Pacific Northwest NATIONAL LABORATORY

OES the task formerly known as Annex IV ENVIRONMENTAL

OES-Environmental Meeting of Country Analysts

June 27 & 28, 2019

Online Meetings

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

Today…

- Updates from:
  - Denmark
  - Spain
- State of the Science 2020 Update
  - MSP Survey
- Retiring Risk Update
- OES-Environmental Phase 4
- OES-Environmental Activities
  - 1-on-1 Analyst Calls
  - Enhancing Outreach Activities
  - Social Media
  - Upcoming Activities
- Roundtable

Ocean Renewable Energy: Denmark

A contribution to IEA OES Annex IV

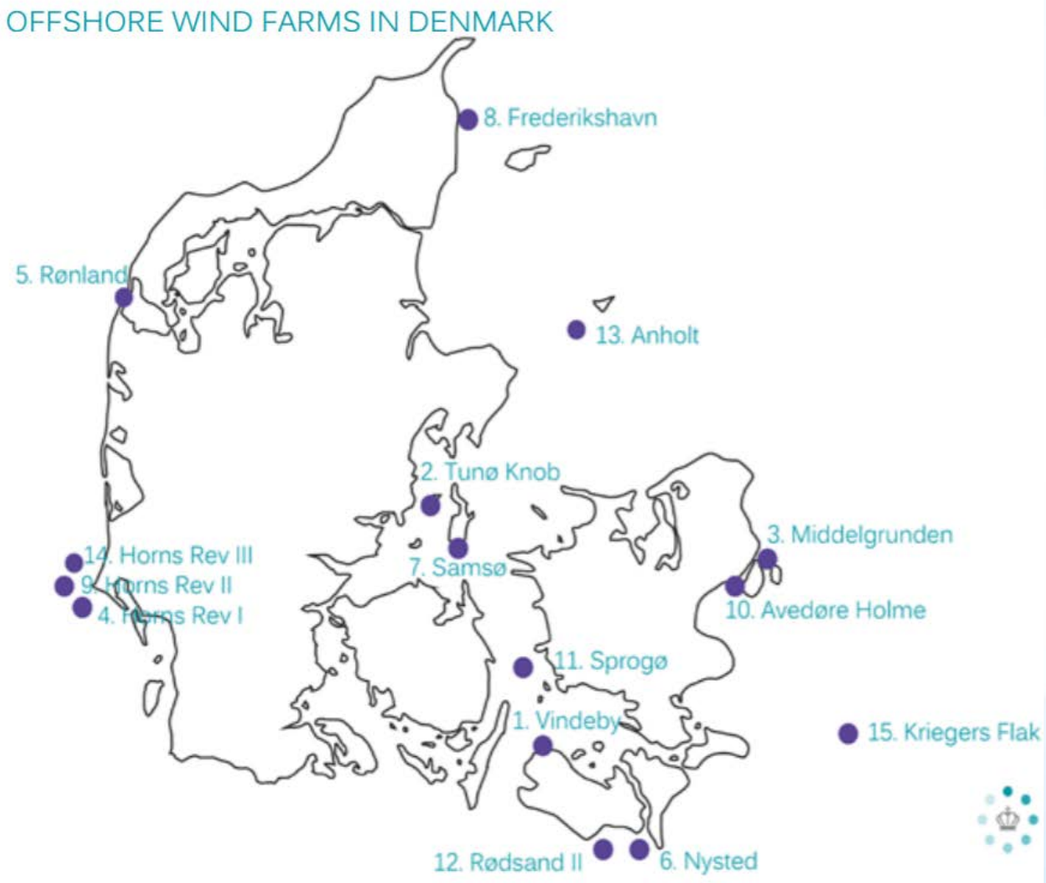
by

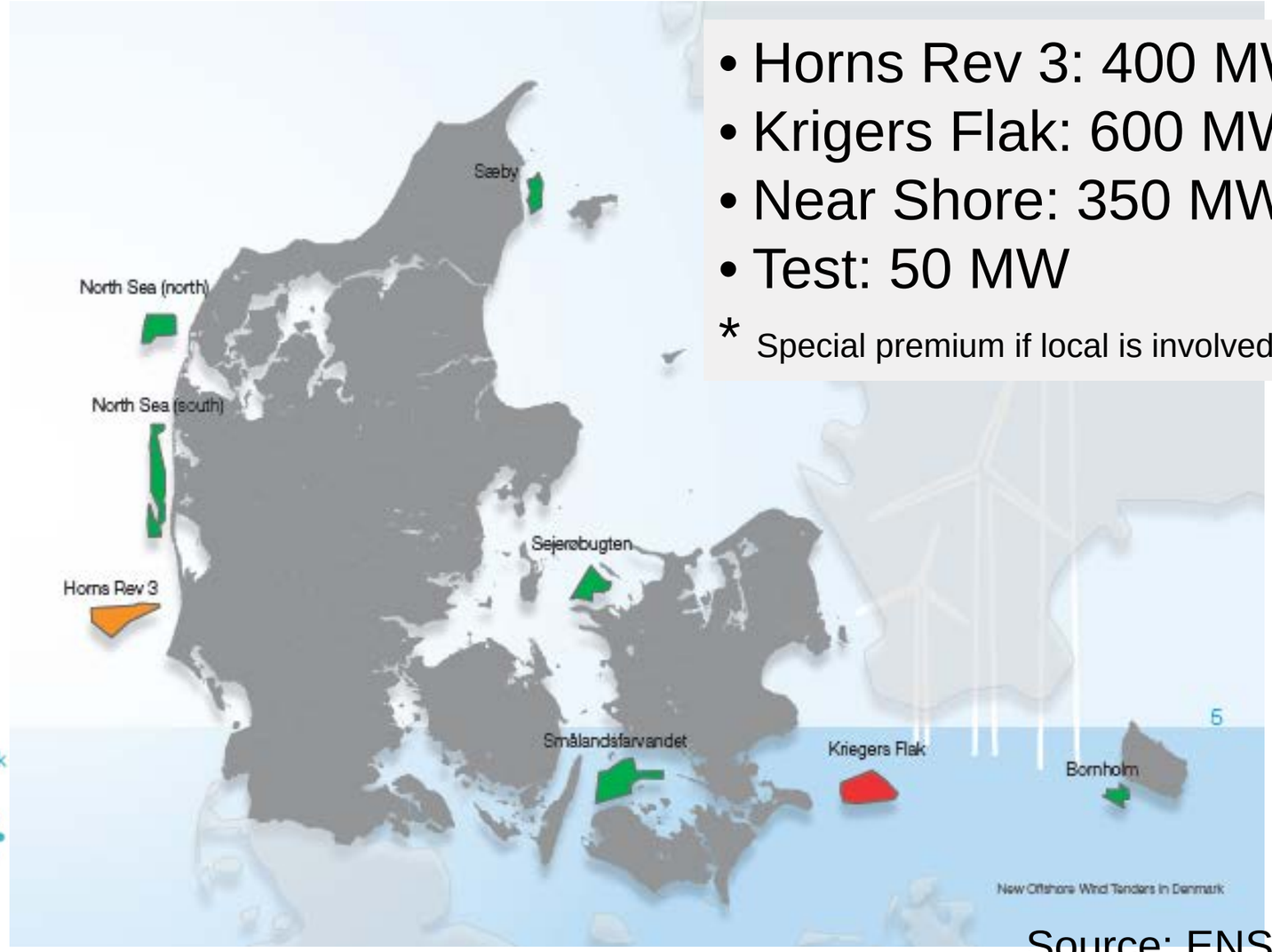
Hans Chr. Soerensen, PhD

Energy Agreement (Energy Bill) 2020–2024

- Denmark’s electricity consumption can be covered by renewable energy in 2030.
- Financing of the renewable energy sources are secured to reach a share of renewable energy of approx. 55 pct. in 2030.
- 3 new offshore wind farms totaling 2,400 MW - which can cover more than all Danish households' electricity consumption is included.

Offshore Wind DK 2013-2020





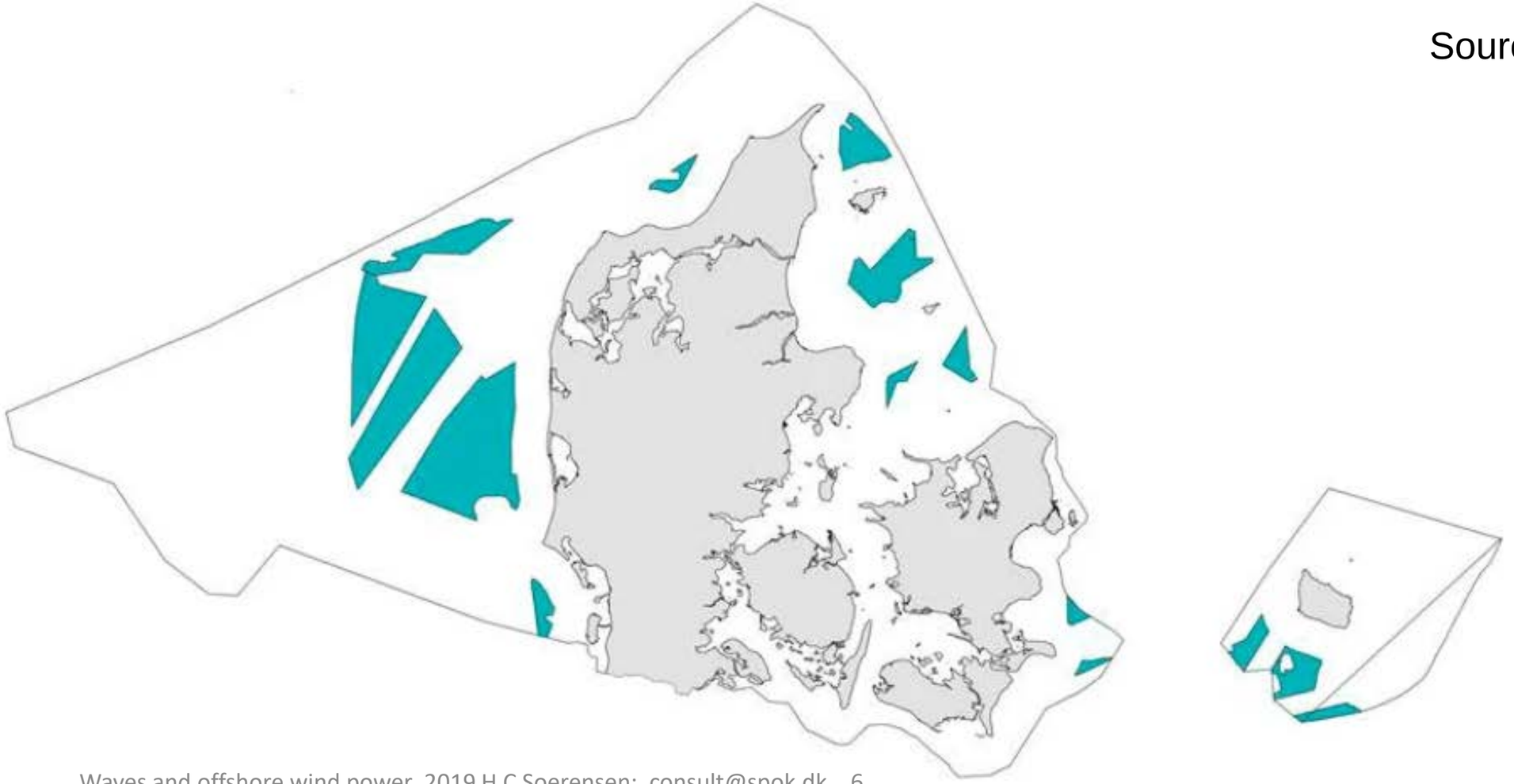
- Horns Rev 3: 400 MW
- Krigers Flak: 600 MW
- Near Shore: 350 MW*
- Test: 50 MW

* Special premium if local is involved

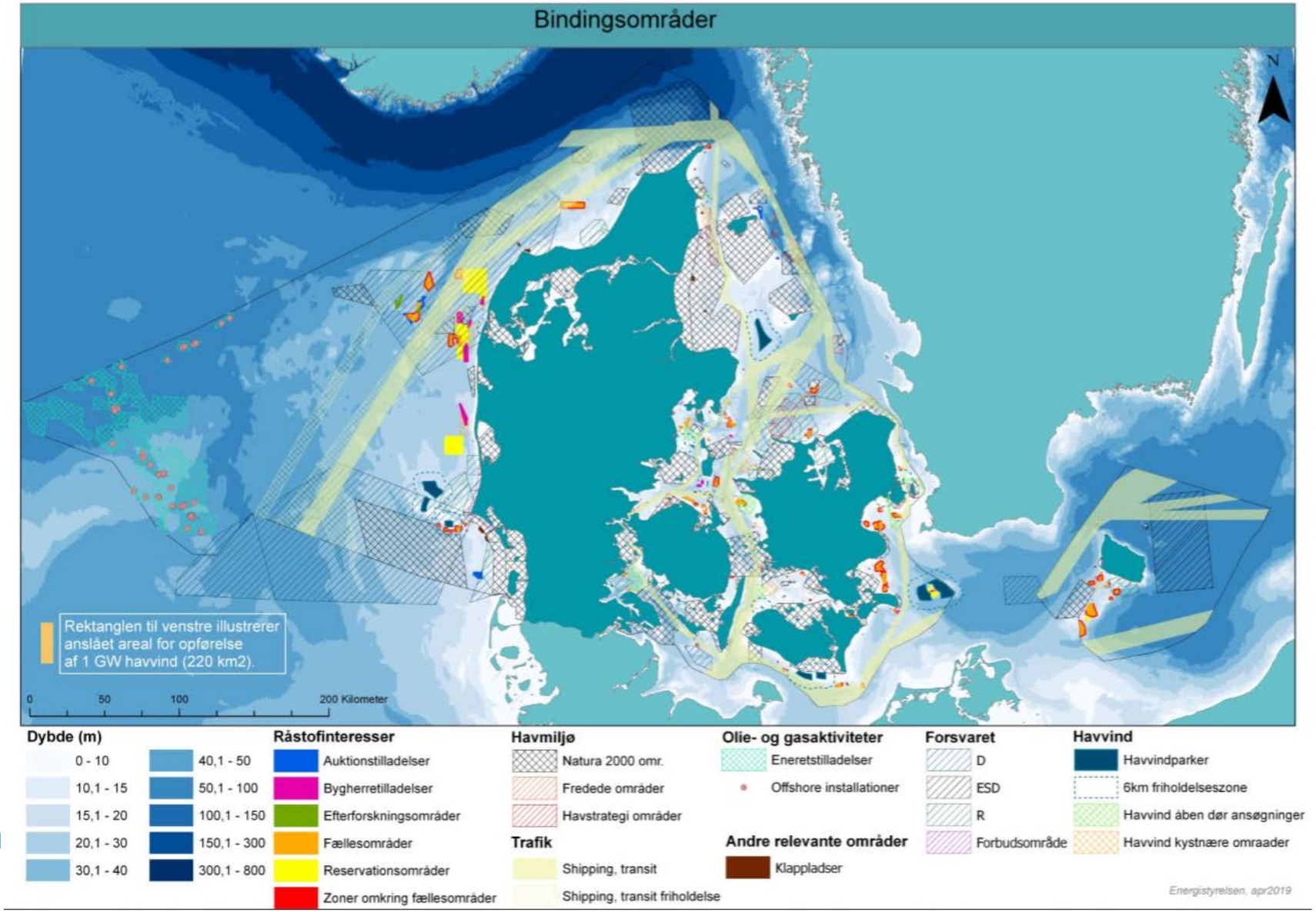
Source: ENS

The Danish Potential is alone 12.4 GW

Source: ENS



The potential is large but there are space enough



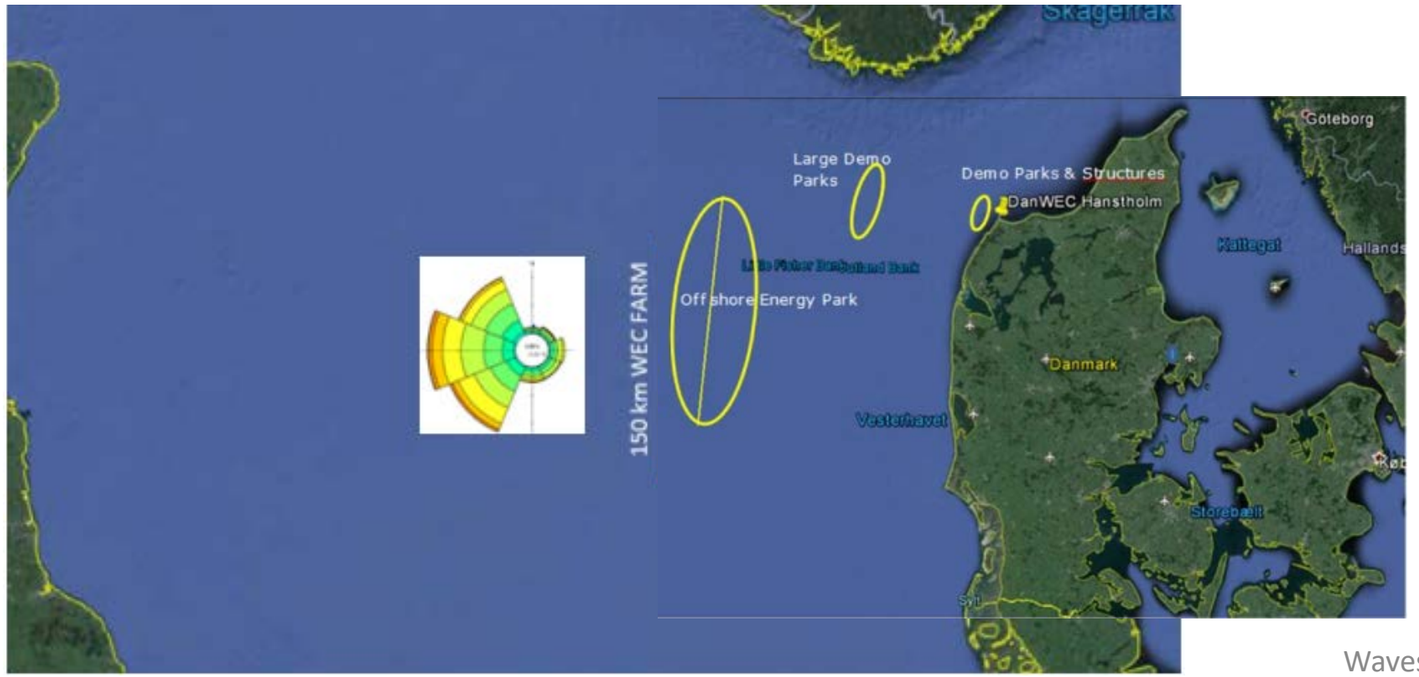
Source: ENS

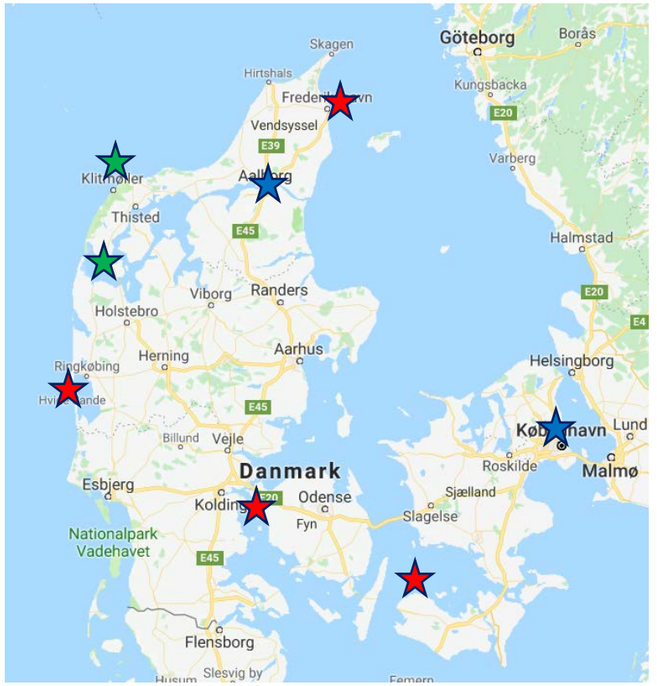
Study like the EU Windspeed from 2011.

By end of 2018 we have 18.8 GW power consumption in the World.

Danish Wave Energy Policies

- THE STRATEGY FOR WAVE POWER 2012
- THE DANISH WAVE POWER ROADMAPS 2015
- DENMARK WORKING TOWARDS MARINE SPATIAL PLAN
- WAVE ENERGY POLITICALLY NOT A PRIORITY
- DENMARK HAS ESTABLISHED TEST SITES - DANWEC
- EUDP SUPPORTS WAVE ENERGY





DanWEC sites

Labs

Individual sites

Source: Jens Peter Kofoed AAU

Wave energy open sea test sites

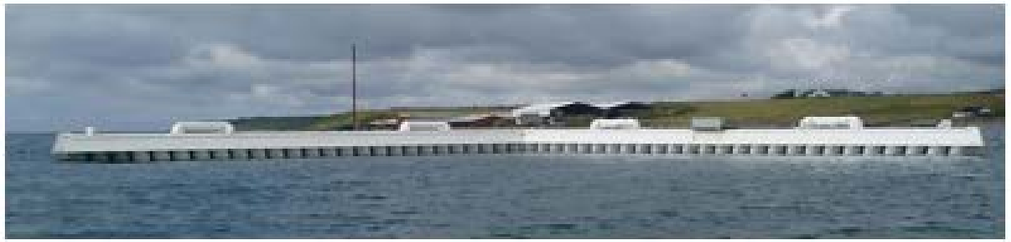
- DanWEC – Hanstholm (1 dev. testing) and Nissum Bredning (2 devs. testing)
- 2 (3) directional wave rider buoys
- Exclusion zone

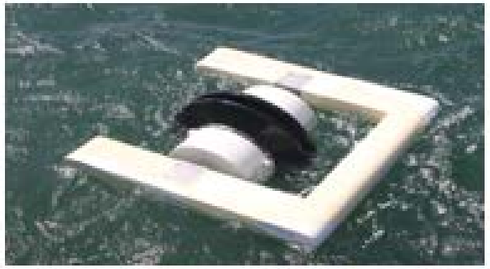
Source: Jens Peter Kofoed AAU

Wave Power in Denmark

Danish Partnership for Wave Power

- Status: 11 active developers
- Exowave
- Wavepiston
- Waveplane
- Weptos
- Floating Power Plant
- Leancon
- Crestwing
- KNSwing
- Wave Dragon
- Resen Waves
- Wavestar





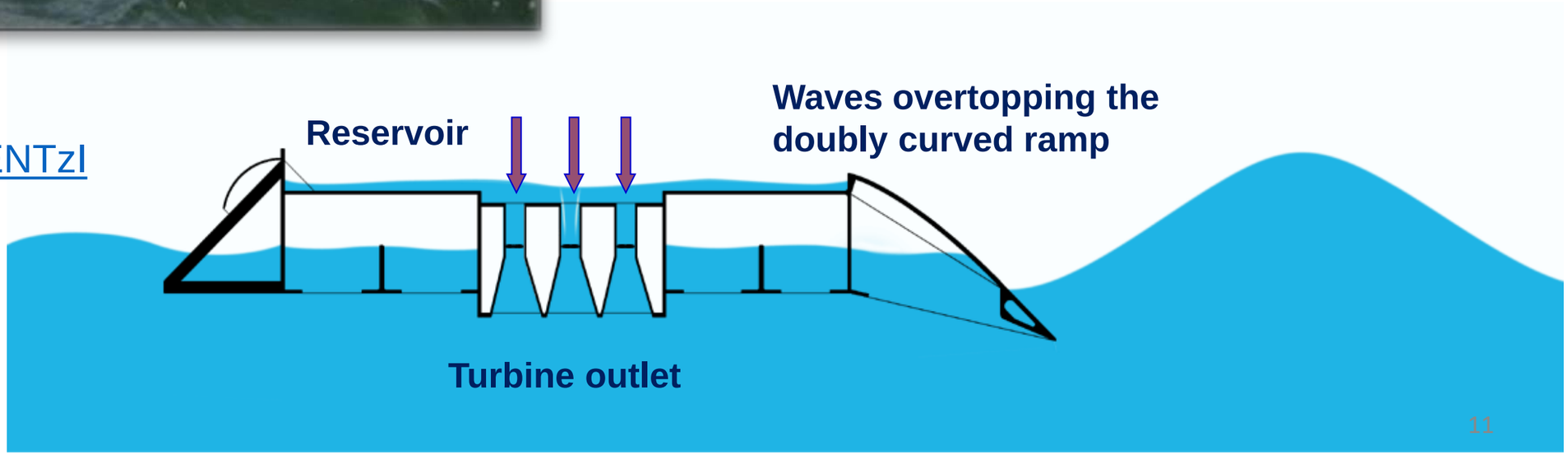
Source: Jens Peter Kofoed AAU

Wave Dragon

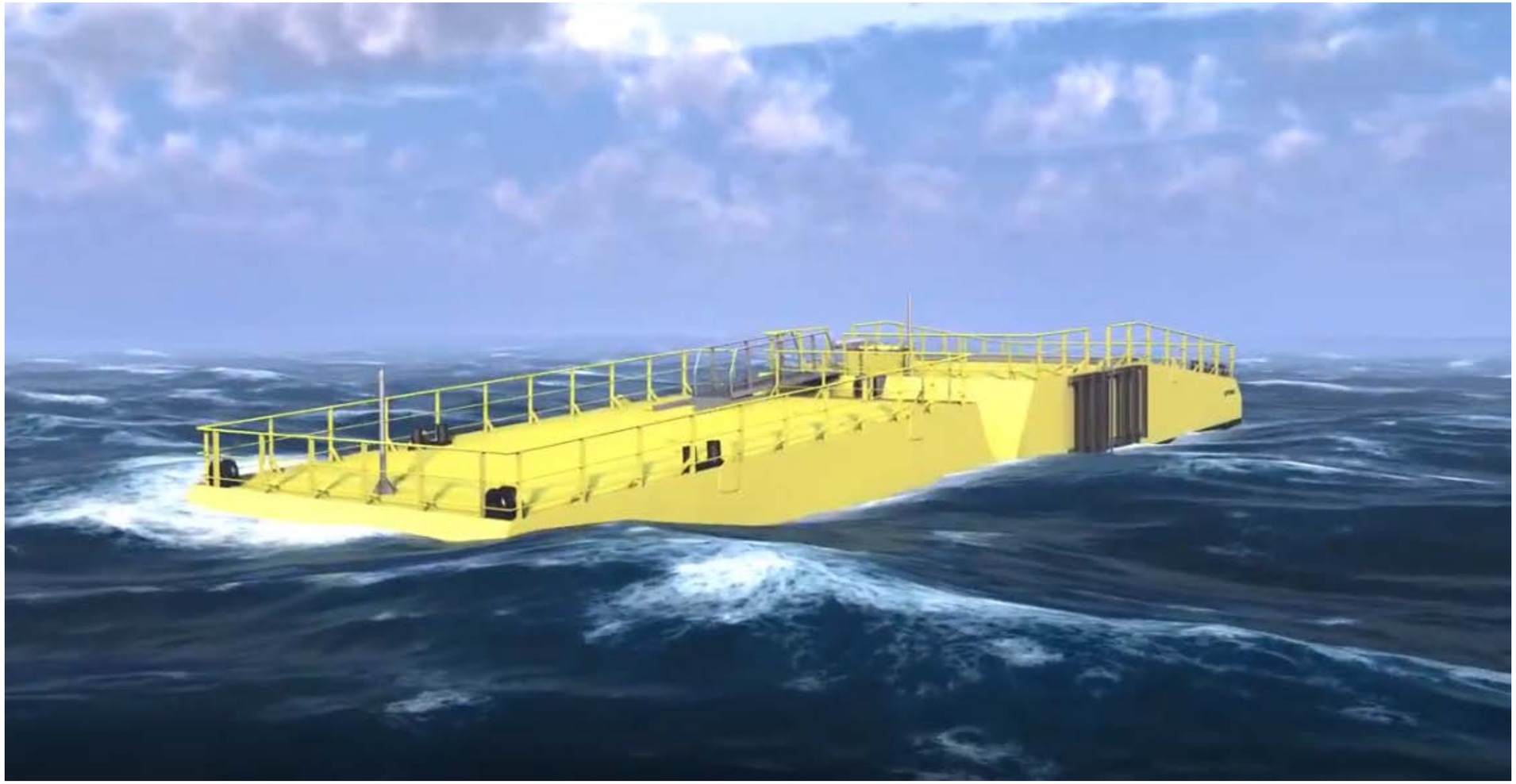
Wave climate - Power - Production		
12 kW/m	1.5 MW	4 GWh/y/unit
24 kW/m	4 MW	12 GWh/y/unit
36 kW/m	7 MW	20 GWh/y/unit
48 kW/m	12 MW	35 GWh/y/unit

20,000 hours power production from 2003-2008

https://youtu.be/Pjq0ynENTzI



CRESTWING



Off the coast of Frederikshavn, DK under testing last month, YouTube video

Floating Power Plant FPP

Active UK and maybe other sites; driven by floating wind, photo Facebook

The Weptos WEC

WEPTOS WEC ROTOR SIZE AT VARIOUS SCALES

WEC version Location	Lab testing -	Prototype Brandsø, Denmark	Demon-stration Hanst-holm, DK	Commer-cial Yeu Island, F
Rotor diam. [m]	0.20	0.9	4.5	7.9
Rotor width. [m]	0.24	1.1	5.4	9.6
Scale relative to prototype	1:4.5	1:1	5.0:1	8.8:1

Pecher, A, Kofoed, JP & Larsen, T 2015, The extensive R&D behind the Weptos WEC. in CG Soares (ed.), *Renewable Energies Offshore: Proceedings of the 1st International Conference on Renewable Energies Offshore, Lisbon, Portugal, 24-26 November 2014.* C R C Press LLC, pp. 351-358.

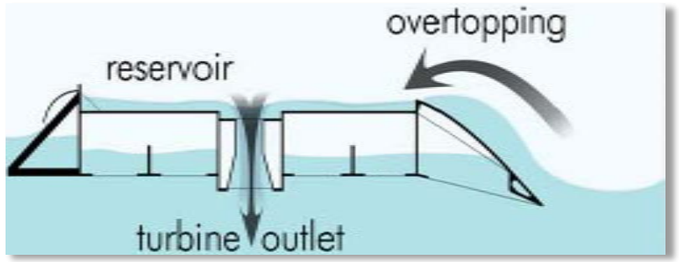
Video on web
https://youtu.be/2_JSZaAgCUw

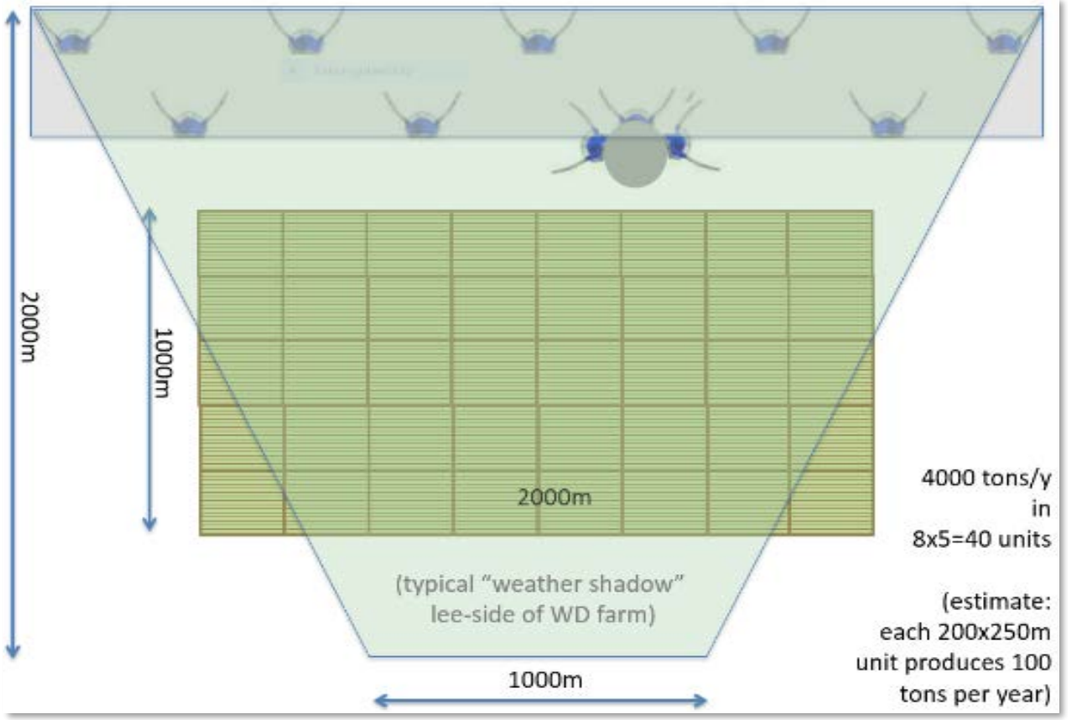
Source: Jens Peter Kofoed AAU

General tendency

- Up to now no funding for wave prototypes in Denmark and EU
- Lot of interest for floating wind
- EU funding for multiuse platforms; new projects after Maribe and Muses and like UNITED and MUSICA (BG5 H2020) from January 2020
- In Denmark: new government the next weeks with a majority for more RE

MARIBE
Marine Investment for the Blue Economy





A Multi use of space example: Combined wave energy converters with a seaweed producing farm – utilizing the calm water behind the Wave Dragon

WAVE + AQUACULTURE

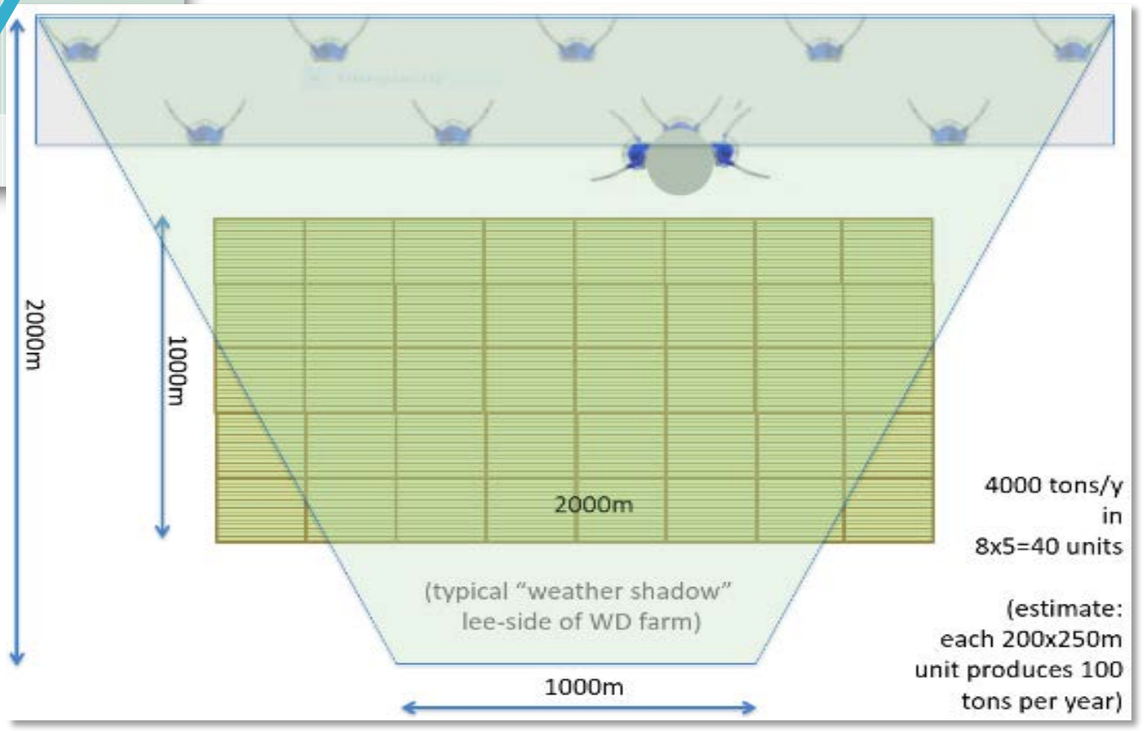
8. Wave Energy and Offshore Aquaculture in Wales, UK

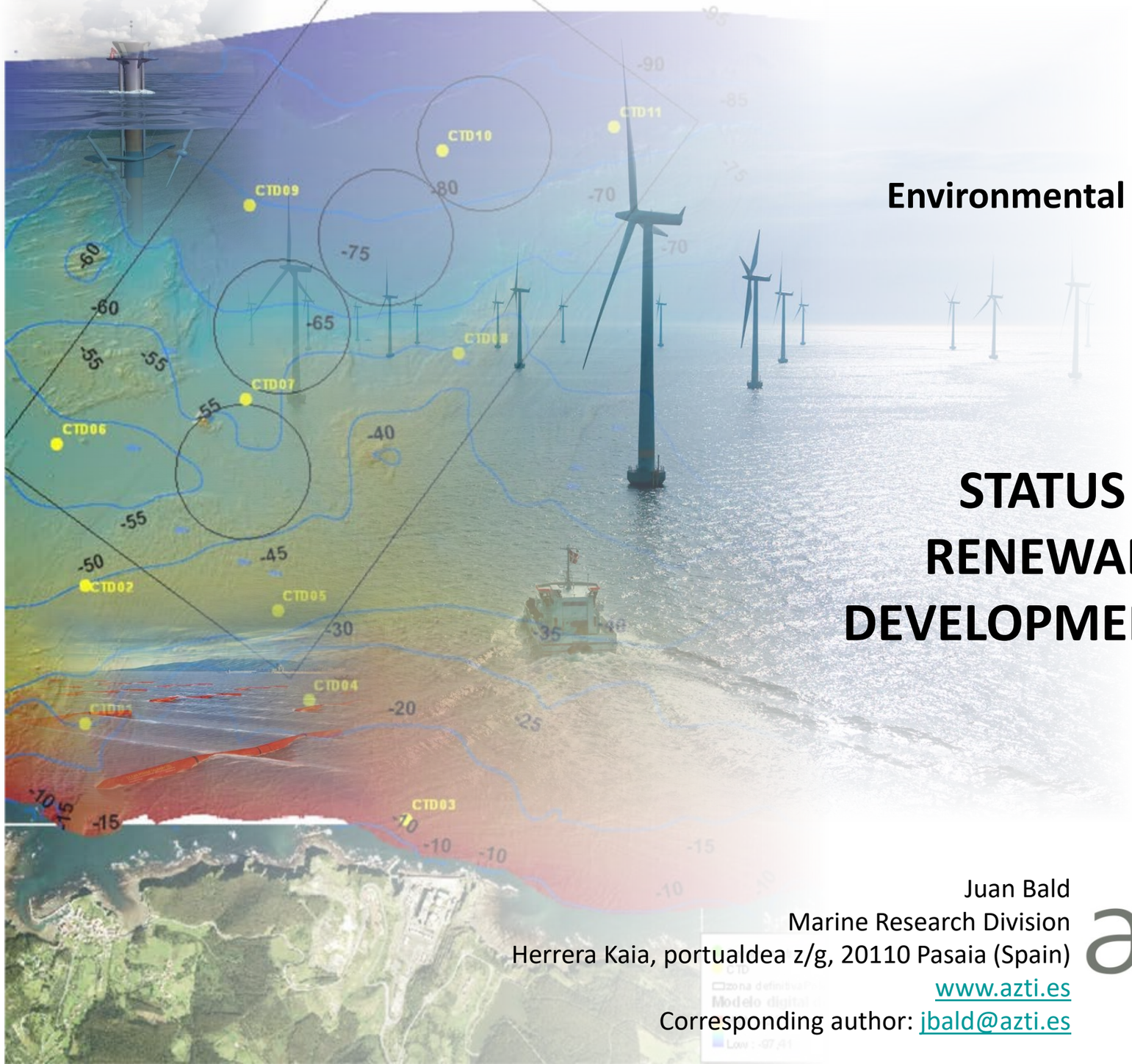
Description of projects

	Pilot project in Wales	1st Commercial project in Wales	2nd Commercial project; new location	3rd commercial project
Wave Dragon	1 WD; 4MW	9 WD; 30MW	9 WD; 30MW	
SES	80 tonnes/y	4000 tonnes /y	4000 tonnes/y	

Key figures

	3rd commercial project
Wave Dragon	45WD@4MW = 180MW
SES	20 000 tonnes/y
Pay back	4.3 years
IRR	24.4%





OCEAN ENERGY SYSTEMS

ANNEX IV

Environmental Analyst Meeting
28 June 2019

STATUS OF MARINE RENEWABLE ENERGY DEVELOPMENT IN SPAIN

Juan Bald
Marine Research Division
Herrera Kaia, portualdea z/g, 20110 Pasaia (Spain)
www.azti.es
Corresponding author: jbald@azti.es

azti tecnalia

WGMRE
Oostende, 26-28 February, 2018

1. Current development status
    1. Commercial deployments
    2. Test sites
    3. Developments
2. Country specific marine energy targets
3. Public Funding Programmes
4. Market incentives
5. Regulatory framework
6. Other relevant national activities
7. Environmental issues of high concern
    1. Environmental research
    2. Other research

- Commercial deployments

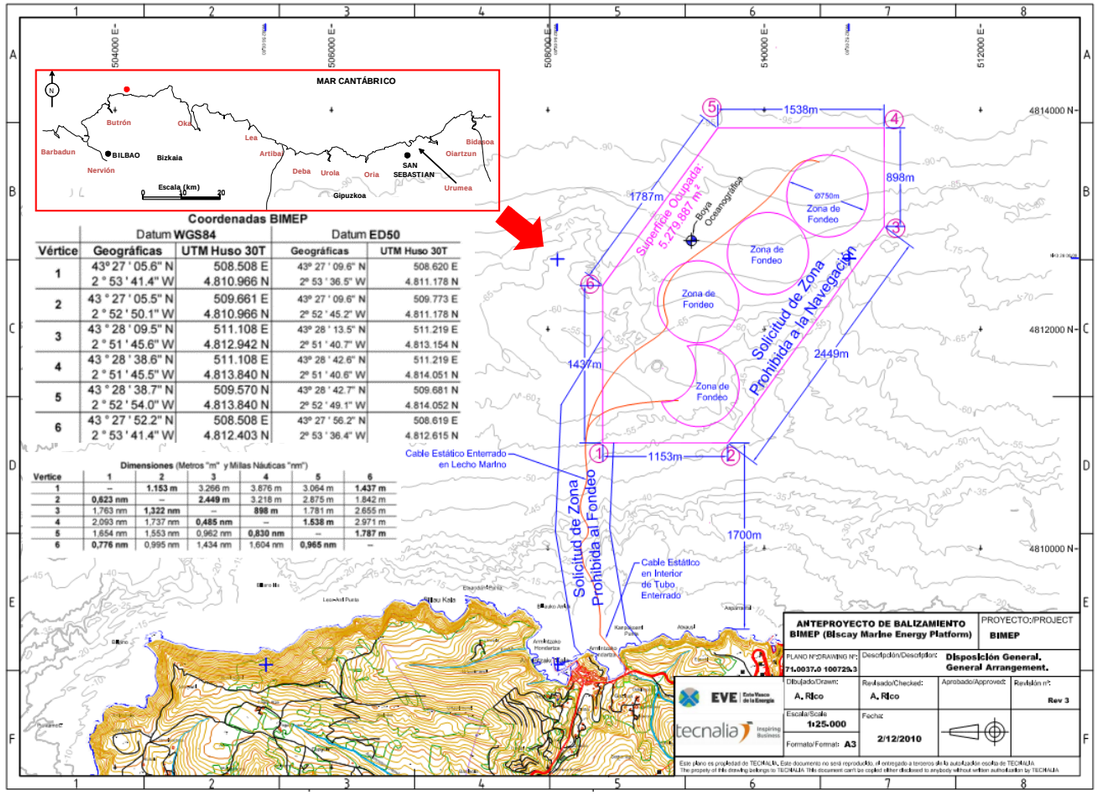
MUTRIKU OWC PLANT

The main milestone of ocean energy in Spain in 2011 was the final deployment of the first grid connected wave power plant, promoted by EVE - Ente Vasco de la Energia (the Basque energy agency) with over 1.77 GWh of cumulative produced power so far

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

- Commercial deployments
- Test sites

The Biscay Marine Energy Platform (bimep) is an offshore infrastructure for the demonstration and testing of wave energy harnessing devices promoted by the Basque Entity of Energy (Ente Vasco de la Energía - EVE).



Characteristics:

Flux of energy: 21 kW/m^2

Surface: 5,2 km^2

Depth: 50-90 m

Distance to shore: 1,7 km

Total energy: 20 MW

7 marking buois

1 oceanographic buoy(feb. 2009)

4 submarine cables/ 5MW)

1 electric substation on land

SCADA

Research centre in Arminza town

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

- Commercial deployments
- Test sites
- Developments

MARMOK-A-5 device deployed by IDOM at BIMEP after refitting with OPERA innovations

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

- Commercial deployments
- Test sites
- Developments

HarshLab deployed by TECNALIA at BIMEP during an inspection

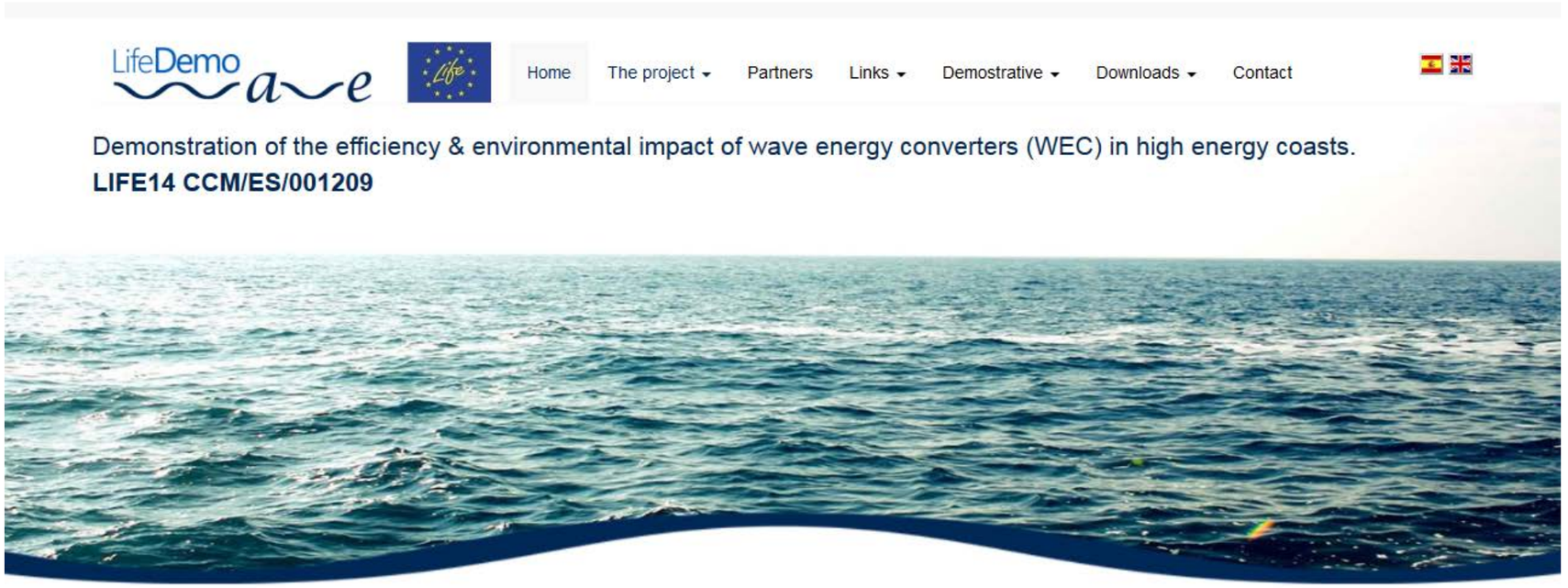
Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

- Commercial deployments
- Test sites
- Developments

WEP+, Ocean ERANET Cofund project, continuation of UNDIGEN and UNDIGEN+

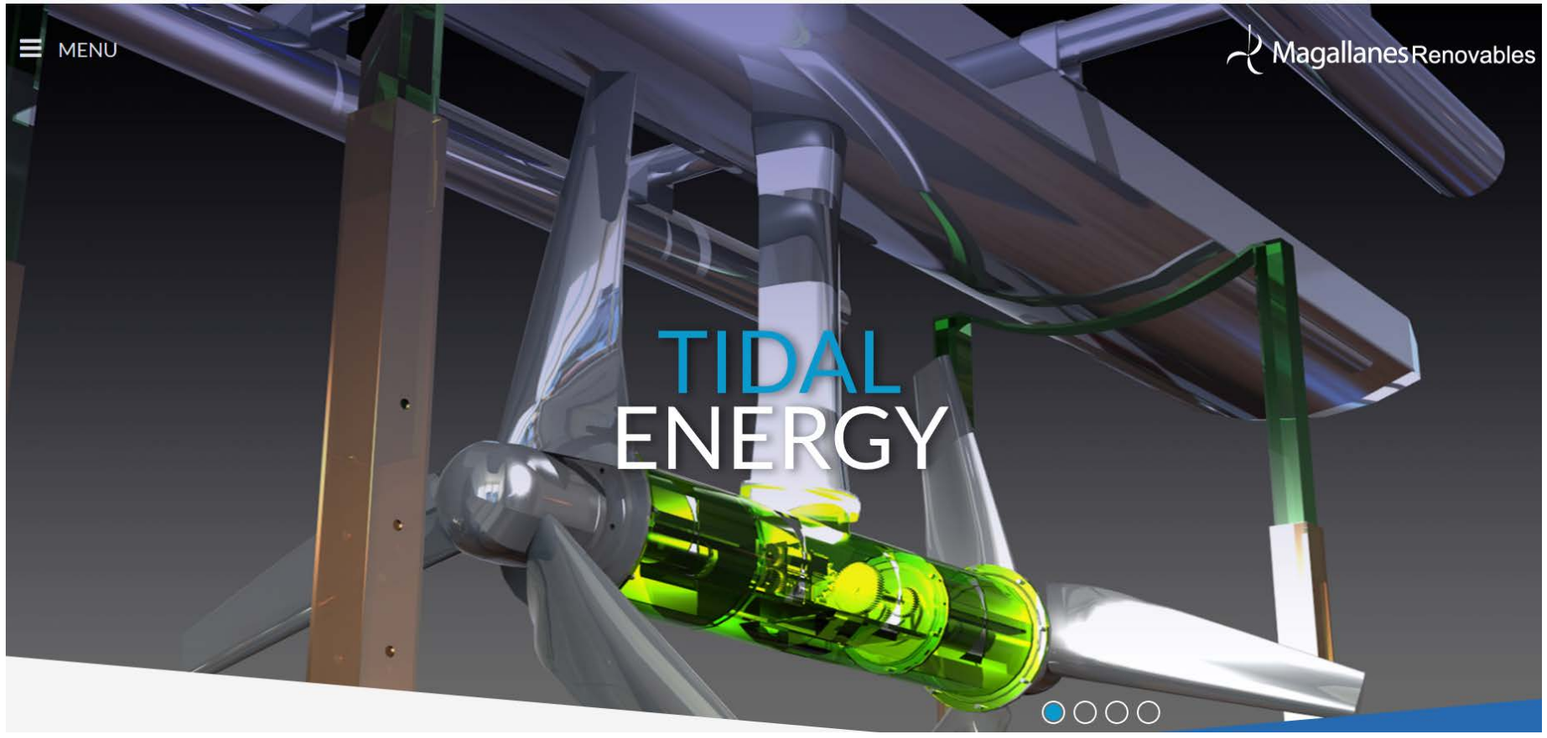
Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

- Commercial deployments
- Test sites
- Developments



Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

- Commercial deployments
- Test sites
- Developments



Galicia-based Magallanes Renovables has been tested its 2MW floating platform for tidal energy at EMEC in Scotland to validate the technology, study O&M costs and approach the market

During 2018 the Spanish Government started to work in the **Energy and Climate National Integrated Plan 2021-2030**, and the Energy Transition and Climate Change Law. Both, likely to be approved during **2019**, will fix targets for 2030 and new rules to boost renewable energy in general and, hopefully, ocean energy specifically.

Nowadays, the energy policy relays on the new Ministry for the Ecological Transition and the main permits needed to develop an ocean energy power plant (environmental, use of the marine space, energy production) have to be approved by this Ministry.

Currently, there is not specific organisation responsible for the implementation of any Ocean Energy programme, because up to now Ocean Energy has not been a priority in the Spanish policy.

The **Basque Government** approved in 2016 its Energy Strategy for 2030, which included a specific initiative to speed up technology and commercial development for marine energy and set a target of 60 MW by 2030.

- **OCEANERA-NET COFUND** is an initiative of eight national and regional government agencies from six European countries, which has received funding from the European Union under the Horizon 2020 Programme for Research and Innovation. The participating countries/regions are: the Basque Country, Brittany, Ireland, Pays de la Loire, Portugal, Scotland, Spain and Sweden. **The project launched the first co-funded call during 2017 and approved projects started in 2018**.
- The Basque Energy Agency (EVE) launched a new call of its **"Demonstration and validation of emerging marine renewable energy technologies" programme in 2018**. As previous calls, the programme has a budget of 2,5 M€ for a maximum of 3-year duration projects

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

There are no specific market incentives for ocean energy in Spain but for renewable energy installations in general

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

In Spain no dedicated consenting process exists for ocean energy technologies but there are several legal documents affecting ocean energy projects

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

The Master in Renewable Energy in the Marine Environment (REM) is an Erasmus Mundus Joint Master Degree (EMJMD)

The main environmental issues of high concern are the following:

- **Acoustic impact** over marine mammals and fishes during installation and operation of marine energy harnessing devices.
- **Seafloor integrity** and **benthic communities**.
- **Electromagnetic Fields** coming from submarine cables.
- **Change** in **marine dynamics** due to energy extraction.
- Competition of Marine Renewable developments with other users and thus the need to develop a **Marine Spatial Planning** approach.

The main project dealing with the environmental issues of marine renewables is the WESE project:

WESE
WAVE ENERGY
IN SOUTHERN EUROPE

http://wese-project.eu/

Project co-funded by the European Maritime and Fisheries Fund (EMFF) of the European Union.

MAIN OBJECTIVE

The main objective of the present project is to contribute to increase the current knowledge on environmental impacts of Wave Energy (WE projects) to better inform decision-makers and managers on environmental real risks and reduce environmental consenting uncertainty of ocean WE projects across Europe and a do better maritime spatial planning (MSP) approach to this nascent industry

SPECIFIC OBJECTIVES

1) Collection, processing, analysis and sharing of environmental data around wave energy harnessing devices currently operating at sea.

2) Improve existing modelling tools and contribute to the overall understanding of potential cumulative impacts of larger scale

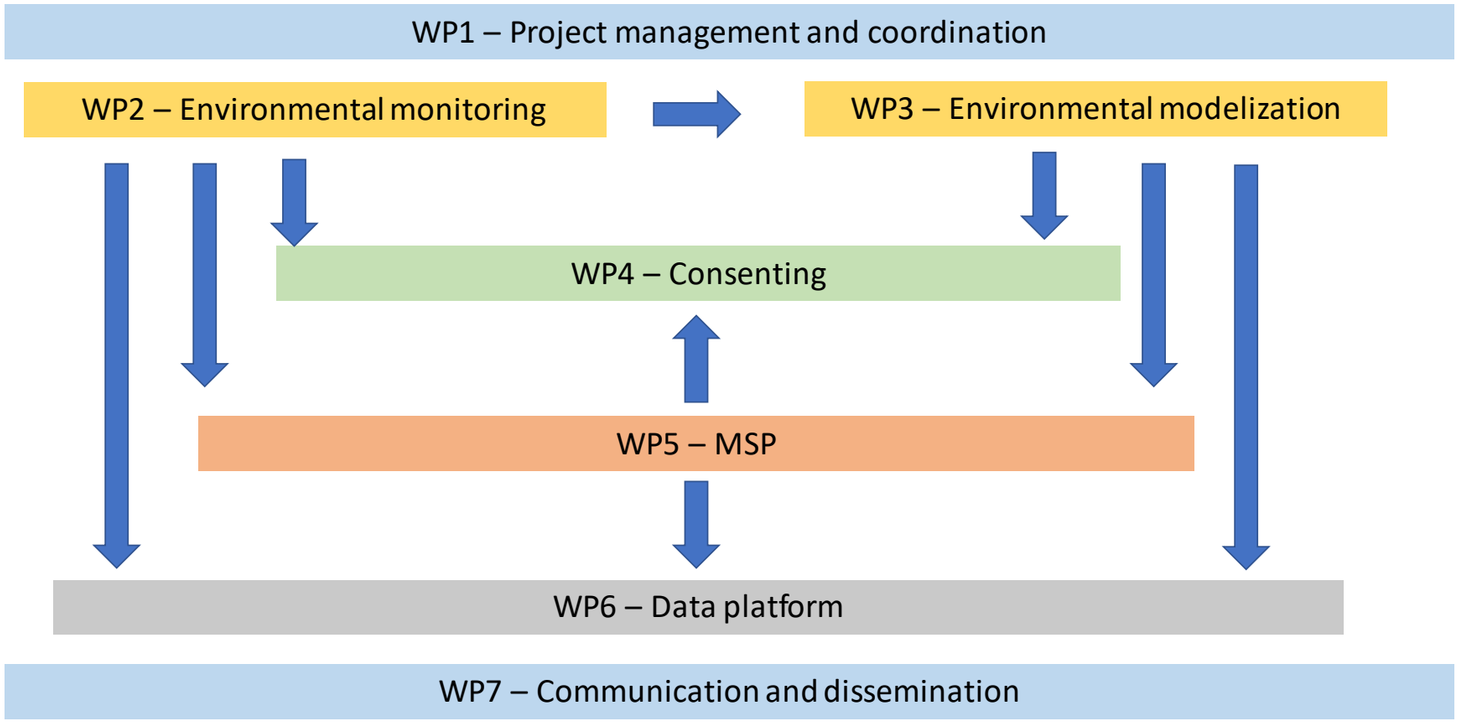
3) Development country-specific licensing guidance on WE licensing processes, including recommendations on good practices

4) Development and implementation of maritime spatial planning (MSP) Decision Support Tools (DSTs)

5) Development of data sharing platforms

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

WESE STRUCTURE



Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

CONSORTIUM

Technological Partners

Industrial partners

Current Development	Country specific targets	Public Funding	Market incentives	Regulatory framework	National activities	Environmental issues

PROGRESS: Main milestone: the launch of environmental monitoring activities

https://wese-project.weebly.com/uploads/1/2/3/5/123556957/wese_2nd_press_release__acoustic_monitoring_campaings_.pdf

WESE
WAVE ENERGY IN SOUTHERN EUROPE

Press release 2 (30/05/2019)

WESE project launch environmental monitoring activities around wave energy converters in BiMEP and Mutriku (Basque Country, Northern Spain)

In the framework of the WESE project devoted to the collection, processing, analysis and sharing of environmental data around wave energy devices currently operating at sea, different monitoring activities were undertaken around the MARMOK-A-5 device of IDOM-Oceantec and Mutriku Wave Power Plant in the Basque Country (Northern Spain) between the 6th and 22nd of May 2019, coordinated by AZTI.

The collection, processing, analysis and sharing of environmental data in sites where devices are operating in Spanish and Portuguese coastal waters, represent different types of technology locations and, therefore, different types of marine environments (onshore, nearshore and offshore) that can potentially be affected by wave energy projects: IDOM-Oceantec MARMOK-A-5 installed in Biscay Marine Energy Platform BIMEP, WaveRoller (AW Energy) installed in Peniche (Portugal) and Mutriku Wave Power Plant in operation in Spain.

Monitoring plans have been developed (see Deliverable 2.1 available from the project website) with the objective of obtaining data for:

a) **Underwater sound** emissions coming from MARMOK-A-5 device of IDOM-Oceantec and Mutriku Wave Power Plant.

b) **Electromagnetic Field (EMF)** generation of submarine cables that provides service to the MARMOK-A-5 device.

c) **Seabed integrity alteration** associated with the MARMOK-A-5 moorings and mooring lines.

Similar campaigns are expected to be undertaken in the Peniche test site in Portugal as soon as the WaveRoller (AW Energy) device is installed during summer 2019. The results and analysis coming from these campaigns are subject of different reports that will be finalized by 2020. These data will support the development of models for the analysis of potential cumulative pressures and environmental impacts of future larger scale wave energy deployments.

More information about the methodology, together with pictures and videos from the monitoring works undertaken, are accessible in the WESE web site (http://www.wese-project.eu/) and in our social media (Twitter, Linkedin).

monitored by means of a combination of static, mobile and
asurements consist in the deployment of a passive acoustic sensor
or a long period of time. In this case, a SoundTrap ST300 HF of
VavEC was moored in BiMEP and Mutriku test sites for a period
the photo shows the mooring line preparation.

coustic measurements in different locations (17 sampling stations
energy devices) during a short period of time (5 minutes in each
ment was used for the static measurements (SoundTrap ST300
during sound measurements at BiMEP.

s preparation. Credits: AZTI. CTD measurements. Credits: AZTI

le in the same locations and time period of that of the mobile
t developed by CTN of Cartagena (Spain). Finally, auxiliary
conductivity and temperature, were undertaken using a CTD to
d profiles to support underwater sound propagation analysis.
yment near to MARMOK-A-5 device.

the seabed integrity by the moorings and mooring lines of the
side scan sonar survey and a visual inspection with a ROV were
of Ekocean Servicios Marinos (www.ekocean.es) providing the
12 m length vessel) and ESGEMAR S.A. Estudios Geológicos
charge of the Side Scan sonar monitoring, and Instalsub
(www.instalsub.com/), in charge of the ROV inspection.

D equipment for depth
edits: AZTI. ROV preparation for seabed integrity visual inspection. Credits: AZTI.

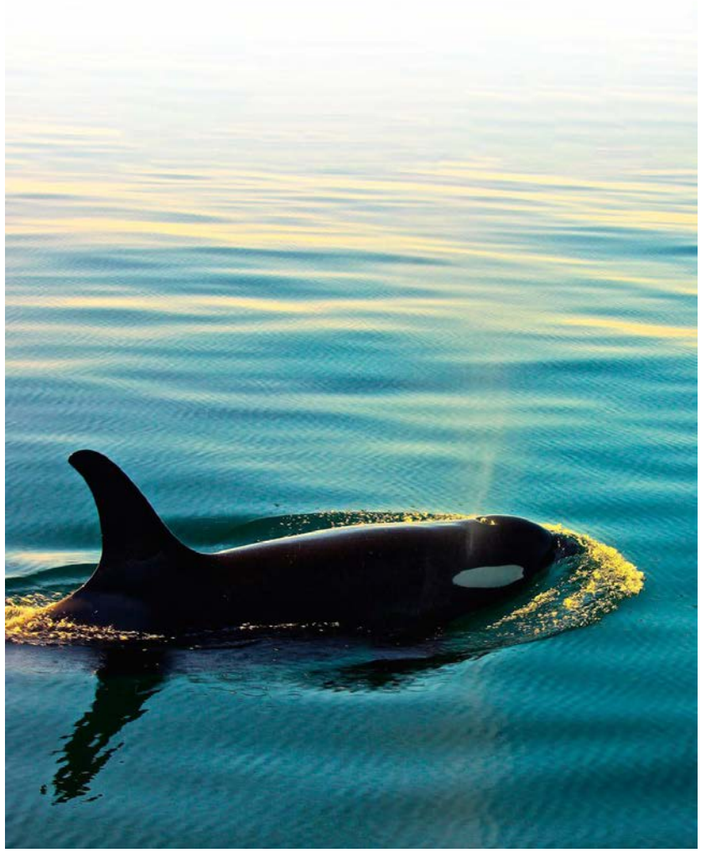
EMF)

s done with the collaboration of MAPPEM Geophysics (www.mappem-
towed 'fish', including 4 channels for very high sensitivity electric field
xgate magnetometer, simultaneously recorded. Data were recorded at 2
equipped with attitude and navigation sensors to recalculate its position
neters, pressure depth sensor and altimeter). Different transects over the
to the MARMOK-A-5 of IDOM-Oceantec were followed for EMF data

ation of the EMF measurements on board. Credits: AZTI.

ible thanks to several people who helped on carrying on with success and
g campaigns. The WESE team is especially grateful to Pedro Losa, Josu
mé and Daniel Tovarez from Ekocean, Jorge Rey and Roger Leis from
Rovirosa, Brais Lorenzo, Sergi Castellar and Josep Fleta from Instalsub,
Gaspari from MAPPEM Geophysics, BiMEP surveillance service and Olatz
om EVE during the acoustic campaings in Mutriku Wave Power Plant.

2020 State of the Science



- Timeline
  - Full outline in January 2019, a few changes since
  - Chapter authors are drafting chapters, to be completed by June/July 2019
  - Full draft by October/November 2019 for OES-Environmental review (all of you!)
  - January 2020 review by OES, peer reviewers
  - Finalize in April 2020
  - To be released as draft at ICOE in May 2020

Updated State of Science Report Outline

Section	Chapter	Chapter Title
Executive Summary		
Introduction	1	Introduction
Section A – Current Knowledge of Key Device Interactions in the Marine Environment	2	Collision Risk for Animals around Turbines
	3	Risks to Marine Animals from Underwater Sound Generated by MRE Devices
	4	Effects of EMF on Marine Animals from Electrical Cables and MRE devices
	5	Changes in Habitats caused by MRE devices: benthic and pelagic habitats, reefing patterns
	6	Changes in Physical Systems: Energy Removal and Changes in Flow
	7	Encounters with MRE Device Mooring Lines by Marine Animals
	8	Social and Economic Data for Consenting/Permitting
Section B – Environmental Monitoring	9	Environmental Monitoring Approaches and Technologies
Section C – Strategies for Accelerating Permitting/Consenting	10	Marine Spatial Planning and Marine Renewable Energy
	11	Adaptive Management
	12	Retiring Risk
Section D – Summary and Path Forward	13	Path Forward

Marine Spatial Planning and Marine Renewable Energy

Dr. Anne Marie O'Hagan,

MaREI Centre, ERI, University College Cork, IRELAND

and OES-Environmental Country Analyst

Purpose of Survey

- To update 2016 information on Marine Spatial Planning (MSP) and MRE
- To understand how marine planning has advanced in your country
- To determine if/how MSP has facilitated MRE (offshore wind, wave and tidal) development

- Hope is to have wide geographic coverage (all continents)
- Depending on level of information returned could have a ‘recommendations’ sections for those countries beginning to implement MSP

Approach

- Questionnaire broadly similar to that circulated for 2016 SoS Report
- Some questions have been amended slightly due to need for Ethical Approval from UCC Social Research Ethics Committee which covers:
  - Consent
  - Right to Withdraw
  - Storage of Data
- All 13 questions are open in format
- Also option to add additional comments / information / resources
- Circulated to all Annex IV Country Analysts on 17th June 2019 with two weeks for completion

Call for OES-Environmental country input

Key themes

- MSP and MRE: Plans, policies and interactions between these (4 questions)
- Scientific information in MSP i.e. the evidence base (1 question)
- Cumulative impacts (1 question)
- Conflicts and zoning (3 questions)
- Tools for MSP (1 question)
- Relationship between consenting / licensing and MSP (1 question)
- Limitations / obstacles to implementation of MSP (1 question)
- Role of the public (1 question)

Themes - general

1. **MSP in your country** – if there is no official MSP process please note this but continue to answer questions in response to whatever planning process does exist

- Try to provide as much information as possible e.g.
  - Where does the planning process described apply – from shoreline to 12 nautical miles? Further? From 12 – 200?
  - Who is responsible? National government / regional government / local council or a combination?
  - Since when has this planning process been in place? Very new – limited implementation, well-established – more mature, less problems?

Themes - general

2. **MRE in your country** – is there an agreed national MRE strategy / plan / policy in your country? Does it contain targets for specific technologies? Are these reflected in the Marine Spatial Plan?
3. **MSP and MRE** – does the Marine Spatial Plan include MRE as a specific sector? Are all technologies included?
4. **MRE in MSP** – how does the MSP take MRE requirements into account? Environmental Assessments? Meetings with key stakeholders?

In all cases please provide links to documents if available in the public domain.

Themes – science for policy

5. Use of **scientific information** in MSP – taken from existing developments/deployments, scientific models, monitoring studies, projections?

6. How have **cumulative effects** been taken into account in MSP? Addressed at a national level or only at site/development level? Specific methodology followed?

Themes – conflicts and exclusion

7. How does MSP address **conflicts** between different sectors / user groups? Does MSP address this or is it left to ‘local’ or pragmatic solutions between those concerned? Can you give examples – what has/hasn’t worked.

8. Areas where MRE is explicitly **excluded**? How is this achieved?

10. Are there **designated zones** for MRE? How do these work? One use only? Mixed activity? Who enforces these? Can develop occur elsewhere / outside these zones?

Themes – tools, interaction and involvement

9. Tools used to implement MSP – could include GIS, exclusion zone, priority areas, regulations, etc.

11. Interactions between licensing decisions and MSP – are licences issued in accordance with the plan or on a first-come, first-served basis?

12. Limitations to implementation of MSP – lack of transparency, lack of priority, lack of resources, lack of scientific information?

13. Public involvement – how are the public involved in MSP and MRE decision-making?

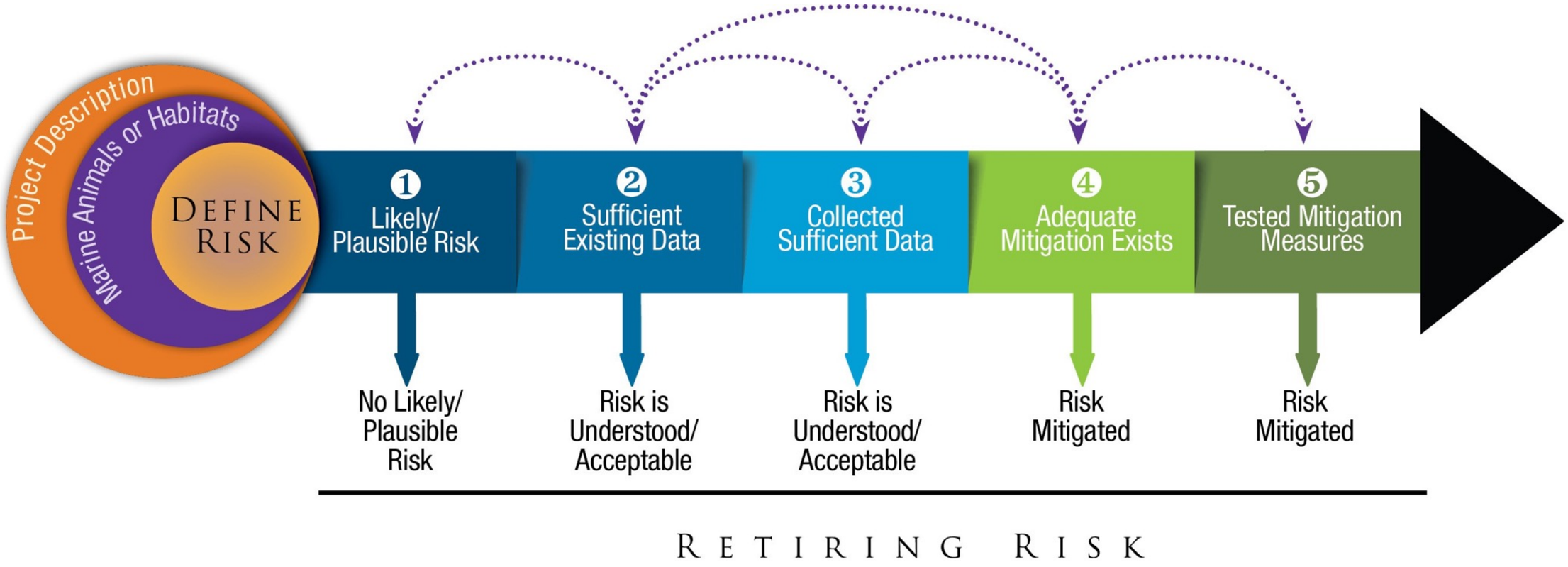
Progress to date

- Hopefully responses will be received by late June/early July so as to ensure timely preparation of associated Chapter (!)
- One response returned already – full marks to **Japan** ☺
- Anne Marie is happy to answer any questions anyone has on this (email or Skype, if needs be - a.ohagan@ucc.ie)
- Can't over-emphasise the need for comprehensive responses – purpose of OES-Envrionmental is learning and transfer of knowledge. This provides an opportunity to share your country's expertise ***and*** learn from experiences elsewhere…

Thank you for your cooperation

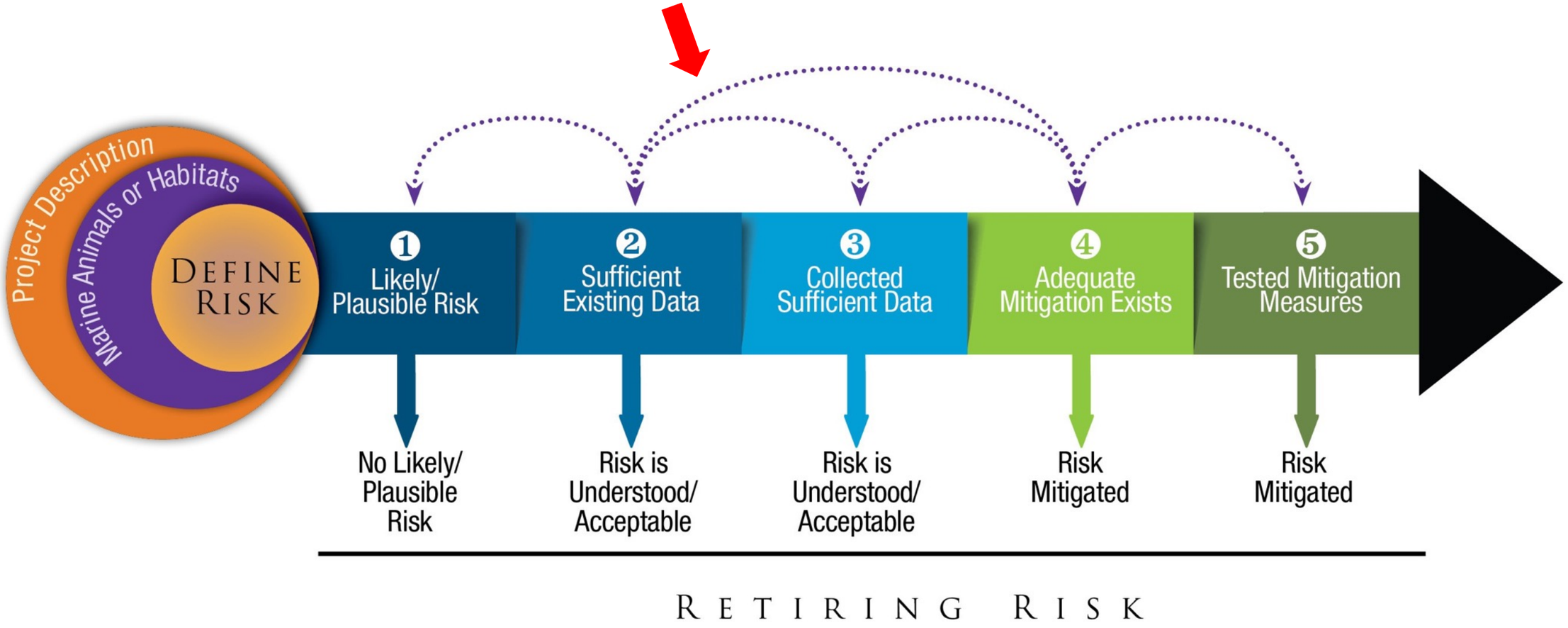
https://www.marei.ie/

Retiring Risk



Data Transferability Process

- Need to ensure datasets from permitted projects are readily available and comparable



Retiring Risk

- US Regulator Workshops
  - 18 regulators (16 new) for Data Transferability Workshop (April 2019)
  - 9 (6 new) for Retiring Risk Workshop (May 2019)
  - Total of 53 regulators engaged 2018-2019

- EWTEC Workshop
  - September 5th afternoon
  - Co-sponsored with ORJIP
  - Invitations/save the date sent out 6/26
  - Retiring Risk for EMF, effects of underwater noise from devices
  - Bringing together datasets to see if we can meet thresholds
  - Include caveats/criteria for which this risk retirement applies
  - Output to SoS, also ORJIP position papers

OES-Environmental Phase 4

- Some ideas:
  - Risk retirement
    - ✓ Processes proposed, to be tested at EWTEC workshop
    - ✓ Monitoring datasets becoming available
    - ✓ Could focus on testing risk retirement systematically
  - Position papers
    - ✓ Providing greater certainty to project applicants
    - ✓ Providing advice to nations/governments
  - Increase connections with other programs
    - ✓ ICES, EC programs, etc.

- Other ideas, discussion

OES-Envr 1-on-1 Analyst calls

- Thank you for taking the time to talk with us!

- What we heard:
  - Many Analysts are not being provided funding for travel or time
  - Many countries engaging in Regulator Survey
  - Updates of where each country is regarding MRE development and focus
    - ✓ For example:
      - India – focus on OTEC
      - Australia – focus on wave power and interest in decommissioning effects
      - China – small projects at this time, not much focus on environmental effects

Enhancing Outreach Activities

- Country presentations during Analyst meetings
  - 1-2 Analysts present at each meeting
    - ✓ Projects or studies
    - ✓ New MRE projects in your country

- Metadata Updates: emails from Cailene Gunn (cailene.gunn@pnnl.gov)

- Regulatory Framework Updates: emails from Debbie Rose (deborah.rose@pnnl.gov)

- Continue to fill out Google Drive Ambassador spread sheet

Call for OES-Environmental country input

OES-Activities – Social Media

@tethys_enviro

@tethys.pnnl.gov

- Posting several times a week to each platform to increase engagement
  - *Tethys* Blasts
  - New environmental effects journal articles
  - MRE and Wind industry news

- If you have any content, news, etc. to highlight please send to Dori Overhaus (dorian.overhaus@pnnl.gov)

Call for OES-Environmental country input

OES-Environmental Activities - Upcoming

- Upcoming Conferences
  - EWTEC 2019 – September 2019, Naples, Italy
  - Other events:
  - OREC 2019 (Portland OR September 11-12, 2019)
  - Oceans 2019 Seattle (October 2019
  - PAMEC 2020 (Costa Rica January 2020)
  - EIMR (??)
  - AWTEC (Tasmania September 2020)

- Retiring Risk Workshop
  - Naples, Italy – EWTEC, September 5th 2019
  - Discuss Retiring Risk for Underwater Noise and EMF

- ICOE 2020
  - Washington, D.C. – May 19th – 21st 2020
  - Release full draft of 2020 State of the Science report

Pacific Northwest
NATIONAL LABORATORY

Round Table

Future Meetings

- September 24, 2019
- December 2019 (date TBD)

Andrea Copping
Andrea.copping@pnnl.gov
+1 206.528.3049

Mikaela Freeman
Mikaela.freeman@pnnl.gov

Lenaig Hemery
Lenaig.Hemery@pnnl.gov

Alicia Gorton
Alicia.gorton@pnnl.gov

Amy Woodbury
Amy.Woodbury@pnnl.gov