



# A global overview on ocean energy: the role of the OES Technology Collaboration Programme

José Luis Villate  
OES Chairman

Havsenergiform 2016  
Smögen, Sweden  
May 11th 2016

# Content

- Global overview and main challenges
- Role and activities of the OES
- Conclusions

# Ocean Energy Resource



Tidal/Ocean Currents

Waves

Tidal Rise & Fall

Thermal Gradient

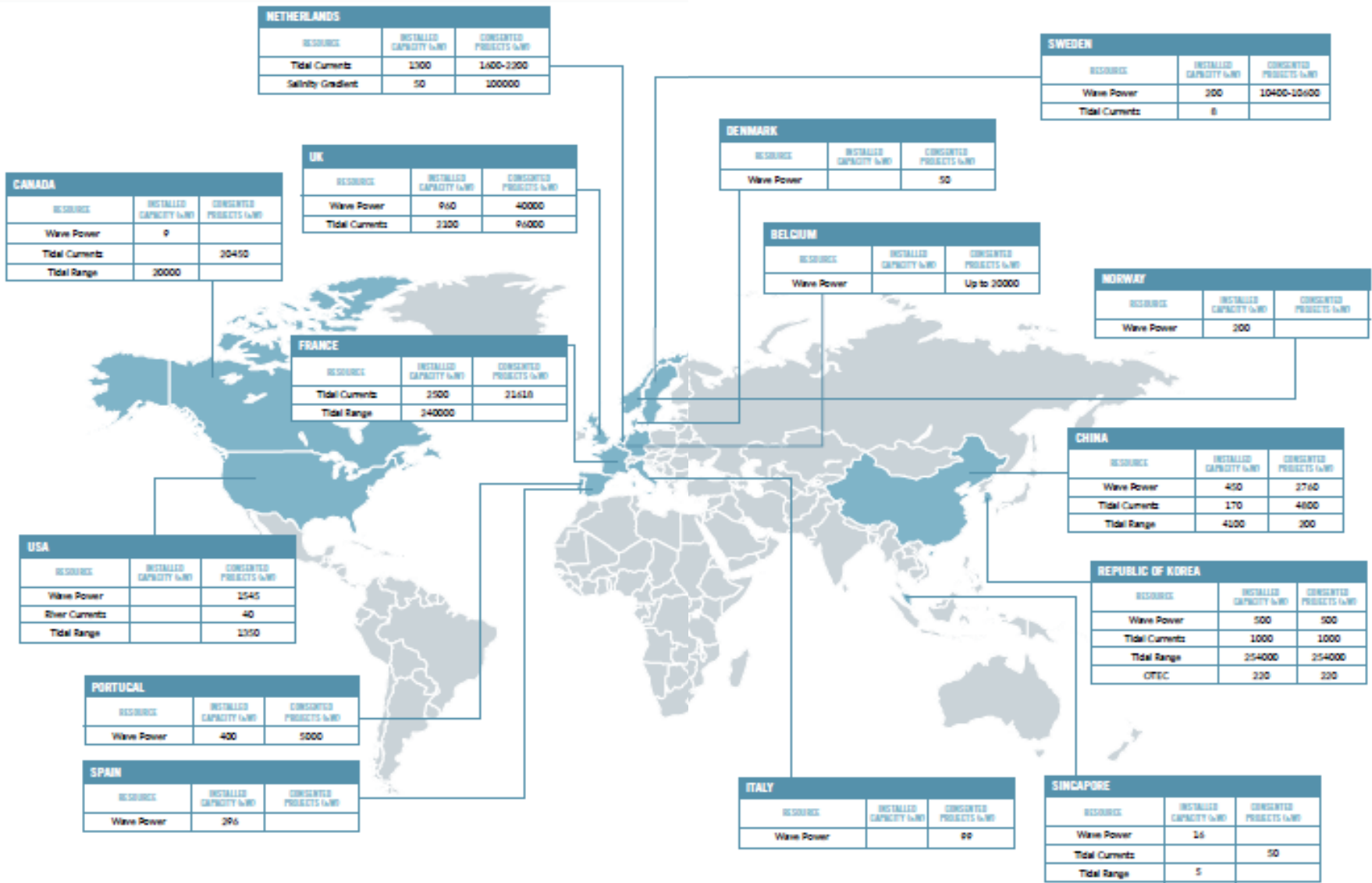
Salinity Gradient

- OES covers all forms of ocean energy, including submarine geothermal, 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 337 GW of ocean energy by 2050
- Ocean energy could create an estimated 300,000 direct jobs by 2050

# Worldwide Ocean Power installed capacity





# Challenges for Ocean Energy

CHALLENGES	POTENTIAL SOLUTIONS AND RECOMMENDATIONS
POLICY ENVIRONMENT	<ul style="list-style-type: none"> <li>• Development of an integrated policy framework with ocean energy specific regulations</li> <li>• International guidelines and standards</li> <li>• Regulatory reform and planning leading to efficient and appropriate consenting processes</li> </ul>
INDUSTRY DEVELOPMENT	<ul style="list-style-type: none"> <li>• Strategic supply chain planning, development and growth</li> <li>• Ocean energy infrastructure development</li> <li>• Technical and professional workforce training and development</li> </ul>
MARKET DEVELOPMENT	<ul style="list-style-type: none"> <li>• Development of appropriate tariff support mechanisms to provide clear market signals to the investment community.</li> <li>• Appropriate electricity market access and grid connection access</li> </ul>
TECHNOLOGY DEVELOPMENT	<ul style="list-style-type: none"> <li>• Prototype devices need to be very robust to withstand the marine environment</li> <li>• Demonstration and testing facilities</li> <li>• Research and innovation support and enabling technology support to facilitate cost reduction and performance improvement</li> </ul>
ENVIRONMENTAL EFFECTS	<ul style="list-style-type: none"> <li>• Establish an improved understanding of baseline environment</li> <li>• Strategic environmental research which is enabled by sharing of environmental data</li> <li>• Consider adoption of deploy and monitor schemes to facilitate sector progression</li> <li>• Familiarity in affected communities</li> </ul>
PLANNING FRAMEWORK	<ul style="list-style-type: none"> <li>• Marine spatial planning leading to the development of common approaches to space and resource allocation.</li> </ul>

# Ocean Energy Policies

Countries are faced with the challenge of achieving energy security, environmental protection and economic competitiveness.

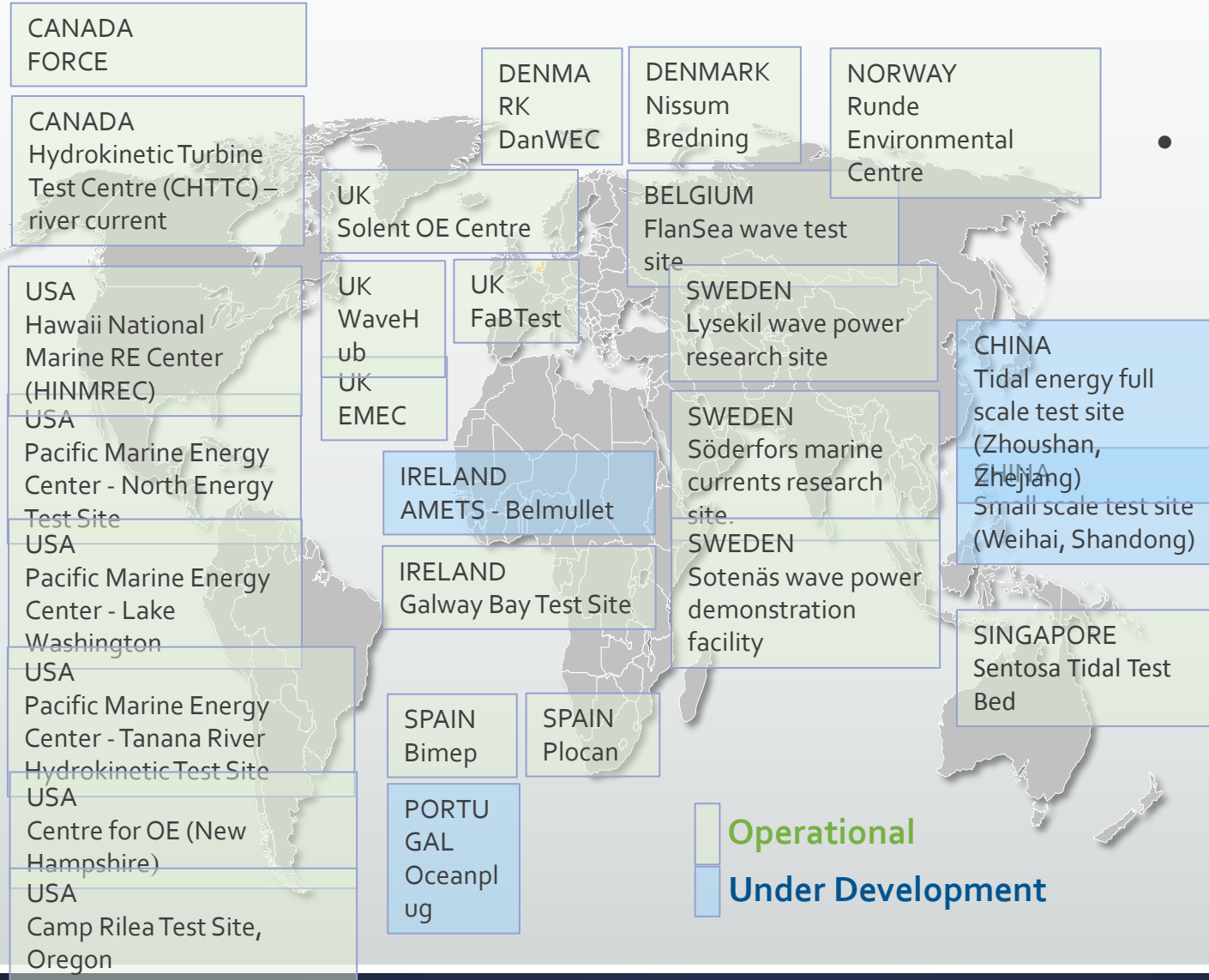
Ocean energy could contribute to these objectives in the medium to long term, provided that policies, which establish support mechanisms to stimulate market deployment and intensify R&D funding are implemented by their governments.

Activities, in these areas are growing, across the world.

	NATIONAL STRATEGY				MARKET INCENTIVES						FINANCING		
	Ocean energy targets	Roadmap for ocean energy	Detailed resource assessment	Marine Spatial Plan	Feed-in tariff	ROC	Tradable green certificates	RE portfolio standard	Open sea testing centers	Streamlined licencing regime	Fundamental R&D	Prototype testing	Testing centers
Australia			X	X						UD			
Belgium			X	X			X		X	X	X	X	
Canada	X		X	X	X				X	UD	X	X	X
China			X	X					UD		X		
Denmark									X		X		
Germany	X		X	X	X						X		
Ireland	X		X	X	X				UD	UD	X		
Italy	X				X						X		
Japan			X								X	X	
Korea	X		X				UD	X			X	X	
Mexico													
Monaco													
Norway				X			X		X		X		
New Zealand			X	X					P		X		
Nigeria		UD											
Portugal	X	UD		X					UD	UD	X		
South Africa		UD		X									
Spain	X		X						X	UD	X	X	X
Sweden				X			X		X	UD	X	X	
United Kingdom	X		X	X	UD	X			X	X	X	X	X
USA			X	X					X	UD	X	X	X

# Open Sea Testing Sites

## Encouraging ocean energy development



- **Facilitating administrative and legal requirements**
- **Enabling practical O&M experience of prototypes**



- 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*



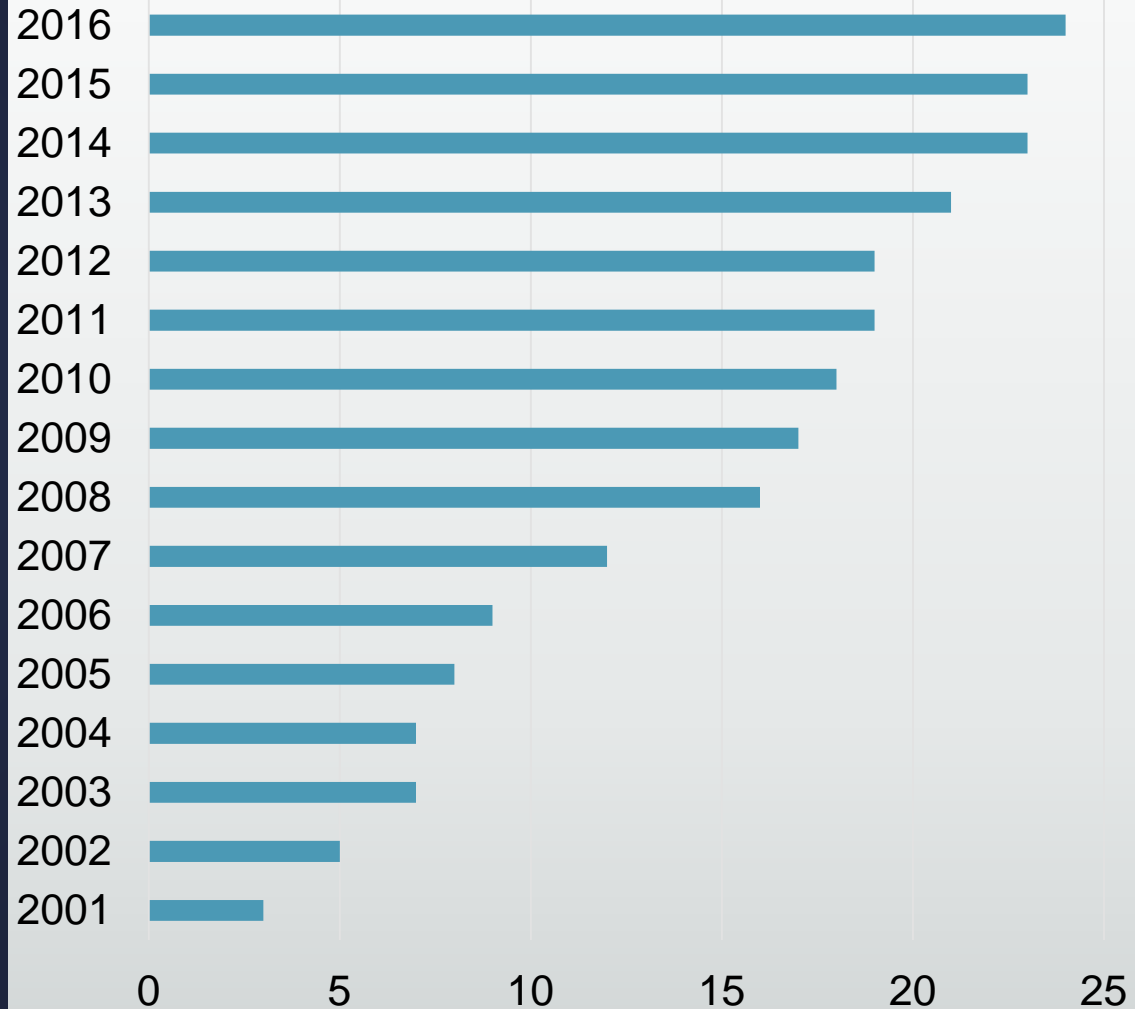


## Mission

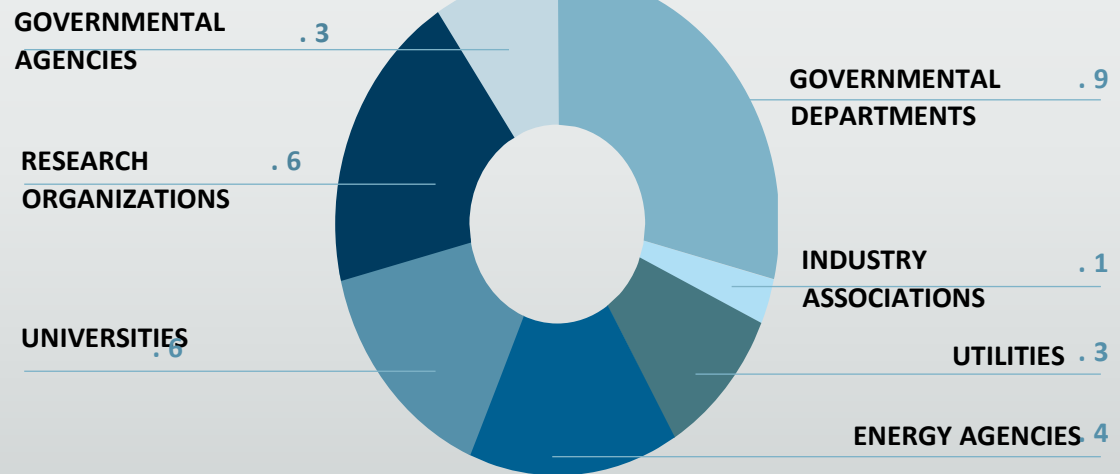
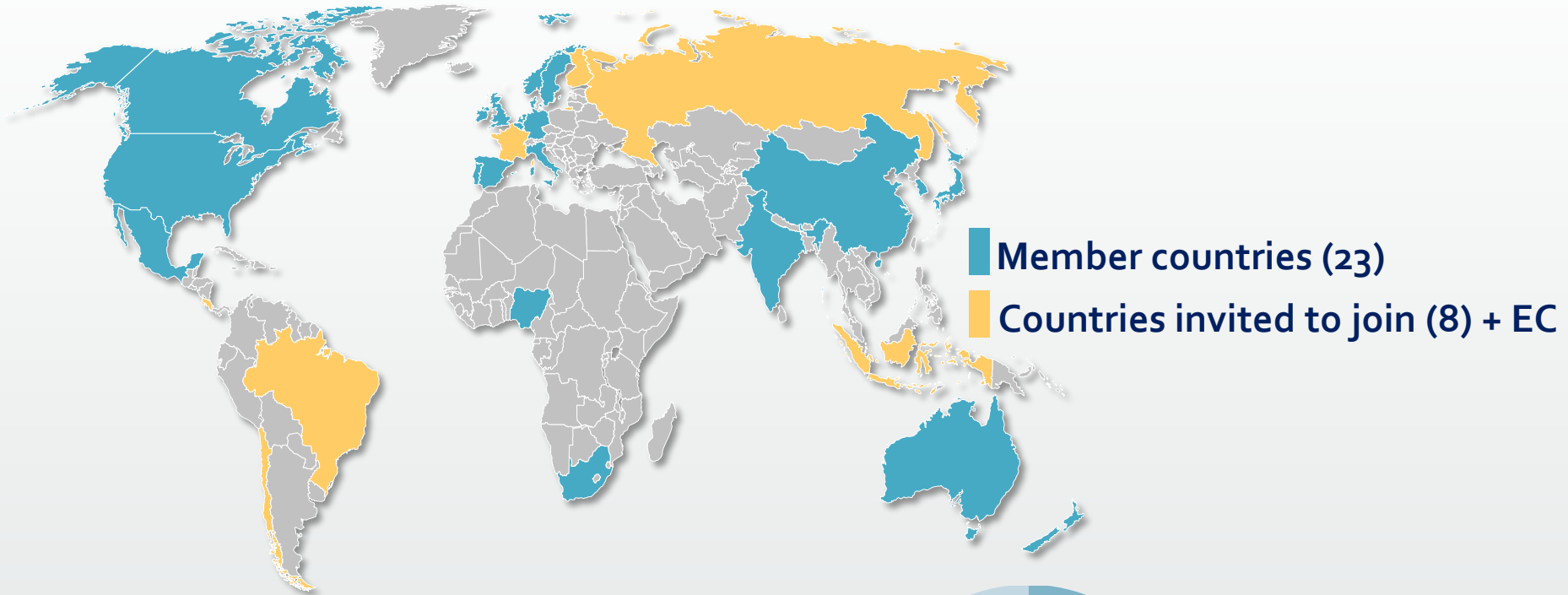
*"As the authoritative international voice on ocean energy we collaborate internationally to accelerate the viability, uptake and acceptance of ocean energy systems in an environmentally acceptable manner."*

# Membership growth

*Participation in OES builds connections between national governments and industries, creates networks of experts and expands national research capacities*



# Membership diversification



*Diversified representation of interests in the ExCo*

# The role of the OES

## CONNECT



*Connect organisations and individuals working in the ocean energy sector*

## EDUCATE



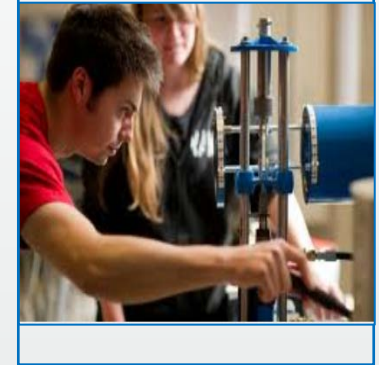
*Educate people globally on the nature of ocean energy systems and the current status on development and deployment*

## INSPIRE



*Inspire governments, corporations, agencies and individuals to become involved*

## FACILITATE



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



# Work Program – ongoing tasks

**1** Review, Exchange and Dissemination of Information

**2** Development of Recommended Practices for Testing and Evaluating OE Systems

**3** Integration of OE into Distribution and Transmission Grids

**4** Assessment of Environmental Effects and Monitoring Efforts

**5** Exchange and Assessment of OE Project Information and Experience

**6** Worldwide Web GIS Database for Ocean Energy

**7** Cost of Energy assessment for Wave, Tidal, and OTEC


**8** Consenting Processes for OE in OES Member countries

**9** International Ocean Energy Technology Roadmap

# Annex IV | Environmental Issues

## Making existing information available and accessible

← → ↻
🔍 ⭐



[Log In](#) | [Register](#)

[ABOUT](#) ▾ | [TETHYS CONTENT](#) ▾ | [CONNECTIONS](#) ▾ | [BROADCASTS](#) ▾ | [HELP](#) ▾

[Home](#) » [Knowledge Base](#)

## Knowledge Base

**You are currently viewing:** Marine Energy Content ▾ Submit

The Knowledge Base provides access to information about the environmental effects of marine and wind energy, supporting **Annex IV** and **WREN** initiatives. Relevant documents and Annex IV metadata forms are compiled into a user-friendly table with **advanced filtering**. Filters may be selected on the right, or keywords entered in the Search Text box. Content may also be sorted alphabetically by clicking on column headers. More entries will load as you scroll down.

As an alternative to the Knowledge Base, check out the [Map Viewer](#) to access geotagged content in a spatial view.

Title	Author*	Date** ▾	Type of Content	Technology Type	Stressor	Receptor
<a href="#">Reviews of Power Supply and Environmental Energy Conversions for Artificial Upwelling</a>	Zhang, D., et al.	April 2016	Journal Article	OTEC, Wave	N/A	Nearfield Habitat
<a href="#">A World First: Swansea Bay Tidal Lagoon in Review</a>	Waters, S., Aggidis, G.	April 2016	Journal Article	Tidal	N/A	N/A
<a href="#">Underwater Noise Modelling for Environmental Impact Assessment</a>	Farcas, A., Thompson, P., Merchant, N.	February 2016	Journal Article	Marine Energy general, Offshore Wind	Noise	N/A
<a href="#">Marine Fouling Assemblages on Offshore Gas Platforms in the Southern North Sea: Effects of Depth and Distance</a>	van der Stap, T., Coolen, J.,	January	Journal Article	N/A	Static	Benthic

[Clear All Filters](#)

### Current search

Search found 1459 items

**Targeted Search**

Search All Fields ▾

Choose an option to select a specific text field in which to search. Search finds items containing the exact terms entered, in any order. Phrases can be searched using quotations.

**Search All**

14

# Exchange and Assessment of Ocean Energy Device Project Information and Experience (Annex V)

## OPERATING AGENT:

US Department of Energy

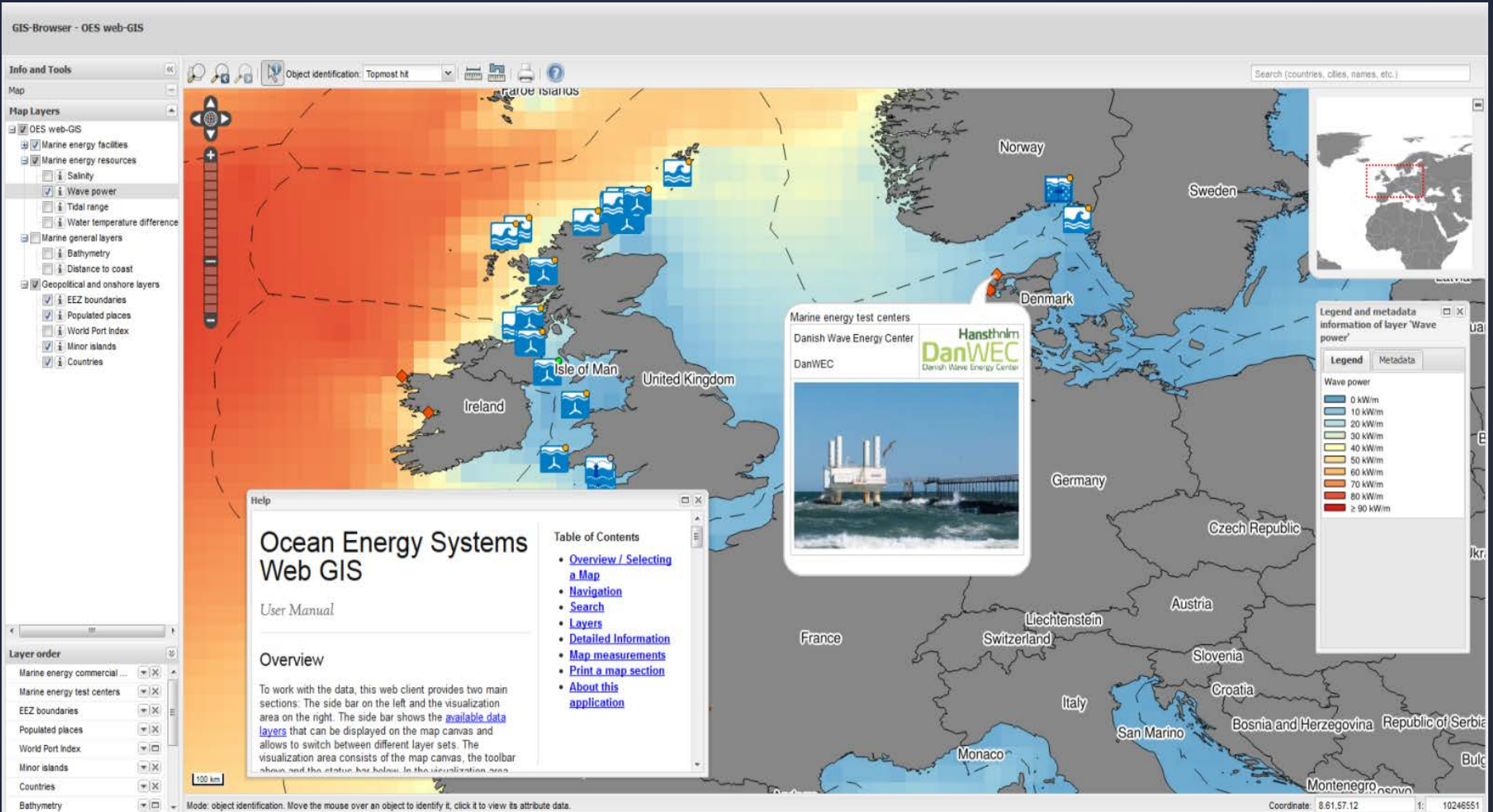
## ACHIEVEMENTS:

- **Workshop I “Open Water Testing”**  
Ireland, October 2012
- **Workshop II “Computational Modeling & Analysis”**  
UK, 25-26 Nov 2013
- **Workshop III “Designing for Reliability”**  
Portugal, 5-6 Feb 2014
- **Workshop IV “Ocean Energy Policy”**  
Sweden, 12 May 2016



# Worldwide Web-based GIS database

(Task 6) Providing detailed information on ocean energy resources and related projects



The screenshot displays the 'GIS-Browser - OES web-GIS' interface. The main map shows wave power density across Europe, with a color scale from 0 to 90 kW/m. Several marine energy test centers are marked with blue icons, including DanWEC in Denmark and Hanstholm in the North Sea. The interface includes a left sidebar for 'Map Layers' with options like 'Wave power', 'Tidal range', and 'Bathymetry'. A top toolbar contains navigation and search tools. A search bar at the top right allows for location queries. A legend and metadata panel on the right provides details for the 'Wave power' layer. A 'Help' window is open in the bottom left, showing the 'Ocean Energy Systems Web GIS User Manual' and a 'Table of Contents' with links to various sections. The bottom status bar shows the current coordinate as 8.61, 57.12 and a scale of 1:10246551.

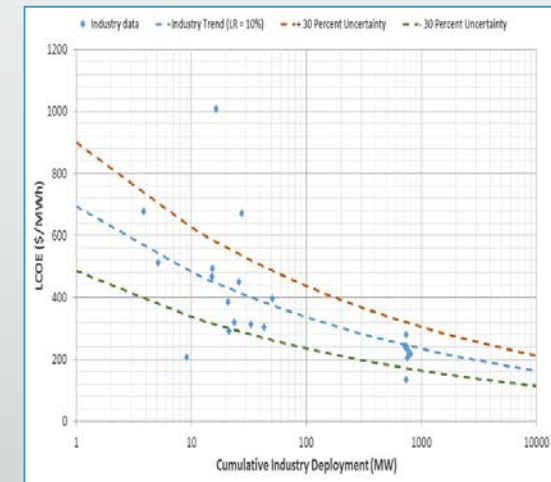
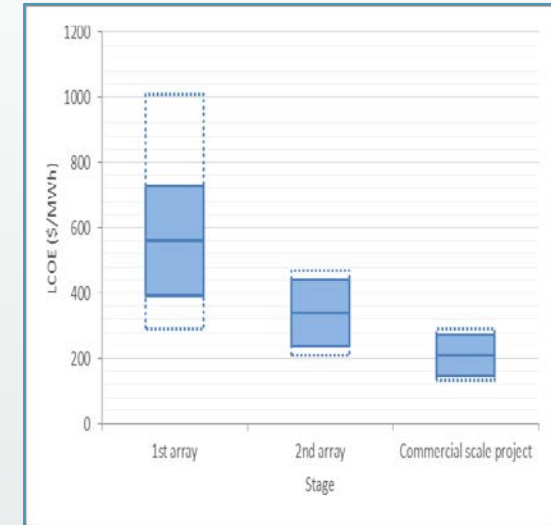


# International Levelised Cost of Energy for Ocean Energy Technologies (Task 7)

**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



- **Consenting Processes for Ocean Energy (Task 8) | 2014 -2016**

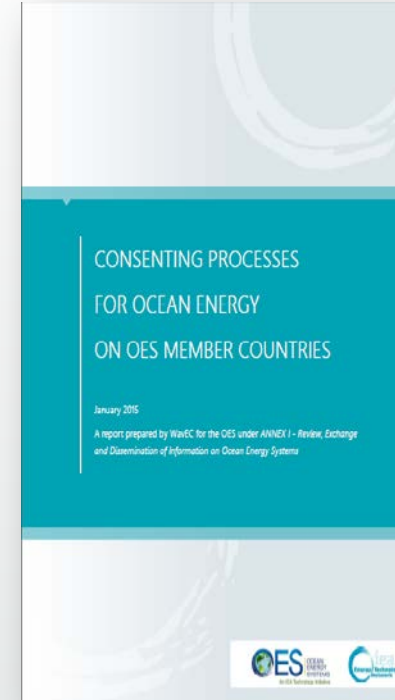
Coordination: WavEC

- Legal, policy and administrative issues
- Coherent overview, highlighting areas which may require further attention

- **Technology Roadmap: Synergies with other Industrial Sectors (Task 9) | 2015 -2016**

Coordination: University of Edinburgh

- Looking for solutions to challenges faced by the ocean energy sector
- Opportunities for potential technology and knowledge transfer from other sectors
- Update of the international vision for ocean energy
- Future work:
  - Identification of specific member countries actions
  - Engage with the IEA to include ocean energy in technology roadmaps.



# International Collaboration



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, 22-24 June 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) - association of early stage researchers. Financial sponsorship



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

# OES Annual Report: an authoritative reference source

## *Special Themes:*

**2012 Annual Report**  
Development of the  
International Ocean Energy  
Industry

**2013 Annual Report**  
Current Perspectives of Key  
Industrial Ocean Energy  
Players

**2014 Annual Report**  
Current Perspectives of 3  
Leading Project Developers

**2015 Annual Report**  
Interview to funding entities



**NEW!**





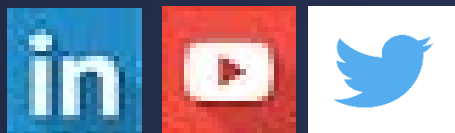
# Conclusions

- Ocean Energy is still in its **early stages of development** and its contribution to global energy production is not highly significant yet.
- The **resource is abundant** and well distributed around the world, in many cases close to high energy demand in coastal areas.
- Technologies to harness ocean energy are not mature enough with **high costs of energy** in comparison to other sources.
- Ocean energy will be an **indispensable actor** for a long-term clean energy mix, contributing to ensure a world-wide energy supply near the point of local use.
- **Dilemma**: how to fund technological development and first deployments at sea oriented to reduce costs in a challenging long-term scenario.
- The **participation of public bodies** committed to a clean energy future is essential to help solve this dilemma.
- OES is playing a significant role and **we want to continue supporting this emerging sector** over the next few years.

# Thank you

FOLLOW US:

[www.ocean-energy-systems.org](http://www.ocean-energy-systems.org)



IEA Technology Collaboration Programme

## Chair

**Jose Luis Villate**

Tecnalia, SPAIN

[joseluis.villate@tecnalia.com](mailto:joseluis.villate@tecnalia.com)

## Vice-Chair

**Keyyong Hong**

KRISO, KOREA

[khong@kriso.re.kr](mailto:khong@kriso.re.kr)

## Vice-Chair

**Henry Jeffrey**

University of Edinburgh, UK

[henry.jeffrey@ed.ac.uk](mailto:henry.jeffrey@ed.ac.uk)

## Secretary

**Ana Brito e Melo**

WavEC, PORTUGAL

[ana@wavec.org](mailto:ana@wavec.org)