

Ocean Energy

EU Policy perspectives

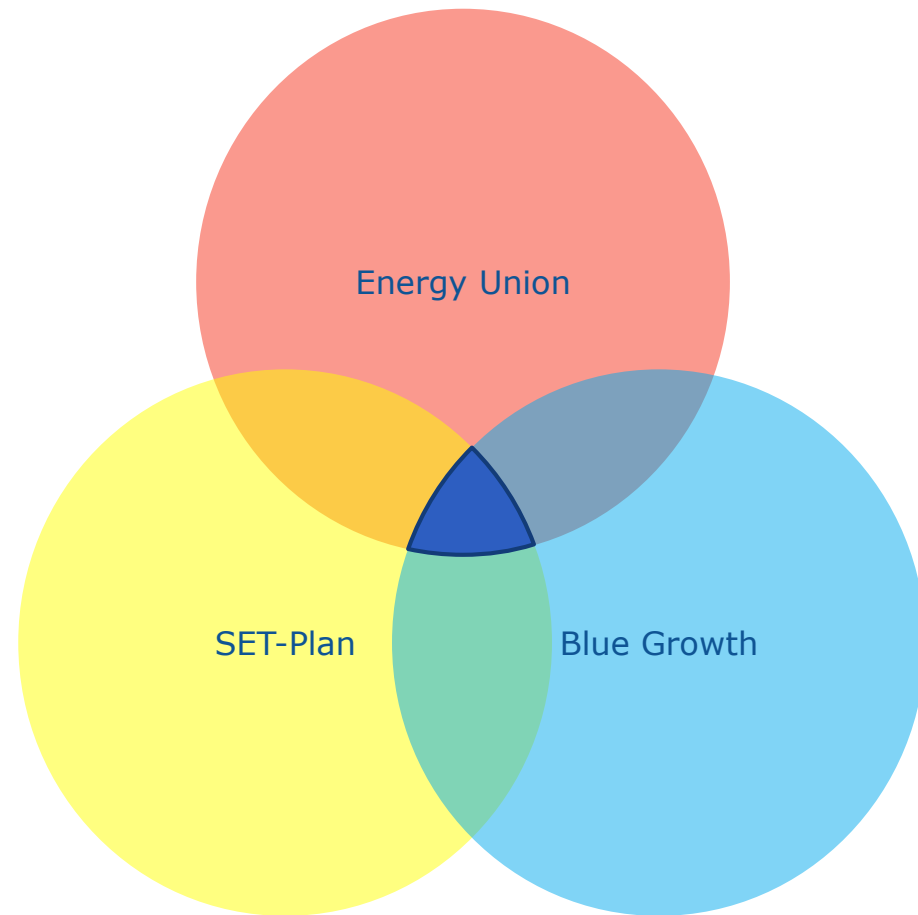
Dr. ir. Matthijs Soede

DG Research and Innovation

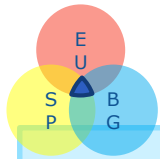
Directorate G: Energy - Unit G3: New Energy Sources

Delft, 24 April 2017

- *Policy Framework*
- *Highlights*
- *Activities*
- *Looking forward*



EU policy framework



Feb 2014	Dec 2014	Feb 2015	Sept 2015	Sept 2016	Nov 2016	Nov 2016
<p>Ocean Energy Communication (COM/2014/08)</p> <p>Setup Ocean Energy Forum</p> <p>Roadmap expected end of 2016</p>	<p>Towards an Integrated Roadmap: Research Innovation Challenges and Needs of the EU Energy System</p> <p>13 Actions in 3 different programmes for the uptake of Ocean Energy in EU</p>	<p>Energy Union (COM/2015/80)</p> <p>Retain Europe's leading role in global investment in renewable energy.</p>	<p>SET-Plan Communication (COM/2015/6317)</p> <p>Reduce the cost of key technologies</p> <p>Increase regional cooperation, in the Atlantic area for ocean energy</p>	<p>SET-Plan Declaration of intent, defining LCOE targets for tidal and wave energy</p>	<p>Publication of the Ocean Energy Strategic Roadmap developed by the Ocean Energy Forum and supported by DG Mare</p>	<p>Publication Energy Winter Package</p>

A stable policy framework at European level is in place to support the development of technology from early stage prototypes through commercialisation, providing stability for developers.

Energy Union

Commission



PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

2020

**-20 %
Greenhouse
Gas
Emissions**

**20%
Renewable
Energy**

**20 %
Energy
Efficiency**

2030

**≤ - 40 %
Greenhouse
Gas Emissions**

**≥27 %
Renewable
Energy**

**30% Energy
Efficiency**

Energy Union Political Context

- *Energy security, solidarity and trust*
- *A fully integrated internal energy market*
- *Energy efficiency first*
- *Transition to a low-carbon society*
- *An Energy Union for Research, Innovation and Competitiveness*



Strategic Energy Technology-Plan

- *Towards a low carbon future - COM(2007)723*
- *Integrated Roadmap 2014*
- *Communication on Integrated SET-Plan - COM(2015)6317*



Energy Union



**Putting energy
efficiency first**



**Demonstrating
global
leadership in
renewables**



**Delivering a
fair deal for
consumers**



**Energy Union
Governance**



Energy Efficiency
(Energy Efficiency
Directive, European
Performance of
Buildings Directive)



Renewables
(Revised Renewable
Energy Directive)



**New Electricity
Market Design
(including Risk
Preparedness)**



**Energy prices
and costs
report**

Energy Union



Delivering on social concerns and job training to ensure a socially fair energy transition



Driving digitalization forward to enable new energy technologies



Setting the right incentives for investment in the energy transition and maximising the use of public funds



Accelerating research and innovation to support leadership in advanced RES



Delivering on key energy infrastructure projects



Enabling Framework



External dimension: Fostering security of supply and promoting clean energy measures abroad



Ensuring regional cooperation: Making the energy transition a multi-level government and stakeholder project



A framework strategy for a resilient **Energy Union** with a forward-looking climate change policy

- Secure, Sustainable, Competitive, Affordable Energy for every European



SET Plan (Strategic Energy Technology Plan):

- **Strategic instrument** to implement the R&I and competitiveness dimension of the Energy Union
- Speed up energy transition through:
 - the **implementation of 10 Actions** to develop and integrate innovative technologies and system solutions
 - a better **alignment of public & private R&I agendas**



SET Plan Actions



Energy Union

Research, Innovation and Competitiveness Priorities

SET-Plan 10 Key Actions

No1 in Renewables



- 1 Performant renewable technologies integrated in the system
- 2 Reduce costs of technologies

Consumers in the Energy System



- 3 New technologies & services for consumers
- 4 Resilience & security of energy system

Efficient Energy Systems



- 5 New materials & technologies for buildings
- 6 Energy efficiency for industry

Sustainable Transport



- 7 Competitive in global battery sector and e-mobility
- 8 Renewable fuels and bioenergy

Carbon Capture Utilisation and Storage



- 9 Carbon Capture Storage / Use

Nuclear Safety



- 10 Nuclear safety

- Addressing the whole **innovation chain**, from basic research to market uptake, in terms of **financing** as well as in terms of **regulatory framework** for these actions.
- Assessment based on the energy system needs and on their importance for the **energy system transformation** and their potential to create **growth** and **jobs** in the EU.

SET Plan steps



SET Plan 10 Key Actions:

Communication published in September 2015

DONE

Setting targets:

agreed through 'Declarations of Intent'

DONE

Set-up of temporary Working Groups:

to prepare Implementation Plans

IN PROGRESS

Implementation Plans: to select R&I Activities, identify Flagships, and define mechanisms

IN PROGRESS

FUNDING

Mainly from
National sources /
Industry

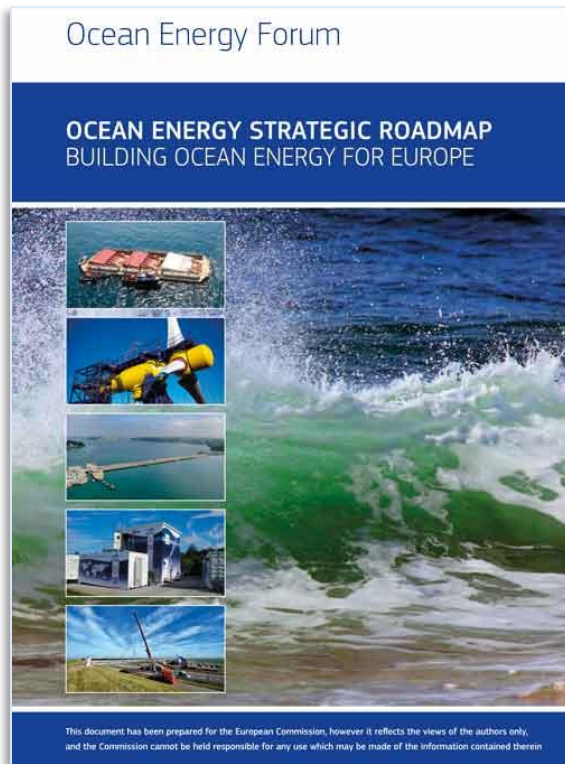
In specific cases
at EU Level.

EU Policy drivers for ocean energy

Communication on Blue Energy (2014): Actions needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond

"Where the EU is currently world leader, such as in [] ocean energy, leadership should be maintained "

Strategic Energy Technology -Plan
Communication



Ocean Energy Forum

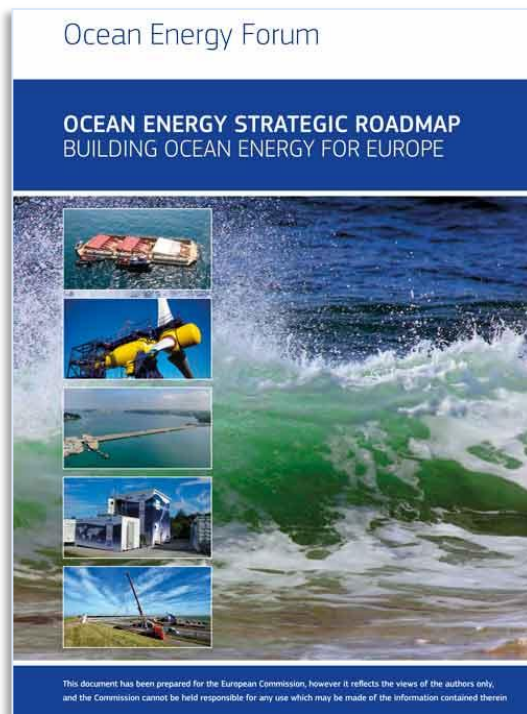
Partnership between Industry and Public Authorities identifying key actions for supporting investments and de-risking Ocean Energy

- *3 working groups (Technology, Finance, Environment & Consenting)*

Action plans

- *1) R&D and prototype: a EU phase-gate technology development process for sub-systems and devices*
- *2) Demonstration & Pre-Commercial: an investment Support Fund for ocean energy farms*
- *3) Demonstration and Pre-Commercial: an EU insurance and Guarantee Fund to underwrite project risks*
- *4) De-risking environmental consenting thorough and integrated programme of measures*

Staff working Document DG MARE (SWD(2017)128)



- *EU-wide phase-gate approach for technology development*
- *A public-private Investment Support Fund should be established to finance start-up capital needs*
- *Create a packaged approach for financing farms*
- *An Insurance and Guarantee Fund should help cover the risk associated with deployments of new technologies*
- *Support studies, research and actions on environmental consenting should help de-risk consenting procedures*

2016 Highlights



ETIP Ocean

European Technology and Innovation
Platform for Ocean Energy (ETIP Ocean)

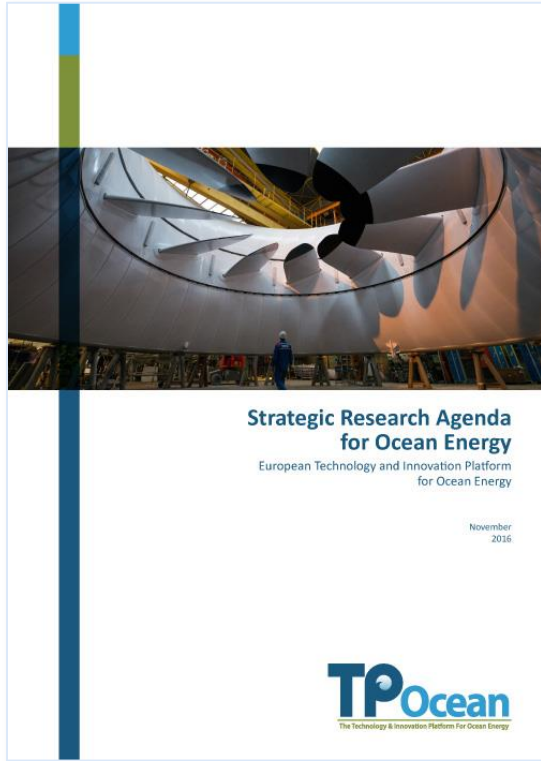
Coordination

Ocean Energy Europe and
EERA JP Ocean (chair: Edinburgh university)

<https://www.etipocean.eu/>

Dialogue, advice, webinars, brokerage
event...

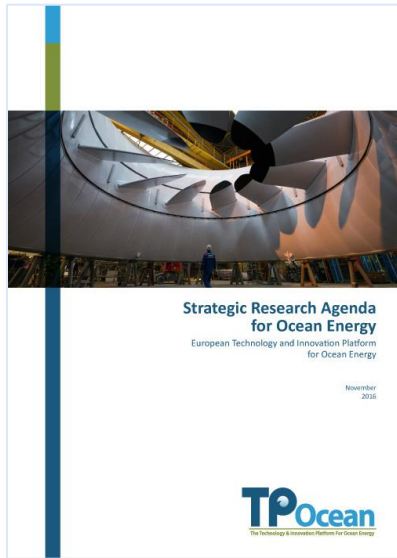
Student/Company Brokerage Lunch at ALL-Energy, Glasgow, 10 May 2017



ETIP Ocean – Strategic Research Agenda

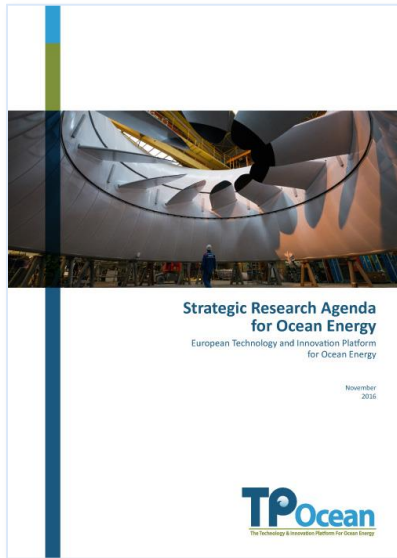
- *1. Demonstration, Testing and Modelling*
 - **Deploy demonstration projects to generate learning necessary for commercialisation**
 - **Technology development through validated numerical models and small scale prototypes**

- *2. Materials, components and Systems*
 - **Develop high quality seaworthy materials**
 - **Increase yield with improved Power Take-off**
 - **Validation of components and sub-systems**
 - **Control systems to increase reliability and survivability**
 - **Condition monitoring systems to optimise operation and maintenance**



ETIP Ocean – Strategic Research Agenda

- *3. Installation, Logistics and Infrastructure*
 - **Access to ocean energy sites, design adapted processes and vessels**
 - **Reduce uncertainty , risk and cost of foundations, anchoring systems and cables**
 - **Power transmission and array cable architecture**



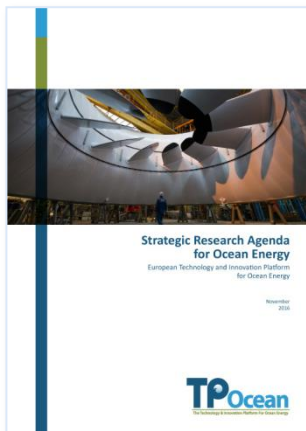
4. Non-technological issues

- **Building a case for investments, including LCoE analysis**
- **Develop manufacturing expertise for ocean energy**
- **Standards, health, safety and environment**

ETIP Ocean prioritisation 2017

- *Prioritisation of challenges in line with the actions recommended from Ocean Energy Forum*

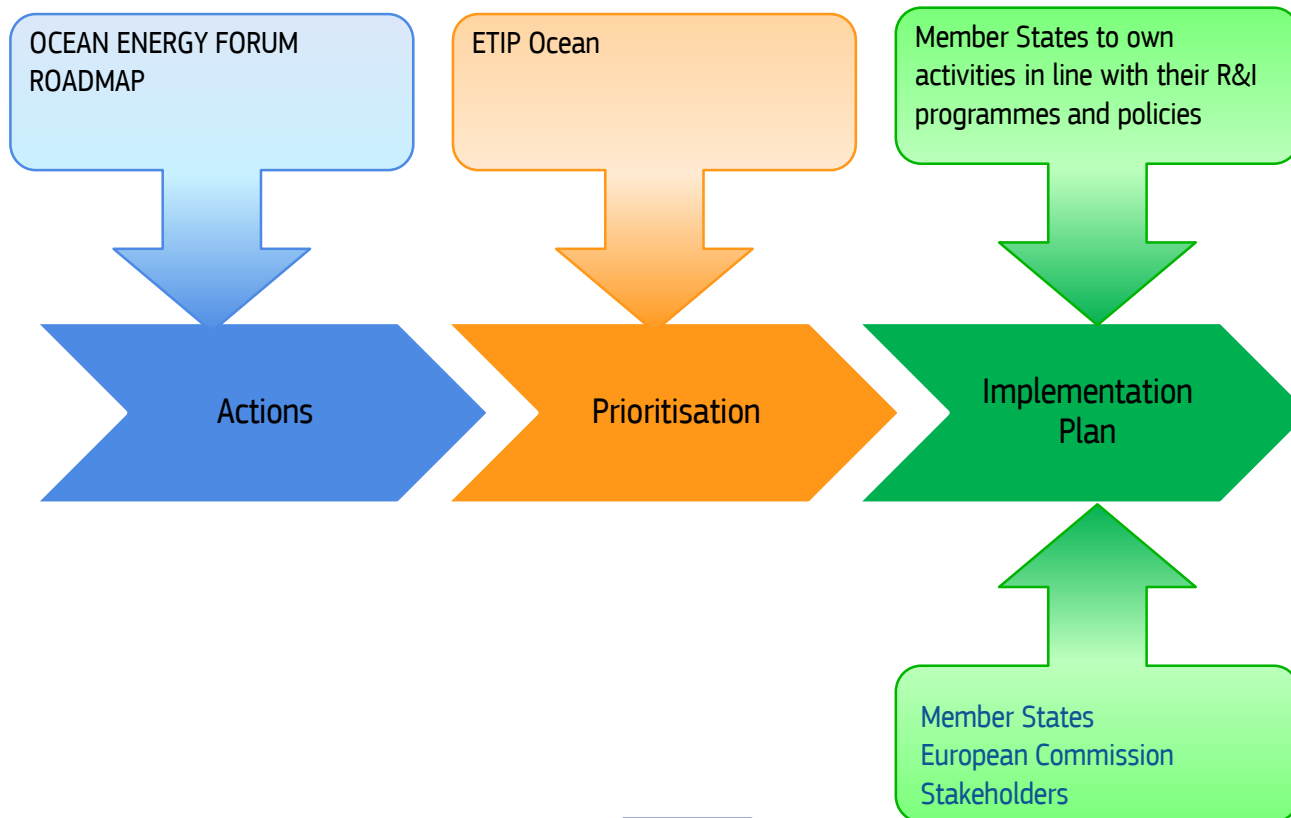
Category	Challenge
Technology	Developing novel concepts for improved power take-offs (PTOs)
	Increasing device reliability and survivability
	Investigating alternative materials and manufacturing processes for device structures
	Investigating novel devices before moving towards convergence of design
	Defining and enforcing standards for stage progression through scale testing
	Developing and implementing optimisation tools
Financial	Providing warranties and performance guaranties
	Linking stage-gate development processes to funding decisions
	Maintaining grant funding for early TRL technologies
	Establishing long term revenue support
Environmental and socio-economics	Enhancing social impact and acceptance
	Minimising negative environmental impacts
	Facilitating knowledge transfer and collaboration
	Implementing adaptive management systems



SET-Plan Ocean Energy

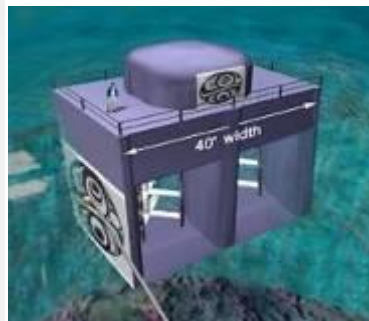
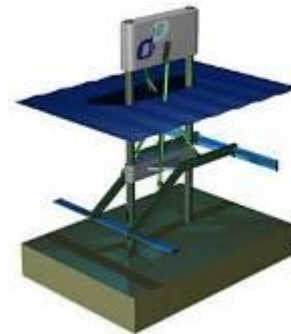
Development of cost competitive ocean energy technologies with high market potential for Europe:

- LCoE for tidal stream 15ct€/kWh by 2025 and 10ct€/kWh by 2030
- LCoE for wave energy 15ct€/kWh by 2030 and 10ct€/kWh by 2035

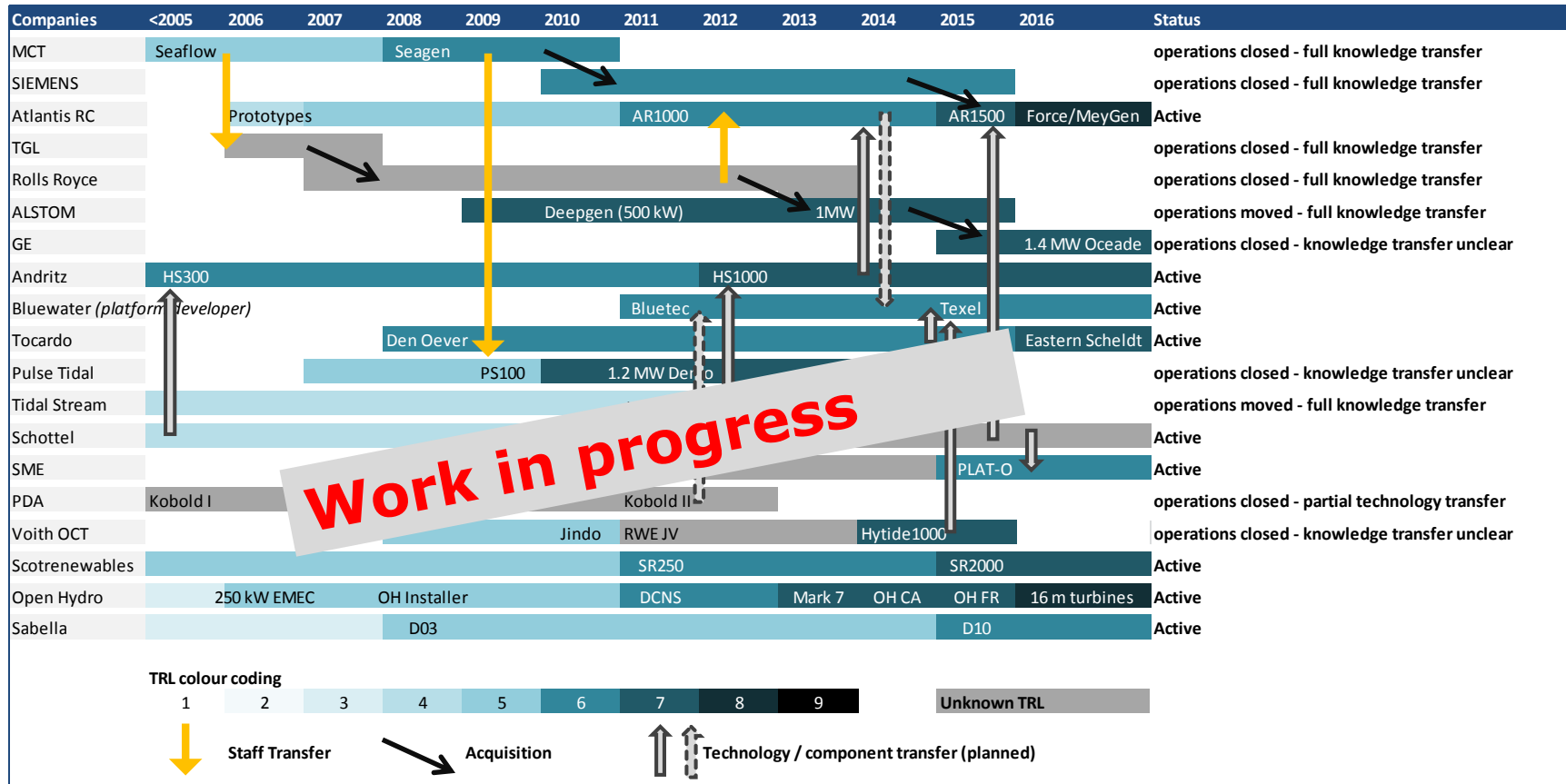


Variety of tidal energy technologies

European
Commission

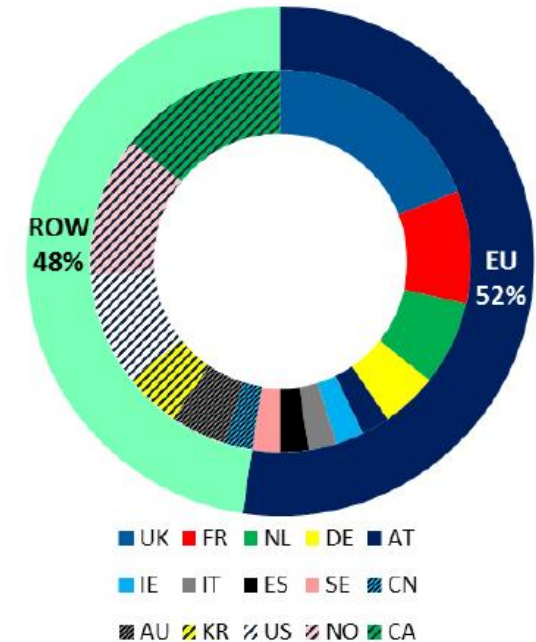
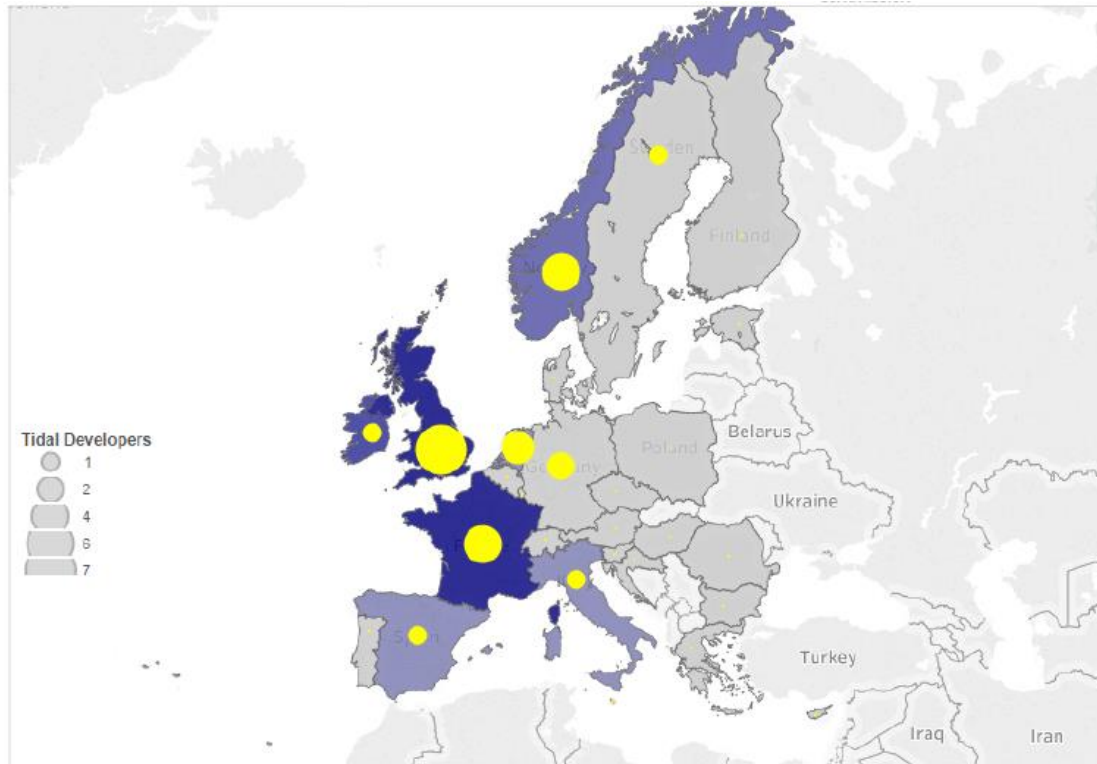


Tidal turbine development



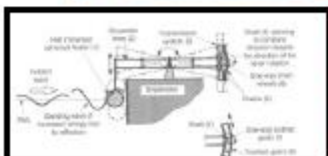
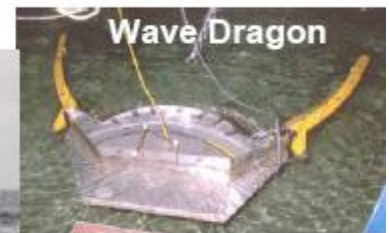
Source: Fraunhofer IWES, Ecorys, Study lessons for Ocean Energy Development

Tidal energy



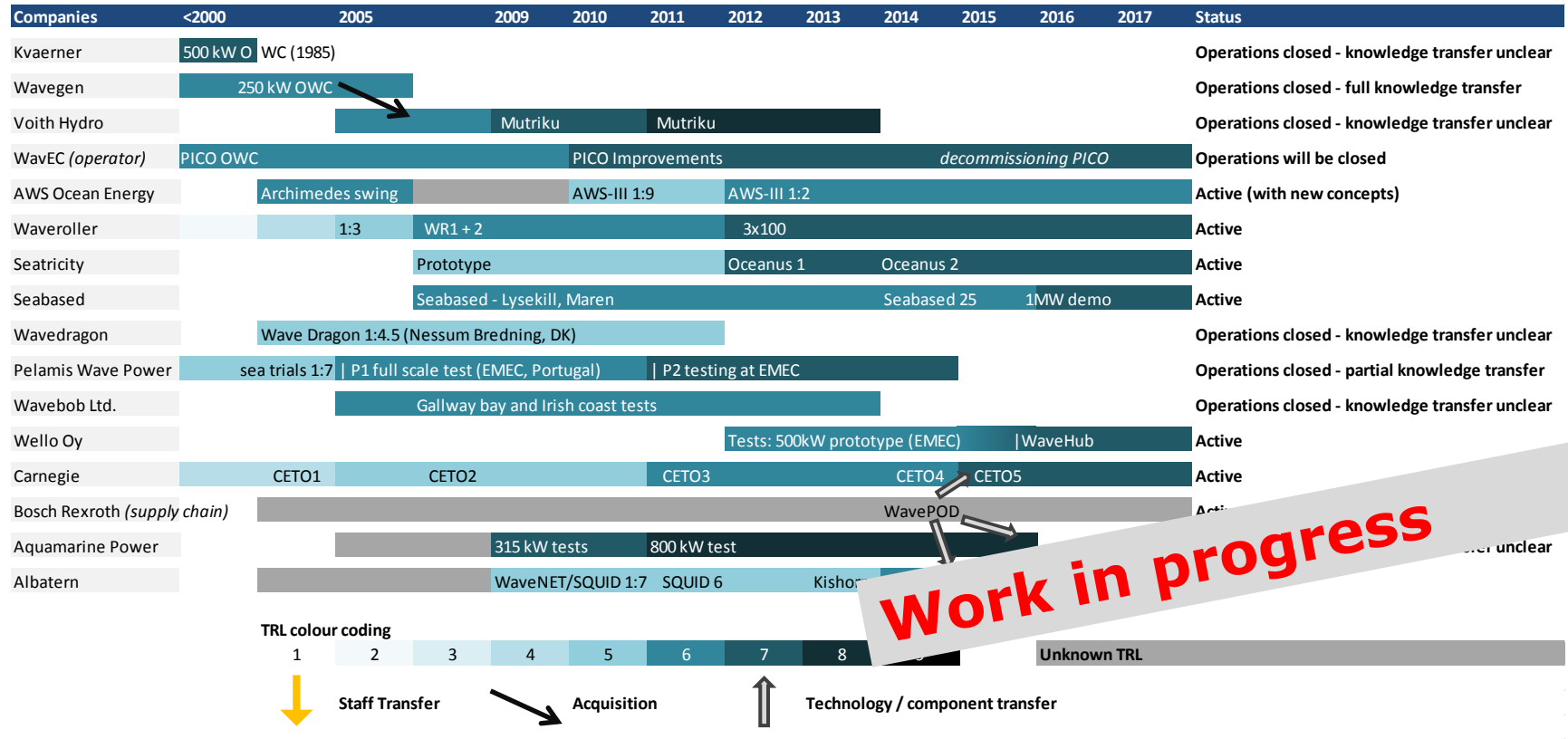
- *EU global leader*
- *600 MW of projects pipeline by 2020, 71MW already funded.*
- *Pipeline to 2024 of 1250 MW.*
- *Support for pre-commercial farms needed to facilitate market creation*

Variety of Wave Energy Convertors



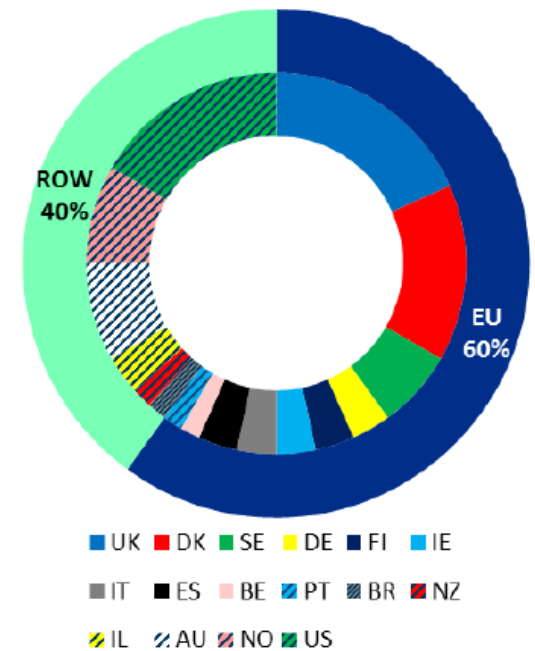
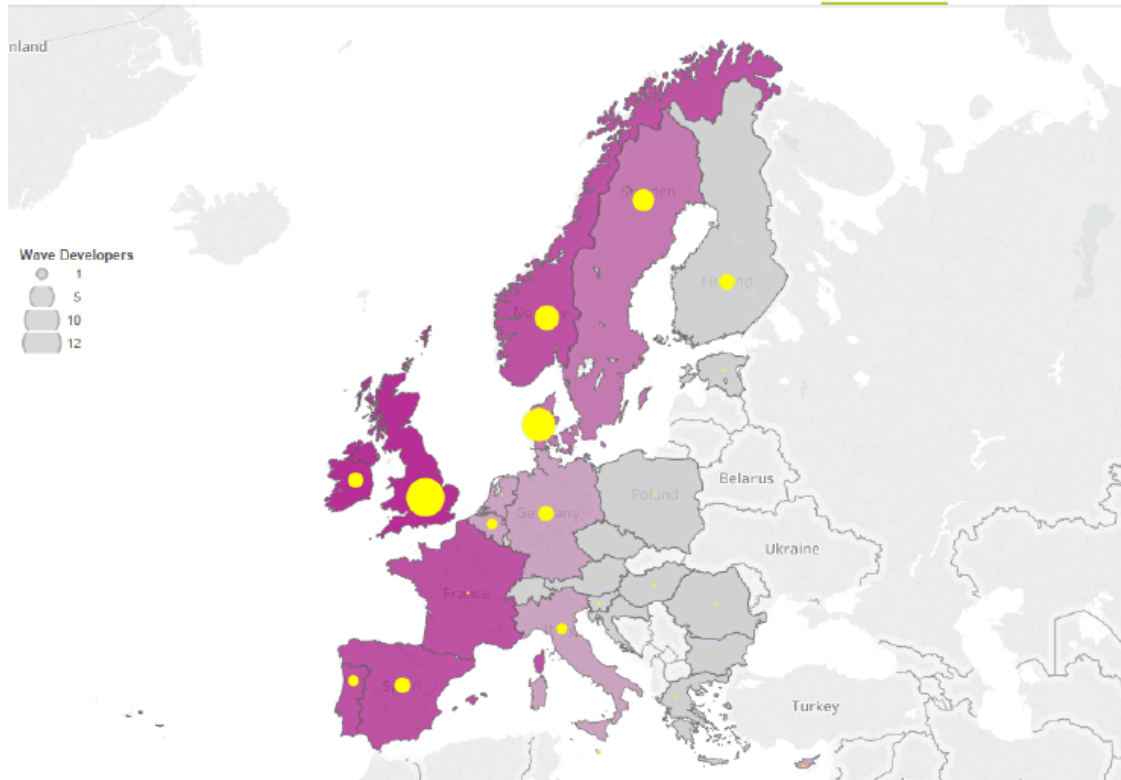
Source: HMRC-UCC

Wave energy



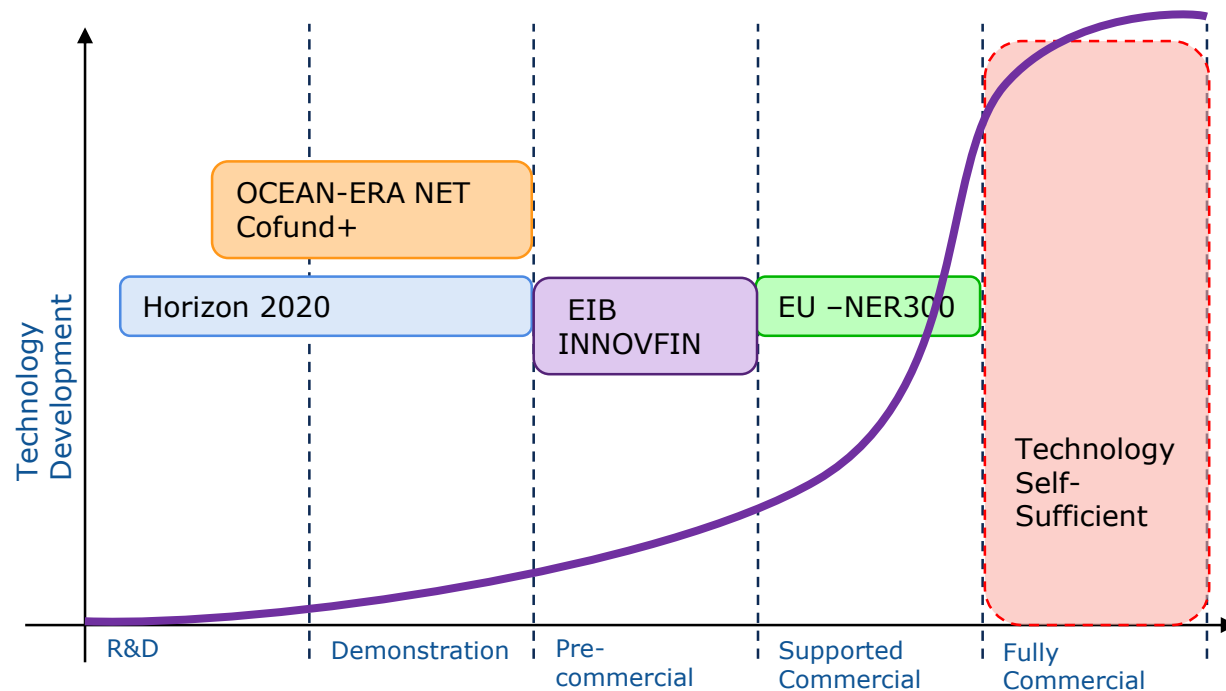
Source: Fraunhofer IWES, Ecorys, Study lessons for Ocean Energy Development

Wave energy



- *EU global leader. Pan-European supply chain.*
- *65 MW of projects pipeline by 2020, 37 MW awarded funding.*
- *Cost reduction of 85% required to meet targets. Technology validation needed, support for R&D and demo plants.*

EU mechanisms support the development and demonstration of ocean energy technology towards commercialisation.



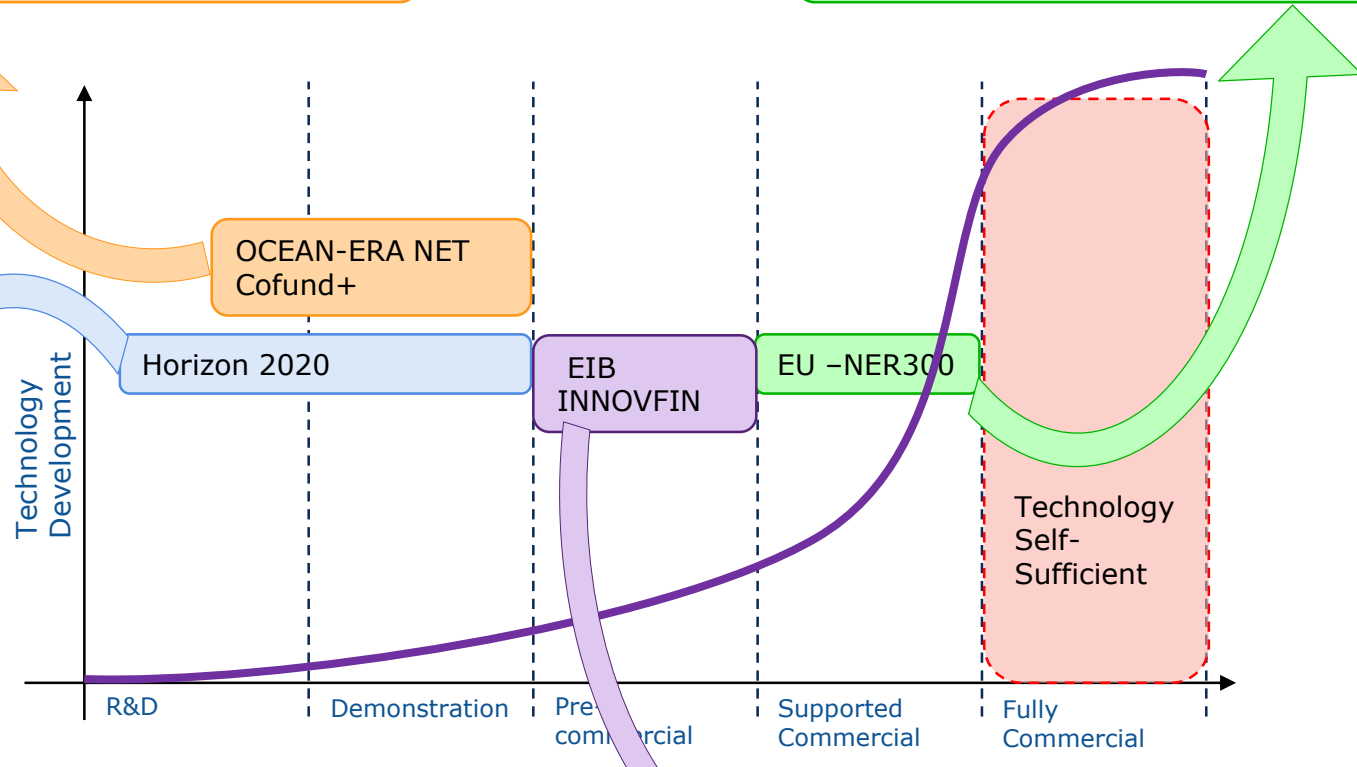
Other support mechanisms are available through Intereg programme (e.g. Foreseas) and S3P Energy

EU Support



Supporting transnational collaborative demonstration – 8 funding agencies

5 Supported projects – 2 tidal, 2 wave, 1 OTEC for 140 Mil EUR



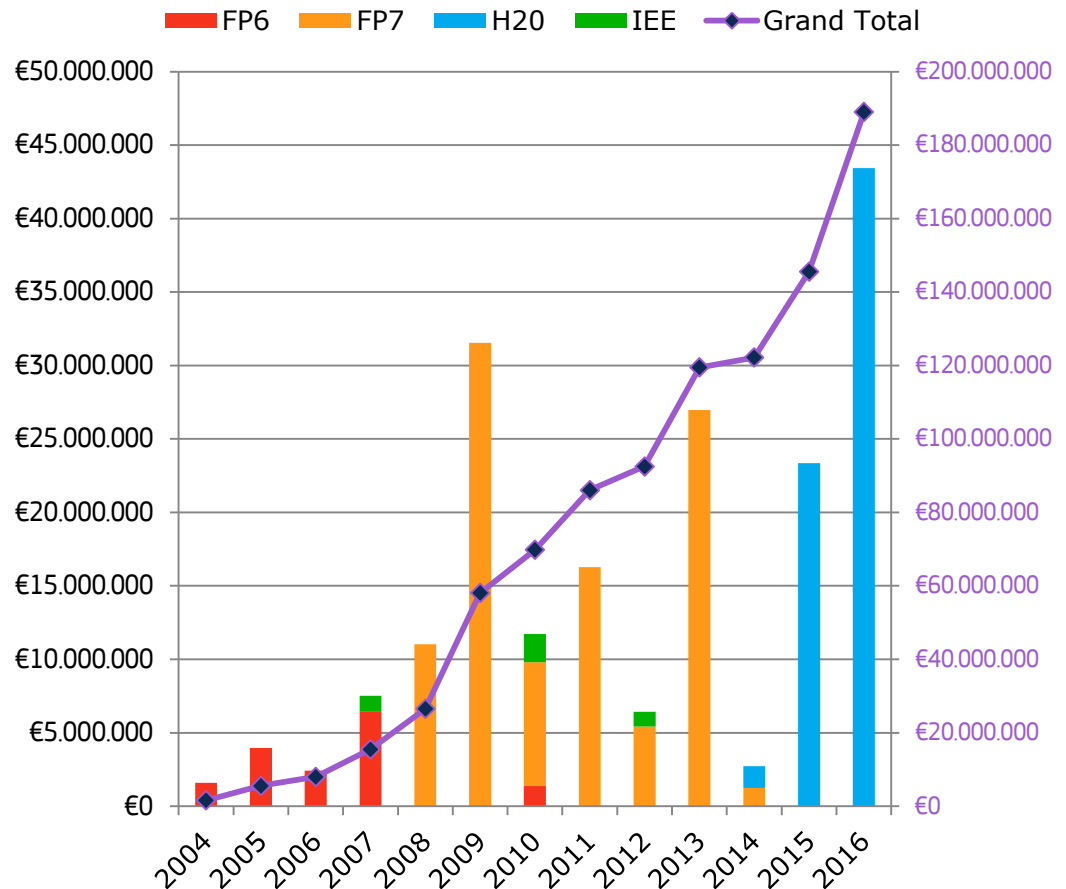
9 R&D Projects funded – 54 Mil EUR
11 SME Projects – 7 Mil EUR

1 Wave project support for 10 Mil EUR

R&D Support



Since 2004 EU provided
EUR 190 millions
24 Projects directed to
device validation/demo
(9 FP6, 8 FP7, 7 H2020)
FP7 – EUR 10
Millions/year
H2020 – EUR 30
Millions/year



Risk finance for demonstration projects

InnovFin Energy Demo Projects Pilot Facility (EDP)

First-of-a kind commercial-scale industrial demonstration projects (TRL 7-8) for unproven pre-commercial technologies in the field of innovative **renewable energy, fuel cells and hydrogen** in support of the SET-Plan

Loan amount: min EUR 7.5 M€, max EUR 75 M€

Loan maturity: up to 15 years

H2020 Projects



Acronym	Technology developer	Focus
InToTidal	Tocado	Demonstration of deployment solutions for tidal turbines
TAOIDE	Ocean Renewable Power Company	Development of wet-gap generators, Life time cost reduction. Achieve availability of 95%
<ul style="list-style-type: none"> • <i>9 projects supporting demonstration of wave and tidal energy converters at different TRL – from TRL 5 to 9</i> • <i>Key research areas: PTO, Survivability, cost reduction</i> 		
DEMOTIDE	DEME Blue energy/Atlantis	device. 50% LCOE reduction The Demotide project aims to reduce the cost of tidal energy generation and progress tidal energy to commercialisation.
FLOWTEC	Scotrenewables	Optimisation of energy extraction
CEFOW	Wello Penguin	3 device to be installed by 2019
OPERA	OceanTEC	Gathering experience and data from demonstration projects
POWERKITE	Minesto	Enhance structural and power performance of the PTO

H2020 Demos



FLOWTEC



CEFOW



OPERA

- ***Implementation of Horizon 2020 Work Programme***
- ***Definition and publication of Work Programme 2018-2020 for Horizon 2020***
- *Publication study on Lessons for Ocean Energy Development*
- *Temporary working group Ocean Energy – development action plan based on key recommendations for Ocean Energy Forum Roadmap*
- *Engagement with key stakeholders – European Technology and Innovation Platform on Ocean Energy*

- *Definition and publication of Work Programme 2018-2020 for Horizon 2020*

***-Tidal energy convertors:** New type of blades needs to be developed with behavioural modelling to achieve extended lifetime and high resistance in marine environment*

***-Monitoring system for marine energy (ocean and offshore wind):** New intelligent sensors and fault detection systems for accurate condition monitoring will enable predictive and preventive Operation & Maintenance processes. Sufficient knowledge of potential failures and the right tools to detect failures are crucial.*

***-European Pre-Commercial Procurement Programme for Wave Energy** Research &Development*

-Offshore – Floating Wind: Technology development including cost efficient anchoring and mooring system, dynamic cabling, installation techniques, and O&M concepts

- *Implementation of Horizon 2020 Work Programme*
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Cooperation
for mutual
benefit



European
Commission



IEA Technology Collaboration Programme OCEAN ENERGY SYSTEMS

Henry Jeffrey
OES Chairman

IEA Technology Collaboration Programmes



International
Energy Agency

Energy
Security

Environmental
Protection

Economic
Growth

Engagement
Worldwide

→ Governments and Industry benefit from sharing resources and accelerating results

→ For this reason the IEA enables independent groups of experts – the IEA Technology Collaboration Programmes

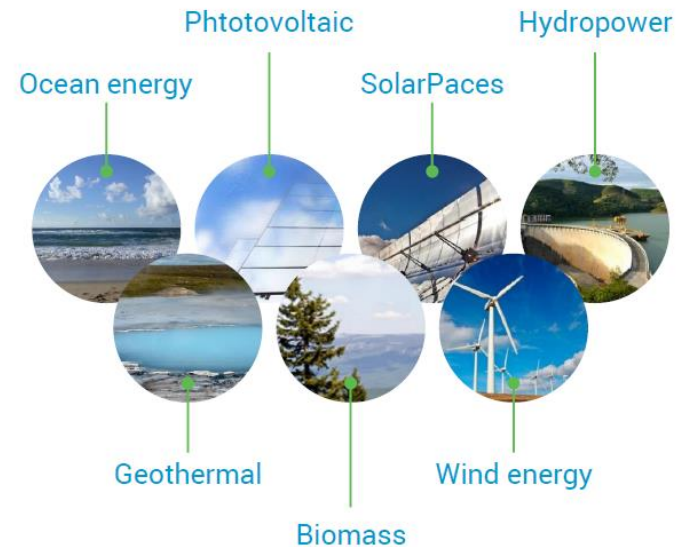
→ Over 40 groups working in the following areas:

Efficient end-use technologies

Renewable energies

Fossil fuel

Cross-cutting issues



Main sources of ocean energy



Tidal/Ocean Currents

Waves

Tidal Rise & Fall

Thermal Gradient

Salinity Gradient

- OES covers all forms of ocean energy, but NOT offshore wind - **seawater must be the motive power**
- **Products can include:** electricity, heat, cooling, water (drinking and pressurized), biofuels, chemicals

THE OES VISION FOR
INTERNATIONAL DEPLOYMENT
OF OCEAN ENERGY

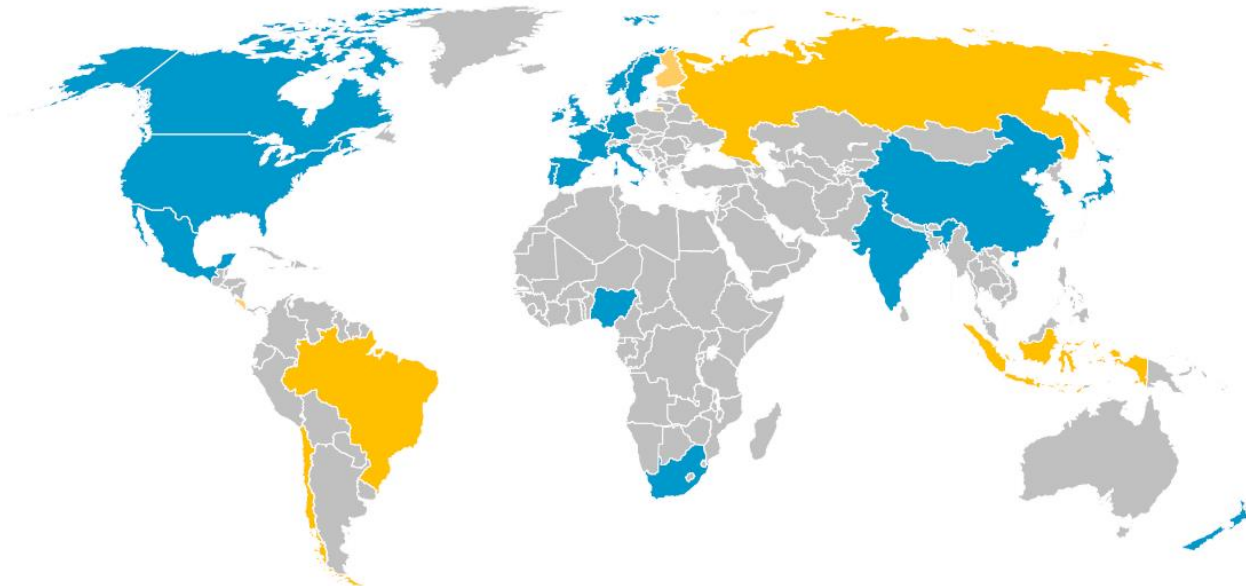
→ Worldwide, there is the potential to develop over 300 GW of ocean energy by 2050

→ By 2050, the ocean energy deployment could create 680,000 direct jobs and saved 500 million tonnes of CO2 emissions.

VISION

“As the authoritative international voice on ocean energy we collaborate internationally to accelerate the viability, uptake and acceptance of ocean energy systems in an environmentally acceptable manner.”

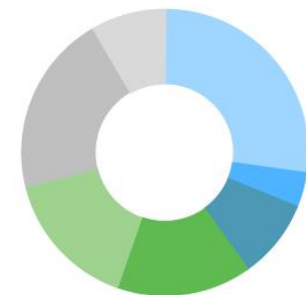
Membership diversification



● Member countries (24) + European Commission

● Countries invited to join (8)

Diversified representation of interests in the ExCo



- GOVERNMENTAL DEPARTMENTS
- INDUSTRY ASSOCIATIONS
- UTILITIES
- ENERGY AGENCIES
- GOVERNMENTAL AGENCIES
- RESEARCH ORGANIZATIONS
- UNIVERSITIES

The role of the OES



CONNECT

Connect organisations and individuals working in the ocean energy sector



EDUCATE

Educate people globally on the nature of ocean energy systems and the current status on development and deployment



INSPIRE

Inspire governments, corporations, agencies and individuals to become involved



FACILITATE

Facilitate education, research, development and deployment of ocean energy systems

Work Program 2011 – 2016 → 2017 – 2022

1.

Review, Exchange and
Dissemination of
Information
(Permanent)

2.

Recommended Practices for
Testing and Evaluating OE
Systems
(Concluded in previous terms)

3.

Integration of OE into
Distribution and
Transmission Grids
(Concluded in previous terms)

4.

Environmental Effects and
Monitoring Efforts
(To be continued)

5.

Exchange of OE Project
Information and Experience
(To be reformulated)

6.

Worldwide Web GIS
Database for Ocean Energy
(To be continuously updated)

7.

Cost of Energy assessment
for Wave, Tidal, and OTEC
(To be continuously updated)

8.

Consenting Processes for
OE in OES Member countries
*(To be updated with more
countries and experiences)*

9.

Technology Roadmap &
International Vision
*(To be updated at the end of the
next term)*

10.

Numerical Modelling – Wave
Energy
(NEW)

11.

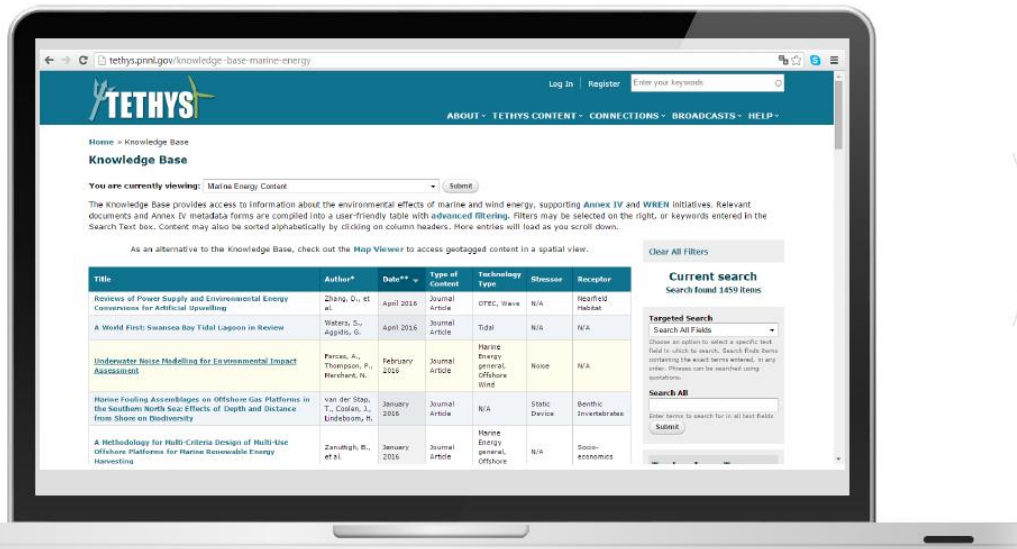
Assessment of OTEC
Resource
(NEW)

*Proposals under
active
consideration.
Identification of
knowledge gaps*

Task 4| Environmental Issues

Making existing information available and accessible

→ OPERATING AGENT: DOE (USA)





Task 5 | Exchange and Assessment of Ocean Energy Device Project Information and Experience

→ OPERATING AGENT: DOE (USA)



ACHIEVEMENTS

1

Workshop I "Open Water Testing"
Ireland, October 2012

2

Workshop II "Computational Modeling & Analysis"
UK, 25-26 Nov 2013

3

Workshop III "Designing for Reliability"
Portugal, 5-6 Feb 2014

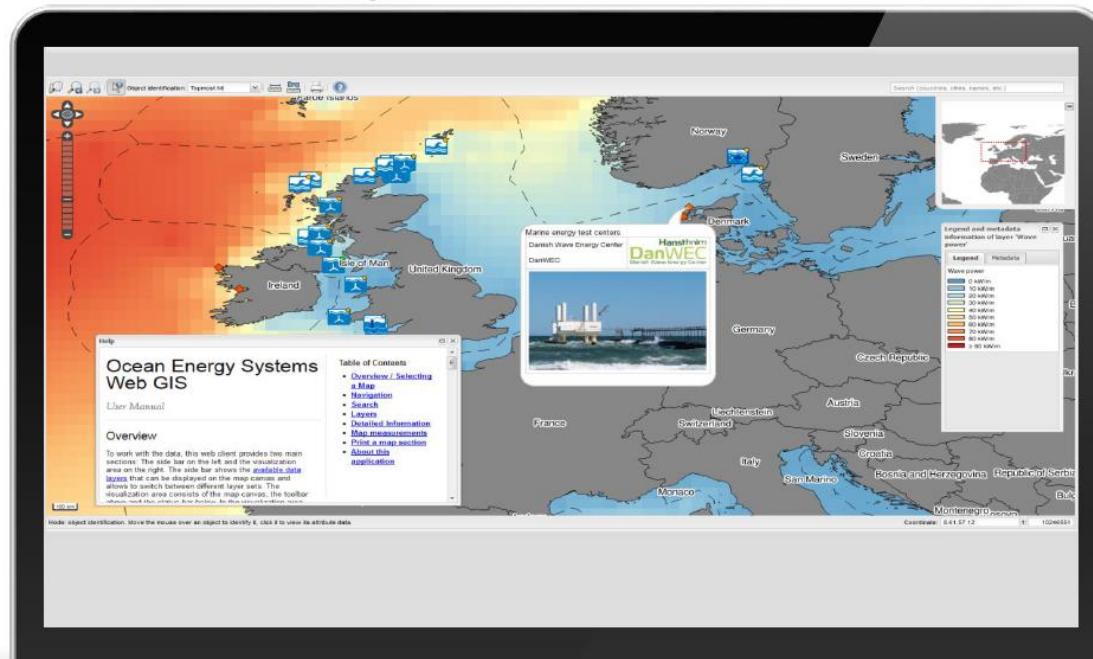
4

Workshop IV "Ocean Energy Policy"
Sweden, 12 May 2016

Task 6 | Worldwide Web-based GIS database

Providing detailed information on ocean energy resources and related projects

→ OPERATING AGENT: Fraunhofer (Germany)



Task 7| International Levelised Cost of Energy for Ocean Energy Technologies

→ OPERATING AGENT: The University of Edinburgh (UK)

ACHIEVEMENTS

Thorough investigation of LCOE for wave, tidal and OTEC technologies; consistent methodology applied

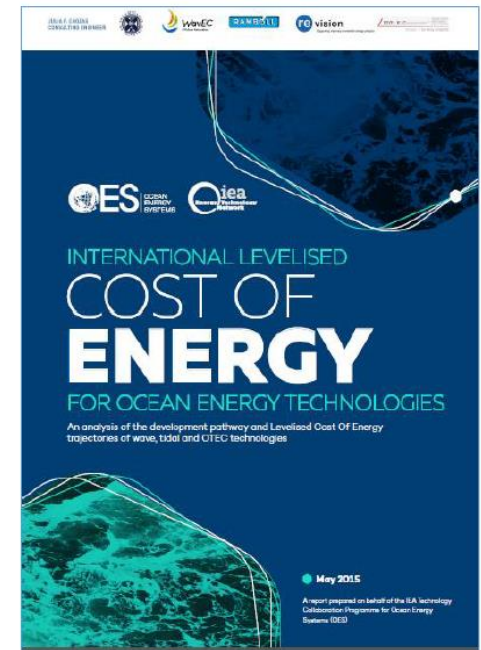
Cost reduction trajectories on an international level.

Industry consultation - development of revised cost models

High costs intrinsic to the early stage development of technology.

Cost reduction trends: clear trajectory towards a more affordable LCOE

Costs in the long-term are expected to decrease from the first commercial project level as experience is gained with deployment



Task 8 | Consenting Processes for Ocean Energy

→ OPERATING AGENT: WavEC (Portugal)

ACHIEVEMENTS

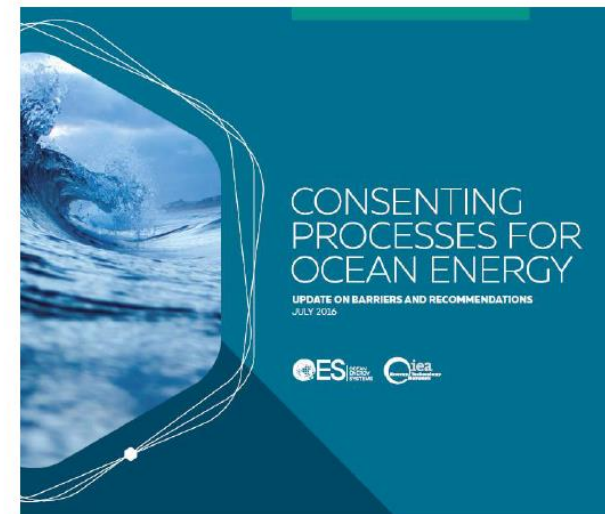
Succinct overview of current practice - providing a holistic picture of the situation in each OES member country

Particular emphasis on investigating the main barriers associated with permitting and licensing with a view to advising regulators and decision-makers.

Developers were given the opportunity to provide their views and insights on barriers.

Particular attention to Marine Spatial Planning and how this is influencing consenting processes.

10 Key Recommendations



Task 9 | Roadmap for Ocean Energy

→ **OPERATING AGENT:** The University of Edinburgh (UK)

INDUSTRIAL GOAL

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

SOCIETAL GOAL

By 2050, ocean energy has the potential to have created 680,000 direct jobs and saved 500 million tonnes of CO₂ emissions.



Collaboration with International organisations



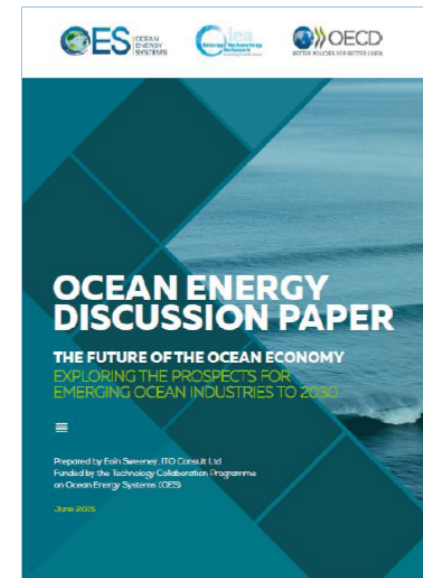
The OES is the organizer of a “poster award” and hosts a website with past conference material

IRENA workshop “Island Energy Transitions: Pathways for Accelerated Uptake of Renewables”, Martinique, 2015

Collaboration with the OECD project “The Future of the Ocean Economy: Exploring the prospects for emerging ocean industries to 2030”

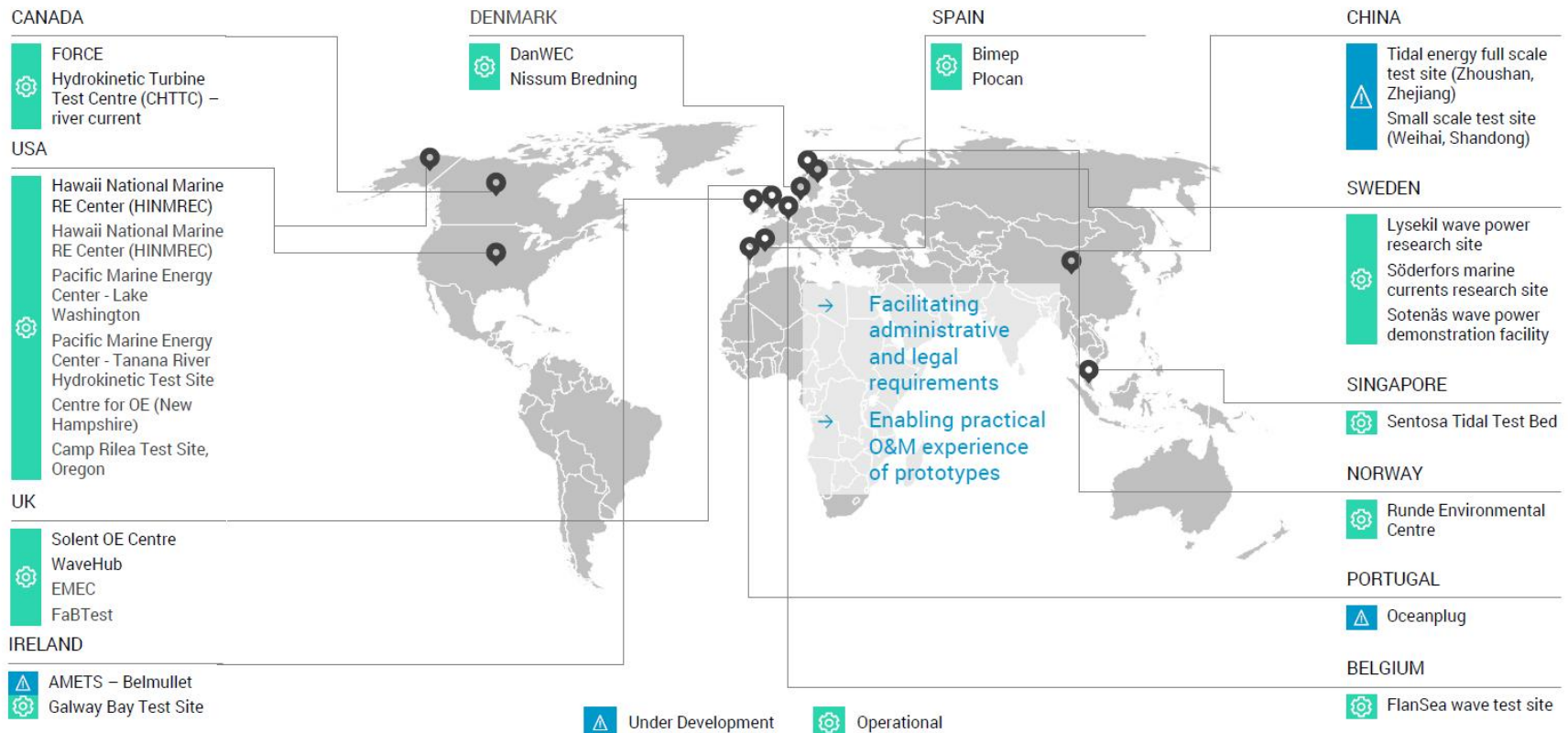
International Network on Offshore Renewable Energy (INORE) - Financial sponsorship

Participation in the Technical Committee (TC) 114: Marine Energy – Wave and Tidal Energy Converters



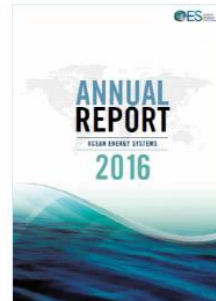
Open Sea Testing Sites

Encouraging ocean energy development



OES Annual Report

Authoritative reference source



- Ocean Energy Policy
- Research & Development
- Technology Demonstration

SPECIAL THEMES >

1

[2012 Annual Report](#)
Development of the
International Ocean Energy
Industry

2

[2013 Annual Report](#)
Current Perspectives of Key
Industrial Ocean Energy
Players

3

[2014 Annual Report](#)
Current Perspectives of 3
Leading Project Developers

4

[2015 Annual Report](#)
Interview to funding entities



Acknowledgement: JRC, ETIP Ocean, Ecorys, Fraunhofer, IEA OES

Thanks for your attention!

