



Supporting Decision-Making for Environmental Effects of MRE

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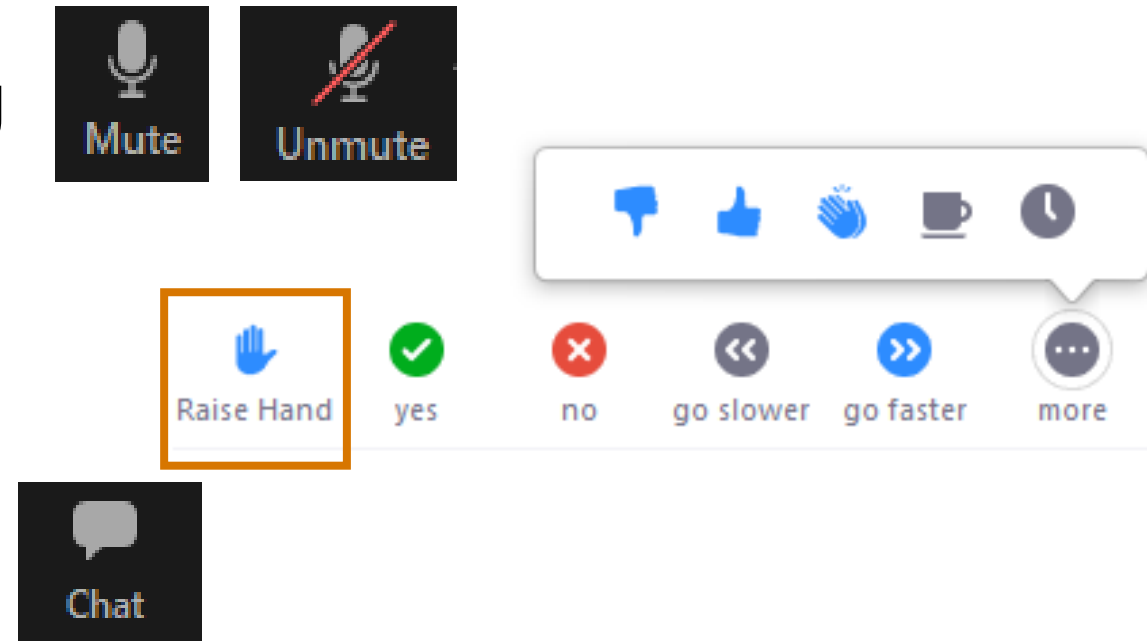


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Technical Notes for Zoom

- Please keep your video off
- Stay muted unless you are speaking
- To ask a question, raise your hand
Or enter it into the chat box any time:



- The workshop will be recorded for our notes and will be edited for sharing to exclude comments and discussion.
- We will also be using Google Jamboards to gather feedback, the link will be provided in the chat.



Objectives of Today's Webinar



1. Continue to engage the marine renewable energy (MRE) community – mainly regulators and advisors
2. Share tools and resources to aid decision-making
3. Solicit feedback on OES-Environmental efforts, notably the guidance documents, to understand applicability and usefulness

Agenda

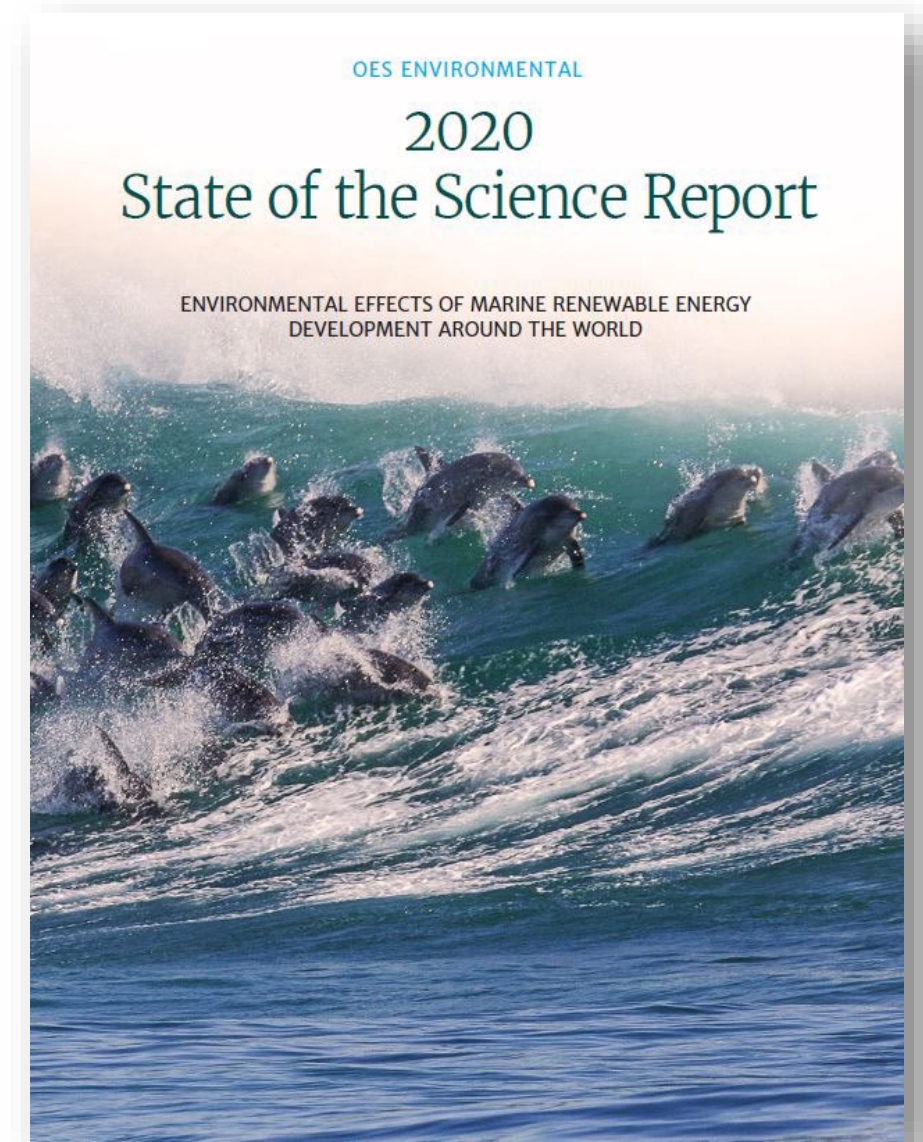
- Introduction and Background
 - OES-Environmental
 - ✓ Risk retirement and data transferability
 - ✓ Moving from science to consenting
- Guidance documents
 - Background document
 - Country-specific documents
 - Stressor-specific documents
 - ✓ Evidence bases
 - ✓ Matrix
 - ✓ Management measures tool
- Feedback and discussion
- Next steps



OES-Environmental

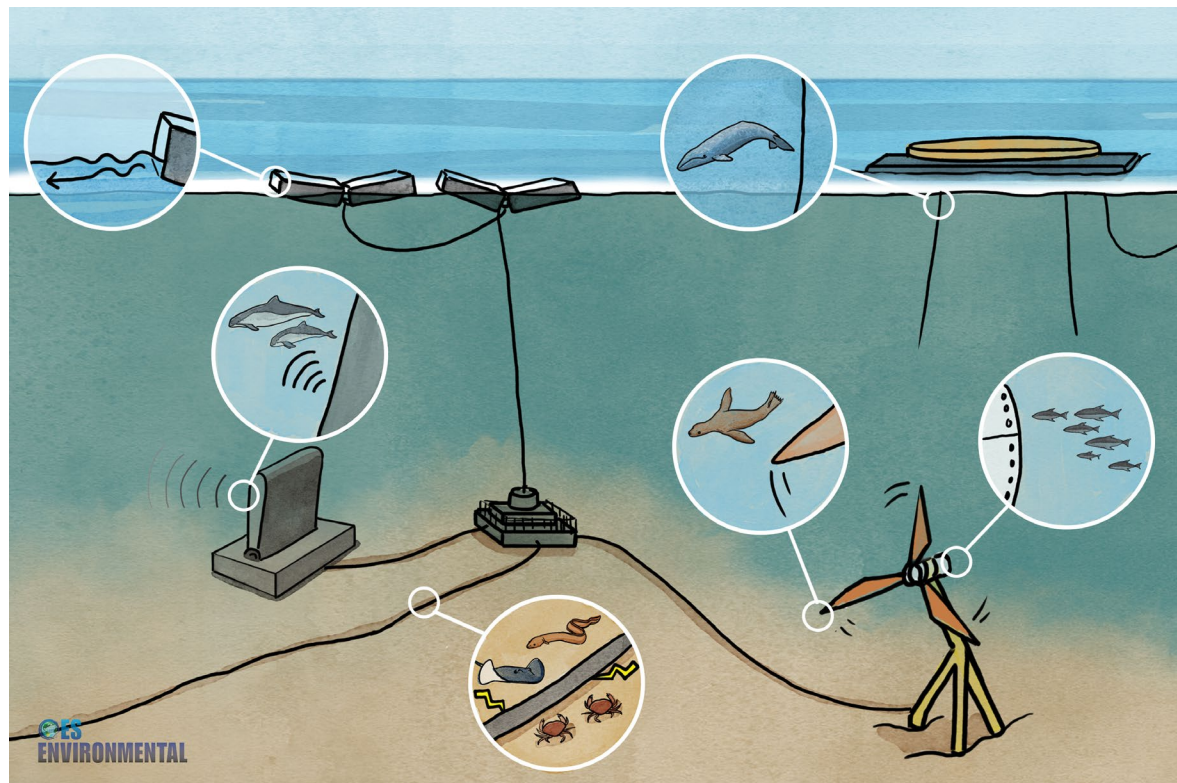
<https://tethys.pnnl.gov/about-oes-environmental>

- Established by the IEA-Ocean Energy Systems in 2010
- Examines environmental effects of 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

Data Transferability and Risk Retirement

- New MRE projects informed by what is already known (data transferability)
- For certain interactions, potential risks need not be fully investigated for every project (risk retirement)
 - Agreement from MRE community on several interactions that can be retired for small developments (1-4 devices)
- Important notes:
 - Does not replace/contradict regulatory processes
 - A retired risk can be reexamined in the future
 - Site-specific data may be needed for new projects

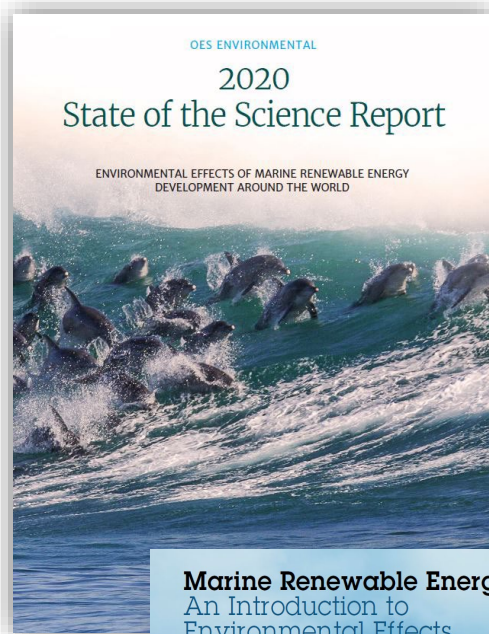
Questions?

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

<https://tethys.pnnl.gov/data-transferability>

Moving from Science to Consenting Processes

Available data and information



Evidence bases



Guidance documents

Guidance Documents for Risk Retirement

This 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 intentional 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

Stressor-specific Guidance Document: Underwater Noise

The guidance documents are intended to be available for regulators and advisors as they carry out their decision-making and for developers as they prepare consenting and licensing applications. The stressor-specific document presents an overview of the scientific information that is known for underwater noise. It is not intended to replace any regulatory requirements or provide action for a particular risk. This document is intended to be used in conjunction with the background document.

Introduction to Stressor

Animals in the marine environment rely on sound for communication, social interaction, orientation and navigation, foraging, and evasion. Ambient underwater sound conditions are made up of natural vocalizations and other behavior, tidal currents and waves, and wind and other weather conditions. Anthropogenic sources, such as shipping, boating, and other industrial activities, also contribute to underwater noise in the marine environment (Durrant et al. 2021). The noise associated with such activities may affect animals that rely on sound, such as marine mammals, fish, sea turtles, and invertebrates; however, the extent to which marine animals detect sound varies by frequency and taxonomy. Figure 1 shows an abbreviated version of where this stressor fits within the guidance document framework.

Figure 1. Purpose of the guidance document framework regarding underwater noise and key receptors, which are required under the regulatory consent process and operations in the UK. The full framework can be found in the background guidance document.

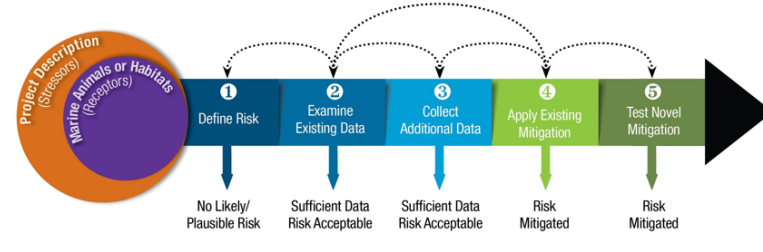
Underwater noise from marine renewable energy (MRE) developments may come from construction and maintenance activities, as well as from operational devices and their components. Impacts from anthropogenic sources of noise may include stress, behavioral changes (such as avoidance), physical injuries, temporary or permanent impacts to hearing ability in marine animals, or making of other important cues in the marine environment. While construction and maintenance activities may create local underwater noise, noise from operational MRE devices is lower in amplitude than some sources, may be of relatively short duration, noise from operational MRE devices is lower in amplitude than some sources, may be of relatively short duration. To understand the potential effects of underwater noise from operational MRE devices on marine animals, an assessment is needed of the ambient noise environment, frequency and levels at which marine species receive sound, and noise output from the device. This will allow noise output from the device to be assessed and related to effects on marine animals.

Table 1. Regulatory jurisdictions in the U.S. 1

Designation	Location	Agency with jurisdiction
Inland waters	Shoreward of the mean low water line	State and some local agencies. Some federal agencies may also have jurisdiction in inland waters.
State waters	From geographic mean high water, but varies by state (0.3 nautical miles)	State agencies. Some federal agencies may have jurisdiction in state waters.
Federal waters	3 to 12 nautical miles	Federal agencies.
Exclusive economic zone	12 to 200 nautical miles	Federal agencies.

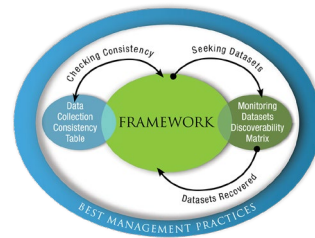
1 This country-specific document should be read in conjunction with the background guidance document, which can be found on Tethys: <https://tethys-tools.nrel.gov/guidance-documents>.
2 Information about state and local-level regulatory processes for MRE can be found in the [Guidance Documents](https://tethys-tools.nrel.gov/guidance-documents).
3 Executive Order 13175 of November 6, 2000, Consultation and Coordination with Indian Tribal Governments, 68 FR 65, No. 218, November 6, 2000.
4 <https://www.eis.noaa.gov/portal/landing.do?cid=1&action=showDetails> and <https://www.fishbase.org/>

Risk retirement



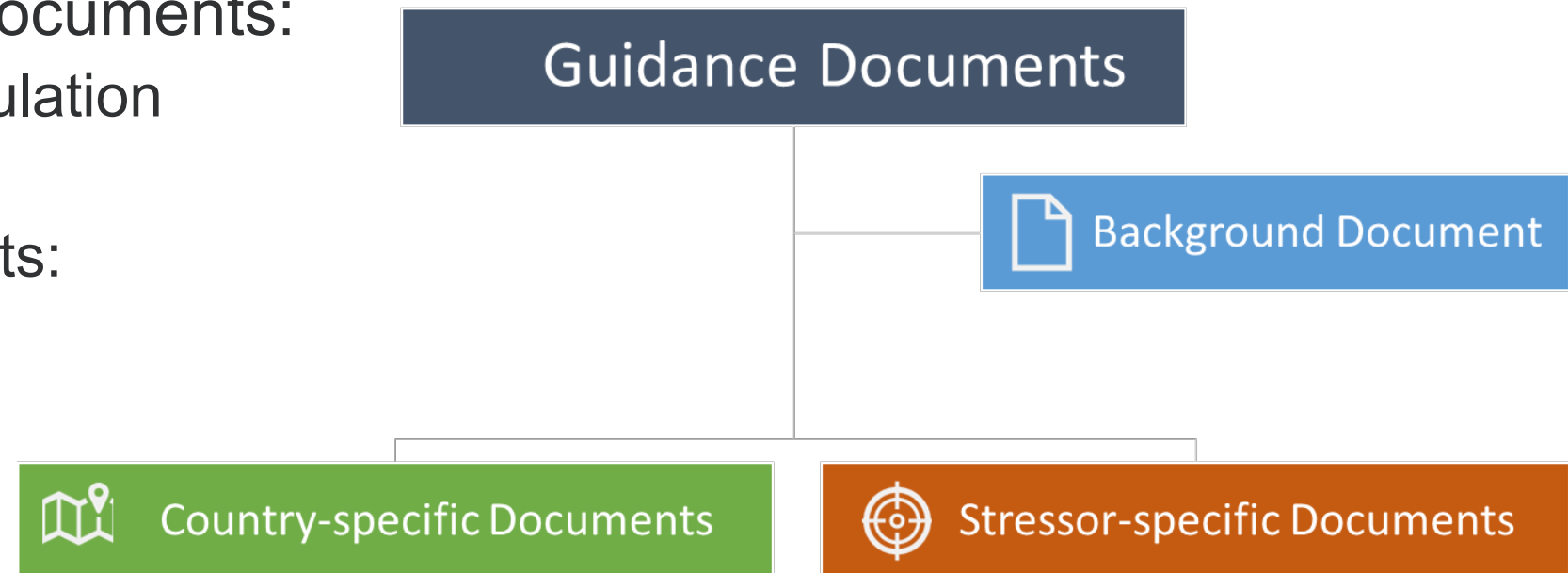
RISK RETIREMENT

Data transferability

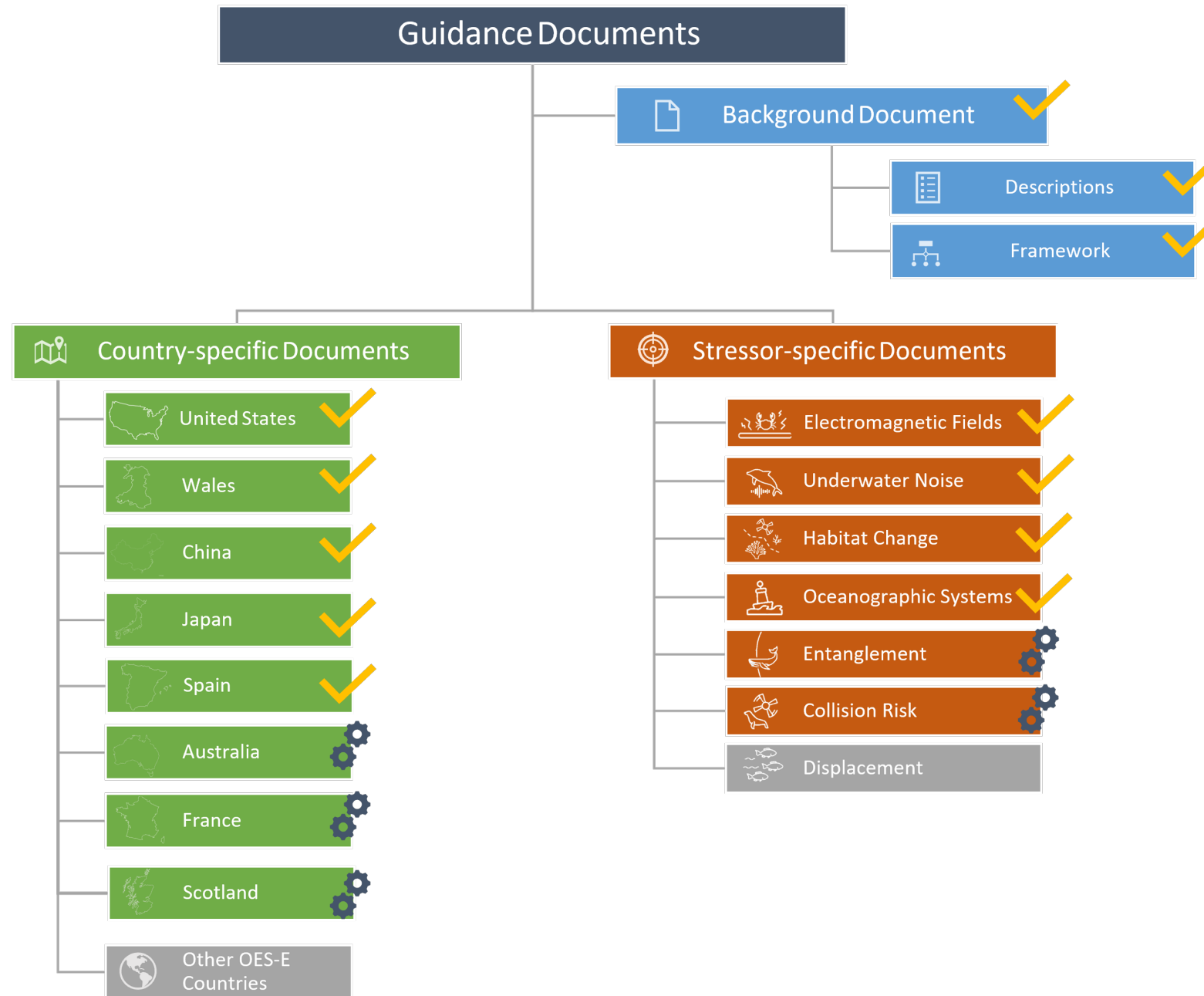


Guidance Documents - Overview

- Guidance documents developed to:
 - Bridge from scientific evidence to regulatory use
 - Provide guidance that fits most nations' regulatory schemes
 - Make information accessible
 - Not intended to replace any regulation or national guidance
- Organization of the guidance documents:
 - Scheme for categories of regulation
 - Overview flowchart
 - 3 types of guidance documents:
 - ✓ Background
 - ✓ Country-specific
 - ✓ Stressor-specific

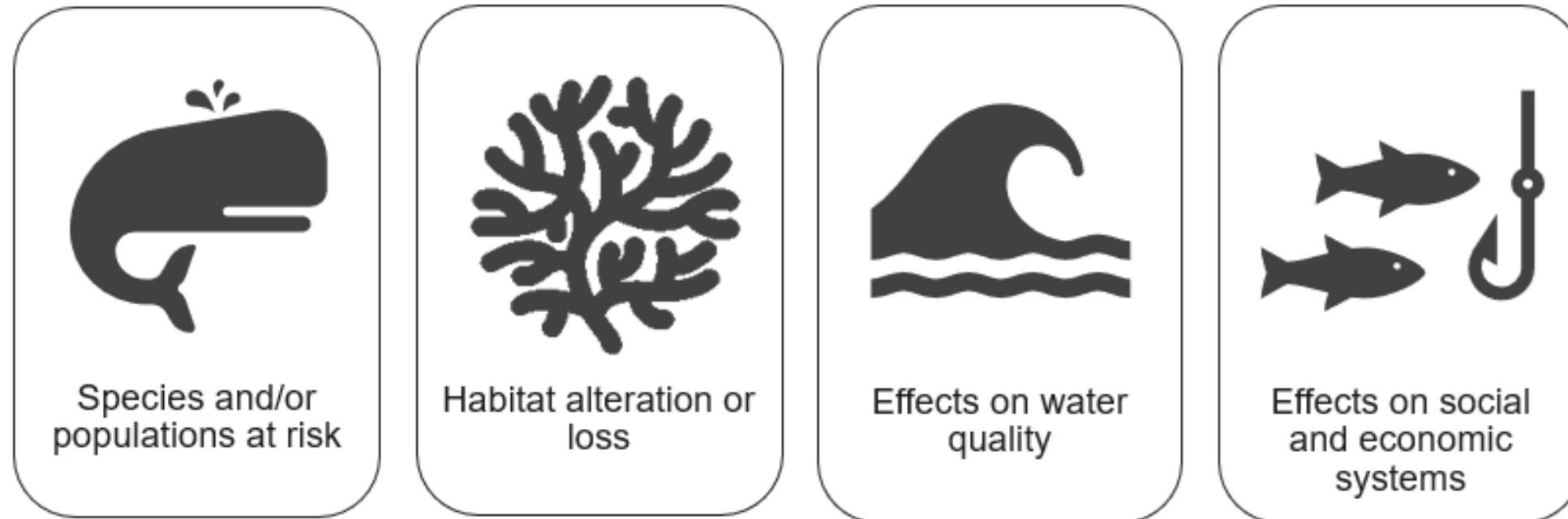


Progress on Guidance Documents to Date



Background Document – Regulatory Categories

4 categories of regulation that fit most countries:



- Each category includes:
 - Explanation of the category
 - Relevant information for consenting
 - ✓ Baseline information
 - ✓ Risks specific to regulatory category

Regulatory Categories – Example



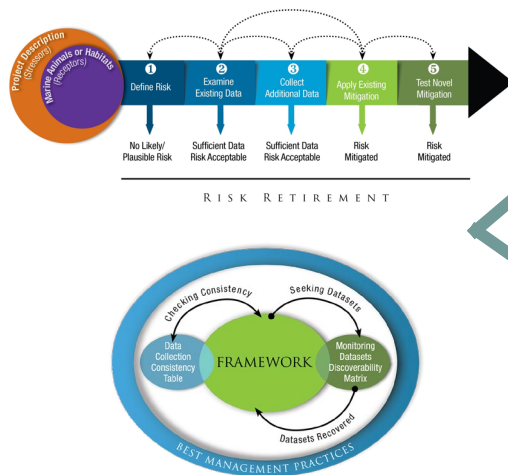
Species and/or populations at risk

- Includes protected species (endangered, threatened, etc.) and commercially, recreationally, and/or culturally valuable species
- Baseline information: data to inform if species live in/migrate through area, and if may be affected by MRE
 - Characteristics of species and MRE project site
- Potential risks: impacts from underwater noise, habitat change, and electromagnetic fields; collision; entanglement; or displacement



Background Document: Framework

Environmental Consenting for Small Numbers of Marine Renewable Energy (MRE) Devices



1. Project scoping completed by developer, potential for consultation with regulator/advisor

2. Application submitted by developer

3. Regulator and advisors evaluate information for environmental assessment

4. Regulator and advisors may request additional data collection

Project consented

Project modified to receive consent

Project abandoned

Discussion Topics

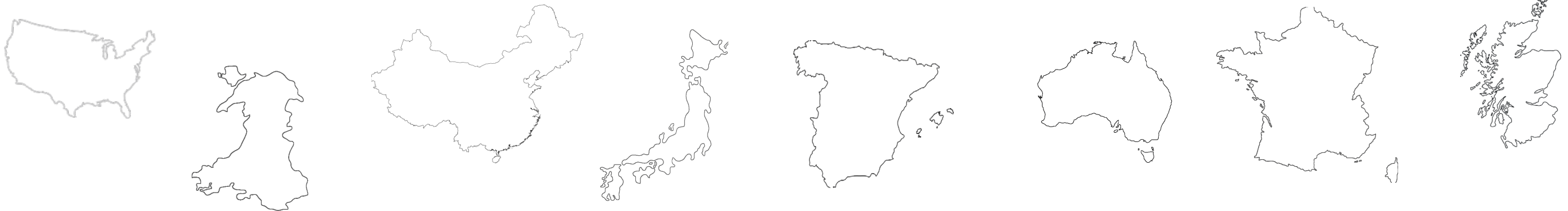
Questions?



- Do the four regulatory categories make sense?
 - Anything missing?
- How could the framework for applying the guidance documents be helpful during consenting processes?
 - Would you recommend it to developers?
- How might risk retirement and data transferability be helpful during consenting processes?
 - Have you already applied these concepts in practice?

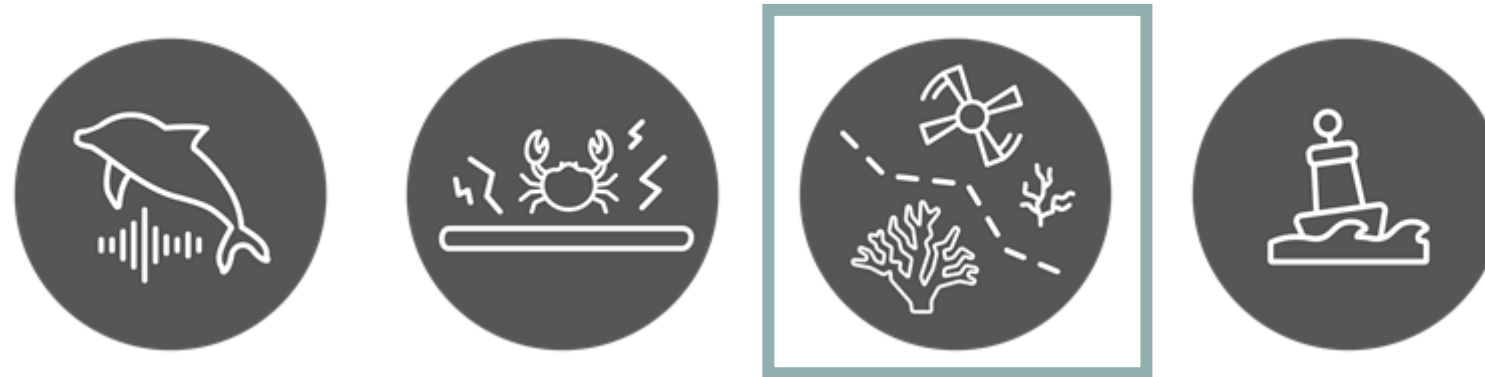
Country-specific Documents

- Compile environmental regulations relevant for MRE in OES-Environmental countries
 - Aimed for use by developers, with application for larger MRE community
- Includes information on:
 - Regulatory jurisdictions
 - Agencies/regulatory bodies with jurisdiction over MRE projects
 - Key regulations/statutes for environmental effects of MRE by four categories
 - Additional information on marine spatial planning, adaptive management, etc.



Stressor-specific Documents

- Bring together current knowledge on stressor-receptor interactions
- Developed for 4 interactions



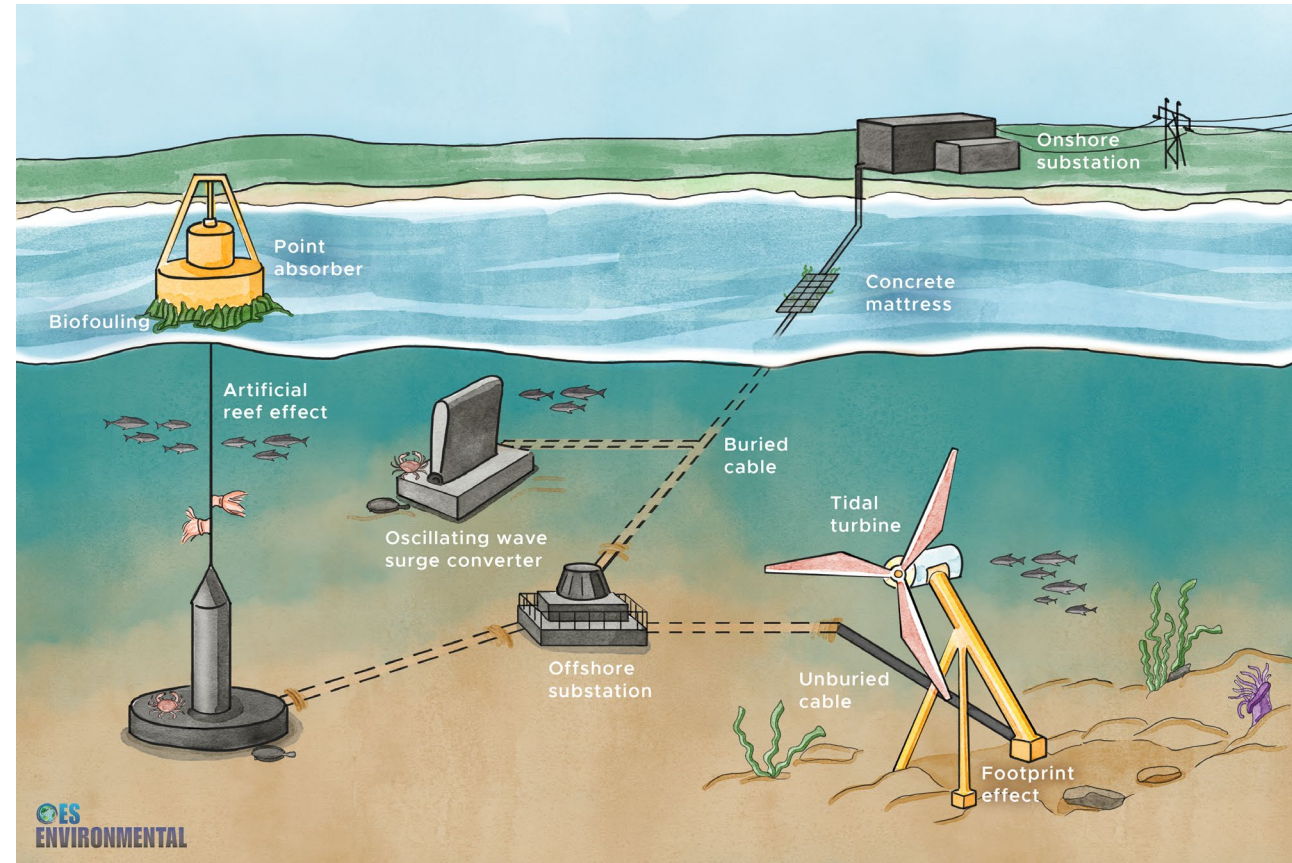
- Includes:
 - Background information on the interactions
 - Links to existing data and information:
 - ✓ State of the Science report, *Tethys* Knowledge Base, evidence bases, matrix
 - Pathway to risk retirement
 - Recommendations

Example: Habitat Change

<https://tethys.pnnl.gov/publications/stressor-specific-guidance-document-habitat-change>

Background:

- Move between interaction to regulatory category
- Potential for habitat alteration, loss, or creation



Existing Data and Information:

Tethys Knowledge Base

2020 State of the Science

Evidence Bases

Monitoring Datasets Discoverability Matrix

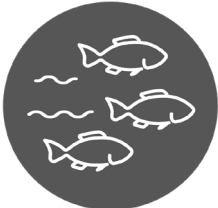
Evidence Bases

- Key research papers, monitoring reports, and documents to inform risk retirement
- Reviewed and discussed by experts
- Focused on small numbers of MRE devices
- Addressed by stressor-receptor interaction:
 1. Electromagnetic fields (EMF) – *16 documents*
 2. Underwater noise – *29 documents*
 3. Habitat change – *60 documents*
 4. Changes in oceanographic systems – *23 documents*
 5. Collision risk – *66 documents*
 6. Entanglement – *11 documents*



Monitoring Datasets Discoverability Matrix

- Interactive tool to guide data transfer
- Makes data and information from existing projects accessible to transfer to future projects
- Categorized by six interactions:



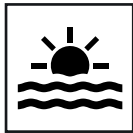
- Data classified by characteristics:



Stressor



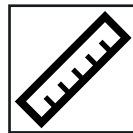
Receptor



Site Conditions

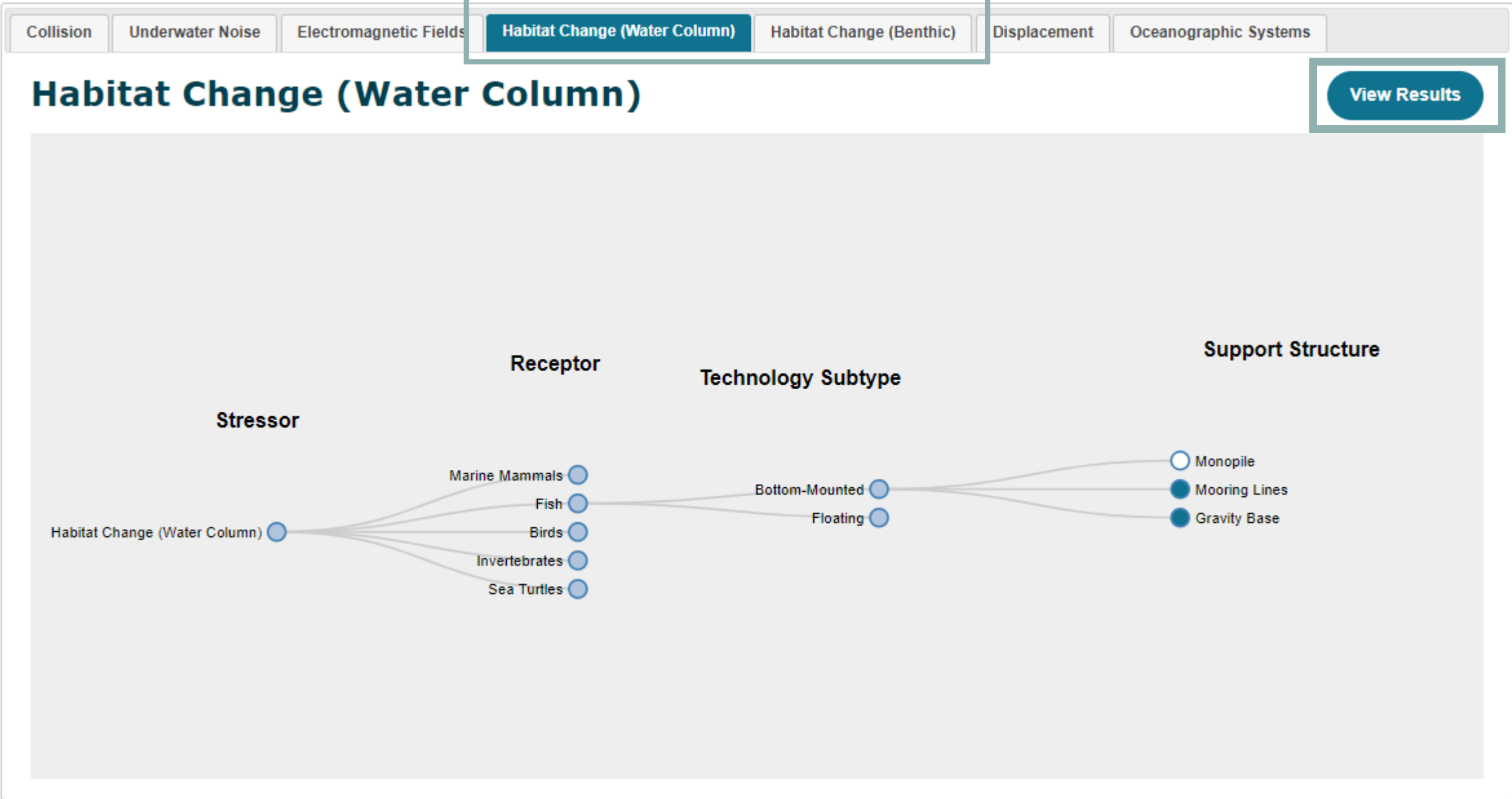


Technology Type



Project Size

Monitoring Datasets Discoverability Matrix





Baseline & Post-Installation Monitoring

Title	Description	Country
Nautricity at EMEC: Baseline - Fish 1	Introduction of marine non-native species (via vessels, devices or other equipment)	United Kingdom
PacWave South Test Site: Post-Installation - Fish 2	Organism Interactions Monitoring Plan (Final License Application - Appendix H)	United States of America
PLAT-O at EMEC: Post-Installation - Fish	Measure the effect the device has with respect to habitat creation and fish aggregation	United Kingdom
U.S. Navy Wave Energy Test Site (WETS): Post-Installation - Fish	WET Year 1 Biological Assessment (October 2003 – October 2004)	United States of America

Research Studies

Title	Description	Country
A Benthic Habitat Monitoring Approach for Marine and Hydrokinetic Sites	This project demonstrated a seafloor survey approach for generating detailed benthic habitat maps at MHK sites. The approach combined multibeam bathymetry and acoustic backscatter (multibeam echosounder, MBES) mapping with sediment profile imaging and plan view (SPI-PV) imaging as a rapid, cost-effective benthic habitat mapping protocol, and it can be used at any marine renewable energy site (e.g., offshore wind farms) where benthic impacts are a concern. A primary technical innovation was the development of image processing software that automatically identifies and measures key features in the images. We also designed, built, and tested a power SPI camera system that is effective in sampling firm substrates. This project is part of the DOE Triton Initiative .	United States of America

Key Documents

Title	Author	Date	Country
Artificial Reef Effect and Fouling Impacts on Offshore Wave Power Foundations and Buoys - A Pilot Study	Langhamer, O., Wilhelmsson, D., Engström, J.	April 2009	Sweden
Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art	Langhamer, O.	December 2012	
Changes in Fish Communities on a Small Spatial Scale, an Effect of Increased Habitat Complexity by an Offshore Wind Farm	van Hal, R., Griffioen, A., van Keeken, O.	May 2017	Denmark
Colonisation of Fish and Crabs of Wave Energy Foundations and the Effects of Manufactured Holes - A Field Experiment	Langhamer, O., Wilhelmsson, D.	October 2009	Sweden

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

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ABOUT CONTENT TOOLS CONNECTIONS BROADCASTS HELP

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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	Changes in water flow Modifications to prey distribution and abundance (to include for other receptors) resulting in changes to foraging behaviour.	Marine Mammals All receptors	Design feature Site selection.		Minimises significance of interaction	N/A	ScottishPower Renewables 2012
Wave, Tidal	Operation & Maintenance	Lighting Potential for lighting to adversely affect nocturnal and migratory species.	Marine Mammals All receptors	Design feature 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	DP Energy Ltd. 2013 , European Marine Energy Centre (EMEC) 2014 , Tidal Lagoon Power 2017
Wave, Tidal	Operation & Maintenance	Contamination Potential for oil/hydraulic spill incident resulting from the maintenance activities	Marine Mammals All receptors	Mitigation All maintenance activities involving oil/hydraulic fluid treatments will be carried out on-shore	Reduces the chance for oil spill to the environment			Foubister 2005
Wave, Tidal	Installation, Operation & Maintenance, Decommissioning	Marine Non-Native Species (MNNS) Potential for introduction of MNNS which can have an adverse impact on the native species at the site.	Marine Mammals All receptors	Mitigation 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	

Management Measures Tool



Filter by Technology:
 Management Measure:
 Project Phase:
 Stressor:
 Receptor:

Search:

Technology	Project Phase	Stressor	Receptor	Management Measure	Implications of Measure	Advantages	Challenges	Project Documents
Wave, Tidal	Installation, Decommissioning	Habitat Loss Direct loss of protected or sensitive sub-littoral seabed communities due to the presence of devices and associated moorings or support structures on the seabed.	Fish Demersal fish	Design feature Micrositing of offshore infrastructure to avoid sensitive habitats and minimise footprint.	This could reduce/remove effects on sensitive habitats and is a relatively low cost measure.	This could reduce/remove effects on sensitive habitats. Low cost measure at single device or small-scale array.	N/A	Foubister 2005, Royal Haskoning and Sea Generation (Kyle Rhea) Ltd. 2013, ScottishPower Renewables 2012, Laminaria 2018, The Marine Institute 2016

Pathway to Risk Retirement



- Evidence to date:
 - Impacts from small-scale MRE developments are limited
 - Does not typically pose a significant risk to habitats or marine organisms when sited properly to avoid critical habitats
- Consensus from MRE community:
 - Risk from habitat change for small numbers of devices can be retired, if project is sited properly
 - Studies at each new project site may not be needed
 - ✓ Any data collected will continue to inform understanding of cumulative effects and increase knowledge of spatial and temporal scales of habitat change

Questions and Discussion



- Breakout groups

- Google Jamboard



Questions and Discussion



- Do the four regulatory categories make sense?
 - Anything missing?
- How could the framework for applying the guidance documents be helpful during consenting processes?
 - Would you recommend it to developers?
- How might risk retirement and data transferability be helpful during consenting processes?
 - Have you already applied these concepts in practice?

Questions and Discussion

Jamboard



- Are the guidance documents useful for applying science?
 - Do they help inform risk retirement?
- How might you use the guidance documents within consenting processes?
 - Stressor-specific documents?
 - Evidence bases or matrix?
 - ✓ Would you use these tools to find available data and information for data transfer?
 - Management measures tool?

MRE Brochure

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

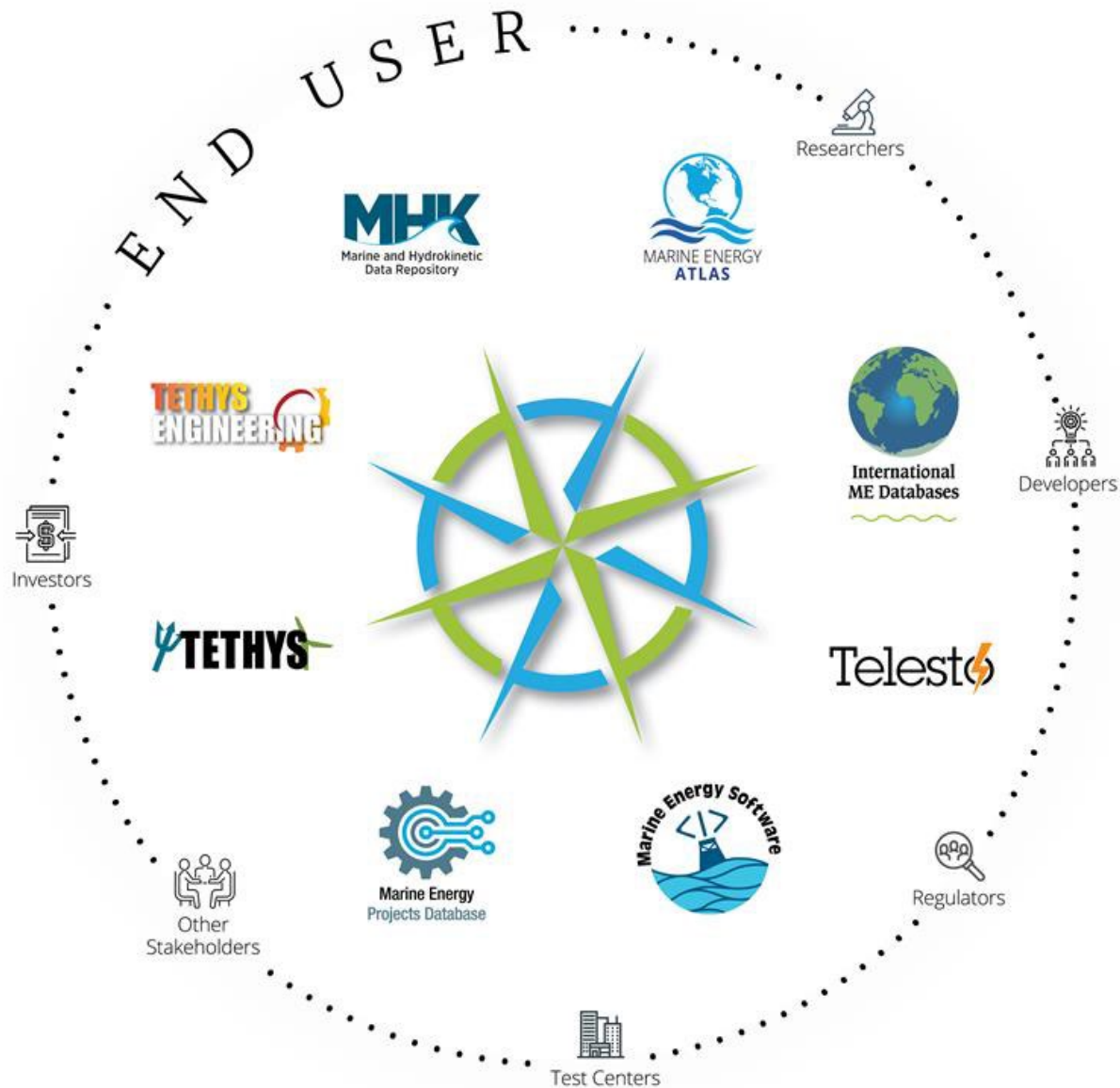


- Developed to provide information for new regulators
- Based on the information in the 2020 State of the Science





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



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

Other Resources and Tools for Environmental Effects of MRE

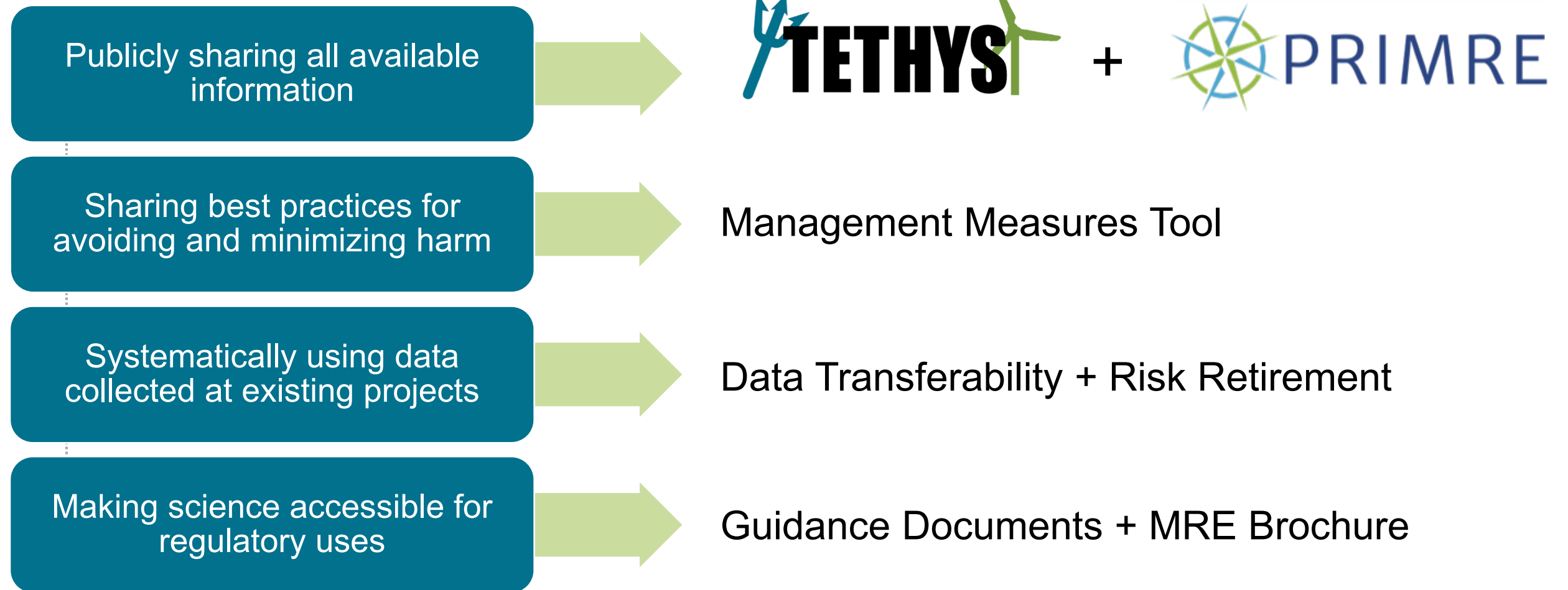
- Offshore Renewables Joint Industry Programme (ORJIP) Ocean Energy
<http://www.orjip.org.uk/oceanenergy/about>
 - Welsh Environmental Information Notes
<https://gov.wales/marine-renewable-energy-environmental-information-notes>
- Deftiq Modules
<https://www.deftiq.com/ore>
- AZTI's Wave Energy Converters Ecological Risk Assessment (WEC ERA) tool and VAPEM – Ecological assessment and marine spatial planning tool
<https://www.azti.es/en/productos/ecological-risk-assessment-of-wave-energy-convertes/>;
<https://www.azti.es/en/proyectos/vapem/>
- Marine Offshore Renewable Energy Lab's MORE-EST Platform
<http://www.moreenergylab.polito.it/more-est-platform/>

Input

Are there other tools you have found helpful?

Moving the MRE industry forward

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



Next Steps

- Post-workshop survey (and review Jamboard) to gather feedback
- Continue to engage with MRE regulatory community
- Sign up for *Tethys* Blast and webinar email list to hear about future efforts!

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



Workshop Feedback



- Any other general comments/questions on the guidance documents or other tools that we shared today?
- How can we best support you with these existing or new tools?



Please fill out our 5-minute survey!

<https://www.surveymonkey.com/r/W7GXPV>



Thank you!

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