Workshop: Environmental Acceptability of Marine Renewable Energy Devices

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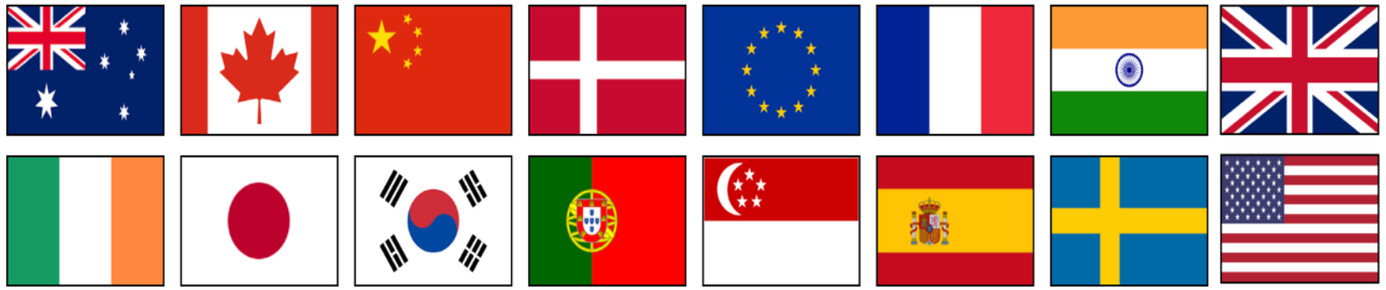
PNNL is operated by Battelle for the U.S. Department of Energy

Workshop agenda

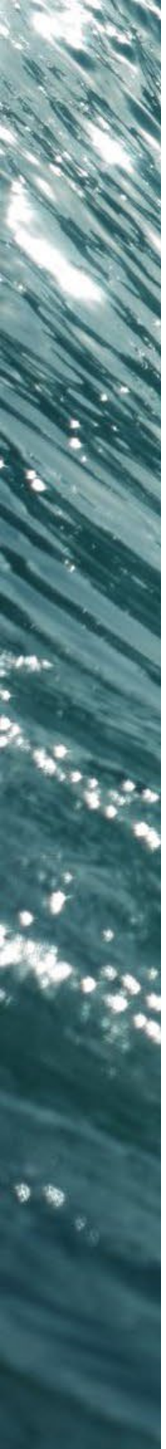
Start Time	Agenda Topic
17:40	Introductions Presentation Purpose of the Workshop
17:50	Breakout Discussion
18:25	Wrap Up & Next Steps
18:30	Adjourn

OES-Environmental

- Established by the IEA-Ocean Energy Systems in 2010
- Examines environmental effects of marine renewable energy (MRE) development to advance the industry in a responsible manner
- Led by the U.S. Department of Energy Water Power Technologies Office and implemented by Pacific Northwest National Laboratory (PNNL)
- Phase 5 (2024-2028): 15 countries + European Commission
- Publishes syntheses of the current available knowledge on environmental effects (e.g., State of the Science reports)

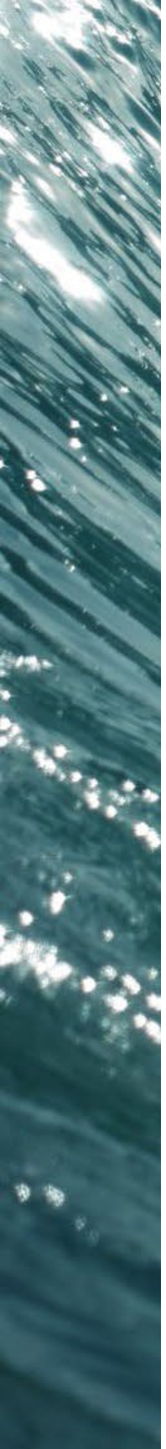


https://tethys.pnnl.gov/about-oes-environmental



In order to get devices in the waters, one must consider:

Resource characterization



Resource characterization

Siting

Tank testing

Resource characterization

Engineering design

Siting

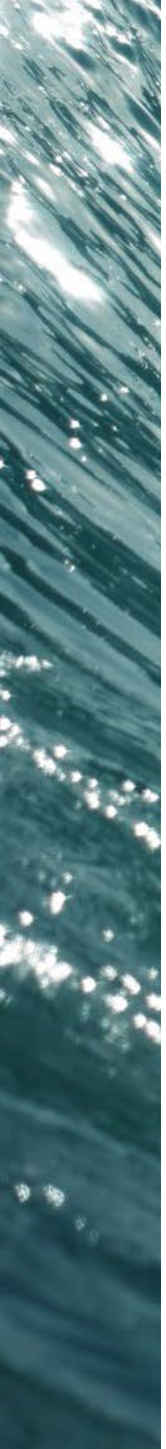
Moorings

Tank testing

Resource characterization

Engineering design

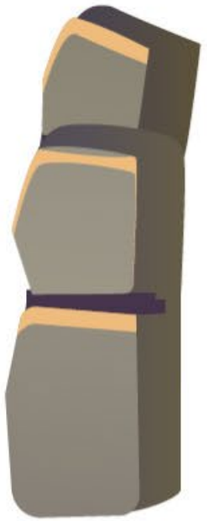
Siting



Moorings

Tank testing

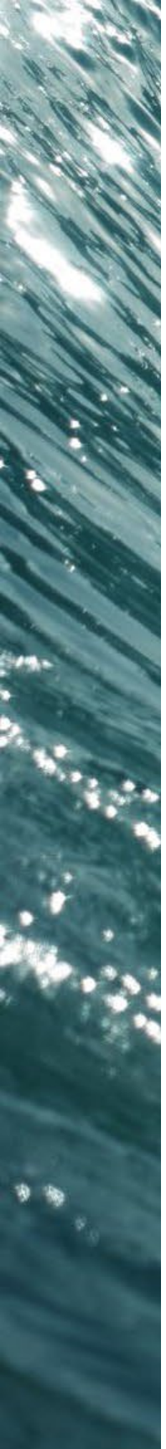
Resource characterization



Survivability

Engineering design

Siting



Fabrication

Moorings

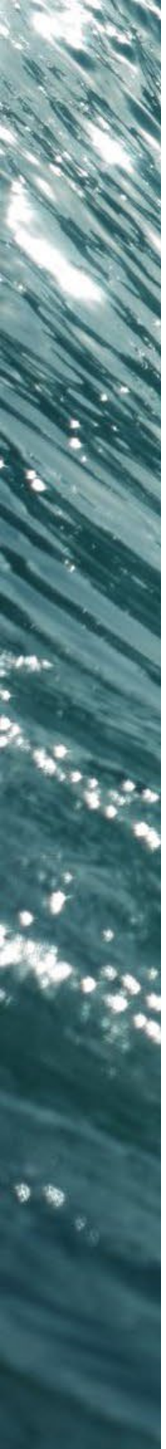
Tank testing

Resource characterization

Survivability

Engineering design

Siting



Fabrication

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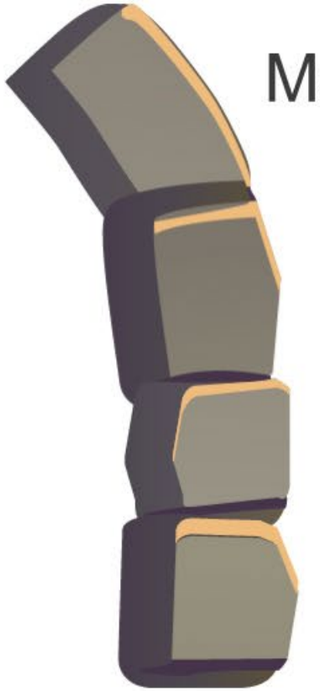
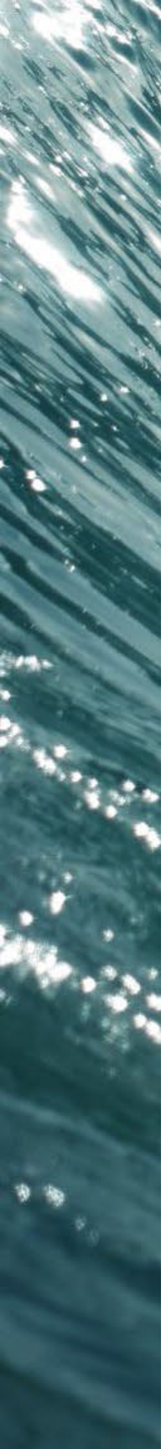


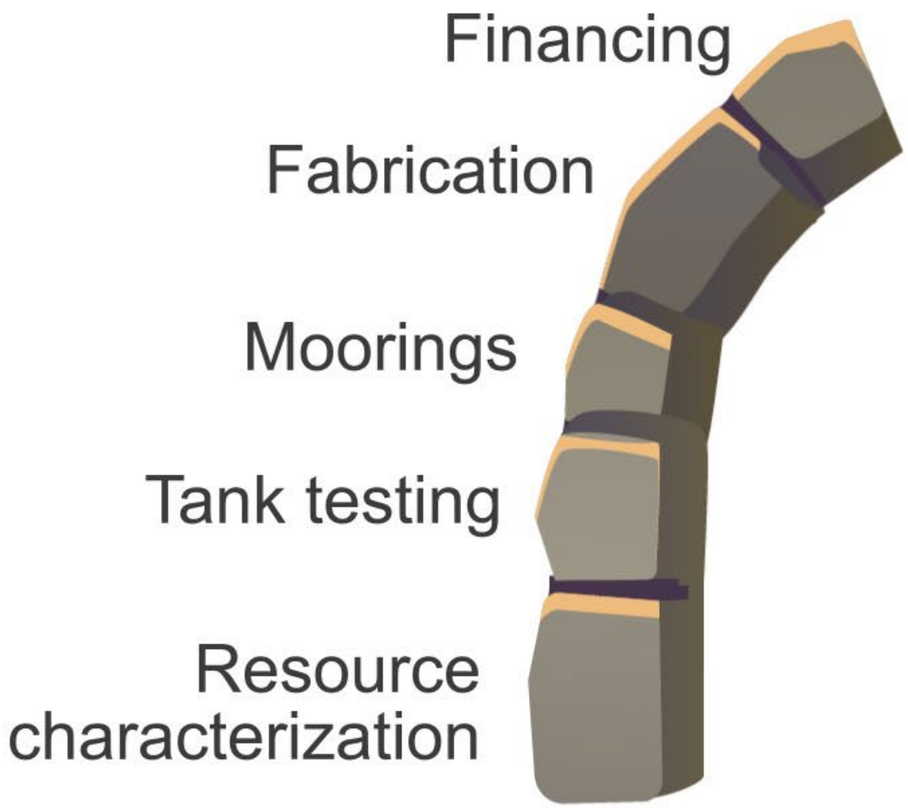
Manufacturing

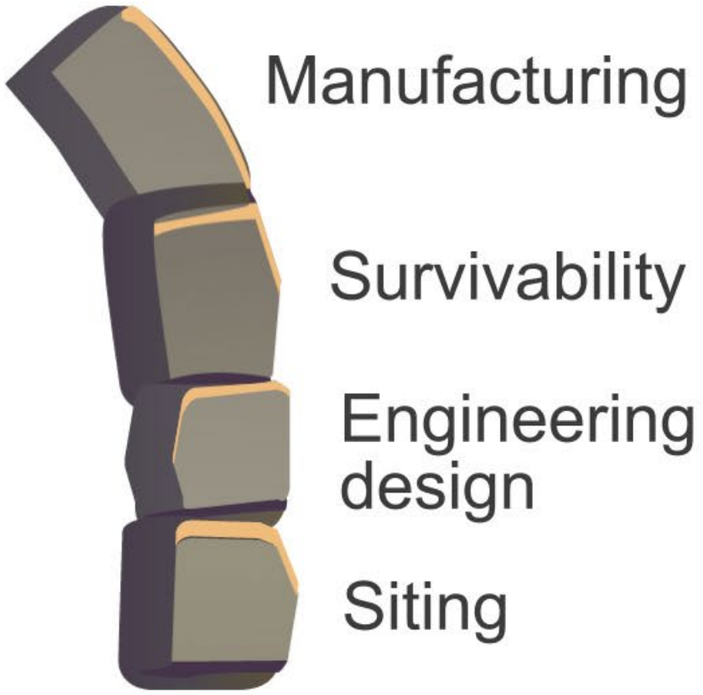
Survivability

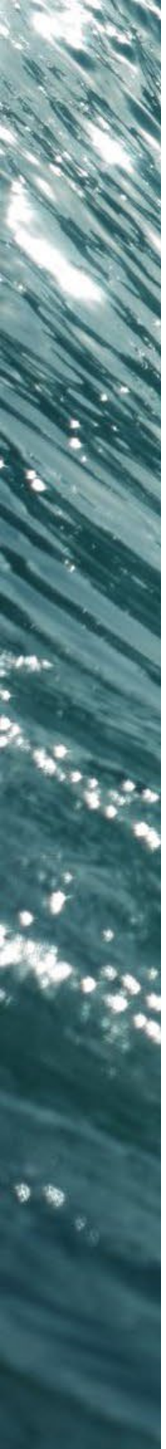
Engineering design

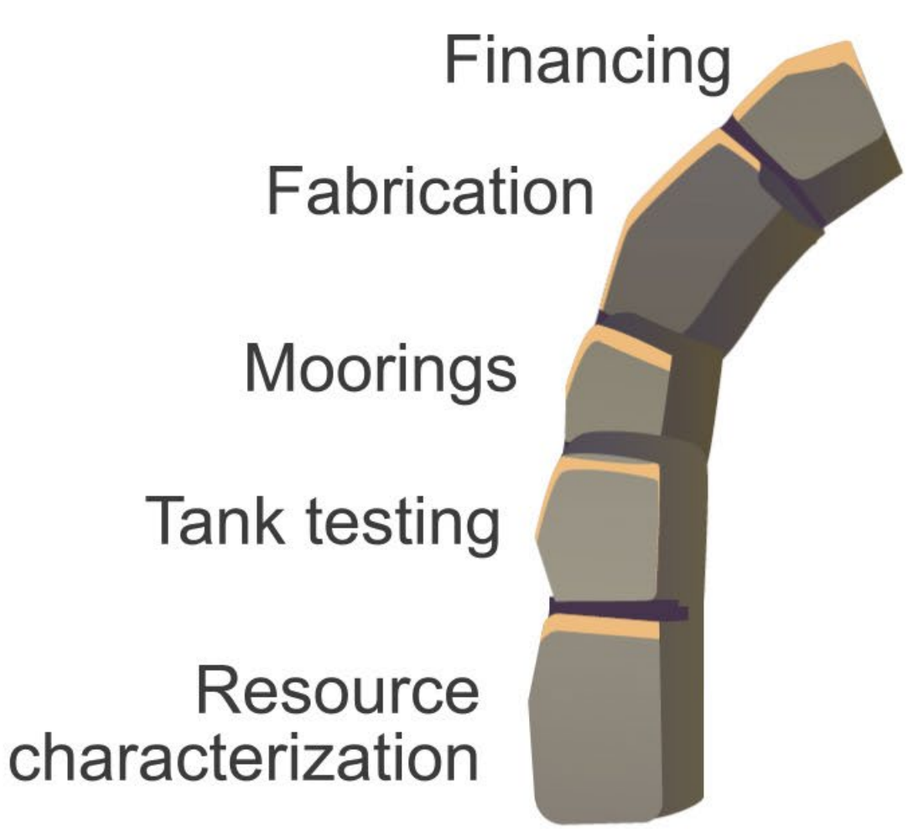
Siting




Financing
Fabrication
Moorings
Tank testing
Resource characterization


Manufacturing
Survivability
Engineering design
Siting




Financing
Fabrication
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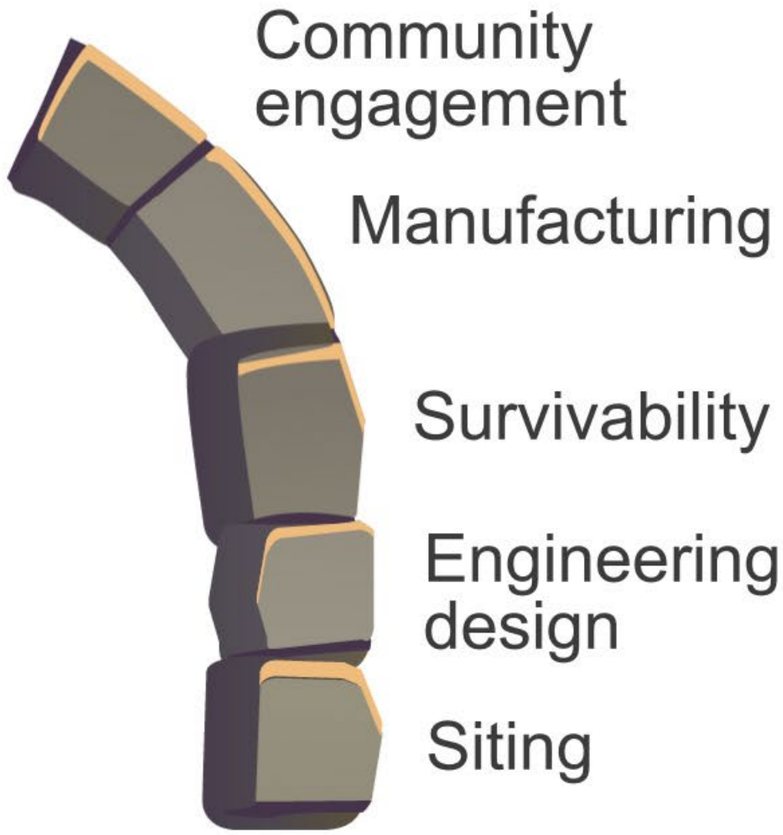
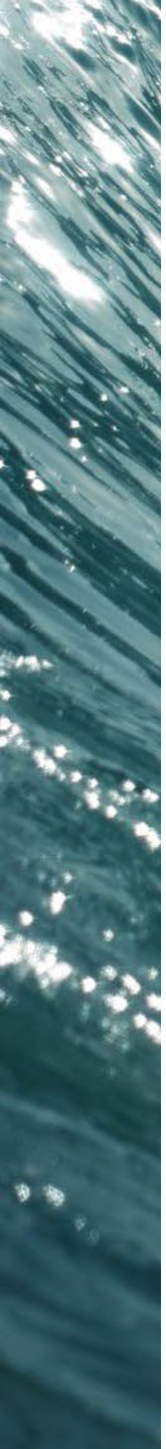
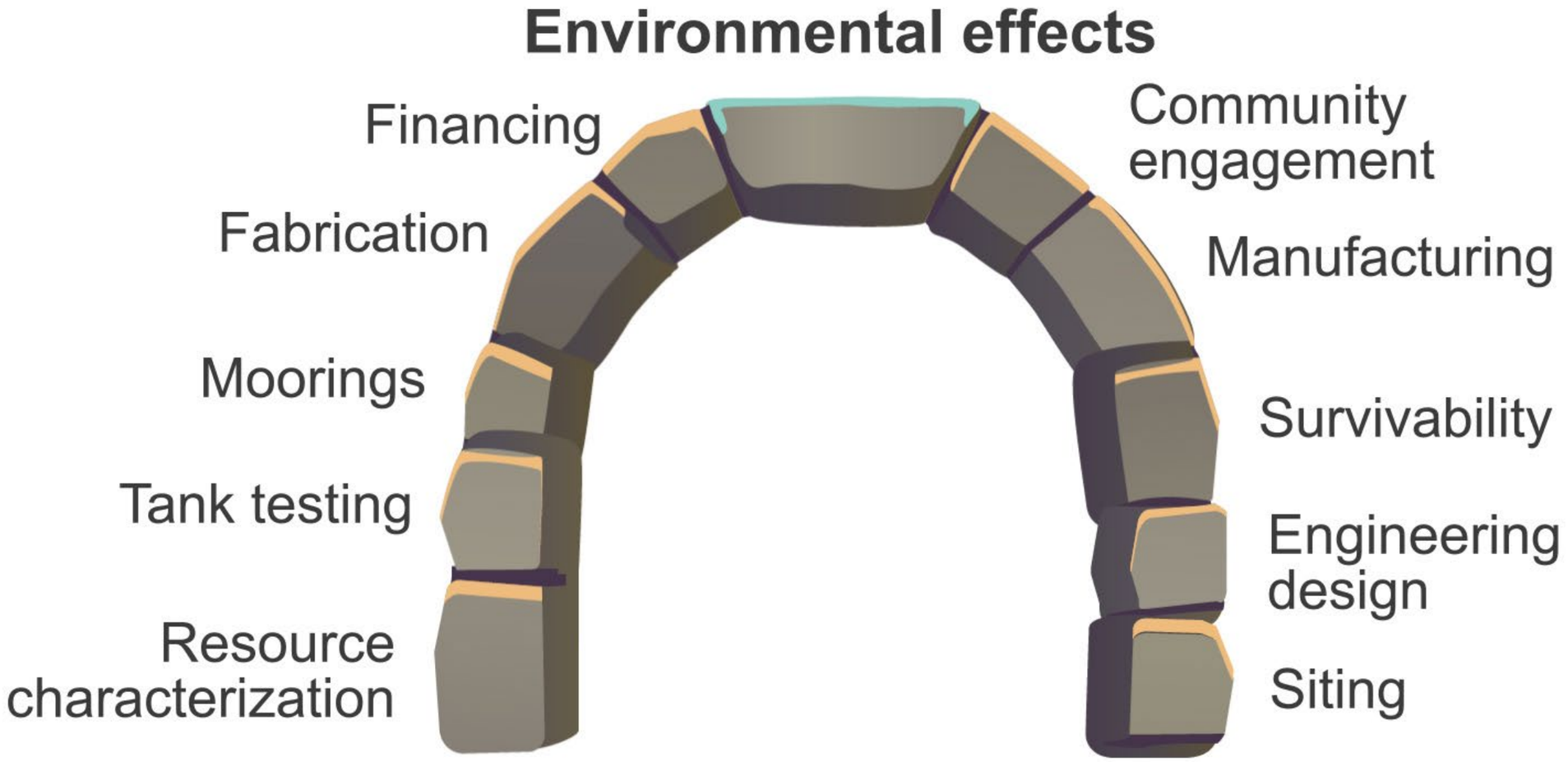
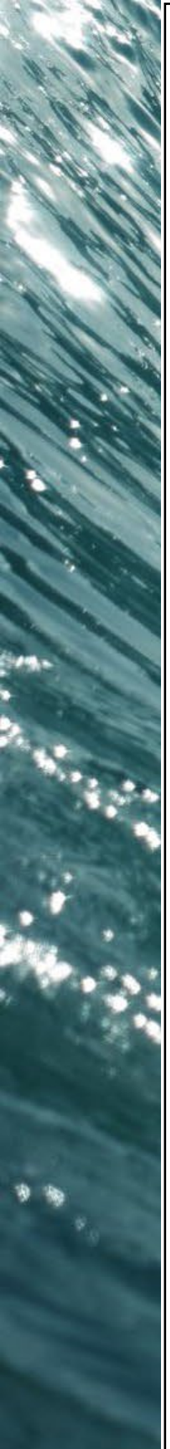
Resource characterization


Community engagement
Manufacturing
Survivability
Engineering design
Siting

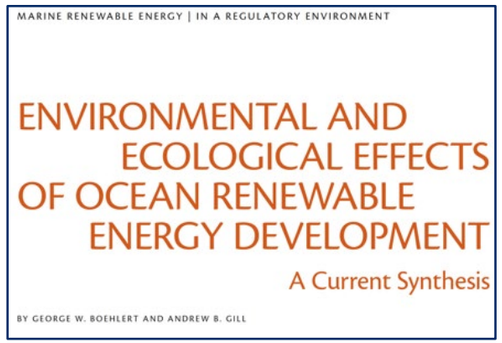



Environmental effects
Financing
Fabrication
Moorings
Tank testing
Resource characterization
Community engagement
Manufacturing
Survivability
Engineering design
Siting



Current knowledge on environmental effects

Before 2009	2009 - 2011	2011	2012 - onward
"There won't be any environmental effects of MRE, so we don't need to worry."	“Every interaction will be a high risk!”	Tethys was created to curate and disseminate all knowledge	• Some risks eliminated: chemical releases from devices, direct effects on birds • Defined stressor-receptor interactions • Gathered information from surrogates, a few monitoring and in-water research studies, and numerical models

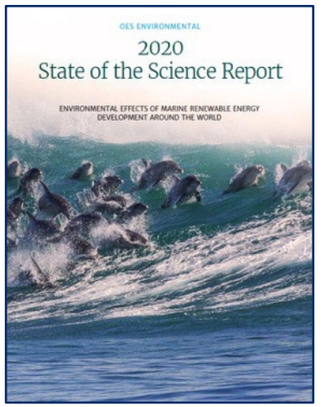


Boehlert & Gill (2010)

TETHYS

2013

2016

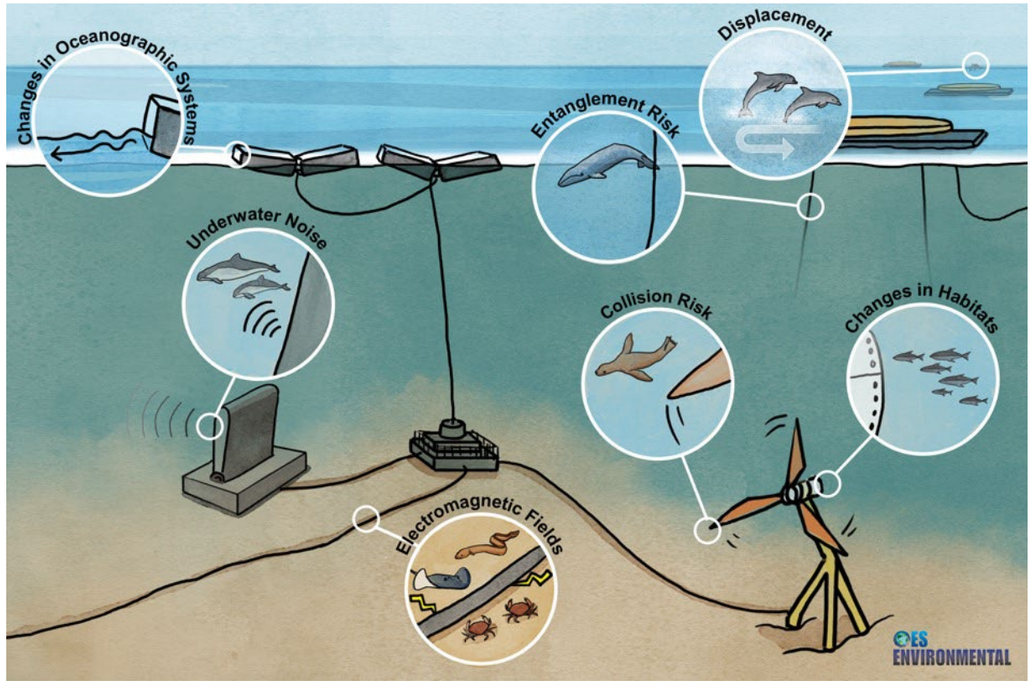


2020

Current knowledge on environmental effects

Stressors: MRE devices and systems that may cause harm

Receptors: marine animals, habitats, ecosystem processes



Priority stressor-receptor interactions

- Collision risk
- Entanglement
- Underwater noise
- Changes in oceanographic systems
- Electromagnetic fields (EMF)
- Displacement
- Changes in habitats

Current knowledge on environmental effects

Risk retirement concept applied to small numbers of devices (one to six)

2019	2020	2021	2022	2023	2024
• Underwater noise and electromagnetic fields retired	• Changes in habitat retired	• Changes in oceanographic systems retired	• Investigations continue on collision risk around tidal turbines	• Displacement defined • Entanglement examined	• System level effects • Tropical ecosystems added • Looking forward







"For certain interactions, potential risks need not be fully investigated for every project (1 - 6 devices), but rather, we need to rely on what is already known: consented projects, research, analogous industries. A "retired risk" can be reexamined in the future."

What else is needed?

- Environmental effects are globally known for wave and tidal energy devices

- Wave/tidal energy devices have different archetypes and can be deployed in diverse ecosystems
  - Need to better understand specific environmental effects
  - Need to design systems that ensure avoiding impacts and/or mitigating them

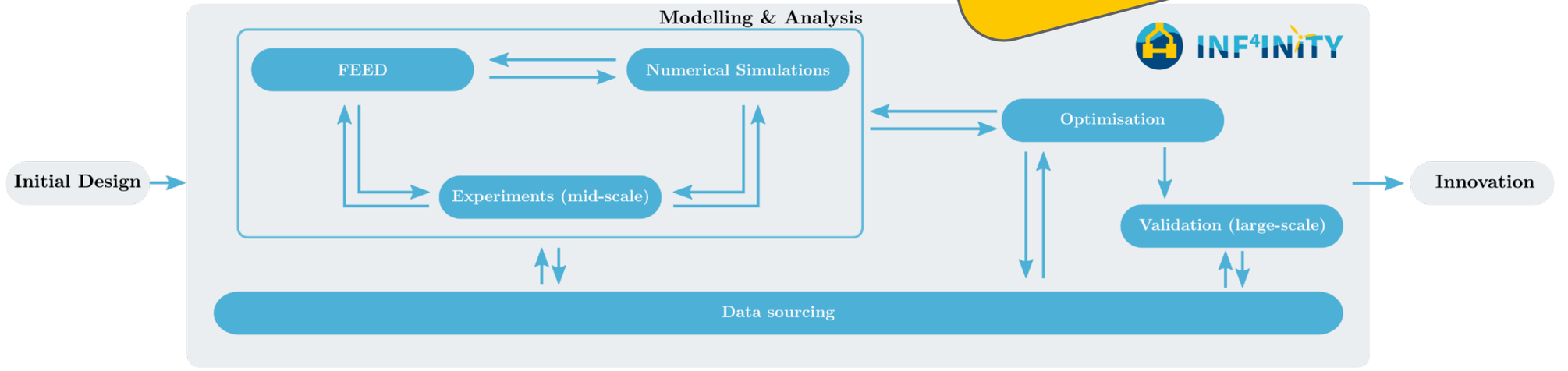
INtegrated designs for Future Floating oFFshore wIND farm TechnologY

Funded by the European Union

Overarching objective:

To provide nature inclusive design (NID) innovations for sub-sea components

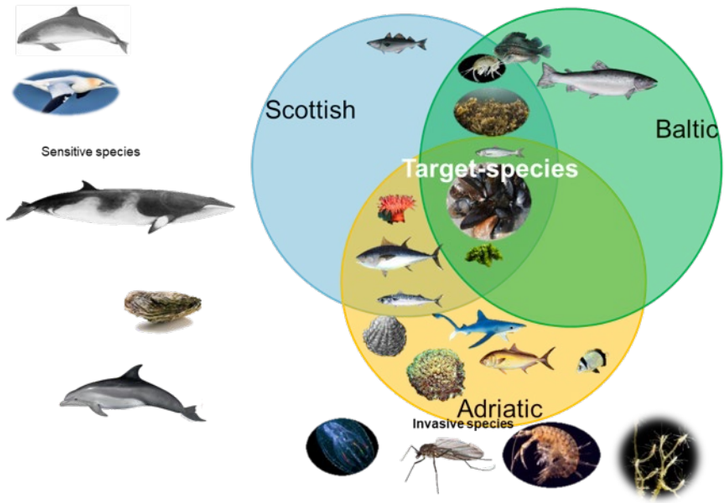
→ Increase **environmental and engineering** performances of FOW system

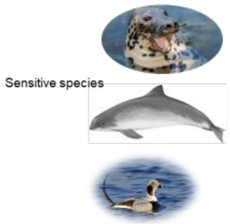


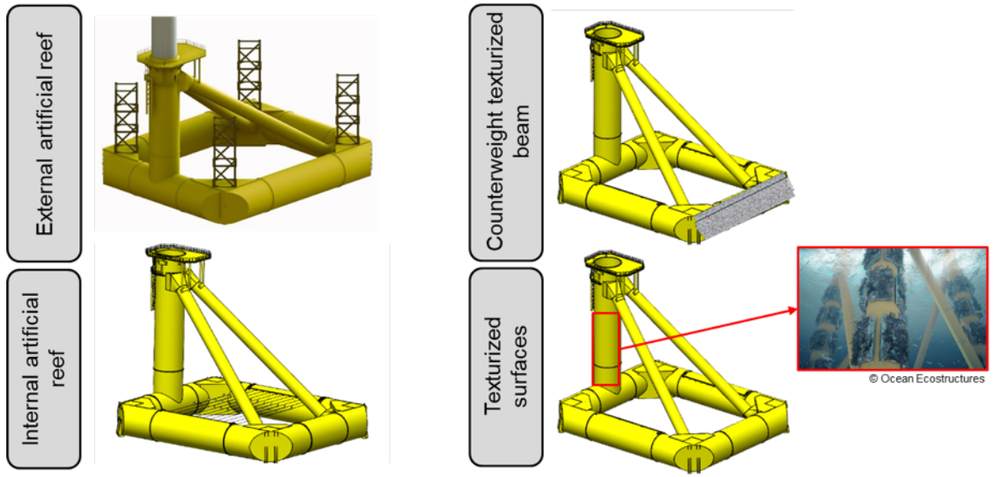
IUCN Global Standard for Nature-based Solutions, Criterion 3: **Net gain to biodiversity and ecosystem integrity**

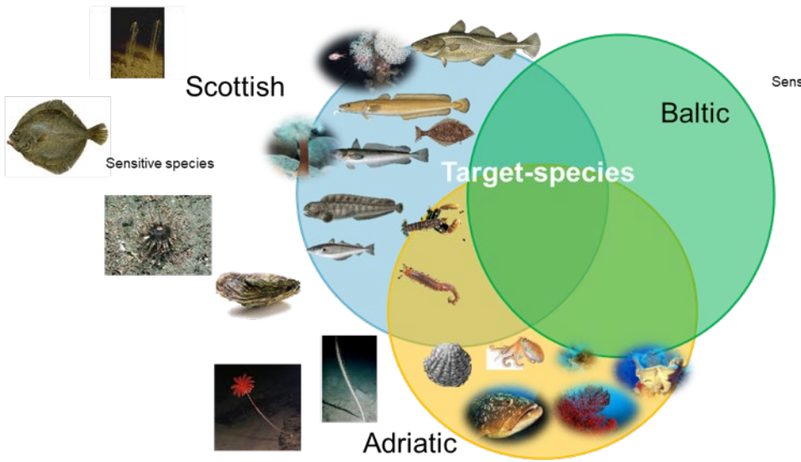
INtegrated designs for Future Floating oFFshore wINd farm TechnologY

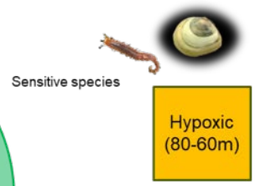
INF4INITY
Funded by the European Union

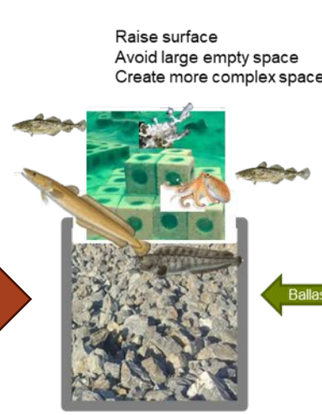


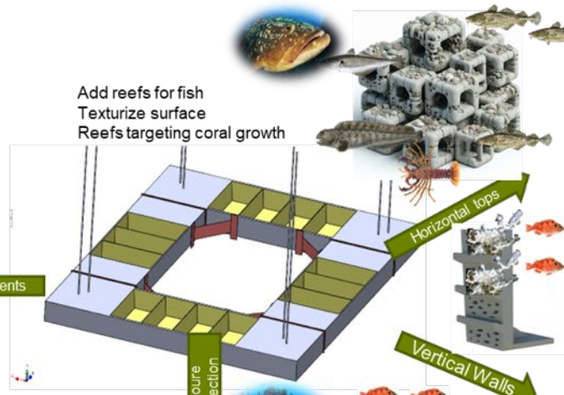


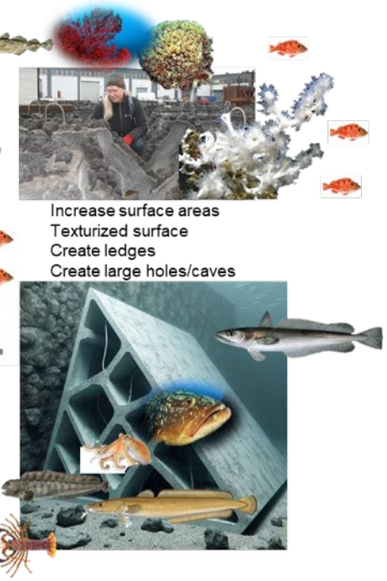










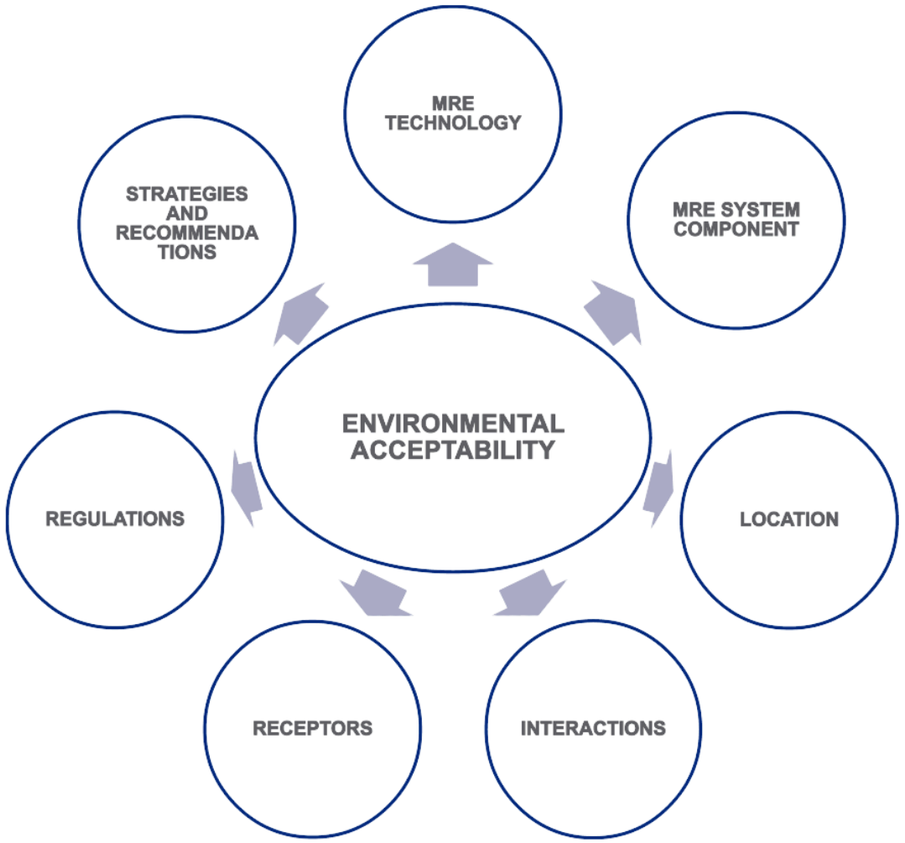


Add mining slag to top rock layer
Or limestone,
Or other complex surface material

Environmental acceptability of MRE devices

Proactive guidance that will allow for harnessing MRE resources efficiently while limiting the risks to the environment (marine animals, habitats, ecosystems), assuring compliance with environmental regulations, and promoting benefits.

- Examine wave and tidal device types and supporting project infrastructure to understand specific environmental risks associated with each component
- Identify opportunities to help improve or enhance environmental acceptability of projects
- Assess potential induced environmental benefits



Use case #1: wave energy and underwater noise

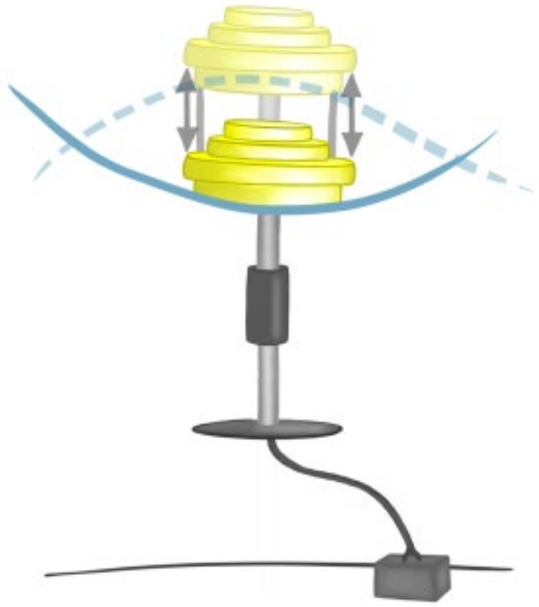
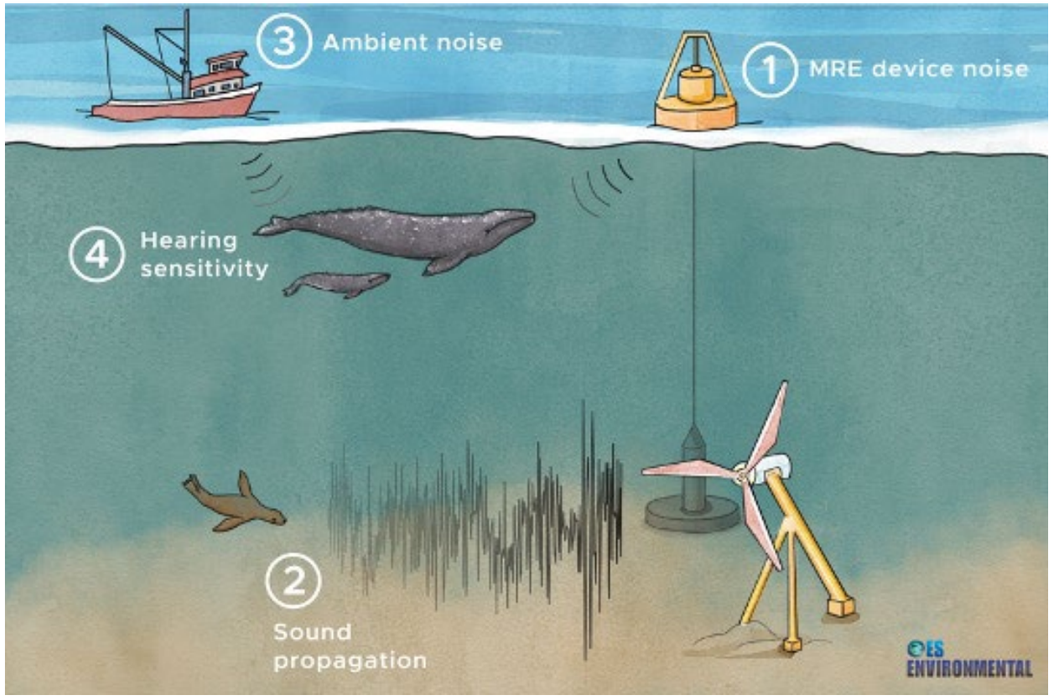
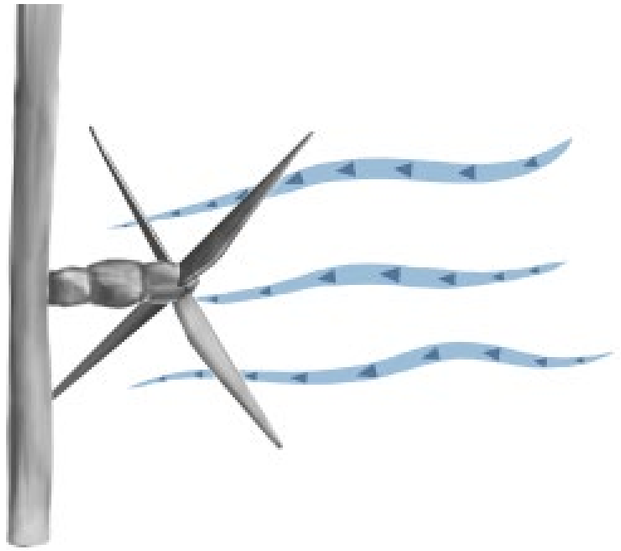


Illustration by Candace Briggs, PNNL



Illustrations by Stephanie King, PNNL

Use case #2: tidal energy and collision risk



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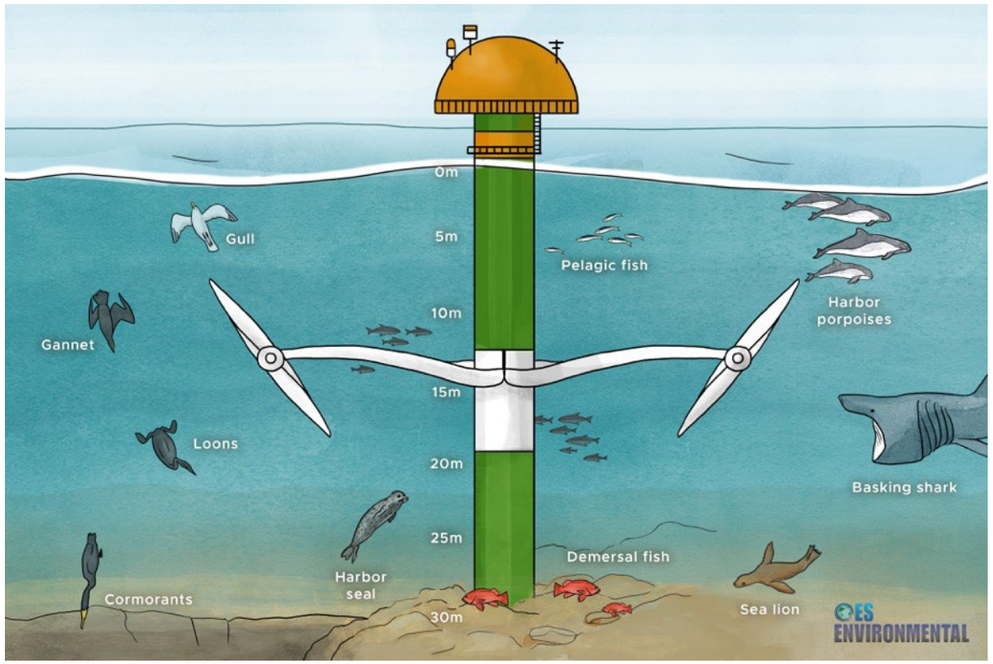
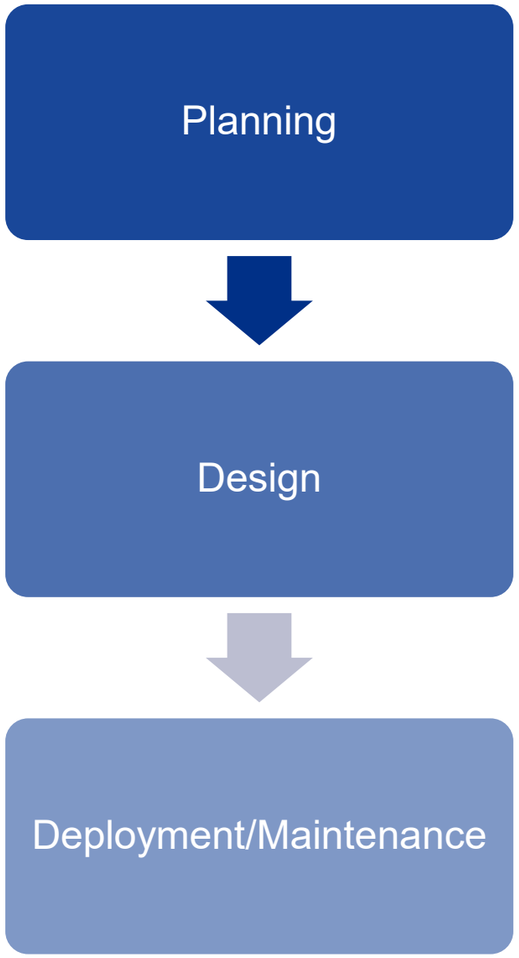


Illustrations by Stephanie King, PNNL

Questions for breakout group

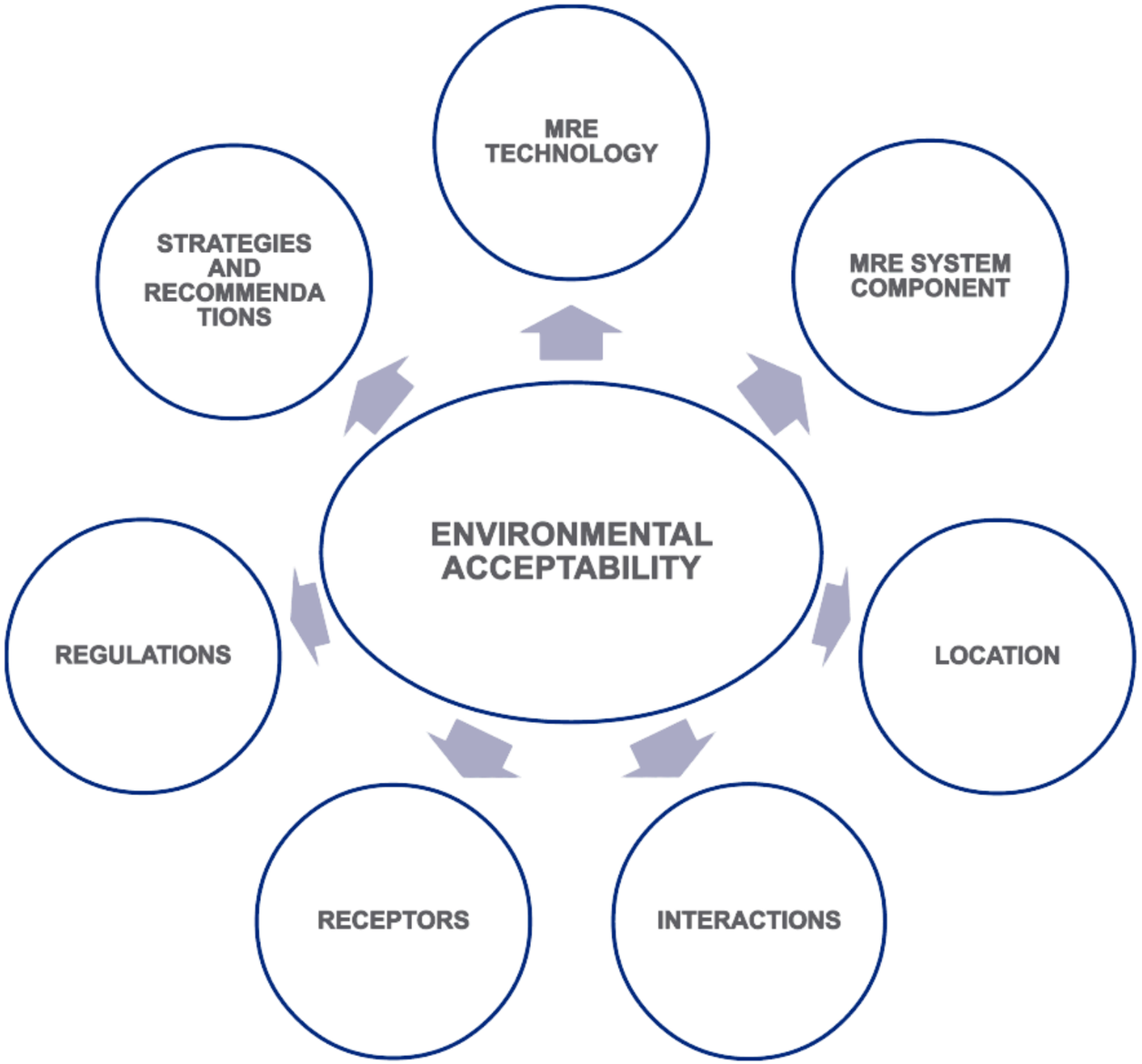


1. Planning a project
    - What can be done at the planning stage to assure device/project is environmentally acceptable?

2. Design a project
    - What changes can be done on a device?
    - What should you consider before deploying?

3. Deploy and maintain a device
    - What monitoring methodologies could you use to maintain the environmental acceptability of your project?
    - What about mitigation measures?

Environmental acceptability of MRE devices



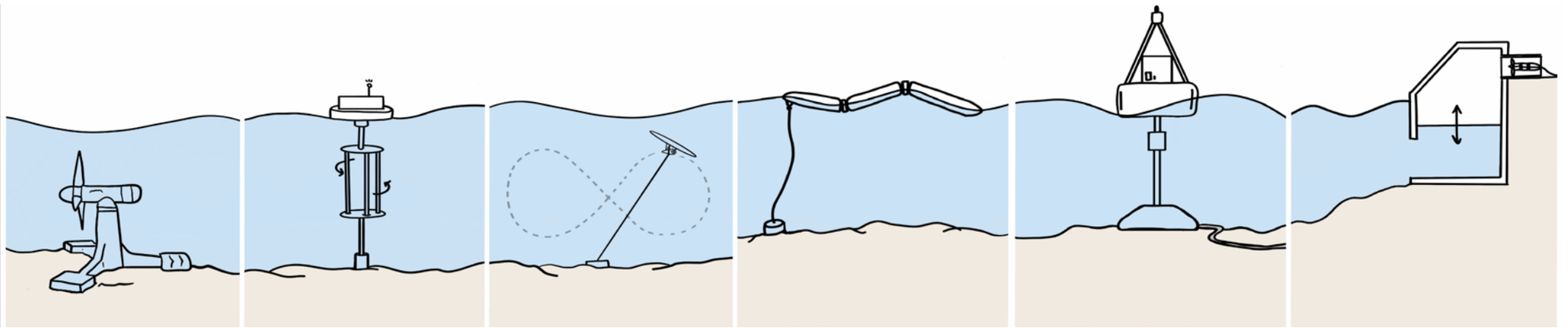
Environmental acceptability - Categories

Archetypes *

Tidal:
- Axial flow
- Cross flow
- Kite

Wave:
- Point absorber
- Oscillating

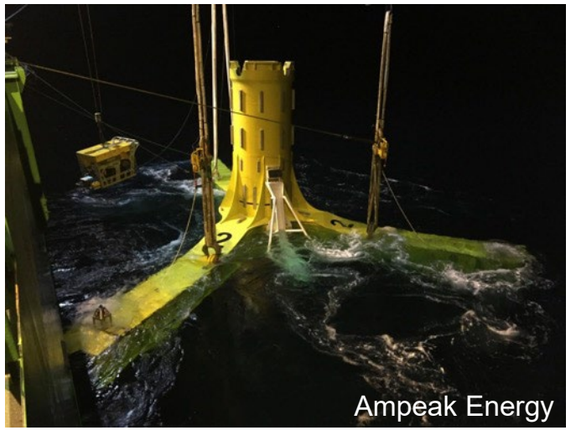
Surface/floating/ bottom-mounted



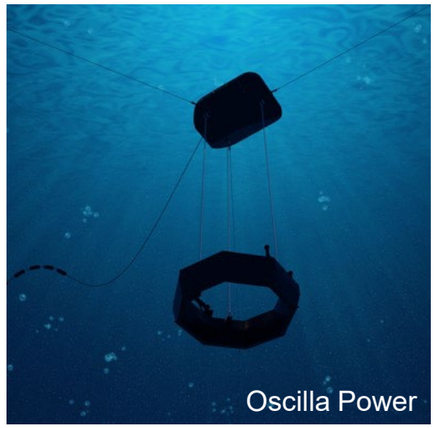
Illustrations by Cailene Gunn, PNNL

Device component *

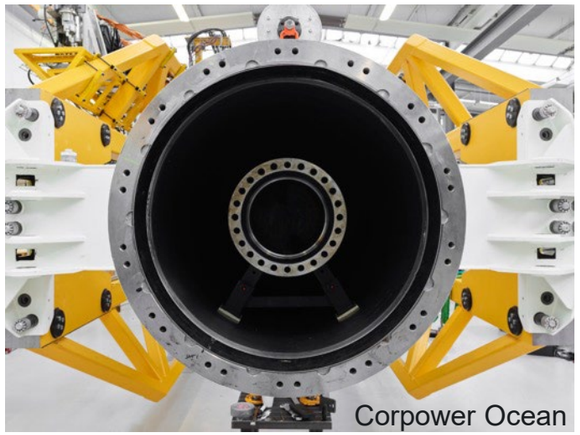
- Anchor
- Foundation
- Mooring
- Power Take-Off
- Turbine
- Materials



Ampeak Energy



Oscilla Power



Corpower Ocean

*non-exhaustive lists

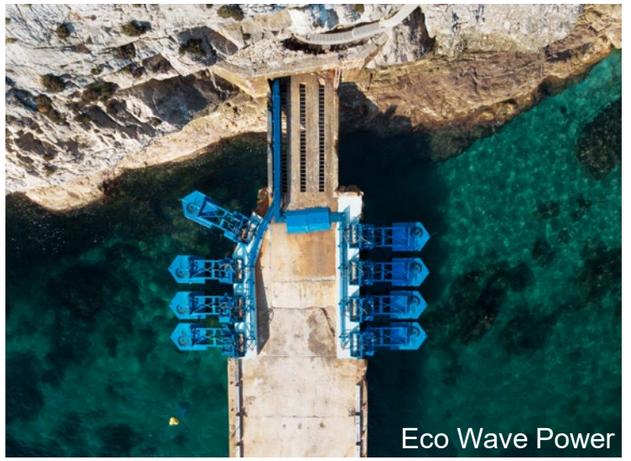
Environmental acceptability - Categories

Site condition *

- Depth
- Channel width
- Seabed type
- Proximity to shore
- Current direction
- Wave climate

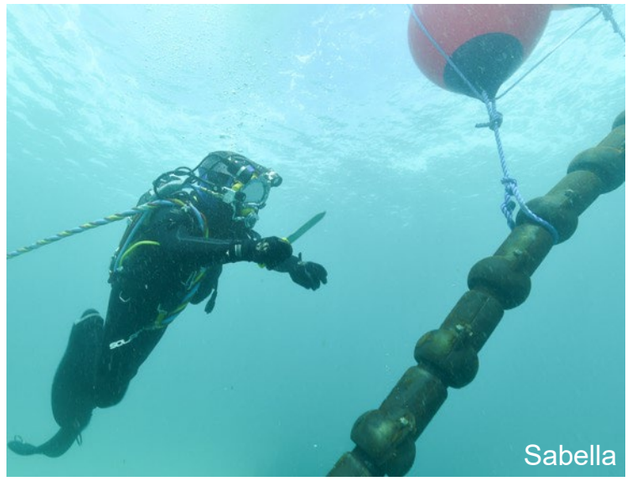

ORPC


CorPower Ocean


Eco Wave Power

Technical considerations *

- Water column position
- Spatial footprint
- Surface expression
- Cable
- Vessel usage


Sabella


Fundy Ocean Research Centre for Energy


CalWave

*non-exhaustive lists

Environmental acceptability - Categories

Interactions

- Collision risk *
- Underwater noise
- Electromagnetic fields
- Habitat changes
- Entanglement
- Changes in oceanographic systems
- Displacement

Receptors

- Fish: *
  - Demersal
  - Pelagic
- Marine mammals:
  - Pinnipeds
  - Small cetaceans
  - Large whales
- Diving seabirds

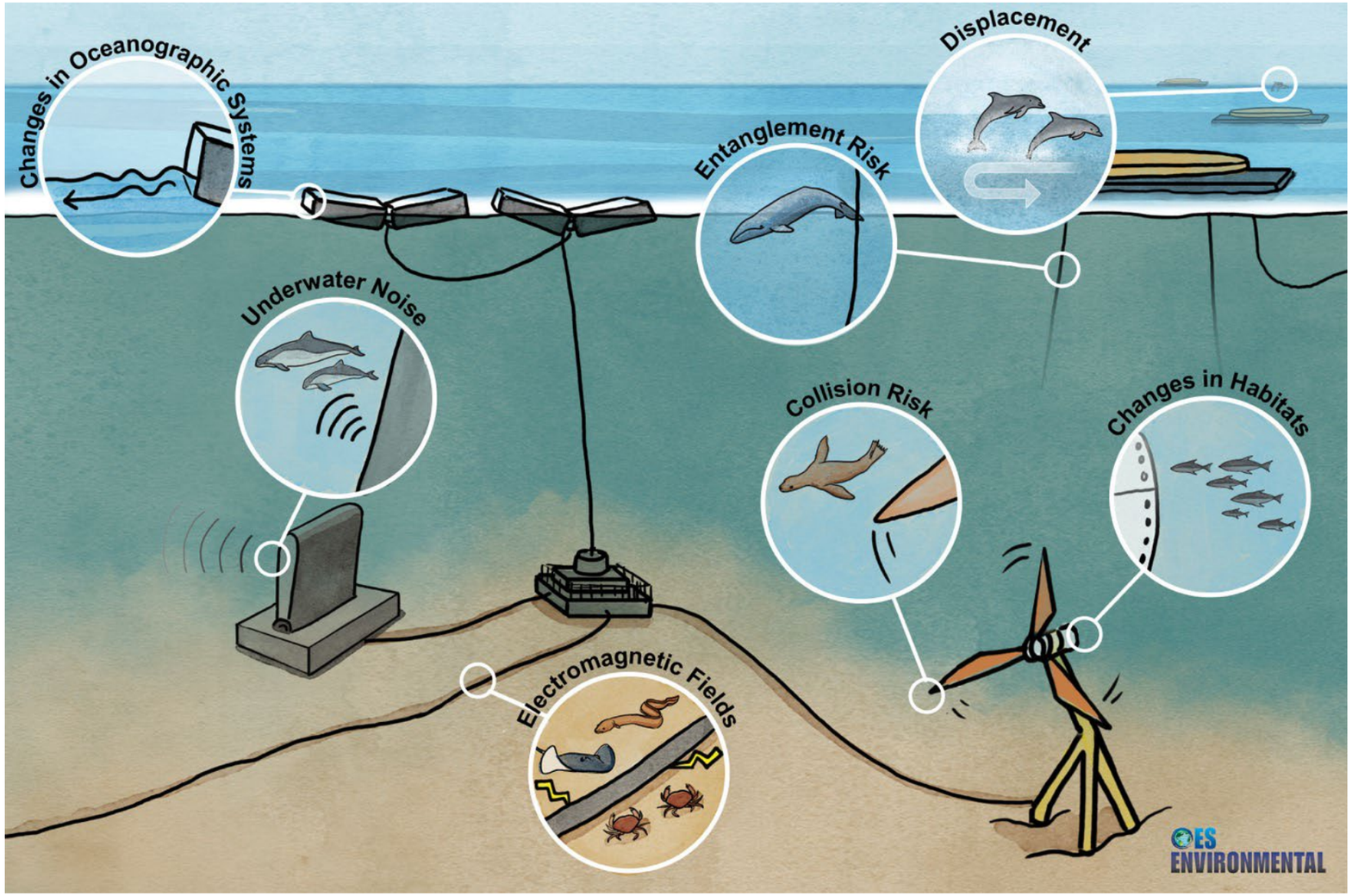


Illustration by Stephanie King, PNNL

*non-exhaustive lists

Questions for open discussion

- What does environmental acceptability of a device/project mean to you?
- What makes a MRE device/project more environmentally acceptable?
- What would you need to integrate the concept of environmental acceptability into your current work?

Wrap up & next steps

- Workshop report written from breakout group discussions:
  - Shared with you for review/feedback
  - Leveraged in future OES-Environmental work

- Further developing the environmental acceptability" process:
  - Integrate net-positive impacts and/or marine net gain into the process
  - Develop guidance to support the implementation of environmental acceptability during project design and consenting

Illustration by Ian Hermanson, PNNL

And please take our post-workshop survey!

Thank you

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Please fill out our short survey!

https://www.surveymonkey.com/r/BVGLKCT