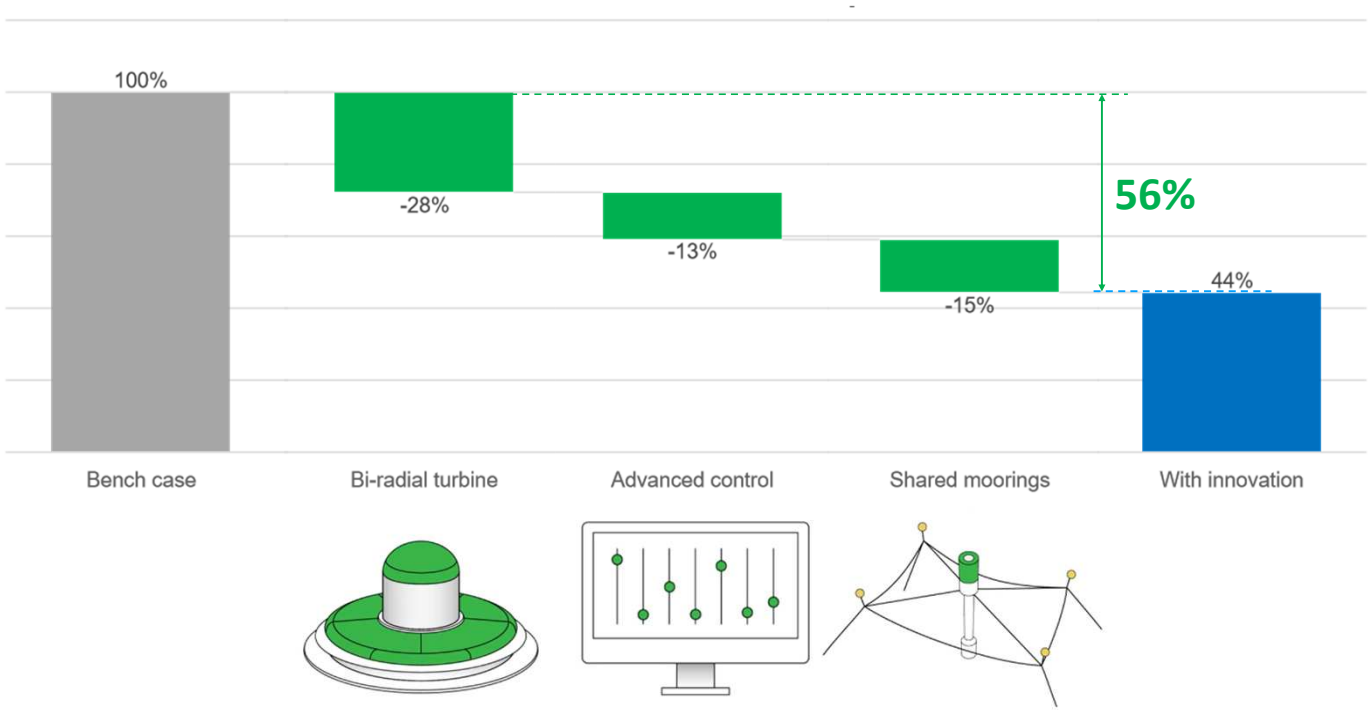
OPERA: Open sea operating experience to reduce wave energy costs

Summary of significant achievements (I)



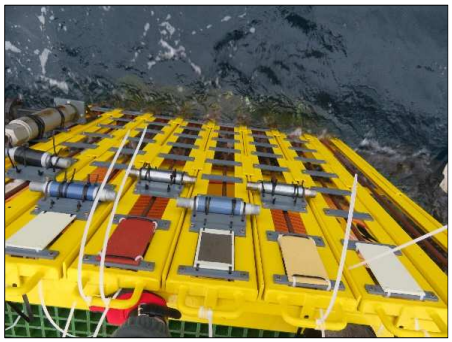
Summary of significant achievements (II)

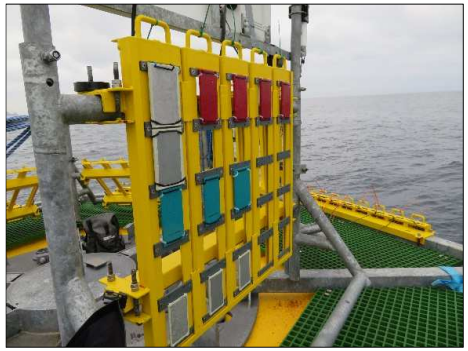
Long-term LCOE reduction potential due to OPERA innovations:
Breakdown of impacts



HarshLab: A unique offshore laboratory

- **<u>CALM buoy adapted to the BiMEP metaocean conditions</u>**
  - Diameter ≈ 5.415 mm
  - Heigh ≈ 4.740 mm
  - Lightweight ≈ 8 ton
  - Net buoyancy ≈ 21 ton
- Equipped with standard **<u>navigation aids</u>** as requested by BiMEP (AIS and lantern).
- It allows the evaluation of **standardized probes and other components** in real offshore environment.
- Atmospheric racks can be inclined at **45º or 90º**
- It can handle **up to 765 samples (125 in atmospheric zone, 320 in splash** and **320 in immersion).**
- **No need of divers for inspections**, immersion and splash probes can be easily extracted





HarshLab: A unique offshore laboratory

Inspection of samples (December 2018)

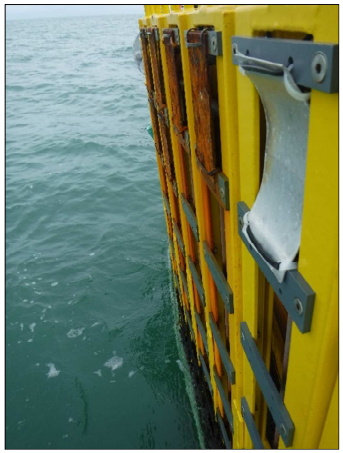
HarshLab: A unique offshore laboratory

HarshLab1.0 can host a variety of assays, such:

- **Corrosion tests**
  Harsh marine environment is ensured, with a **CX** classification in **atmospheric** and **splash zones**, and **Im2** in **immersion** zone. Immersion zone is prone to the formation of biofouling, so it's a good opportunity to study how the presence of barnacles and other biofouling species affect to the corrosion rate of specimens.

- **Antifouling solutions**
  BiMEP area is specially prone to biofouling growth, so test immersion sites at HL1.0 are suitable for testing experimental antifouling solutions under real offshore conditions. Additionally, most common species in BiMEP have been identified:

- **Ageing assays**
  Not only nude and coated metallic surfaces can be tested in HL1.0, but also other non-metallic materials that need to withstand harsh marine conditions while maintaining their properties (flexibility, aesthetic, etc)

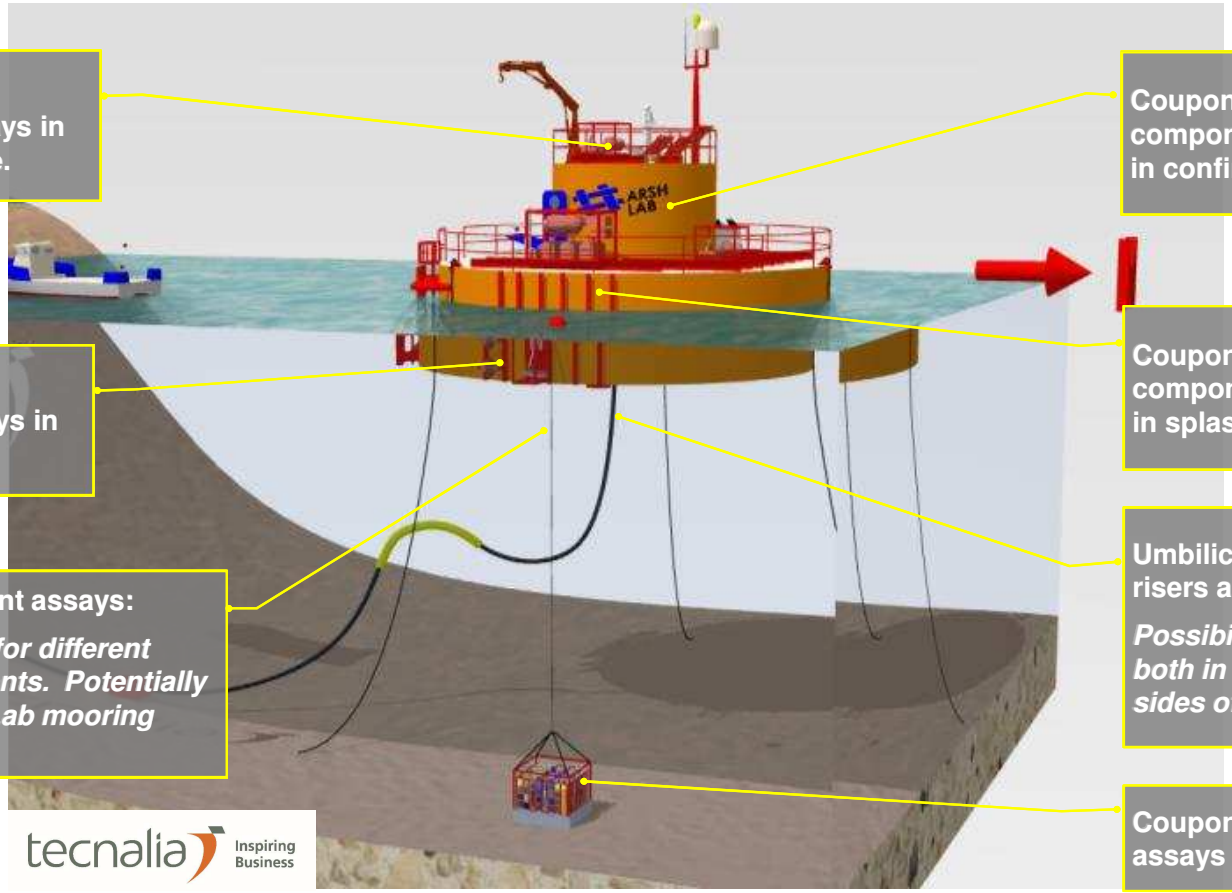







What is next?

HarsLab 2.0



What is next?

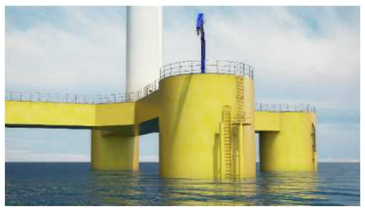
nautilus floating solutions

FLOW Project

The FLOW Project has been granted by the **SPRI** (Business Development Agency of the Basque Government) under the scheme of a **Strategic HAZITEK** (HAZITEK2017-FLOW Exp. ZE-2017/00031)

Development of a **FLO**ating **W**ind turbine for its full-scale demonstration

Main objective:
The development of a **5MW FOWT** to be installed at the **BiMEP** including the adaptation of the Wind Turbine to the floating substructure, the detailed design of the **NAUTILUS** floating platform and the design of the mooring and anchoring systems.



Thank you / Eskerrik asko / Gracias

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