



**mates**



**aquateira**

# Introduction to Marine Energy

**Dr Leuserina Garniati & Jennifer Fox**



Co-funded by the  
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# Housekeeping

- You have control over your own camera and microphone.
- You're welcome to keep your camera on throughout the session
- Please mute your microphone when you're not speaking
- Please use the chat box for questions
- You can also email either of us privately for any reason  
[Jennifer.fox@aquatera.co.uk](mailto:Jennifer.fox@aquatera.co.uk) or  
[Leuserina.Garniati@aquatera.co.uk](mailto:Leuserina.Garniati@aquatera.co.uk)



# Plan for today

- Introduction to trainers and trainees
- Introduction to Aquatera
- Objectives of the course
- Plan and schedule for the course
- Expected outputs
- Introduction to marine energy
- The role and history of marine energy
- The global state of marine energy
- Marine energy definitions



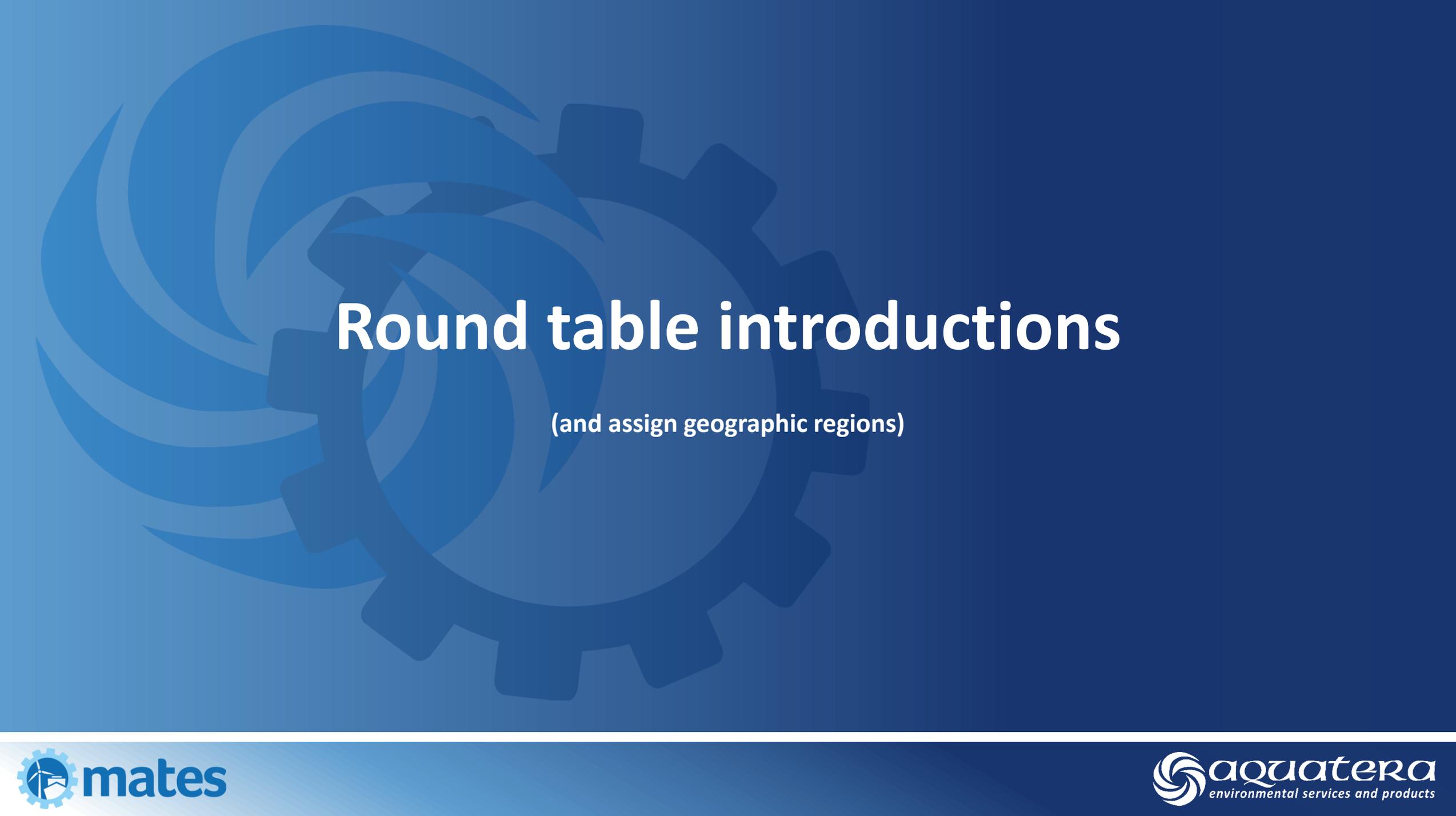
# Schedule for today

Item	Start time
• Welcome and housekeeping	09:00
• Agenda & introductions	09:05
• Mates intro	09:15
• Objectives of the course	09:20
• Plan and schedule for the course	09:25
• Expected outputs	09:30
• Module summaries	09:35
• Role and history of MRE	09:55
• <b>Break</b>	<b>10:30</b>
• Global state of MRE	10:45
• Group work 1	11:00
• Individual assignment 1	11:30
• <b>End</b>	<b>12:00</b>

# Our team

- Dr Gareth Davies
- Ian Johnstone
- Dr Leuserina Garniati
- Jennifer Fox
- Isa Walker

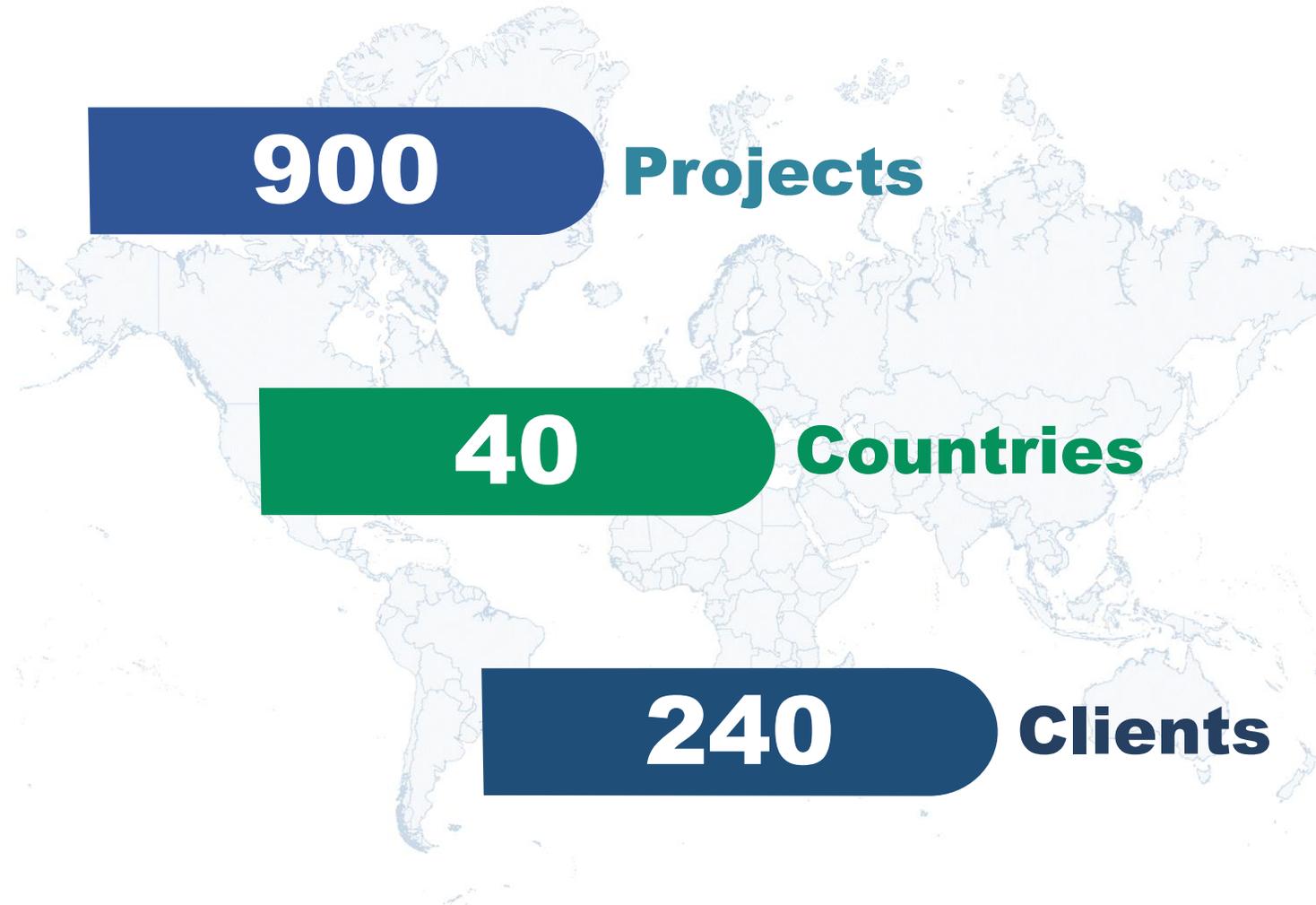




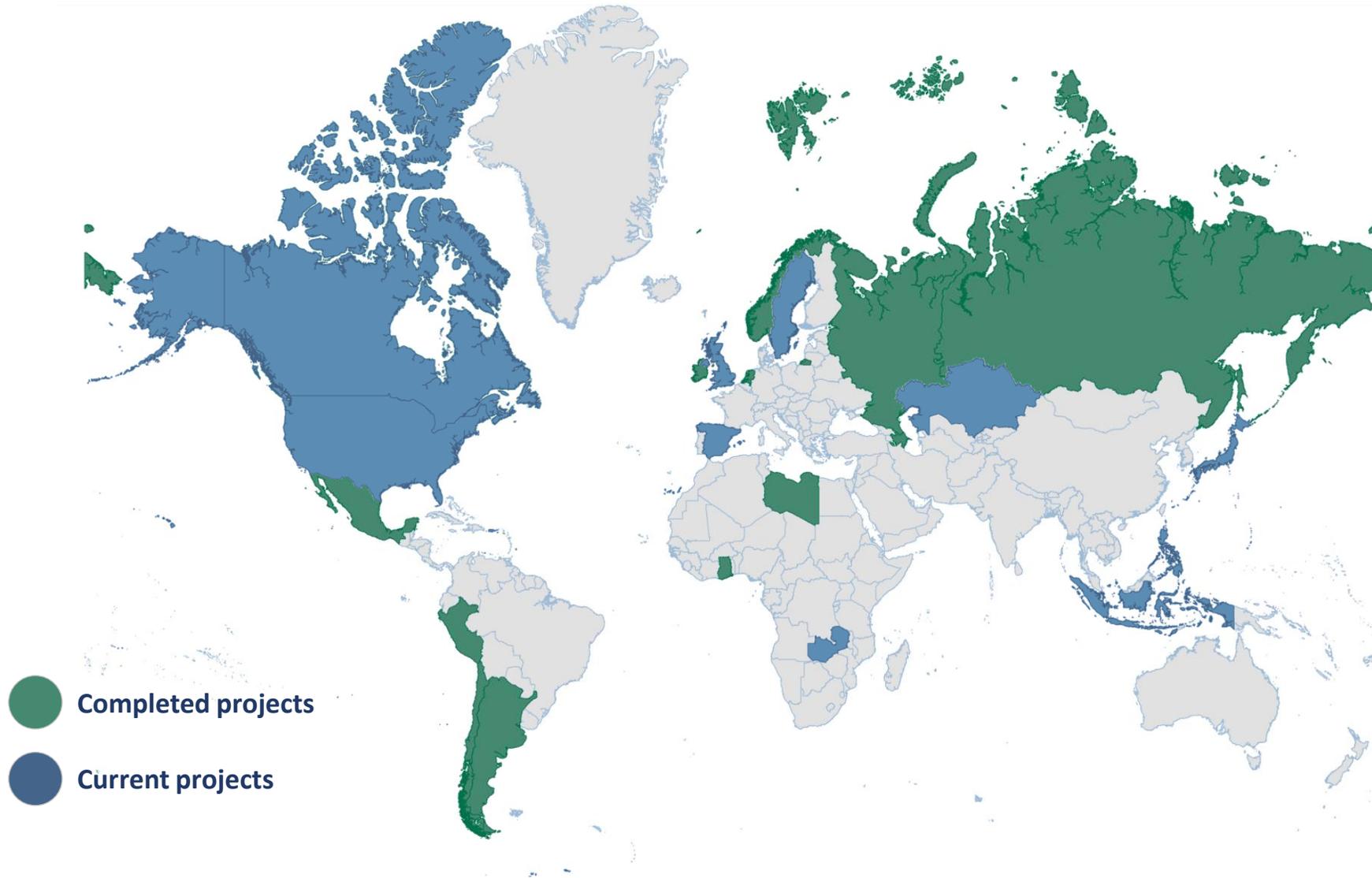
# Round table introductions

(and assign geographic regions)

# Aquatera Ltd- Thinking locally acting globally



# Where we work



- Completed projects
- Current projects

# Sectors

Offshore wind



Oil and gas



Infrastructure



Aquaculture



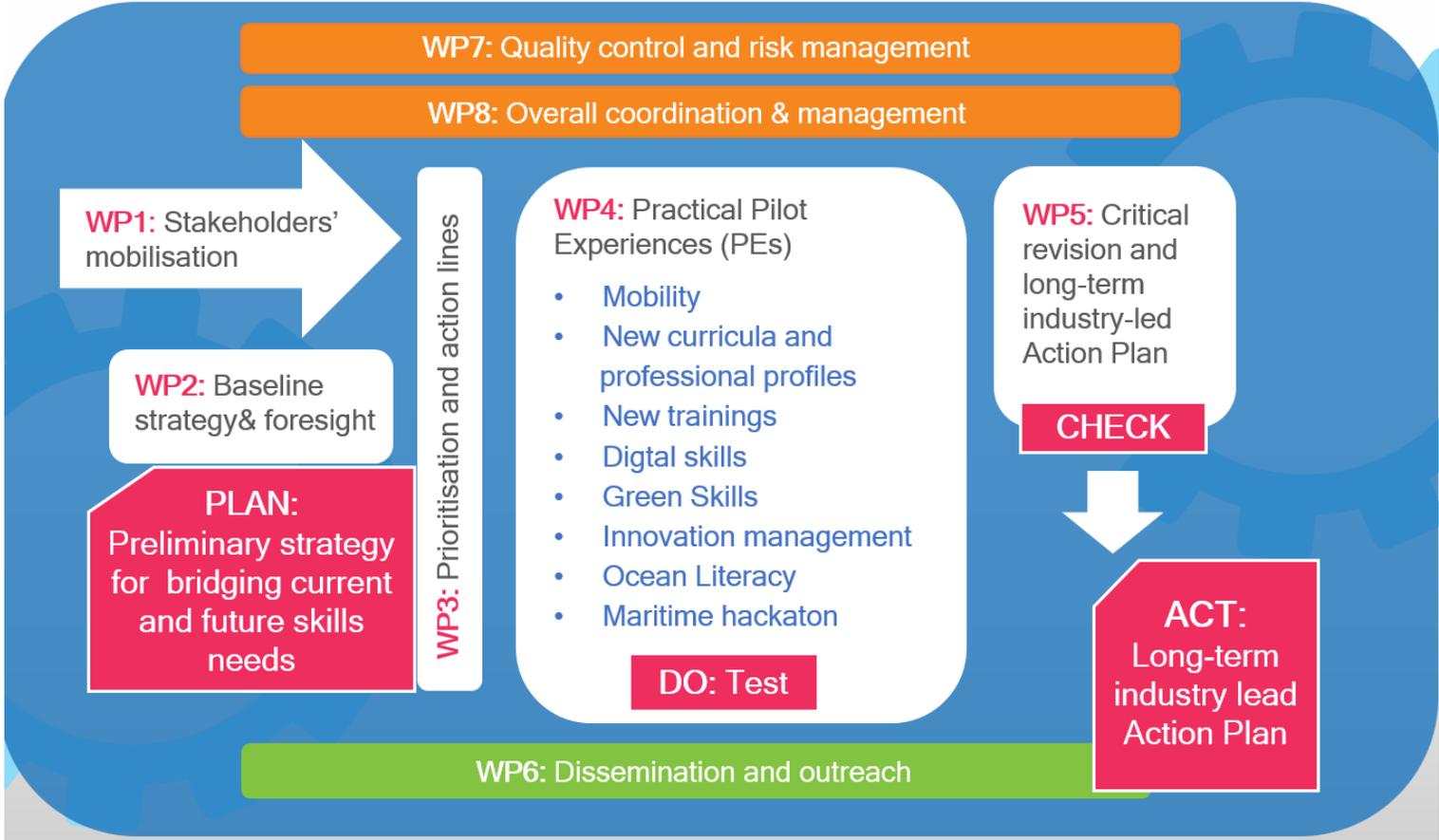
Wave and tidal energy



Onshore wind



# MATES Project



**AT A GLANCE**

PROGRAMME: ERASMUS+

INSTRUMENT: Sector Skills Alliances (SSA)

TOTAL BUDGET: €4.9 million

DURATION: January 2018 - December 2021 (48 months)

COORDINATOR: Centro Tecnológico del Mar (Fundación CETMAR), Spain

CONSORTIUM: 17 partners from eight countries



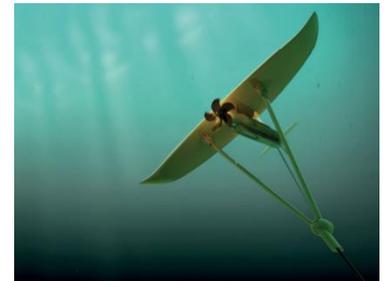
© The Carbon Trust

# Key skills gaps in the Offshore Renewable Energy sector

Reference No.	Title
ORE 1	Training, reskilling/ upskilling workforce in the use of <b>new digital technologies</b> (artificial intelligence, mechatronics, 3D printing, Internet of things, cloud computing, big data).
ORE 2	Training, reskilling/ upskilling workforce in order to increase technical knowledge on <b>Energy storage</b>
ORE 3	<b>Develop synergies among sectors with significant similarities</b> in their needs to promote skills transferability between them (e.g. Oil and gas, offshore wind energy, ocean energy)
ORE 4	<b>Opportunities for skills diversification from parallel sectors</b> e.g. Fisheries, aquaculture, and marine operations. Particular skills in ROVs, health and safety, marine operations.
ORE 5	<b>Multi-disciplinary skills</b> outside of specialization. E.g. Ecologists should also have skills in technological development, business/ financial aspect of ORE
ORE 6	Increasing the levels of <b>experience and specialization gained by temporary employment</b>
ORE 7	Specialization and experience in <b>offshore economics related to market, financial and investment analysis</b> , such as Levelized Cost of Energy (LCOE) reduction, subsidy framework, etc.
ORE 8	Need for specialization and expertise in <b>skills that are not yet standardized</b> and are still under development e.g. Decommissioning
ORE 9	Research and development of <b>legislation, guidelines and policies</b> associated with offshore renewable energies
ORE 10	Promote/ enhance <b>21<sup>st</sup> Century skills</b> : adapted to the different needs of ‘blue collar’ and “white collar” roles: teamwork, communication, analytical skills. (Also referred to as soft skills, and including capacities such as creative thinking and innovation, critical thinking and problem solving, communication and collaboration, knowledge management and transfer, flexibility and adaptability, initiative and self-direction, productivity and accountability).
ORE 11	Enhance <b>Ocean Literacy</b> in offshore renewable energy to increase attractiveness of maritime careers for <b>graduates and early-career skilled workers</b>
ORE12	Promoting <b>STEM women in ORE</b>

# Objectives of the Crash Course

- Aim: to advance the exposure of the fast-developing MRE to those working in parallel or similar work streams in order to build the awareness and knowledge of the sector and ultimately to ensure that the skills requirements for this growing sector are met.
- This will be achieved by:
  - raising awareness of MRE as part of the energy mix
  - introducing a basic understanding of MRE systems development
  - providing up-to-date information on the latest situation of MRE in a global context.



# Learning Outcomes

1. Creation of linkages where people can transfer from their current sector to MRE
2. Understanding of the key fundamental industry skills that will be needed to work with the MRE industry
3. Understanding of participants' current sectors' role in MRE
4. Understanding of what participants can provide to the MRE sector within the skills that they already have.
5. Development of an advanced and questioning mind about MRE development in general



# Schedule for the course

Time	Module	Led by
Monday 0900 - 1200	Core Cluster	Jennifer Fox & Leuserina Garniati
Monday 1330 - 1630	Technical Cluster	Isa Walker
Tuesday 0900 - 1200	Business Cluster	Ian Johnstone
Tuesday 1330 - 1630	Policy Cluster	Leuserina Garniati
Wednesday 0900 - 1200	Environment Cluster	Jennifer Fox
Wednesday 1330 - 1630	Group work- Fantasy Island	All

# Key things to remember

- This will be informal and interactive
  - Please interrupt us to ask questions and use the chat for questions
- This is a pilot exercise
  - Your feedback is really important to us
  - We will issue feedback forms
  - Please feel free to send us your thoughts and comments
- You will be awarded a certificate of completion after the final session



# Course structure

- 1. Technical (T) cluster
  - a. MRE resources assessment (Module ET1)
  - b. MRE technology innovation pathways (Module ET2)
  - c. MRE site selection (Module ET3)
- 2. Policy (P) cluster
  - a. MRE global policy (Module EP1)
  - b. MRE stakeholders and planning (Module EP2)
  - c. Policy case study (Module EP3)
- 3. Environmental (E) cluster
  - a. MRE impact assessment (Module EE1)
  - b. MRE Receptors and Stressors
  - c. Environmental case study (Module EE3)
- 4. Business development (B) cluster
  - a. MRE markets and end users (Module EB1)
  - b. MRE project development (Module EB2)
  - c. MRE economics and supply chain (Module EB3)



# Grading

- Final Grade Breakdown:
  - Group work 1: 10% of final grade
  - Group work 2 (a and b): 45% of final grade
  - Individual Coursework: 45% of final grade
  - Participation: 15% of final grade
- Grading Scale:
  - 60 & Above Successful
  - 59 & Below Not successful
- While collaboration is encouraged and highly valued in group assignments, academic integrity is expected when completing the individual coursework. References to work by others are expected in any documents/presentations submitted for grading.



# Group work 1

- Each of you have a geographical region to consider

- Europe
- Asia (Southeast & East)
- North America
- South America
- Australia

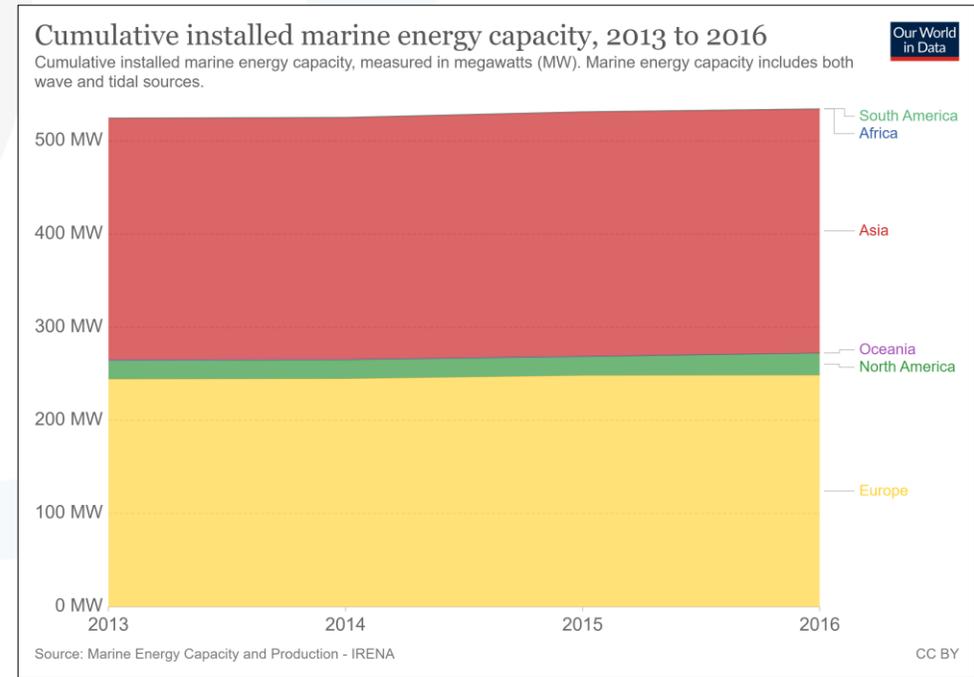
- What are the ideal key outcomes for the region in ten years in relation to marine energy?

- Consider specific political, economic and social circumstances of the region

- What is the current status of marine energy in this region (Baseline)

- What are the key milestones that should be targeted in order to meet the ideal outcomes in ten years?

BASELINE	Milestones to be achieved in year-x									TARGET
Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	



# Individual assignment

- Review the document you've been sent called "Individual Assignment V1"
- The main purpose is for us to get to know you a little better and to make sure that the course to come will be relevant and of interest to you
- Use this time to answer the following questions
  - **The most pertinent and/or interesting take-away message(s) from the Core Modules**
  - **How the issue(s) above is/are relevant to your country of residence or country of origin (choose 1)**
  - **Which Module(s) below you think would be most relevant to you?**
    1. Policy
    2. Environment
    3. Technical
    4. Business Development
  - **Please reflect and review on how your educational and/or professional background and/or interests have influenced your selection to the Module(s) above.**

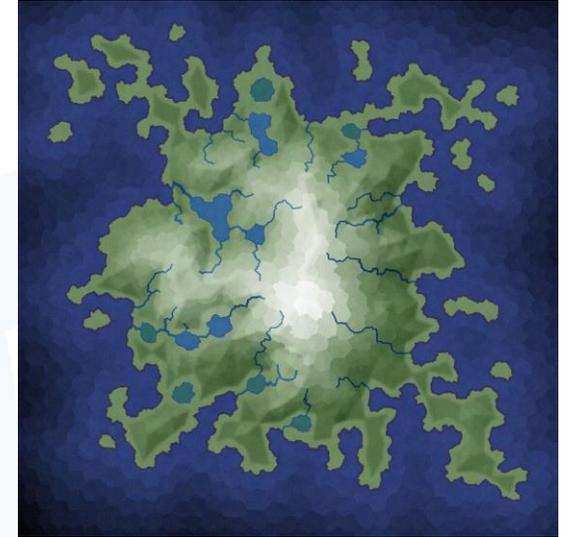


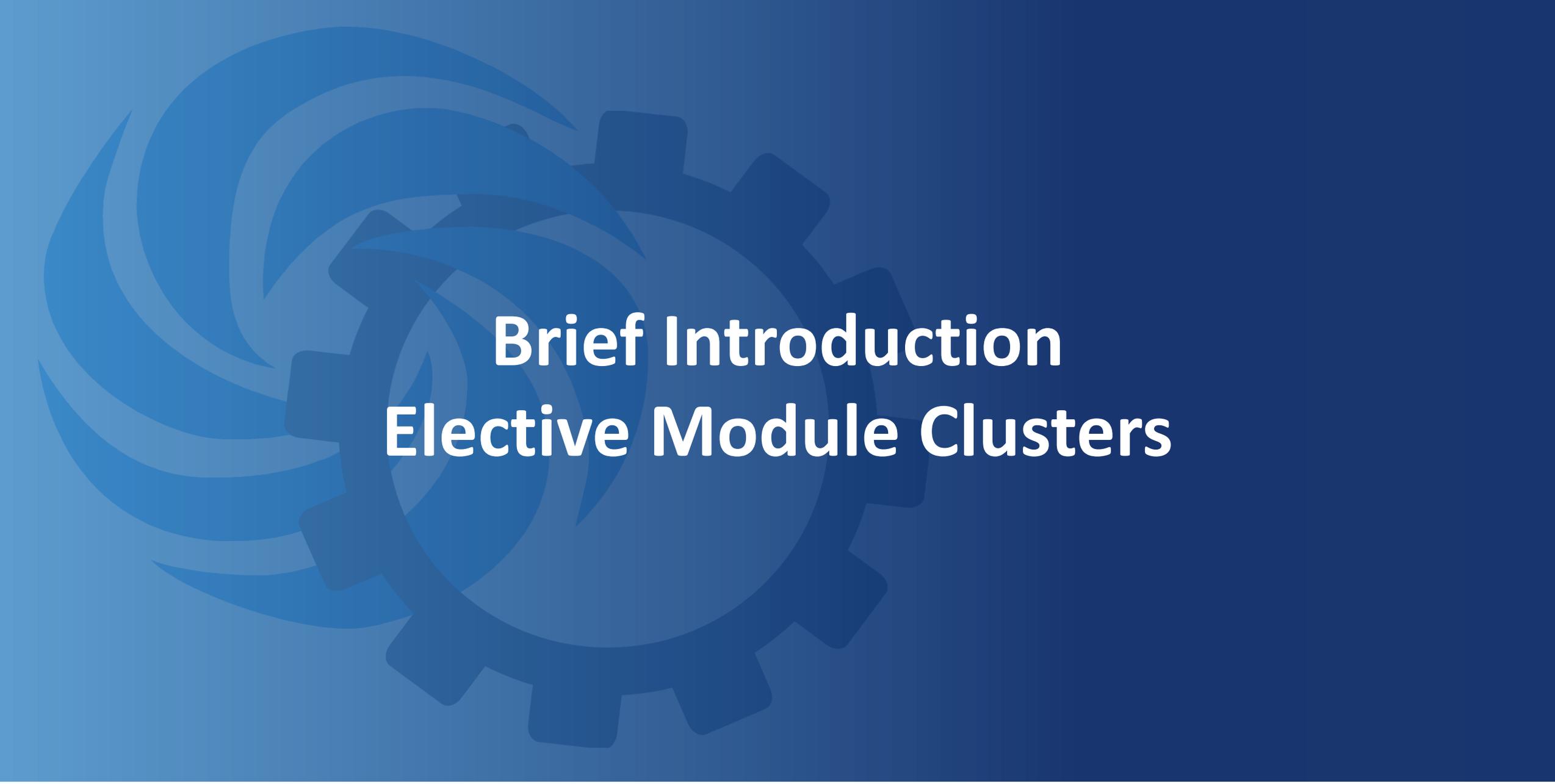
# Group work 2a

- Within each module, there will be a short group assignment based on the learning within that module
- This will be carried out through discussion and doesn't need to be submitted in writing
- Specific questions will be put to the group and you will be invited to input into the discussion
- For example
  - Policy module:
    1. Which of the Market and Non-Market Incentive Policy(ies) have been planned for or are being implemented in each case study area?
    2. What stakeholders engagement techniques do you think have been employed to collect information and plan strategic frameworks in each case study area?
    3. Who are the likely stakeholders engaged in both case study areas?

# Group work 2b- Fantasy Island

- The final session of the course will be dedicated to this assignment
- You will be given baseline information on our Fantasy Island
- You will be divided into four groups
  - Regulators (representing Policy module)
  - Project developers (representing Business module)
  - Technology suppliers (representing Technology module)
  - Third sector/ community group (representing Environment module)
- Each group will be given specific tasks to determine what the key considerations are for a marine energy development
- We will break into our groups to discuss these tasks
- We will then come back together to present our findings to the whole group
- These findings will then be discussed by the whole group





# Brief Introduction Elective Module Clusters



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# TECHNOLOGY CLUSTER (ET)

**Isa Walker & Natalia Rojas**



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# Module ET1. MRE Resources Assessment

## Global Distribution

- The available sites for tidal stream are nature limited
- The strongest marine currents are found in narrow straits, around headlands, between islands, bays and estuaries entrances
- In 2000. Blue Energy reported that only around 450GW of total tidal current resource could potentially be harnessed



© Aquatera Jan 2016: Not to be shared publically

# Module ET2: Technology Innovation Pathways

## Ocean Renewable Technologies: Currents

### Tidal energy converters

- \* Horizontal axis turbines
- \* Vertical axis turbines
- \* Reciprocating hydrofoils

### Moorings and support structures

(all considered with mooring lines present)

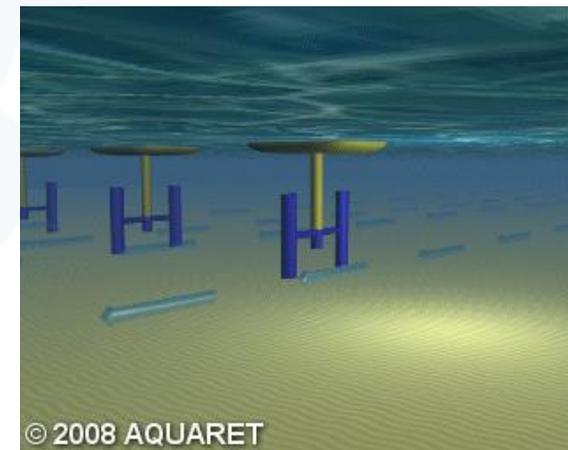
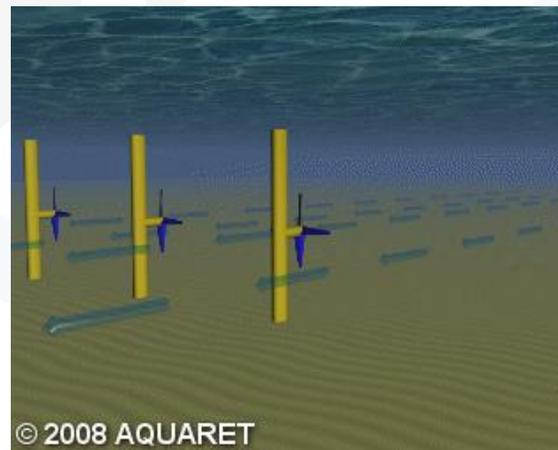
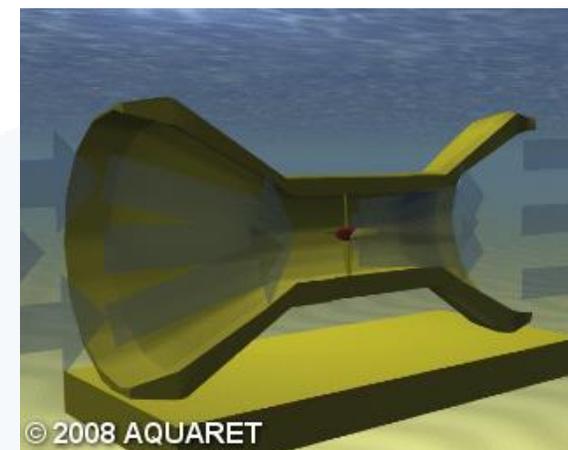
- \* Gravity/deadweight anchors
- \* Embedment anchor
- \* Rock anchors

### Support structures

- \* Gravity base
- \* Monopile

#### Horizontal axis turbines:

- \* Placed in a tidal stream
- \* May also be housed in ducting/cowling to create secondary flow effects







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# POLICY CLUSTER (EP)

Leuserina Garniati



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environmental services and products

# Module EP1. Global Energy Policy

- International agreements and targets
  - Kyoto Protocol (1997)
  - Paris Agreement (2016)
- Definition of Marine Renewable Energy (MRE)  
Country Policies
- Types of MRE Policies
  - Non-Market Incentive Policies (NMI)
  - Market Incentive Policies (MI)
  - Examples

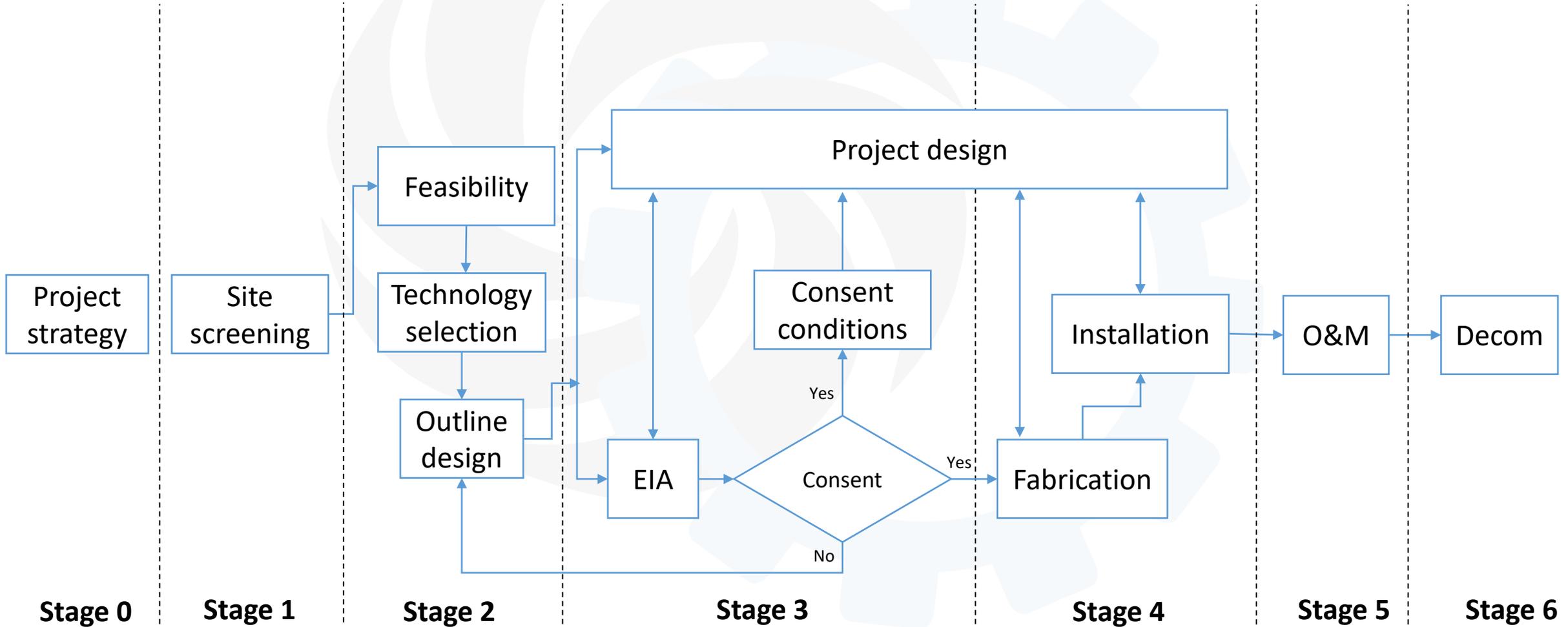
## NMI Policies

- National Strategy
- Specific Laws
- Renewable Portfolio Standards (RPS)
- EIA Process
- Information Publicity Strategy

## MI Policies

- Public Funding Programme
- Tax Preference
- Feed-in Tariff
- Tradeable Renewable Certificate (TRC)
- Contracts for Difference (CfD)

# Module EP2. MRE Stakeholders & Planning



# Module EP3. MRE Policy Case Study

- Indonesia MRE Roadmap Recommendation

- Partners
- Methods
- Tasks
- Key Findings
- Recommendations

- Chile MRE Roadmap Recommendation

- Partners
- Methods
- Tasks
- Key Findings
- Recommendations



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# BUSINESS CLUSTER (EB)

Ian Johnstone



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# Module EB1. Markets & End-user

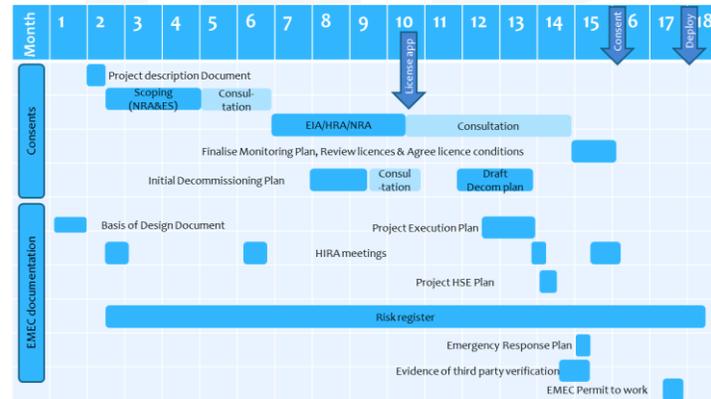
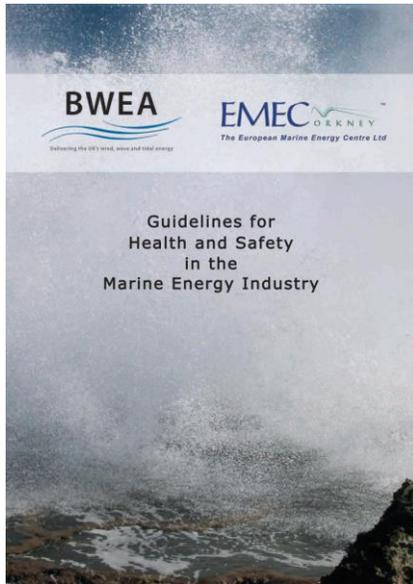
## Global Energy Markets

- Global energy needs related to climate priorities and targeted energy services with community focus
- The marine energy contribution, its key determining factors
  - Technical success
  - Market suitability
  - Economic viability
  - Added value
  - Situation specific competitive advantage
- Marine energy market segments for different users depending on market value (US\$50- \$1000/MW hr) and demand

Users	Markets
Subsea O&G Military Science	Macro grid connected electricity
Surface O&G Coastal industry Ocean shipping Coastal tourism Fish farming Isolated islands	Off-grid and micro grid
Ferries Conversion Local grids Desalination Vehicle transport Macro grids City energy	Niche non-electrical

# Module EB2. MRE Project Planning

## Project characteristics

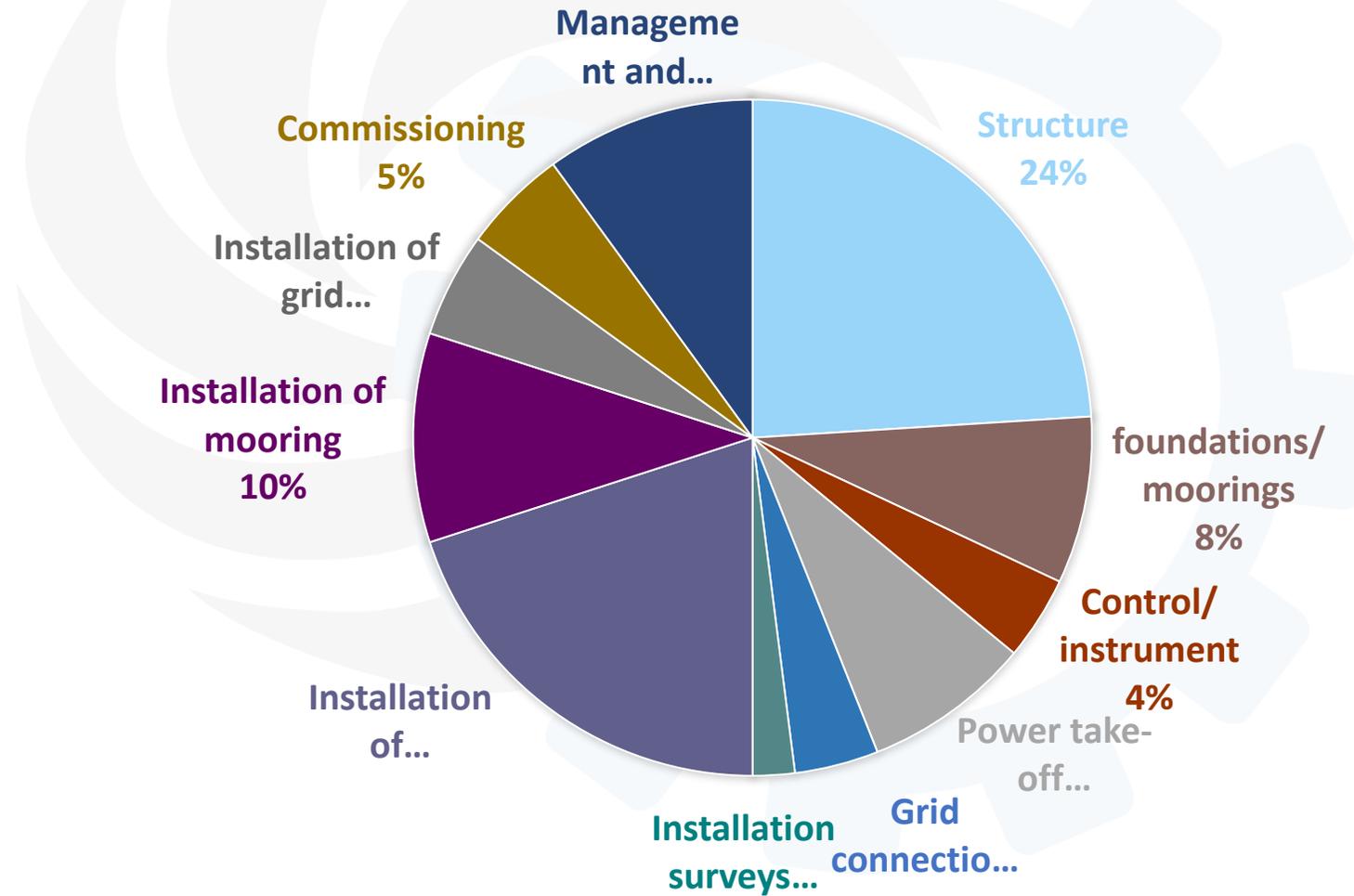


- Project timetable – GANTT Chart
- Risk Planning
  - Safety Plan tailored to the project based on the Organisation Safety Management System Records
  - Hazard identification and Risk assessment (HIRA) – workshop discussion, risk register production and monitoring
  - Emergency Response Plan – elaboration in coordination with local and regional emergency response systems and dedicated guidance
- Method Statements – execution of tasks plan



# Module EB3. Economics & Supply Chain Opportunities

## Breakdown of capital costs for Wave Energy Technologies





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# ENVIRONMENT CLUSTER (EE)

**Jennifer Fox**



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# Module EE1. MRE Impact Assessment

## Context of Environmental Protection

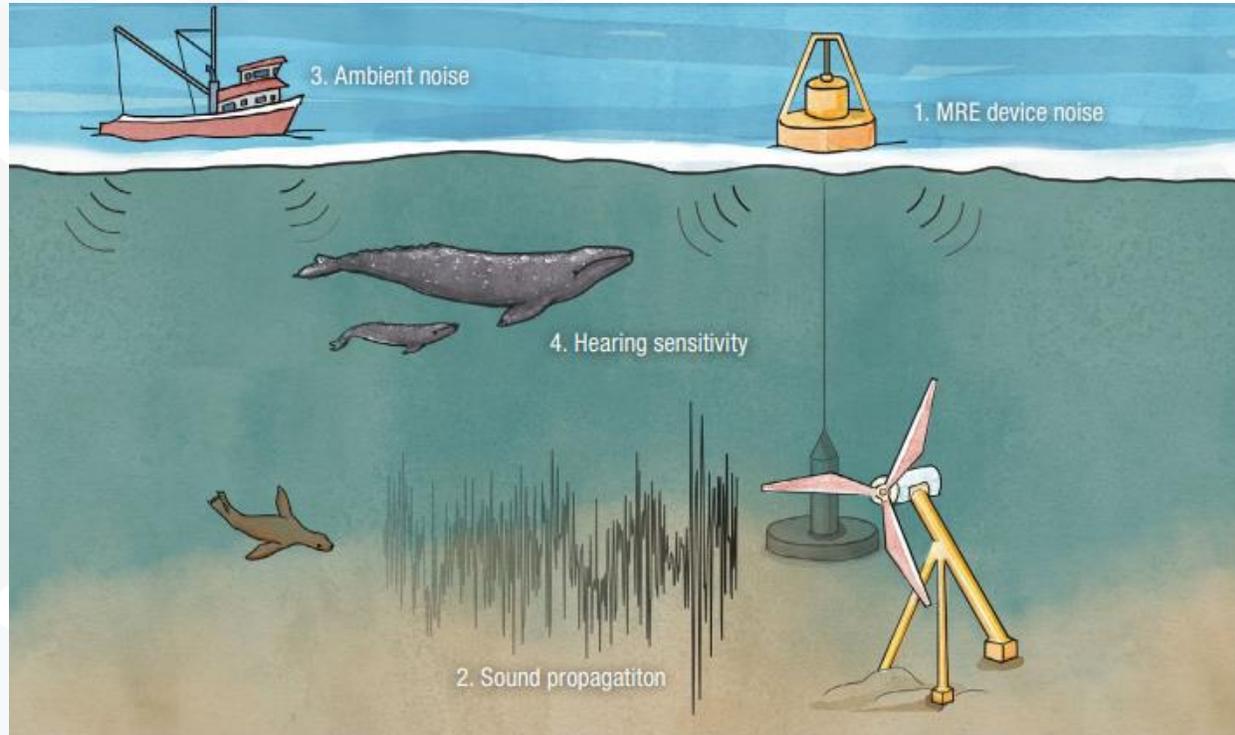
- Legal & regulatory requirement to understand the potential effects on the natural environment
- Environmental Impact Assessment (EIA) Allows decision makers to make informed decisions
- Environment:
  - Physical area
  - Habitats
  - Animals
  - Human environment
- Potential environmental effects
  - Collision risk, underwater noise, socio economic impacts
- Process of EIA
  - Screening, scoping, EIAR, consultation etc.



# Module EE2. Stressors and receptors

## Underwater Noise

- Many marine animals rely on sound for biological functions, including communication, social interaction, orientation, foraging, and evasion.
- Marine energy devices as well as the vessels installing and maintaining them create noise in the marine environment
- There are many other sources of human created noise in the marine environment- shipping, fishing, military activities, oil and gas drilling



Source: OES Environmental, 2020

# Module EE3. MRE Case studies

## MeyGen

- 2014- EIA completed and Marine License granted
- 2015- Onshore construction commenced
- 2018- MeyGen Phase 1A officially enters into operation
- Consent was sought in phases
  - Phase 1 consent for 86 MW
  - Phase 2 consent will be sought separately (312 MW)
- Turbines 1 MW capacity each, with an export cable to shore each



Source: Gillespie, 2020 Presentation. OES Environmental International Monitoring Forum

# Project Outline: Getting a Marine Renewable Energy Device in the Water

- Technical Cluster
- Policy Cluster
- Environmental Cluster
- Business Development Cluster

## PROJECT MANAGEMENT 1 2 3 1 3

site selection project planning financing and contracts

3

### CONSENTING 1 2 3

technology

1 2

pre-application → application → decision

outline design → design refinements → detailed design

## CONSTRUCTION

3

fabrication and assembly  
installation/deployment  
environmental monitoring  
grid connection established

## OPERATION AND MAINTENANCE

3

environmental monitoring  
switching on  
performance monitoring

## DECOMMISSIONING

3

retrieval of device and removal of all components  
testing

## CONSULTATION 1 3 2 2

# End of Presentation

