



Science to Consenting: Resources for Environmental Effects of Marine Renewable Energy

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Today's Webinar

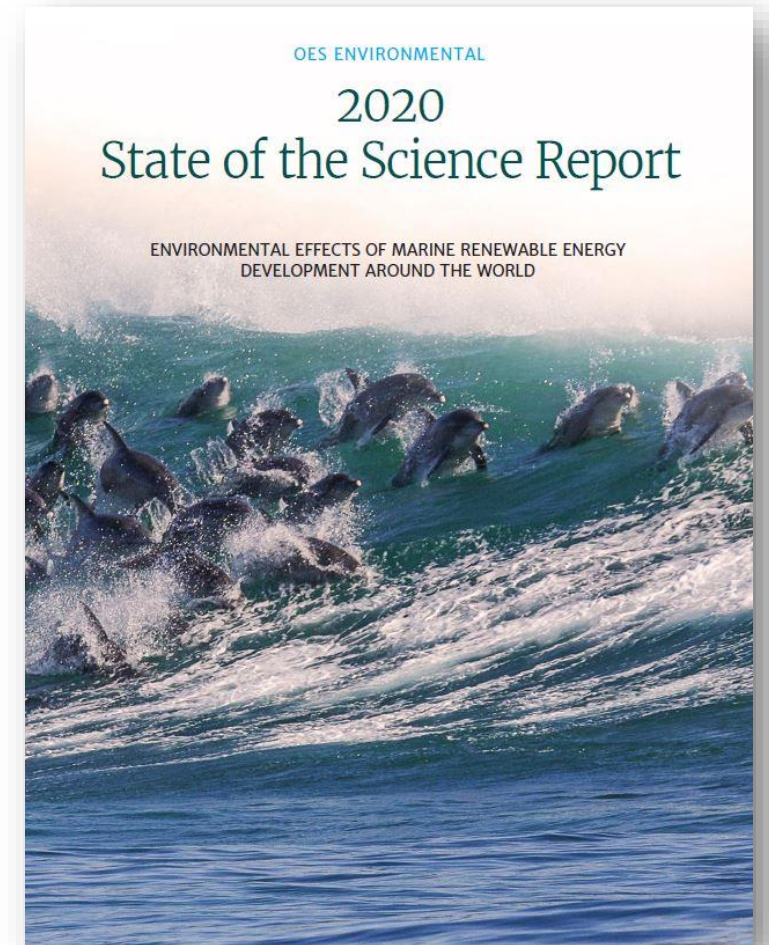
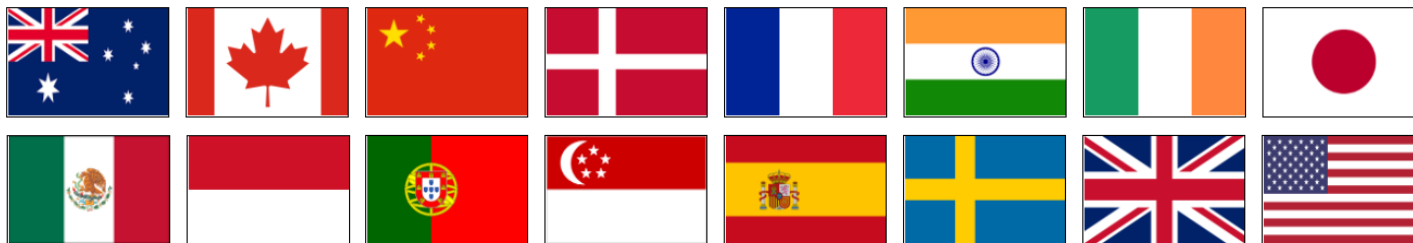
- OES-Environmental overview
- Moving from science to consenting processes
- Risk retirement and data transferability
 - OES-Environmental Guidance Documents
- Adaptive management
- Systems Perspective
- Good practices and lessons learned



OES-Environmental

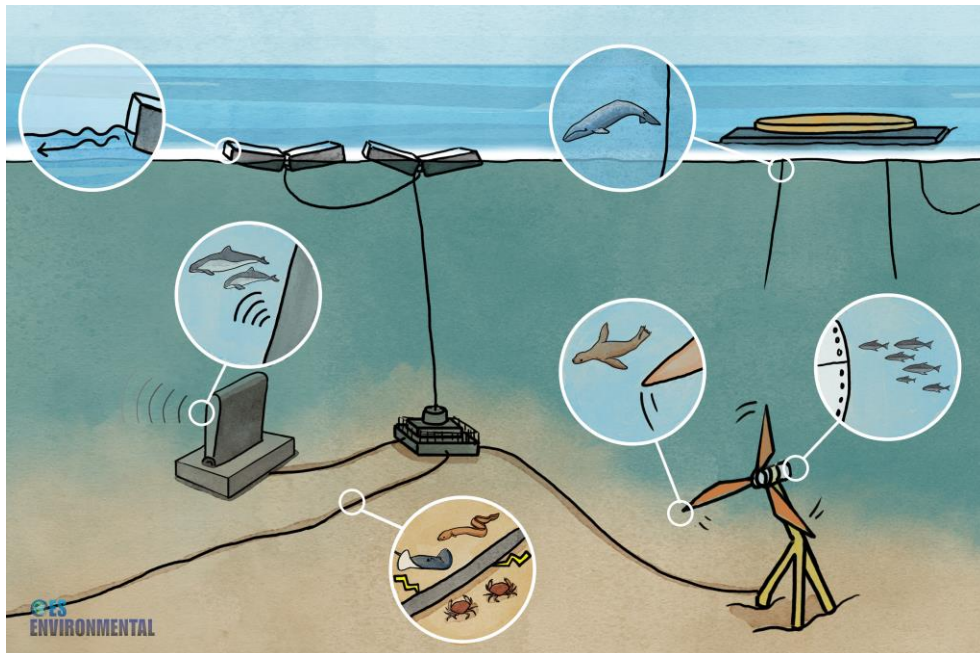


- Established by the IEA-Ocean Energy Systems in 2010
- Examines environmental effects of marine renewable energy (MRE) development to advance the industry in a responsible manner
- Led by the US DOE Water Power Technologies Office and implemented by Pacific Northwest National Laboratory
- 16 member 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



Entanglement



Underwater noise



Changes in oceanographic systems



Electromagnetic fields



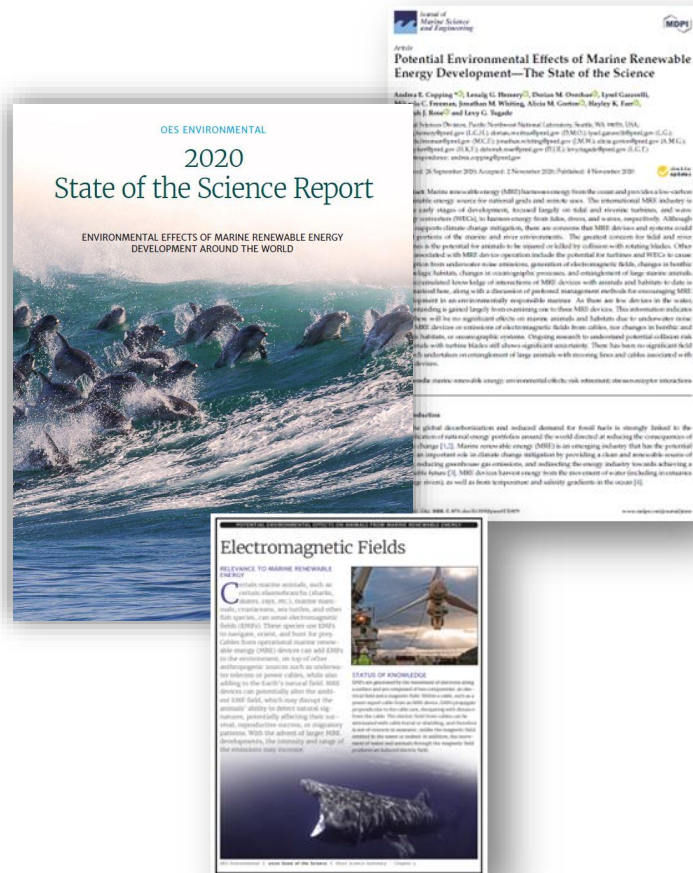
Displacement



Habitat changes

Moving from Science to Consenting Processes

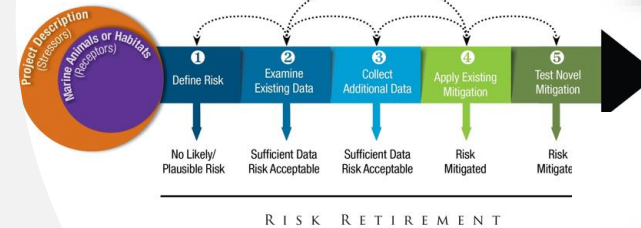
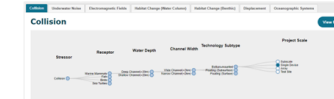
Scientific information



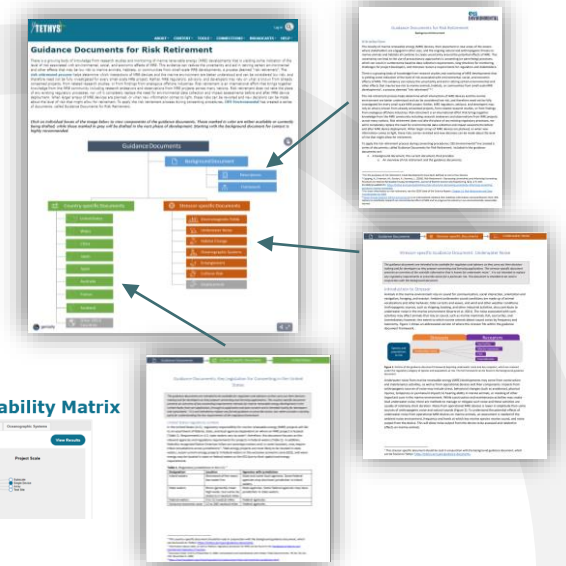
Management Measures Tool

Area	Measure	Priority	Start Date	End Date	Status
Marine Mammals	Marine Mammal Observations	High	2020	2021	Completed
Marine Mammals	Marine Mammal Observations	Medium	2020	2021	In Progress
Marine Mammals	Marine Mammal Observations	Low	2020	2021	Not Started

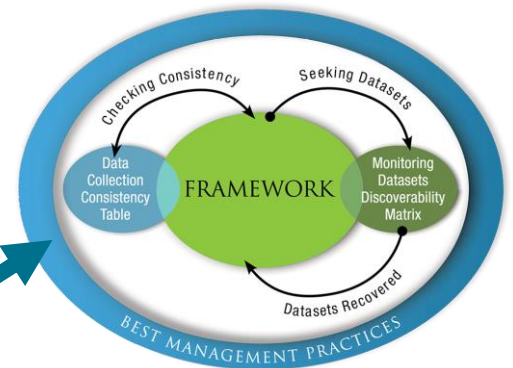
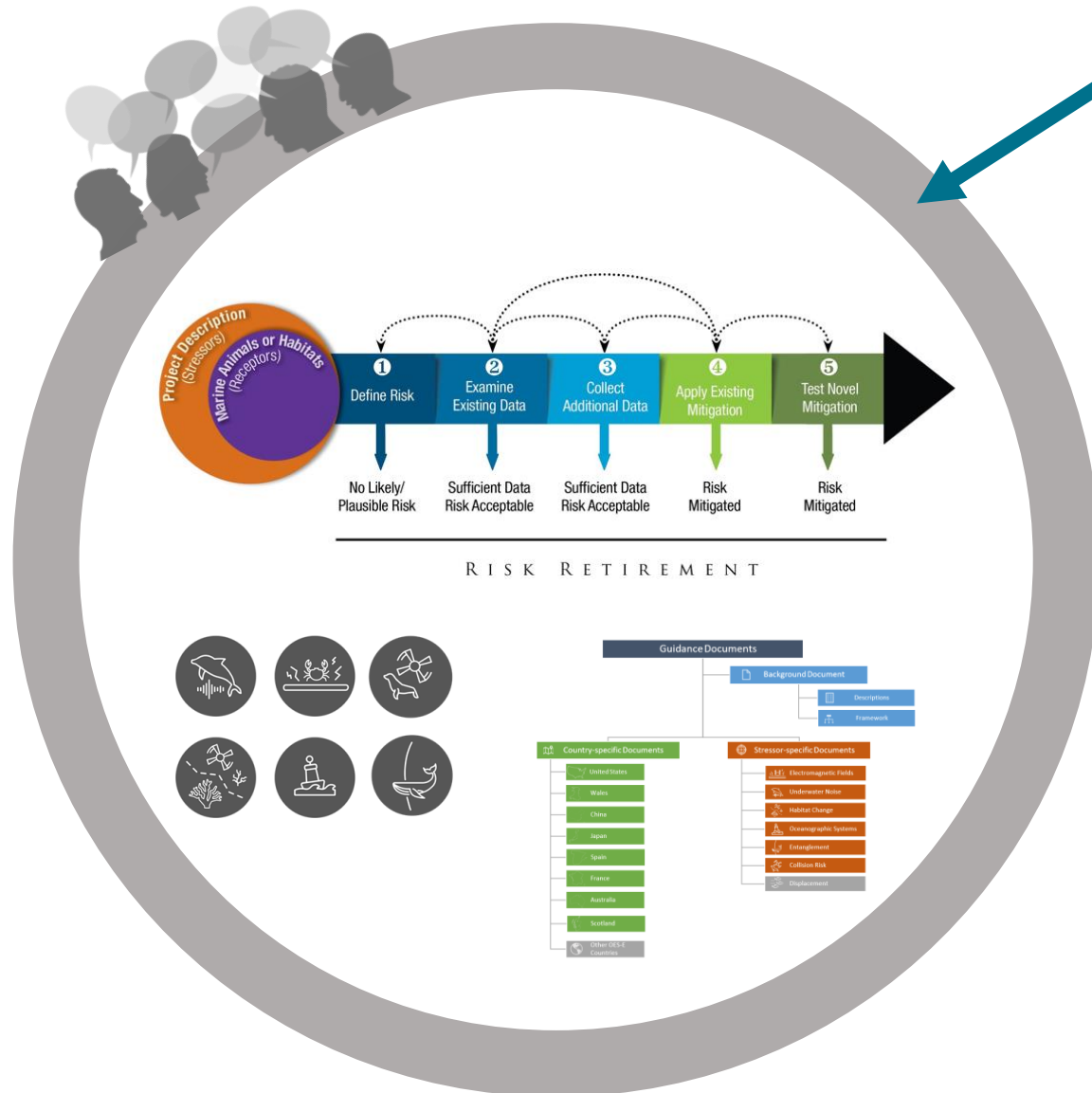
Monitoring Datasets Discoverability Matrix



Useful formats, approaches and tools for application



Risk Retirement



Data consistency and transferability

- 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

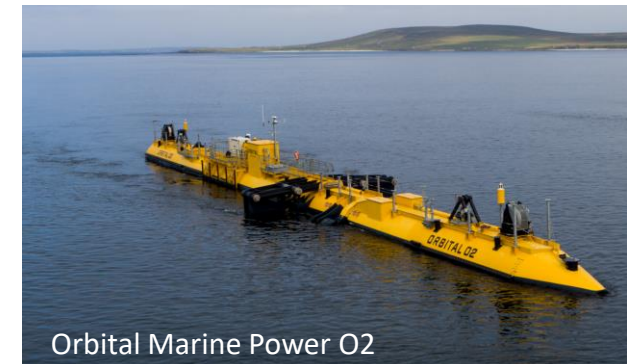
Evidence Base

- Key research papers, monitoring reports, and documents to inform risk retirement
- Focused on small number of MRE devices
- Reviewed and discussed by experts
- Addressed by stressor-receptor interaction:
 1. Electromagnetic fields (EMF) – 16 documents
 2. Underwater noise – 29 documents
 3. Habitat change – 58 documents
 4. Changes in oceanographic systems – 23 documents
 5. *Entanglement* – 11 documents
 6. *Collision Risk* – 66 documents



Data Transferability

- Data/information collected through research studies and monitoring from other projects should inform new projects
 - Site-specific data will be needed for all new projects
- Data from established projects and analogous industries can be applied and may reduce site-specific data collection needs
- These data that might be "transferred" need to be collected consistently for comparison



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:



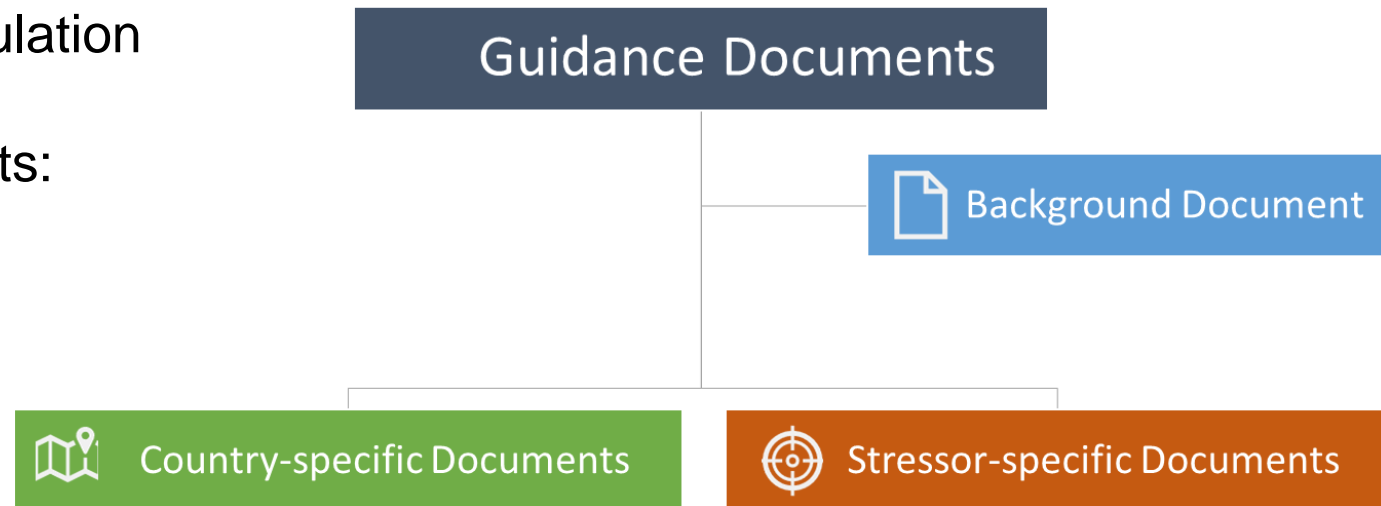
- Data classified by characteristics:



Stressor Receptor Site Conditions Technology Type Project Size

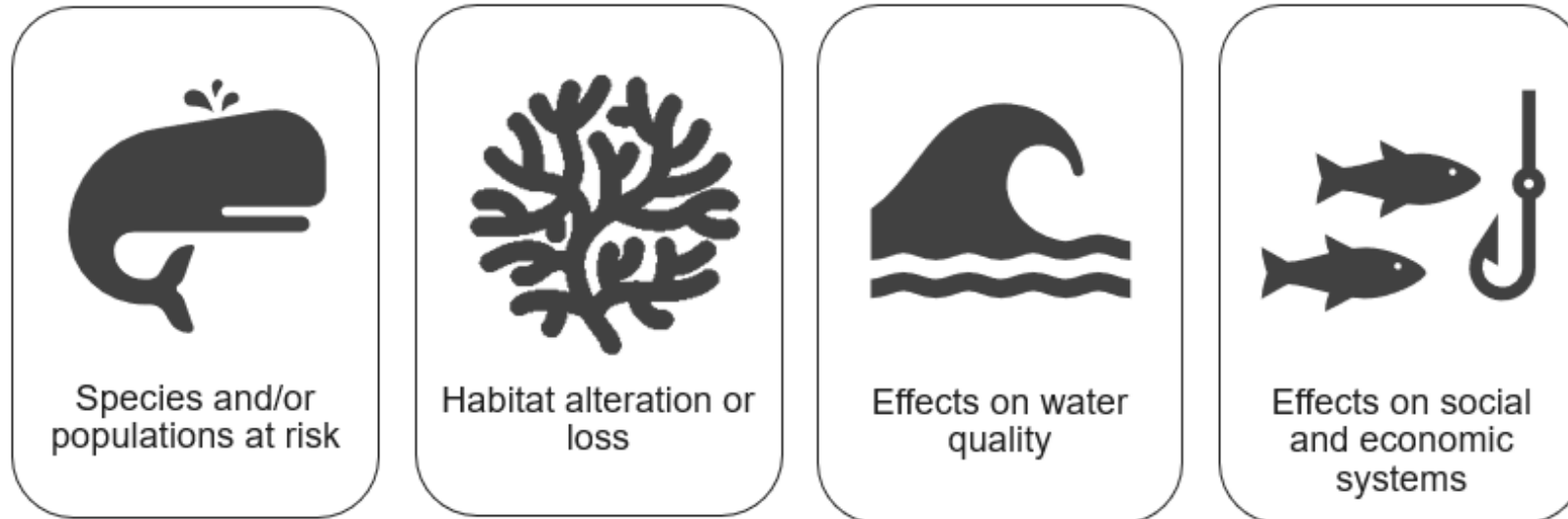
Guidance Documents - Overview

- 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



Background Document – Regulatory Categories

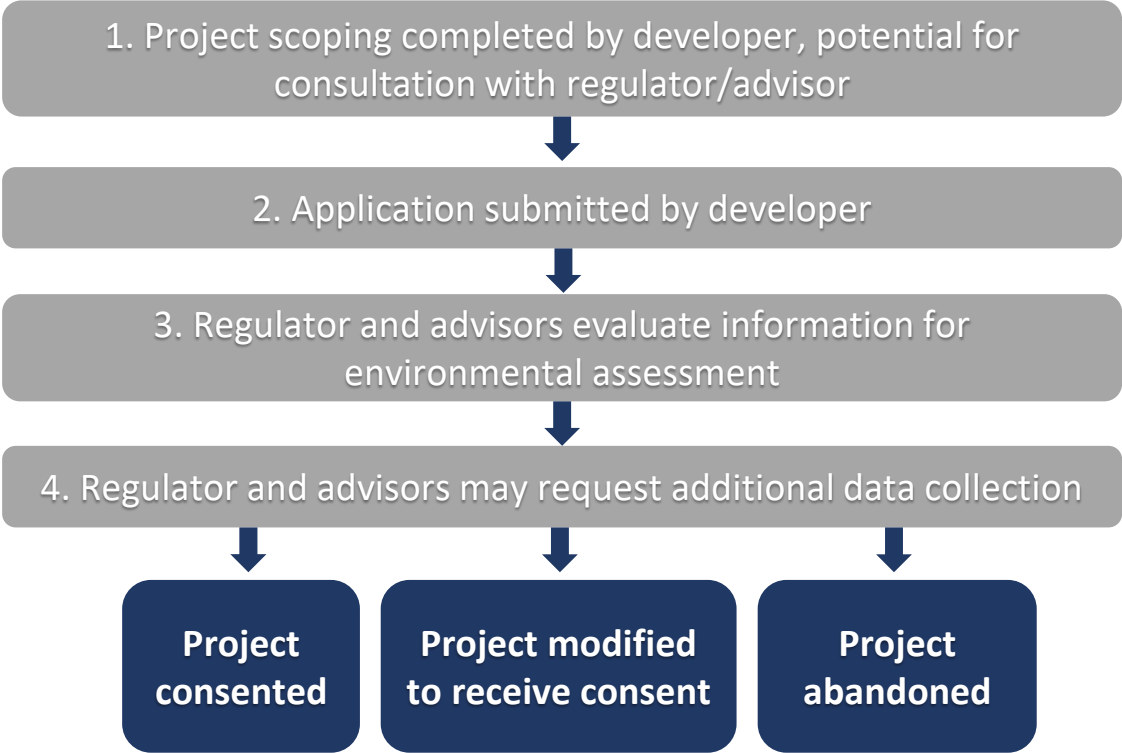
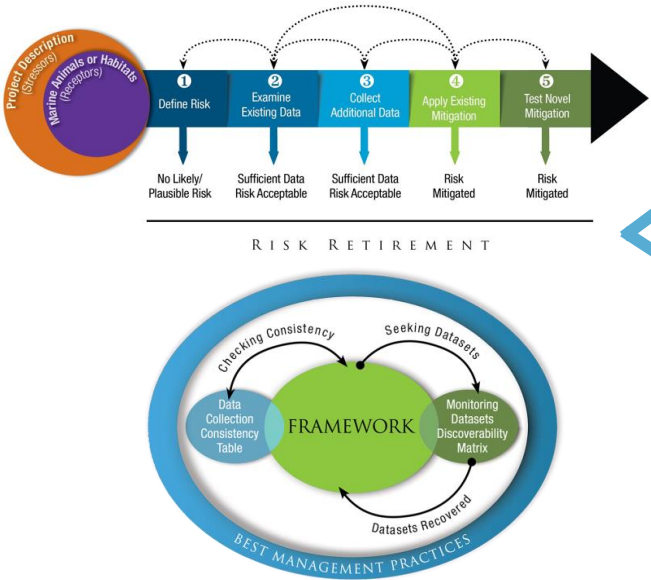
4 categories of regulation that fit most countries:



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

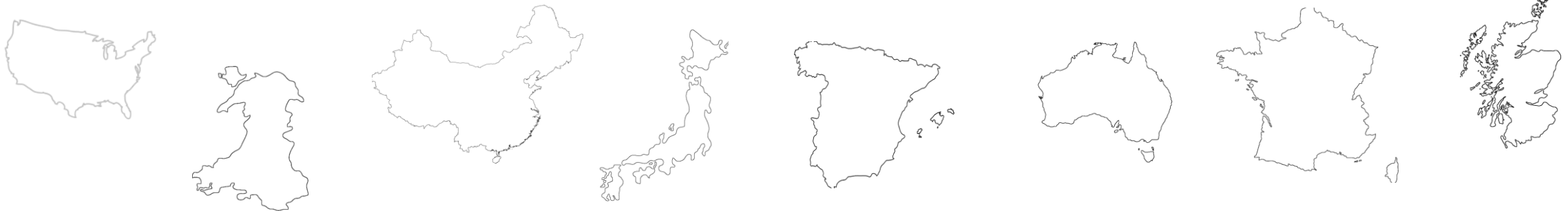
Background Document – Framework

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



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.



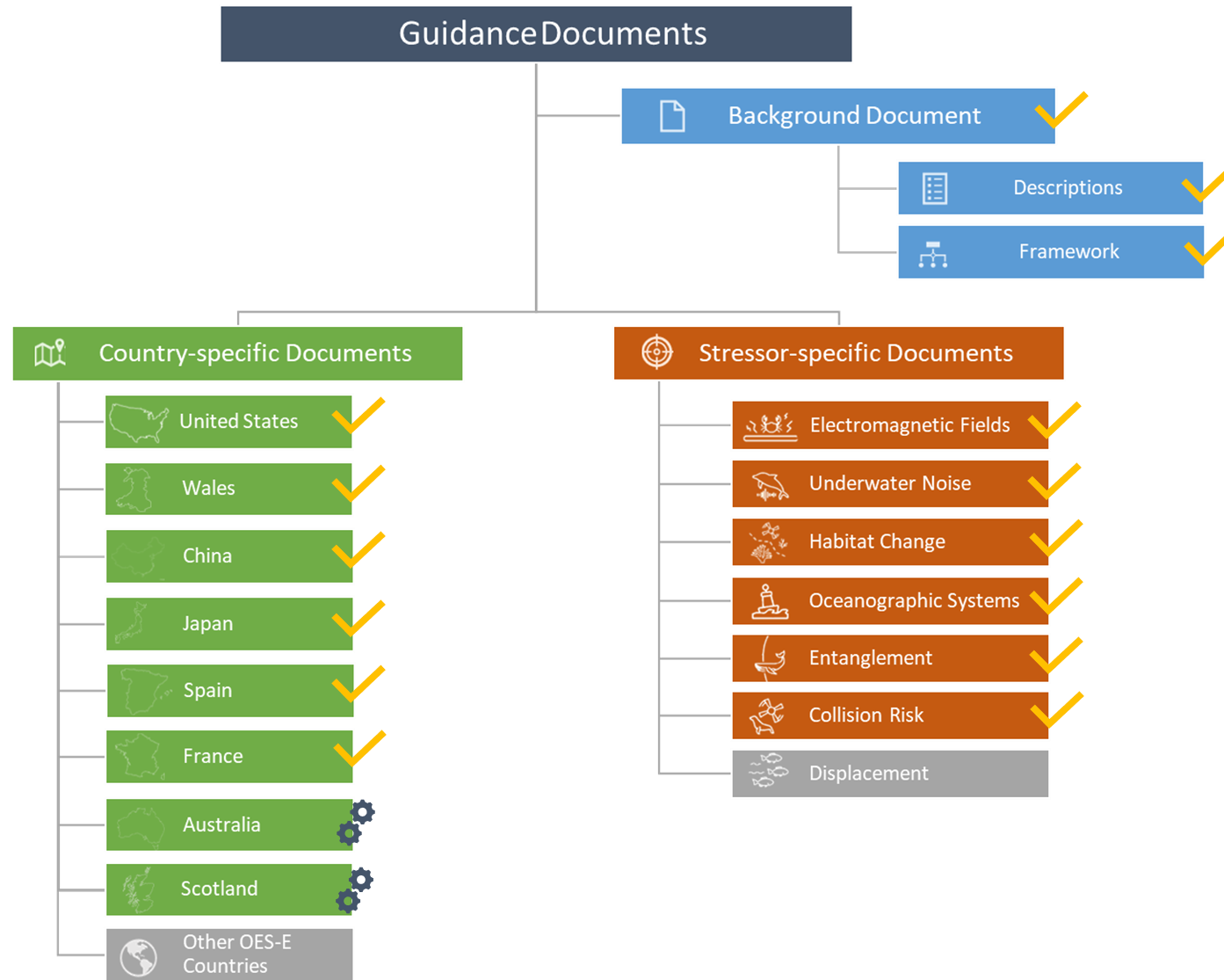
Stressor-Specific Documents

- Bring together current knowledge on stressor-receptor interactions
- Developed for 6 interactions



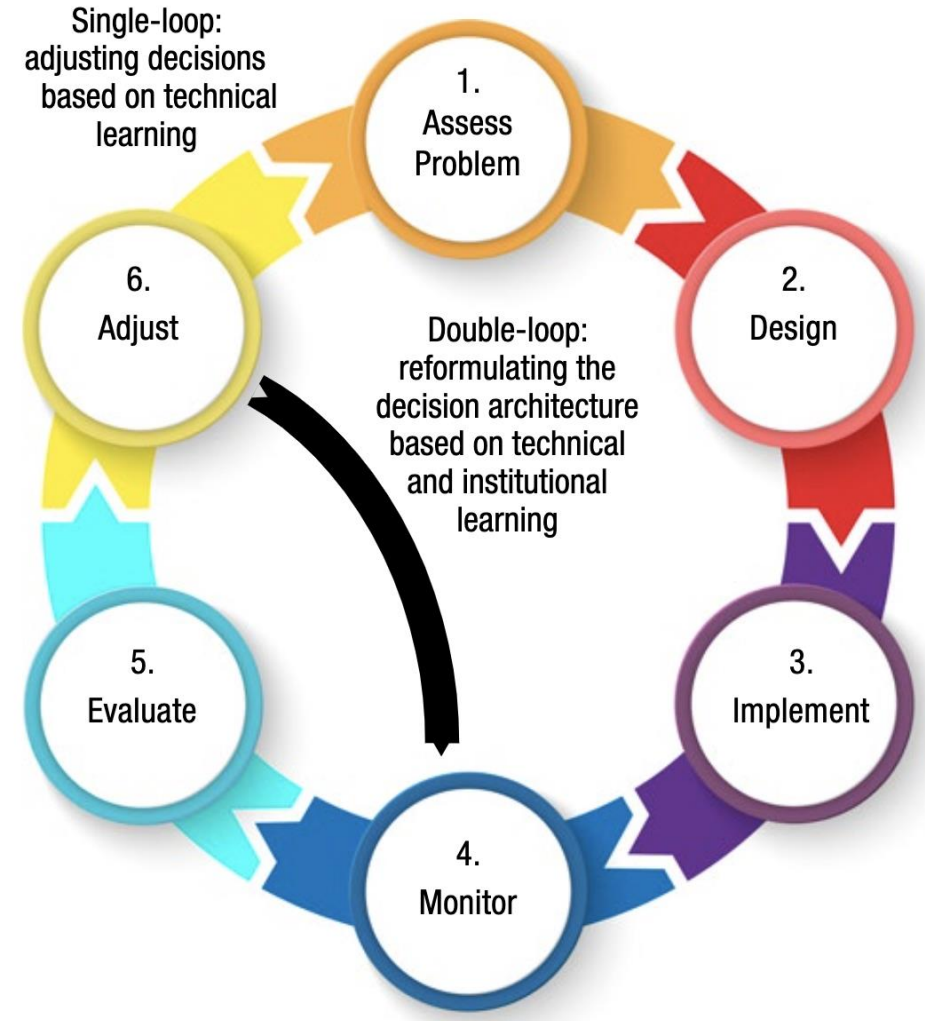
- Includes:
 - Background information on the interactions
 - Links to existing data and information:
 - ✓ State of the Science report, *Tethys* Knowledge Base, evidence bases, matrix
 - Pathway to risk retirement
 - Recommendations

Progress on Guidance Documents to Date



Adaptive Management

- Adaptive management (AM) is “learning by doing”
- Structured, iterative management process to reduce scientific uncertainty and improve management decisions
- Decisions for consenting based on monitoring outcomes, ability to adjust monitoring details
- AM has moved several MRE projects processes forward for single devices and small arrays



(Le Lièvre 2020)

Management Measures Tool

- 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

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

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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: [Apply] [Reset]

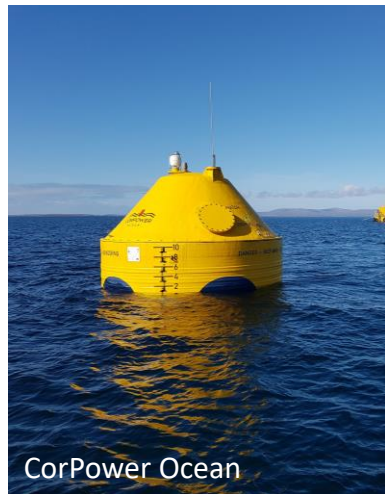
Technology	Project Phase	Stressor	Receptor	Management Measure	Implications of Measure	Advantages	Challenges	Project Documents
Tidal	Operation & Maintenance	Changes in water flow Modifications to prey distribution and abundance (to include for other receptors) resulting in changes to foraging behaviour.	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	

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 written, journal manuscripts coming soon



Examples from Marine Energy Consenting



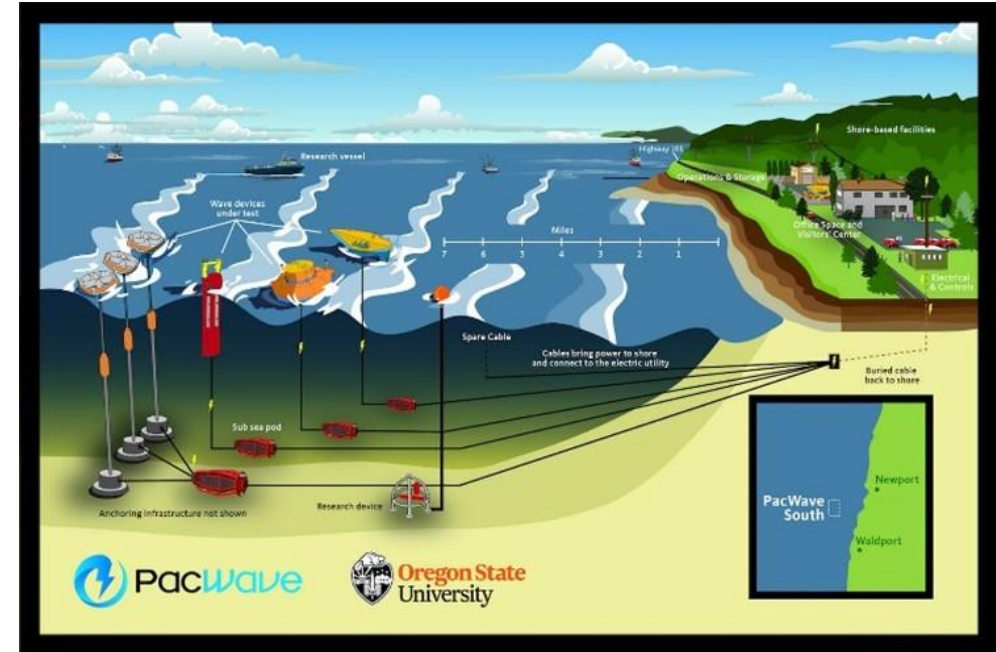
Good Practices and Lessons Learned Stressor-Receptor Interactions

PacWave – Oregon, US (2011 – current)

- United State's first commercial-scale, grid-connected wave energy test center
- 10-year consenting process (2011 – 2021)
 - 2024 expected operational start

Defining environmental concerns

- First discussions focused on devices and systems
 - Difficult to define
 - Uncertainty about future devices to be tested
- Then shifted to specific environmental concerns: stressor-receptor interactions
 - ✓ **Concerns could be addressed more efficiently**
 - ✓ **Discussions able to move forward in the face of uncertainty**



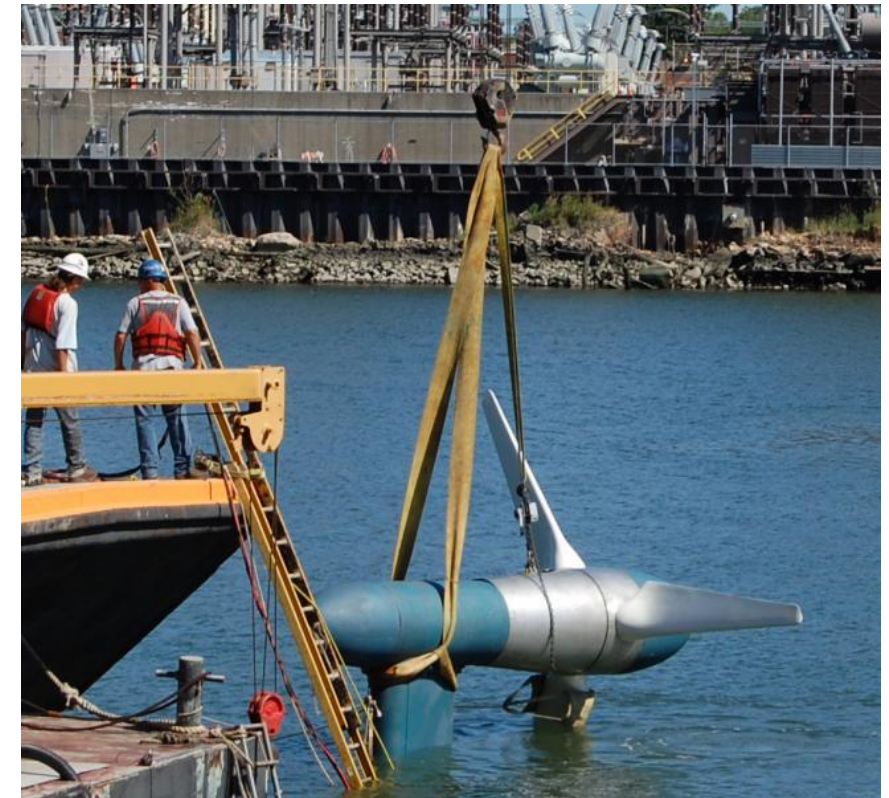
(Freeman et al. 2022)

Good Practices and Lessons Learned Risk Retirement

Verdant Power – Roosevelt Island Tidal Energy project, New York, US (2012)

- TriFrame with three tidal turbines
 - Collision risk with fish
- Studies performed:
 - Fish movement using acoustic telemetry
 - Hydrodynamics and fish response
 - Encounter probability models
- Little evidence of potential harm to fish species
 - ✓ **The risk of collision to fish was retired for this project**

(Verdant Power LLC, 2018)



Good Practices and Lessons Learned Adaptive Management

Ocean Renewable Power Company (ORPC) – Cobscook Bay, Maine (2012-2014)

- AM required for licensing the single tidal turbine TidGen (FERC license)
- AM plan developed with regulatory agencies, stakeholders, and local communities
- Applied a monitoring and science-based decision-making process
 - Sounds levels produced by pile-driving were below the threshold of concern for Atlantic salmon
 - ✓ **Removal of seasonal restrictions on pile-driving** (ORPC 2013)
 - Minimal changes observed in marine mammals' presence and behavior during pile-driving
 - ✓ **Transitioned from dedicated to incidental observations** (ORPC 2014)



Good Practices and Lessons Learned

Data Transferability

Sustainable Marine Energy (SME) Plat-O #1 – UK (2016)

- Deployed tidal device in Yarmouth, England
 - Acoustic monitoring to assess effects of anchor installation on marine mammals and basking sharks
- Data collected from Yarmouth informed deployment at EMEC's Fall of Warness test site in Orkney, Scotland
 - Informed development of environmental management plan for EMEC
- ✓ **Alleviated the need for marine mammal observers or acoustic monitoring during system installation at EMEC**
(Marine Scotland 2015)
- ✓ **Decreased need for offshore personnel on site, reduced costs, and streamlined operational planning**



Good Practices and Lessons Learned Scaling to Arrays

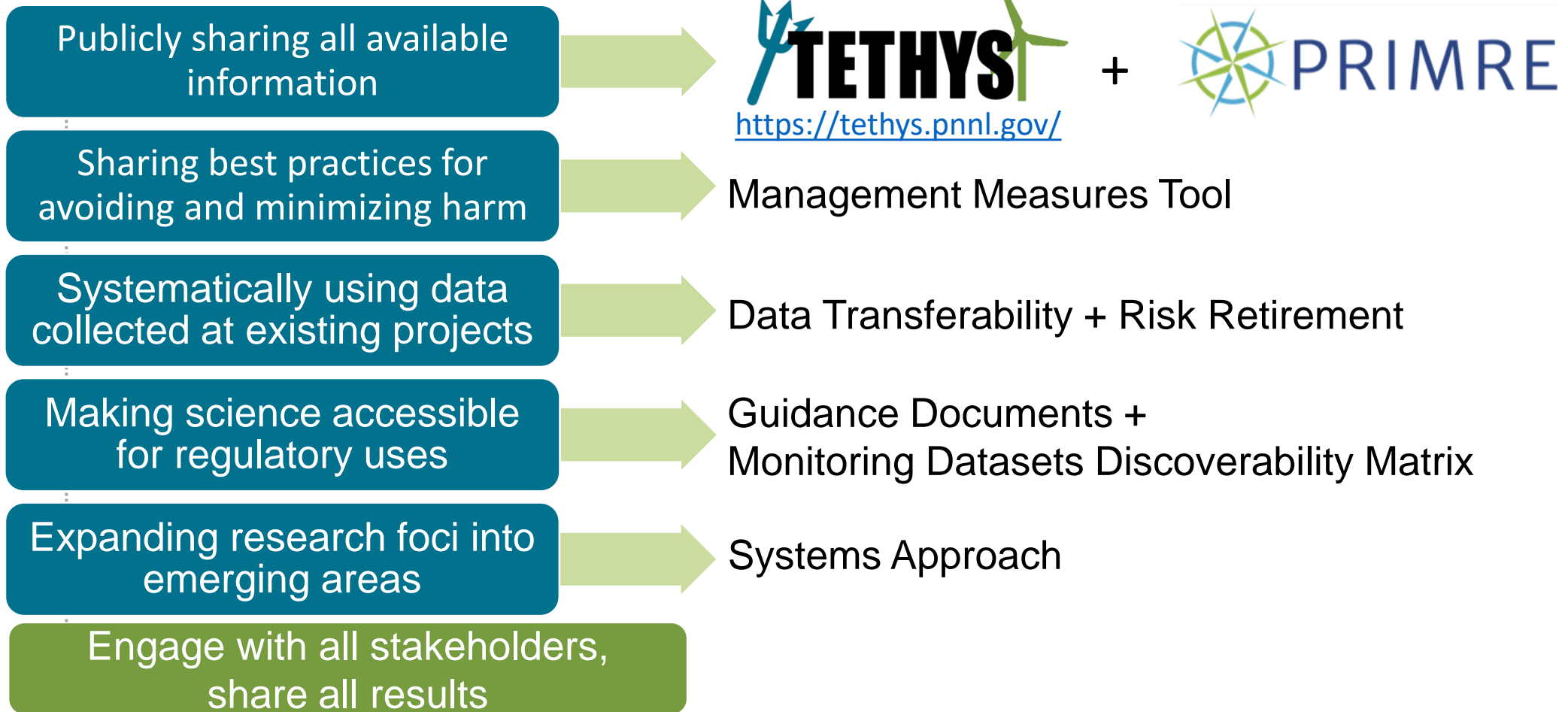
MeyGen – Pentland Firth, Scotland (2010 – present)

- Largest commercial tidal development
 - Consented up to 86 MW generating capacity
 - Lease allows for capacity up to 398 MW
 - Phased approach to scaling up:
 - Phase 1 – 6 MW installed to date
 - Next steps:
 - Phase 2 – 28 MW; targeting turbines operating by 2027
 - Phase 3 – 52 MW
 - Phase 4 – 312 MW
 - Comprehensive monitoring of deployed turbines before move to Phase 2
 - Research on marine animal behavior/interaction around tidal turbine
 - No collision or other detectable impacts from presence of turbines, data suggest avoiding operational turbine
(Onoufriou et al. 2021)
- ✓ **Demonstrating survey-deploy-monitor approach and helping progress MeyGen**



Moving the MRE Industry Forward

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



The Work of Many:



PNNL Team

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Thank you!

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