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

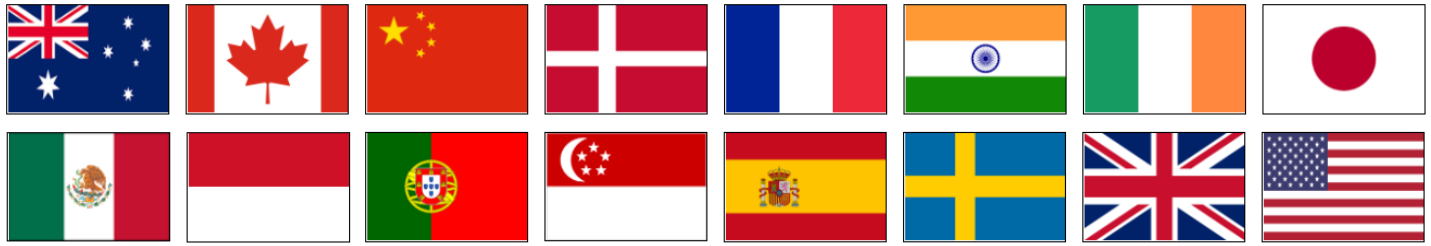
OES ENVIRONMENTAL

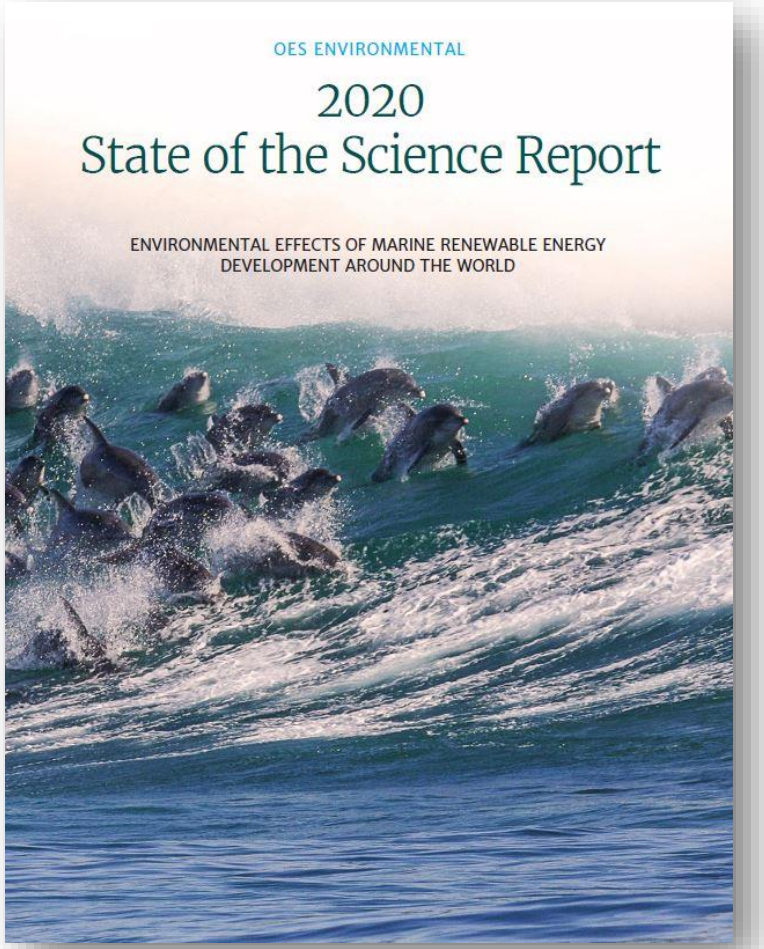
Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

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

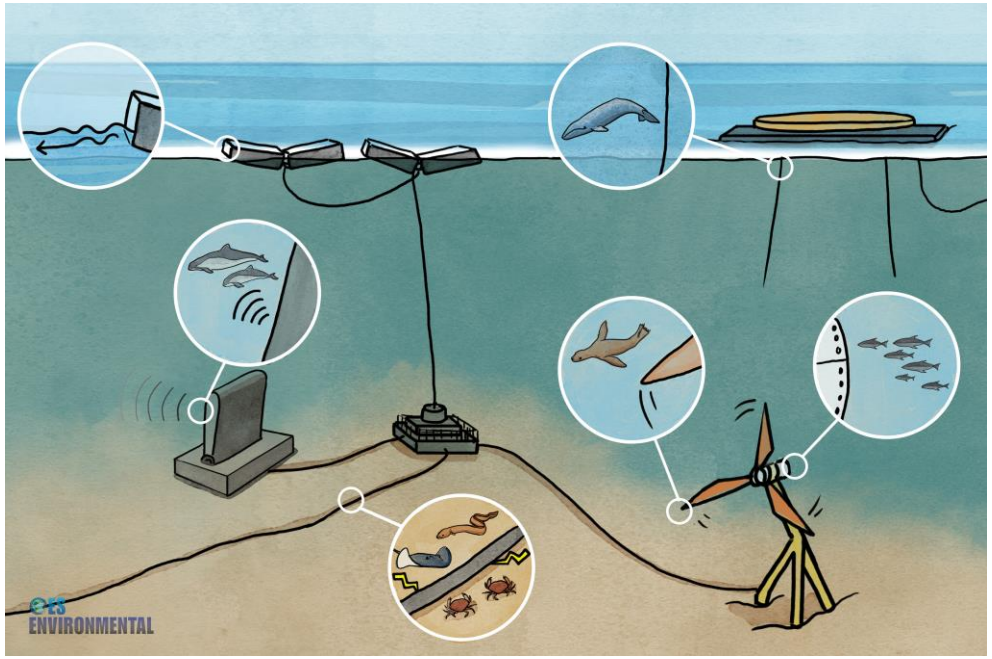




https://tethys.pnnl.gov/about-oes-environmental

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:

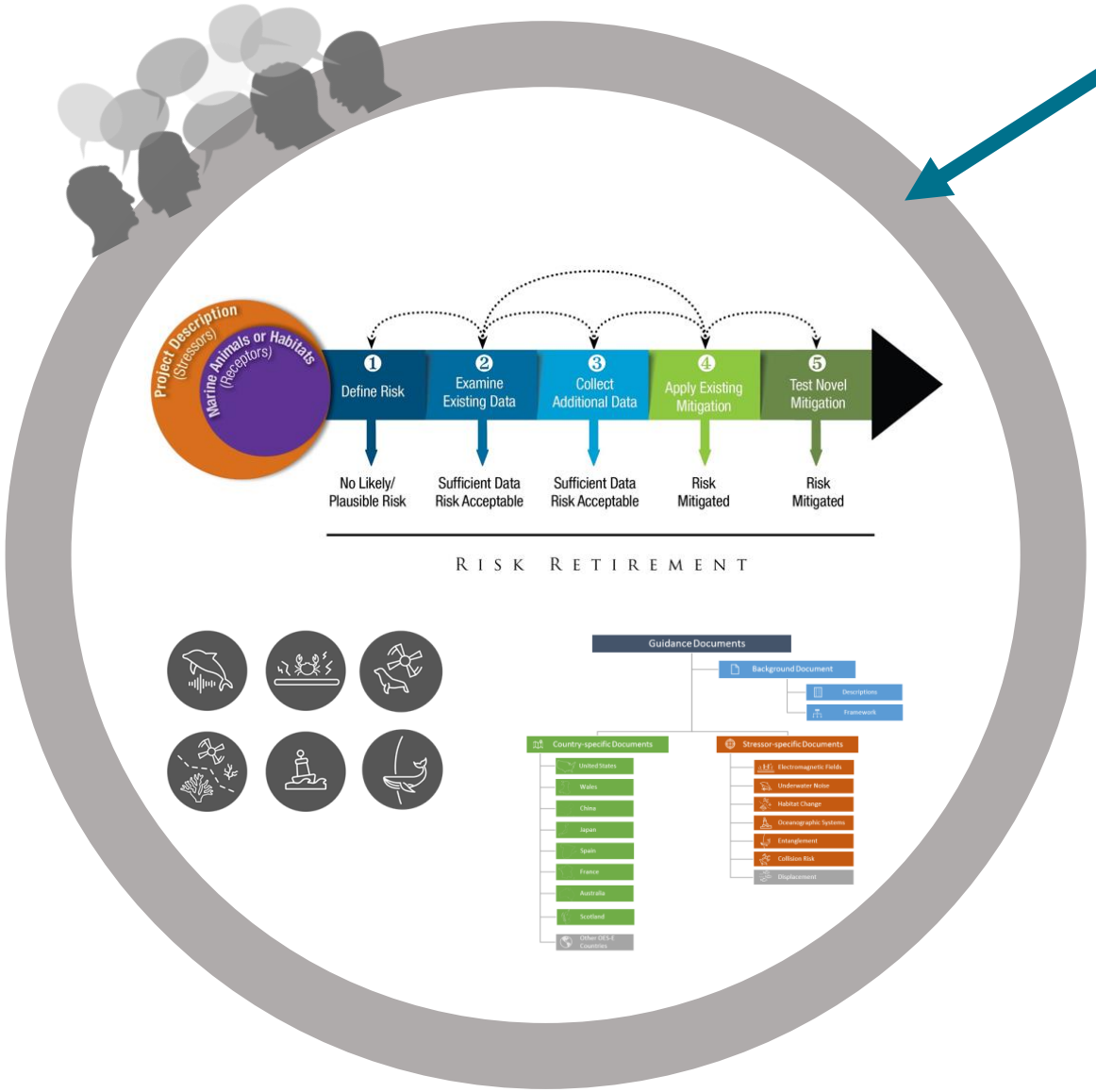
- Collision risk
- Entanglement
- Underwater noise
- Changes in oceanographic systems
- Electromagnetic fields
- Habitat changes
- Displacement

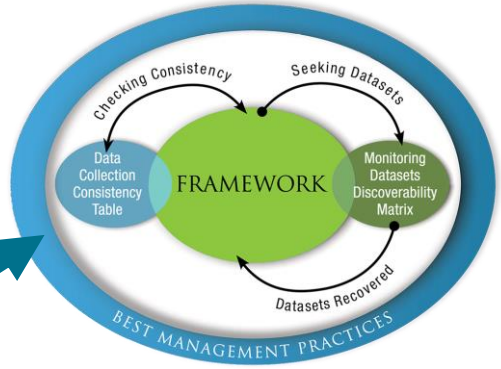
Moving from Science to Consenting Processes

Scientific information

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

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

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*

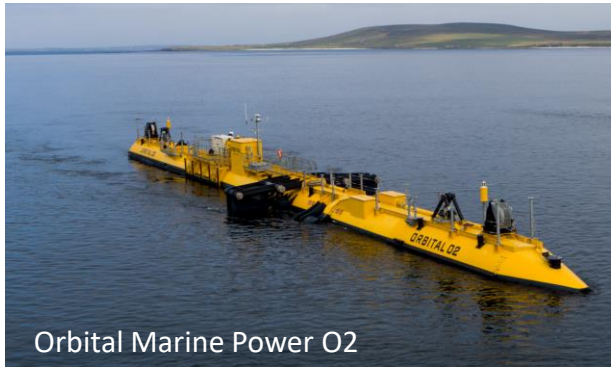
https://tethys.pnnl.gov/risk-retirement-evidence-bases

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


Wedge Global W1


OceanBased Perpetual Energy



Orbital Marine Power O2

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

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:

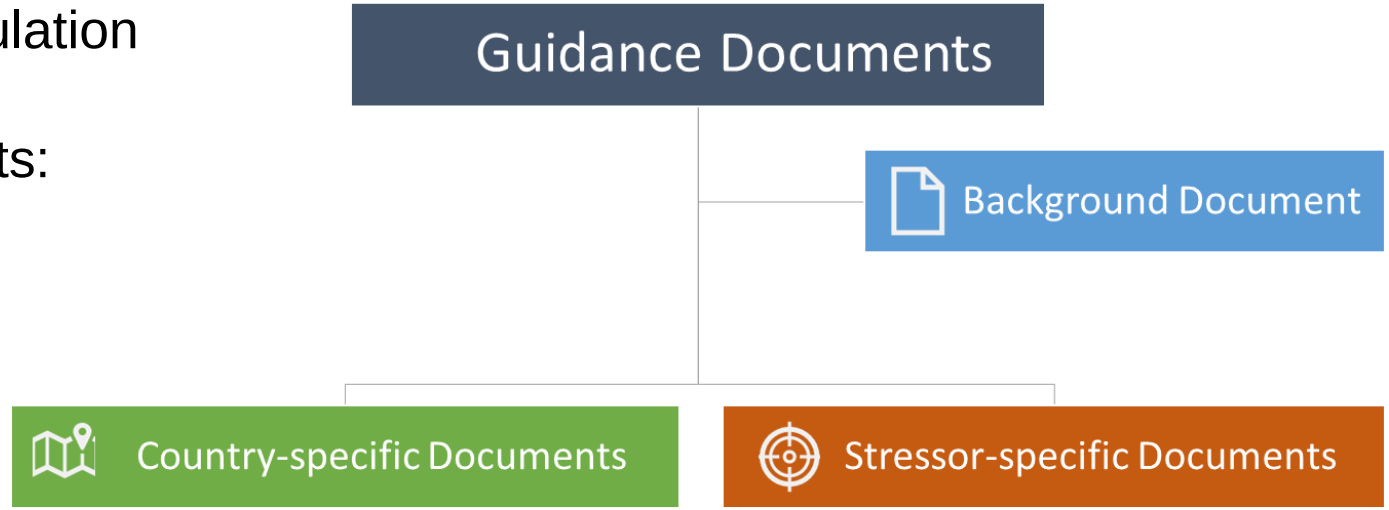
- Data classified by characteristics:

https://tethys.pnnl.gov/monitoring-datasets-discoverability-matrix

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



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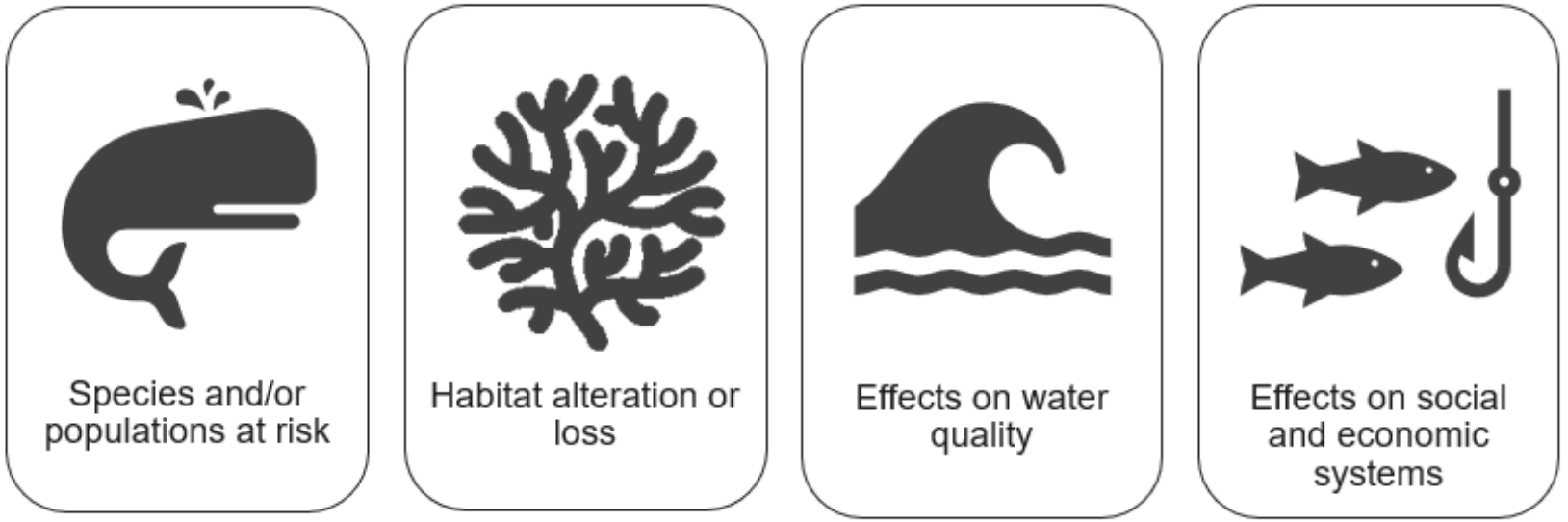
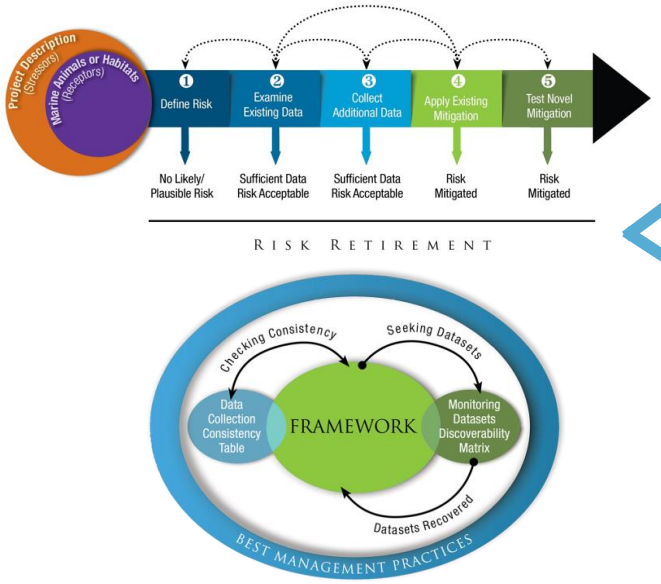
Background Document – Regulatory Categories

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

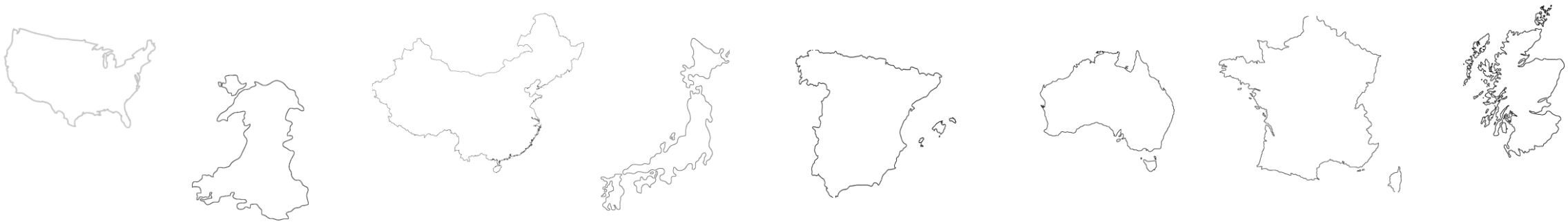
1. Project scoping completed by developer, potential for consultation with regulator/advisor
2. Application submitted by developer
3. Regulator and advisors evaluate information for environmental assessment
4. Regulator and advisors may request additional data collection

Project consented | **Project modified to receive consent** | **Project abandoned**

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.



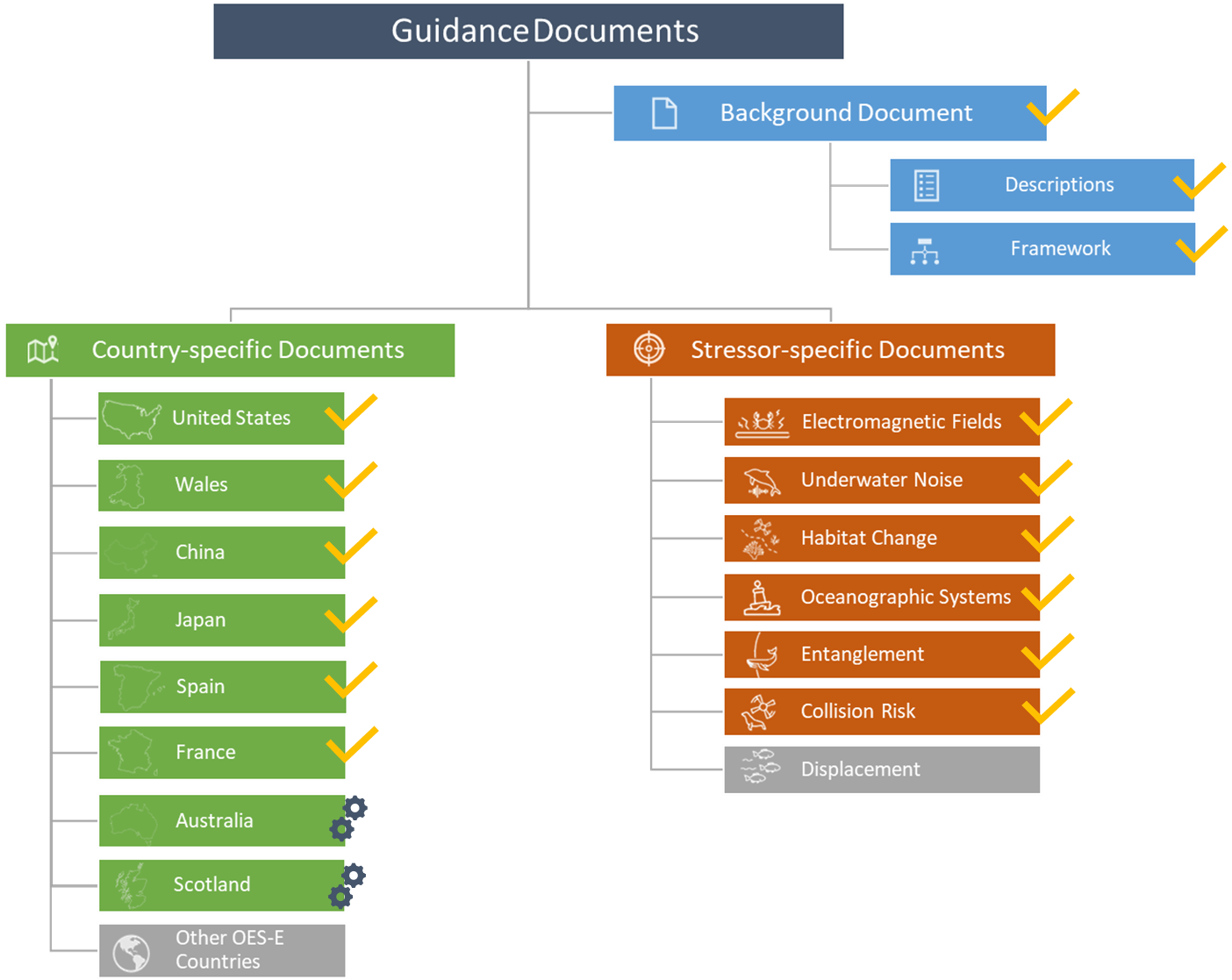
https://tethys.pnnl.gov/guidance-documents-country-specific-documents

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



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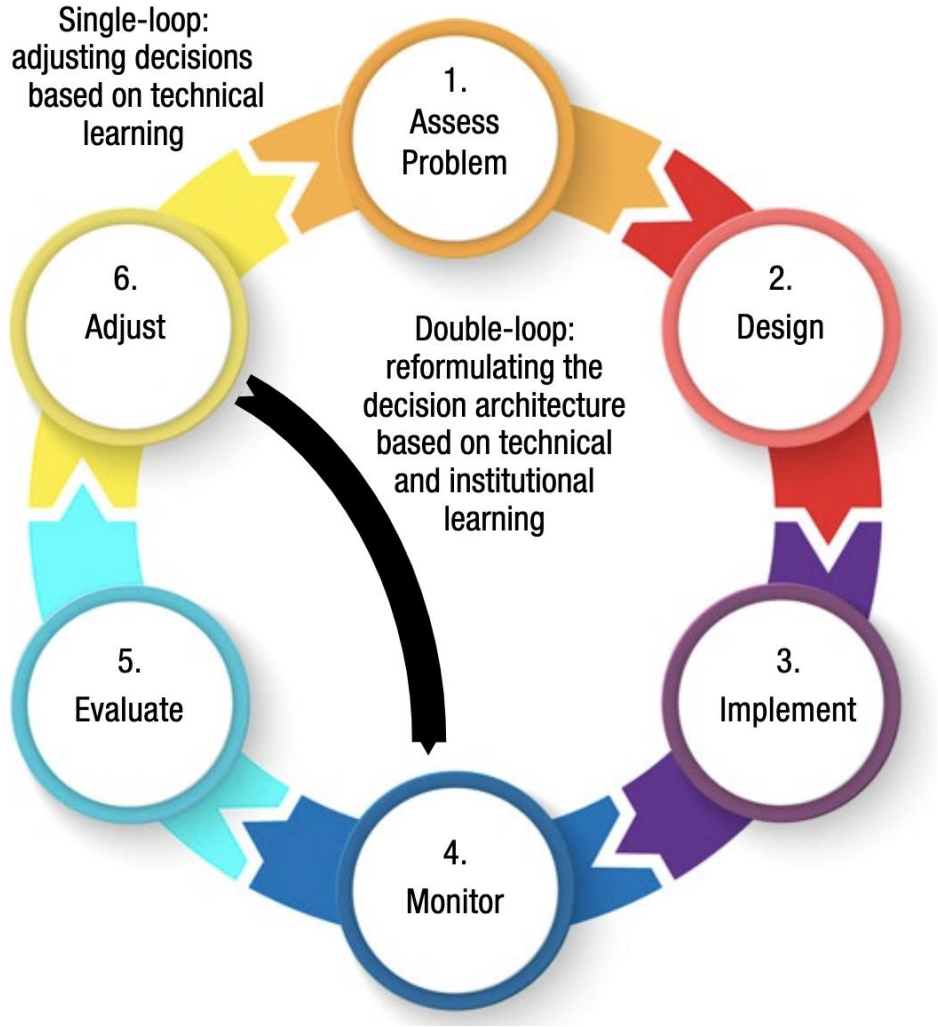
Adaptive Management

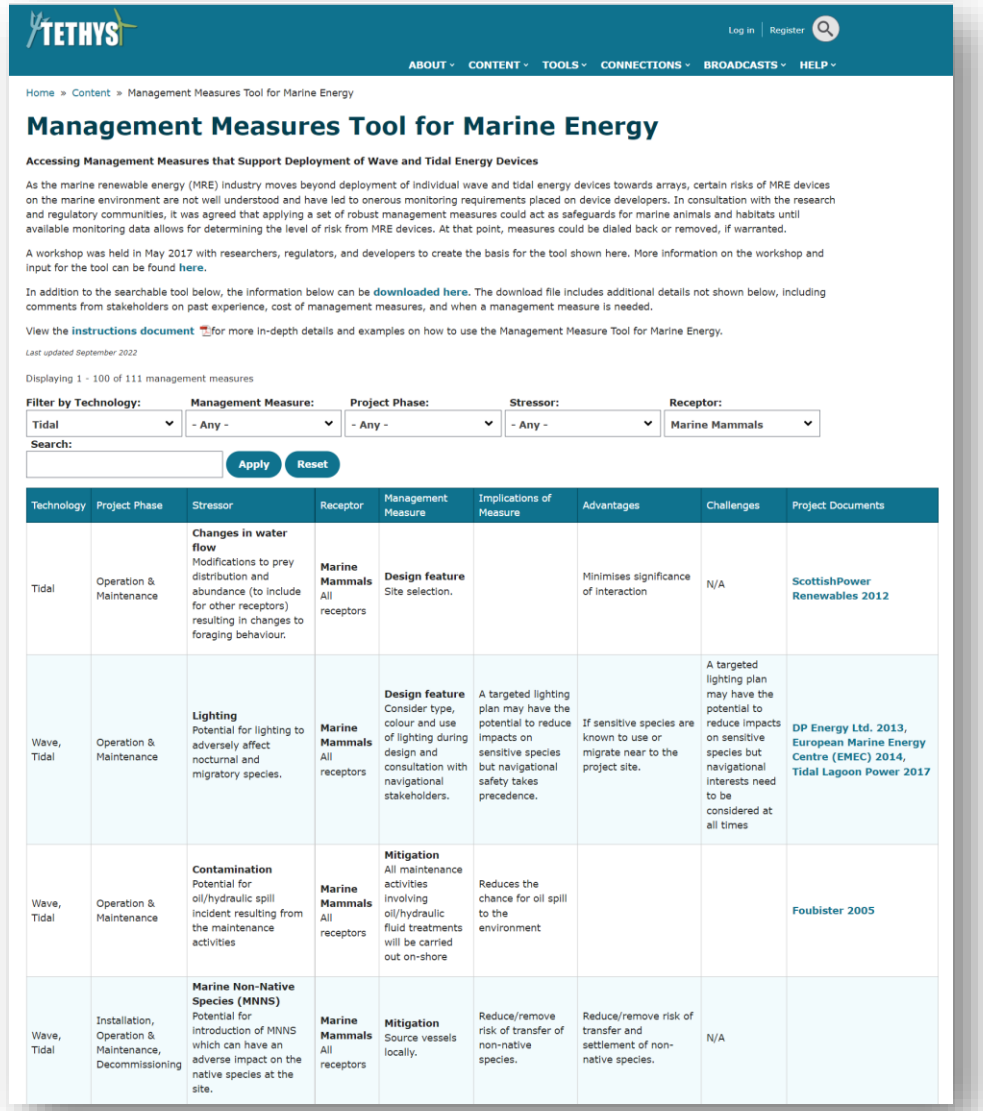
- Adaptive management (AM) is “learning by doing”
- Structured, iterative management process to reduce scientific uncertainty and improve management decisions
- Decisions for consenting based on monitoring outcomes, ability to adjust monitoring details
- AM has moved several MRE projects processes forward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



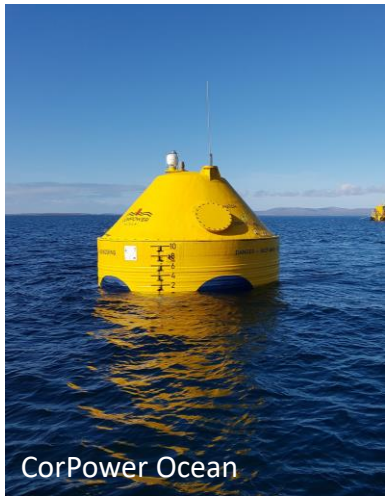
https://tethys.pnnl.gov/management-measures

Moving Towards a Systems Perspective

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

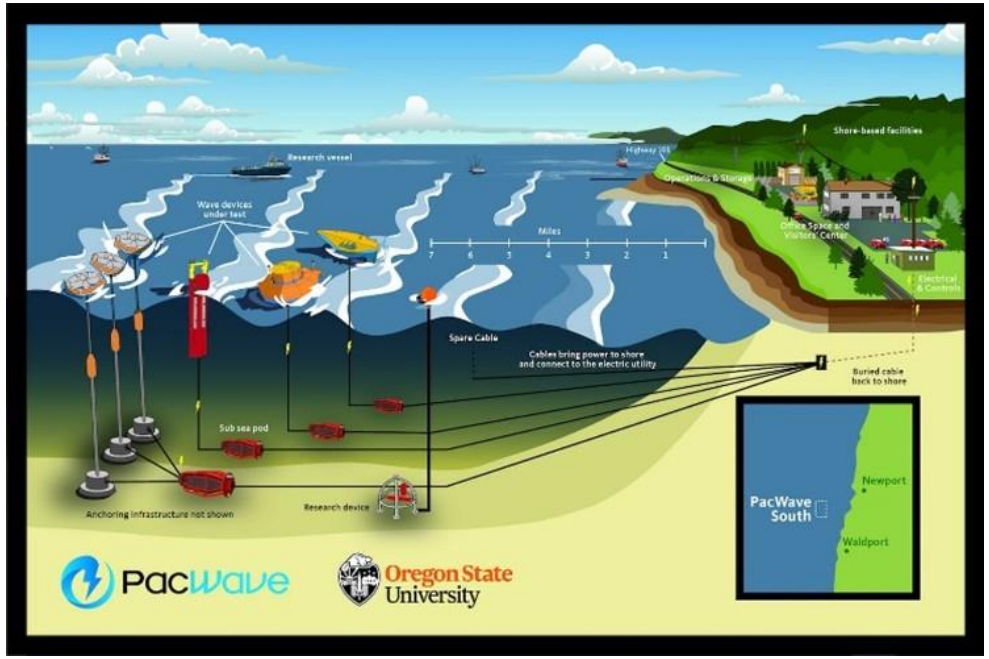
- Scaling environmental effects of MRE from single devices to large arrays
- Cumulative effects of MRE with other anthropogenic stressors
- Ecosystem effects of MRE, including ecosystem services

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

<u>Defining environmental concerns</u>

- 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

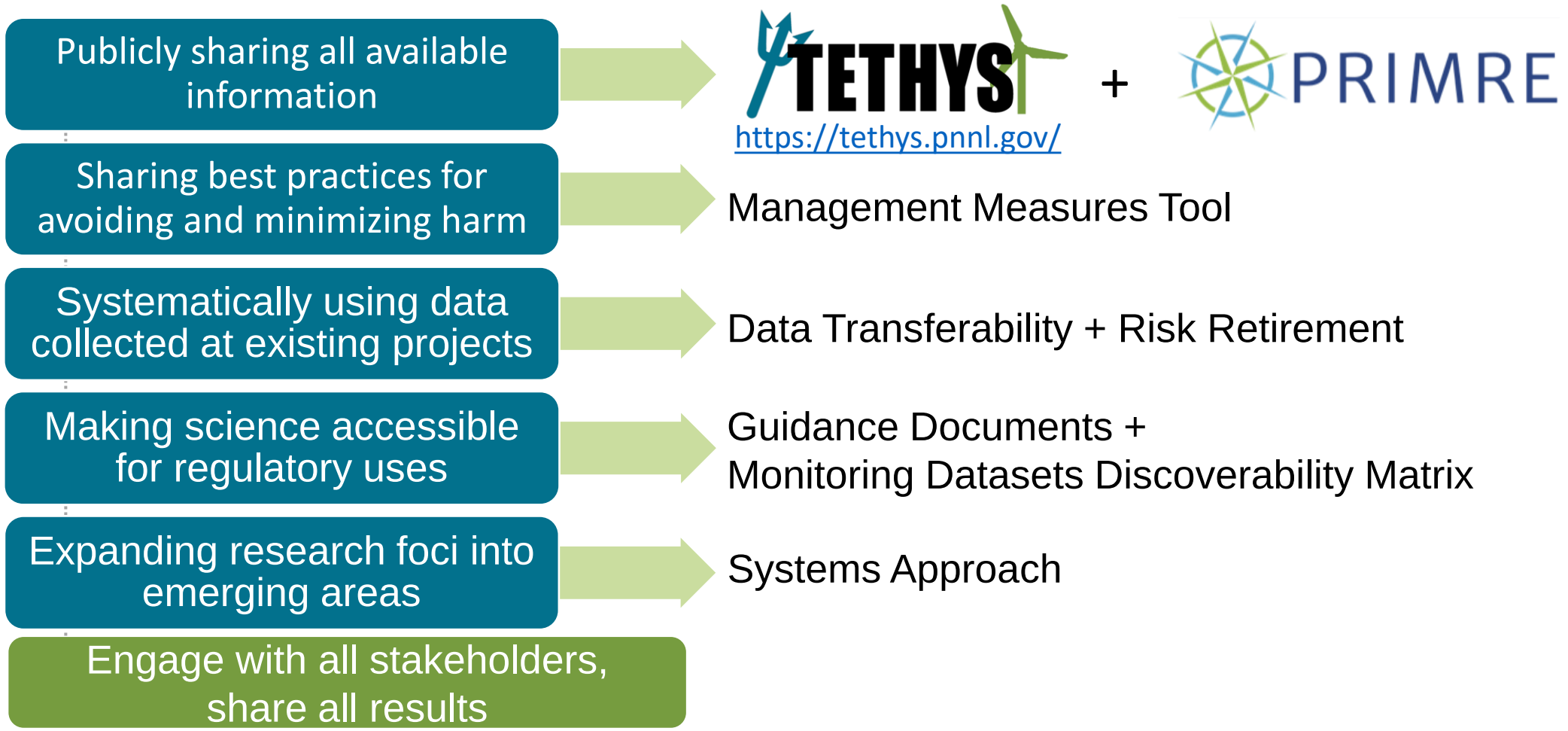
- Comprehensive monitoring of deployed turbines before move to Phase 2
  - Research on marine animal behavior/interaction around tidal turbine
  - No collision or other detectable impacts from presence of turbines, data suggest avoiding operational turbine

(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:

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Thank you!

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