



# From Science to Consenting: 2022 Highlights

OES-Environmental Public Webinar  
September 22, 2022

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# Agenda

- OES-Environmental overview
- *Tethys*
- Risk retirement and guidance documents
- 2022 – 2023 Focus Areas
- Outreach
- Next steps



# Objectives of Today's Webinar

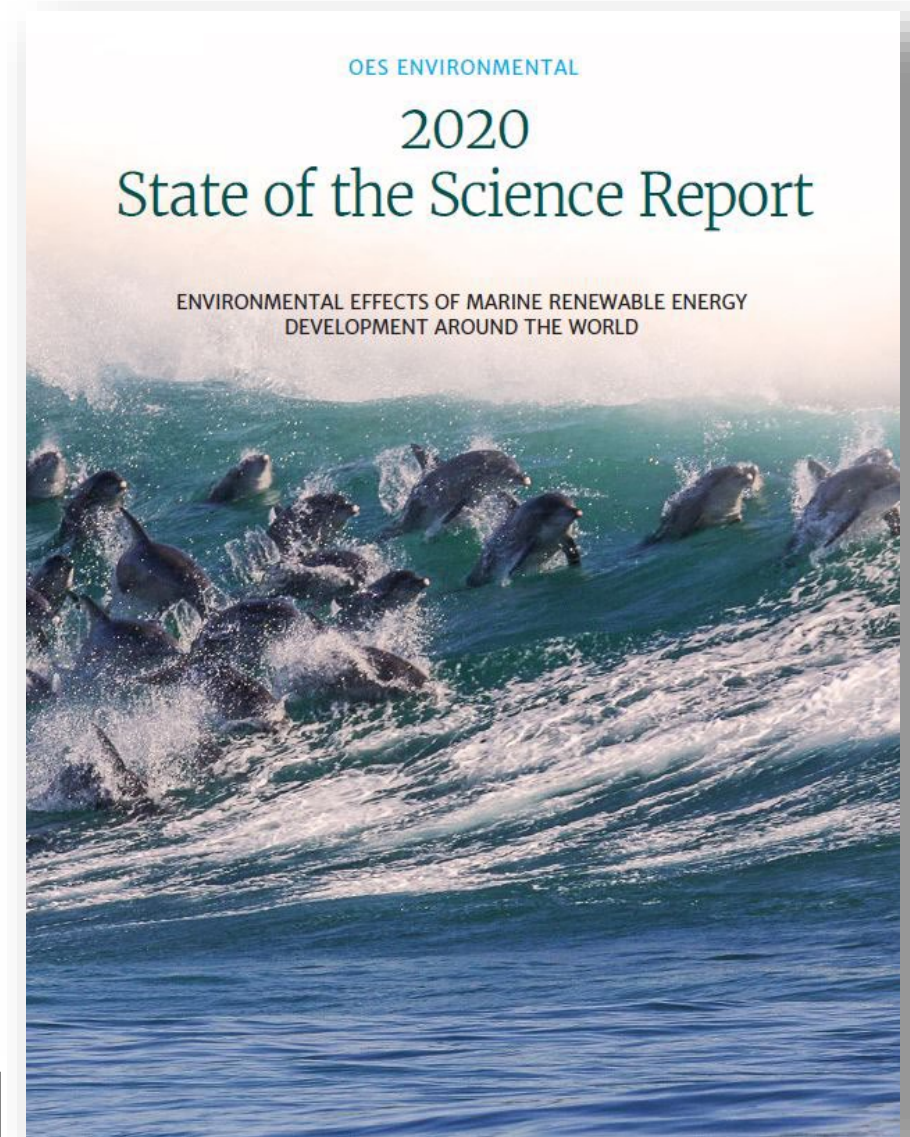


1. Continue to engage the marine renewable energy (MRE) community to ensure information on environmental effects is readily available
2. Solicit feedback on OES-Environmental efforts, including the guidance documents, systems approach, and outreach efforts

# OES-Environmental

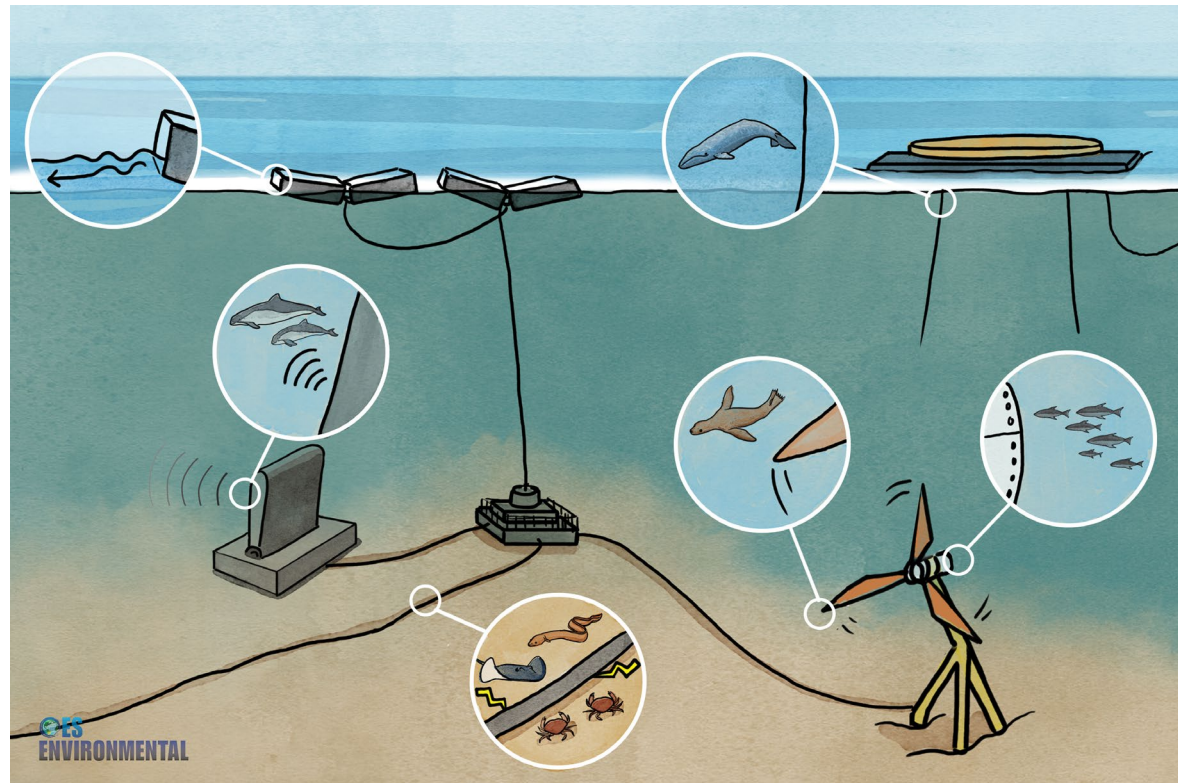
<https://tethys.pnnl.gov/about-oes-environmental>

- 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 US DOE Water Power Technologies Office and implemented by Pacific Northwest National Laboratory
- 16 member countries for Phase 4










# Marine Renewable Energy (MRE)

- Energy harnessed from waves and tides, and other moving water, gradients
- Early stages of development, deployment, and commercialization
- Environmental concerns continue to slow consenting/permitting worldwide



## Key stressor-receptor interactions:

- |   |                        |   |                                  |
|---|------------------------|---|----------------------------------|
|   | Collision risk         |   | Mooring line encounter           |
|  | Underwater noise       |  | Changes in oceanographic systems |
|  | Electromagnetic fields |  | Displacement                     |
|  | Habitat changes        |   |                                  |

# Moving the MRE industry forward

**We need more MRE devices in the water to collect data, test hypotheses, and validate numerical models.**

Publicly sharing all available information

Sharing best practices for avoiding and minimizing harm

Systematically using data collected at existing projects

Making science accessible for regulatory uses

Expanding research foci into emerging areas

Share results publicly



Management Measures Tool

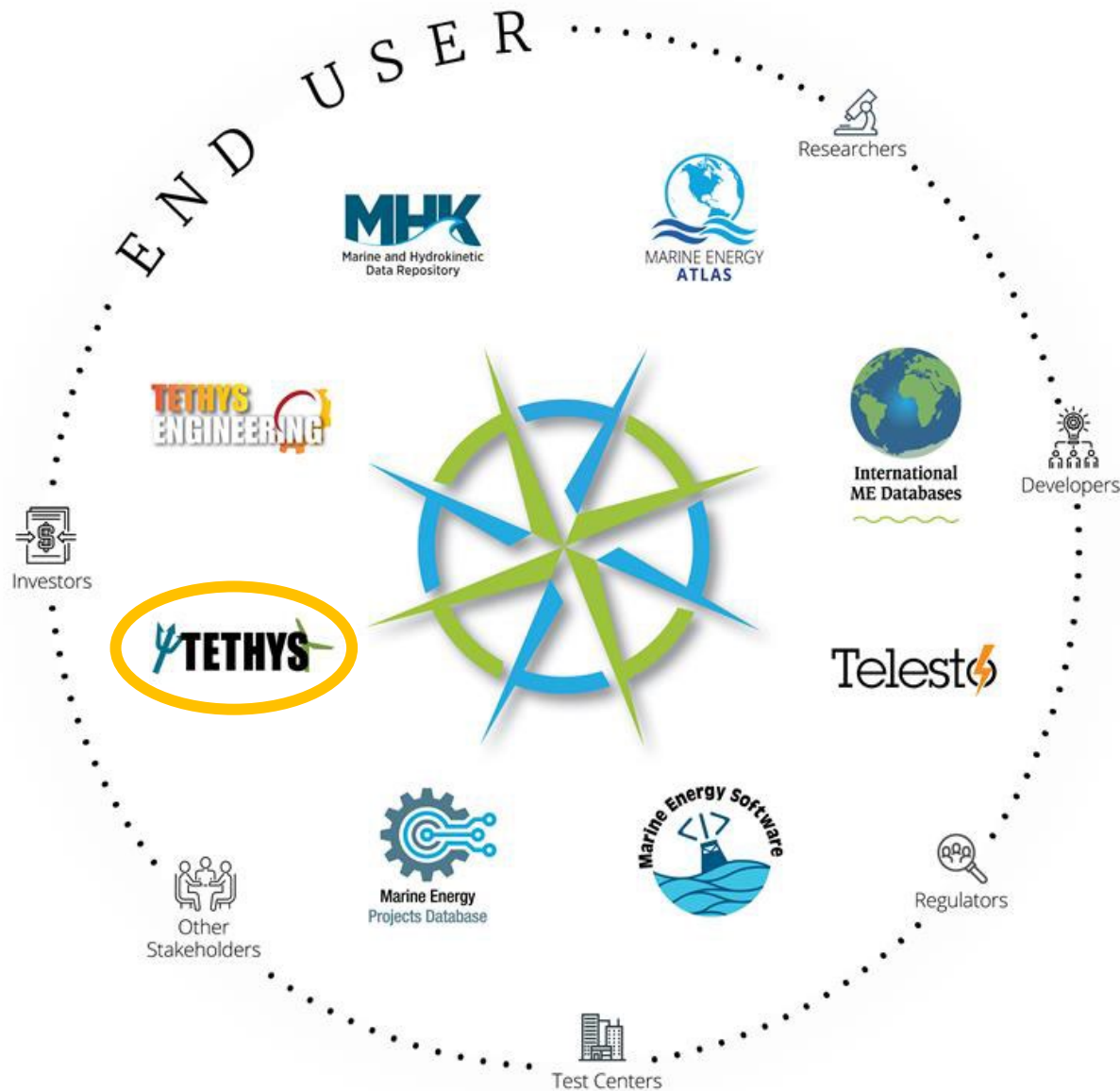
Data Transferability + Risk Retirement

Guidance Documents

Systems Approach



<https://openei.org/wiki/PRIMRE>



- Portal and Repository for Information on Marine Renewable Energy (PRIMRE)
- Provides centralized access to a variety of marine energy resources, including:
  - Datasets and documents
  - Project information
  - Archived webinars
  - Codes and software
  - Testing guidance
  - Educational resources
- Organized into 7 Knowledge Hubs, including *Tethys & Tethys Engineering*



<https://tethys.pnnl.gov/>

The screenshot shows the TETHYS website interface. At the top, there is a navigation bar with 'Log in' and 'Register' links. Below the navigation bar, the 'TOOLS' menu is expanded, showing options like 'MRE Risk Retirement', 'MRE Discoverability Matrix', 'MRE Educational Resources', 'MRE Management Measures Tool', and 'MRE Regulatory Frameworks'. A featured article titled 'The OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World is out!' is displayed. Below this, there are two main content cards: 'MARINE ENERGY' (Generating electricity from the sea) and 'WIND ENERGY' (Generating electricity from wind on land and at sea). To the right of these cards, there is a 'GET STARTED' button and a 'KNOWLEDGE BASE' section with the text 'Access thousands of publications and more, all in a searchable database.'

- *Tethys* is a publicly available knowledge management system, developed and maintained at PNNL
- All OES-Environmental activities are documented on *Tethys*
  - Almost 4,000 documents on MRE!
  - Tools, webinars, additional content
  - Sign up for *Tethys* Blast:  
<https://tethys.pnnl.gov/subscribe-tethys>
- Includes environmental effects of onshore and offshore wind – not the focus for today



# Management Measures Tool

<https://tethys.pnnl.gov/management-measures>

- Online tool that collates management measures that have been used and tried for current and previous MRE projects
- Management measures related to compliance, design feature, mitigation, or monitoring
- Search, filter, download information
- Updated in 2022

Webinar in late 2022 – sign up for the *Tethys* Blasts to get notified

<https://tethys.pnnl.gov/subscribe-tethys>

**TETHYS** Log in Register

ABOUT CONTENT TOOLS CONNECTIONS BROADCASTS HELP

Home » Content » Management Measures Tool for Marine Energy

## Management Measures Tool for Marine Energy

**Accessing Management Measures that Support Deployment of Wave and Tidal Energy Devices**

As the marine renewable energy (MRE) industry moves beyond deployment of individual wave and tidal energy devices towards arrays, certain risks of MRE devices on the marine environment are not well understood and have led to onerous monitoring requirements placed on device developers. In consultation with the research and regulatory communities, it was agreed that applying a set of robust management measures could act as safeguards for marine animals and habitats until available monitoring data allows for determining the level of risk from MRE devices. At that point, measures could be dialed back or removed, if warranted.

A workshop was held in May 2017 with researchers, regulators, and developers to create the basis for the tool shown here. More information on the workshop and input for the tool can be found [here](#).

In addition to the searchable tool below, the information below can be [downloaded here](#). The download file includes additional details not shown below, including comments from stakeholders on past experience, cost of management measures, and when a management measure is needed.

View the [instructions document](#) for more in-depth details and examples on how to use the Management Measure Tool for Marine Energy.

Last updated September 2022

Displaying 1 - 100 of 111 management measures

Filter by Technology: Tidal Management Measure: - Any - Project Phase: - Any - Stressor: - Any - Receptor: Marine Mammals

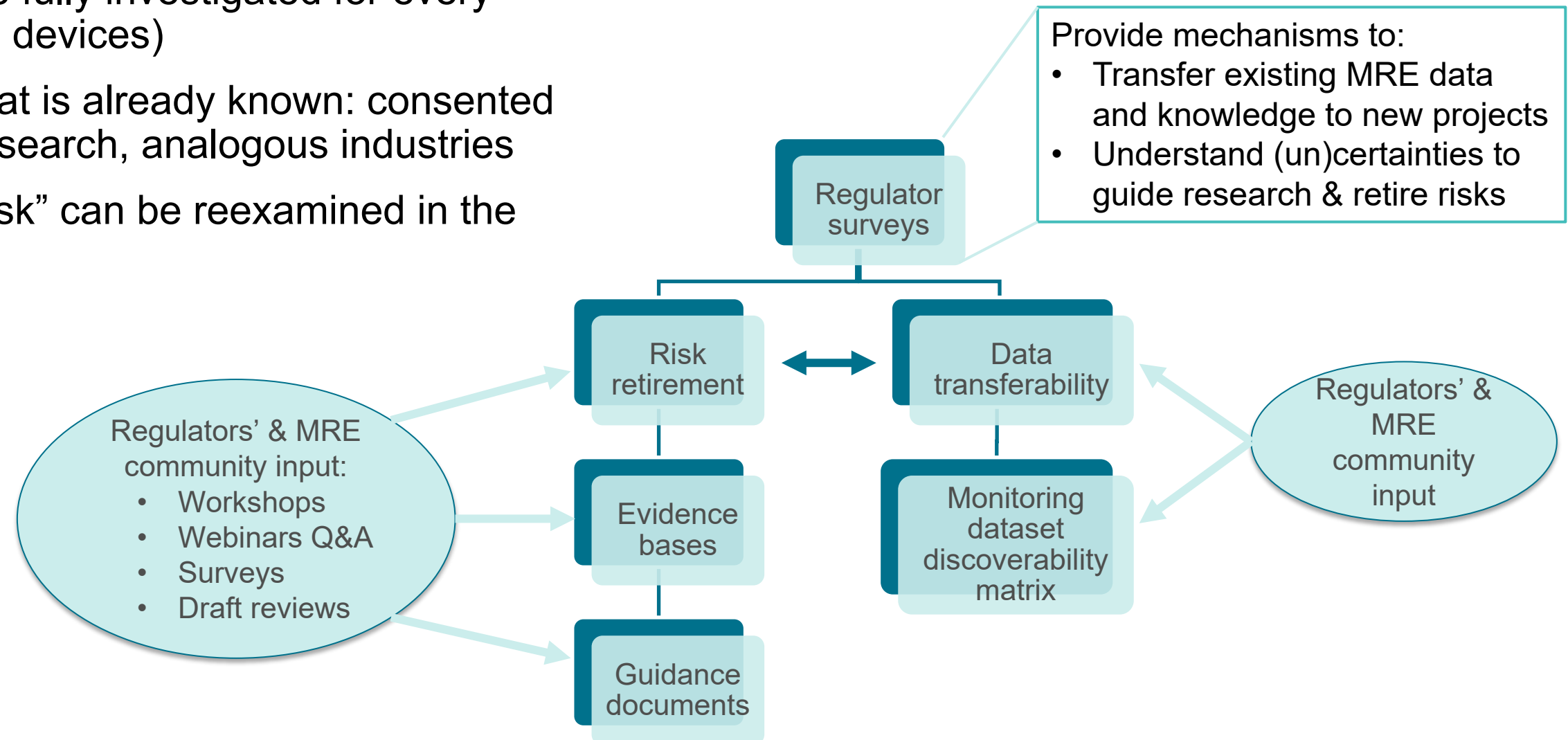
Search:

Technology	Project Phase	Stressor	Receptor	Management Measure	Implications of Measure	Advantages	Challenges	Project Documents
Tidal	Operation & Maintenance	<b>Changes in water flow</b> Modifications to prey distribution and abundance (to include for other receptors) resulting in changes to foraging behaviour.	<b>Marine Mammals</b> All receptors	<b>Design feature</b> Site selection.		Minimises significance of interaction	N/A	<a href="#">ScottishPower Renewables 2012</a>
Wave, Tidal	Operation & Maintenance	<b>Lighting</b> Potential for lighting to adversely affect nocturnal and migratory species.	<b>Marine Mammals</b> All receptors	<b>Design feature</b> Consider type, colour and use of lighting during design and consultation with navigational stakeholders.	A targeted lighting plan may have the potential to reduce impacts on sensitive species but navigational safety takes precedence.	If sensitive species are known to use or migrate near to the project site.	A targeted lighting plan may have the potential to reduce impacts on sensitive species but navigational interests need to be considered at all times	<a href="#">DP Energy Ltd. 2013</a> , <a href="#">European Marine Energy Centre (EMEC) 2014</a> , <a href="#">Tidal Lagoon Power 2017</a>
Wave, Tidal	Operation & Maintenance	<b>Contamination</b> Potential for oil/hydraulic spill incident resulting from the maintenance activities	<b>Marine Mammals</b> All receptors	<b>Mitigation</b> All maintenance activities involving oil/hydraulic fluid treatments will be carried out on-shore	Reduces the chance for oil spill to the environment			<a href="#">Foubister 2005</a>
Wave, Tidal	Installation, Operation & Maintenance, Decommissioning	<b>Marine Non-Native Species (MNNS)</b> Potential for introduction of MNNS which can have an adverse impact on the native species at the site.	<b>Marine Mammals</b> All receptors	<b>Mitigation</b> Source vessels locally.	Reduce/remove risk of transfer of non-native species.	Reduce/remove risk of transfer and settlement of non-native species.	N/A	

# Risk Retirement Overview

<https://tethys.pnnl.gov/risk-retirement>

- For certain interactions, potential risks need not be fully investigated for every project (1-4 devices)
- Rely on what is already known: consented projects, research, analogous industries
- A “retired risk” can be reexamined in the future



- Risk retirement does not replace or contradict any regulatory processes

# Guidance Documents

<https://tethys.pnnl.gov/guidance-documents>

- Help make scientific evidence easily accessible for application in regulatory processes
- Continue to update and develop additional documents
  - Country-specific: completed Spain, draft documents for Scotland and France
  - Stressor-specific: drafting documents for entanglement and collision risk

**Guidance Documents for Risk Retirement**

There is a growing body of knowledge from research studies and monitoring of marine renewable energy (MRE) developments that is yielding some indication of the level of risk associated with environmental, social, and economic effects of MRE. This evidence can reduce the uncertainty and aid in retiring certain environmental and other effects that may be low risk to marine animals, habitats, or communities from small-scale MRE developments, a process deemed "risk retirement". The **risk retirement process** helps determine which interactions of MRE devices and the marine environment are better understood and can be considered low risk, and therefore need not be fully investigated for every small-scale MRE project. Rather, MRE regulators, advisors, and developers may rely on what is known from already consented projects, from related research studies, or from findings from analogous offshore industries. Risk retirement is an international effort that brings together knowledge from the MRE community including research endeavors and observations from MRE projects across many nations. Risk retirement does not take the place of any existing regulatory processes, nor will it completely replace the need for environmental data collection and impact assessments before and after MRE device deployment. When larger arrays of MRE devices are planned, or when new information comes to light, these risks can be revisited and new decisions can be made about the level of risk that might allow for retirement. To apply the risk retirement process during consenting procedures, **OES-Environmental** has created a series of documents, called Guidance Documents for Risk Retirement.

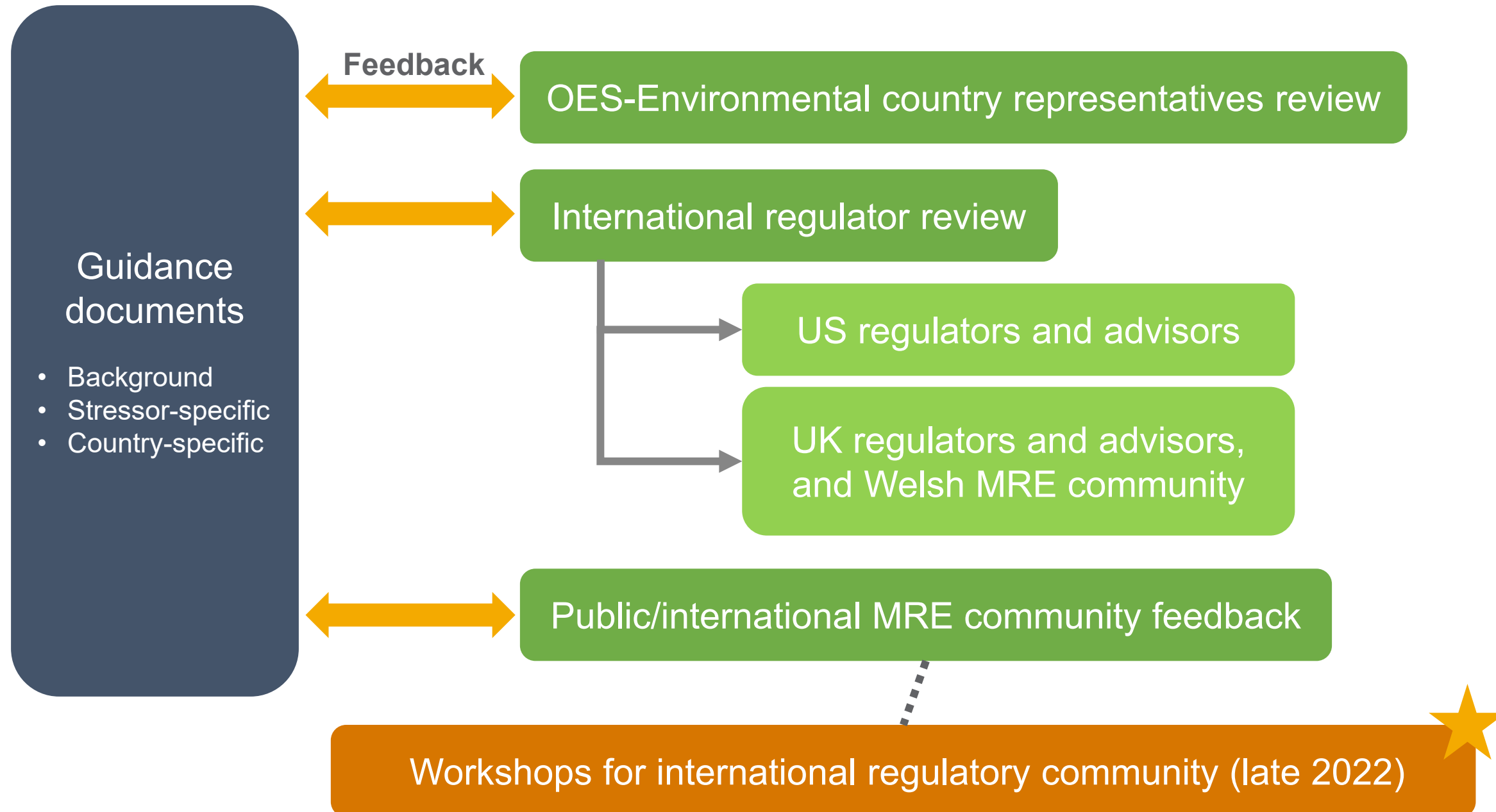
*Click on individual boxes of the image below to view components of the guidance documents. Those marked in color are either available or currently being drafted, while those marked in grey will be drafted in the next phase of development. Starting with the background document for context is highly recommended.*

**Guidance Documents**

- Background Document
  - Descriptions
  - Framework
- Country-specific Documents
  - United States
  - Wales
  - China
  - Japan
  - Spain
  - Australia
  - France
  - Scotland
  - Other OES-E Countries
- Stressor-specific Documents
  - Electromagnetic Fields
  - Underwater Noise
  - Habitat Change
  - Oceanographic Systems
  - Entanglement
  - Collision Risk
  - Displacement

Last year's webinar: <https://tethys.pnnl.gov/events/oes-environmental-public-webinar-guidance-documents-risk-retirement>

# Guidance Documents Outreach



# 2022 – 2023 Focus Areas

- Systems approach:
  - Scaling up to arrays
  - Cumulative effects
  - Ecosystem approach
- Tropical and subtropical environmental effects
- Displacement
- Collision risk

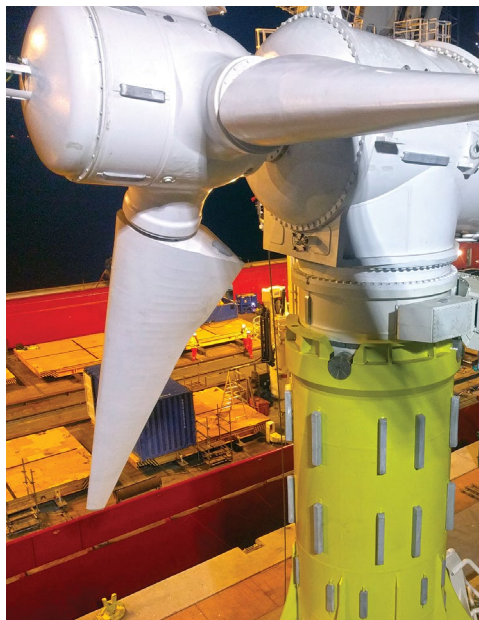


# Moving Towards a Systems Perspective

Holistic approach, looking ahead to potential system effects, particularly as numbers of devices in the ocean increase:

- Scaling environmental effects of MRE from single devices to large arrays
- Cumulative effects of MRE with other anthropogenic stressors
- Ecosystem effects of MRE, including ecosystem services

White papers on each topic coming soon!



# Scaling up our Understanding of Environmental Effects from Single Devices to Arrays

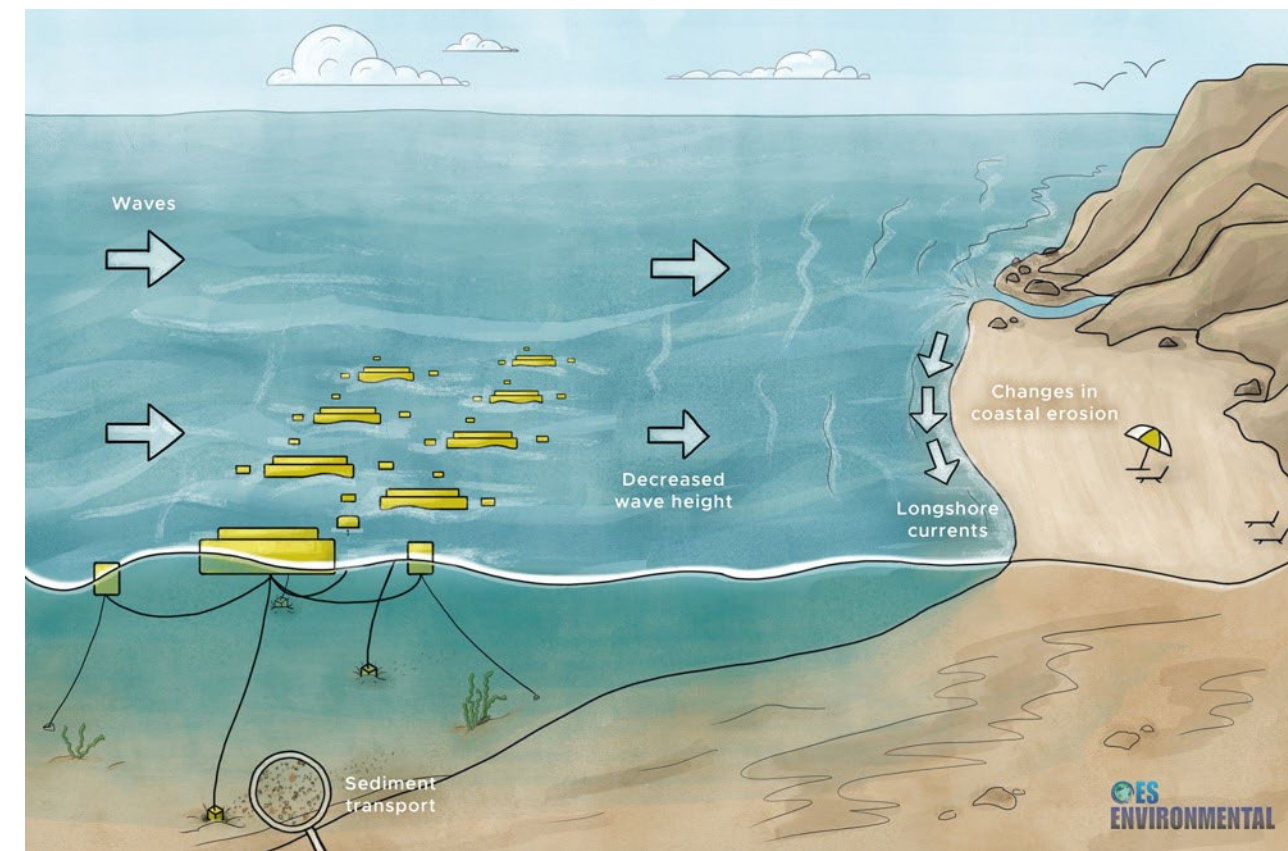
Led by Fundy Ocean Research Centre for Energy, Canada

## Scaling to Arrays:

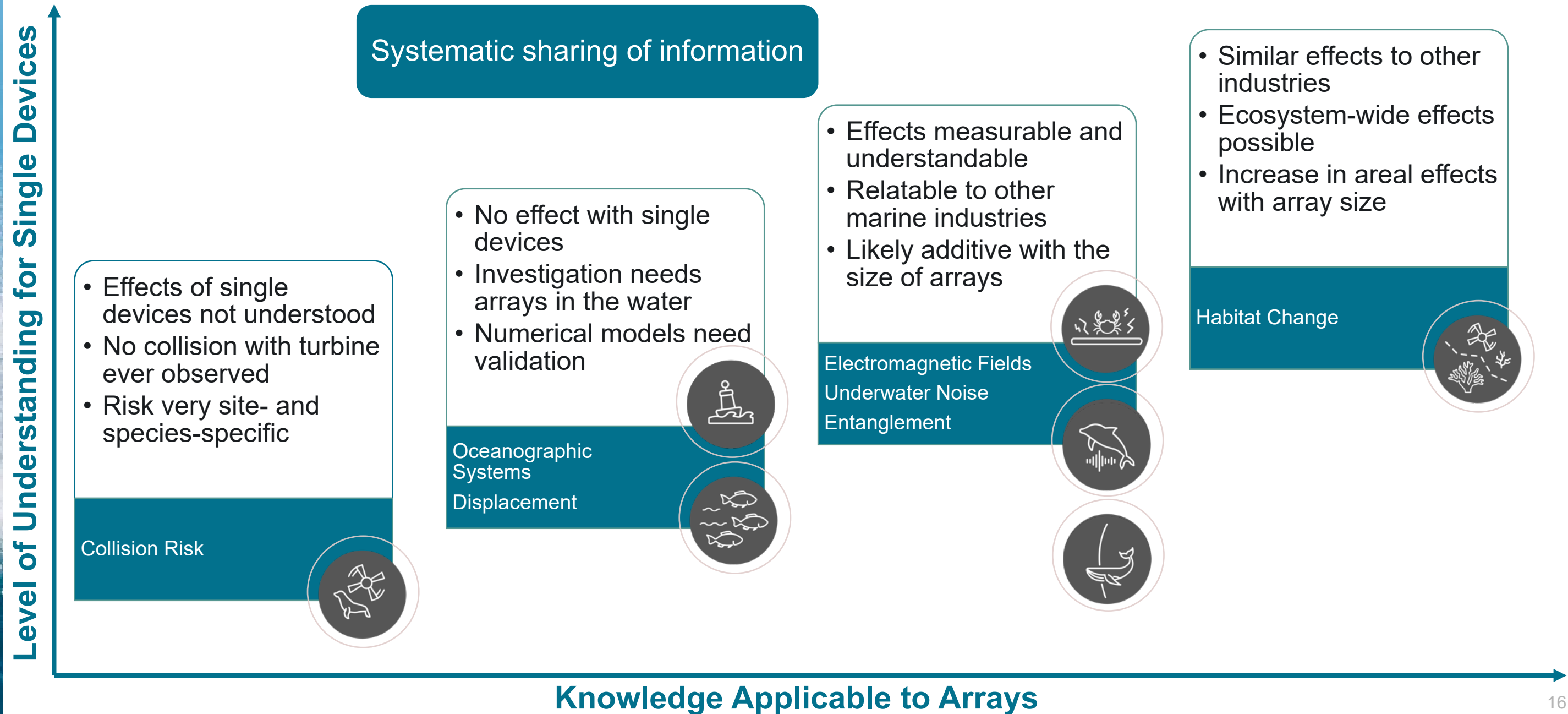
- Investigations of MRE interactions to date on small numbers of devices. Little is known about effects of arrays
- Define array for this purpose of 10-30 devices (depending on device size, array geometry, and ambient environment)

## Questions that drive this inquiry:

- How do we apply the knowledge of stressor-receptor interactions we have learned for single devices to effects from arrays?
- How should we examine interactions that are not significant around single devices when arrays are in the water?



# Scaling up our Understanding of Environmental Effects from Single Devices to Arrays





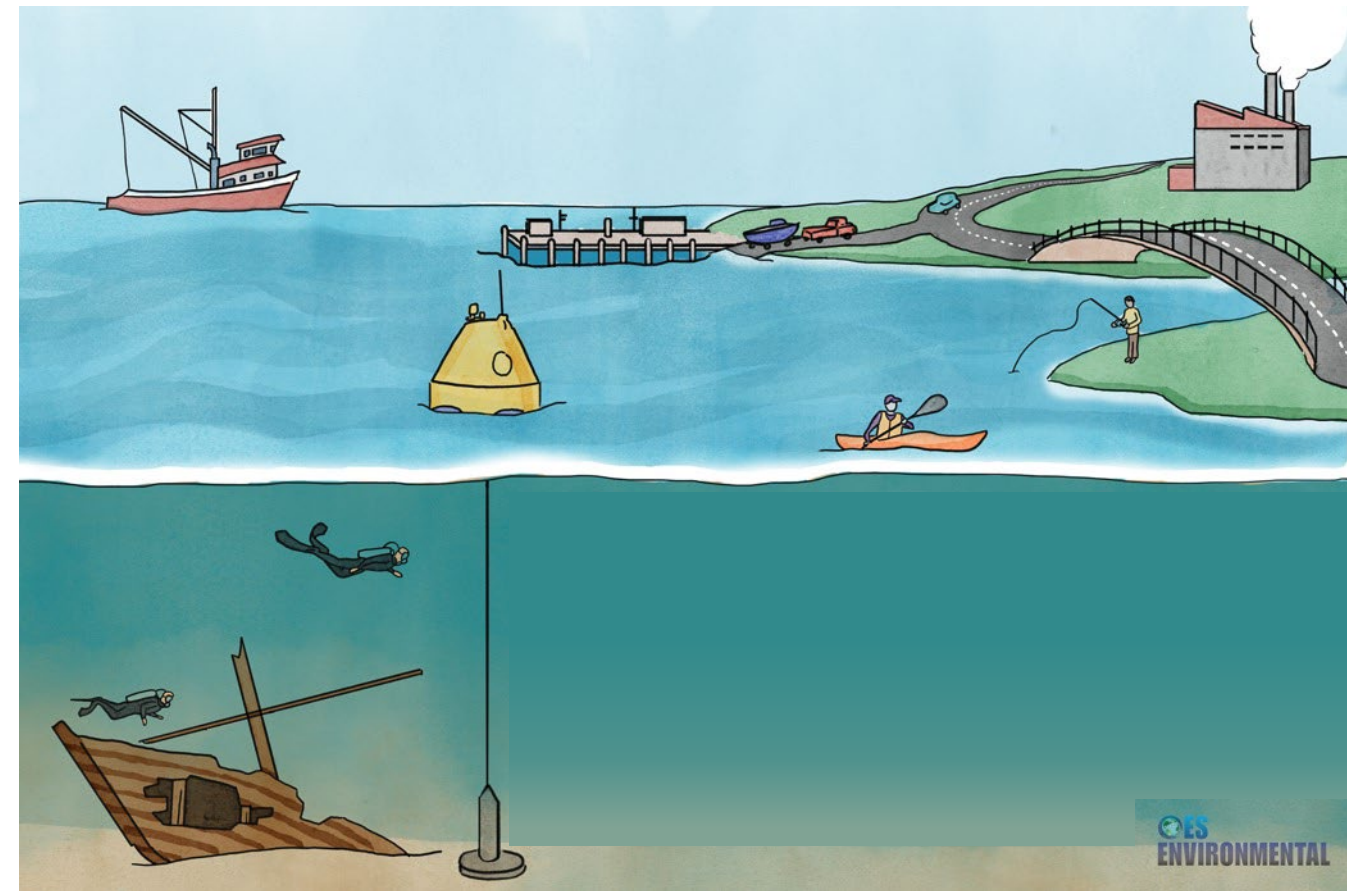
# Cumulative Effects of MRE with Other Anthropogenic Activities at Sea

Led by Commonwealth Scientific and Industrial Research Organisation, Australia

**Cumulative Effects:** direct and indirect effects from the variety of activities that occur within a region over time (e.g., MRE, fishing, shipping, climate change)

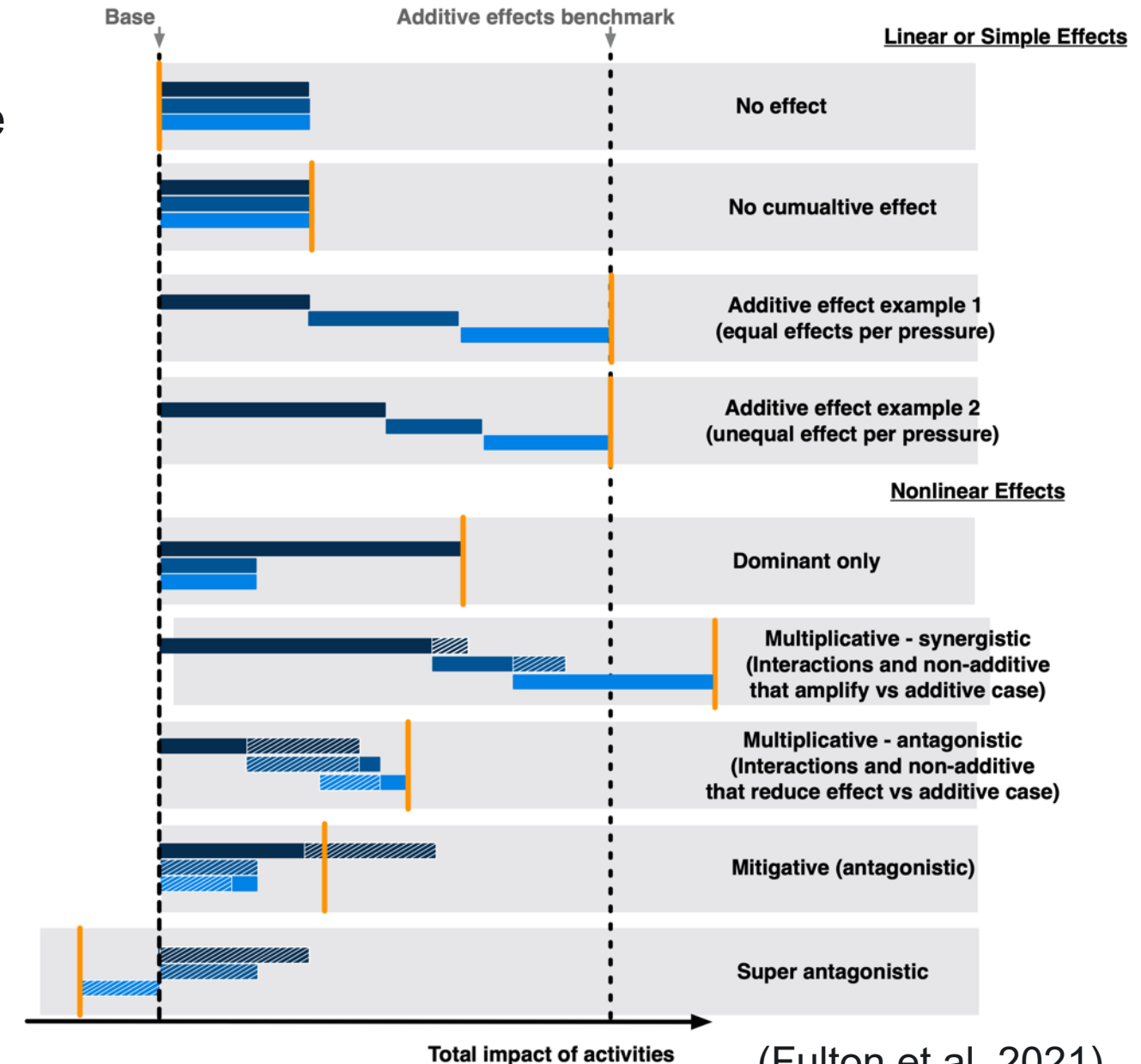
Questions that drive this inquiry:

- What are the cumulative effects of MRE developments?
- How do these effects combine with or affect other human uses of the ocean?
- What tools and research studies can be used to best assess these effects?



# Cumulative Effects of MRE with Other Anthropogenic Activities at Sea

- Different forms of cumulative effects:
  - **Additive**: sum of individual effects is equal to the sum of each effect alone
  - **Masking**: one stressor dominates the signal, masking the effects of other stressors
  - **Synergistic**: interaction of multiple stressors is greater than the sum of the individual effects
  - **Antagonistic**: interaction of multiple stressors is less than the sum of the effects
- Common approaches to cumulative effects assessments assume effects are additive
- Often struggle with non-linearities, and lack of readily accessible data
- Model-based outcomes



(Fulton et al. 2021)

# Ecosystem Approach of MRE

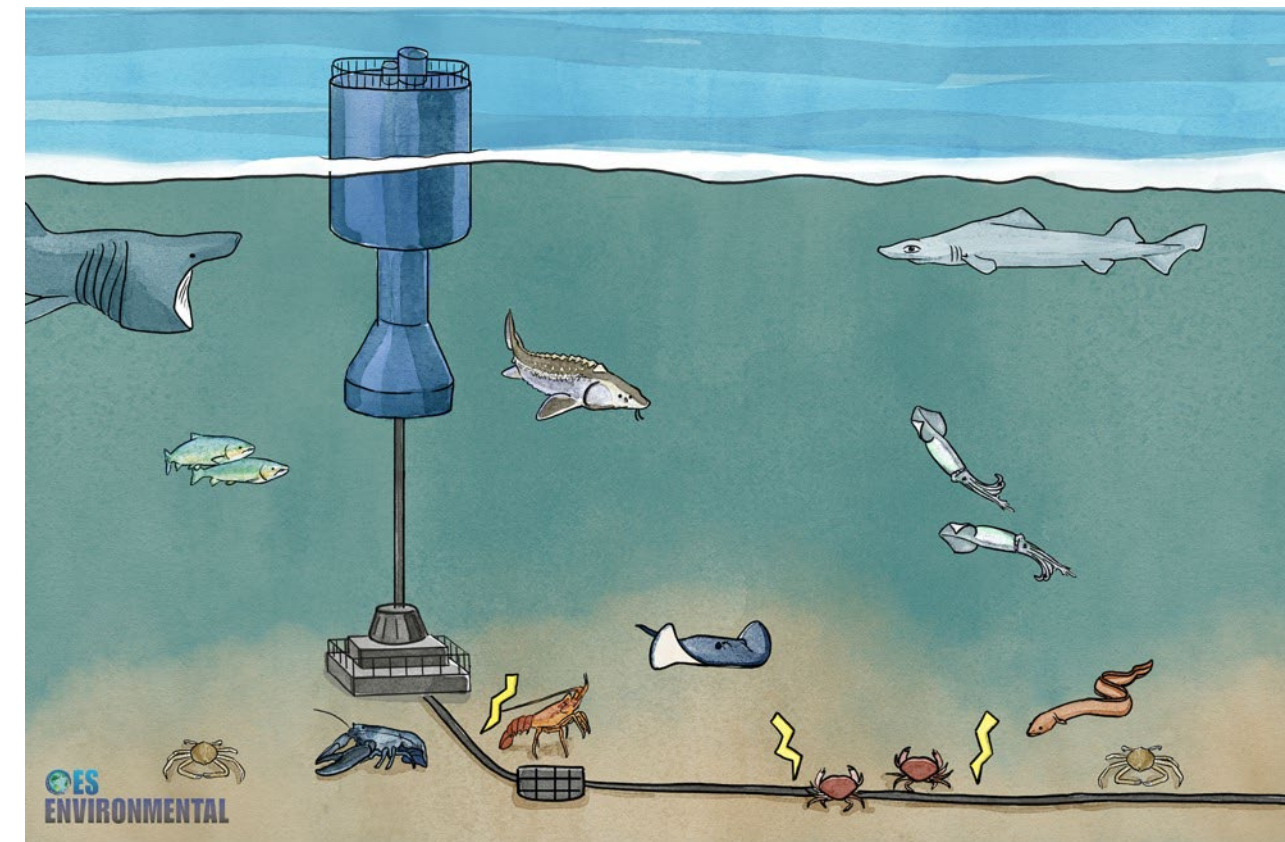
Led by France Energies Marines, France

**Ecosystem Approach** defined by the Convention on Biological Diversity, no mention to MRE:

- Integrated management strategy that promotes equitable conservation and sustainable use of resources and spaces
- Scientific methodologies that encompass processes, functions and interactions among organisms and their environment

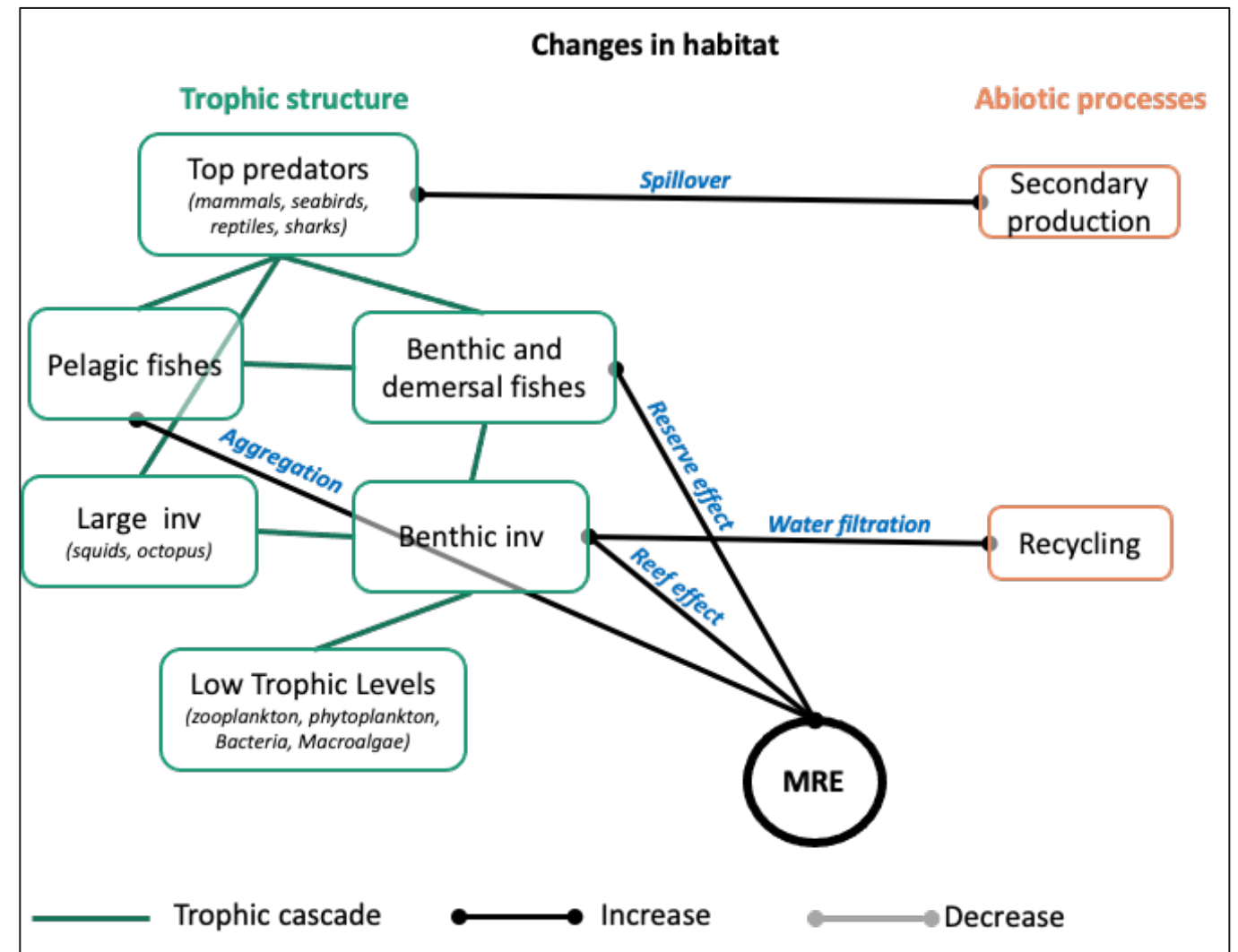
Questions that drive this inquiry:

- How do MRE development and operation affect the ecosystem into which it is deployed?
- How are ecosystem services affected and/or assisted by MRE?



# Ecosystem Approach of MRE

- Conceptual framework underway for global qualitative analysis describing interactions between ecosystem components and MRE systems
- Current models under review, assessment for applicability for MRE
- Survey of experts to refine the definition of ecosystem approach, conduct these assessments, and identify knowledge gaps specific to ecosystems for MRE



Draft conceptual framework of the ecosystem-wide effects changes in habitats caused by MRE developments.

# Environmental Effects in Tropical and Subtropical Regions

- Highest, untapped source of MRE resources in tropical and subtropical coastlines
  - Often overlap with biodiversity hotspots
- Need to examine the potential environmental effects specific to these regions and their unique habitats and species
- Collecting information on MRE and environmental effects
  - Online survey
  - Expert interviews (Aquaterra)
- Working to understand which additional environmental interactions are relevant for tropical and subtropical regions



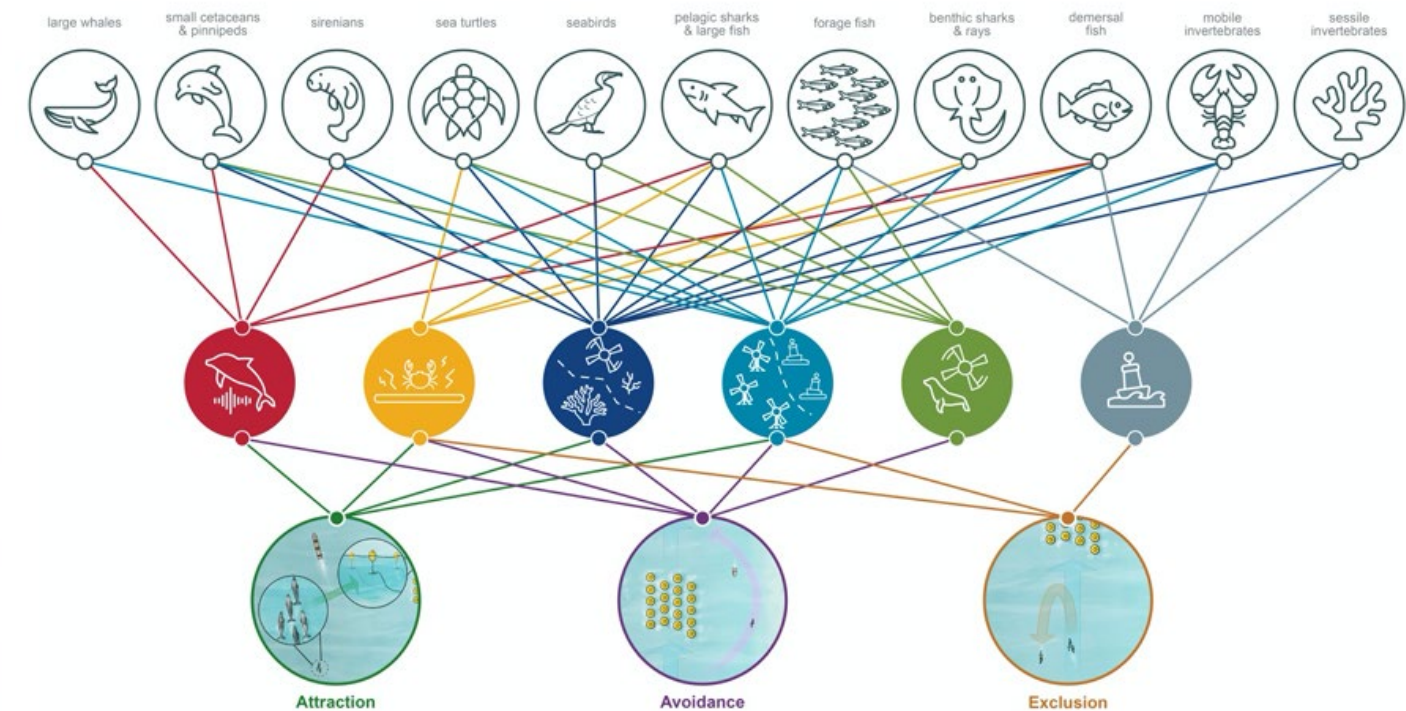
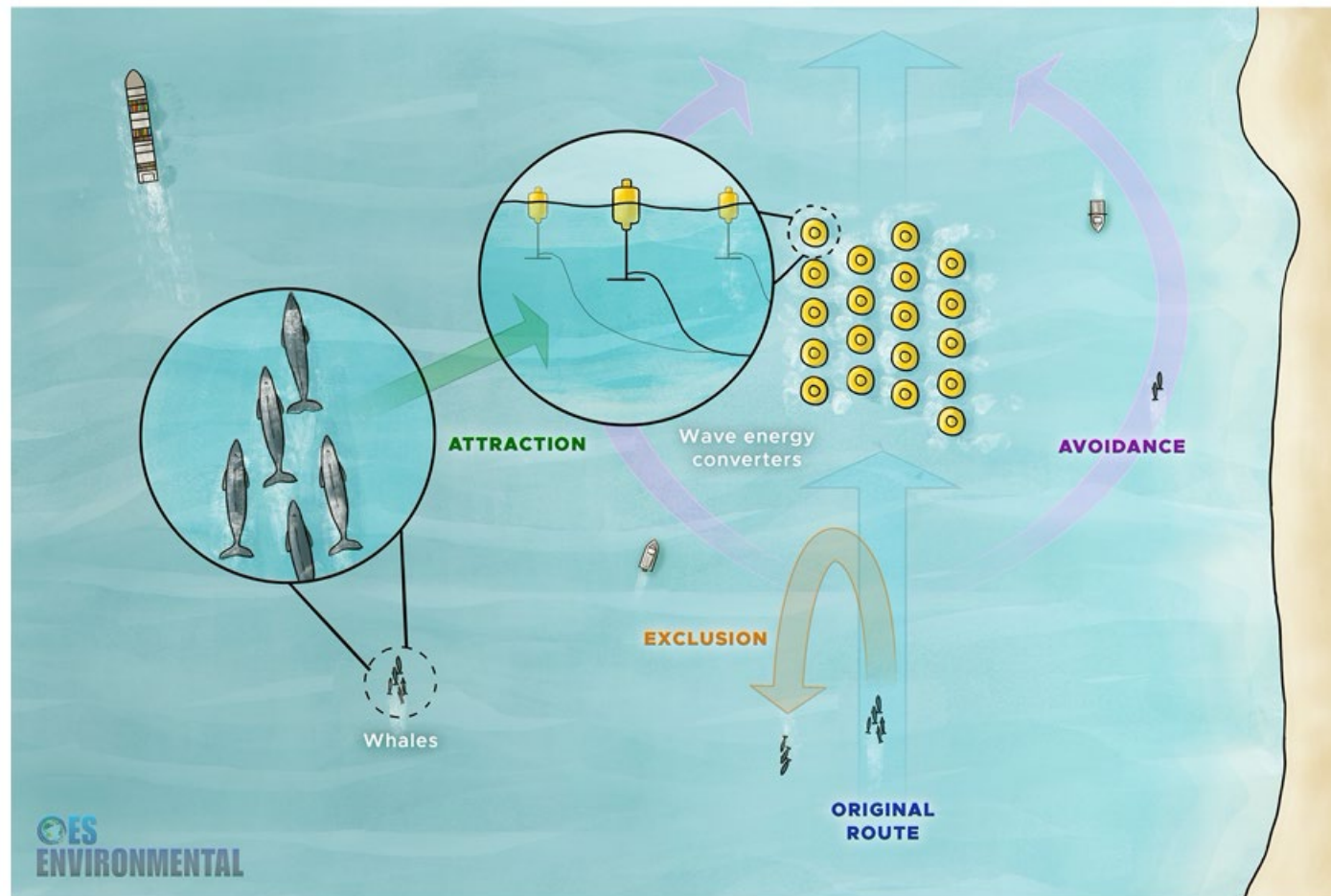
SURVEY



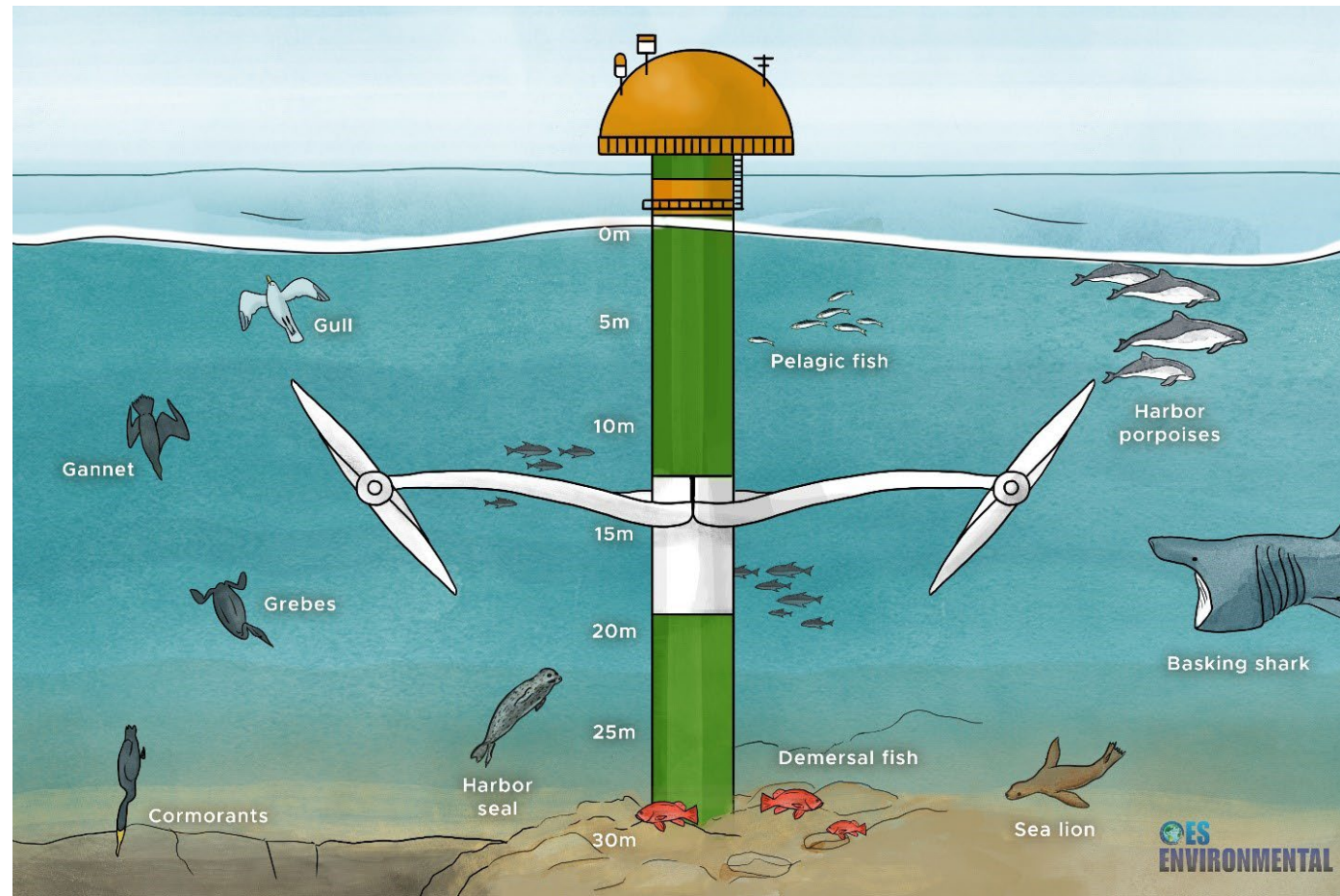
<https://www.surveymonkey.com/r/tropical-southern-mre>

# Displacement

- **Definition:** Outcome of one of three mechanisms (i.e., attraction, avoidance, and exclusion) triggered by a receptor's response to one or more stressors. Potential for a range of consequences, from effects on individuals to populations.
- Animals most susceptible: e.g., large whales, sea turtles, forage fish, benthic sharks
- Expert forum to gather feedbacks from international experts on definition and methods



# Collision Risk



- Evidence base  
<https://tethys.pnnl.gov/collision-risk-evidence-base>
- List of priorities and methods for understanding risk
- Research framework for fish
- Recommendations:
  - Design research projects that fulfill data needs for models and monitoring that aligns with key questions
  - Identify the most appropriate tools for monitoring
  - Utilize models as possible instead of extensive data collection efforts at each new project site

# Outreach

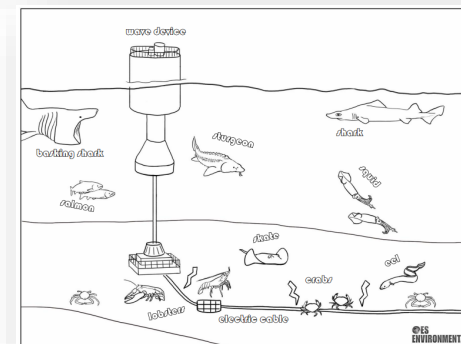
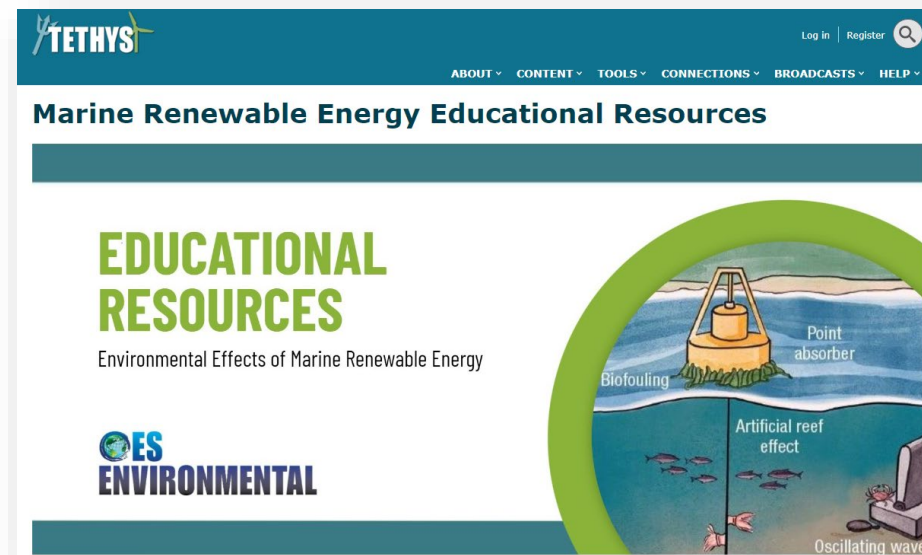
New regulators  
and advisors



<https://tethys.pnnl.gov/mre-brochure>

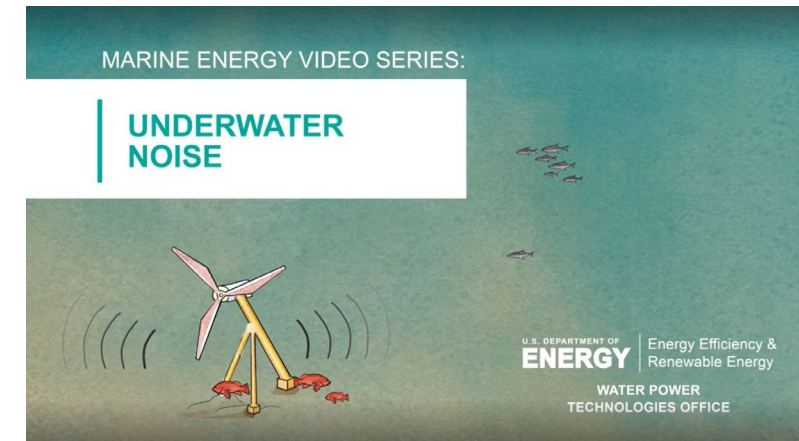
STEM students  
(science, technology, engineering,  
and math)

<https://tethys.pnnl.gov/marine-renewable-energy-educational-resources>



All audiences

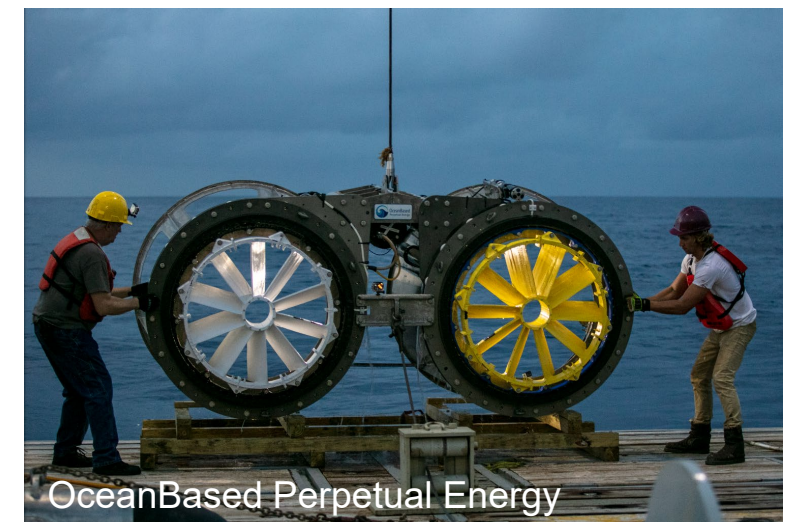
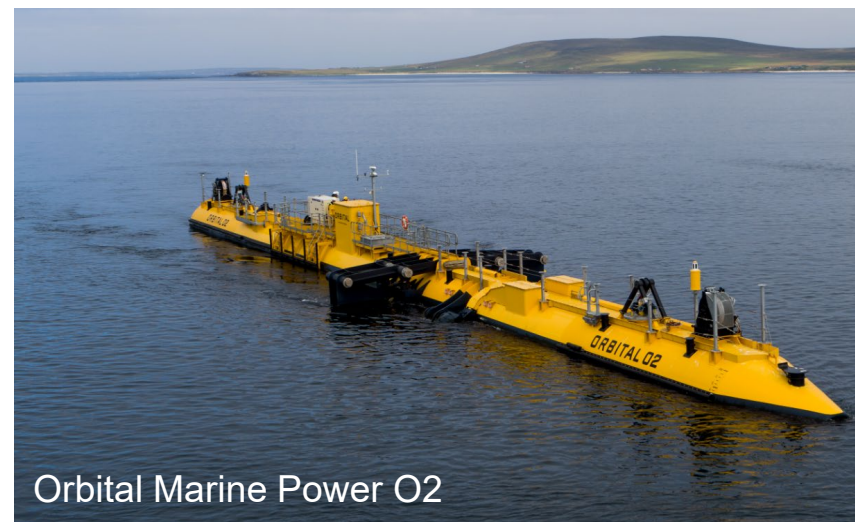
<https://tethys.pnnl.gov/marine-energy-video-series>





# Next Steps

- Finish up guidance documents
  - Upcoming regulator/advisor workshop – gather feedback on application of the documents
- Working on collision risk
- Displacement expert forum
- Continuing efforts on systems approach
- 2024 State of the Science



# Questions & Feedback



Please fill out our 4-minute survey!

[https://www.surveymonkey.com/r/OES-E\\_2022](https://www.surveymonkey.com/r/OES-E_2022)



**Thank you!**

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