Marine Energy Environmental Toolkit for Permitting and Licensing

Final Technical Report

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Acronyms and Abbreviations

ADA	Americans with Disabilities Act
API	application programming interface
BIA	Bureau of Indian Affairs
BOEM	Bureau of Ocean Energy Management
BP	budget period
DOE	U.S. Department of Energy
ECCA	Environmental Compliance Cost Assessment
EMF	electromagnetic field
FERC	Federal Energy Regulatory Commission
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
ORPC	Ocean Renewable Power Company
PNNL	Pacific Northwest National Laboratory
PRIMRE	Portal Repository for Information on Marine Renewable Energy
Q3	third quarter
RAPID	Regulatory and Permitting Information Desktop
RITE	Roosevelt Island Tidal Energy
SME	subject matter expert
Toolkit	Marine Energy Environmental Toolkit for Permitting and Licensing
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
WEC	wave energy converter
WPTO	Water Power Technologies Office

Executive Summary

The permitting and licensing process for marine energy in the U.S. could take up to 7 years for even small demonstrations or pilot studies despite existing resources like Tethys, MarineCadstre, and the FERC E-Library. The goal of the Marine Energy Environmental Toolkit Project was to increase regulators, developers, and marine energy innovators' understanding of potential environmental effects of marine energy conversion devices deployments and provide information to make efficient and effective determinations during permitting and licensing; develop a one-stop shop for existing environmental, spatial, regulatory, and scientific data that allows users to access disparate sources of data through a series of tags and spatial queries. The Toolkit (marineenergy.app) builds upon prior U.S. Department of Energy (DOE) Water Power Technologies Office (WPTO) investments by pulling from WPTO-funded and outside resources to facilitate the permitting and licensing process, inform technology developers of required permits, and disseminate the latest knowledge of the environmental effects of these devices to regulators, developers, and marine energy innovators and stakeholders.

Project Goals and Objectives

The goal of this project was to increase regulators, developers, and marine energy innovators' understanding of marine energy projects, devices, and their potential environmental impacts while reducing permitting time and costs of marine energy projects. The primary objectives are as follows:

1. Distill scientific knowledge into an **assessment framework** (a framework for regulatory agencies that helps users identify the known knowns—issues studied to date, known unknowns—issues that need to be studied, and unknown unknowns—issues that are unknown) and status reports—reports of best practices and state of knowledge across a combination of receptors, stressors, and technologies that reveal the most current understanding of risk and methods for environmental studies (collision, fish and fisheries, marine habitat, electromagnetic fields [EMFs], etc.), mitigation, and monitoring.

2. Develop an easily accessible online Marine Energy Environmental Toolkit for Permitting and Licensing ("**Toolkit**") that integrates relevant regulatory, scientific, and spatial marine energy data that, for a site of interest, can be run through the assessment framework to assist regulators in determining the studies and the monitoring and adaptive management plans needed for a specific site, resulting in reduced permitting times and costs.

3. **Conduct in-person meetings and webinars** with relevant regulators from federal and state agencies to share and gather input on the Toolkit and to share experts' understanding of potential impacts and the state of known/unknown science for marine energy projects. This review of the Toolkit with regulators will ensure that the Toolkit provides the necessary scientific information in a usable format to decrease the time and resources required to complete marine energy permitting documents and environmental assessments. Agencies of interest include:

    a. National Marine Fisheries Service (NMFS),

b. Federal Energy Regulatory Commission (FERC),

c. U.S. Army Corps of Engineers (USACE),

d. Bureau of Ocean Energy Management (BOEM),

e. U.S. Fish and Wildlife Service (USFWS),

f. Bureau of Indian Affairs (BIA),

g. U.S. Coast Guard (USCG]), and

h. State agencies including agencies in Alaska, California, Florida, Oregon, Massachusetts, and Washington, DC with the following focus:

   i. fisheries agency,

   ii. 401 agency , and

   iii. cultural resources agency.

4. **Pilot test** the Toolkit and develop lessons learned through a specific project permitting process or processes.

Project Activities

The project team engaged stakeholders (state and federal regulators, technology and project developers, and subject matter experts [SMEs]) at critical times throughout the project to gather feedback and input on the development of the Toolkit, synthesis of relevant information and data, and future outreach and engagement events. Initial outreach and engagement focused on state and federal regulators due to their important role in the permitting and licensing process, project goals, and ensuring the Toolkit was easily accessible to inform their review of projects. Select state and federal regulators were interviewed initially to gather one-on-one feedback on the Toolkit's function, data sources, and regional issues. The feedback gathered directly informed preparations for six in-person workshops with regulators in Danvers, Massachusetts; Washington, DC; Boca Raton, Florida; Anchorage, Alaska; Salem, Oregon; and Sacramento, California. At the workshops, the project team presented the Toolkit concept to participants, conducted facilitated exercises around certain components or elements of the Toolkit, and invited SMEs to present on a relevant regional topic of interest.

During the preparation and execution of the in-person workshops, the project team developed initial concepts for integrating the separate data sources, identified primary data sources, developed conceptual models for stressor-receptor interactions, compiled regulatory information, and identified how to categorize tags for easy querying of data. After the initial workshops, the project team implemented a prototype web portal and Toolkit, developed regulatory process diagrams and document examples, and tagged existing permitting and licensing documents. Once the prototype web portal was complete, stakeholders (federal and state regulators, project and technology developers, and SMEs) were engaged for additional refinement of the Toolkit and its functionality.

Once the prototype Toolkit and web portal were developed, outreach efforts culminated in a series of six virtual workshops for regulators, developers, marine energy innovators, and other marine energy community stakeholders. Participants at the workshop previewed the prototype Toolkit, heard updated presentations from SMEs from the first workshop to share important developments on specific environmental interactions, and provided feedback on the functionality and potential applications for the Toolkit. The Toolkit was refined based on feedback provided in the virtual workshops as well as one-on-one demonstrations and interviews with select regulators and developers. These demonstrations and interviews were focused on improving the user experience of the Toolkit and understanding potential cost savings of the Toolkit. A list of regulators and developers engaged in the one-on-one demonstrations is included in the Task 3 section.

The final activity of the project was to conduct a pilot testing process with regulators and developers in an active permitting and licensing process. Due to timing and current stage in the permitting process, Ocean Renewable Power Company's (ORPC) Cook Inlet project was selected. Regulators overseeing the ORPCs Cook Inlet project were trained, surveyed, and interviewed to understand the Toolkit's use during permitting and licensing. The project team synthesized the feedback collected through the interviews and survey to identify lessons learned to further refine the Toolkit.

Task 0: Project Management

The goal of Task 0 was to establish regularly scheduled meetings among project team members, establish regularly scheduled meetings between project team members and DOE, and manage the project overall. During Budget Period (BP) 1, the project team focused on setting up the appropriate and legal relationships for completing all tasks. In BP2, the focus was to continue internal coordination on a regular basis, conduct a cost analysis of the potential savings of the Toolkit using outcomes from the Marine Energy Environmental Compliance Cost Assessment (ECCA) Project as a baseline, and outline all costs for maintaining the Toolkit.

Accomplishments

During BP1, the project team met weekly as the project kicked off. After the initial round of workshops, described in Task 3, the project team began meeting every 2 weeks. All project partners were under contract the month following completion of negotiations with DOE.

The goal for Task 0 in BP2 was to continue internal coordination meetings between project team members and DOE, coordinate meetings with PRIMRE and Tethys teams, conduct a cost-assessment analysis of potential cost savings for the Toolkit, and outline all costs for maintaining the Toolkit. During BP2, the project team met with DOE monthly to provide updates and discuss project progress, conducted an internal analysis of cost-savings for the Toolkit, and have the internal cost-savings analysis reviewed and approved by developers and regulators.

Subtask 0.1

The goal of Subtask 0.1 was to outline all costs for maintaining the Toolkit. This included all direct and indirect costs and expertise required to carry out maintenance. The costs were categorized in a low-, medium-, and high-cost scenario. All scenarios would maintain the functionality of the Toolkit, but medium- and high-cost scenarios included additional items such as outreach workshops, further piloting of the Toolkit, identification and integration of additional datasets into the Toolkit, and the tagging and integration of additional regulatory documents. A summary of the costs outlined is available in Appendix A.

Milestone 0.1

Using cost information provided by developers for permitting and licensing a marine energy project, collected from the Sandia National Laboratories-led ECCA project, a set of bar graphs (Figures 1 and 2) were developed showing the potential cost savings of the Toolkit for tidal commercial deployments and wave test sites. The average tidal graph combines reported permitting costs from Cobscook Bay and Roosevelt Island Tidal Energy sites. The average wave graph combines reported costs from PacWave-North and PacWave-South test sites. Costs presented here include only those reported in categories of Agency Interaction or related to specific phases of licensing (Draft License Application, Final License Application, etc.).

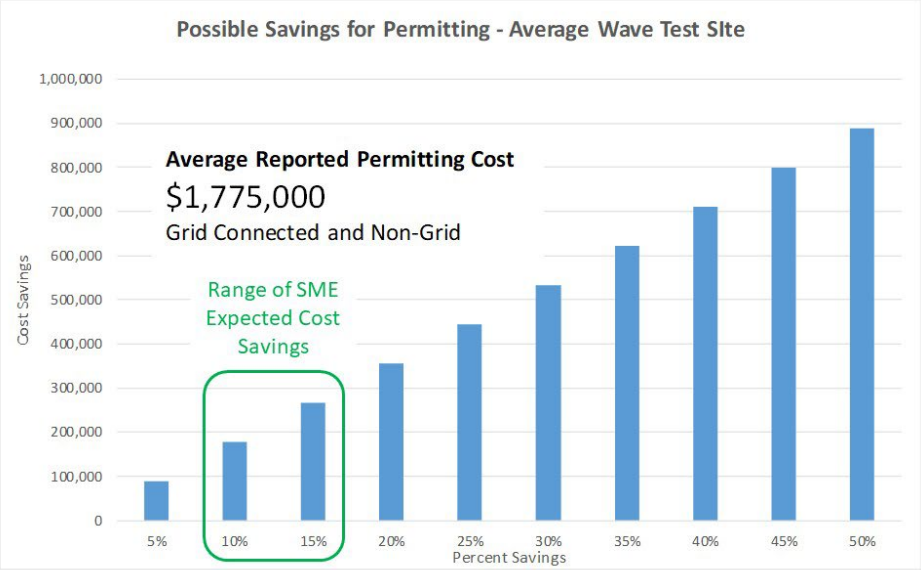


Figure 1. Possible savings from Marine Energy Environmental Toolkit for Permitting and Licensing for wave test sites. Data from the ECCA project with an identified range of cost savings, 10-15%, highlighted.

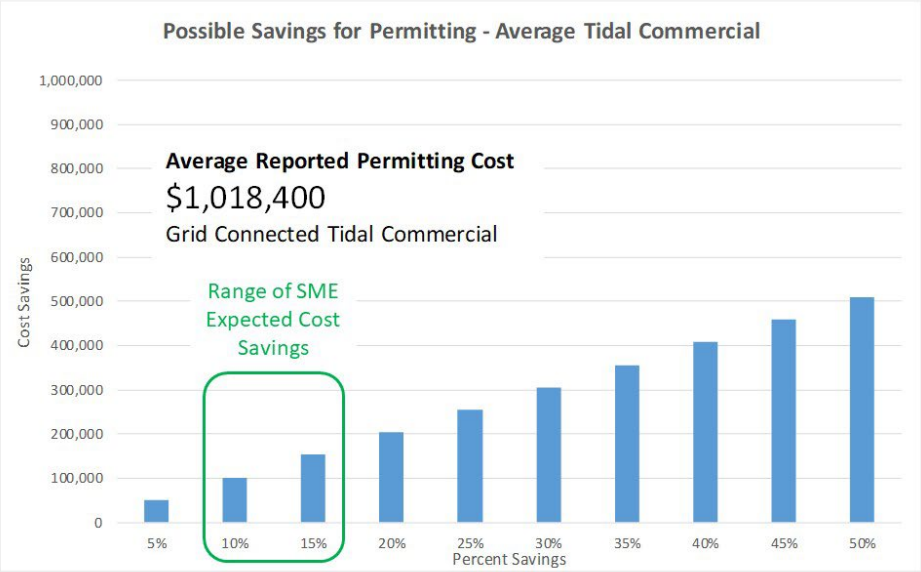


Figure 2. Possible savings from Marine Energy Environmental Toolkit for Permitting and Licensing for tidal commercial deployments. Data from the ECCA project with an iIdentified range of cost savings, 10-15%, highlighted.

These graphs were reviewed and discussed by team members with direct experience in the permitting and licensing of marine energy projects. These team member's feedback suggested the expected cost savings are in the 10–15 percent range, highlighted in green in Figures 1 and 2, with some caveats:

- Smaller, less complicated projects will likely see a larger cost savings from the Toolkit
- Permitting efficiencies (i.e., using the Verdant exemption, states with existing memorandum of understandings) at the federal and state level may provide additional cost savings complementing the Toolkit cost savings
- Some cost savings may not be attributable to an individual project but will reduce costs industry-wide
    - The education of regulators (from the Toolkit and SME presentations)
    - Availability of regulatory resources for developers
    - Access to information for improved siting of potential projects

Milestone 0.2

The assumed cost savings shared in Figures 1 and 2, along with an interview guide that was used in cost-assessment interviews with state and federal regulators and developers to confirm cost savings of the Toolkit based on baseline established in Task 0.

Table 1. Cost Assessment Interviewees

Name(s)	Organization	Role, Project/Experience
Stephen Bowler and Josh Dub	FERC Headquarters	Federal Regulator, Marine Energy Lead
Delia Kelly	Oregon Department of Fish and Wildlife	State Regulator, PacWave North and South
Denis Nault	Maine Department of Marine Fisheries	State Regulator, Cobscook Bay
Jennifer Martin	U.S. Army Corps of Engineers Alaska District	Federal Regulator, Igiugig Project
Jonathan Colby	Verdant Power	Developer, Roosevelt Island Tidal Energy Project
Marcus Lehman and Dan Petrovic	CalWave	Developer, CalWave Technology Developer
Roak Parker	DOE	NEPA Program
Dan Hellin	OSU, PacWave North	Developer, PacWave North

Name(s)	Organization	Role, Project/Experience
Jeff Young	NMFS Pacific Northwest Division	Federal Regulator, PacWave South Wave Energy Test Site

During these interviews, participants noted that the Toolkit would provide tremendous cost savings, especially in the preliminary phases of projects, though they did not express the cost (time and resources) saved with the same metric. For example, one interviewee believed the Toolkit would remove a total of six months from the permitting and licensing process while another suggested it would remove the need to conduct 1-2 resource surveys. The interview guide and summary of the discussion and feedback collected during the interviews is available in Appendix B.

Significant Findings, Departures, and Challenges

A summary of key Task 1 results and departures is presented in Table 2.

Table 2. Summary of Task 0 Key Results and Departures

Milestones	Completion	Key Results and Departures
0.1 Cost Savings Analysis using ECCA Data	01/30/2021	The project team used cost information for permitting a wave test site and a commercial tidal project from the ECCA project. Assuming a 10–15 percent total cost savings based on expert team members with direct permitting experience, the Toolkit could save up to $266,250 for permitting a wave energy test site, and $152,760 for a commercial tidal project. No departures or deviations from defined scope.
0.2 External Review and Confirmation of Cost Savings	4/30/2021	The project team interviewed five state and federal regulators and five technology and project developers sharing the findings from Milestone 0.1. All interviewees agreed with the figures shared and offered additional insight on potential cost savings of the Toolkit. Some regulators shared that it could take up to 6 months off of the process. Smaller developers shared it could remove the need for certain studies. No departures or deviations from defined scope.

There were no specific challenges for Task 0.

Task 1: Toolkit Development

The Task 1 goal was to develop the web-based Marine Energy Environmental Toolkit for Permitting and Licensing (Toolkit; https://marineenergy.app/). The Toolkit wireframe was developed in BP1, as well as the plan for integration of the following information:

- Spatial Database. Design the relational database for incorporating spatial datasets such as MarineCadastre, including a data upload strategy. MarineCadastre is a joint Bureau of Ocean Energy Management (BOEM) and National Oceanic and Atmospheric Administration (NOAA) tool that provides authoritative data to meet the needs of the offshore energy planning community. Example relevant datasets include: 12 NM territorial sea, vessel traffic, marine mammal abundance and richness, and Essential Fish Habitat.
- Document Database. Define strategies for incorporation and storage of other data sources from sites such as Tethys Knowledge Base and FERC E-Library.

The BP2 goal for Task 1 was to complete tasks associated with the web-based Toolkit. The second year of the project was dedicated to developing the front-end Toolkit interface (i.e., web browser user interface) and guidelines for future data and code integration, and finalization of the Toolkit to include Regulatory Diagrams; Environmental Interactions; General Information about Marine Energy, and the Reporting Tool for customized filtered searches among Projects, Spatial Datasets, Documents (FERC E-Library), and Publications (Tethys Knowledge Base).

Summary of Task 1 Accomplishments

In BP1, the project team developed the necessary back-end web infrastructure for the Toolkit, which was informed by initial interviews and Round 1 workshops (see Task 3). BP1 activities also included identification, distillation, and initial upload of data sources that are relevant to marine energy environmental permitting and licensing. BP2 was dedicated to the development of the front-end interface and guidelines for future data and code integration, and finalization of the web-based Toolkit. A summary of Task 1 accomplishments included completion of the following:

1. Subtask 1.1. Web-based Toolkit wireframe
2. Subtask 1.2. Prototype of back-end spatial and document database.
3. Subtask 1.3. Prototype web-based Toolkit
4. Subtask 1.4. Guidelines for document upload to Toolkit user accounts
5. Subtask 1.5. Finalize web-based Toolkit.

Subtask 1.1

The goal of Subtask 1.1 was to develop relational database diagrams and strategies for including data sources to define a working structure for the spatial and document databases that will form the back end of the Toolkit. The structure included a specification for all applicable file formats and a fully

developed data management plan, including incorporation of existing datasets into the Toolkit backend database.

Milestone 1.1

Database diagrams and strategies for linking the various data sources.

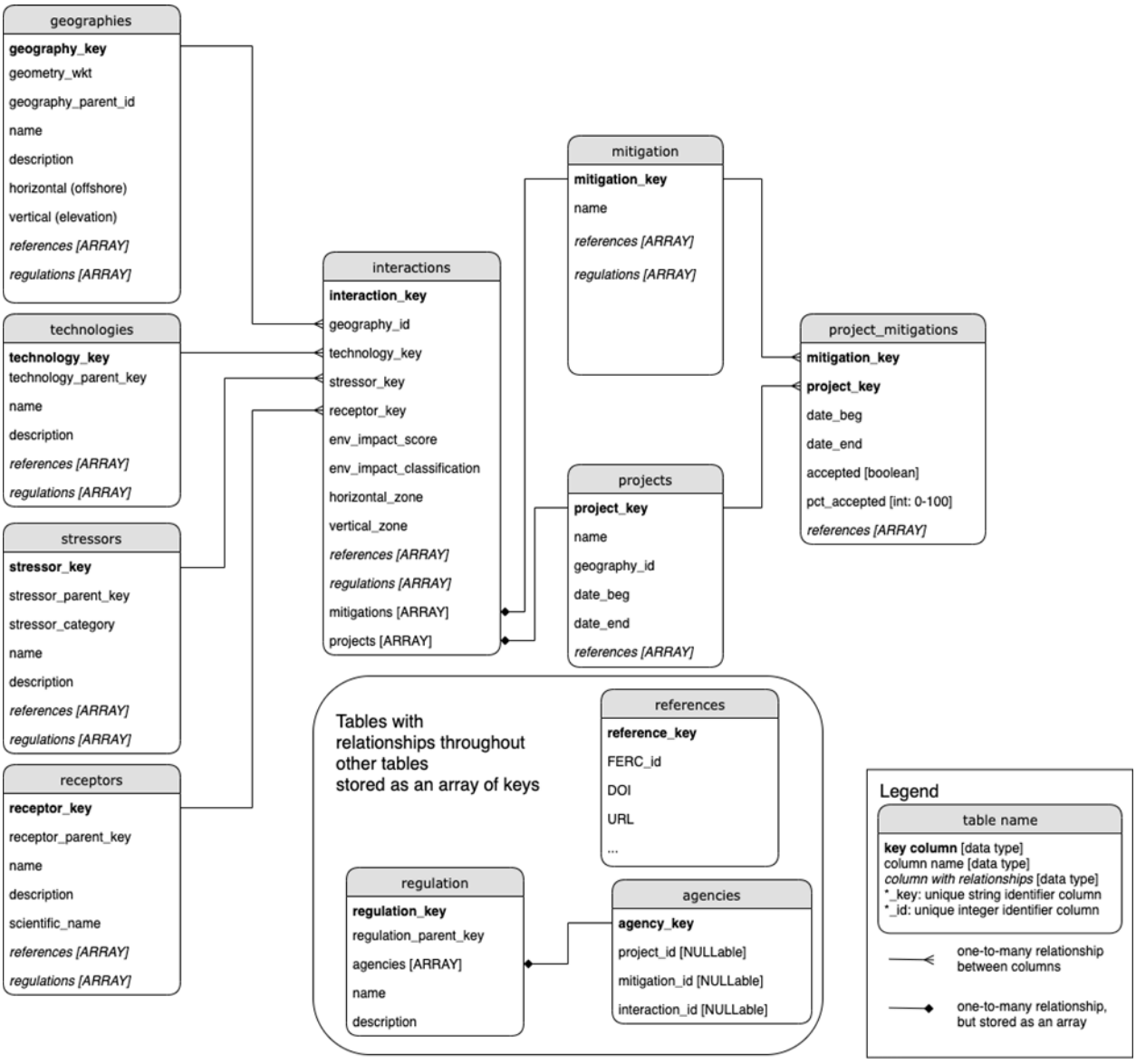


Figure 3. Toolkit relational database diagram.

The relational Toolkit database diagram (Figure 3) defines the tables, columns, and relationships between database entities such that redundancy of stored information is minimized and integrity of values is maximized (i.e., database normalization). The structure of these tables determines how easily searchable and relatable the underlying database content is through the user interface. The end user

does not see this database structure, but the database constrains the ways in which the interface is navigated.

The web-based Toolkit allows users to search marine energy projects by name and/or location, with a map presenting associated geometries. Links to documentation (references) for related projects (e.g., previous relevant research or project precedent) is provided. This documentation is accessed through Tethys, OpenEI, and internal Toolkit databases containing, for example, FERC E-Library documents. The query results also enable further queries related to, for example, recommended management measures which provide best practices to streamline the permitting process.

Database terminologies and relationships between database tables are further described by using the following example of a wave energy converter (WEC) pilot project off the coast of Oahu, Hawaii. Here, only one example of a potential stressor and receptor is provided, and only one example project is described.

geography: Oahu, Hawaii

technology: wave energy converter

stressor: noise

receptor: humpback whale

project: Fred Olsen Lifesaver

The linkage of data sources between the Toolkit and various databases (Table 3) may take three different forms; these are: caching, harvesting, or scraping, each of which are described below. *Caching* enables regularly scheduled scripts. These scripts are commonly called "cron jobs," which are time-based job schedulers used by computer operating systems to automatically run scripts periodically at fixed dates, times, or interval(s) to harvest the latest information from external databases and populate databases on a regular basis. The advantage of caching is that it is quicker than querying external data sources. Ideally, *harvesting* techniques will be implemented from a regular application programming interface (API), such as openei.org/services. An API is a communication protocol or interface between a server and a client such that if the client makes a request in a specified format, it will get a response or initiate a defined action. Many sites do not have an API; therefore, data *scraping* methods may be employed programmatically by simulating a web browser. Data scraping produces output that is intended for display to an end user and not necessarily as input to another program and may be suitable for posting documentation (references) resulting from queries.

Throughout the project period, the team worked with the Portal Repository for Information on Marine Renewable Energy (PRIMRE), Regulatory and Permitting Information Desktop (RAPID) toolkit, and Tethys teams to ensure that the Toolkit database uses language and file formats consistent with existing DOE marine energy databases.

Table 3. Relevant Databases to the Toolkit, Developed in BP1

Organization	Link	Region	Data Type
MarineCadastre	marinecadastre.gov	USA	spatial
MarineCadastre	marinecadastre.gov/oceanreports/		spatial
OpenEI	mhkdr.openei.org	U.S.	literature, zip files
OpenEI	openei.org/wiki/Marine_and_Hydrokinetic_Technology_Database	Global	
OpenEI	openei.org/wiki/MHK_ISDB		
OpenEI	https://openei.org/wiki/PRIMRE		
OpenEI	https://openei.org/wiki/RAPID	U.S.	
Tethys	tethys.pnnl.gov/data-portal	Global	data
Tethys	tethys.pnnl.gov/knowledge-base	Global	literature
Tethys	tethys.pnnl.gov/management-measures	Global	table
NMFS	habitat.noaa.gov/application/efhmapper/index.html	U.S.	spatial
NOAA	cetsound.noaa.gov/cda	U.S.	spatial
National Renewable Energy Laboratory (NREL)	MHK Atlas	U.S.	spatial
FERC E-Library	https://www.ferc.gov/docs-filing/elibrary.asp		
DOE	www.eere-pmc.energy.gov	U.S.	
Regional Ocean Planning	caoffshorewind.databasin.org	California, U.S.	spatial
Regional Ocean Planning	gsaaportal.org	Southeastern U.S.	
Regional Ocean Planning	northeastoceandata.org	Northeastern U.S.	

Organization	Link	Region	Data Type
Regional Ocean Planning	portal.midatlanticocean.org	Mid-Atlantic U.S.	
Regional Ocean Planning	portal.westcoastoceans.org	Western U.S.	
USGS	usgs.gov/centers/asc/science/north-pacific-pelagic-seabird-database?qt-science_center_objects=4#qt-science_center_objects	U.S.	spatial
Duke University	http://seamap.env.duke.edu	U.S.	
Energy in general	https://www.ourenergypolicy.org/resources/	U.S.	
Oregon State	https://www.coastalatlas.net/index.php/tools	Oregon, U.S.	spatial
Europe-Southern	wese-project.eu	Portugal and Spain, Europe	
Europe-UK	orjip.org.uk	U.K., Europe	
Europe-UK	http://www.marine-impact.co.uk/assessment-tool.asp?cat=2	U.K., Europe	

Subtask 1.2

Subtask 1.2 involved the development of prototype back-end spatial and document databases populated with preliminary regulatory and environmental data. The structure defined in Subtask 1.1 was implemented, and the databases were populated with information compiled as part of Task 2. The back-end infrastructure provides the software structure for incorporation of information developed throughout the course of the project.

Milestone 1.2

Prototype back-end spatial and document database.
The back-end spatial and document database of the Toolkit supports four major components (Figure 4):

1. **Data Catalog and Mapper**
   Relevant datasets were obtained from MarineCadastre with the ability to identify overlapping species, habitats, and human uses for a proposed development area.

2. **Guidelines and Flowcharts**
   General guidelines and flowcharts for permitting were defined, similar to RAPID (NREL), as part of Task 2.

3. **Searchable Documents**
   Documents relevant to projects, precedent, and mitigation are searchable.

4. **Engagement and Communication**
   Community engagement, with a focus on communication and outreach between regulators, developers, and other SMEs and stakeholders was accomplished as part of Task 3. As a way to develop a Toolkit responsive to stakeholder needs, explain the data sources of the Toolkit, and how to operate the Toolkit.

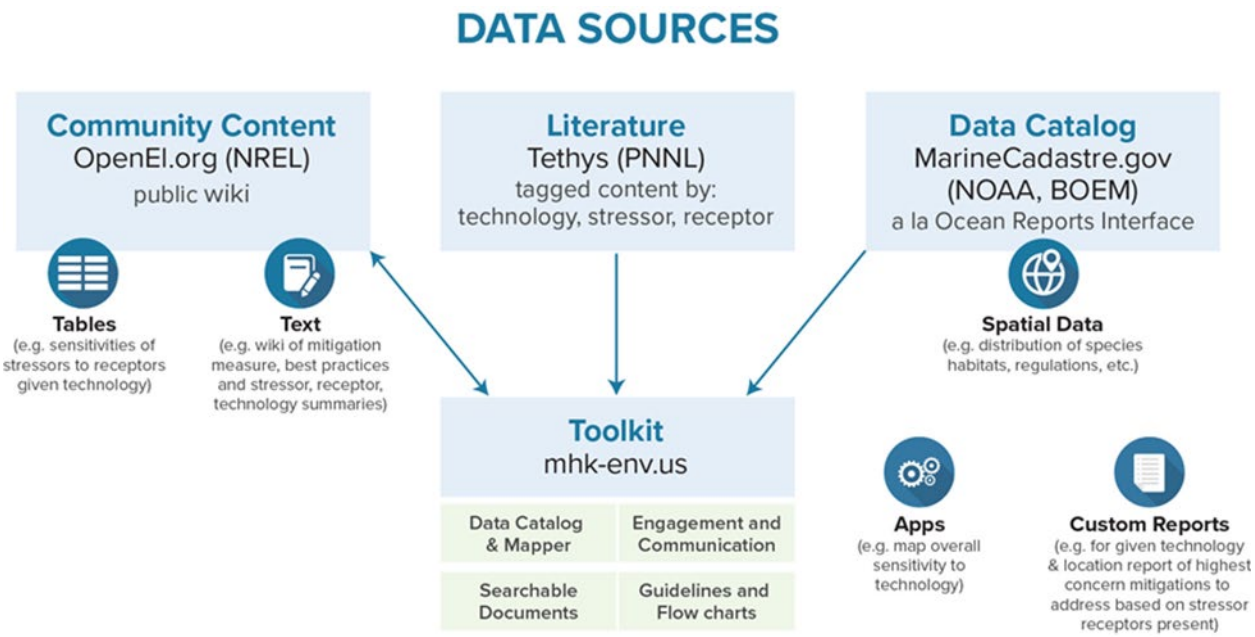


Figure 4. Example data sources and main components of the Toolkit.

The structure, content, and preliminary front-end design of the Toolkit was completed and presented to regulators during third quarter (Q3) workshops on the east coast (Massachusetts, Washington, DC, and Florida) and west coast (Alaska, Oregon, and California) as part of Task 3. The purpose of these workshops was to gather feedback from regulators on Toolkit content and functionality. Most workshop participants envisioned using the Data Catalog and Mapper and Searchable Documents components of the Toolkit most heavily; therefore, BP1 back-end Toolkit development was primarily focused on these two aspects.

Data Catalog and Mapper

Relevant spatial databases were cataloged to identify replicates (many regional databases are duplicates or subsets of the MarineCadastre database), relevance, type, and accessibility. Database relevance was based on regulator comments during workshops held in Q3. These included Natural Resources and Conservation databases (e.g., critical habitat designations, cetacean biologically important areas).

A mock-up of the Data Catalog and Mapper was developed in BP1 as part of Subtask 1.2. This component of the Toolkit enables users to define a geography (location) and technology (Figure 5),

which results in a custom report that provides user-defined/queried information. This component of the Toolkit was later integrated (in BP2) with searchable Documents and Publications to provide the user with relevant published information on the designated geography and technology, including related projects, mitigation, and scientific research findings.

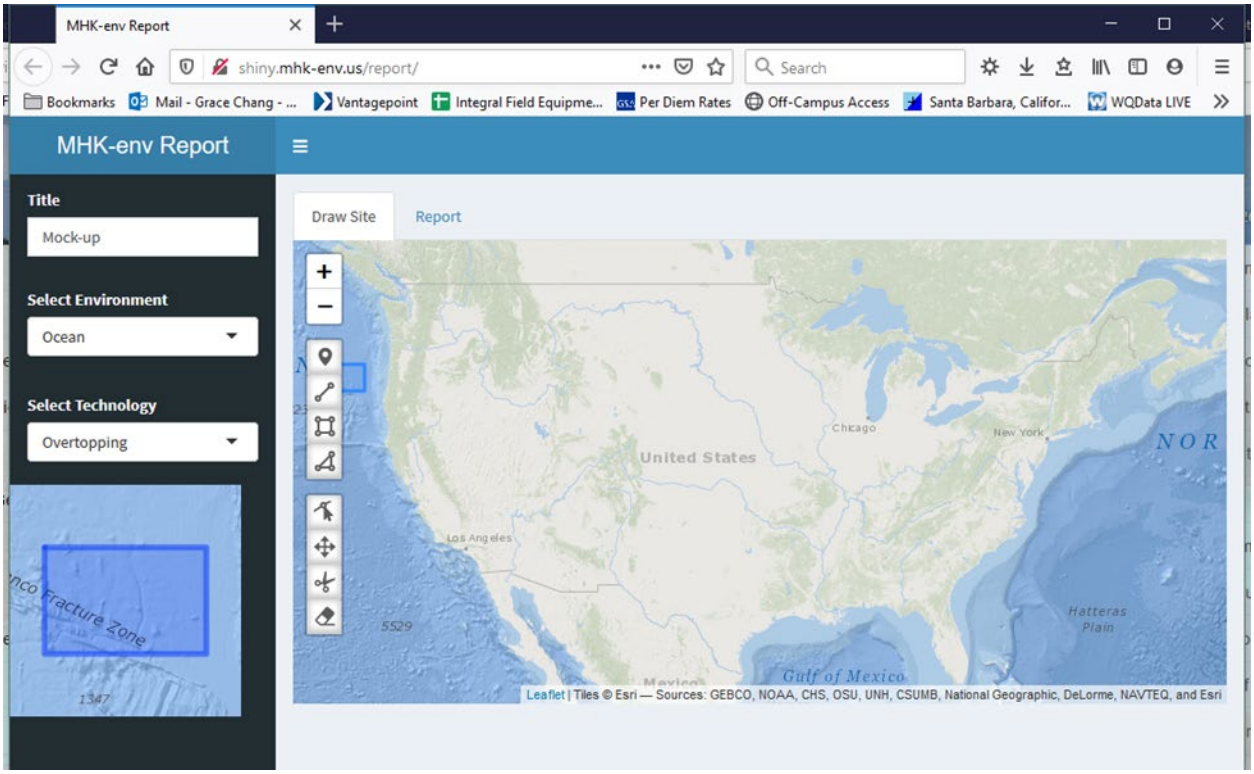


Figure 5. Toolkit Data Catalog and Mapper mock-up from Subtask 1.2. In this example, a polygon has been drawn off the coast of Oregon and an overtopping WEC has been selected as the key technology.

Searchable Documents

Several different forms of searchable documents are available to enable users to query and access available documents for previously permitted projects, as well as publications discussing (e.g., stressor–receptor interactions). The Searchable Document components of the Toolkit include:

- Interactions. Web-based displays of the number of documents available by stressor–receptor pairing (Environmental Interactions), where tabulated values are hyperlinks to a complete bibliography available through the Tethys Knowledge Base (Figure 6).
- Documents. Tagged and filterable FERC E-Library documents relevant to marine energy. A custom FERC E-Library tagging app was initially developed in BP1 (completed in BP2) to facilitate linkages between synthesized topical information (see Task 2) and marine energy project documents that have gone through or are going through the permitting process (i.e., project precedent).
- Literature. Filterable literature through the Tethys Knowledge Base API.

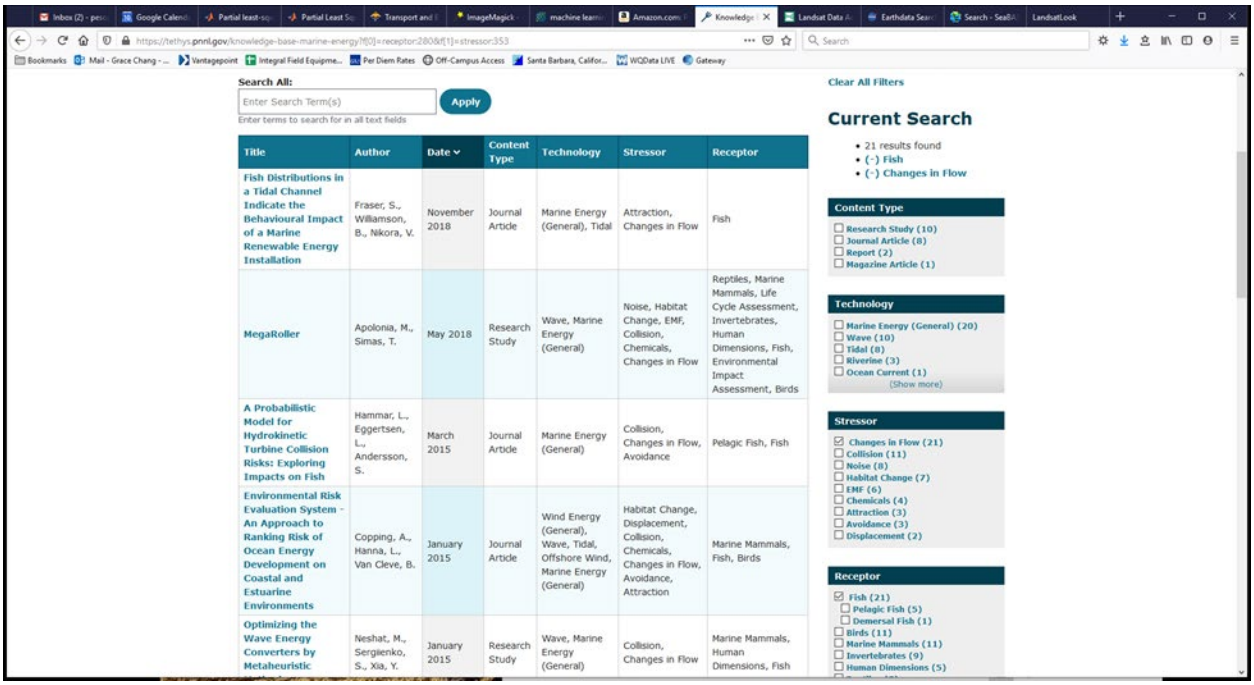


Figure 6. Bibliography resulting from clicking on the number of documents available for the stressor-receptor pair, Fish-Changes in Flow on the Toolkit Interactions page.

Guidelines and Flowcharts

The project team developed significant marine energy content using the OpenEI platform, including a glossary of terms and a synthesis of marine energy technologies and stressors-receptors. Regulatory flowcharts were developed starting in BP1 (see Task 2) to serve as guidelines to marine energy permitting.

Subtask 1.3

An initial wireframe of the Toolkit was developed as part of the project Bridge Task between BP1 and BP2 and completed in BP2. During BP2, the team designed the web-based Toolkit front-end interface using feedback collected during the first round of workshops (see Task 3). The Toolkit user interface provides tools for overlaying uses, receptors (potential resources affected), and other elements (existing spatial information, other ocean uses, etc.) to enable users to determine potential studies, impacts, and mitigation and monitoring.

Milestone 1.3

Prototype web-based Toolkit submitted to DOE for review and approval.

The initial wireframe of the web-based Toolkit was developed as part of Subtask 1.3 (Figure 7). In BP2, the front-end interfaces for various Toolkit components were initially developed as separate pages following the wireframe design and linked to back-end databases and infrastructure developed during BP1. Subtask 1.3 Toolkit components included Projects, Interactions, Management Measures, Regulations, and Reporting (consisting of publications and spatial datasets), which are described briefly

below; webpage screenshots of each of these pages are presented in Appendix C. After receiving feedback from potential users and DOE, several of the Toolkit components (Projects, Management Measures, Documents, Publications, and Spatial datasets) were integrated into one custom Reporting Tool app.

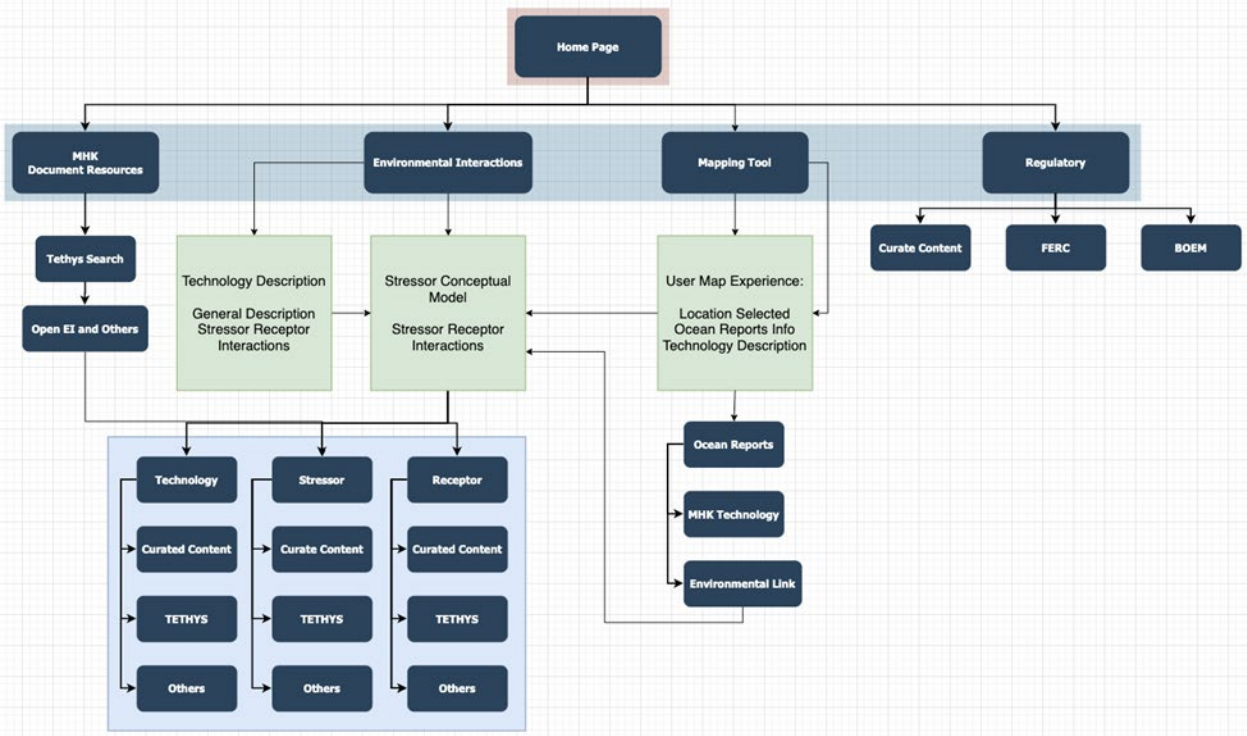


Figure 7. Initial web-based Toolkit wireframe developed as part of Subtask 1.3.

Projects

The Projects component of the Toolkit serves as a means for regulators and developers to obtain information about project precedent (i.e., what is the regulatory environment for past and current U.S. marine energy projects?). It consists of an interactive Map and Timeline, each of which provides the user with a display of known U.S.-based marine energy projects and the permit applications associated with each project. The Map and Timeline enable users to access relevant FERC E-Library documents for each project by selecting either the project location (Map; Appendix C), or a permit type for each project as a function of time (Timeline; Appendix C). For example, if a regulator has just been presented with a tidal energy draft license application and is seeking information on project precedent, this regulator could click on the mapped location of RITE (Roosevelt Island Tidal Energy site) or any of the colored triangles on the timeline and have direct access to the available permit application documents that were submitted to FERC.

Interactions

The Environmental Interactions page organizes literature by stressor–receptor interactions (Appendix C). This page provides a broad overview of the state of the knowledge and gaps in knowledge of various stressor–receptor interactions. This document page displays the number of documents available by stressor–receptor pairing as hyperlinks to a complete bibliography, linked to the Tethys Knowledge Base through its API. Thus, any updates to the Tethys Knowledge Base will be automatically reflected in this Toolkit page.

Management Measures

The Toolkit Management Measures page is pulled directly from Tethys (with appropriate acknowledgement and link). It enables users to select a technology, category, project phase, stressor, and/or receptor to explore potential interactions, management measures, and implications of the measures (Appendix C).

Regulations

The interactive Regulations component of the Toolkit is aimed at guiding the user through federal and state regulatory processes for permitting marine energy device deployments. Much of the linked content was developed and published on the OpenEI platform. The initial regulatory diagram developed as part of Subtask 1.3 (Appendix C) was later improved, aesthetically and functionally (see Subtask 1.5), based on user feedback received during Task 3 activities.

Reporting Tool

The Reporting app developed as part of Subtask 1.3 featured a configuration tab that prompted the user to specify a location and tags for receptors, stressors, and technology (Appendix C). User queries resulted in a bibliography of literature (by tags that are consistent with those of the Tethys Knowledge Base) and a table of relevant tagged spatial datasets. The literature and spatial results could be saved in a custom report for archival and sharing purposes.

Subtask 1.4

The goal of Subtask 1.4 was to describe to users how to upload external documents. Software mechanisms and guidance for adding external documents were developed. The mechanisms already existed as part of the back-end structure, but this task enables seamless integration of external documents into the Toolkit and allows uploads to be shared among users and included in reports generated by the Toolkit.

Milestone 1.4

Guidelines for document upload to Toolkit user accounts developed.

A Toolkit document uploader was developed in coordination with user login functionality (see Subtask 1.5) to enable users to include additional information with Toolkit content. The document uploader was developed as a Google Form, and uploads are automatically recorded on a Google sheet in the Toolkit backend. As shown in Figure 6, the document uploader is linked solely to a user's Toolkit account. The user would enter their contact information, select a document type, fill in a summary description of the document, add the file(s), and submit. Files can be added by browsing the user's

device directories or by dragging and dropping files directly from the user's device. Each document uploaded is recorded and saved in the Toolkit database (Figures 8 and 9).

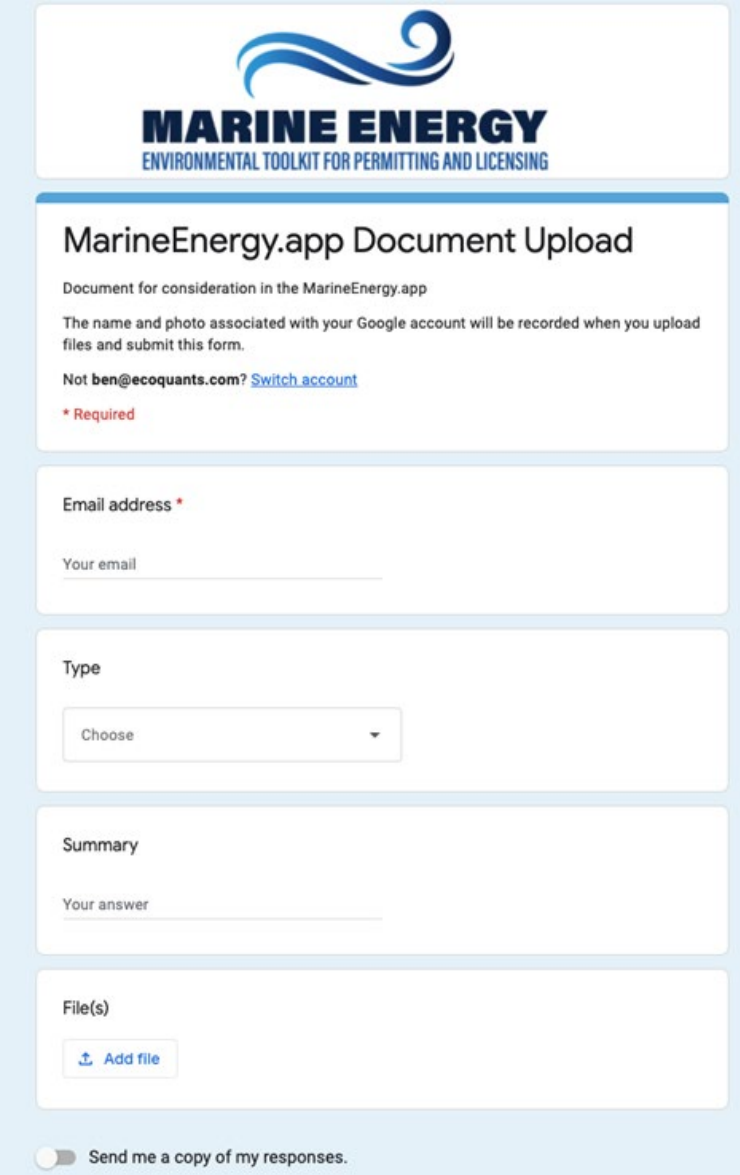


Figure 8. Toolkit document uploader.

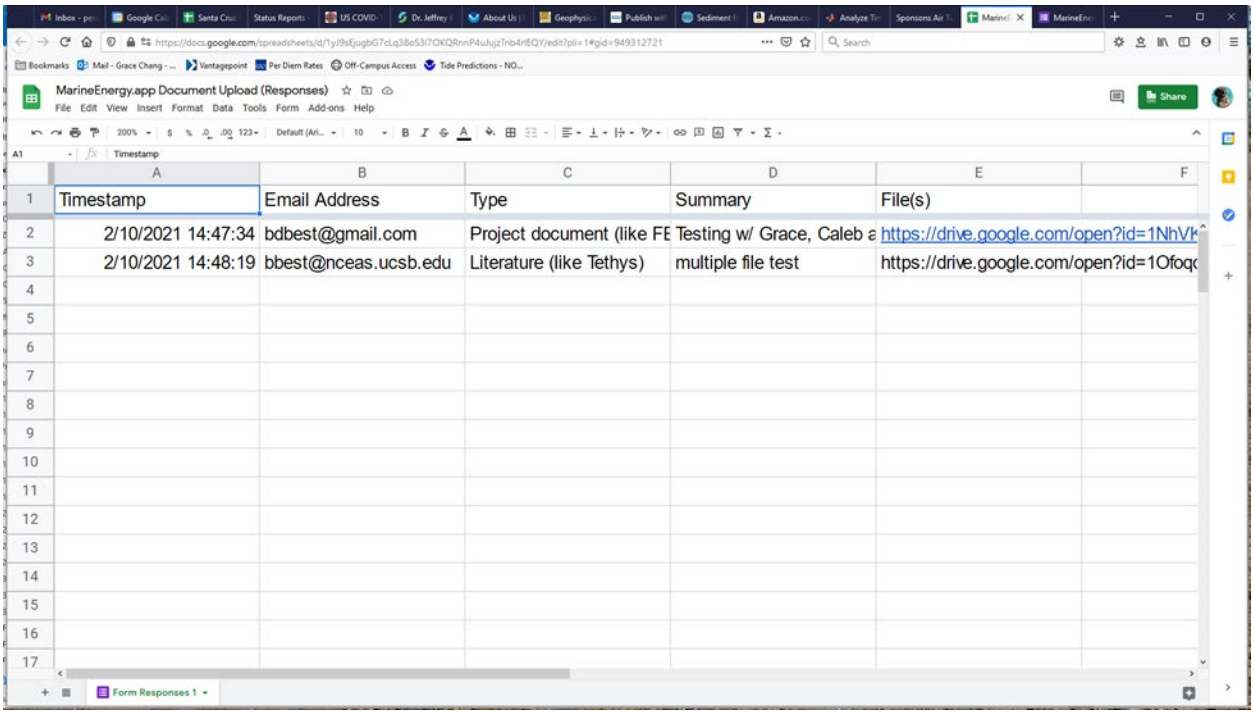


Figure 9. Toolkit document uploader log file.

Subtask 1.5

The goal of Subtask 1.5 was to finalize the web-based Toolkit with demonstration to DOE. The Toolkit user interfaces were to be finalized based on earlier feedback. Full functionality of the finalized, live Toolkit was demonstrated with user interfaces connected to spatial and document databases.

Milestone 1.5

Final web-based Toolkit demonstration for DOE staff.

A Toolkit demonstration was given to DOE on May 25, 2021. The Toolkit presents relevant, collated marine energy information to help regulators and developers streamline the environmental permitting process. The primary components of the finalized Toolkit are:

- Splash Page (see Appendix C)
- Reporting Tool app
    - Projects (Map and Timeline, links to FERC E-Library documents)
    - Management Measures (Tethys)
    - Documents (FERC E-Library documents)
    - Publications (Tethys Knowledge Base literature)
    - Spatial Datasets (MarineCadastre)

- Regulations
- Environmental Interactions
- About the Toolkit (see Appendix D)
- Frequently Asked Questions (see Appendix D)
    - Help Documentation

Additional BP2 Toolkit development efforts involved exposing an API (i.e., offering an access to the Toolkit through an interface) for sharing Toolkit information with the PRIMRE search engine, creating a Toolkit "sandbox" site for offline testing purposes, and quality assurance of the Toolkit webpages (e.g., to ensure against broken web links).

Reporting Tool App

The Reporting Tool app features a configuration tab that prompts the user to specify, or filter by location and tags for technology, stressor, receptor, phase, management measure, and consequence (Figure 10). User queries result in the following:

- A map and timeline of previously permitted marine energy projects in the U.S. (see Projects)
- A compilation of marine energy management measures identified by international marine renewable energy regulators and researchers (see Management Measures)
- Bibliographies of environmental compliance project documents and gray and white literature (see Searchable Documents in Task 1, Milestone 1.2)
- A table of relevant spatial datasets.

The Reporting Tool app results can be saved in custom reports in html format. A user login function is implemented through Google so that the team does not have to manage passwords; and the back-end report generation function was streamlined to enable users to continue to peruse the Toolkit while their reports are being published and saved to their user portal.

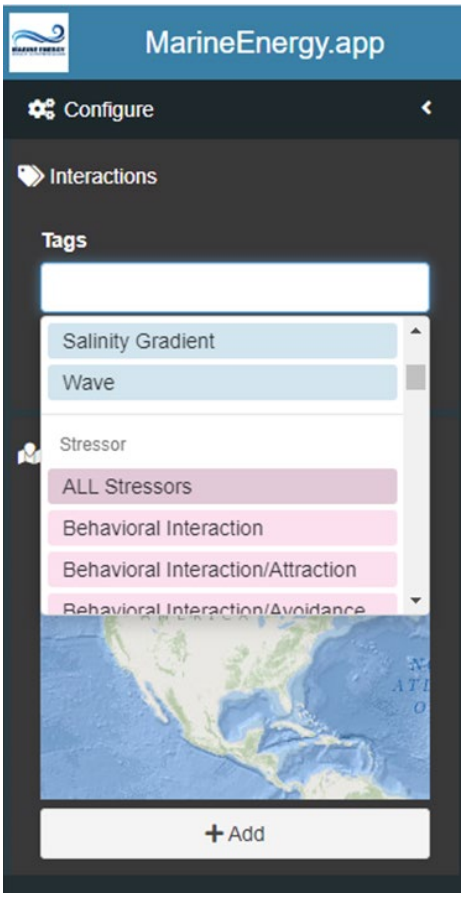


Figure 10. The Toolkit reporting tool configuration tab.

Projects

The Projects component of the Toolkit was updated from Subtask 1.3 development efforts. The timeline color palette was edited to be compliant with the Americans with Disabilities Act (ADA), and shaded bars were implemented to distinguish active projects from inactive projects (Figure 11). The Projects page is filterable/searchable by Technology. An error message will display should the user select a Technology that is not represented on the map and timeline (i.e., a non-marine energy project or marine energy technology that has not yet been permitted in the U.S. such as ocean thermal energy conversion).

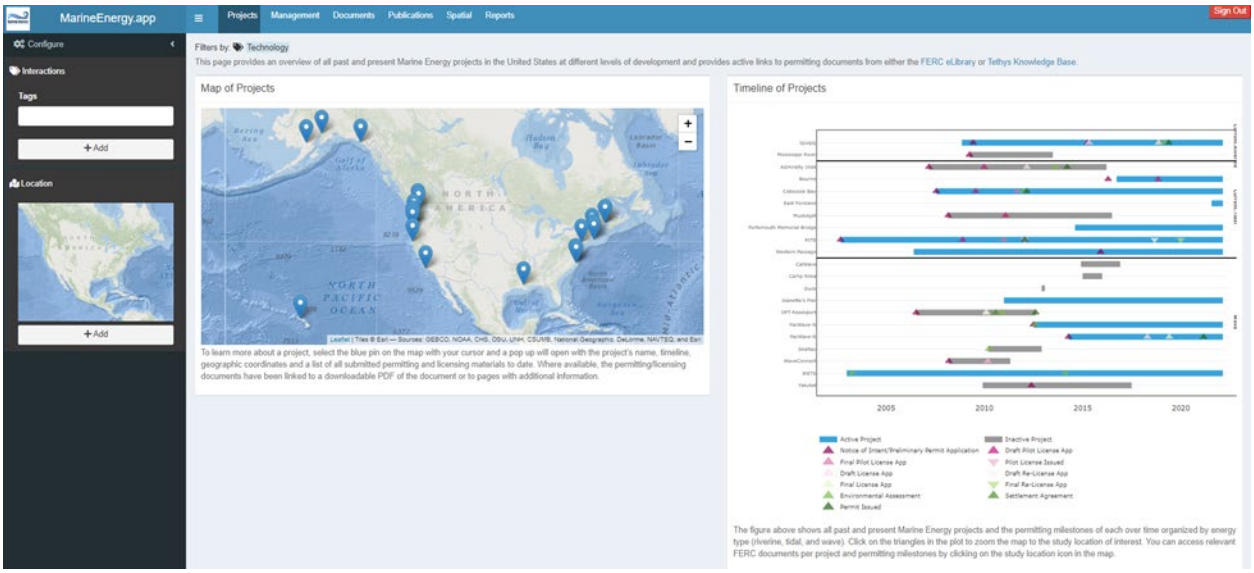


Figure 11. Toolkit interactive Projects page.

Management Measures

Primary updates to the Toolkit Management Measures page integrated content with the Reporting Tool app (this page was previously stand-alone), including color-coding this page's available tags by technology, stressor, receptor, project phase, and/or management measures. Again, this page enables the user to explore potential interactions, management measures, and implications of the measures (Figure 12).

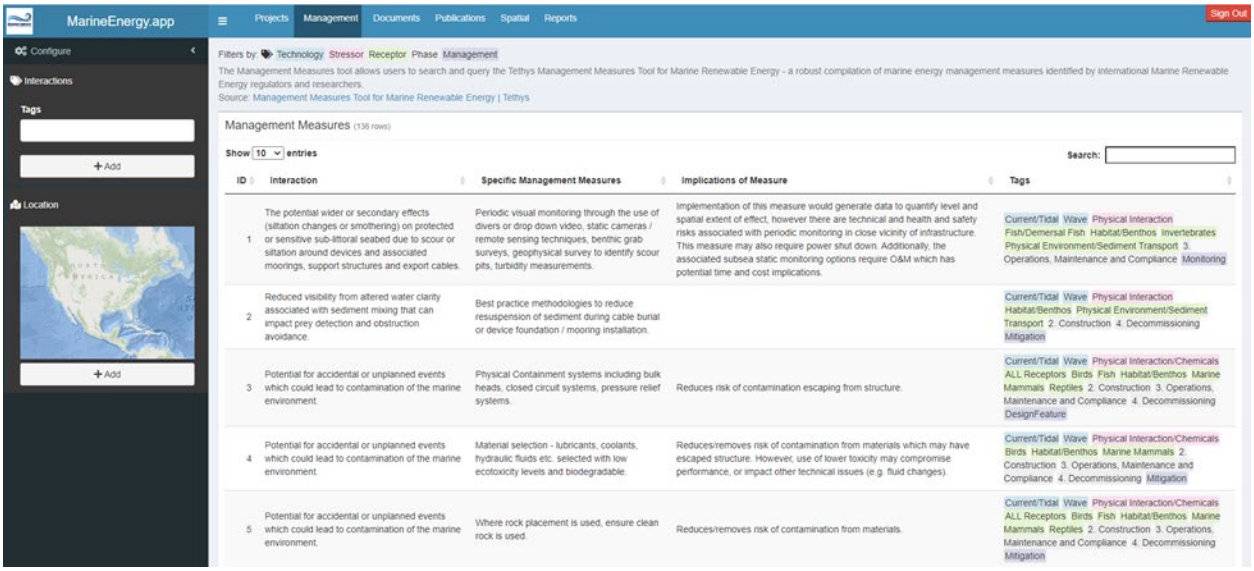


Figure 12. An excerpt from the Toolkit Management Measures page.

Documents and Publications

As part of Subtask 1.5, the Documents (FERC E-Library licensing documents) and Publications (Tethys Knowledge Base literature) components of the Toolkit were integrated with the Reporting Tool app. The front-end functionality of each component remained virtually unchanged from earlier versions. However, several back-end updates were performed to improve efficiency including the following:

- Manual tagging of FERC E-Library documents was streamlined through a custom tagging app, which was completed in BP2. FERC E-Library documents are searchable/filterable by technology, stressor, receptor, project phase, and/or consequence, with binary filters available for, for example, monitoring plan and/or adaptive management plan (Figure 13).
- A Tethys Knowledge Base API eliminates the need for web scraping of Tethys content. This ensures consistent search outputs between the Toolkit and the Tethys Knowledge Base (except OES-E Project Sites and Research Studies documents, which are currently not exposed in the Tethys API); searchable/filterable by technology, stressor, receptor, and/or consequence (Figure 14).

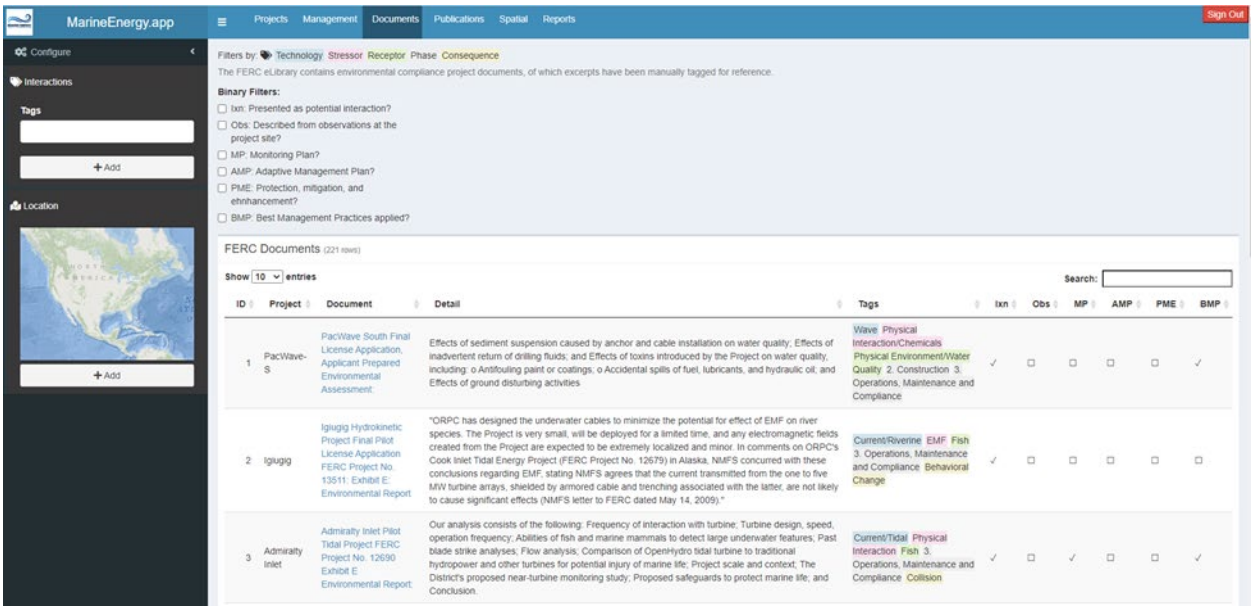


Figure 13. An excerpt from the Toolkit Documents (FERC E-Library) page.

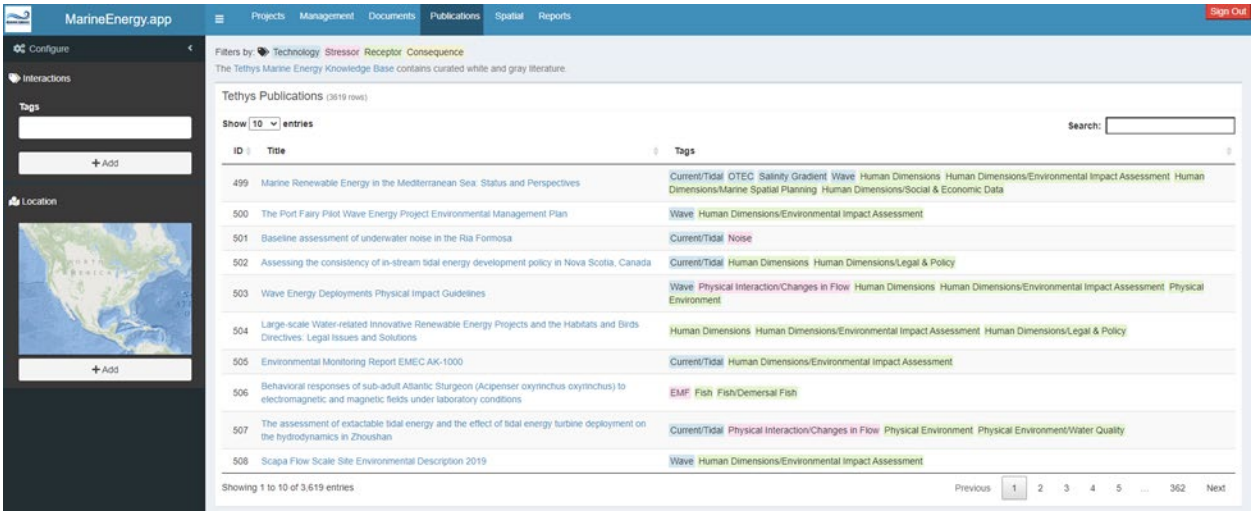


Figure 14. An excerpt from the Toolkit Literature (Tethys Knowledge Base) page.

Spatial

Relevant spatial datasets from the MarineCadastre repository are displayed in tabular format based on user-selected location. Displayed datasets are tagged by receptor (e.g., animal type, habitats, and human uses) and provide data source links (Figure 15).

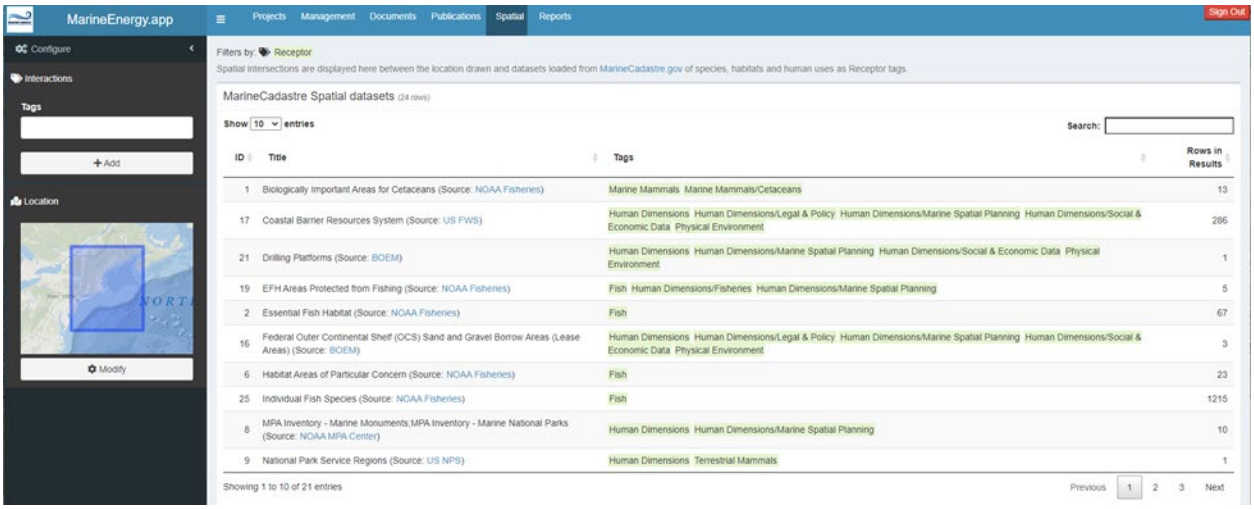


Figure 15. An excerpt from the Toolkit Spatial Dataset page; results are shown for the eastern seaboard.

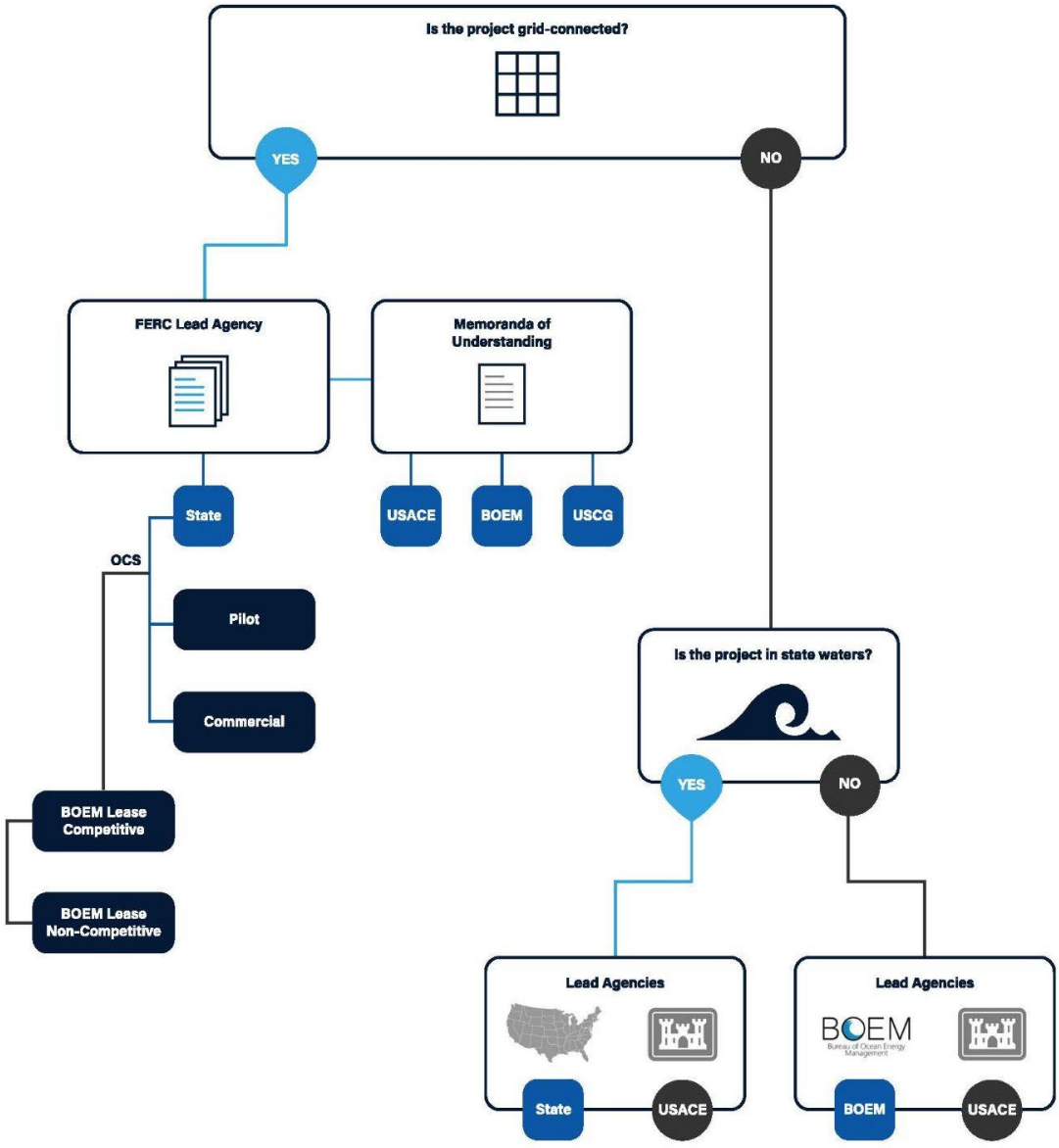
Regulations

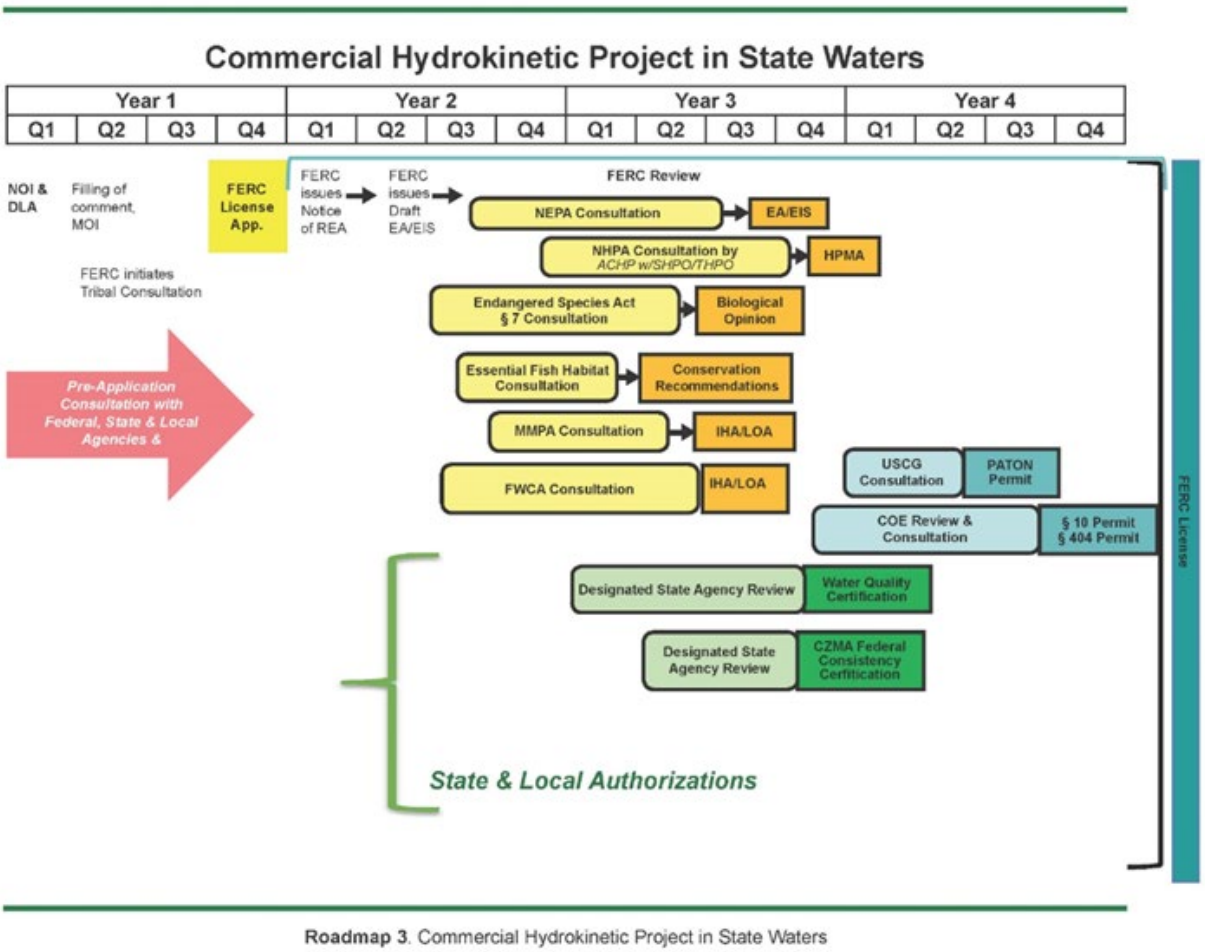
Significant improvements were made to the interactive Regulations component of the Toolkit; aesthetically, functionally, and to increase content (Figure 16). Again, the regulatory diagram is aimed at guiding the user through federal and/or state regulatory processes for permitting marine energy device deployments. It is anticipated that this component of the toolkit will be most useful for developers.

Regulatory Diagram

The diagram below provides a step-wise guide to the regulatory process for different types of Marine Energy projects. This provides users with little to no experience in permitting and licensing Marine Energy projects access to relevant state and federal regulations and links to additional resources based on project factors such as: grid connection, project location and jurisdiction, and lead agency.

Follow the prompts to navigate the diagram. At the end of the decision tree, select the node to access additional information.





Roadmap 3. Commercial Hydrokinetic Project in State Waters

Figure 16. Top: The Toolkit Regulatory Diagram. Bottom: Interactive Regulatory Timeline page, linked from the state-led marine energy project button on the diagram.

Environmental Interactions

The Environmental Interactions page, functionally, was not updated from Subtask 1.3 efforts. For Subtask 1.5, it was formatted to be consistent with the Toolkit splash page design elements (color, fonts, etc.) (Figure 17).

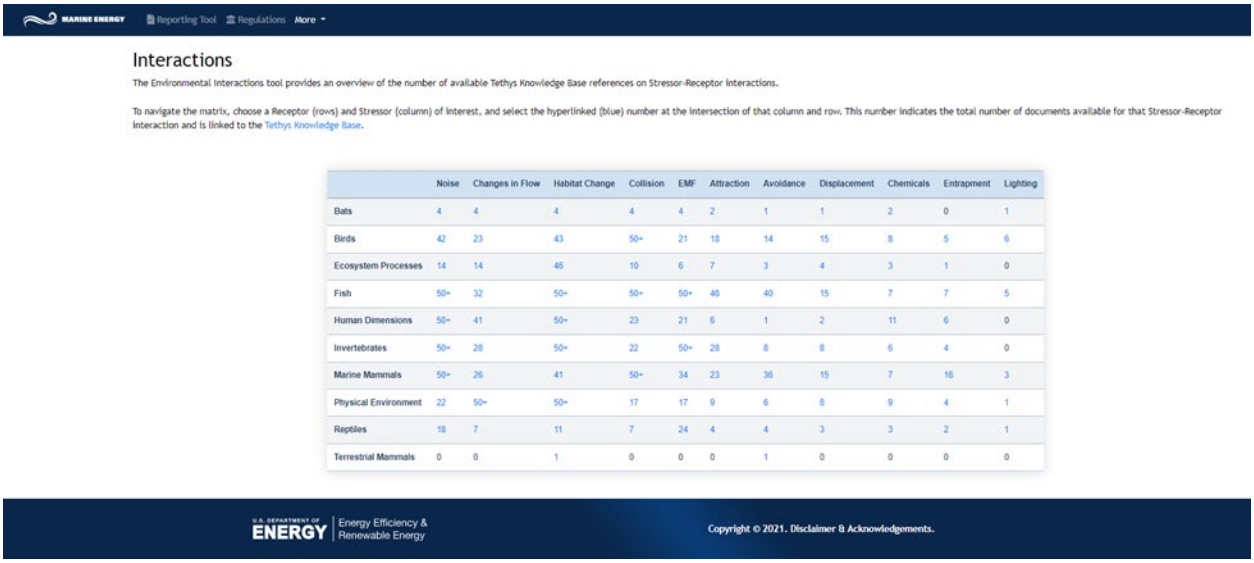


Figure 17. Toolkit Environmental Interactions page.

Toolkit Sustainability

In concert with Toolkit development, testing, and debugging in BP2, back-end applications were developed to facilitate updates to Toolkit content and to ensure sustainability and longevity. Examples of these applications are as follows:

- Projects: A spreadsheet was developed to enable simple addition of new marine energy project license information, including project name, location, license type, and link to webpage and/or relevant FERC E-Library documents, which are housed in the Toolkit database. Additions are automatically reflected in the Projects map and timeline.
- FERC E-Library documents: An interactive tagging interface is available for users to update the Documents component of the Toolkit. This tagging interface is integrated with the Toolkit database and front-end user interface. This allows any new and relevant FERC E-Library documents to be manually tagged. Results are automatically updated in the Toolkit and filterable by user-selected tags.
- Publications: This content is automatically updated through the Tethys Knowledge Base API. That is, any updates to the Tethys Knowledge Base are automatically reflected in the Toolkit.
- Spatial: Similar to Projects, a Google spreadsheet has been developed to enable addition of new, tagged spatial datasets to the Toolkit. Toolkit back-end code integrates spreadsheet information with front-end user functionality.
- Regulations: Changes to the regulatory landscape can be edited by users via the OpenEI platform through PRIMRE.

Significant Findings, Departures, and Challenges

A summary of key Task 1 results and departures is presented in Table 4.

Table 4. Summary of Task 1 Key Results and Departures

Milestones	Completion	Key Results and Departures
1.1 Database diagrams	9/30/2019	The relational Toolkit database diagram (Figure 3) defines the tables, columns, and relationships between database entities such that redundancy of stored information is minimized, and integrity of values is maximized. The structure of the database facilitates querying, making the underlying content relatable through the user interface. No departures.
1.2 Back-end databases	6/30/2020	MarineCadastre spatial databases were tagged and uploaded to the Toolkit server. FERC E-Library documents were manually downloaded, tagged, and stored on the Toolkit server. Publications are linked to the Toolkit through the Tethys Knowledge Base API. Additional marine energy information was curated on the OpenEI platform. Departures: Spatial data from regional planning body ocean portals were not integrated into the Toolkit; it was determined that many regional portal datasets are replicates from MarineCadastre.
1.3 Prototype Toolkit	12/31/2020	The prototype Toolkit was developed with pages for Regulations, Environmental Interactions, Projects, Management Measures (status reports), and Reporting Tool with spatial data and literature. Departures: Decision-making apps for siting or risk-ranking were not developed based on regulators' feedback. Regulators did not want apps for decision-making.
1.4 Document upload	3/31/2021	A Google-based document uploader was developed to provide guidance and a mechanism for addition of external documents to a user's Toolkit account. No departures.

Milestones	Completion	Key Results and Departures
1.5 Final Toolkit	6/30/2021	The final, fully functional Toolkit was demonstrated to DOE in May 2021. The Toolkit in its final form (marineenergy.app) has a stylish splash page with links to pages for Regulations, Environmental Interactions, About, FAQs (including Toolkit guidance videos), and the Reporting Tool, which enables users to query permitted U.S. marine energy projects, spatial data (MarineCadastre), documents (FERC E-Library and Tethys Knowledge Base), and management measures by technology, stressor, receptor, project phase, management measure, and consequence. Departures: None.

Challenges and Lessons Learned The biggest challenges faced in the latter phases of Toolkit development are issues related to server upgrades and maintaining consistency across different types of software. ata analytics continues to be an emerging field and different software platforms are upgraded at different rates. Differing upgrade rates can lead to and has led to dependency issues, which causes broken links and loss of front-end functionality.

An additional ongoing challenge is the lack of API exposure for MarineCadastre spatial datasets. During initial discussions with the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management, their developers indicated that an API would be shareable with the Toolkit team. However, subsequent conversations revealed that the NOAA programmers were asking the Toolkit team to develop their API, which would have been out of the scope of this project, and a significant effort. Therefore, spatial information for the Toolkit is scraped from MarineCadastre.

Technical hurdles that were overcome during BP2 Toolkit development were associated with inconsistencies between Toolkit tags and tags exposed via the Tethys API. These tagging issues involved, for example, more detailed user-selected tags (e.g., “Noise/Underwater” as opposed to just “Noise”) that resulted in No Data search results because the Tethys Knowledge Base does not tag literature to the level of detail as it does for its Management Measures. To mitigate this issue, rather than requesting a retagging of publications by the Tethys team, the Toolkit technical team developed code to automatically search the next level up in the tag hierarchy with a notification/message to the user that, for example, “Noise” results are provided instead of “Noise/Underwater.” Another tagging issue was associated with the Technology tag “Current,” which was eventually resolved by the PRIMRE group. Issues arose as the result of the removal of tags “Ocean Current,” “Riverine,” and “Tidal” from the “Current” tag, leaving only “Current.” Therefore, user searches for “Tidal” technology through the Toolkit, which maintained this granularity, resulted in zero results. After discussion with the PRIMRE group, they added the granularity back into the “Current” tag and the issue was resolved.

Task 2: Data Synthesis

The Task 2 goal was to collect and synthesize relevant topical expertise for uploading into the Toolkit throughout the project, focusing on regulatory process information and scientific information on stressor–receptor interactions. SMEs provided feedback by providing bibliographies and data sources. During BP1, the project team focused on regulatory process information while also beginning to identify supplementary environmental and regionally specific information. Environmental topics included, but were not limited to, the following areas:

- EMFs
- Sound/Noise
- Marine Mammal Interaction/Entanglement
- Fish Interactions
- Benthic Interactions

During BP2, the project team focused on the supplemental environmental and regional-specific databases as well as confirming document library functionality.

Budget Period 1 Accomplishments

In BP1, the project team focused on compiling and synthesizing information on regulatory process and regulations for marine energy, while also beginning to identify supplementary environmental and regionally specific information. BP1 Task 1 accomplishments included work on the following:

1. Subtask 2.1. Synthesizing regulatory framework data
2. Subtask 2.2. Synthesizing existing scientific data

Subtask 2.1

This task focused on compiling and synthesizing all relevant regulatory data, including information on permitting processes and regulations. This task included a review of regulatory best practices internationally to ensure any practical and effective efficiencies in the processes were leveraged, where possible. The project team focused on FERC, BOEM, USACE, and state processes for permitting marine energy projects and coordinated with other existing sources, such as the Pacific Energy Ventures MHK permitting handbook and the Pacific Northwest National Laboratory (PNNL) Handbook of Marine Hydrokinetic Regulatory Processes (2020). Much of this information was used to support the workshops with SMEs and regulators in Task 3.

Milestone 2.1

Regulatory process diagrams were collected for all relevant FERC, BOEM, USACE, and state processes internally reviewed by the project team for relevance and accuracy.

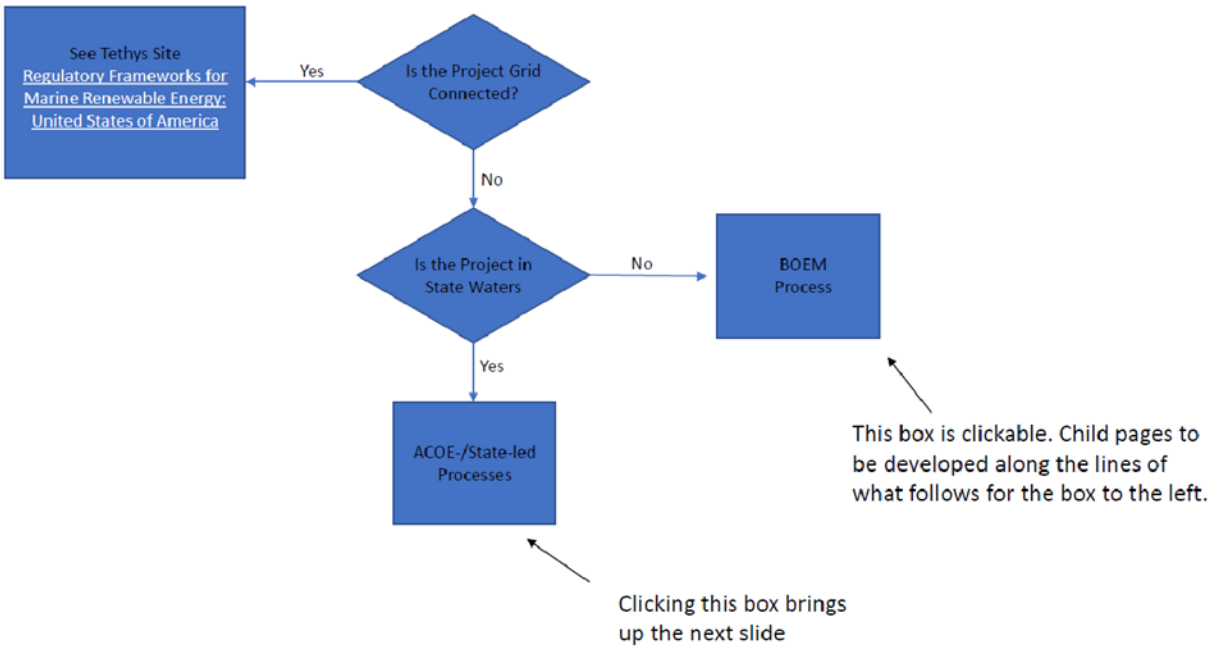


Figure 18. Flow diagrams for regulatory process, a decision-pathway approach was used for ease of incorporation into the Toolkit.

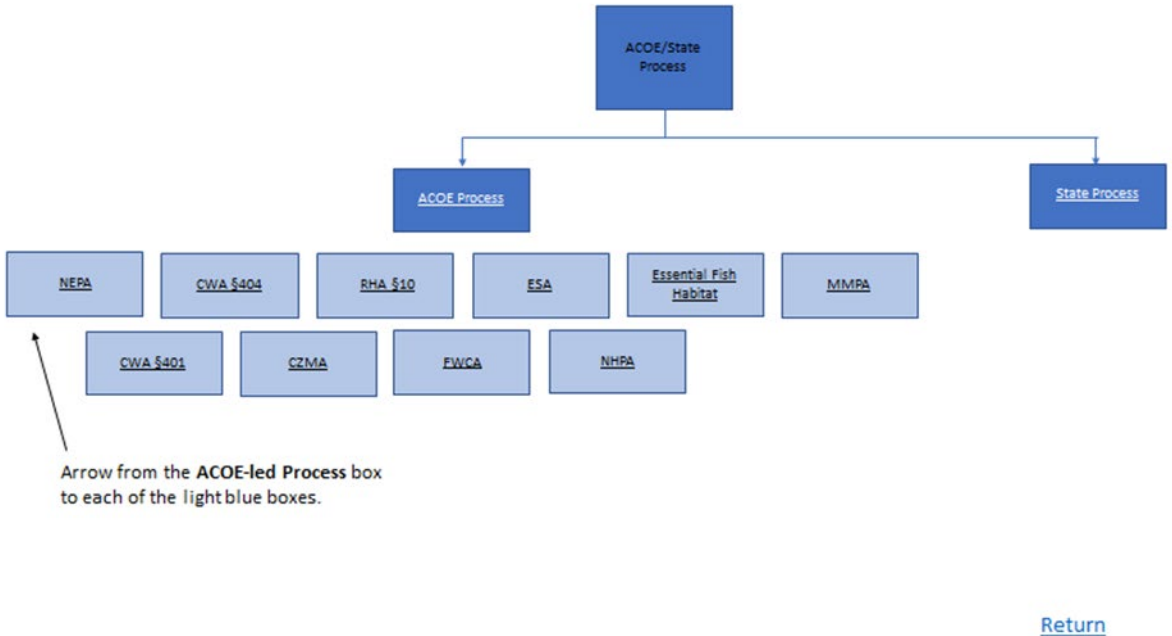


Figure 19. Example of a U.S. Army Corps of Engineers-led process

Figure 20. Example of state processes: Oregon's permitting process.

Regulatory process diagrams were developed using a decision pathway with clickable links for ease of use and incorporation into the Toolkit. The federal processes included non-grid connected project regulatory process (USACE as lead federal agency), and grid-connected FERC-led regulatory process both in state and federal (BOEM co-lead agency) waters. Development of the state process diagrams was initiated in BP1, using the Pacific Energy Ventures 2009 siting guidelines and the 2019 PNNL regulatory processes literature review documents, as well as specific searches for links to state processes. The regulatory process diagrams focused on using common regulatory processes with hydropower, linking to NREL's RAPID toolkit, where possible, with clear decision pathways for marine energy that deviate from FERC-led hydropower regulatory processes.

Subtask 2.2

This task focused on synthesizing the existing scientific information in academic articles, databases, and other sources for reference in the web Portal. The synthesis included input from SMEs within the technical team and external SMEs as needed. The information synthesized was used to inform materials developed for the first round of workshops (see Task 3).

Conceptual models of stressor–receptor interactions for five main environmental interactions were refined for sound/acoustics and benthic interactions based on input from workshops, including regulators and SMEs. These stressor–receptor interactions were further split into four project phases: 1) site characterization/assessment, 2) construction, 3) operations and maintenance, and 4) decommissioning. Conceptual models identify the linkages between stressors and receptors as a

framework for summarizing knowledge and level of understanding and identifying gaps and uncertainties. The interaction terminology was linked to the terms used in Tethys so that the synthesis information can be directly tied to the Tethys database, which is updated regularly once it is incorporated into the Toolkit.

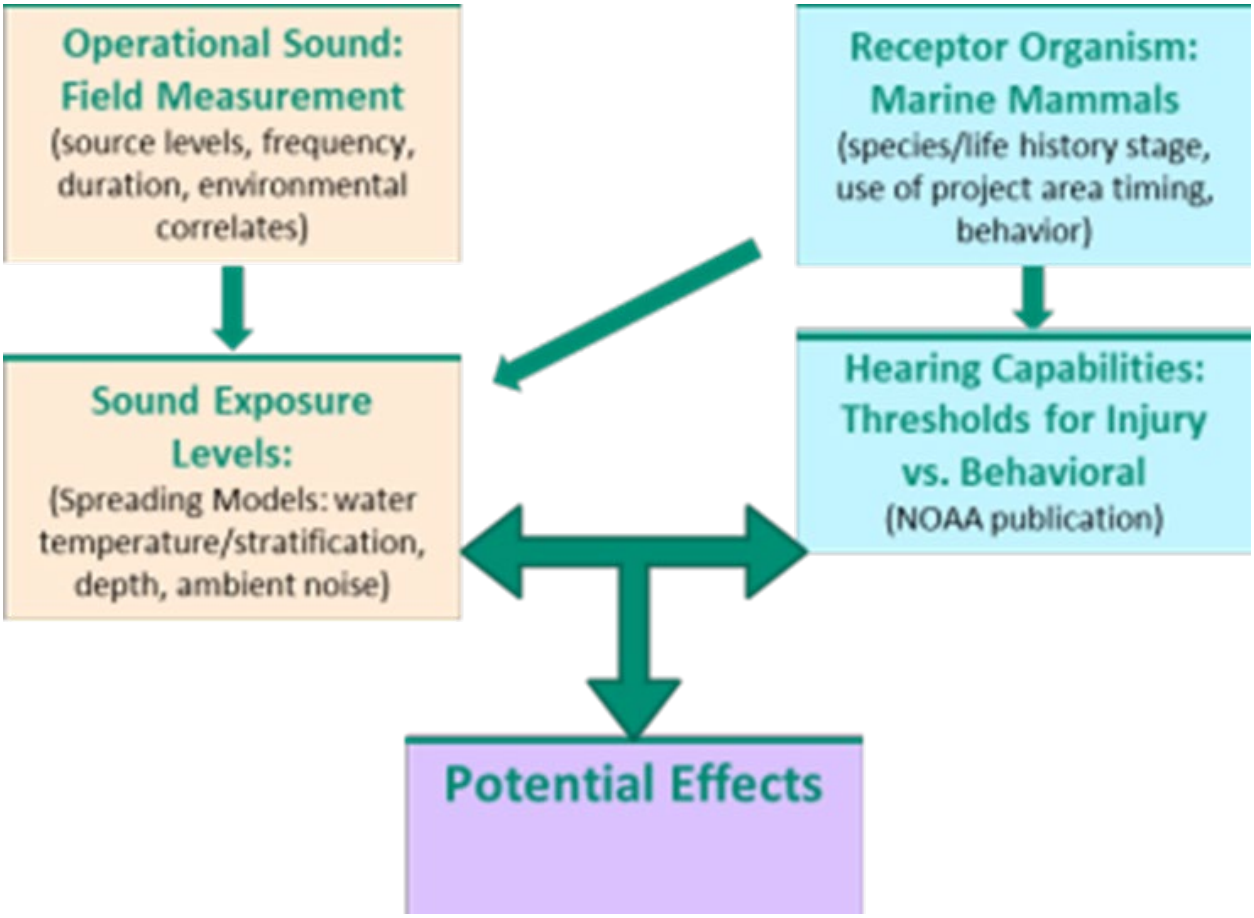


Figure 21. Example updated conceptual model for acoustics and marine mammals.

The stressors addressed include acoustics, EMF, and static and dynamic structure interactions with benthos and marine mammals. Additional syntheses were initiated for bird, fish, and sea turtle interactions, based on comments received from the east coast regulators workshops (Task 3). Direct and indirect interactions include behavioral (e.g., avoidance, attraction, displacement) and harm (e.g., injury, delays in migration, effects on communication, feeding, or predation) (Table 5).

Table 5. Example of Draft Stressor–Receptor Interaction Matrix for Projects at the Site Characterization/Assessment Phase

Activity	Stressor	Receptor	Key effect	Magnitude/Duration
Geotech/geophysical surveys	Acoustics: hydroacoustic surveys, Vessels	Marine Mammal	Avoidance, Communications masking	Negligible/Low
		Fish	Avoidance	Negligible/Low
		Sea Turtles	Avoidance	Negligible/Low
		Seabirds	Avoidance	Negligible/Low
	Physical Interaction: vessels	Marine Mammals	Injury/mortality	Low/Low
	Physical Interaction: Coring/Boring	Benthic habitat	mortality	Negligible/Negligible

For the marine energy projects that had undertaken FERC licensing, permitting documents were available on FERC's E-Library site. Specific permitting documents and studies were selected as case studies and incorporated in the Toolkit. These documents were downloaded and tagged using Tethys terminology (Tethys glossary https://tethys.pnnl.gov/glossary) so that when a user conducts a search in the Toolkit, it will link to specific documents in a manner similar to conducting a search directly in Tethys. Examples of projects that were tagged include PacWave South and North, ORPC's Cobscook Bay tidal project, Verdant's RITE project, Snohomish Public Utility District's Admiralty Inlet tidal project, Pacific Gas and Electric's Humboldt WaveConnect, and Ocean Power Technologies' Reedsport Wave Park. Tagged documents include license applications and supporting documents (e.g., site characterization, study plans, adaptive management plans), National Environmental Policy Act (NEPA) documents (e.g., environmental assessment), Endangered Species Act documents (e.g., biological assessments, biological opinions and concurrences), and other environmental regulatory documents. The document tagging matrix used drop-down menus in an Excel spreadsheet.

The project team evaluated the FERC documents for specific Tethys glossary terms and found that stressor–receptor terminology is not consistent across FERC permitting and licensing documents. Therefore, a list of synonyms to key Tethys glossary terms was developed by the project team to facilitate searches in instances of differing nomenclature (Table 6).

Table 6. Synonyms for Tagging FERC Documents [1]

Stressor/Receptor Term	Synonyms
Noise	Noise Acoustic Sound
Changes in Flow	Flow Current
Habitat Change	Habitat Species
Collision	Collision Collide Strike Contact
EMF	EMF Electric Field Field Magnetic Field Electromagnetic EMR
Attraction	Attract Aggregation Aggregate
Avoidance	Avoid
Displacement	Displace
Entrapment	Entanglement
Human Dimensions	Human Cultural resources Fisheries Commercial Fishing Use
Fish	Demersal Pelagic
Physical Environment	Temperature Geologic Sediment

Stressor/Receptor Term	Synonyms
Invertebrates	Benthic Floor
Birds	Avian Diving
Ecosystem Processes	Environmental Benefits
Reptiles	Turtle

[1] Terms not included in Table 5 did not require synonyms.

Subtask 2.3 (Bridge Task)

This task spanned both BP1 and BP2. This task focused on collecting and synthesizing all information not already found in existing databases (e.g., *Tethys* and MarineCadastre) such as FERC E-Library environmental and permitting documents. During BP1, the project team began identifying relevant supplementary information and initiated reviewing/tagging this information to upload into the Toolkit. This subtask continued through the go/no-go decision point as a bridge task and was completed in BP2.

Subtask 2.4 (Bridge Task)

This task also spanned both BP1 and BP2 with a focus on collecting geographical regional information in the U.S. During BP1, the project team identified relevant regional data to be included in the web Portal. This subtask continued through the go/no-go decision point as a bridge task and was completed in BP2.

Budget Period 2 Accomplishments

In BP2, the project team focused on the supplemental environmental and regional-specific database as well as confirming document library functionality.

BP2 Task 2 accomplishments included completion of the following:

1. Subtask 2.3. Synthesizing environmental information
2. Subtask 2.4. Synthesizing geographical regional information

Subtasks 2.3 and 2.4

The project team continued and completed identification and population of databases with supplemental environmental information utilizing international databases and reputable scientific sources. The focus for BP2 was to make sure that data could be seamlessly uploaded to the web Portal and required focused interaction with the Toolkit team.

Regulatory process diagrams were further developed, revised, corrected, and more fully integrated into the Toolkit. The regulatory process diagrams laid out a yes/no decision tree approach for the regulatory pathway needed to permit a project and provided the legal framework for the toolkit and synthesis. Members of the marine energy industry are the intended users for the regulatory process diagrams; the diagrams focus on providing already existing information on regulatory agencies, relevant federal and state statutes, and agency guidance for preparation of supporting documents. The main focus during BP2 was to make corrections and additions based on input from webinars during BP2, such as revising the FERC and non-FERC pathways, improving and clarifying the role of BOEM, indicating Memorandums of Understanding with federal and state agencies, clarifying the pilot FERC license pathway, and fixing links to state regulatory pathways.

During BP2, once the wealth of FERC documents and other project documents were tagged, the focus was to switch from the Excel spreadsheet tagging master document to the tagging application developed for the Toolkit. The FERC tagging application focused on approved projects, rather than new projects or projects that were ultimately not licensed, and associated documents such as NMFS biological opinions were included. The goal of the application was to make it straightforward to add future projects to the Toolkit, which provides a menu of interaction types based on identifying stressors, receptors, and consequences of those interactions. The application allows users to edit or add new FERC documents simply and efficiently.

Actual project timelines were an important part of the Toolkit to help developers and regulators understand realistic timelines for licenses and permits. As part of the timeline development, for each project, the draft and final license applications, and other relevant (non-FERC) permitting documents, were linked to the timeline as zipped files, so that the Toolkit user could click on a project draft license application and get linked to the zipped files that the application comprises.

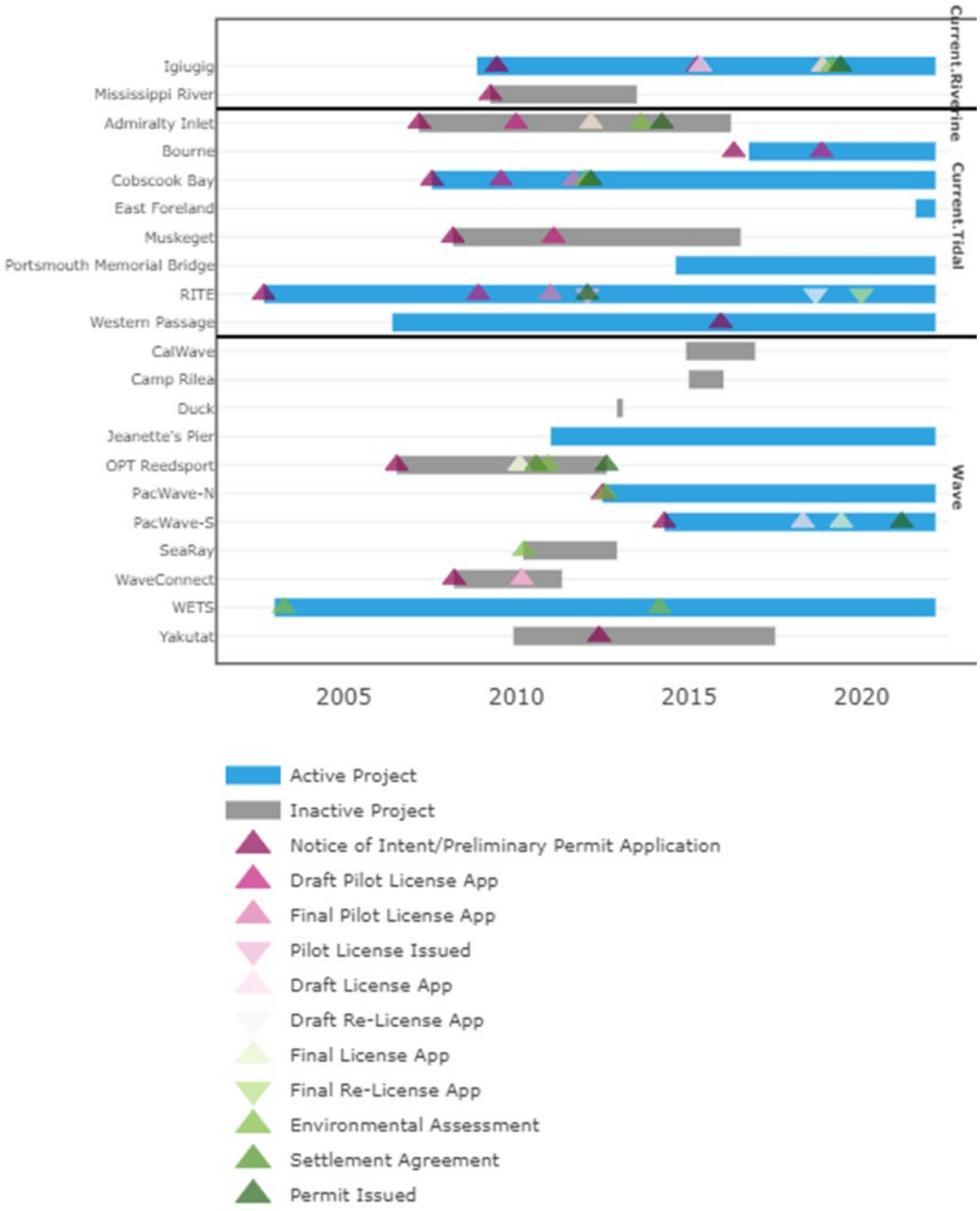


Figure 22. Example timelines for various projects.

Significant Findings, Departures, and Challenges

A summary of key Task 2 results and departures are presented in Table 7.

Table 7. Summary of Task 2 Key Results and Departures

Milestones	Completion	Key Results and Departures
2.1 Regulatory process diagrams	4/30/2020	The regulatory process diagram approach was drafted with initial decision pathway but required further revision to integrate it into the Toolkit; the diagram was finalized when the Toolkit was finalized. No departures.
2.2 Working document library	11/25/2020	The working document library was completed (Tethys and MarineCadastre spatial databases, initial FERC document tagging) and a document library walkthrough/demonstration was conducted with DOE on 11/25/2020. No departures.
2.3 Environmental database internally reviewed	6/30/2021	Supplemental environmental information was added to the Toolkit based on feedback from outreach meetings. Much of this focused on improving the tagging database and the FERC tagging app for FERC E-Library and other relevant permitting documents. No departures.
2.4 Regional-specific database internally reviewed	6/30/2021	Regional-specific information was added to the Toolkit focusing on mapping and timelines for relevant FERC and other permitting documents. No departures.

Specific challenges for the regulatory process diagram milestone were incorporating the information in a user-friendly way into the Toolkit, adding less frequently used pathways, documenting the relevant statutes for each state (which vary by state even for those statutes that provide consistency with federal regulations), and ensuring that the links provided the appropriate information.

FERC E-Library and other document tagging challenges were carefully and systematically reviewing documents to verify the specific stressor–receptor interactions that were actually analyzed for a given phase of a project and developing the application for the document tagging information so it was readily searchable and straightforward to add new projects. Additional challenges included achieving consistency in tagging and deciding how much information to provide to the user. For example, simply tagging a document by stressor–receptor, phase, and type (e.g., wave, tidal) is reasonably straightforward; however, noting best management practices and providing more information for the context for the stressor–receptor interaction, and finding the right level of detail, was a challenge. As the process went from an Excel spreadsheet to the Toolkit app, the team had to revisit the early tagged projects to determine the appropriate level of detail, and bugs in the app needed to be fixed.

For the project timeline, specific challenges include careful documentation of projects and timelines, specific pathways for permitting, especially for those not using the FERC pathways that are less available without contacting developers (e.g., USACE), and correct documentation of complicated multi-permit pathways.

Task 3: Outreach and Engagement

The Task 3 goal was to engage regulators and developers throughout the development of the Toolkit to ensure uptake and buy-in of the Toolkit by stakeholders, primarily developers and regulators, involved in permitting a marine energy project. Twelve interviews with state and federal regulators were conducted in BP1 to gather initial input on a series of six in-person workshops used to inform the development of the Toolkit. The goal in BP2 was to host another series of in-person workshops, conduct one-on-one or small group demonstrations, conduct a series of interviews focused on the cost–benefit of the Toolkit, and complete a pilot testing process.

Budget Period 1 Accomplishments

During BP1, the project team developed a project fact sheet and stakeholder database, engaged state and federal regulators for initial interviews, and prepared for, planned, and facilitated six in-person regulator workshops.

Subtask 3.1

The goal of Subtask 3.1 was to collect initial feedback and qualitative information related to the general goal of the project, potential interface elements of the Toolkit, additional data resources to integrate, and environmental interaction topics of interest in the region. Interviewees were selected according to their region, agency, and previous experience in permitting or licensing a marine energy project. In total, the following 10 regulators were interviewed:

- Jim R. Beyer, State of Maine Department of Environmental Protection
- Stephen Bowler, Federal Energy Regulatory Commission
- Kathryn Ford, Massachusetts Division of Marine Fisheries
- Delia Kelly, Oregon Department of Fish and Wildlife
- Kevin Keith, Alaska Department of Fish and Game
- Andy Lanier, Oregon Department of Land Conservation
- Dennis Nault, State of Maine Department of Marine Resources
- Stefani Stravakas, U.S. Fish and Wildlife Service
- Eric Wilkins, California Department of Fish and Wildlife
- Jeff Young, National Marine Fisheries Service, Pacific Northwest Region

Milestone 3.1

A critical piece of information gathered during these interviews consisted of environmental interaction topics related to the region. This was used to directly invite appropriate SMEs as guest speakers during the in-person workshops. The following five topics were recommended:

- Fish interactions
- EMFs

- Benthic interactions
- Acoustic/noise
- Marine mammal interactions/entanglement

Additional feedback shared by interviewees is summarized (Appendix B).

Subtask 3.2

The goal of Subtask 3.2 was to create a comprehensive stakeholder database of marine energy developers, SMEs and researchers, and state and federal regulators. The project team built on a stakeholder database of federal and state regulators developed during the Sandia-led Marine Energy ECCA project. Members representing select departments within the agencies below are included in the database.

Federal Regulators

- Bureau of Ocean Energy Management
- National Marine Fisheries Service
- National Parks Service
- National Oceanic and Atmospheric Administration
- Federal Energy Regulatory Commission
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- U.S. Coast Guard

State Regulators

- Alaska
    - Department of Environmental Conservation
    - Department of Fish and Game
    - Department of Natural Resources
    - Energy Authority
- California
    - Coastal Commission
    - Energy Commission
    - Ocean Protection Council
    - Office of Historic Preservation
    - State Lands Commission

    - State Water Resources Control Ford
    - Department of Fish and Wildlife
- Florida
    - Department of Environmental Protection
- Maine
    - Bureau of Land Resources
    - Bureau of Submerged Lands
    - Coastal Program
    - Department of Agriculture, Conservation, and Forestry
    - Department of Environmental Protection
    - Department of Marine Resources
    - Land Use Planning Commission
- Massachusetts
    - Coastal Zone Management
    - Department of Conservation and Recreation
    - Department of Environmental Protection
    - Department of Fish and Game
    - Environmental Policy Act Unit
    - Heritage and Endangered Species
- North Carolina
    - Division of Coastal Management
    - Wildlife Resources Commission
- New York
    - Department of Environmental Conservation
- Oregon
    - Coastal Management Program
    - Department of Energy
    - Department of Environmental Quality
    - Department of Fish and Wildlife
    - Department of Land Conservation and Development
    - Department of State Lands

  - Department of State Parks and Recreation
- Washington
  - Department of Ecology
  - Department of Fish and Wildlife
  - Department of Natural Resources

The stakeholder database was used to notify and advertise outreach and engagement events, primarily the in-person and virtual workshops.

Milestone 3.2

The project team internally reviewed and approved the stakeholder database before the in-person workshops.

Subtask 3.3

The goal of Subtask 3.3 was to host six in-person workshops, three on either U.S. coast, to share the project vision, gather feedback on the proposed design and functionality of the Toolkit, and provide an overview of existing scientific knowledge on one or two relevant environmental topics. Below is a list of the final in-person workshops.

Table 8. Round 1 Workshop Locations, Environmental Topics, and SME Presenters

Date	Location	Environmental Topic(s)	Presenting SMEs
January 13, 2020	**Danvers, MA** DoubleTree by Boston North Shore 50 Ferncroft Rd. Danvers, MA 01923	• Collision with Fish • Benthic Interactions	• Dr. Gayle Zydlewski, *University of Maine* • Dr. Emma Sheehan, *Plymouth University*
January 15, 2020	**Washington, DC** Federal Energy Regulatory Commission 888 First Street NE Washington, DC 20246	• Fish Collision with Tidal Energy Converters (TEC) • Acoustics of Wave Energy Converters	• Ana Couto, *University of Aberdeen* • Michael Macrander, *Integral Consulting Inc.*
January 16, 2020	**Boca Raton, FL** Florida Atlantic University 901 NW 35th St. Boca Raton, FL 33431	• Electro Magnetic Fields (EMF) • Acoustic Tracking of Cetaceans	• Dr. Stephen Kajiura, *Florida Atlantic University* • Joshua Lawrence, *European Marine Energy Center*

Date	Location	Environmental Topic(s)	Presenting SMEs
February 3, 2020	**Anchorage, AK** Marriott Anchorage Downtown 820 West 7th Avenue Anchorage, AK 99501	• Fish Collisions	• Dr. Andy Seitz, *University of Alaska Fairbanks*
February 5, 2020	**Salem, OR** Salem Convention Center 200 Commercial Street SE Salem, OR 97301	• Acoustics and Wave Energy Converters • Electro Magnetic Fields (EMF)	• Brandon Southall, *Southall Environmental Associates, Inc.* • Andrew Gill, *Centre for Environment, Fisheries and Aquaculture Science*
February 6, 2020	**Sacramento, CA** California Energy Commission HQ 1516 9th Street Sacramento, CA 95814	• Benthic Interactions • Fish Interactions and Wave Energy Converters	• Sarah Henkel, *Oregon State University* • Daniel Pondella, *Occidental College*

The project team coordinated with each presenter prior to the workshops. During these discussions, the project team provided an outline to develop the presentation focusing on answering these following questions:

- What is the potential interaction between a marine energy device and resource of concern both directly and indirectly?
    - Is there regionality to the interaction?
    - What is transferable knowledge between regions?
- What is known about the topic in terms of marine energy analogues (e.g., other industries)?
    - What is unknown or poorly known that would be helpful to know?
    - What are some common misconceptions?
- What needs to be measured to understand the interaction?
- How do you measure the metric (protocols, instrumentation)?
    - Are there accepted standards for measuring the metric?
    - What is the current state of the science?
- What is the role of models in the permitting process?

    - Are models available?
    - Can modeling help focus monitoring efforts to validate models?
    - What is the state of the science on current models?
    - What are the current limitations of existing models?
- What questions or information gaps remain?
- Conclusion and path forward
    - What is the level of confidence in understanding of the interaction and impact?
    - What are the needs for additional research or instrumentation development and additional monitoring data?

The project team developed the following basic agenda to build out each workshop.

1. Welcome & Introductions
2. Project Background
    a. Goals and Objectives
    b. Marine Energy Overview
    c. International Experience
    d. Wave and Tidal Energy Devices
3. Toolkit Summary
    a. Purpose and Intended Users
    b. Information Flows
    c. Demonstrations
    d. Synthesis and Data
4. Subject Matter Expert Presentations
5. Closing and Next Steps

In addition to the agenda, the project team developed a logistics and facilitation plan, presentation, and evaluation form. The presentation and evaluation form are included in Appendix E. A recording of each presentation, including SME presentations, is available on the Marine Energy Environmental Toolkit YouTube Channel.

Milestone 3.3

After completing the six in-person workshops, the project team summarized the discussion during the workshop, feedback and input gathered on the Toolkit and workshop setup, action items and next steps, and attendees. A full workshop summary is available in Appendix F.

In addition to the listed accomplishments, the project team developed the following marketing materials:

- Project Logo
- Project Fact Sheet
- Project PowerPoint Template

The materials listed above are included in Appendix G.

Budget Period 2 Accomplishments

The focus of the outreach efforts in BP2 was on the second round of virtual workshops and engaging potential developers to participate as a pilot project.

Subtask 3.2

The goal of Subtask 3.2 in BP2 was to continue to update and collect additional contacts. In total, the final stakeholder database included contact information for more than 350 marine energy regulators, developers, and SMEs.

Subtask 3.4

The goal of Subtask 3.4 was to host a second round of workshops with the entire marine energy community, i.e., not only regulators but also marine energy technology developers. This subtask included the planning, preparation, facilitation, note-taking, recording, and summarizing of the workshops. In preparation, the project team conducted an additional round of interviews and demonstrations with state and federal regulators.

Table 9. Virtual Workshop Preparatory Interviews

Name	Organization	Date/Time (Pacific Time)
Chris Potter	California Department of Fish and Wildlife	January 14, 2021, 3:00 p.m.
Jim Beyer	Maine Department of Environmental Protection	January 12, 2021, 8:00 a.m.
Dennis Nault	Maine Department of Marine Resources	January 8, 2021, 11:30 a.m.
Kathryn Ford	Massachusetts Department of Fish and Game	January 13, 2021, 9:00 a.m.
Delia Kelly	Oregon Department of Fish and Wildlife	January 12, 2021, 10:00 a.m.
Stefanie Stavrakas	U.S. Fish and Wildlife Service	January 6, 2021, 2:00 p.m.
Sean Eagan	National Marine Fisheries Service (Alaska)	January 12, 2021, 10:00 a.m.
Jeff Young	National Marine Fisheries Service (Oregon)	January 14, 2021, 11:00 a.m.

Name	Organization	Date/Time (Pacific Time)
Keith Kirkendall	National Marine Fisheries Service (Pacific Northwest)	January 14, 2021, 11:00 a.m.
Josh Dub	Federal Energy Regulatory Commission	January 13, 2021, 8:00 a.m.
Stephen Bowler	Federal Energy Regulatory Commission	January 13, 2021, 8:00 a.m.
Bill Foster	National Marine Fisheries Service (California)	January 15, 2021, 1:00 p.m.
Maria Eggert	Maine Department of Environmental Protection	January 12, 2021, 8:00 a.m.
Josh Brekken	Alaska Department of Fish and Game	January 27, 2021, 2:00 p.m.

The 14 regulators interviewed were asked a series of questions after a demonstration of the Toolkit related to the overall design and usefulness of the Toolkit, future application development, and use cases to inform the interactive demonstration of the Toolkit at the second round of workshops.

Feedback

Generally, interview participants were pleased with the current state of the Toolkit as the upcoming outreach schedule. Several indicated they could envision themselves using the Toolkit. One state east coast regulator directly asked if the Toolkit was available for use now and indicated they would recommend updating their department's internal protocols for reviewing applications with the use of this Toolkit. One state and three federal west coast regulators and two state east coast regulators inquired about the application's use or expansion to include information relevant to permitting offshore wind projects. One federal west coast regulator suggested confirming the Toolkits usefulness with leadership in NMFS and the broader public.

Toolkit Components and Interface

Participants were asked to provide initial feedback on the Toolkit interface, components, and design, whether the reporting tool contains useful information, and if the Toolkit met expectations.

- Several interviewees, at state and federal agencies based on both coasts, appreciated the ability of the Toolkit to pull in several sources of information that would ultimately cut down on the amount of Google searches during their process.
- Two federal regulators based on the east coast suggested a reordering of the configuration tab on the reporting tool, stating that the process to develop queries by selecting different tags for stressor, receptor, and technology was not intuitive.

- A majority of the interviewees (~70 percent) indicated they would be able to provide more specific feedback once they could interact with the Toolkit themselves.[1]

Improvements

Interviewees were asked what improvements could be made to the Toolkit to improve its usefulness during a permitting and licensing process.

- Five regulators, from both state and federal agencies on both coasts, stated that the Toolkit should include more academic and literature resources than the Tethys Knowledge Base. For example, academic literature from other industries (telecom, oil and gas, and offshore wind) may be applicable to marine energy.
- One state east coast regulator specifically referenced the North East Ocean Portal as a regional resource to include in the Toolkit. The Project Team is aware of the Ocean Portal and is considering its integration along with other data sources into the Toolkit.
- One state east coast regulator indicated the need for more information on specific environmental interactions with different technologies and a better understanding of how this would be included in regulators' workflow.
- One state west coast regulator suggested that information is displayed related to when the Toolkit was last updated or pulled information from the source database or application.
- Two federal regulators, one from each coast, recommended the inclusion for more holistic information such as literature on battery technology or grid interconnection and funding resources for developers.

Application Development

Interviewees were asked to prioritize two potential applications: either a siting application that compared resource value and species sensitivity on a heatmap and table or an issues matrix that organized key effects and magnitudes of various development activities; both applications were showcased in the initial workshops. Participants were also invited to share any additional ideas for future application developments.

- One federal east coast and four state east coast regulators prioritized the siting application, and one west coast state regulator prioritized the issues matrix.
- Seven interviewees did not share a priority for either application.
- One federal east coast regulator suggested leveraging the MarineCadastre to identify potential user conflicts.
- One state west coast regulator suggested that the siting application may cause concern with other ocean stakeholders or users who would want to be involved with any application development that would prioritize or zone the marine environment. They further indicated that

[1] After the interview process, several interviewees shared the state of the interface (where to click) to develop queries for a report was clunky and difficult to navigate. This led to the redevelopment of the interface for improved user experience.

the issues matrix may not get used by developers who have a set way of reviewing applications they receive.

The feedback provided directly informed the project team's preparation and planning for the virtual workshops.

Table 10. Round 2 Virtual Workshop Dates, Environmental Topics, and Presenters

Date	Workshop	Environmental Topic	Subject Matter Expert Presenter(s)
February 2, 2021	General Webinar 1	• International Examples	• Paul Tait, European Marine Energy Center
February 9, 2021	General Webinar 2	• International Examples	• Paul Tait, European Marine Energy Center
February 17, 2021	Regulatory Webinar 1	• Tidal and Wave Technology • Fish Collision	• Justin Klure, *Pacific Energy Ventures, and Kerry Grantham, Ocean Renewable Power Company* • Garrett Staines, *Pacific Northwest National Laboratory*
February 24, 2021	Regulatory Webinar 2	• Acoustics • Tidal Technology	• Joe Haxel, *Pacific Northwest National Laboratory* • Jonathan Colby, *Verdant Power*

Date	Workshop	Environmental Topic	Subject Matter Expert Presenter(s)
March 3, 2021	Regulatory Meeting 3	• Electromagnetic Fields (EMF) • Acoustics and Marine Mammals	• Andrew Gill, *Centre for Environment Fisheries and Aquaculture Science (Cefas)* • Kaus Raghukumar, *Integral Consulting Inc.* and Dr. Brandon *Southall, Southall Environmental Associates, Inc.*
March 15, 2021	Q&A Webinar	N/A	N/A

Similar to the initial round of workshops, the project team developed a presentation outline for SME presenters and conducted dry runs of their presentations.

Academic Researcher

- Topic you are addressing
- Who you are, background
- 2020 presentation recap/high level, questions addressed were:
    - Potential interaction between marine energy project and resource of concern both direct and indirect
    - What is known about [topic] in terms of marine energy case studies or marine analogues (e.g., other industries)?
        - What is unknown/poorly known and would be good to know
    - What needs to be measured (metrics)?
    - How do you measure the metric (protocols, instrumentation)?
    - What is the role of models, and are they available; for example, the use of probability of encounter models for collision risk (for marine mammals and fish)?
    - Can modeling help focus monitoring (to validate models)?
        - What questions/gaps remain?

    - Conclusions and path forward (i.e., confidence in understanding of impact, need for additional research or instrumentation development, need for additional monitoring data).
- Updates since 2020 workshops
    - New studies or research conducted, references (if available)
        - Marine energy projects, analogues
        - Metrics update
        - Protocols and instrumentation update
        - Models update
    - Synthesis of any new findings and current understanding of risks
    - New uncertainties/information gaps that need to be addressed, and how?
        - Are the uncertainties the same as last year, or are we making progress addressing them and new uncertainties have arisen?
- Thinking about the path forward, what steps should we take to decrease uncertainties in the short term (next few years), and in the longer term (next 5–10 years)?

Government or Laboratory-Led Initiatives

- Who you are, background
- The research initiative you are addressing, background, goals
- How does your initiative/studies help the marine energy industry and permitting process? Does it address
    - Metrics
    - Protocols
    - Instrumentation
    - Models
- Overview of current studies (what is being studied and where, anticipated timeline, any early sharable results)
- Challenges

Project Developers

- Topic you are addressing [marine energy project, studies conducted]
- Who you are, background
- Project description, describe device types, location etc.
- History of main environmental permitting issues
    - Overview of studies required as part of permitting requirements

    - How issues were ultimately resolved
- Device deployments and environmental study findings
- Lessons learned – what would you do differently, the same, ...
- How has your project contributed to improving understanding of interactions and decreasing uncertainty?
- What are remaining knowledge gaps, and what is the path forward for your sector of the marine energy industry?

Materials

The project team developed the following materials for the second round of virtual workshops.

- Agenda
- PowerPoint Presentation
- Updated Project Fact Sheet
- Post-workshop Evaluation Form
- Pilot Testing Factsheet
- Meeting Support Plan
- Additional Materials from DOE, NOAA, and BOEM Projects
    - DOE Marine Energy Work Projects Overview
    - MarineCadastre
        - The Ocean is Open for Business
        - Ocean Reports FAQ
        - Ocean Reports Top Five Things to Know
    - TEAMER. Better Together Fact Sheet

Milestone 3.4

Upon completion of the virtual workshops, the project team summarized the discussions and feedback. A summary is available in Appendix F.

Subtask 3.5

The goal of Subtask 3.5 was to engage potential projects to pilot test the Toolkit. During BP1, the focus was to identify an initial list of potential projects. Using the FERC E-Library and contacts within various organizations, the project team identified the following projects as potential pilot testing projects.

- Turnagain Arm Tidal Energy Corp Turnagain Arm Tidal Electric Generation Project
- Ocean-Based Perpetual Energy Gulf Stream Current Project
- Marine Energy Collaborative of New England (MRECo) Borne Tidal Test Site

- Littoral Power Systems Kootznahoo Inlet Tidal Energy Project
- ORPC's Cook Inlet Tidal Project

The project team also developed a pilot questionnaire, available in Appendix E, to gather specific feedback on the user experience with the Toolkit.

Due to timing and interest, ORPC's Cook Inlet Tidal Project was selected as the pilot testing project. The project team hosted a series of meetings to train regulators and developers on how to use the Toolkit and collect feedback on changes or improvements of the Toolkit.

Table 11. Pilot Testing Process Outreach and Engagement

Date	Participants

December 17, 2021	• Project Team
	  ○ Zach Barr, *Kearns & West*
	• Ocean Renewable Power Company
	  ○ Nathan Johnson
	  ○ Marie Caspard
	  ○ Merrick Jackinsky
	• U.S. Fish and Wildlife Service
	  ○ Elizabeth Gratton
	  ○ Douglas Cooper
	  ○ Kevin Foley
	• National Marine Fisheries Service
	  ○ Sean Eagan
	  ○ Jill Seymour

May 9, 2022	• Project Team
	  ○ Zach Barr, *Kearns & West*
	• National Marine Fisheries Service
	  ○ Sean Eagan
	  ○ Jill Seymour
	• U.S. Fish and Wildlife Service
	  ○ Carol Mahara

Date	Participants

June 29, 2022	• Project Team
	  ○ Sharon Kramer, *H.T. Harvey & Associates*
	  ○ Zach Barr, *Kearns & West*
	• Ocean Renewable Power Company
	  ○ Katie Reynolds
	  ○ Corrine Lamond
	  ○ Marie Caspard
	  ○ Merrick Jackinsky

June 30, 2022	• Project Team
	  ○ Sharon Kramer, *H.T. Harvey & Associates*
	  ○ Zach Barr, *Kearns & West*
	• Ocean Renewable Power Company
	  ○ Katie Reynolds
	  ○ Corrine Lamond
	  ○ Marie Caspard
	  ○ Merrick Jackinsky
	• National Marine Fisheries Service
	  ○ Sean Eagan
	  ○ Jill Seymour
	• U.S. Fish and Wildlife Service
	  ○ Carol Mahara

Regulators during the meetings shared the following feedback.

- Data collection for federal agencies typically begins with internal systems and information (studies or biological opinions), reaching out to other analogue or similar projects, and contacting other regulatory organizations. Regulators recommended using publicly available databases (i.e., NMFS repository) as an additional information source for the Toolkit.
- Developing a Toolkit with all the information for one-stop searching would be beneficial to the permitting process. If a Toolkit is able to bring in all the information into one place, it will continue to get use from the regulatory community.
- Information from other analogue industries would be another great database or information source to include in the Toolkit. Regulators noted that this may be a technical challenge due to the nascency of the marine energy industry and what existing information other industries may have. Regulators also cited international sources of information where more projects are deployed as a helpful resource.

- Regulators must use the best available science and not prioritize papers or research conducted by their own, or other, agencies. When studies or research contradict each other, the agency prefers approaches that consider both studies.
- Agencies often have access to standard mitigations for certain effects on the environment.

Milestone 3.5

After completing the meetings with ORPC and various federal agencies, the project team summarized the feedback collected through pilot questionnaires and meeting discussions. A summary of the feedback is available in Appendix B.

Additional Accomplishments

In addition to the described tasks and milestones above, the project team engaged developers and other groups and organizations to conduct a demonstration of the Toolkit.

Table 12. Toolkit Demonstrations

Date	Organization
May 25, 2021	DOE Project Team
May 25, 2021	DOE NEPA Team
May 25, 2021	Ocean-Based Perpetual Energy
June 2, 2021	ORJIP
June 3, 2021	BOEM
June 3, 2021	Resolute Marine Energy
June 4, 2021	Barrett Energy Resources
June 4, 2021	MRECo
June 4, 2021	Littoral Power Systems
June 9, 2021	TEAMER
June 15, 2021	National Hydropower Association Marine Energy Council
June 17, 2021	Resolute Marine Energy (2)

Conference Appearances

The project team was also able to increase Toolkit awareness through several poster presentations and similar activities at various conferences.

- International Conference on Ocean Energy 2021, Virtual Poster Presentation, April 28–30
- National Hydropower Association Clean Currents Conference 2021, Poster Presentation, October 20–22
- Ocean Sciences Virtual Meeting 2022, Townhall Presentation, February 24–March 4
- Waterpower Week 2022, Marine Energy Council Regulatory Affairs Work Group Tabling and Demonstrations, April 5–7
- Ocean Technology Conference, Conference Paper and Presentation, May 2–5

Materials developed for these events are available in Appendix G.

Significant Findings, Departures, and Challenges

A summary of key Task 3 results and departures is presented in Table 13.

Table 13. Summary of Task 3 Key Results and Departures

Milestones	Completion	Key Results and Departures
3.1 Stakeholder Assessment Synthesis	9/30/2019	The Stakeholder Assessment Synthesis summarizes the feedback provided from state and federal regulators. This includes features of a successful Toolkit, regional topics for presentation at the initial round of workshops, additional resources to include in the Toolkit, and workshop design and execution. No departures.
3.2 Internal Review of Stakeholder Database	9/30/2019	The Stakeholder Database contains contact information of stakeholders (federal and state regulators, developers, and SMEs) who may be interested in the Toolkit. The database was used by the project team to send invitations, notifications, and other project materials throughout the project. No departures.
3.3 Round 1 Workshop Summary	4/30/2020	The project team planned, facilitated, and summarized the initial round of workshops. The feedback gathered informed Toolkit development, data synthesis, and future outreach. North Carolina was originally selected as a destination for one of the in-person workshops. However, due to lack of regulator interest, the project team selected Florida in lieu of North Carolina as a destination for one of the east coast workshops.

Milestones	Completion	Key Results and Departures
3.4 Round 2 Workshop Summary	4/30/2021	The project team planned, facilitated, and summarized the second round of workshops. The feedback gathered informed Toolkit development, data synthesis, and future outreach. Originally, the second round of workshops were to be in-person like the initial round of workshops. However, due to Covid-19 restrictions and guidelines, these workshops were held virtually. In addition, due to developer interest, the project team hosted two general webinars and invited developers and regulators.
3.5 Pilot Project Lessons Learned	6/30/2022	The project team conducted trainings and an exit interview for developer and agency staff members of the ORPC's Cook Inlet Project. No departures.

Challenges and Lessons Learned

Specific challenges for conducting the second round of workshops stemmed from the Covid-19 pandemic. In addition to restricting in-person congregating, the Covid-19 pandemic heavily impacted the normal workday, method of working, and overall mental health of stakeholders. This required a new approach to engaging stakeholders for the second round of workshops to ensure the highest quality feedback possible. This included reducing the length of the workshops to 3 hours to reduce screen fatigue, separating out the question-and-answer portion of the workshops into a separate workshop, and conducting smaller group engagements around busy stakeholder schedules to gather feedback.

Specific challenges to the pilot testing process included engaging potential projects at the correct time. The permitting process for marine energy projects typically takes several years. The timeframe to conduct the pilot testing process was 4 months, making the feedback from the process based partly on what is occurring now and what could potentially come up as an issue during the permitting process in the future. The exit interview was used as a forum to collect some of the information on what future issues could arise during the permitting and licensing process.

Appendix A.

Summary Cost Memo.

Marine Energy Environmental Toolkit Costs Memo

Introduction and Purpose

The Marine Energy Environmental Toolkit for Permitting and Licensing project team has developed a one-stop shop for academic literature (largely from Tethys), regulatory documents (FERC E-library), and spatial information (MarineCadstre) in coordination with state and federal regulators and developers. Currently, the project is scheduled to conclude in December 2021[1]. Based on discussions between the PRIMRE and Toolkit teams, the current Toolkit team is best positioned to maintain the Toolkit due to its expertise in Rstudio and Shiny applications and the team's existing Shiny server. Additionally, developing and setting up a new Shiny server, moving the current Toolkit, and debugging the new system would incur an additional cost. This document outlines the tasks and estimated costs for annual maintenance of the Toolkit. An executive summary table outlines the maintenance costs (Table 1) at the end of this document.

Technical System Requirements

All software used is open-source and code developed and is publicly available. Code is stored and versioned in the following Github repositories for free under the organization github.com/**marineenergy**.

Hosting. Our current cloud hosting at DigitalOcean.com costs a total of $90/month ($1,080/year):

- $40/month: machine
  4 vCPU, 8 GB memory, 160 GB storage -
- $50/month: extra storage
  500 GB volume

Once the bulk of spatial datasets are ingested of those downloaded from MarineCadastre.gov we anticipate upgrading the server to the next tier for faster performance and dropping the extra storage so operating costs of $80/month ($960/year):

- $80/month: machine
  8 CPUs, 16 GB memory, 320 GB storage

Maintenance

The estimated cost to maintain current Toolkit components ranges from zero to 40 FTE hours per month. These hours would be for attending to new spatial datasets (if any; updated spatial data would be automatically detected and technical staff would be alerted), updating new marine energy projects (if any) including location and permitting and licensing documentation curation, ensuring that the latest FERC E-Library documents are tagged and curated, and updating website language as necessary. More details regarding each Toolkit component are described below.

[1] A six-month no-cost time extension was requested on December 6, 2021

Components

Projects

The project components consist of an interactive map and timeline of Marine Energy projects in the U.S. and allows users to access project information and permitting and licensing documents based on milestones of each project. The information displayed on the map and timeline is housed in a Google sheet, to which users may suggest edits if new information is available. Updates to the Google sheet are done manually and then automatically ingested with an R script into the map and timeline.

Regulations

The regulations component of the Toolkit includes a regulatory diagram, a repository of existing resources (or links to external sources), brief descriptions for state and federal regulations, and regulatory roadmaps (PEV/PNNL 2020). The regulatory diagram and roadmaps are static images on the Toolkit website. These images are currently drawn in Adobe Illustrator and must be updated manually. However, future iterations may make use of Google Drawings, which enables community updates. The repository of existing regulatory resources, including brief descriptions, is maintained on OpenEI, a wiki-based platform that is community editable.

Spatial

Spatial data are currently automatically scraped from MarineCadastre. These datasets are curated in a Google Sheet, where they are manually tagged to create Structured Query Language (SQL) to communicate with the database. Tagging of a new dataset is estimated to require between 10 min to 1 hr, depending on the complexities of the data. Ideally, the MarineCadastre team will provide notice of any updates (new datasets or new metadata fields of existing datasets within the Toolkit) that would require maintenance.

Literature, Interactions, and Management Measures

The Environmental Interactions tool provides an overview of the number of available Tethys Knowledge Base references based on specific stressor-receptor interactions (i.e. pairs of stressor-receptors). The Management Measure tool allows users to search and query a robust compilation of marine energy management measures that were identified by international marine energy regulators and researchers. Both the Environmental Interactions and Management Measures are currently “scraped” from the Tethys website, so updates are brittle to changes on the website. Whereas the Literature from Tethys is consumed via an API which is expected to be consistent with future updates and less prone to breaking.

Documents: FERC eLibrary Tagging

Without the implementation of natural language processing (NLP) tools to automatically tag FERC E-Library documents, manual tagging by an expert would be required. A users guide to using the FERC E-Library to find FERC docket numbers, conduct a FERC docket search to find appropriate documents and description of how to tag them has been developed and is available here. The “how to” guide also explains how to track a docket number so that the user can receive emails when new documents are available on the FERC E-Library.

If we assume there are 2 or fewer projects per year with significant progress on FERC applications (e.g,. draft license application or final license application), it takes approximately 24 hours to tag, review, and finalize tags for all relevant documents in a FERC license application (NEPA, ESA, MMPA, and other

appendices that include study plans, adaptive management frameworks, etc.); therefore, up to 50 hours annually for tagging and QA/QC. The staffing required would be a minimum of a Bachelor's degree with relevant experience, or an MS degree or higher, in biological, ecological, or environmental fields. Ideally, the FERC document tagging would occur at least annually.

Outreach and Engagement

One of the reasons the Toolkit has been well received to date is the active engagement and listening to reviewer feedback, and providing subject matter expert presentations of interest. During maintenance and updating of the Toolkit stakeholders would be engaged on a quarterly or milestone basis to share updates, gather feedback, and discuss users' needs. These meetings would likely be virtual webinars or in-person at large conference events such as IMREC, ICOE, or OREC, as appropriate. Subject matter experts would also be invited to present on relevant topics, similar to the workshops held as a part of the initial Toolkit effort. Additional outreach will be conducted with pilot testing projects. Estimated costs include technical staff to present Toolkit updates, planning, preparation and advertisement of the event, and honorariums for subject matter experts.

Summary of Annual Costs

Annual low-cost scenario summary table. Annual assumptions:

- *One new project for FERC document tagging*
- *Minimal updates and ingestion of new spatial datasets*
- *One virtual meeting*

Category	**Task**	**Cost**
Technical System Requirements	Server Hosting	$960
Maintenance	Component Maintenance	$30,000
Maintenance	FERC E-Library Documents Tagging	$6,000
Maintenance	Outreach and Engagement	$18,000 (virtual meeting) $5,000 (pilot testing outreach)
Contracting	Lab Overhead Costs (assumes AOP contracting method)	17-20% ($10,193 - $11,992)
	Total Annual Costs	$71,952 (20% lab overhead)

Mid-cost scenario summary table. Annual assumptions:

- *One new project for FERC document tagging*
- *Moderate updates and ingestion of new spatial datasets*
- *One in-person meeting and one virtual meeting*

Category	**Task**	**Cost**
Technical System Requirements	Server Hosting	$1080
Maintenance	Component Maintenance	$47,500
Maintenance	FERC E-Library Documents Tagging	$6,000

Maintenance	Outreach and Engagement	$25,000 (in-person meetings) $18,000 (virtual meeting) $5,000 (pilot testing outreach)
Contracting	Lab Overhead Costs (assumes AOP contracting method)	17-20% ($17,439 - $20,516)
	Total Annual Costs	$123,096 (20% lab overhead)

High-cost scenario summary table (all assumptions mentioned above)

Category	**Task**	**Cost**
Technical System Requirements	Server Hosting	$1560 ($80/mo for enhanced CPU and $50/mo for larger storage) for contingency of data requirements of MarineCadstre Datasets
Maintenance	Component Maintenance	$95,000
Maintenance	FERC E-Library Documents Tagging	$12,000
Maintenance	Outreach and Engagement	$25,000 (per in-person meeting, 4 meetings total); $5,000 (pilot testing outreach)
Contracting	Lab Overhead Costs (assumes AOP contracting method)	17-20% ($36,305 - $42,712)
	Total Annual Costs	$256,272 (20% lab overhead)

These maintenance costs could be funded through a laboratory annual operating plan (AOP). The costs provided above include lab overhead costs for this contracting method.

Appendix B.

Stakeholder Interview Summaries

Stakeholder Discussions: Summary

Interviewees:

Kearns & West has interviewed a total of 10 regulators from state and federal agencies, including the Federal Energy Regulatory Commission, U.S. Fish & Wildlife Service and National Marine Fisheries Service. From state agencies, we have spoken to representatives from Alaska, California, Massachusetts, Maine and Oregon. The purpose of these interviews is to gather initial feedback regarding regulators' needs and comfort with the project, Toolkit, and possible user interfaces. The names of the interviewees are listed below:

- **Jim R. Beyer**, State of Maine Department of Environmental Protection
- **Stephen Bowler**, Federal Energy Regulatory Commission
- **Kathryn Ford**, Massachusetts Division of Marine Fisheries
- **Delia Kelly**, Oregon Department of Fish and Wildlife
- **Kevin Keith**, Alaska Department of Fish and Game
- **Andy Lanier,** Oregon Department of Land Conservation
- **Dennis Nault**, State of Maine Department of Marine Resources
- **Stefani Stravakas**, U.S. Fish & Wildlife Service
- **Eric Wilkins**, California Department of Fish and Wildlife
- **Jeff Young,** National Marine Fisheries Service – Pacific Northwest Region

Toolkit Development:

1. What are the key features of a successful Toolkit? What features would make a Toolkit most usable for you?

   Recommended Content (the first bullet is mentioned by two people; the remainder by a single individual)

   - Include extensive information from federal and state agencies.
   - Provides transparency with caveats, limitations and the methodology behind what information is and is not included.
   - Include the state-by-state titles and agencies of relevant staff (departments, not names of individuals since this will change) to the MHK permitting process.
   - Apart from having scientific literature, the Toolkit must have information on how developers/regulators have solved MHK related problems.
   - Include information on where projects are happening, what stage they are in the permitting process, what other projects have been licensed nearby and what comments were made in those projects.
   - Include information that helps regulators determine when a geographical area has reached full capacity of MHK development.

- Habitat type, ESA/protected species, interactions with proposed WEC technologies, baseline information, interactions and behavioral changes, jurisdiction resources, and estuaries information.
- Information related to proposed activity impacts or environmental impacts.
- State by state regulatory differences and program needs.

GIS (first bullet by 2 ppl; second 1)

- Include spatial information (GIS maps) that allows you to obtain data on specific geographical areas and assess the issues specific to that area.
- Has the ability to layer the proposed area of development to understand the various environmental resources.

Searchability (first bullet by 2 ppl; others 1)

- Easily searchable by having an opening portal that provides users a roadmap of the information that is available in the Toolkit.
- Accurate and updated in a timely fashion.
- Meta data catalog records that are searchable and meet appropriate data standards for ISO and catalog.

User Interface (individuals)

- Fosters engagement by notifying users via email when new projects/information is added. (D.K)
- A simple interface that's easy to navigate.

2. Feedback on Scotland Natural Heritage toolkit mockup (snh.ecoquants.com)

Praise (first bullet 3 ppl; others 1)

- Enthusiasm that the Toolkit will bring all communications in one place, enabling inter-agency cooperation and avoiding multiple agencies from attempting to solve the same problem.
- Excitement about the Toolkit's ability to show where MHK projects are taking place.
- Transparency and the ability to maintain a log of issue resolution.

Concerns (individuals for each bullet)

- Reservations about the Toolkit's attempting to convert "complex and dynamic" regulatory proceedings into simplified conversations through the "issues" page.
- Concern that having a record of regulator's exchanging ideas will create room for misinterpretation and may prompt developers to use the discussions taking place for one specific location and apply them elsewhere.
- Concern regarding regulators' lack of familiarity with the Toolkit's issue listings and communication tracking. This may impede regulators from understanding the usability of the Toolkit.

- Concern about who will have the ability to contribute to conversations and how will the identity of contributors be verified. In addition, how will regulators choose what conversations should take place in public (through the Toolkit) or in private.
- Concern that the data provided through GIS mapping tends to be too broad for the complex MHK regulatory process that requires specialized data that is needed for specific permitting processes.
- Concern that MHK data is constantly changing and having information about past projects in the Toolkit may quickly become irrelevant.
- Concern that the criteria for ranking issues is project specific.
- Concern this would ultimately add more work for regulators in the permitting and licensing process.

Suggestions (Individuals)

- Suggestion to make the conversations in the Toolkit password protected so only authorized individuals can make comments.
- Suggestion to make the conversations in the Toolkit based on individual projects and not in an open forum style.

Synthesis of Topical Expertise Feedback

1. What topics would you like included in the Toolkit?

   The project team suggested the following five topics, they are positioned based on ranking of agreement from the interviewers:

   - Fish interactions
   - Electromagnetic interactions
   - Benthic interactions
   - Acoustics/noise
   - Marine mammal interactions/entanglement

   The following topics emerged from our conversations with regulators. They are listed based on ranking of agreement from the interviewers:

   Marine topics:

   - Commercial fishing information
   - Impacts related to cables placed on seafloor
   - Freshwater fish information
   - Fisheries' location near project and shore
   - Marine species present in the proposed areas for development
   - Marine resources present
   - Marine resources throughout the water column
   - Fouling information: how to prevent it
   - Behavioral changes
   - Marine mammal collision

Off-shore topics:

- Nearby infrastructure/resources (on shore and offshore)
- Private landowners' information
- Cultural resources
- On-shore resources information: Accessibility to the area of development
- Horizontal directional drilling information
- Aesthetic impacts to viewshed
- Habitat type

Avian

- Avian information, including migratory birds and lighting interactions for seabirds

Regulatory topics

- State by state regulatory frameworks

Other topics

- Information from relevant international projects
- Endangered Species
- Resource guide for developers to understand DOE's funding mechanisms
- Resource guide to make BOEM's information easier to find
- Case studies of previous MHK projects detailing how problems have been mitigated
- GIS currents data to help developers know where to locate projects
- Jurisdictional resources
- Estuaries

2. What resources should we include in the Toolkit?

National

- U.S.F.W Information for Planning and Consultation (IPaC)
- Data Basin
- BOEM – Environmental Study Page
- DOE Technology Database
- DOE Research Database – resource assessment on promising areas for MHK development
- TETHYS Engineering
- NOAA digital coast
- BOEM environmental studies programs

West

- Oregon Marine Map
- Oregon's Department of Land Conservation and Development – Maps, data and tools

- Oregon Coastal
- West Coast Ocean Alliance
- MarineBIOS
- OR Coastal Atlas
- Hasting Hydrokinetic Project

South

- Free Flow Power Mississippi Project

Northeast

- Northeast Regional Ocean Council (NROC)
- North East Ocean Data Portal
- Massachusetts Ocean Resource Information System (MORIS)
- State of Maine Department of Marine Resources – Aquaculture Map
- Verdant Power Project
- Bourne Tidal Test Site

International

- Coastal Project

State-by-state

- Individual State Coastal Plans

3. Are there any ongoing studies that we should be sure to include in the development process?
    - State offices are conducting economic assessments for military use of areas for offshore renewables – CA, OR, WA
    - There is a lot of information that OR does through partnerships with universities and other agencies, but the information and data does not end up in a published format
    - The Western Passage project is developing a pre-application for its license this fall

Stakeholder Outreach and Workshops

1. What environmental topics would you like to see covered in the workshop in your region? In addition to national and international experts there may also be local academic or other experts are you aware of any subject matter experts should we engage in your region?

Oregon

- Synthetic (oils) interaction
- Acoustics
- EMF

- Behavioral changes
- Marine Mammal collision
- Marine mammal entanglement

California

- Fish and Fisheries interactions
- Benthic interactions

Northeast

- Danger to fish and birds (K.F); Kevin Stokesbury – University of MA Dartmouth (Fisheries and Oceanography expert)
- Acoustics
- EMF
- Benthic interactions
- Marine mammals' interactions
- Fisheries interactions
- Experts
    - Denis Marc-Nault
    - Jay Clement (USACE)
    - John Perry or Bob Strattion (ME DFW – Avian species)

Alaska

- Fish interactions
-

2. Do you have suggested locations for the workshop?

Oregon

- Newport
- Portland
- Southwest WA

California

- Sacramento
- San Francisco

Northeast

- Weymouth, MA
- New England Fishery Management Council can provide scheduled meetings that may conflict
- North, MA (more ME friendly)
- Portland, ME

Alaska

- Anchorage
- Juneau

D.C.

- FERC conference room

3. Are you interested in co-sponsoring one of the workshops? Are you willing to help coordinate?

- Kathryn Ford (Northeast)
- Chris Potter (CA OPC)
- Mark Heely (Colique Tribe may be interested in cosponsoring an event)

Marine Energy Environmental Toolkit for Permitting and Licensing

Cost Assessment Interview Summary

This document provides a summary of the feedback from regulators and developers gathered during cost assessment interviews for the Marine Energy Environmental Toolkit for Permitting and Licensing project. The purpose of these interviews was to understand the benefit of using the Toolkit and its potential cost savings (time and resources) from the perspective of regulators and developers familiar with the permitting and licensing process. An executive summary is provided below, followed by specific responses from participants.

Executive Summary

Participants primarily attributed major costs and frustration in the permitting/licensing process to coordination with permitting and licensing agencies, the engagement required by the Federal Energy Regulatory Commission (FERC) Alternative Licensing Process (ALP), and information gathering, especially for the Endangered Species Act (ESA) consultations.

Both regulators and developers shared an overwhelmingly positive response to the Toolkit, stating it would reduce costs by serving as a repository of information and data, and provide background information and context for the development of new proposals, especially for technology developers who may not be aware of the environmental and regulatory elements of the process. They added that the siting, monitoring, environmental analysis, and regulatory interactions phases would benefit from the Toolkit, to varying degrees.

For regulatory interactions specifically, participants stated that the Toolkit could facilitate coordination between regulators and developers by better helping developers prepare materials for meetings and discussions with regulators. In this regard, the Toolkit could outline the regulatory process and players, provide background context and information, and inform developers of the needs of specific regulators.

In conclusion, participants noted that the Toolkit would provide tremendous cost savings, especially in the preliminary phases of projects, though they expressed uncertainty about the exact cost (time and resources) saved. An estimated range of 10% to 40% of a full-time employee's (FTE) effort was provided for time savings, with the upper ranges expected for developers and their consultants. While some regulators believed it would reduce the total time to permit a project by months.

For more details, please see the participant responses, which are organized by major themes, below.

Background Information

1. **What is your experience with permitting Marine Energy projects? If you were involved in permitting a Marine Energy project, what permitting pathway (FERC or USACE) was used?**

<u>Experience with a USACE led permitting process.</u>

- Experience with Igiugig, which was permitted by USACE.
- Worked on the Pacwave South site, OPT Reedsport, and the Pacwave North site (which was not grid connected). Pacwave North was U.S(USACE) led permitting and DOE decision to fund. Also

participated in small research projects associated with Marine Energy (though, not wave energy conversion), small non-grid connected versus short-term tests. Both Pacwave North and South were Bureau of Ocean Energy Management (BOEM) and US Army Corps of Engineers (USACE) led permitting since they were grid connected.
- Two projects including temporary deployments for R&D, which was a USACE – European Marine Energy Center (EMEC) project. Also, a shallow water device in Bodega Bay in CA, which was rejected from California State Lands Commission (SLC), migrated around and ended up at Scripps for a demonstration. It had a total of nine initial agency contacts for permits.

Experience with a FERC led permitting process.
- The Branch Chief of FERC's North Carolina, South Carolina, Florida and Texas branches, and serve as the general point of contact for Marine Energy questions that come into FERC. Participated, to varying degrees, on the Gulf Stream, Gulf of Mexico, Admiralty Inlet and others.
- Participated in the following roles to varying degrees: National Environmental Policy Act (NEPA) review for the DOE Water program; NEPA review and Environmental Assessment (EA) for variety of marine energy projects; permitting representative for DOE with FERC (co-op on PacWave, and USACE) project deployment projects; consultation, namely the permitting and engaging with agencies; and as a federal funder.
- Experience with US Coast Guard (USCG) processes, which was led by FERC, but includes several cooperating agencies, such as BOEM, USACE, etc. DOE ultimately signed on to that.

Experience with other permitting processes.
- Experience largely revolves around Cobscook Bay (ORPC), but also includes several other attempted projects, mostly tidal barrages (1k-2k ft), which haven't moved forward. Both Cobscook and tidal barges were FERC, USACE and state processes. Currently coordinating with ME Aquaventis for OSW; previously engaged Statoil, but nothing is active.

2. What aspect of the process was most costly (in time or resources)? What aspect was most frustrating?

Coordinating with permitting/licensing agencies was costly and frustrating.
- Coordination with state resource agencies was most costly, specifically several discussions with one agency. There was a very high threshold of what was accepted and not accepted (e.g., information from a site within close proximity wouldn't work).
- The process seemed random at times for e.g., without talking to a specific person we would have not known about a specific permit. Furthermore, a lot of agencies have "trigger" words that can help or hurt you. The costliest elements were the biological opinion (BiOp) and National Oceanic and Atmospheric Administration (NOAA) requirements, which included a biological assessment (BA). Ultimately, we were not able to use our desired kind of anchors (gravity anchors versus sand screws) due to permitting costs. It also felt like there was no time.
- Pacwave had extensive pre-consultation. Not everyone was needed at each meeting since the discussion was only about marine mammals for 6 months. It is not always necessary to contact all agencies up front, but that's a general frustration of the resource agencies, but others come in later when it's almost complete.
- The lack of consistency among, within, and between regulatory/permitting agencies is most frustrating and expensive. For example, DOE may want to deploy a metocean buoy in the Pacific

Northwest and the requirements/concerns may be different than deploying the same thing off the north east coast. There are different species with different concerns, but what is frustrating is that from office to office, person to person, what they want, or think is important or required is not consistent.

- The most frustrating aspect of the licensing process is the change in people over time. While onboarding is relatively easy because of the level of documentation available from the FERC docket, rebuilding rapports with regulators is difficult.
- Some things agencies required were not feasible (for e.g., pinniped haul outs).
- The process was frustrating because the agencies did not know what they wanted and then we were often handed over to new contacts. It took a lot of time to find the point of contact and receive responses. Once we're in contact with the agencies themselves, they're easy to work with and restrictions were not too onerous (US Fish and Wildlife Service had a lot of restrictions). The actual restrictions were less onerous than the process.

<u>Engagement related to ALP was costly.</u>

- All the projects were so unique, which makes them hard to compare. For PacWave South, the main driver of the time frame was the licensing process, the ALP, which was selected and is unusual in Oregon. The ALP requires engagement in a collaborative process ahead of time, which causes the process to take long. That process included extensive use of Tethys, FERC dockets, and Marine Cadaster, and relied on scrounging for proxy data, both in and outside of the United States. Any information that could inform discussions about multiple significant unknowns was needed. Without a comprehensive Toolkit, individual spatial and literature databases were used.
- The ALP was time consuming. Though we wouldn't have done it another way, by default everything had to be hashed out.

<u>Gathering/receiving information on environmental impacts (ESA-related) was costly.</u>

- It takes a long time to get information from developers on potential impacts e.g., information on acoustics, prey avoidance, direct harm, etc. It's helpful during the design phase if they consider environmental impacts. For Marine Mammal Protection Act (MMPA) applicants, USACE strictly looks at ESA, which is prioritized, but all species are helpful. ESA is time-consuming with regards to getting consultation underway and moving through the process.
- The most time-consuming aspect is the ESA and Marine Mammal negotiations with trust agencies. Although FERC facilitates the process, trust agencies mandatory condition authority i.e., FERC must wait for the completion of those negotiations. FERC also writes permitting documents/license orders, but these aren't much worse than the ESA and Marine Mammals negotiations.

<u>The permitting/licensing process was costly and frustrating.</u>

- A consistent theme in permitting is that the citing and design of the project comes before the engagement of resources agencies, based on NEPA's structure and the environmental permitting process. By the time resources agencies are consulted, the proposal design is somewhat completed. Then, the developer engages in environmental analysis and understands the resources in that jurisdiction. More and more it's gravitating toward the West coast. It's positive to hone in on specific habitat types and resources. In previous years, this was not the case, so there is inherent frustration in dealing with new things with old systems. Agencies are trying to understand what it means for species that haven't had this done before and trying to apply regulations that aren't built for this activity in the ocean, and to have productive discussions about solutions when data aren't there yet. Engagement is required before things are set-in-stone.

- The costliest aspect of the process, in terms of time and resources, was the process of getting up to speed on the environmental impacts of wave energy converters and associated infrastructure and the procedures in constructing the test site, obtaining and becoming familiar with the science, and drafting the biological opinion. What was most frustrating was the pressure our agency received to complete the biological opinion when there was still an entire state permitting process to get through that took more than a year after completing the biological opinion before FERC issued the license.

<u>Data/information gathering, and approval was costly and frustrating.</u>

- During the process, there had been an attempt to provide comprehensive data and an analysis of what that data means. There has been a significant collection of data, but that wasn't present 10 years ago. Decisions on whether data are sufficient is up to resources agencies, not PRNL or NREL. That decision needs to be clearly contained where it belongs (from a legal perspective).
- Having to navigate to several sites to gather information on environmental impact statement (EIS) or EA compilation, complete data sets, project location, ambient conditions, existing species, etc. was time consuming and often frustrating to save and organize.

<u>Other</u>

- Other user conflicts, for example submerged cables, slow things down. Newer issues also take time to be resolved.
- From an applicant's perspective, it's frustrating to negotiate with agencies regarding adaptive management schemes to help flesh out considerations for ESA and move forward with licensing. It takes some time because there is a new alternate maritime power (AMP) and new species not yet dealt with.
- Everyone (regulators and developers) was in a new place that was entirely novel to the state and the developer.

Potential Cost Savings

1. **In what ways do you envision the Toolkit reducing the costs (time or resources) of the permitting and licensing process? Is there a particular phase (siting, monitoring, environmental analysis, regulatory interactions, etc.) that you expect the most benefit from?**

<u>The Toolkit will reduce cost by serving as a repository of easily accessible data and information.</u>

- The key element is having an easy and easily understandable way to get all the data, pulling it together and presenting it to agencies to highlight what exists. The benefit will depend on the databases and how up to date they are, but if the user is able to point to it and say this is the bulk of knowledge and everyone buys in then that will be huge. Then time will be spent on little things that have not been well documented and are not well known; having updated information will save a fortune in time and money.
- On the regulatory side, the Toolkit provides studies that can be easily accessed in one location and will help answer questions, reducing the need for general searches from the web.
- It is helpful to know the kind of consultant that will be needed, the level of expense expected, the regulators roles and how best to prepare for those discussions.
- It will also help identify studies to answer questions raised when writing comments or talking with other stakeholders (public and fishermen), which will provide huge cost savings. An additional use of

the Toolkit could be siting for offshore wind (OSW). There are a lot of issues with OSW and lobsters on the east coast, and a lot of concerns about cable lay and where fisherman can fish.
- The best value of the Toolkit is that everything is centralized. Like the spatial data and having information from state waters can provide information and spatial recognition for non-biologically trained regulators (e.g., attorneys). Information on federal waters, showing permits for state and federal zone councils and fishing zones would be helpful.

<u>The Toolkit will reduce cost to developers by providing background information and context for the creation of an initial proposal.</u>

- The Toolkit would be beneficial if a survey of work needed to be done.
- This is also useful for making initial proposals and designs more sophisticated and informed. There is a real benefit so long as it's not misconstrued as checking regularity box.
- The Toolkit would help collect background information ahead of time, and directly reduce the costs of searches. The Toolkit can reduce the potential permits required if used in the design process. It would also ensure more informed consultation about environmental analysis and documentation, especially if the risks/uncertainty of the information is provided too. Providing more information on what agencies care about (e.g., FERC and USACE which care about specific things) is also helpful.
- For inventors, the Toolkit will be helpful to gather data, information, and examples from one place, and to get a sense of regulations, context and use data for applications. It would be very helpful for them to think outside of the technological context and into the environmental context. For others, this is a practical tool to compile information more efficiently. A one-stop shop for regulators, and reference materials which would be helpful to newcomers. It helps users access information that is not published; studies costing upwards of $100K+ for projects with data/knowledge but that were not permitted or completed, for e.g., Strangford Loch, a tidal project in Northern Ireland, and MS River.
- It could reduce the amount of time required for industry and their consultants to prepare environmental documents required for permitting and ESA consultation.

<u>The siting phase will benefit from the Toolkit.</u>

- The Siting Tool would be really useful to the developer, speaking as someone who was an environmental consultant to oil and gas before becoming a regulator.
- It could be helpful at the beginning of the process, especially with siting and gaining familiarity with what will be needed for the site being selected. For e.g., CalWave may not have considered the site at Bodega Bay.
- It will provide a lot of time savings for the siting phase especially when coordinating with other stakeholders such as fishermen.

<u>The monitoring phase will benefit from the Toolkit.</u>

- It will help provide the science behind environmental monitoring, which ties into all pieces, providing the location of information and giving agencies confidence that they can protect themselves (with documentation). When the permitting process started, there was a huge amount of concern regarding electromagnetic fields (EMF) and cables, but studies and other research proved it was a non-issue which enabled the agencies to agree and “check that box off”.
- It could help with identifying the best monitoring methods, once it’s kept up to date with the most recent and best available information from projects.

The environmental analysis phase will benefit from the Toolkit.

- The most likely savings could be during the environmental analysis, i.e., having a common set of information and data that can be easily accessed by consultants, with direct references and citation so they can also be found by agencies. It's unclear that agencies will loosen their processes to accept reliance on the data sets provided in the Toolkit versus their current standard operating protocol (SOP).

The regulatory interactions phase will benefit from the Toolkit.

- The permitting process and state regulations diagram is fantastic, as it helps regulators understand the whole process.
- The Toolkit will help with staff turnover at agencies.

2. Would the Toolkit facilitate coordination (i.e., meetings or discussions) between developers and regulators?

The Toolkit would facilitate coordination between developers and regulators by helping developers with information gathering and thus, better prepare for their interactions with regulators.

- Yes, of course. We wish we had this body of information in 2005.
- It helps developers understand players and provides initial contacts to start the permitting process.
- Developers could gather information based on the information regulators deem important.
- Will help developer get better understanding of what they need to do. Developers are engineers and don't understand regulatory agencies with authority in the ocean. They think of the ocean as wide open but it's not. The Toolkit will save a lot of time and the proposals/packages brought to regulators will be much better.
- For developers, there are a lot of tools and bins of information they can use for an application. Some are very site specific, which this Toolkit will not help with. Some are susceptible to different study methods and knowing which methods could be transferred and which would help facilitate negotiations/consultations could save time for everyone if it's a proven technology. Some things may be universal, for e.g., if the Reedsport project were keeping sealions off the buoys, it could be used for another project (other marine mammals that like to haul out buoys), and provide information, validation, and experience with those technologies.
- It will help prepare materials for environmental review by providing information in one spot which will help developers know what they don't know. Having that understanding should facilitate contact with regulatory and other agencies. For instance, with test centers there's an issue of scoping, in that, if you want to change devices it must be bounded as projects that are too broad and don't have a full environmental review cannot be authorized.
- Yes, to have or use it as a framework for navigating the process will facilitate things well.
- Absolutely, if we had the Toolkit during permitting and licensing of the ORPC Cobscook project it would have saved time. If it links to regional databases NE regional portal, it would be even better. Rather than starting from scratch, there is data to work with.

Other

- From a regulatory perspective, it will save time because it's a one-stop-shop, that is, if it's being updated and is current.

- Not sure.
- I hope so. I would hope that the developer, more specifically the consultant to the developer, could rely on the Toolkit (data set) and that the agencies would then accept that reliance and agree that the information presented is best available science and could lead to appropriate permitting or consultation. Again, while this can help the consultant, agencies may or may not change their SOP to agree with the process. EMF is a good example because the science identifies this as a non-issue, but certain regulators may not agree. This often depends upon the knowledge of the individual and their background.

3. Given the functionality of the Toolkit and your knowledge of permitting – what is the estimated time savings, in actual hours or percentage of total time, of the Toolkit?

<u>The Toolkit could save10-25% of time.</u>

- An estimate is that it could save a consultant 10% of time in developing materials. Don't believe it will speed up the process timeline for obtaining permits and concurrences.
- From a regulatory perspective, time savings are hard to assess, but it is huge. It allows users to go to the same location to get data and information rather than doing generalized research on scientific studies, interactions, etc. Before adaptive management teams would be occasional meetings with study projects a few times a year because it was unclear what needed to be looked at when the device was in Cobscook. Now that we know and have information, the Toolkit synthesizes the information and would have saved a lot of time, though not all information needed existed at the time. For ORPC on study projects, it would have easily provided 15-20% time savings for the regulators.

<u>The Toolkit could save at least 25% of time.</u>

- It would decrease a full time employees time spent by 25-40%.
- Tough to say, due to different projects. Igiugig would be 25%-time savings (or more) if the information was provided earlier; a more highly informed applicant would gain more benefits from the Toolkit.
- Approximately 25% savings or more for time and cost. It's not going to solve all issues with permitting but once there is a tool stakeholder's have bought into and are comfortable with, it will save so much time. It also helps with the frustration of the process, and levels the playing field to have the discussions.

<u>Could save time, but the amount is unclear.</u>

- For an inventor applicant, this could save months, but at different points in the permitting process. This could provide context for newer folks and make for a much better application. For example, one person came in and said "there is no manatees in the project area" but Google Earth showed otherwise. It may not necessarily save the burden of environmental analysis, but will allow people to understand context earlier, and that they aren't one project in isolation.
- For later stage developers, this could help with the ESA negotiations, as some information could be used again, and it could save months. It could provide a realistic application, the information needed for it and an overview of the later stage, which can be difficult and have major conflicts. For ESA marine mammal issues, the more that's in the Toolkit, the better.
- Although it's highly variable, there is a lot of potential if users are not aware of procedures or make mistakes. For example, Reedsport went through the process twice; the first time it collapsed, but

then it succeeded (for authorization). One reason it succeeded was because of the more collaborative approach, but they did use everything they could for information (e.g., UACE data for sand dredging, existing literature on cetaceans, etc.) which made things much more reasonable. If this Toolkit was around, it might have been able to get it right the first time.

Other

- Not comfortable doing that. Things may vary widely based on a project, e.g., a two-week test of one device versus a 25-year project with multiple projects; these are so different.
- Well, it is very difficult to say.

Developer Specific Questions

1. **Given the functionality of the Toolkit – what is the estimated percentage costs savings of the Toolkit?**

- It is helpful that resources on environmental and regulatory advancements from around the world are available to inform regulators about the science of environmental effects. However, the responsibility to synthesize this data to something directly relevant to the project under review remains with the developer. Unless a resource agency spends the time and effort to use the Toolkit, it is unlikely that direct savings will be realized. Having said that, if even on licensing study issue is avoided or "retired" there could be a savings on the order of $50k to $100k.
- No dollar amount but 25-40% FTE.

2. **Are there other issues developers (of technologies or projects) think the Toolkit would help address?**

- It will help alleviate confusion and help address resource allocation by taking down sites that are difficult. It is also helpful in knowing how early to start processes and is needed to start the process.

APPENDIX A: INTERVIEWEES

Name	Organization	Role
Stephen Bowler & Josh Dub	FERC Headquarters	Federal regulator
Delia Kelly	Oregon Department of Fish and Wildlife	State regulator
Denis Nault	Maine Department of Marine Fisheries	State regulator
Jennifer Martin	USACE Alaksa District	Federal regulator
Jonathan Colby	Verdant Power	Developer (technology and project)
Marcus Lehman & Dan Petrovic	CalWave	Developer (technology)
Roak Parker	DOE	NEPA program
Dan Hellin	OSU PacWave North	Developer
Jeff Young	NOAA	Federal regulator

Appendix C.

Web-based Toolkit pages developed as part of Subtask 1.3

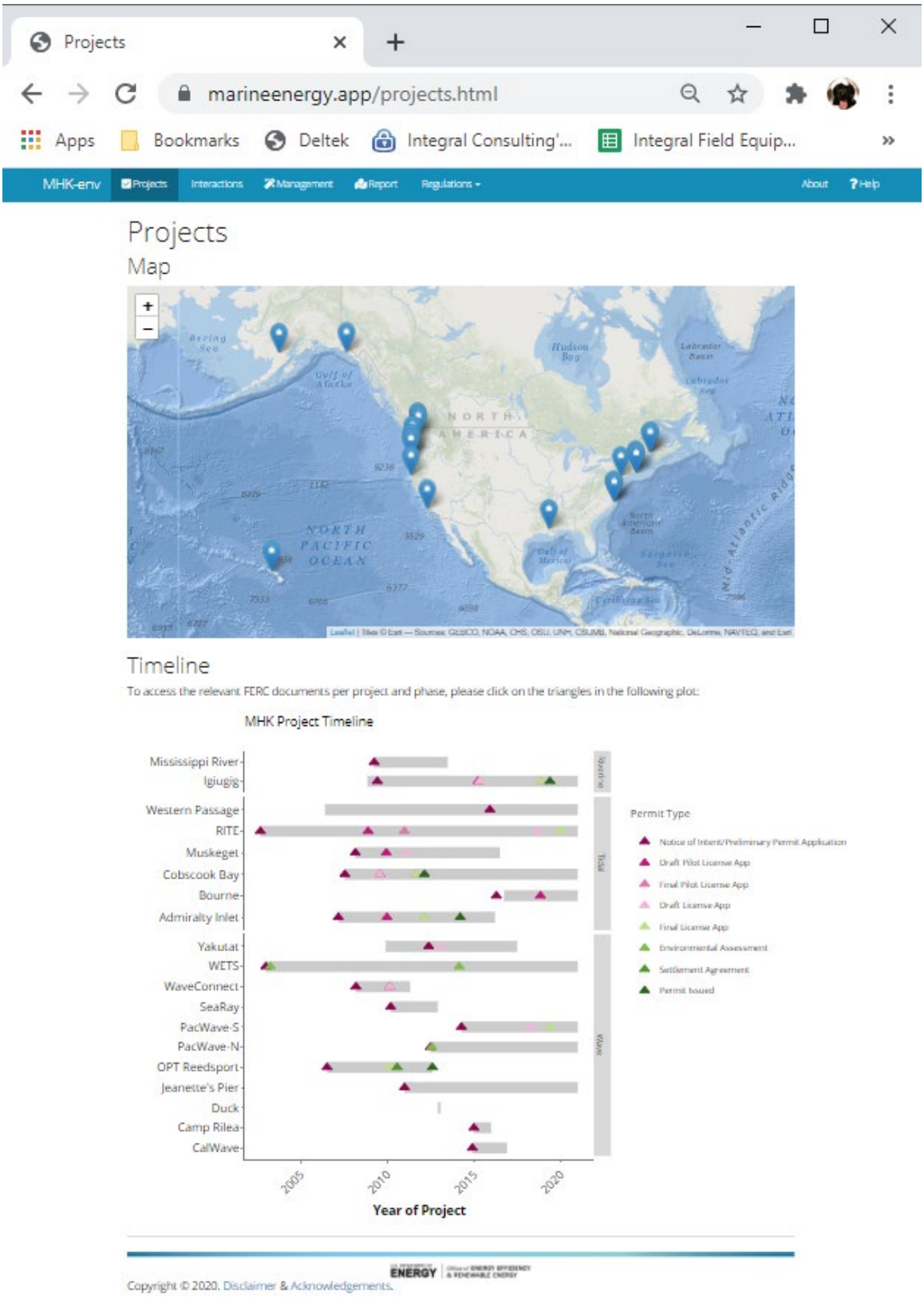


Figure A1. Toolkit interactive Projects Page.

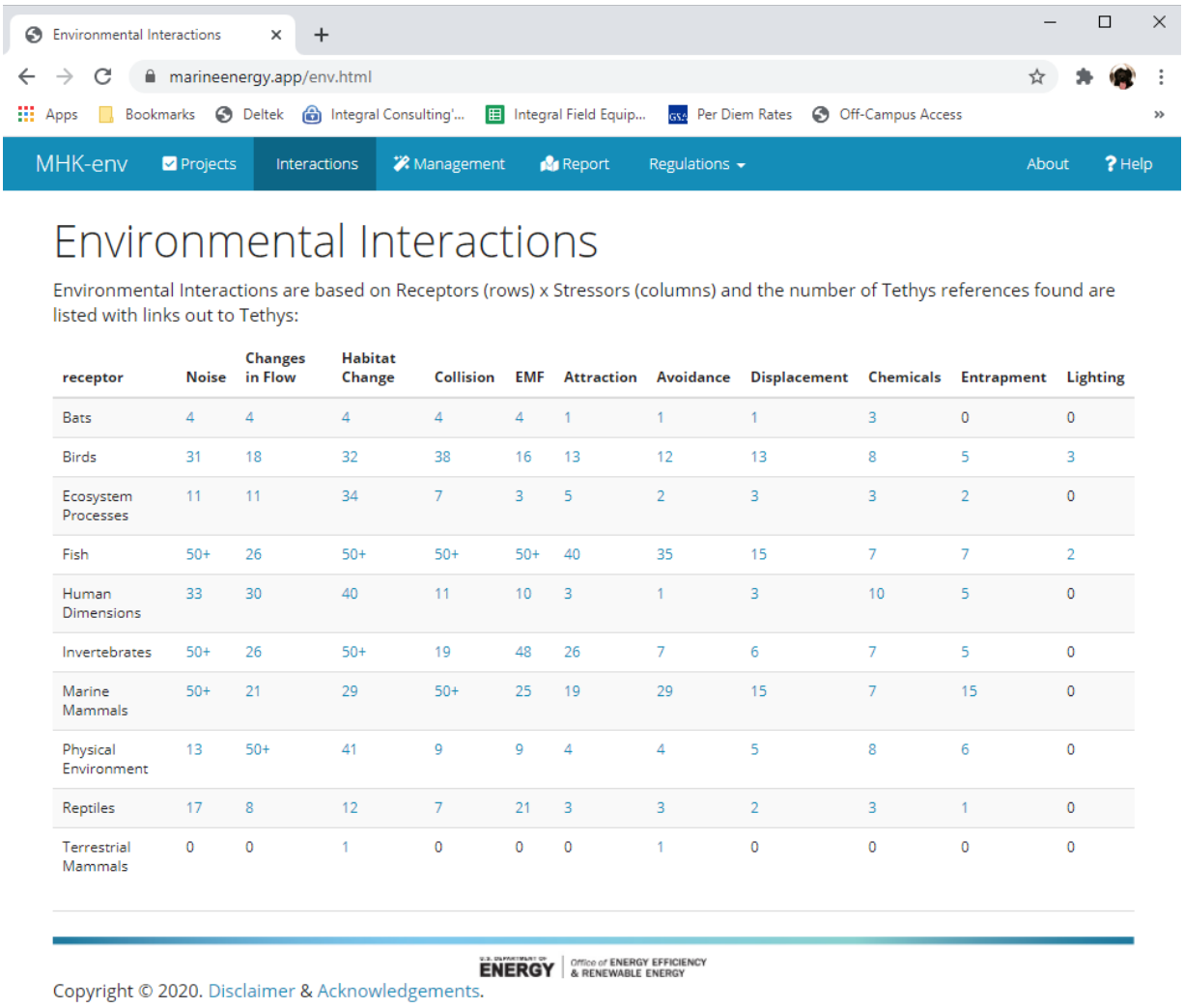


Figure A2. Toolkit Environmental Interactions Page.

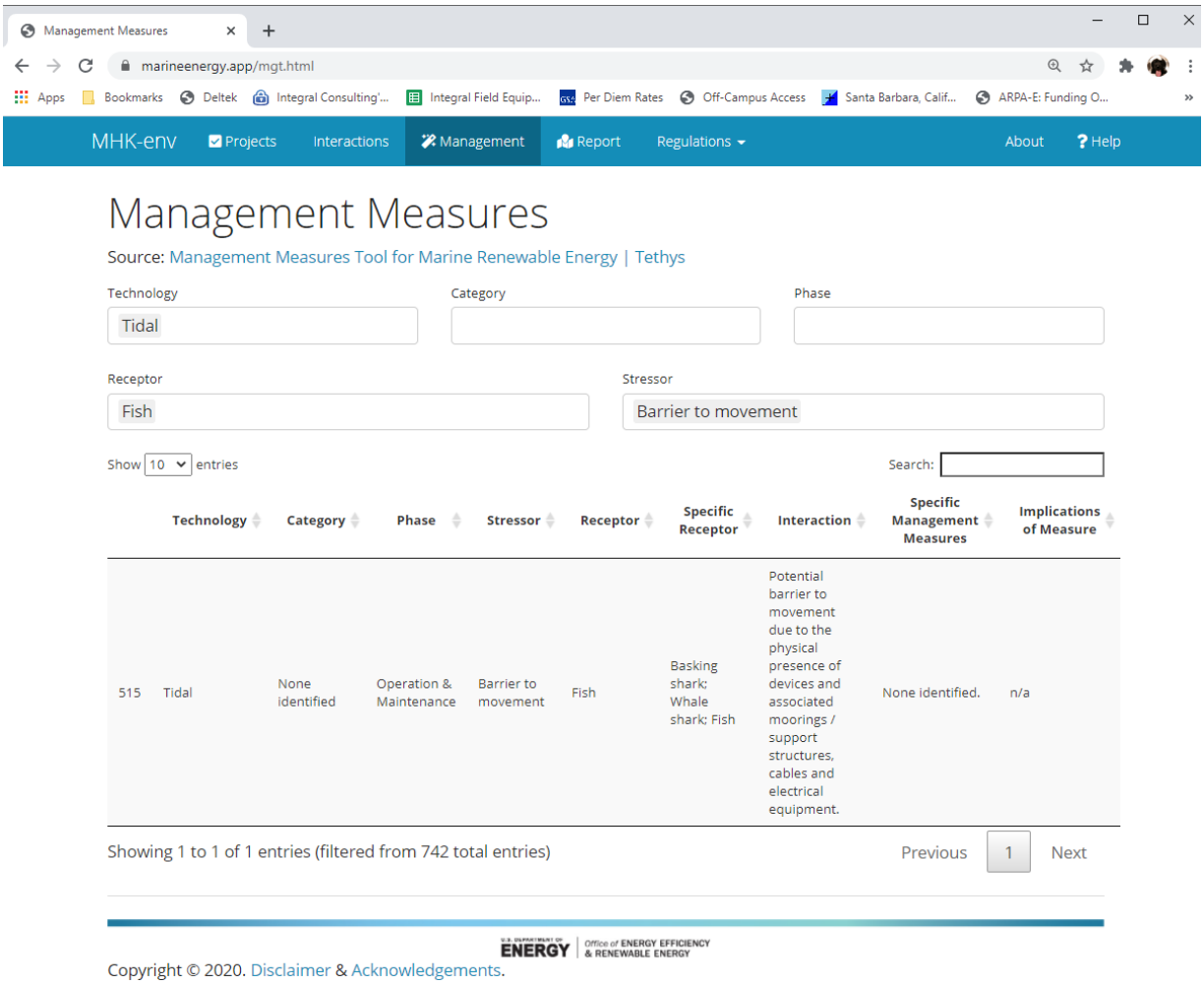


Figure A3. Toolkit Management Measures Page.

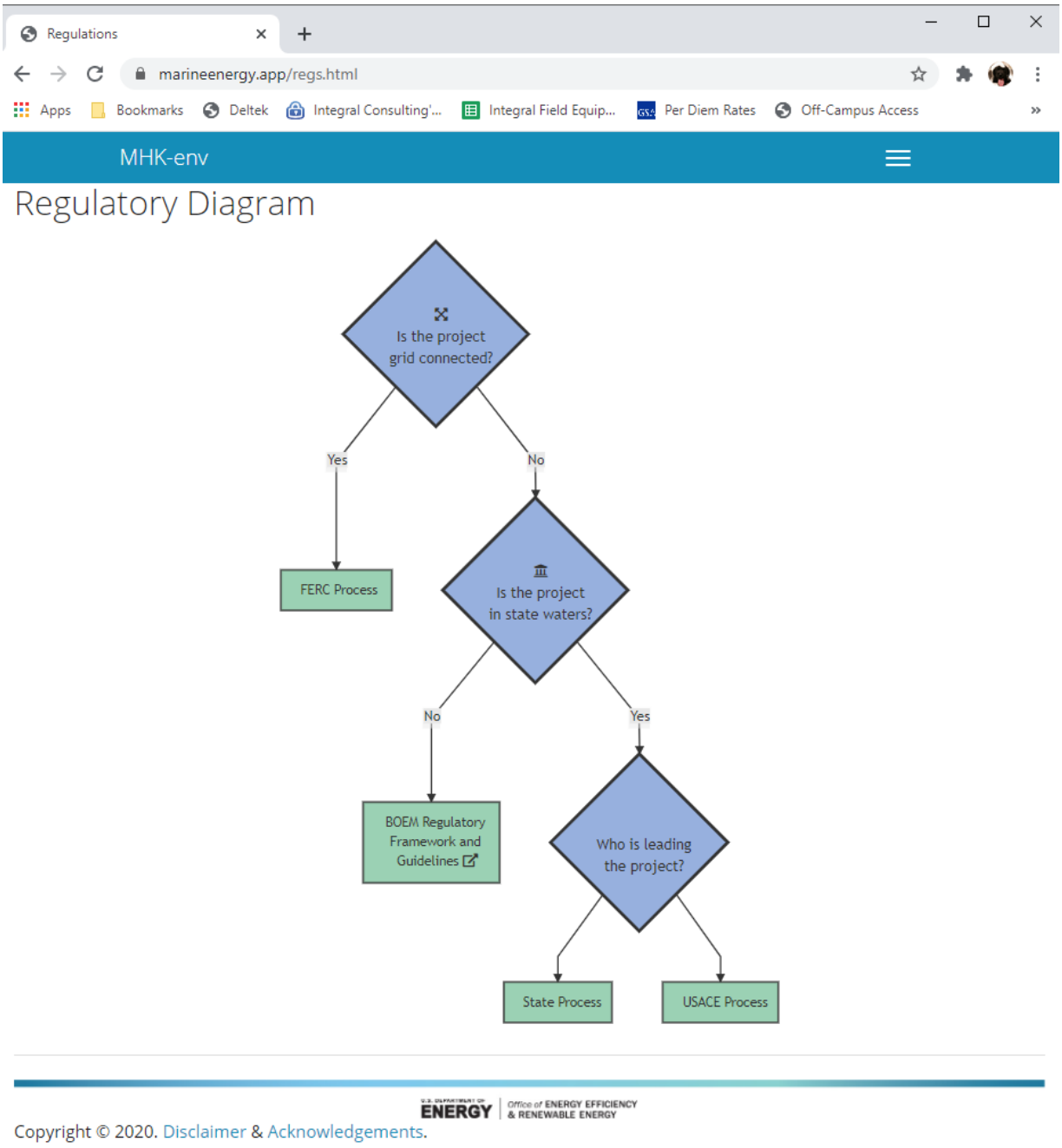


Figure A4. Toolkit Regulatory Diagram.

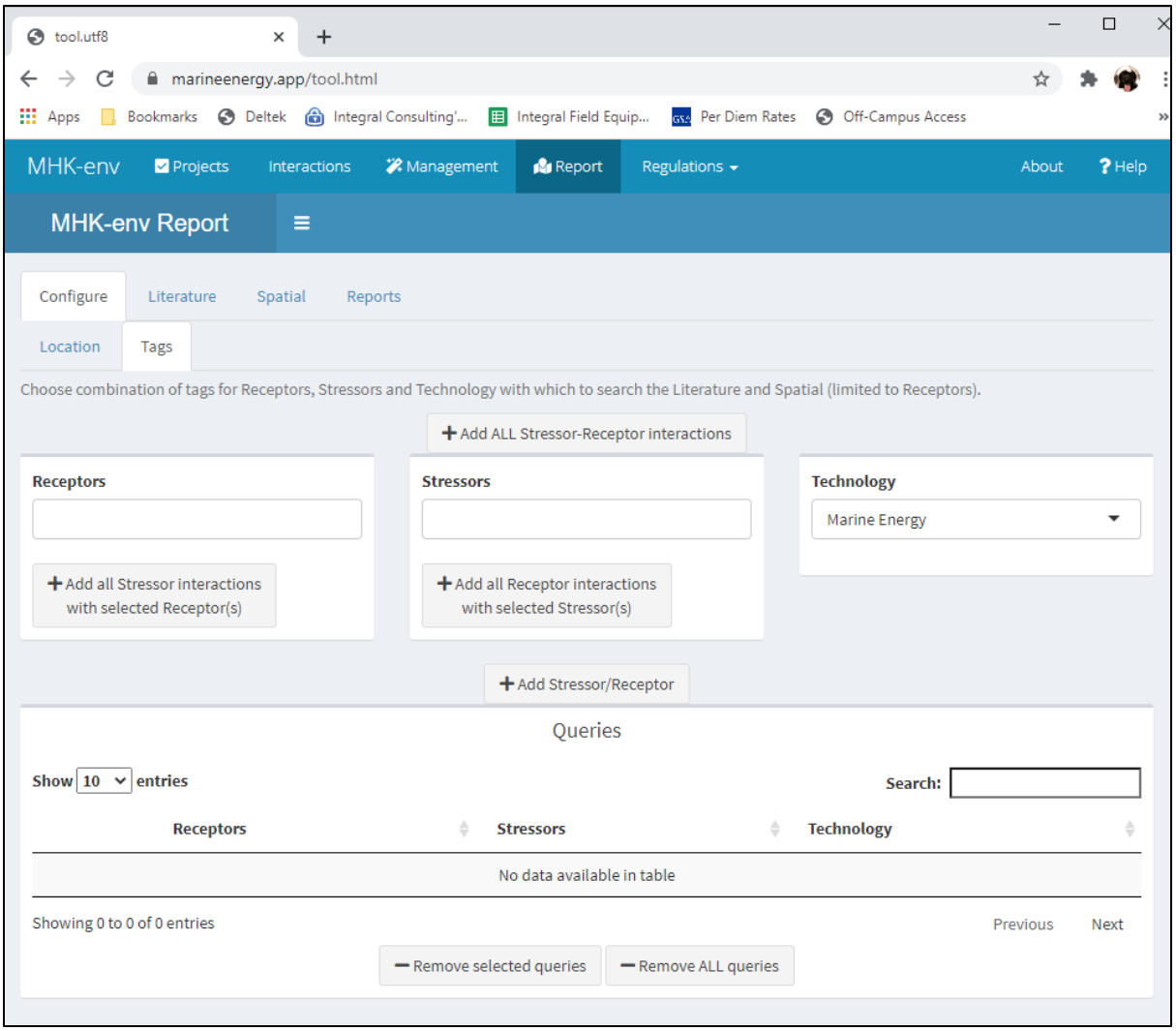


Figure A5. Configure-Tags page of the Toolkit Report App.

Appendix D.

Web-based Toolkit splash page and additional Toolkit information, developed as part of Subtask 1.5

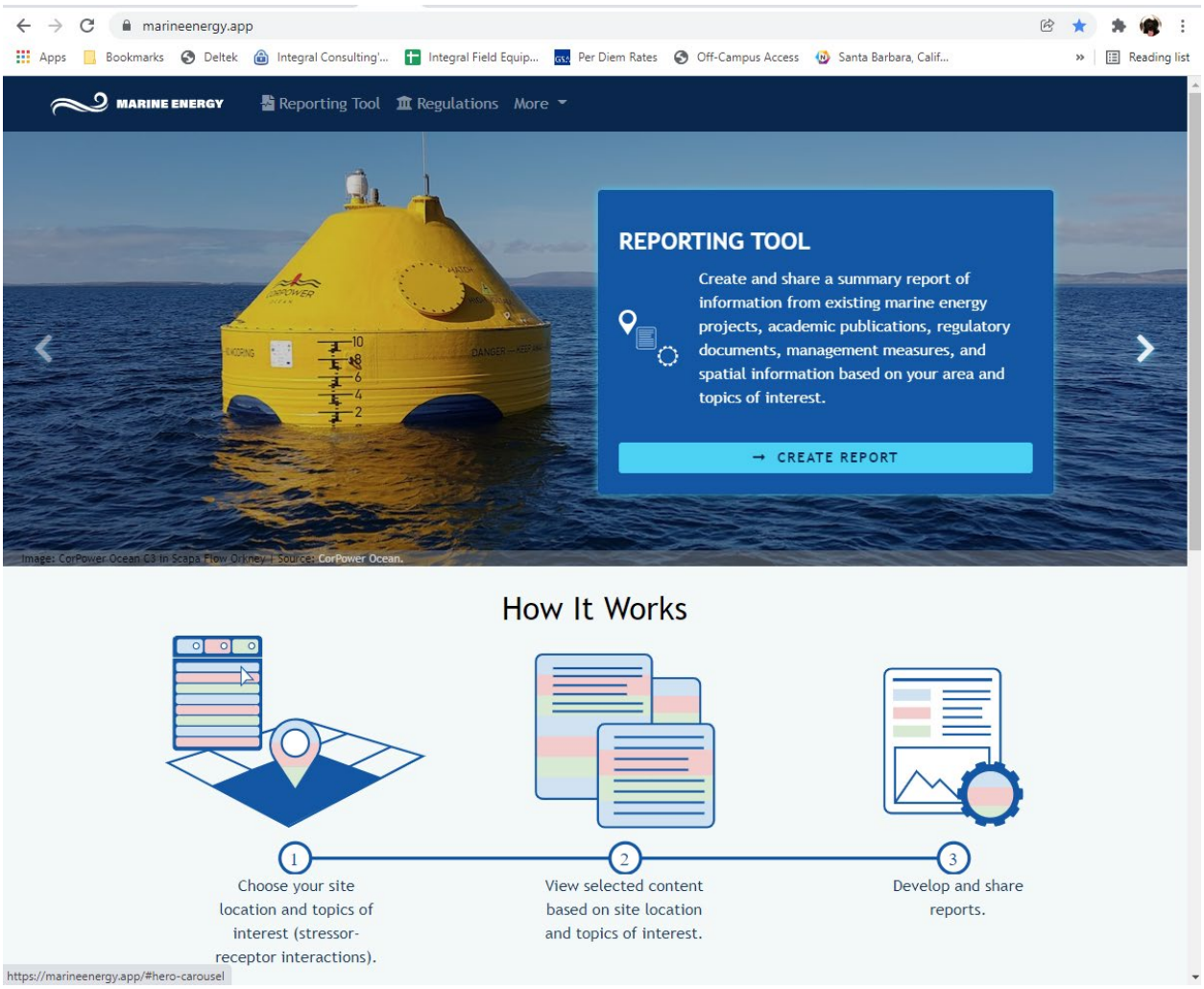


Figure B1. Marine Energy Toolkit splash page (upper part) featuring the Reporting Tool callout on the “carousel”.

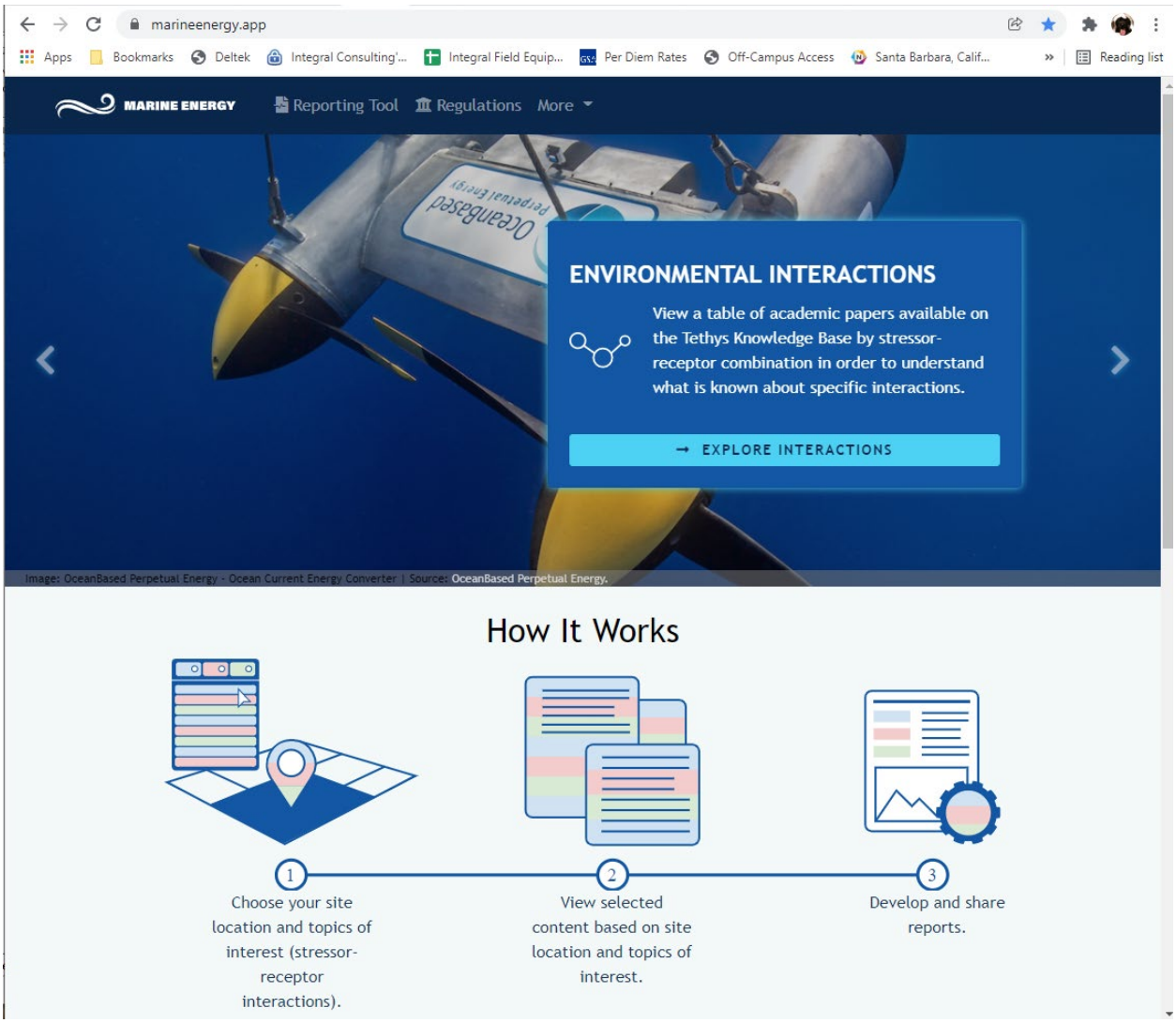


Figure B2. Marine Energy Toolkit splash page (upper part) featuring Environmental Interactions callout on the carousel and “How It Works”.

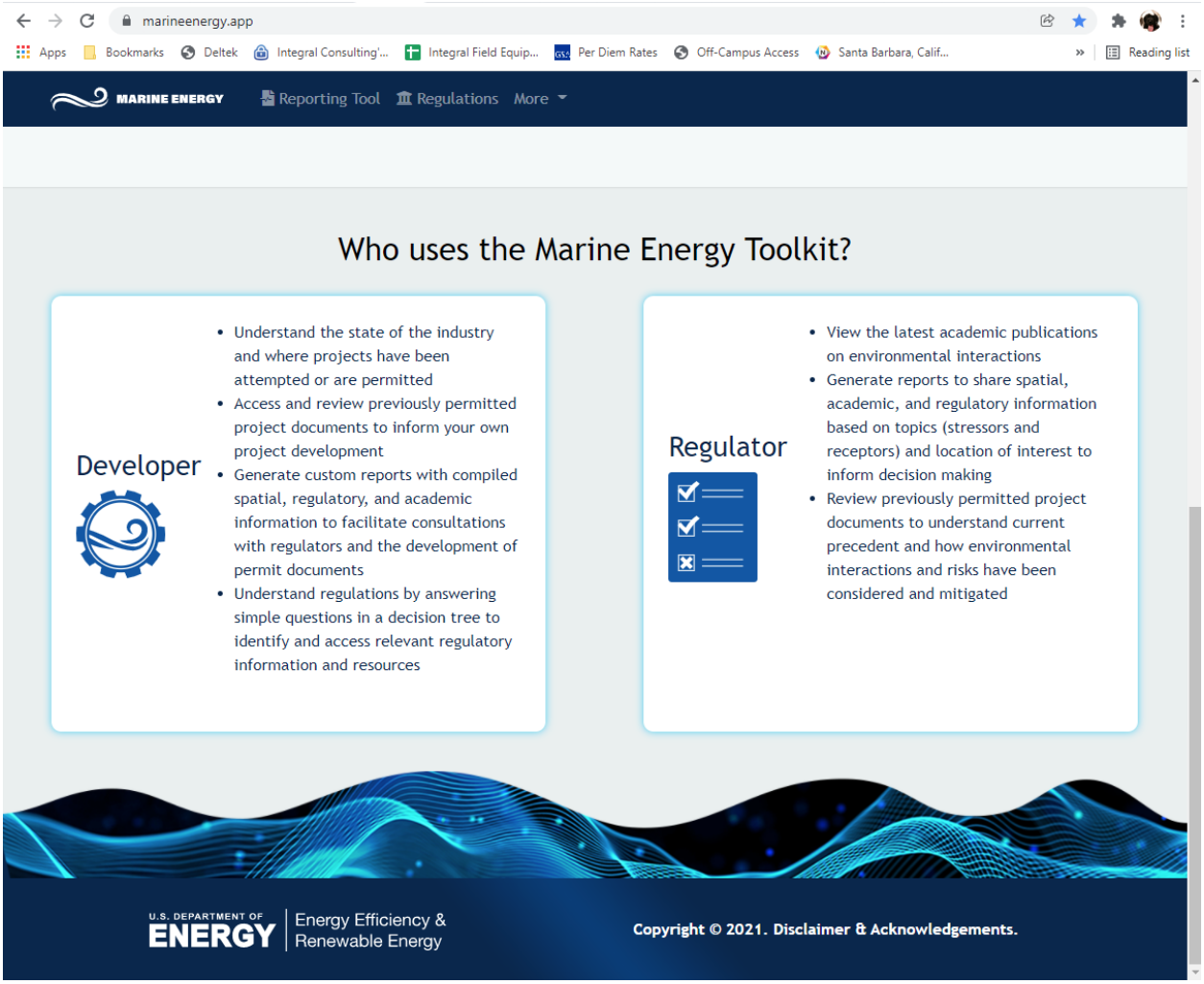


Figure B3. Marine Energy Toolkit splash page (lower part).

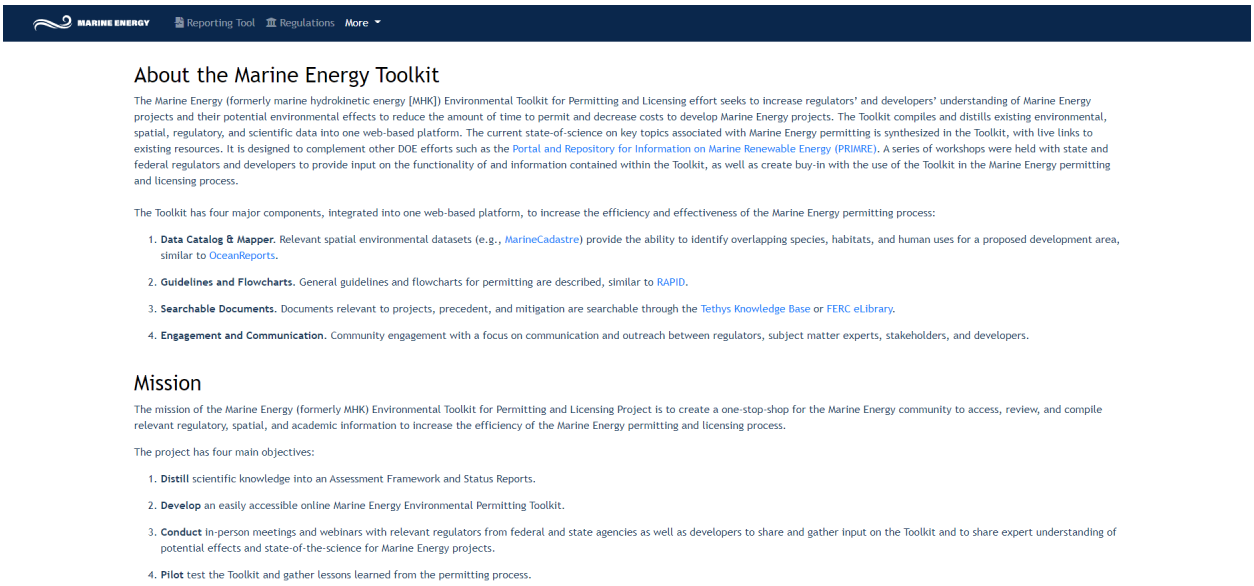


Figure B4. Toolkit About page (top part).

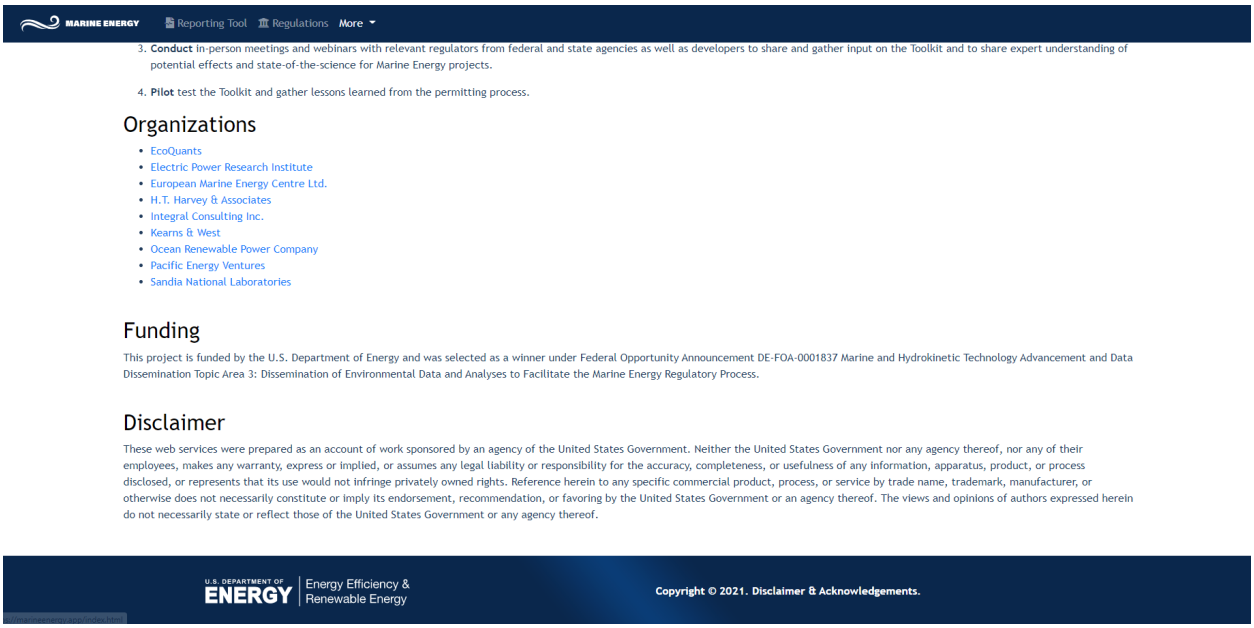


Figure B5. Toolkit About page.

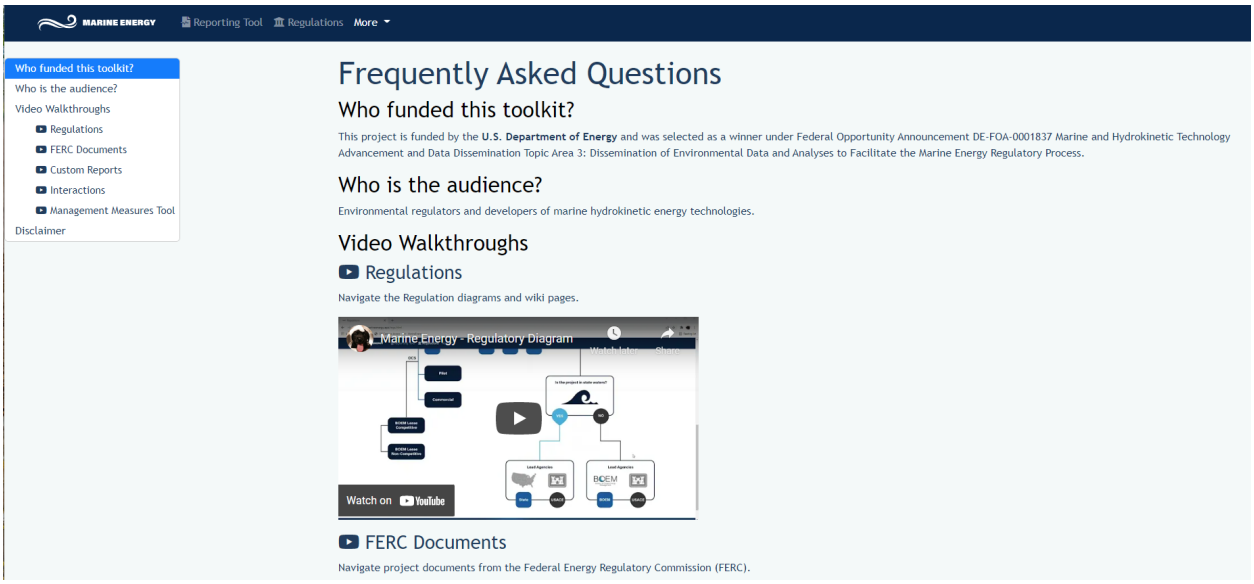


Figure B6. Toolkit Frequently Asked Questions page (top part). Additional walk-through videos, as listed on the table of contents on the upper left, are provided below what is visible in this screenshot.

Appendix E.

Workshop Materials

MARINE ENERGY
ENVIRONMENTAL TOOLKIT FOR PERMITTING AND LICENSING

REQUEST FOR PROJECT NOMINATIONS

to Pilot Test the Marine Energy Environmental Toolkit for Permitting and Licensing

What is the Toolkit?

The Toolkit is an information portal of environmental, spatial, regulatory, and scientific data relevant to the permitting and development of wave, tide, river, and ocean current energy-harvesting technologies. The Toolkit was developed to provide federal and state regulators and developers a key "one stop shop" to access the state of knowledge on Marine Energy project impacts.

The Toolkit is funded by the U.S. Department of Energy (DOE), and developed in collaboration with regulators, developers, and other interested stakeholders.

Pilot Testing the Toolkit

DOE and the Toolkit Team are looking to pilot the Toolkit on a new or existing marine energy project in 2021. We are soliciting nominations for projects with developers or regulators that would be willing and interested to test the usefulness of the Toolkit in their permitting and licensing efforts.

Pilot Testing Methodology

The process of piloting the Toolkit on a given project includes, 1) training the users on the components and functions of the Toolkit, 2) providing materials to support users in testing the Toolkit on their own, 3) gathering feedback from users and identify potential changes or improvements to the Toolkit, and 4) compiling feedback on an ongoing basis for DOE's consideration. The graphic below outlines the piloting process and details of engagement.

Who's the ideal candidate?

If you are a developer working on a new and/or existing Marine Energy project this Toolkit is the ideal starting point for your project.

Contact Us

If you wish to be part of the group of developers who will be able to pilot the Toolkit, fill out the registration form here. If you have any questions or concerns, please contact Natalie Raymores (nraymores@kearnswest.com, (415) 839-7308).

01

Training

An initial meeting will be conducted to review the components of the Toolkit with the piloting team. During this meeting, a questionnaire and packet of materials for use during piloting will be provided and reviewed.

02

Testing

The piloting team will use the toolkit to support the siting, permitting, licensing, or monitoring and compliance phase of their marine energy project. The piloting team will record their experience with the Toolkit via the questionnaire provided.

03

Feedback

After the submittal of the questionnaire, a second meeting will be scheduled to debrief the piloting team's experience with using the Toolkit, and discuss potential improvements.

04

Documentation

Feedback from the piloting team will be recorded via the questionnaire and interviews and compiled on an ongoing basis. Periodic reports will be made available to DOE and the Toolkit development team until the end of the piloting process, and then compiled into a final report.

MHK Environmental Toolkit for Permitting and Licensing

Overview

Monday January 13th, 10am – 4pm
Danvers, MA

Agenda

Item No.	Time	Topic	Presenter
1.	10:00 am	Welcome & Introductions	Anna West, *Kearns & West*
2.	10:10 am	Project Background • Goals and Objectives • MHK Overview • Regional Case Study • Wave and Tidal Energy Devices	Anna West and Zach Barr, *Kearns & West* Kerry Strout Grantham, *ORPC*
3.	10:40 am	Toolkit Summary • Purpose and Intended Users • Information Flows • Demonstrations • Synthesis and Data	Grace Chang, *Integral Consulting* Sharon Kramer, *HT Harvey*
	12:40 p.m.	*Lunch (1 hour)*	

Agenda Continued

Item No.	Time	Topic	Presenter
4.	1:40 pm	Subject Matter Expert Presentations • Fish Collision • Benthic Interactions	Gayle Zydlewski, *University of Maine School of Marine Sciences* Emma Sheehan, *Plymouth University*
5.	3:40 pm	**Closing and Next Steps** • Thank you • Evaluation Forms • Next Steps	Anna West and Zach Barr, *Kearns & West*
	4:00 p.m..	*Adjourn*	

Welcome & Introductions

Ground Rules

- "Honor" the agenda
- Participate actively and respectfully
- Focus comments and speak concisely
- Speak in order; facilitator will mind the queue
- Limit side conversations or take them outside to avoid distractions
- Cell phones off/silent
- Remote participants:
  - Utilize the 'raise the hand' or webinar chat functions for questions
  - Please mute your line while not talking
  - Use chat functions to troubleshoot issues and provide answers to questions

MHK Environmental Toolkit for Permitting and Licensing

- This project seeks to:
  - Increase regulators' understanding of MHK projects and their potential environmental effects;
  - Reduce the amount of time to permit MHK projects by developing a useful Toolkit for all stakeholders; and
  - Help decrease time and resources permitting MHK projects.

MHK Overview

Industry Landscape

- Most project developers are technology developers of a specific device design
- Projects can generally be separated into the following categories
  - Grid connected
  - Non-grid connected
  - Test center/site
    - Generally pre-permitted
    - Allows for scaling up devices
- European market is more mature than the U.S. market
- Growing role in the U.S. clean energy strategy that offers a domestic way to offset traditional non-renewable electricity generation and provides resiliency for coastal communities.

OPEN SEA TEST SITES

There are many open sea test sites established across the world and each has its own challenges, such as consenting issues, resource and operating environments. Test centres also provide very different service offerings to industry.

The development of open sea testing facilities encourages ocean energy development by enabling practical experience of installation, operation, maintenance and decommissioning activities for prototypes and farms, as well as on services and streamlining procedures.

NETHERLANDS

TEST SITE NAME	LOCATION
Oosterschelde	Eastern Scheldt barrier
Tidal Test Centre (TTC)	Den Oever
BlueTec floating platform	Texel Island
REDstack	Afsluitdijk

SWEDEN

TEST SITE NAME	LOCATION
The Lysekil wave energy research test site	Lysekil
Söderfors research site	Dalälven

UNITED KINGDOM

TEST SITE NAME	LOCATION
European Marine Energy Centre (EMEC)	EMEC Orkney, Scotland
Wave Hub	Wave Hub Cornwall, England
FaBTest	Falmouth Bay in Cornwall
Marine Energy Test Area (META)	Milford Haven Waterway in Pembrokeshire
Morlais Tidal Demonstration Zone	West Anglesey

DENMARK

TEST SITE NAME	LOCATION
DanWEC	Hanstholm
DanWEC NB	Nissum Bredning

CANADA

TEST SITE NAME	LOCATION
Fundy Ocean Research Centre for Energy (FORCE)	Minas Passage, Bay of Fundy, Nova Scotia
Canadian Hydrokinetic Turbine Test Centre (CHTTC)	Winnipeg River, Manitoba
Wave Energy Research Centre (WERC)	Lord's Cove, Newfoundland & Labrador

BELGIUM

TEST SITE NAME	LOCATION
Ostend wave energy test site	Harbour of Ostend

NORWAY

TEST SITE NAME	LOCATION
Runde Environmental Centre (REC)	Runde Island

IRELAND

TEST SITE NAME	LOCATION
Galway Bay Marine and Renewable Energy Test Site	Galway Bay
AMETS	Belmullet, Co. Mayo

USA

TEST SITE NAME	LOCATION
U.S. Navy Wave Energy Test Site	Kaneohe Bay
Pacific Marine Energy Center PacWave North Site	Newport, Oregon
Pacific Marine Energy Center PacWave South Site	Newport, Oregon
Pacific Marine Energy Center Lake Washington	Seattle, Washington
Pacific Marine Energy Center Tanana River Hydrokinetic Test Site	Nenana, Alaska
Jennette's Pier Wave Energy Test Facility	Jennette's Pier, North Carolina
U.S. Army Corps of Engineers (USACE) Field Research Facility (FRF)	Duck, North Carolina
Center for Ocean Renewable Energy	Durham, New Hampshire
UMaine Offshore Intermediate Scale Test Site	Castine, Maine
UMaine Deepwater Offshore Renewable Energy Test Site	Monhegan Island, Maine
OTEC Test Site	Keahole Point, HI
Marine Renewable Energy Collaborative (MRECo) Bourne Tidal Test Site (BTTS)	Bourne, Massachusetts
Southeast National Renewable Energy Center - Ocean Current Test Facility	Boca Raton, Florida

PORTUGAL

TEST SITE NAME	LOCATION
Pilot Zone	Viana do Castelo
Aguçadora test site	Aguçadora

SPAIN

TEST SITE NAME	LOCATION
BiMEP	Basque Country
Mutriku Wave Power Plant	Basque Country
Oceanic Platform of the Canary Islands (PLOCAN)	Canary Islands

MEXICO

TEST SITE NAME	LOCATION
Port El Sauzal	Ensenada, Baja California
Station Puerto Morelos	Puerto Morelos, Quintana Roo

FRANCE

TEST SITE NAME	LOCATION
SEM-REV, wave and floating offshore wind test-site	Le Croisic
SEENEOH estuarine and ¼ scale tidal site	Bordeaux
Paimpol-Brehat, tidal site	Bréhat

CHINA

TEST SITE NAME	LOCATION
National small scale test site	Weihai, Shandong Province
Zhoushan tidal energy full scale test site	Zhoushan, Zhejiang Province
Wanshan wave energy full scale test site	Wanshan, Guangdong Province

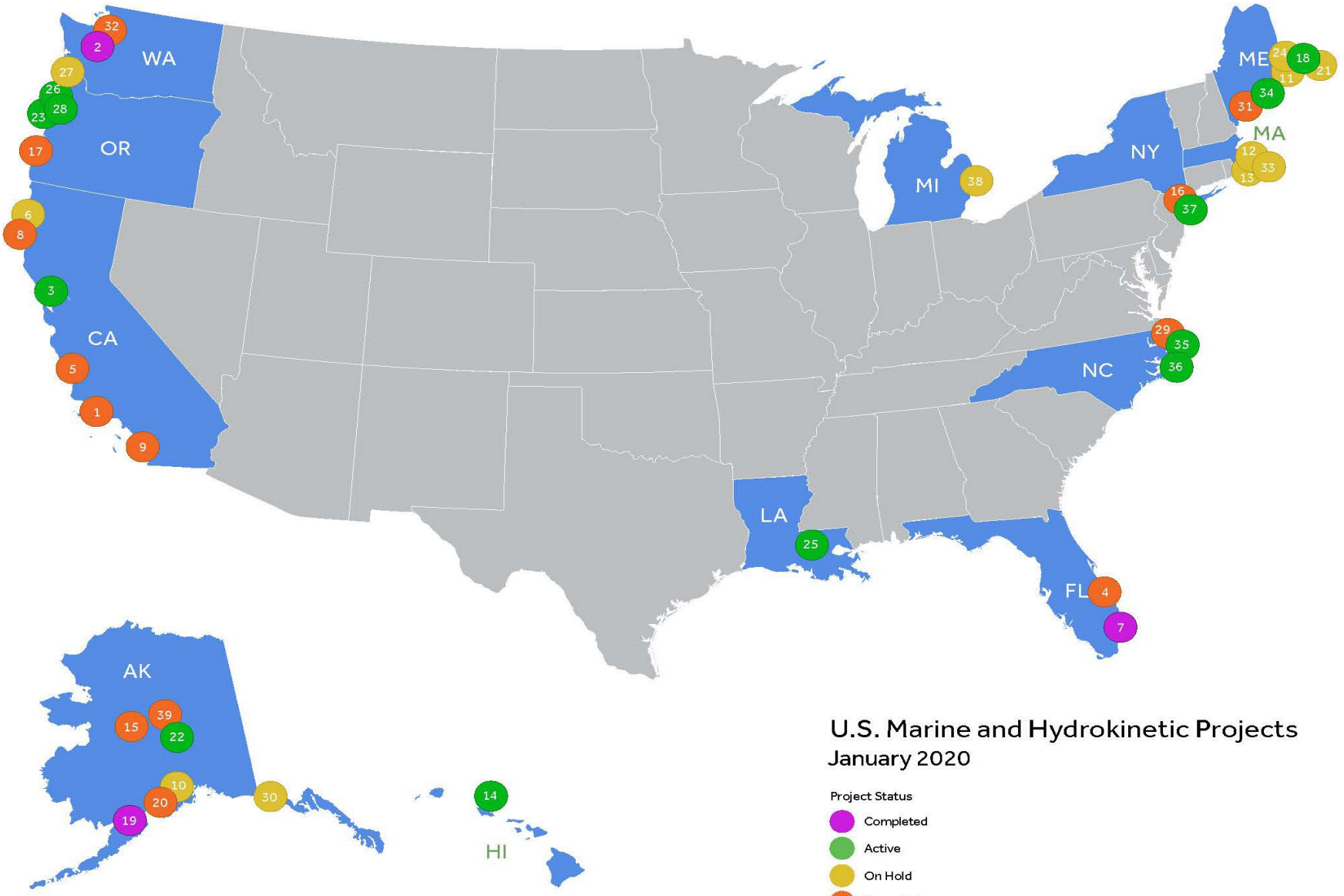
REPUBLIC OF KOREA

TEST SITE NAME	LOCATION
K-WETEC (Korea Wave Energy Test and Evaluation Centre)	Jeju
Korea Tidal Current Energy Centre (KTEC)	Undecided

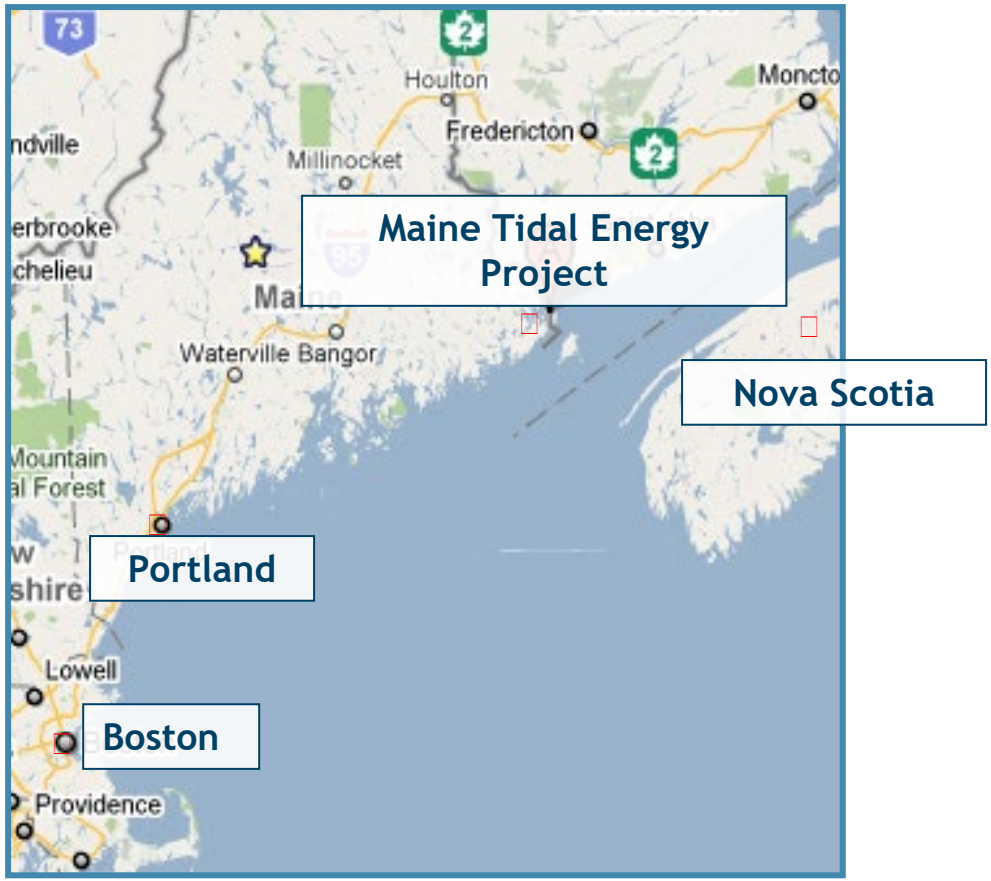
SINGAPORE

TEST SITE NAME	LOCATION
Sentosa Tidal Test Site	Sentosa Island

Source: https://report2018.ocean-energy-systems.org/


WA
OR
CA
AK
HI
MI
NY
ME
MA
NC
LA
FL
U.S. Marine and Hydrokinetic Projects
January 2020
Project Status
Completed
Active
On Hold
Cancelled

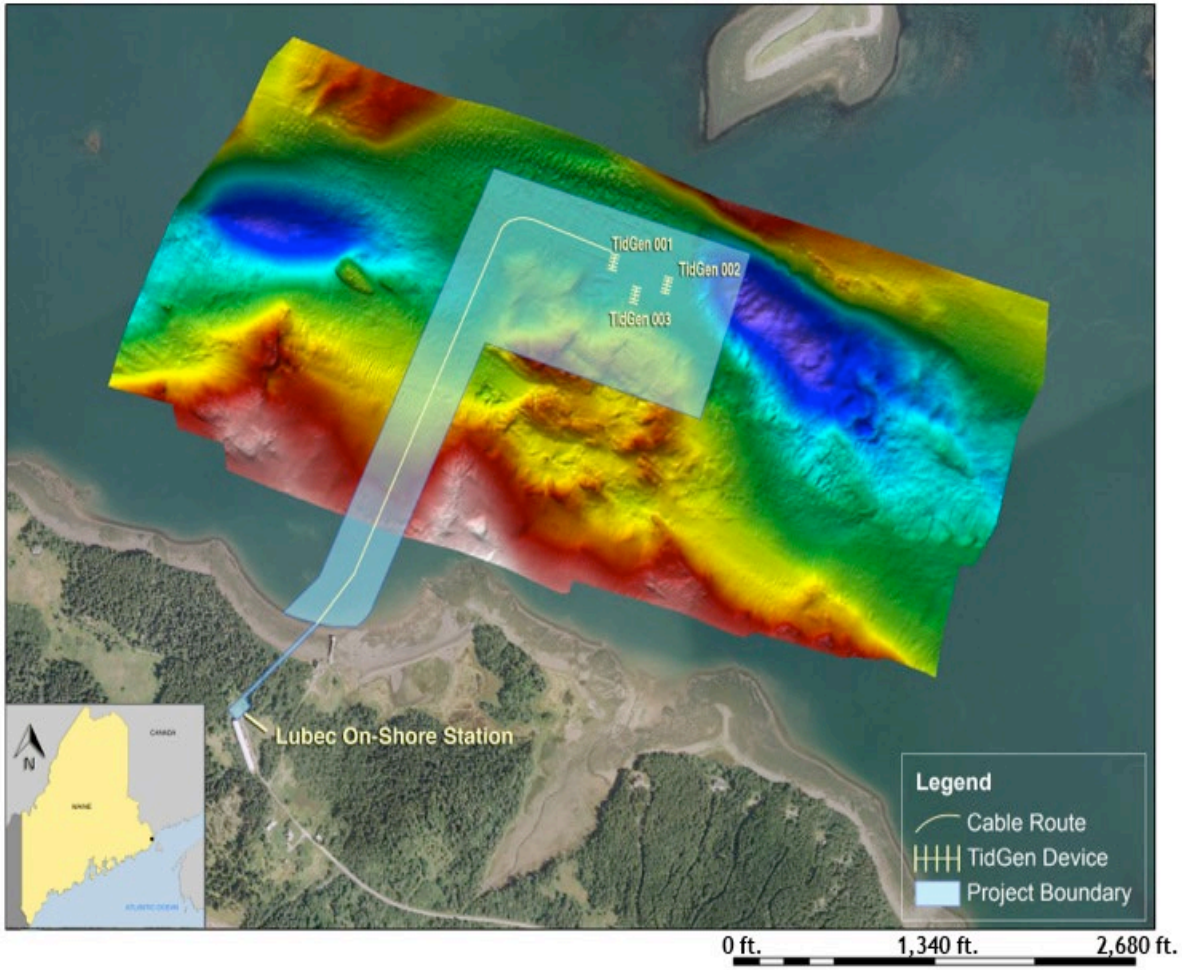
Region Case Study



Cobscook Bay Tidal Energy Project

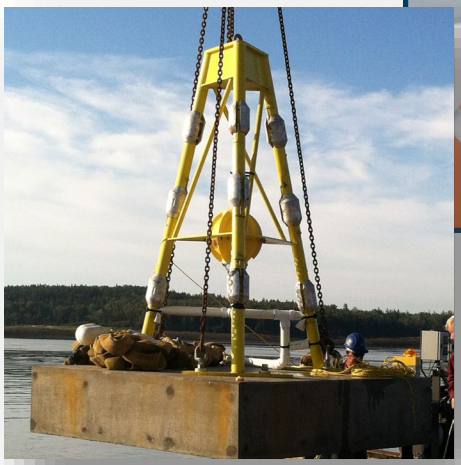
- Located at the mouth of the Bay of Fundy in Downeast Maine
- First tidal energy project to be built in the U.S. under a FERC pilot project license
- Long term PPA approved by Maine PUC on April 24, 2012
- ORPC has initiated consultation with the same resource agencies using the Cobscook Bay Tidal Energy project and adaptive management process as a foundation.
- The adaptive management model is being utilized for tidal and wave projects in Alaska.

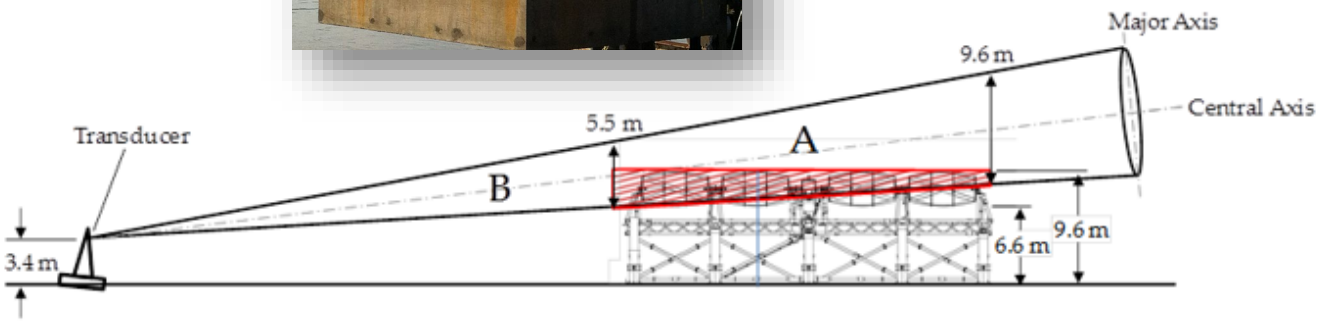
- Bordered the municipalities of Eastport and Lubec, Maine
- Total project area approximately 60 acres
- Approximately 4100’ of submerged power & data cable
- Construction began March 2012 and power delivered to the grid on September 5, 2012
- Surface marked in accordance with USCG aids to navigation regulations



Six Monitoring Plans

- Acoustic
- Benthic and Biofouling
- Hydraulic
- Fisheries and Marine Life Interaction
- Marine Mammal
- Sea and Shorebird





Role of Adaptive Management – Success Model

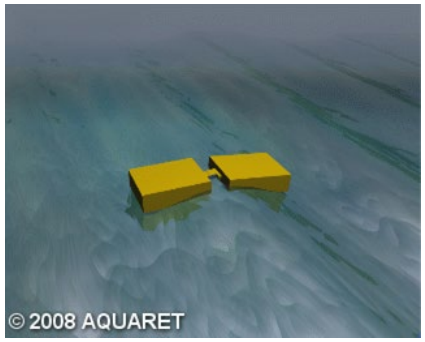
Adaptive management is fundamental to ORPC's approach to minimize environmental risk.

- Build and maintain regulatory trust through:
  - Honesty and integrity
  - Understanding the demands on regulators
  - Submitting informed, detailed project applications
  - Delivering on commitments
- Utilize science-based data collection
  - Working with respected technical advisors
  - Developing innovative monitoring methodologies and technology
- Engage the community and stakeholders
- Initiate adaptive approach in the pre-application phase and continue through project operation

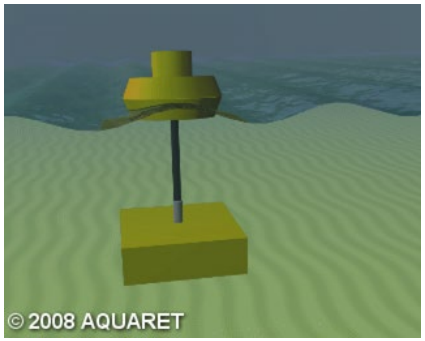
Wave and Tidal Energy Devices

Wave energy device types

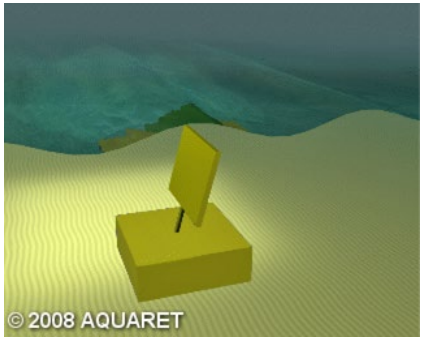
Attenuator



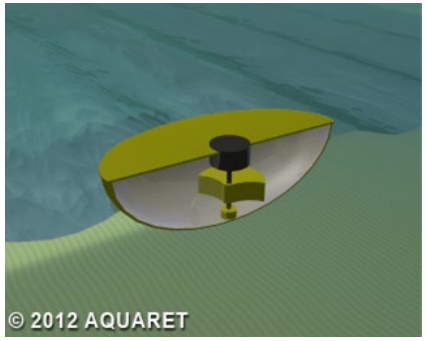
Point absorber



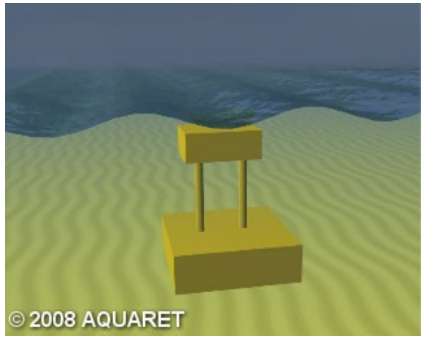
Oscillating wave surge



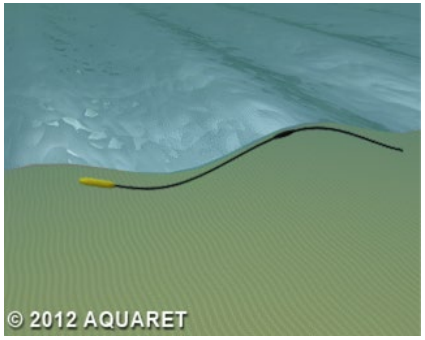
Rotating mass



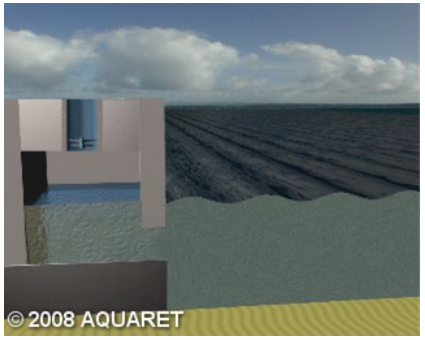
Pressure differential



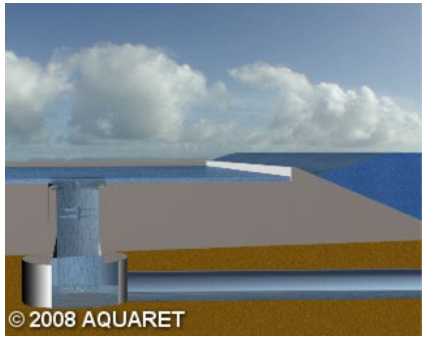
Bulge



Oscillating water column

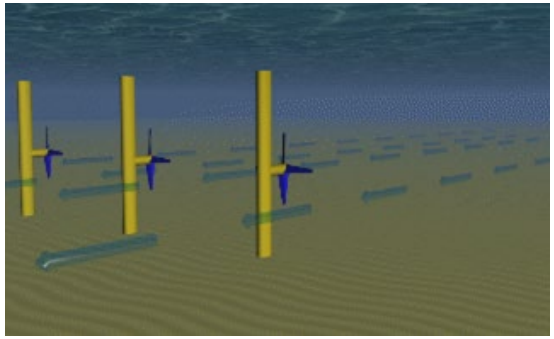


Overtopping

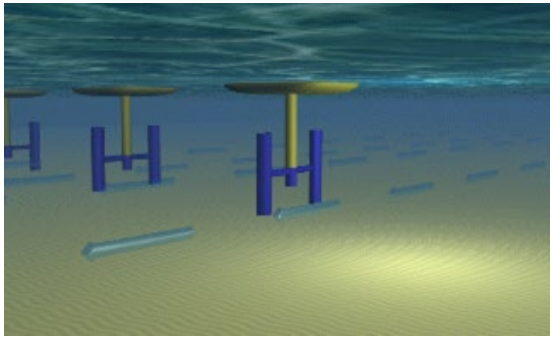


Tidal energy device types

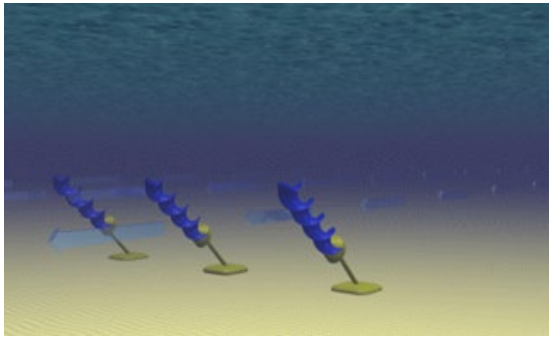
Horizontal axis



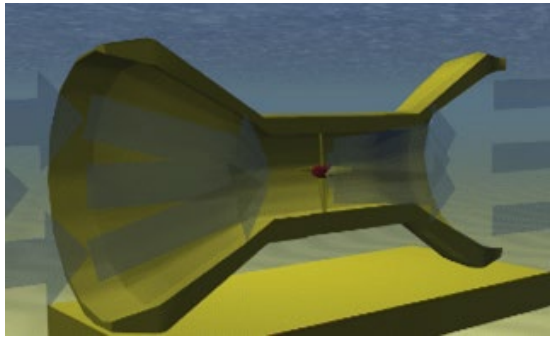
Vertical axis



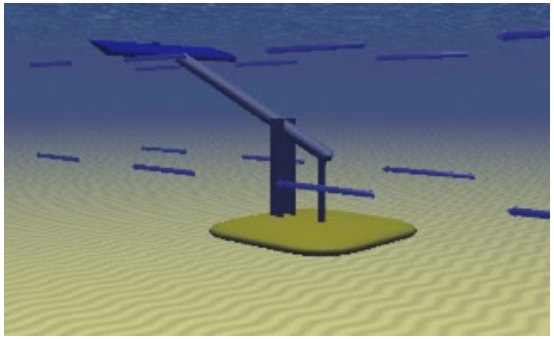
Archimedes screw



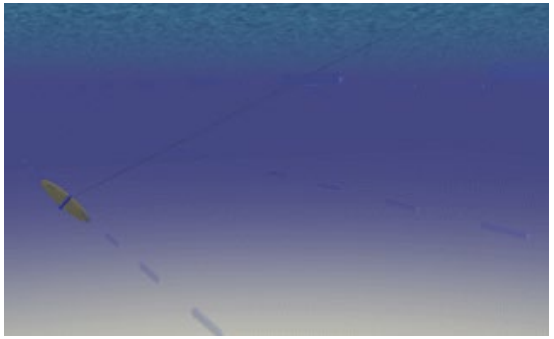
Venturi effect



Oscillating hydrofoil



Tidal kite



Supporting Projects

- Portal Repository for Information on Marine Renewable Energy (PRIMRE)
- Regulatory and Permitting Information Desktop (RAPID)
- Tethys & OES Environmental (formally Annex IV)
- National Oceanic and Atmospheric Administration – Ocean Reports
- Triton Initiative
- Various FOAs
  - Environmental Effects Assessment and Monitoring
  - Environmental Instrumentation
  - Environmental Monitoring Technology Advancement
- MHK Permitting Handbook
- Environmental Compliance Cost Assessment (ECCA)
- The U.S. Testing Expertise and Access for Marine Energy Research (TEAMER) Program

Example Project Components

Discussion Questions and How to Participate

- At select times during the presentation we will be soliciting your feedback using PollEverywhere.
- To participate via web use PollEv.com/kwpoll2 (also provided in the webinar chat)
- To participate via phone messaging, text KWPOLL2 to 22333 to join the session

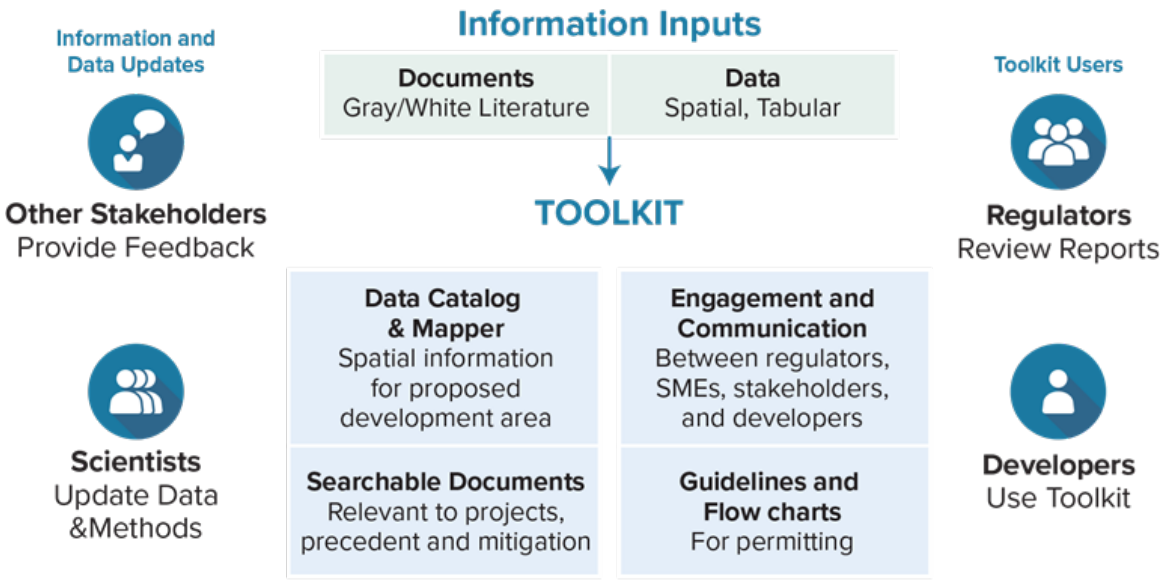
Toolkit Summary

MHK Environmental Toolkit

Increase understanding of MHK projects and their potential environmental effects

Reduce the amount of time to permit MHK projects by developing a useful toolkit for all stakeholders

Help decrease costs (time and resources) of MHK projects



Environmental Interactions

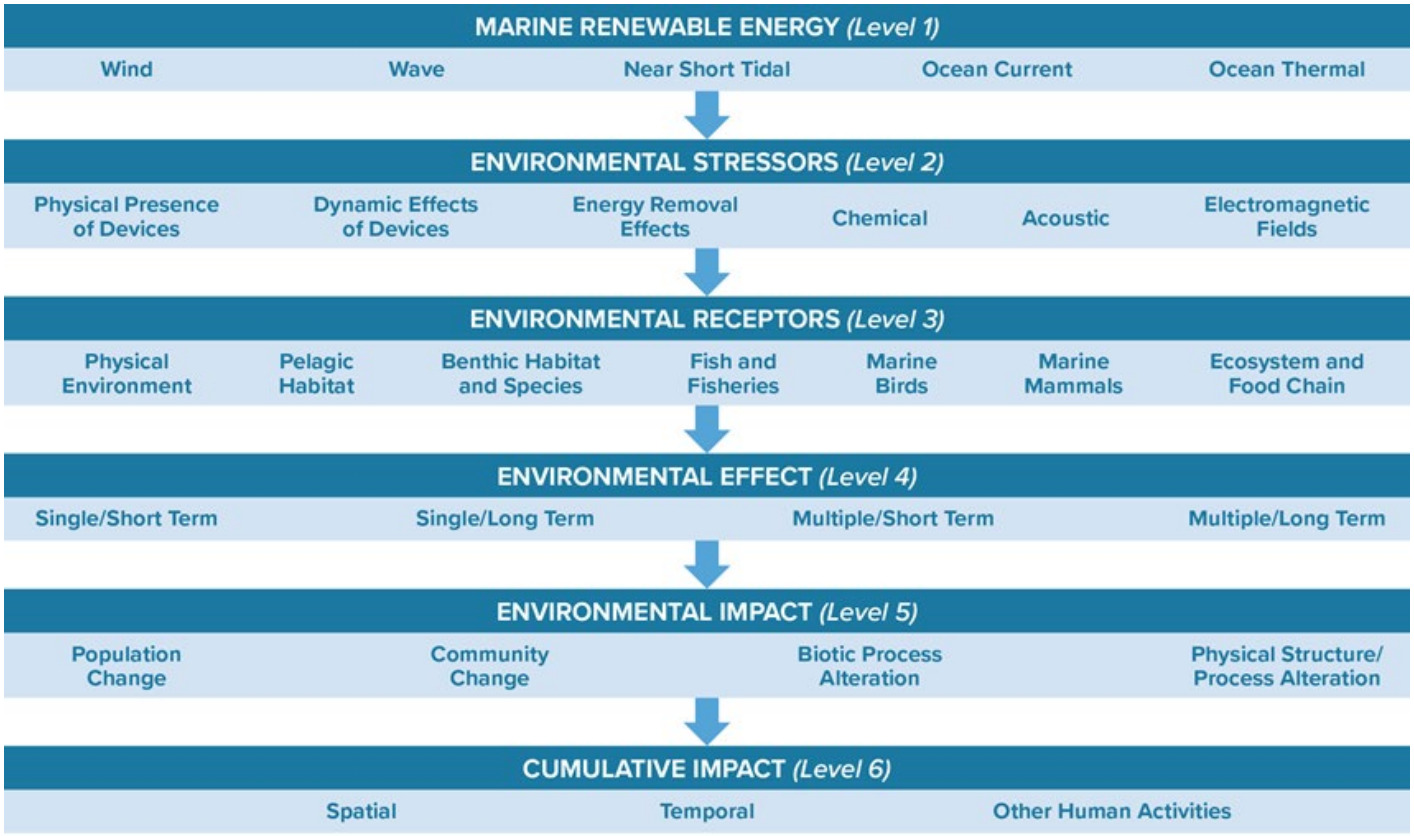


Figure 1. Framework for the consideration of environmental effects of marine renewable energy encompassing different scales (Boehlert and Gill 2010).

Key Challenges

Multiple devices, configurations, and functionality

Environmental interactions are often complex with multiple aspects to ongoing research

Limited regulatory precedent

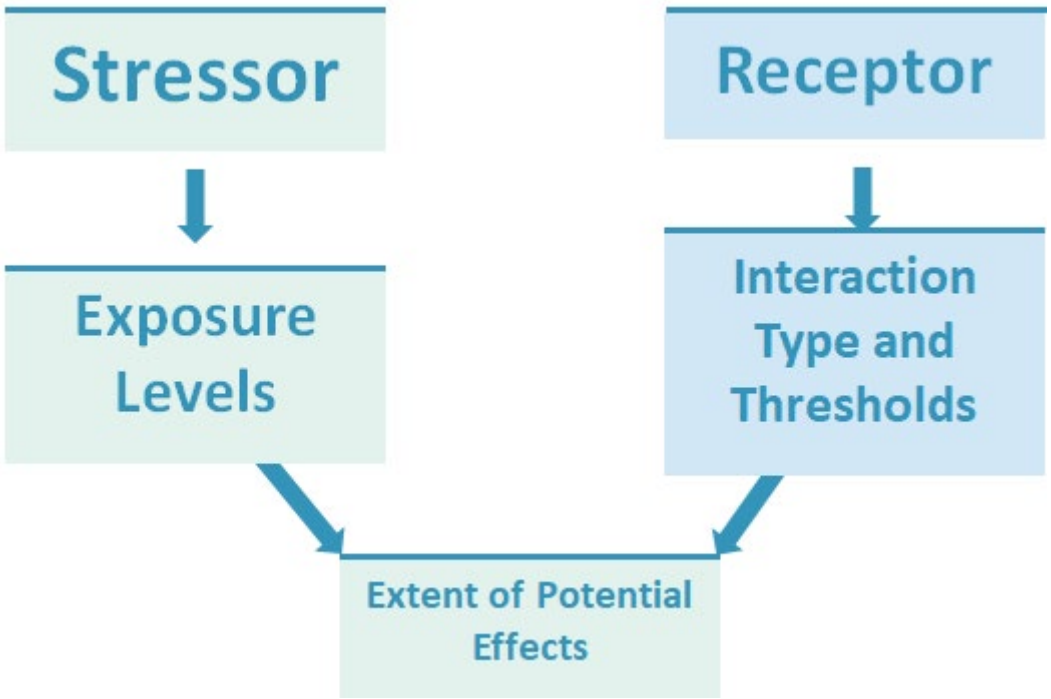
No consistent forum for information sharing

Conceptual Model of Key Information

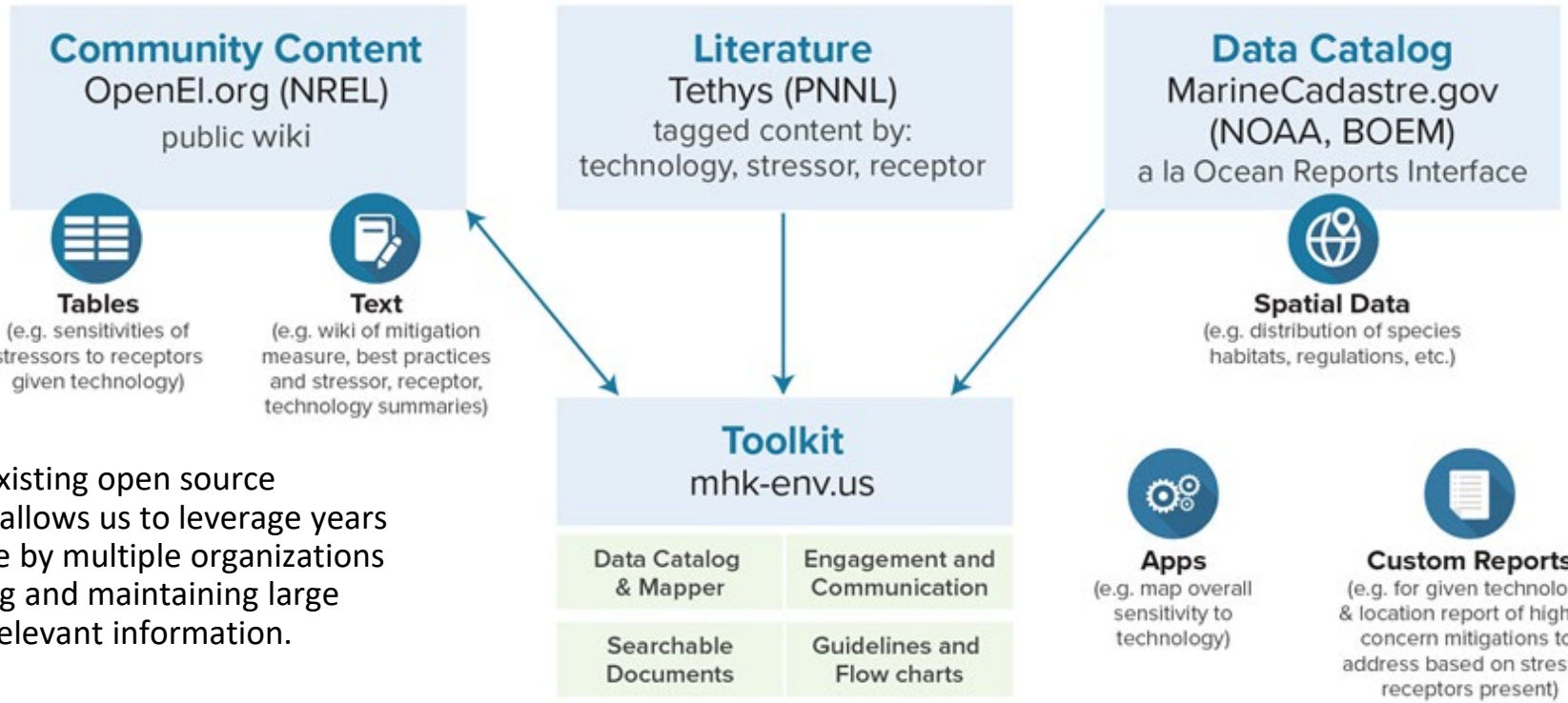
Fundamental stressor and receptor relationships guide our understanding of potential MHK effects

Having consistent definitions and understanding of the stressors allows us to better define the interactions with receptors

The Toolkit is being designed to offer a consistent way to share and access information allowing for a consistent understanding and sharing of available information



DATA SOURCES

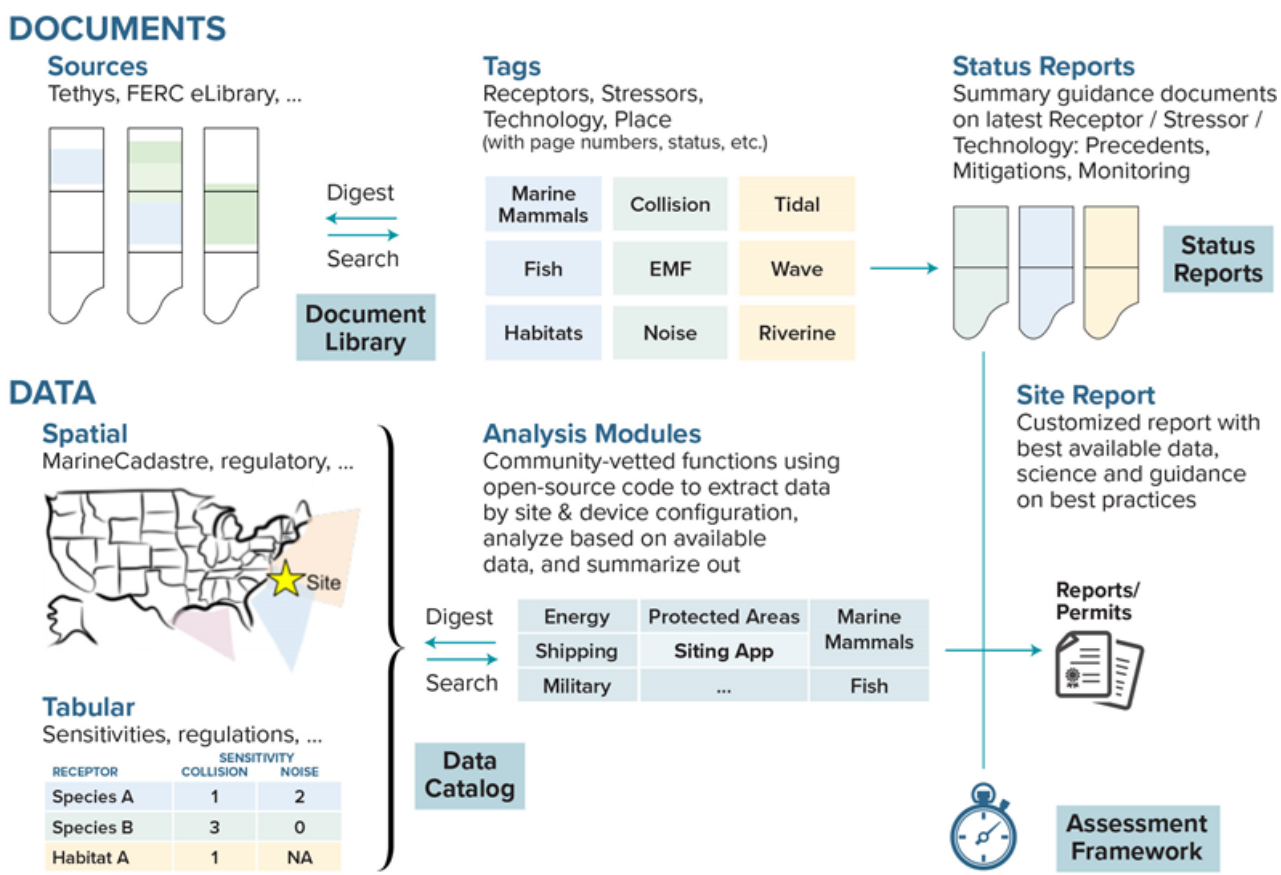


Relying on existing open source information allows us to leverage years of work done by multiple organizations in completing and maintaining large catalogs of relevant information.

OpenEI
Tethys
MarineCadastre

Information Flow

Increased understanding and decreased need for resources to accomplish this are accomplished through effective synthesis of information



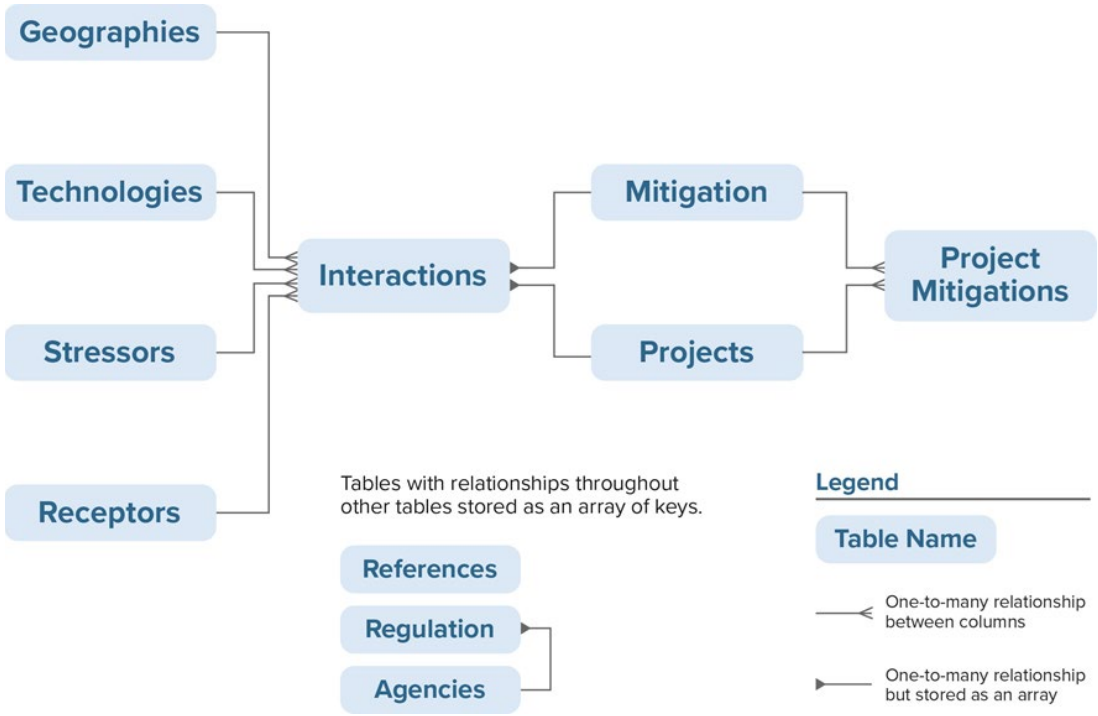
Database Structure

Relational database diagram of tables, uniquely defined by information areas (key in **bold**)

Additional key attributes of each information source are included

Regulations and other references throughout are included to capture one or more possible areas of relationships

This structure makes it possible for us to represent the conceptual model of MHK environmental interactions in a flexible relational database



Database Structure

Geographies

geography_key

geography_wkt

geography_parent_id

name

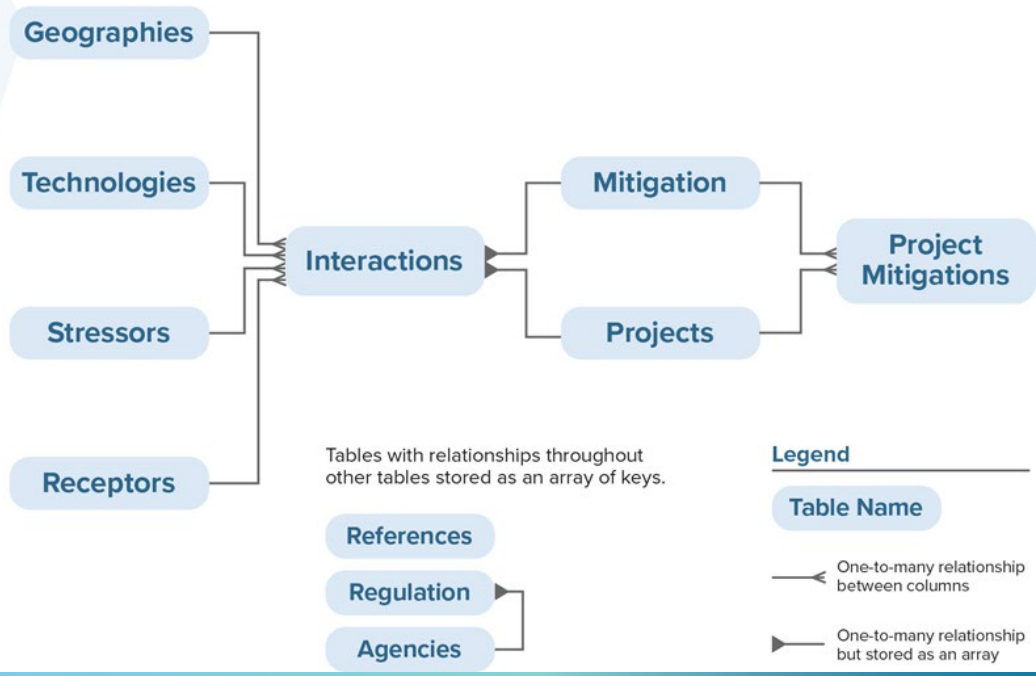
description

horizontal (offshore)

vertical (elevation)

references [ARRAY]

regulations [ARRAY]



Feedback Exercises

- Are there different databases or sources of data to include?

Feedback Exercises

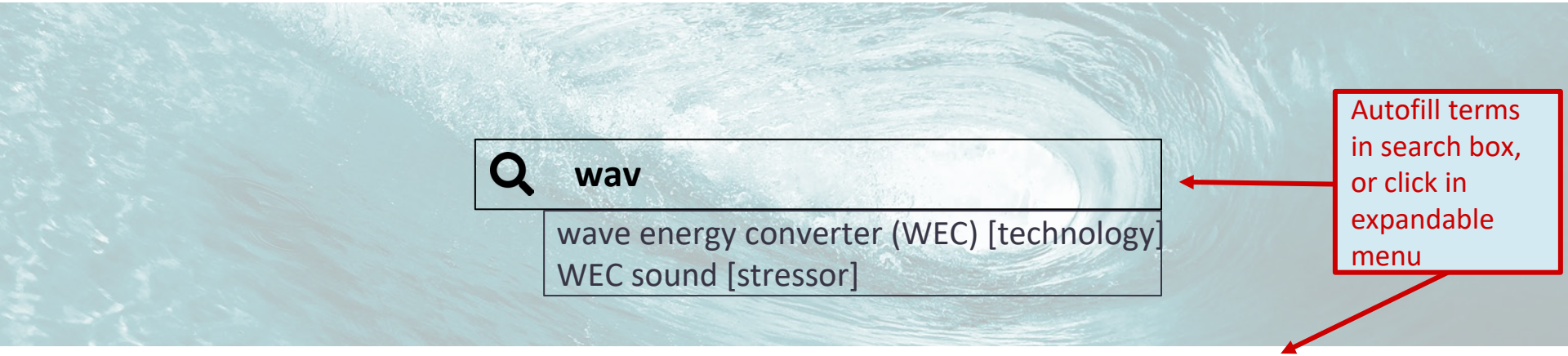
Does the flow and use of information make sense?

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Start the presentation to see live content. Still no live content? Install the app or get help at **PollEv.com/app**

MHK Environmental Toolkit Example

Login



Site Map

Regulations and Permitting Database

Regulatory and permitting information by jurisdiction, including comparisons between jurisdictions

Reference Library

A collection of links to regulatory and permitting documents, regulations, and tools available on other websites

Best Practices

A collection of best practices for efficiently permitting renewable energy and bulk transmission projects

Terms

- Technology
  - Wave
  - Tidal
- Stressor
  - …
- Receptor
  - …
- Regulatory
  - Agency
  - Regulation
- Geography
- **Mitigation**

MHK Environmental Toolkit Example

Login

wave energy convertor

+ wave energy converter (WEC) [technology]
+ WEC sound [stressor]

Continue adding terms to investigate interactions using search box, or click in expandable menu

Wave Energy Converter (WEC) [technology]

Summary

Wave energy (or **wave** power) is the transport and capture of **energy** by ocean surface **waves**.
The **energy** captured is then ….

Stressors

- Sound +
- Collision +
- …

Bibliography

Editing the page takes user to OpenEI platform

Terms

- Technology
  - Wave
  - Tidal
- Stressor
  - …
- Receptor
  - …
- Regulatory
  - Agency
  - Regulation
- Geography
- **Mitigation**

MHK Environmental Toolkit Example

Login

wave energy converter noise

+ wave energy converter (WEC) [technology]
+ WEC sound [stressor]

Continue adding terms to investigate interactions using search box, or click in expandable menu

Technology Type

(-) Tidal
Marine Energy (General) (59)
Wave (11)
Offshore Wind (3)
Wind Energy (General) (2)
Ocean Current (1)
OTEC (1)

Receptor

Marine Mammals (30)
Fish (21)
Invertebrates (16)
Birds (15)
Human Dimensions (8)
Nearfield Habitat (8)
Reptiles (4)
Ecosystem Processes (3)
Physical Environment (3)

Stressor

(-) Noise
Habitat Change (9)
Collision (7)
Avoidance (5)
EMF (5)
Changes in Flow (4)
Attraction (2)
Chemicals (2)
Entrapment (1)

Wave Energy Converter (WEC) [technology] X noise [stressor]

Summary

Underwater noise from a wave energy converter system

…

Receptors

- Whales +
- Fish +
- …

Bibliography

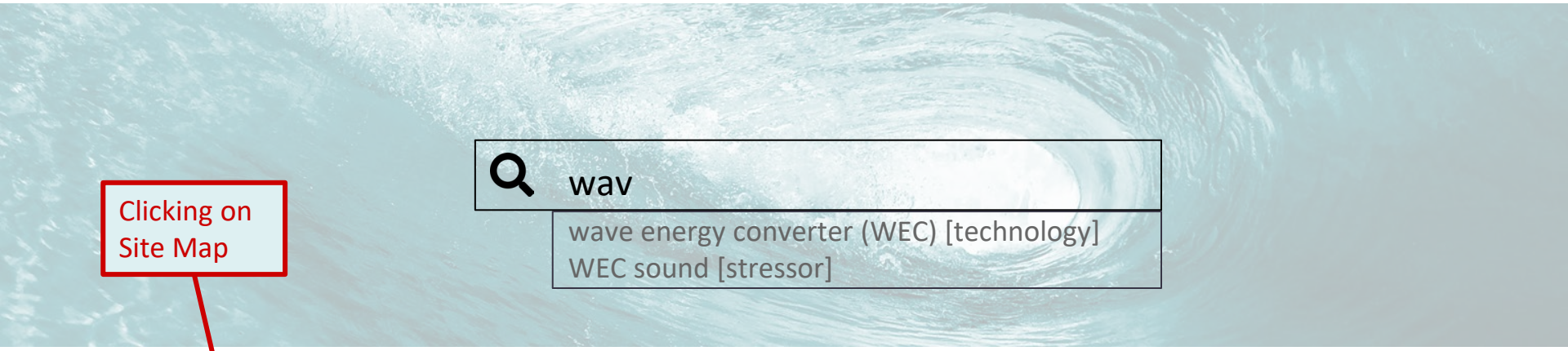
MHK Environmental Toolkit Example

Logout

After login, get option to save projects, manage account, searches, and notes

MHK Environmental Toolkit Example

Login



Clicking on Site Map

Site Map

Regulations and Permitting Database

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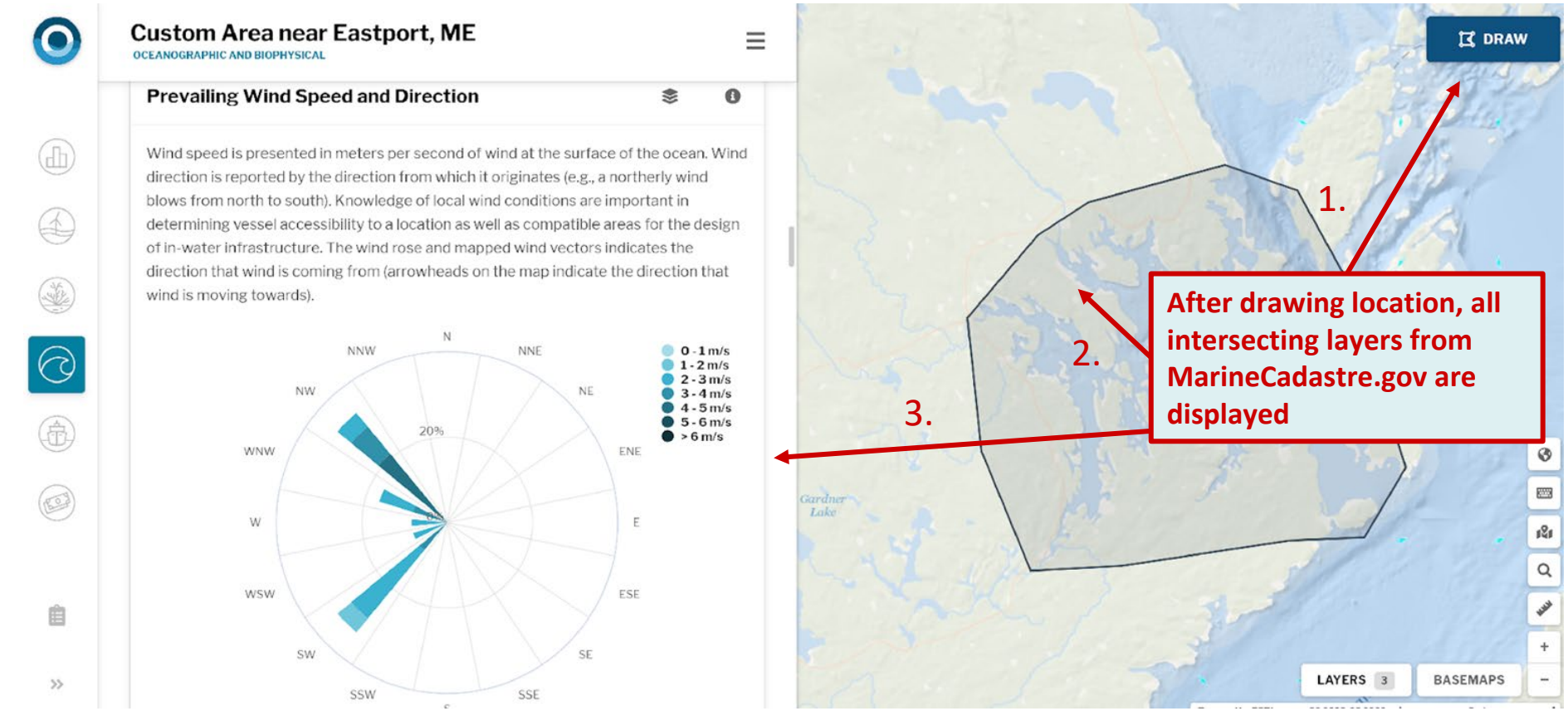
  - Wave
  - Tidal
- Stressor
  - …
- Receptor
  - …
- Regulatory
  - Agency
  - Regulation
- Geography
- **Mitigation**

MHK Environmental Toolkit Example

Login



MHK Environmental Toolkit Example

Login

Custom Area near Eastport, ME

NATURAL RESOURCES AND CONSERVATION

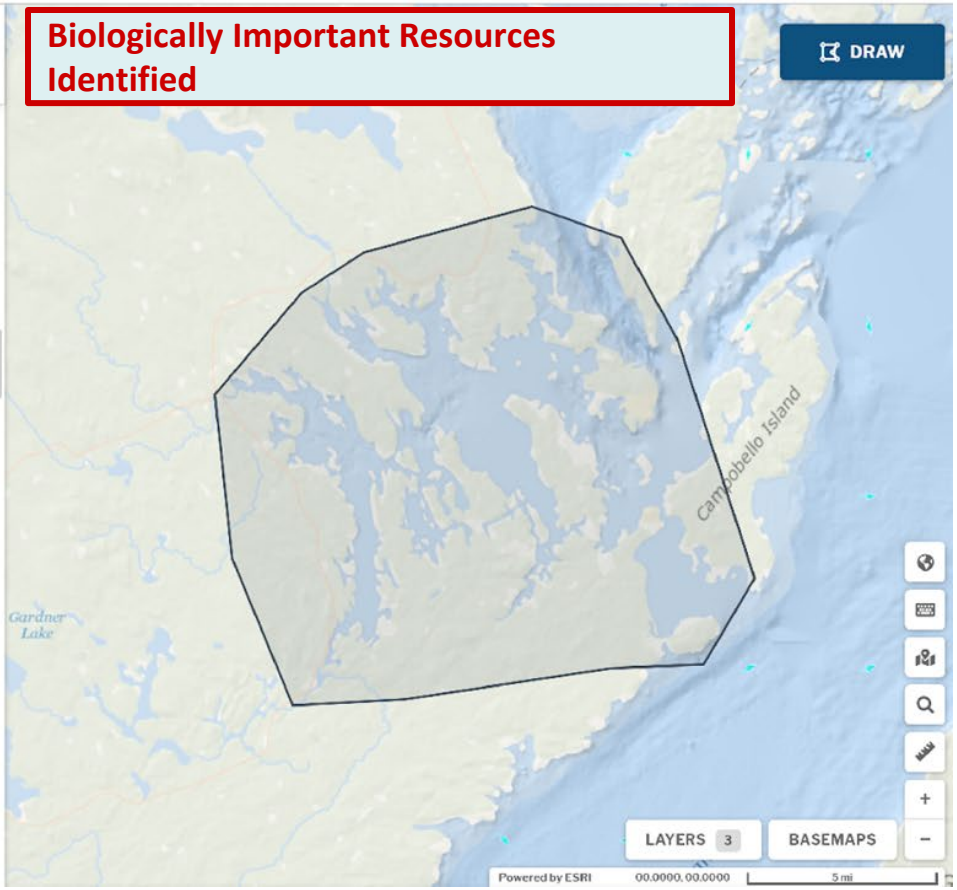
Cetacean Biologically Important Areas

Biologically important areas are places essential for specific species or species groups of cetaceans for migration, or feeding or reproduction, or areas that are permanently populated with small resident populations. Many cetacean species (whales and dolphins) are threatened or endangered and serve as important apex predators in their respective ecosystems. Cetaceans can be especially susceptible to noise, entanglement in fishing gear, and disturbances from other human activities. Activities in areas corresponding to a biologically important area may require consultation with regional experts to determine sites that will minimize interactions with threatened and endangered cetacean species.

Name	Type	Area	Count
Harbor porpoise	Small and resident	Gulf of Maine	1
Humpback whale	Feeding	Gulf of Maine; Stellwagen Bank; Great South Channel	1
Fin whale	Feeding	Northern Gulf of Maine	1

Showing biologically important areas by species and type inside the report area and within 10 nautical miles.

Biologically Important Resources Identified



MHK Environmental Toolkit Example

Login

Custom Area 1.31 nauti...

NATURAL RESOURCES AND CONSERVATION

Endangered Species

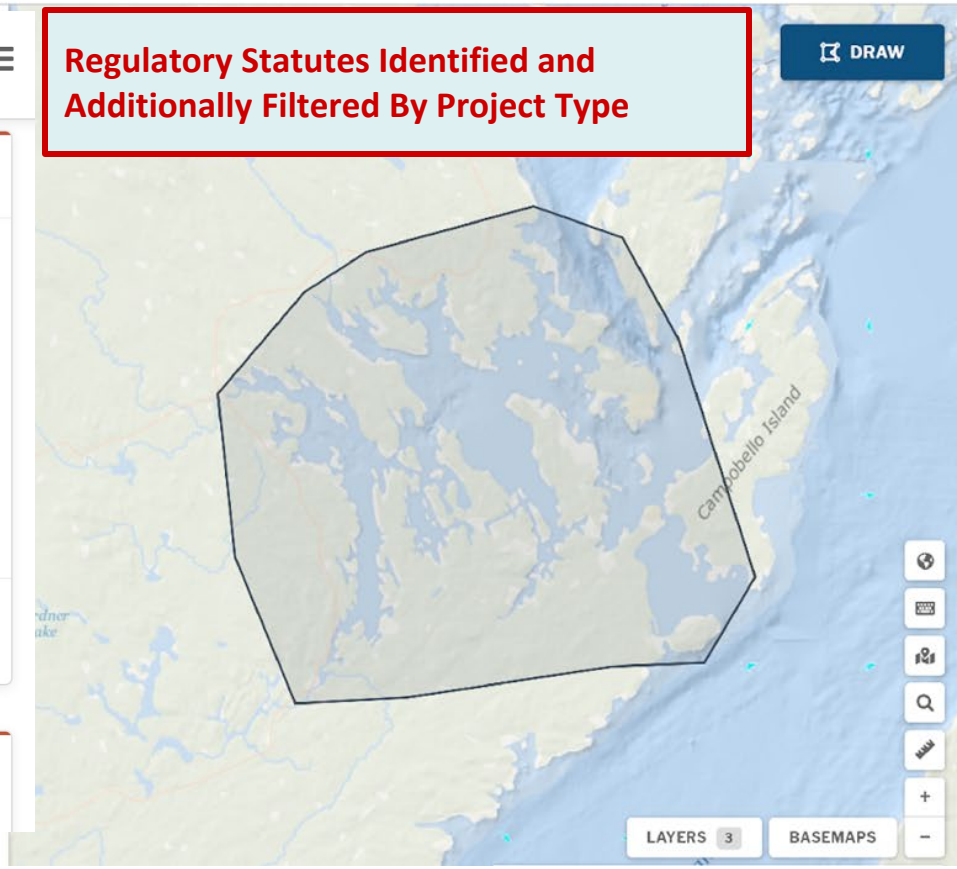
Endangered species include those species and habitats protected by the Endangered Species Act of 1973. Explore species and habitats managed by the United States Fish and Wildlife Service (USFWS) to see if any listed species, migratory birds or other natural resources coincide within the area of interest. For more information, visit the Information for Planning and Consultation (IPaC) website. For NOAA-managed endangered species, visit the Fisheries Species Directory for threatened and endangered species. For information about ESA Section 7 consultation, see S7 Consultation Technical Assistance Step-by-Step Instructions.

Managed endangered species may be present inside the report area. Please visit the above websites to learn more.

Endangered Species Act Critical Habitat Designations

Indian Land Areas

Regulatory Statutes Identified and Additionally Filtered By Project Type



Technology

Click on Technology configuration to launch a popup window for setting the technology type and specifications.

Receptors are spatially derived, and Stressors can be added after setting Technology configuration. Then interactions and mitigation options are associated with elements in the report which can be saved for future viewing

Cross Flow Turbine

Capture kinetic energy of moving water with spinning blades oriented perpendicular to the direction of flow. Turbines can be open or ducted (shrouded) and placed anywhere in the water column, though bottom-mounted is the most common.

There is typically less environmental concern for **collision** between turbine blades and marine organisms because, depending on the design, blades are spinning in the same direction to the flow of water. Concerns about **noise**, **electromagnetic fields**, **changes in flow**, and impacts on **water quality** are similar to that of axial flow turbines.

MHK Environmental Toolkit: Project Database Example

Project Status:
Device in operation

Technology:
Advanced design cross flow turbine (Turbine Generator Unit – TGU)

Project Scale:
From a single device TidGen™ Power System to an array consisting of a 3-device power system.

Installed Capacity:
The total generating capacity of the project at the completion of Phase 2 will be approximately 450 kW (see phases in the additional description below)

Description:
The Cobscook Bay Tidal Energy Project consists of the following phases:

Phase 1 – A single-device TidGen™ Power System with a rated capacity of 150 kW was secured to a bottom support frame, which was attached to the seafloor. Subsea power and data cables were deployed on the seafloor and connected to the TidGen™ device. Electricity generated by the TidGen™ Power System was delivered by an underwater power cable to an On-shore Station in Lubec, Maine, where it was power-conditioned and connected to the Bangor Hydro Electric Company (BHE) utility grid on September 13, 2012.

Phase 2 – Two additional devices with a rated capacity of 150 kW will be added to form a commercial-scale, multi-device power system. The underwater power and control cables from the turbine devices will be connected to an underwater consolidation box, and a single underwater power and control cable will connect this box to an electrical substation onshore. The complete system will be interconnected to the BHE grid.

Location:
The device is located in Cobscook Bay on State of Maine submerged lands, near Eastport and Lubec, Maine, United States.

Project Site OES-Environmental

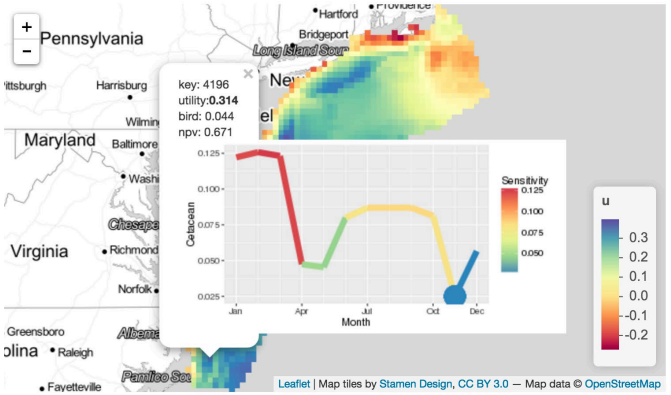
Title:	Cobscook Bay Tidal Energy Project
Author:	ORPC Maine
Developer:	Ocean Renewable Power Company
Website:	http://www.orpc.co
Start Date:	September 13, 2012
Docket Number:	P-12711 (FERC Disclaimer)
State:	Maine
Country:	United States of America
Technology Type:	Marine Energy (General), Tidal
Info Updated:	December 10, 2012

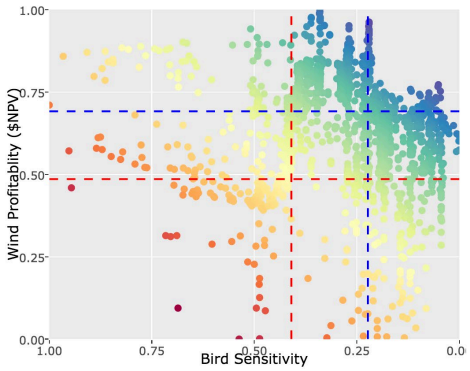
TidGen™ Power System

Process Status:
Current status of the project implementation and future developments:
The installation and start-up of the single-device TidGen™ Power System (Phase 1) is 100% complete. This is first grid-connected marine hydrokinetic project in the Western Hemisphere. It has received a 20-year Power Purchase Agreement from the Maine Public Utilities Commission. Detailed testing and monitoring of the nearby environment, as well as all device components and subsystems and initial operations is ongoing. Engineering enhancements for the multi-device power system has begun.

Apps

- Qualitative analysis of environmental impacts
  - App to report out stressor-receptor interactions
- Siting to evaluate specific interactions and potential impacts
- Reporting on:
  - Uncertainty state of knowledge
  - Potential impacts
- Others?





rank	utility	bird	npv	key
1	0.371	0.22	0.962	1615
2	0.369	0.22	0.957	1674
3	0.364	0.221	0.949	1733

Example app for siting offshore wind energy development to minimize impacts on birds in space and whales in time by team member EcoQuants

Apps

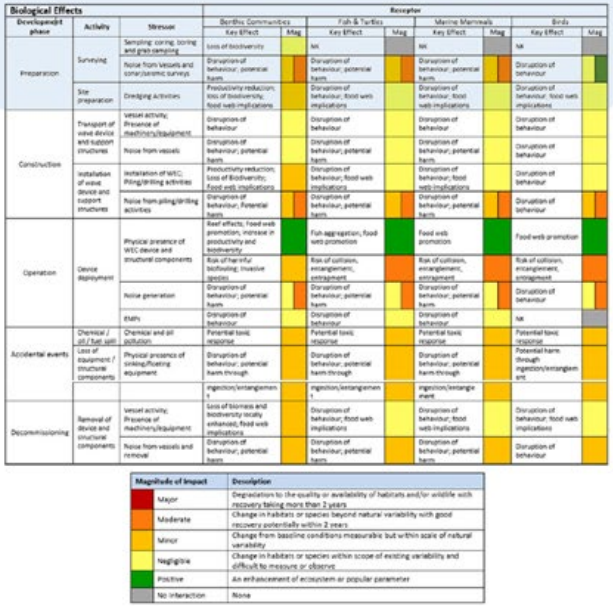
- Qualitative analysis of environmental impacts for a Wave Energy Convertor Project
- Reports out stressor-receptor interactions during project phases

Biological Effects			Receptor							
Development phase	Activity	Stressor	Benthic Communities		Fish & Turtles		Marine Mammals		Birds	
			Key Effect	Mag	Key Effect	Mag	Key Effect	Mag	Key Effect	Mag
Preparation	Surveying	Sampling: coring, boring and grab sampling	Loss of biodiversity		NK		NK		NK	
		Noise from Vessels and sonar/seismic surveys	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Site preparation	Dredging Activities	Productivity reduction; loss of biodiversity; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	
Construction	Transport of wave device and support structures	Vessel activity; Presence of machinery/equipment	Disruption of behaviour		Disruption of behaviour		Disruption of behaviour		Disruption of behaviour	
		Noise from vessels	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Installation of wave device and support structures	Installation of WEC; Piling/drilling activities	Productivity reduction; Loss of Biodiversity; Food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour	
		Noise from piling/drilling activities	Disruption of behaviour; Potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
Operation	Device deployment	Physical presence of WEC device and structural components	Reef effects; Food web promotion; increase in productivity and biodiversity		Fish aggregation; food web promotion		Food web promotion		Food web promotion	
			Risk of harmful biofouling; Invasive species		Risk of collision, entanglement, entrapment		Risk of collision, entanglement, entrapment		Risk of collision, entanglement, entrapment	
		Noise generation	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
		EMFs	Disruption of behaviour		Disruption of behaviour		Disruption of behaviour		NK	
Accidental events	Chemical / oil / fuel spill	Chemical and oil pollution	Potential toxic response		Potential toxic response		Potential toxic response		Potential toxic response	
	Loss of equipment / structural components	Physical presence of sinking/floating equipment	Disruption of behaviour; potential harm through		Disruption of behaviour; potential harm through		Disruption of behaviour; potential harm through		Potential harm through ingestion/entanglement	
			ingestion/entanglement		ingestion/entanglement		ingestion/entanglement			
Decommissioning	Removal of device and structural components	Vessel activity; Presence of machinery/equipment	Loss of biomass and biodiversity locally enhanced; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	
		Noise from vessels and removal	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	

Magnitude of Impact	Description
Major	Degradation to the quality or availability of habitats and/or wildlife with recovery taking more than 2 years
Moderate	Change in habitats or species beyond natural variability with good recovery potentially within 2 years
Minor	Change from baseline conditions measurable but within scale of natural variability
Negligible	Change in habitats or species within scope of existing variability and difficult to measure or observe
Positive	An enhancement of ecosystem or popular parameter
No Interaction	None

Apps

Biological Effects			Receptor							
Development phase	Activity	Stressor	Benthic Communities		Fish & Turtles		Marine Mammals		Birds	
			Key Effect	Mag	Key Effect	Mag	Key Effect	Mag	Key Effect	Mag
Preparation	Surveying	Sampling: coring, boring and grab sampling	Loss of biodiversity		NK		NK		NK	
		Noise from Vessels and sonar/seismic surveys	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Site preparation	Dredging Activities	Productivity reduction; loss of biodiversity; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	



MHK Environmental Toolkit

Increase understanding of MHK projects and their potential environmental effects

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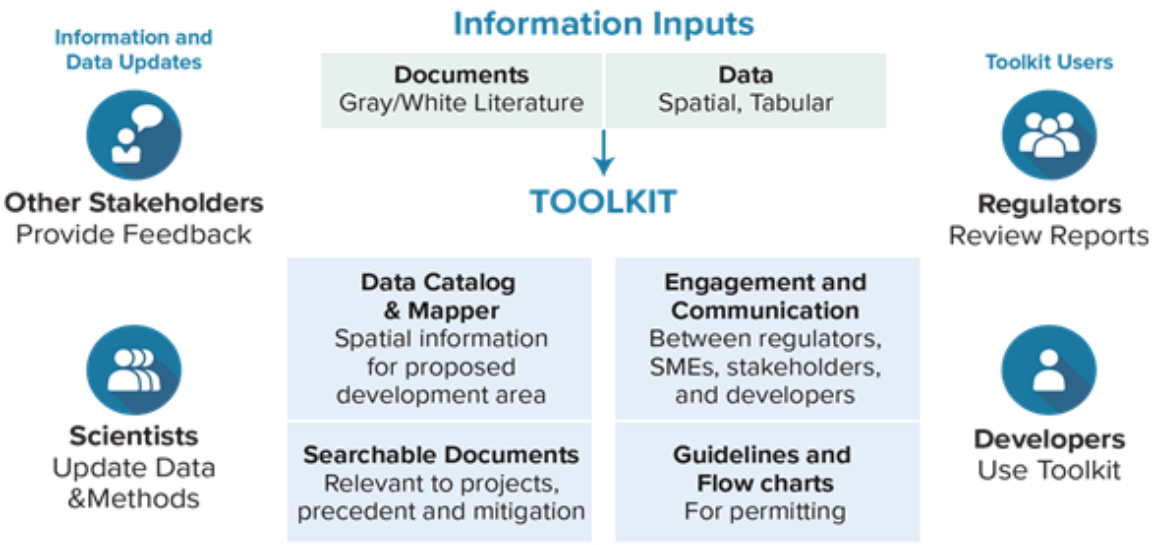
Help decrease costs (time and resources) of MHK projects



Feedback Exercises

- Current content:
  - Data Catalog and Mapper
  - Engagement and Communications Tools
  - Searchable Documents
  - Guidelines and Flowcharts
- What is missing from the Toolkit?

Biological Effects			Receptor							
Development phase	Activity	Stressor	Benthic Communities		Fish & Turtles		Marine Mammals		Birds	
			Key Effect	Mag	Key Effect	Mag	Key Effect	Mag	Key Effect	Mag
Preparation	Surveying	Sampling: coring, boring and grab sampling	Loss of biodiversity		NK		NK		NK	
		Noise from Vessels and sonar/seismic surveys	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Site preparation	Dredging Activities	Productivity reduction; loss of biodiversity; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	

- Is the qualitative review of environmental interactions helpful (above)?

Feedback Exercises

What component of the Toolkit would you use in the permitting/licensing process?

Data Catalog & Mapper

Engagement and Communication Tools

Searchable Documents

Guidelines and Flowcharts

Feedback Exercises

What component of the Toolkit would you NOT use in a permitting/licensing process?

Data Catalog & Mapper

Engagement and Communication Tools

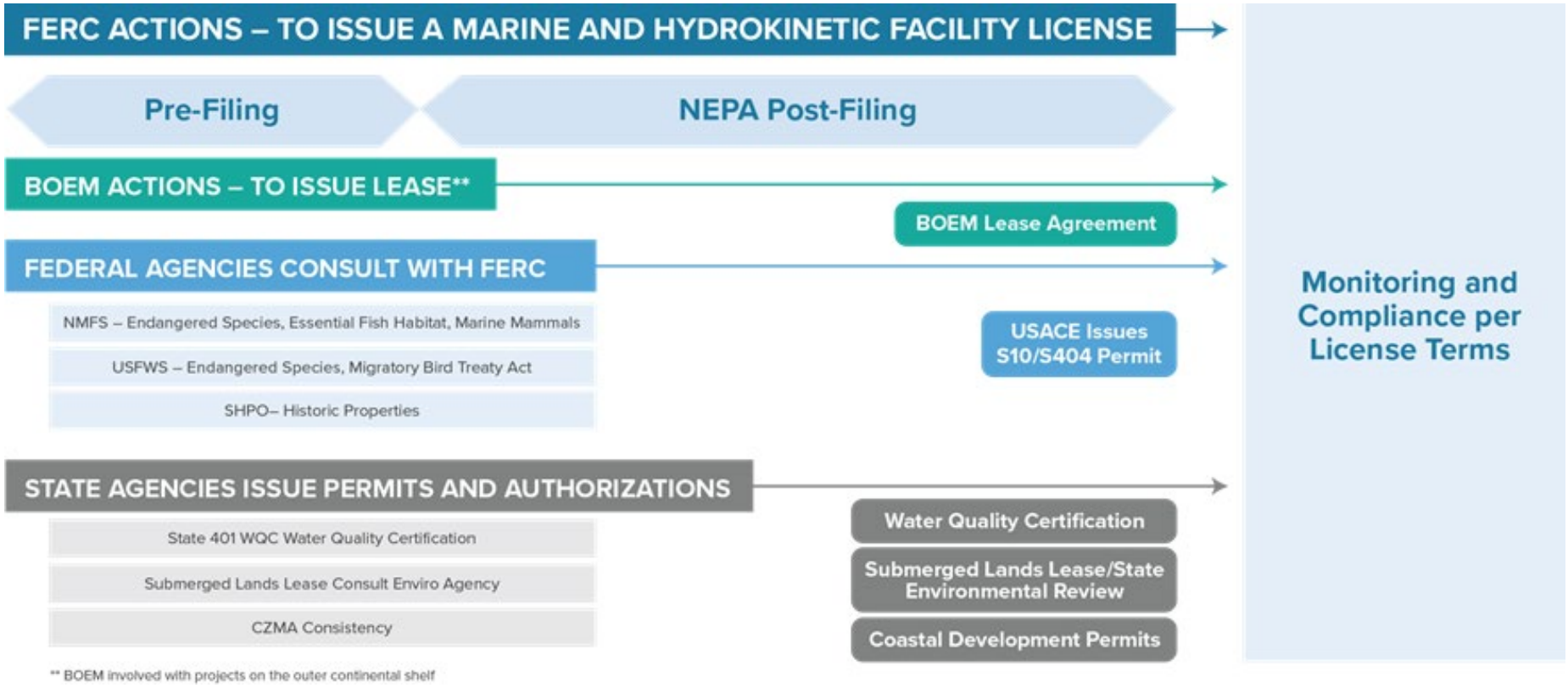
Searchable Documents

Guidelines and Flowcharts

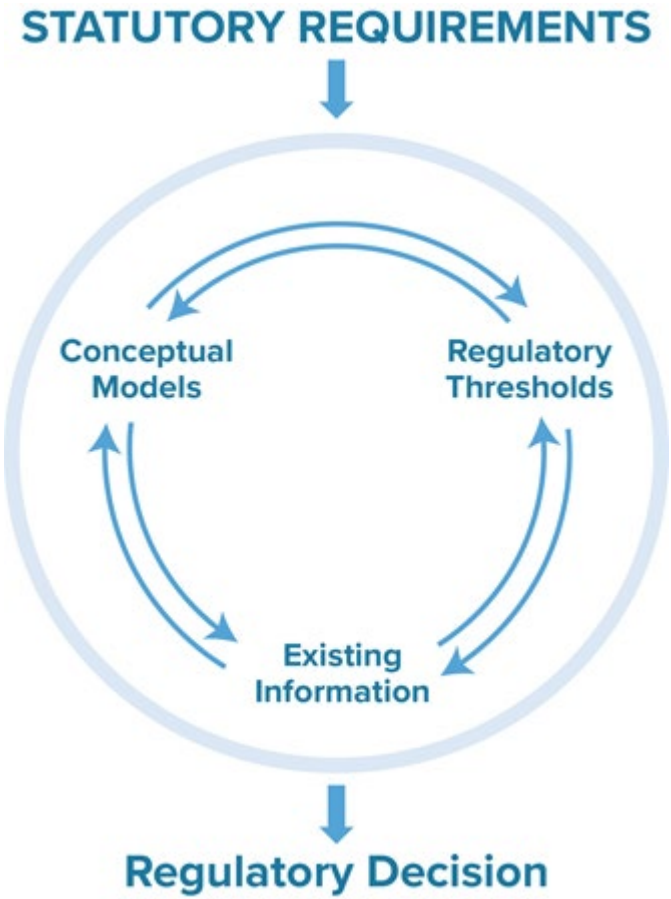
Start the presentation to see live content. Still no live content? Install the app or get help at **PollEv.com/app**

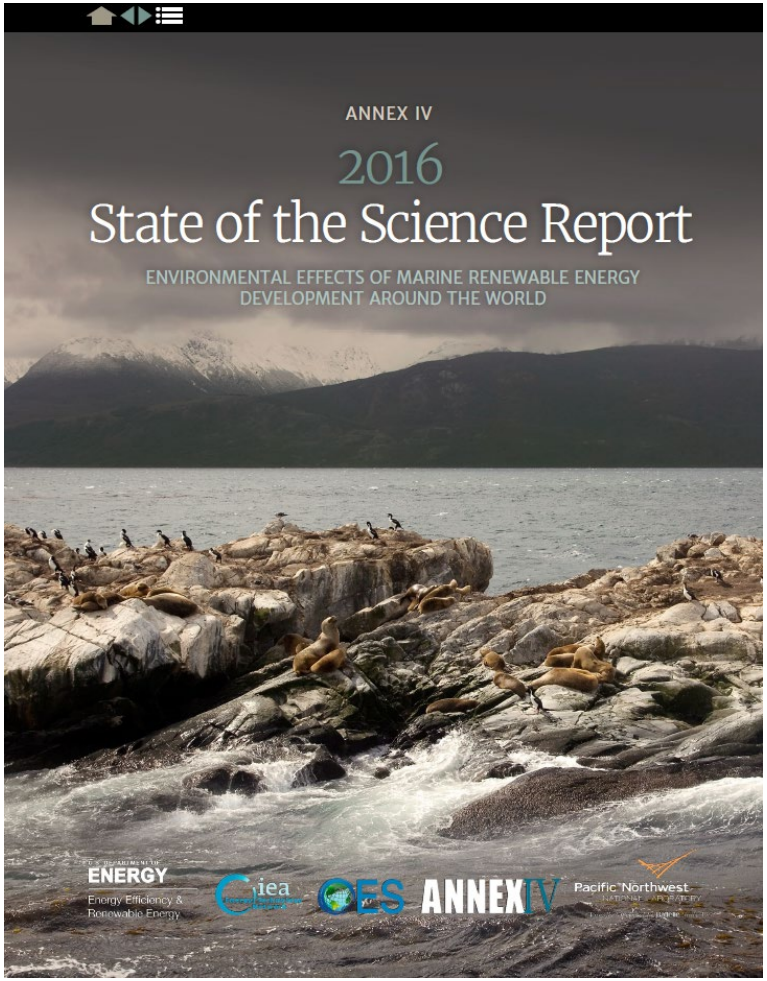
Overview of Regulatory Process

- Pilot Grid Connected, Commercial Scale Project Permitting, and Test Site Permitting



Stepwise Approach for Permitting Information





https://tethys.pnnl.gov/publications/state-of-the-science-2016

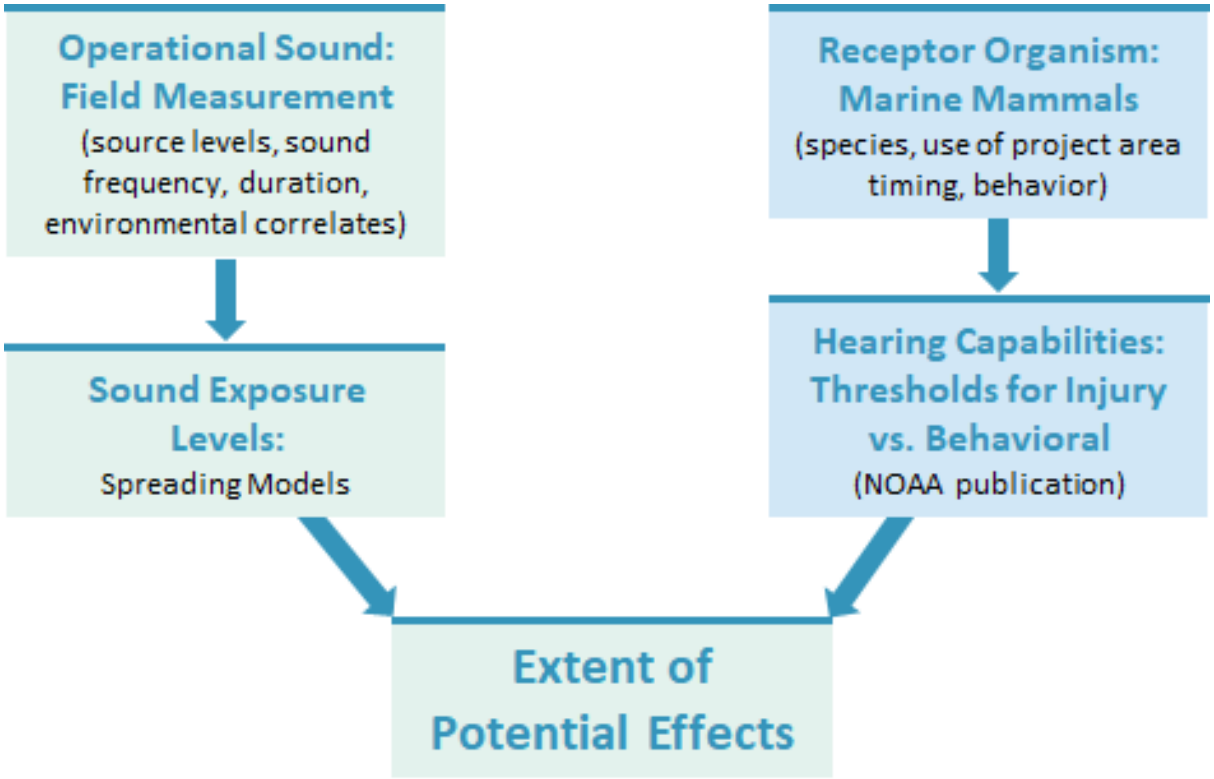
This report summarizes the state of the science of interactions and effects of marine renewable energy (MRE) devices on the marine environment, the animals that live there, and the habitats that support them. This report serves an update and a complement to the 2013 Annex IV report that can be found at http://tethys.pnnl.gov/publications/final-annex-iv-report-2013.

The report is currently being updated, and should be available in May 2020

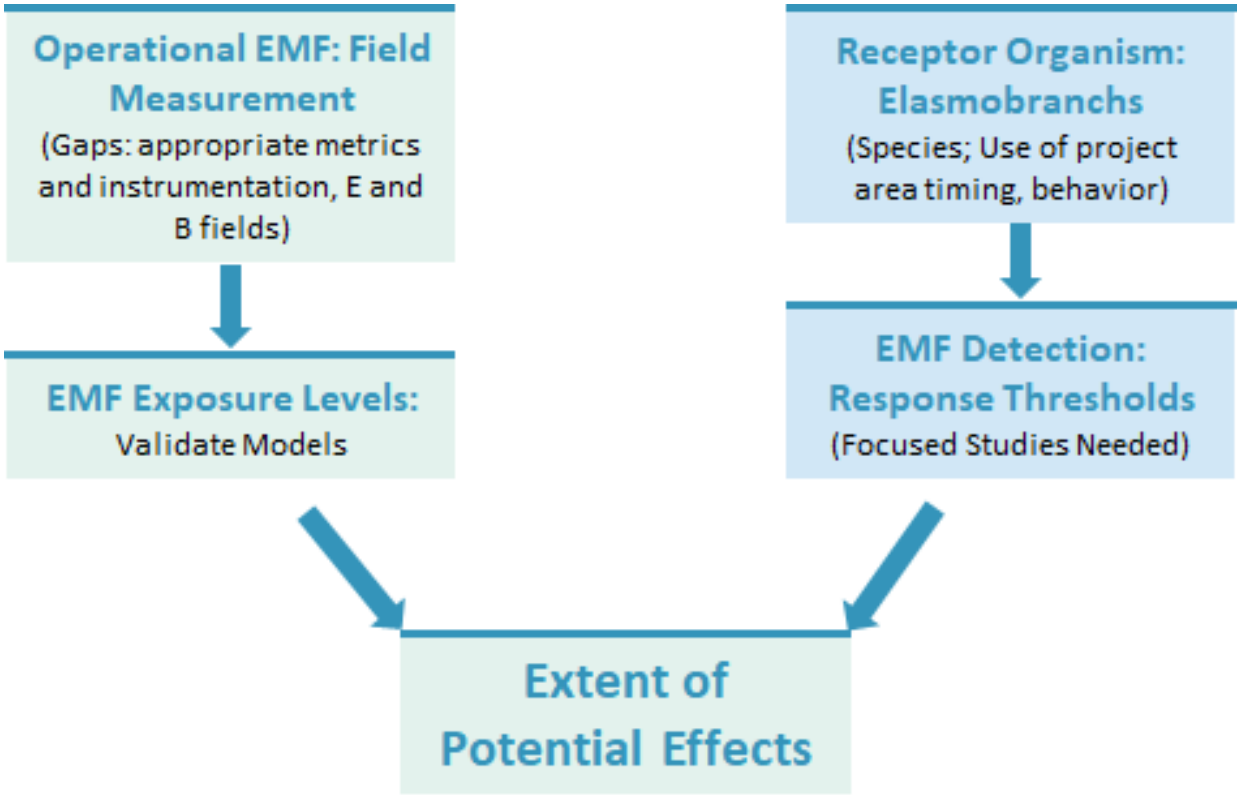
Interactions Addressed

PHYSICAL CHANGE	MARINE MAMMALS	FISH	BIRDS	BENTHOS
Acoustics • **Construction** • **Vessels** • **Operational**	• Attraction • Avoidance • Injury • Masking communication • Feeding and predation	• Attraction • Avoidance • Injury • Masking communication • Feeding and predation	• Attraction • Avoidance • Injury • Masking communication • Feeding and predation	• Injury/Stress • Behavior
EMF • **Magnetic** • **Induced electric**		• Attraction • Avoidance • Migration • Feeding and predation		• Attraction • Avoidance • Feeding and predation
Structure/Static • **Reef** • **FAD** • **Biofouling** • **Benthic disturbance (include anchors, cable)**	• Collision/entanglement	• Attraction • Avoidance • Migration • Feeding and predation	• Collision/entanglement • Feeding and predation	• Attraction • Avoidance • Feeding and predation
Moving Structure • **Area swept, RPM** • **Turbulence**	• Strike/Collison • Avoidance • Attraction • Feeding and predation	• Strike/Collison • Avoidance • Attraction	• Strike/Collison • Avoidance • Attraction	• Injury/Stress • Behavior

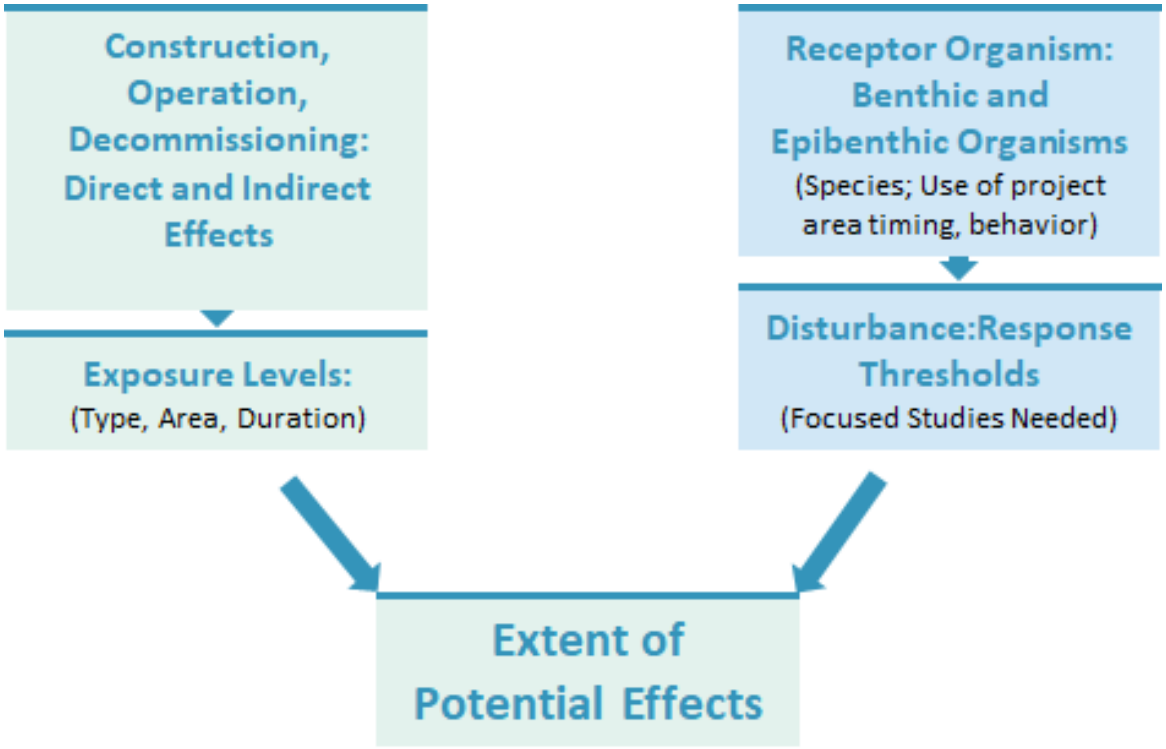
Conceptual Model of Interaction: Marine Mammals and Acoustics



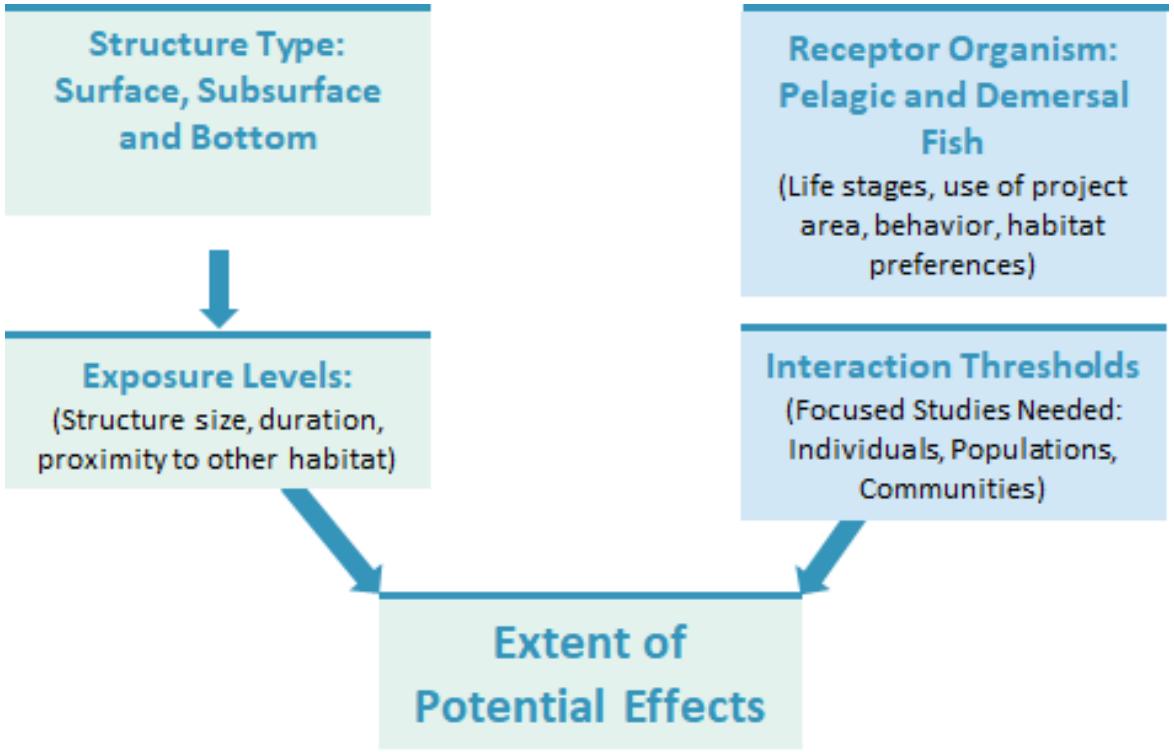
Conceptual Model of Interaction: EMF Interactions with Elasmobranchs



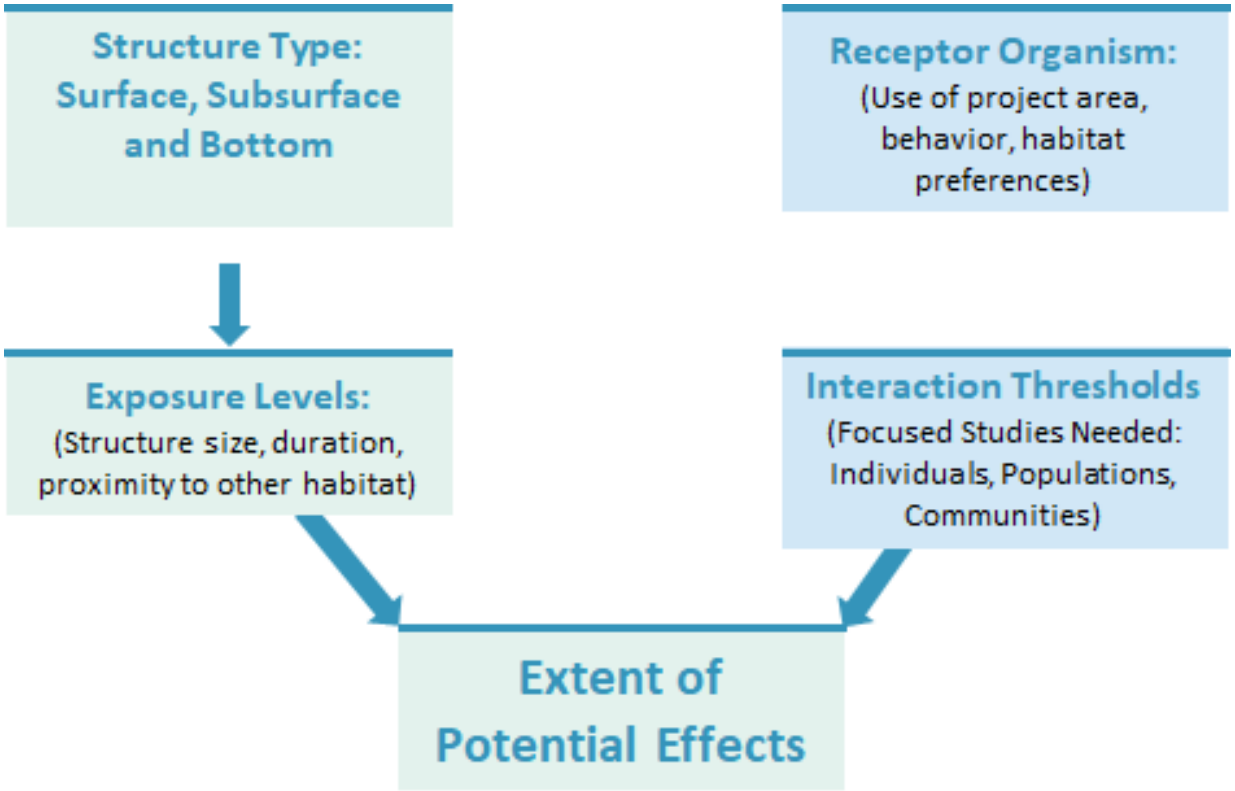
Conceptual Model of Interaction: Benthic Interactions

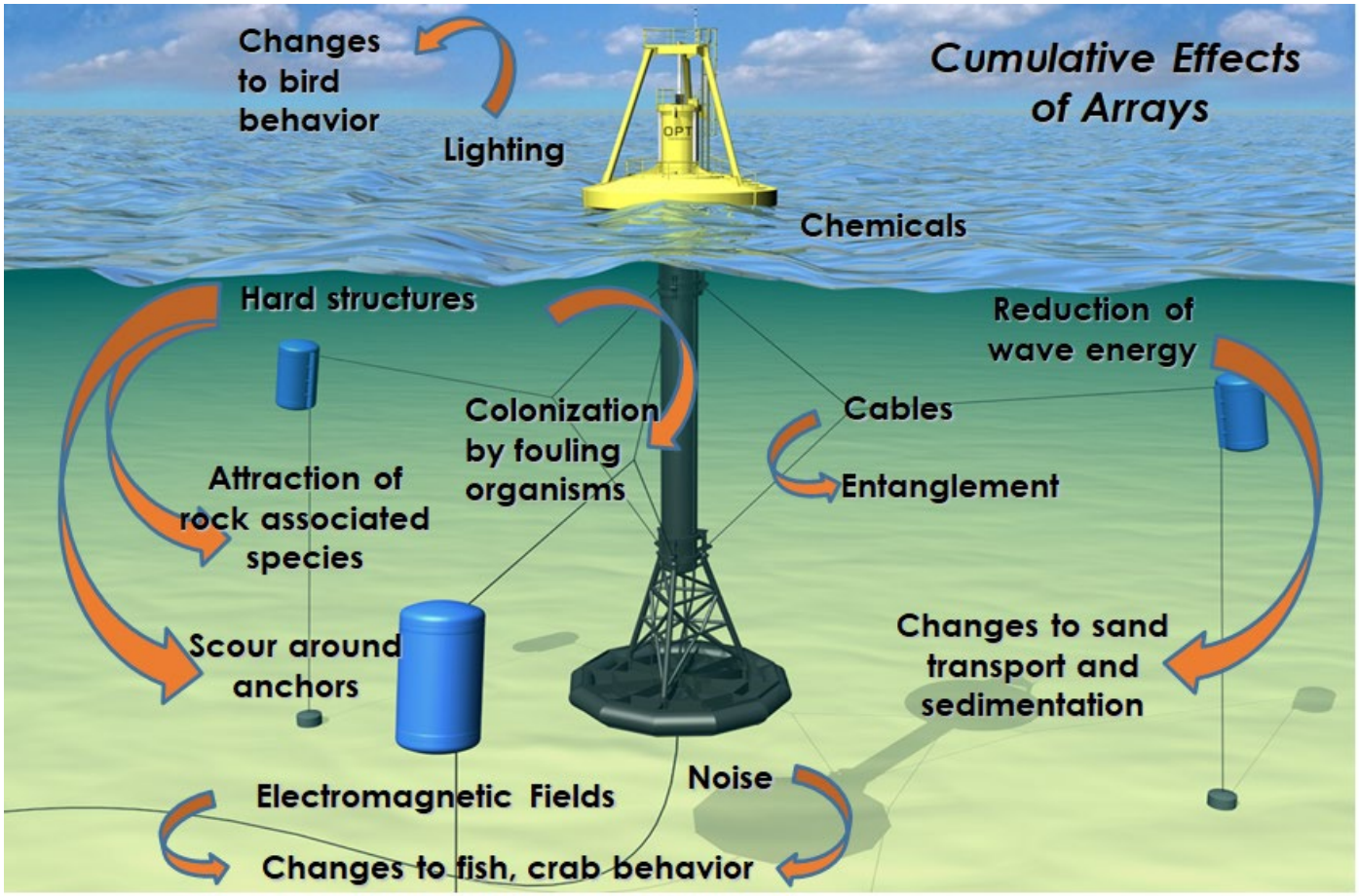


Conceptual Model of Interaction: Fish Interactions



Conceptual Model of Interaction: Marine Mammal Interactions





Graphic provided by Oregon State University

Feedback Exercises

- Top five environmental interactions:
  - Marine mammals and acoustics
  - EMF
  - Benthic interactions
  - Fish interactions
  - Marine mammal interactions
- Are the top five environmental interactions correct?
- How would you envision using the Toolkit during Permitting/Licensing? If you had this before, how would you use the Toolkit to inform your regulatory decision?

Feedback Exercises

During which regulatory phases would you use the Toolkit?

NOI or Prefiling

Monitoring and Compliance

Decommissioning

Other

Start the presentation to see live content. Still no live content? Install the app or get help at **PollEv.com/app**

Lunch

Meeting to resume at XX:XX

Conclusion and Next Steps

- Refine Toolkit with feedback from workshops
  - Danvers, MA
  - Washington DC
  - Boca Raton, FL
  - Anchorage, AK
  - Salem, OR
  - Sacramento, CA
- Targeted agency outreach
- 2nd round of workshops (expected early 2021)
- Pilot project outreach
- Evaluation Forms
  - Remote participants please send to zbarr@kearnswest.com

MHK Environmental Toolkit for Licensing and Permitting
Round 1 Workshop Evaluation Form

Name: _____ Date: _____

Toolkit Feedback

1. For the following statements, please indicate the extent to which you agree or disagree.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Toolkit will improve efficiency and effectiveness of permitting and licensing					
The Toolkit will be beneficial to MHK regulators					

Please list any additional comments below.

2. Would you find this Toolkit useful in the permitting and licensing process?
   a. If yes, how (please describe below)?
   b. If not, what would make it useful (please describe below)?

3. Based on what you know to date, would you recommend or support the use of this Toolkit for other regulators, developers, or other stakeholders?

Synthesis and Data Feedback

4. Are there regional databases we should make sure to include (including both marine and terrestrial information)?

5. Are there upcoming research papers or studies related to MHK our team should be aware of to include in the Toolkit?

6. Were the expert presentations useful?

7. What environmental topics would you like subject matter experts to present during the next workshop?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The workshop was well organized					
The workshop provided useful information relevant for advancing the industry					

Workshop

If you have any other comments please include them below.

Thanks very much for your participation and interest. If you have additional thoughts or questions please contact us! Zach Barr, zbarr@kearnswest.com, or 415-697-0576.

Appendix F.

Workshop Summaries

MHK Environmental Toolkit for Licensing and Permitting

Round 1 Workshop Summary

January 13 – February 6, 2020

This document provides a summary of the presentations, discussions, and feedback exercises conducted during the initial round of workshops for the Marine and Hydrokinetic (MHK) Environmental Toolkit for Permitting and Licensing project. Workshops took place at the following locations:

East Coast	West Coast
1. Danvers, MA – January 13, 2020	4. Anchorage, AK – February 3, 2020
2. Washington, DC – January 15, 2020	5. Salem, OR – February 5, 2020
3. Boca Raton, FL – January 16, 2020	6. Sacramento, CA – February 6, 2020

For the full presentations, workshop recordings, and other materials from each workshop please see the following folder: https://drive.google.com/drive/folders/1J1ipR1GP3ZC7vbWegg3MblgNoURTUS9U?usp=sharing

Background and Project Objectives

Anna West and Zach Barr, Kearns & West, welcomed participants, led introductions, reviewed the agenda, presented workshop ground rules, and provided the objectives for the toolkit project, which are:

- Increase regulators' understanding of marine and hydrokinetic (MHK) projects and their potential environmental effects;
- Reduce the amount of time to permit MHK projects by developing a useful Toolkit for all stakeholders; and
- Help decrease time and resources for permitting MHK projects.

MHK Overview

Mrs. West provided an overview of the MHK industry, both globally and in the U.S. and Mr. Barr provided an overview of wave and tidal energy devices, MHK project components, and other federal projects that support the development of MHK technology and industry. Descriptions and diagrams for wave devices can be found on the European Marine Energy Centre (EMEC) website here and for tidal devices here.

Regional Case Studies

Each workshop featured unique regional case studies that highlighted existing MHK efforts throughout the country and abroad.

Northeast - Kerry Strout Grantham, Ocean Renewable Power Company (ORPC)

Ms. Grantham, ORPC, provided an overview of the **Cobscook Bay Tidal Energy Project**, the first tidal energy project to be built in the U.S. under a Federal Energy Regulatory Committee (FERC) pilot project license. The project deployed four advanced design crossflow turbines to generate a total capacity of 450 kW at the mouth of the Bay of Fundy in Downeast Maine. Construction began in March 2012 and power was first delivered in September of 2012. ORPC developed six monitoring plans – acoustic, benthic and biofouling, hydraulic, fisheries and marine life interaction, marine mammal, and sea and shorebird. Adaptive management was used to minimize environmental risk and helps to 1) build and maintain regulatory trust, 2) utilize science-based data collection, 3) engage the community and stakeholders, and 4) initiate an adaptive approach in the pre-application phase and continues throughout the project operation.

The studies and monitoring plan allowed regulators and the project team to identify what environmental effects needed to be monitored and tailor specific monitoring plans accordingly. Given the innovation of MHK, there were no triggers established but the adaptive management plan allowed the state to decide what to review as the data was received.

International Experience – Caitlin Long, European Marine Energy Center (EMEC)

Ms. Long presented an overview of EMEC, the longest-standing test center for MHK technology. The test center allows for plug and play testing for wave and tidal devices which helps reduce costs for developers and helps regulators make decisions on monitoring programs. The amount of developers using the center has varied over the years as subsidy programs and governmental support has come and gone. The center has diversified and supports wind, energy systems, as well as hydrogen, in addition to wave and tidal devices. EMEC also supports additional research into species colonization on cables, biofouling, collision, and monitoring techniques related to MHK. EMEC expects a shift in testing to United States facilities as European subsidies decline and political uncertainty rises (ex. Brexit).

Florida – Gabe Alsenas, Florida Atlantic University (FAU)

FAU is home to the **Southeast National Marine Renewable Energy Center** (SNMREC), one of three U.S. Department of Energy (DOE) test centers focused on marine renewable energy including MHK resources. The goal of SNMREC is to cooperatively develop MHK technology by understanding the ecosystem, regulatory framework, and stages of development, encouraging testing, and conducting outreach and training. FAU received the first Bureau of Ocean Energy Management (BOEM) lease on the outer continental shelf for marine renewable energy. The lease was relinquished but FAU looks forward to modifying the process in the future.

Alaska – Nathan Johnson, ORPC

Mr. Johnson, ORPC, provided an overview of the **Igiugig Hydrokinetic Project** located on the Kvichak river in the Igiugig Village, one of the 250 remote microgrid communities in Alaska. This project, which is had its final license application granted in May 2019, has been led by the Igiugig community in collaboration with ORPC, the Alaska Energy Authority, and DOE. To date, ORPC has installed a two-device 70 kW RivGen Power System with smart microgrid controls and electronics, and a 100 kWh energy storage system. Throughout the process, fish monitoring has been a major focus. Conveniently, the Kvichak river is shallow enough to use video cameras to monitor interactions between fish and the tidal energy converter (TEC). Like the Cobscook Bay Tidal Energy project, adaptive management is used to minimize environmental risks.

Oregon – Justin Klure, Pacific Energy Ventures (PEV)

Mr. Klure, PEV, discussed the **PacWave South Project** located 6 miles off the coast of Newport, Oregon, and the first grid connected wave energy test site in the US. The project, which is sponsored by DOE and the State of Oregon, was designed to be pre-permitted for every viable wave energy technology available today, meaning that, through this all-inclusive, plug and play approach, the test site will make it easy for developers to test different wave energy converters and study their impacts. The final license application was approved in 2019 and construction will begin in the spring/summer of 2020. Oregon State University (OSU) led a collaborative process at the initial conception of the project. Environmental measures include monitoring plans for benthic, organism interaction, acoustic, and electromagnetic fields (EMF); protection mitigation and enhancement (PM&E) measures, and other tools such as an adaptive management framework, and bird and bat conservation strategy.

Toolkit Summary

Craig Jones and Grace Chang, Integral Consulting, presented the Toolkit purpose, intended users, and information flow (Figure 1), and provided a demonstration of what the toolkit site would look like when complete. The Toolkit is targeted towards regulators and developers as an easily accessible portal for information relevant to the permitting and licensing process that is maintained on existing informational and spatial databases.

Users will be able to search for documents and data, search by keywords/tags (stressors, receptors,

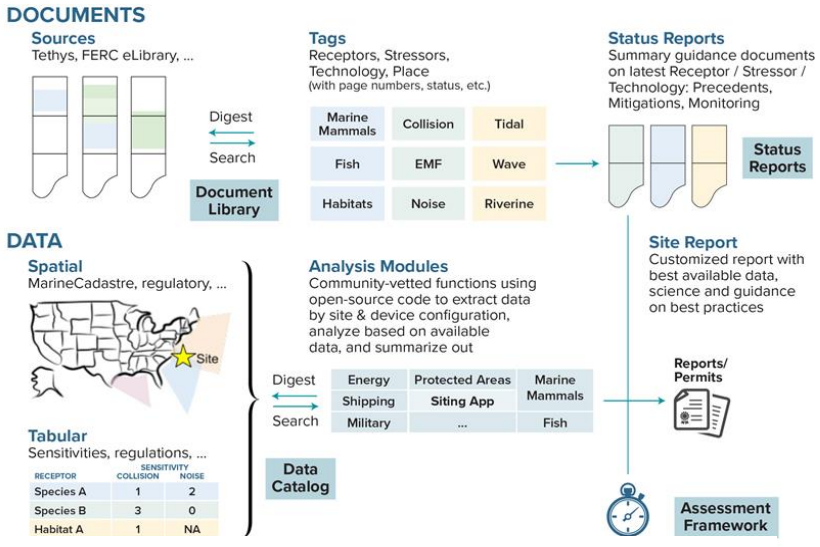


Figure 1: Toolkit information flow

technologies, locations, etc.), save search results, and find the latest information available related to MHK. Data sources will include community generated content from the National Renewable Energy Laboratory's (NREL) OpenEI, tagged literature from the Tethys website maintained by Pacific Northwest National Laboratory (PNNL), and spatial data catalogues from MarineCadastre Ocean Reports maintained by National Oceanic Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM).

Users will also have the ability to use an interactive geographical information systems (GIS) map to draw polygons around and area to generate spatial data such as wind, tides, currents, biologically identified resources, regulatory statutes, and technology in an area. The ability to make an account to save and share information with other users will also be available. The intent is for the Toolkit to tie into existing databases so information is constantly updated as well as provide a way to edit and add information in a wiki nature on the OpenEI platform.

Biological Effects			Receptor							
Development phase	Activity	Stressor	Benthic Communities		Fish & Turtles		Marine Mammals		Birds	
			Key Effect	Mag	Key Effect	Mag	Key Effect	Mag	Key Effect	Mag
Preparation	Surveying	Sampling: coring, boring and grab sampling	Loss of biodiversity		NK		NK		NK	
		Noise from Vessels and sonar/seismic surveys	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Site preparation	Dredging Activities	Productivity reduction; loss of biodiversity; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	
Construction	Transport of wave device and support structures	Vessel activity; Presence of machinery/equipment	Disruption of behaviour		Disruption of behaviour		Disruption of behaviour		Disruption of behaviour	
		Noise from vessels	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Installation of wave device and support structures	Installation of WEC; Piling/drilling activities	Productivity reduction; Loss of Biodiversity; Food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour	
		Noise from piling/drilling activities	Disruption of behaviour; Potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
Operation	Device deployment	Physical presence of WEC device and structural components	Reef effects; Food web promotion; increase in productivity and biodiversity		Fish aggregation; food web promotion		Food web promotion		Food web promotion	
			Risk of harmful biofouling; Invasive species		Risk of collision, entanglement, entrapment		Risk of collision, entanglement, entrapment		Risk of collision, entanglement, entrapment	
		Noise generation	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
		EMFs	Disruption of behaviour		Disruption of behaviour		Disruption of behaviour		NK	
Accidental events	Chemical / oil / fuel spill	Chemical and oil pollution	Potential toxic response		Potential toxic response		Potential toxic response		Potential toxic response	
	Loss of equipment / structural components	Physical presence of sinking/floating equipment	Disruption of behaviour; potential harm through		Disruption of behaviour; potential harm through		Disruption of behaviour; potential harm through		Potential harm through ingestion/entanglement	
			ingestion/entanglement		ingestion/entanglement		ingestion/entanglement			
Decommissioning	Removal of device and structural components	Vessel activity; Presence of machinery/equipment	Loss of biomass and biodiversity locally enhanced; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	
		Noise from vessels and removal	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	

Magnitude of Impact	Description
Major	Degradation to the quality or availability of habitats and/or wildlife with recovery taking more than 2 years
Moderate	Change in habitats or species beyond natural variability with good recovery potentially within 2 years
Minor	Change from baseline conditions measurable but within scale of natural variability
Negligible	Change in habitats or species within scope of existing variability and difficult to measure or observe
Positive	An enhancement of ecosystem or popular parameter
No Interaction	None

In addition, users will have access to apps (ways to pull and analyze spatial data) and custom reports (save searches, information, etc.) that will be featured in the Toolkit. Apps, such as the report in Figure 2, will allow users to obtain or input their own qualitative analysis of environmental impacts by easily accessing data and information on stressor-receptor interactions. The template will assist with the identification of the magnitude of impacts. Through the mapping tool, users can conduct siting to evaluate specific interactions and potential impacts.

Figure 2: Qualitative analysis of environmental impacts for Wave Energy Converters Source: WavEC: Identifying key environmental effects of wave energy deployments - SINTEF.com blog

Discussions:

Key themes from survey exercises and facilitated discussions are provided below. Tables present aggregated results from East and West Coast workshops and feedback from each individual workshop can be found in Appendix II.

	Response	East Coast	West Coast	Total
Does the flow and use of information make sense?	Strongly Agree	21%	27%	24%
	Agree	75%	73%	74%
	Neutral	4%	0%	2%
	Disagree	0%	0%	0%
	Strongly Disagree	0%	0%	0%

- The information flow makes sense conceptually as presented, but users will need time to use the platform to be able to provide detailed input on the use and flow of information. (MA)
- Functionality is a concern for the tagging portion as some information may not show up in a tag. (D.C.)
- A drag and drop bucket might be useful for people to build a library of useful items for a project. (D.C.)
- There needs to be enough information at the local scale for the Toolkit to be useful and relevant. (D.C.)
- The information flow makes sense, but it all depends on how it is used or implemented in the permitting and licensing process. (AK)
- This information would be helpful, but not enough. The national or universal value of the information in the Toolkit would have to be made specific to users' specific geographies. (OR)
- The use of information is great; however, some agencies have staff who are experts at finding the existing documents. (CA)

Are there different databases or sources of data to include?

- Oak Ridge National Laboratory's HydroSource (Hydropower Mitigation Database). (D.C.)
- NOAA's Office of Protected Resources will have Endangered Species Act (ESA), Biological Opinions (BiOps), and Marine Mammal Protection Act (MMPA) Incidental Harassment Authorization (IHA) information that may be useful. (D.C.)
- NOAA's Environmental Consultation Organizer (ECO) may provide ESA Section 7 and Essential Fish Habitat (EFH) information. (D.C.)
- The Navy may need to be consulted about some cable routes. Some information on cable routes could be found in BiOps. (D.C.)
- USFWS Information Planning and Conservation database. (D.C.)
- The Marine Exchange of Alaska tracks data in Alaska. (AK)
- Consider pulling information on environmental interactions and sediment changes from other related industries such as offshore wind and oil and gas. (CA)
- DataBasin contains a lot of marine spatial information collected for offshore wind in California. (CA)

What is missing from the Toolkit in terms of content?

- There needs to be a way to describe or show the level of uncertainty regarding the amount of information on effects. There are gaps and people need to know that. This could be relative or descriptive and gathered from prior projects from where uncertainty or data gaps were an issue. (MA)
- Cumulative impacts are a key missing item. Having access to projects from outside the U.S., multiple devices, and projects people are not as familiar with will be useful to help understand the potential cumulative impact. (MA)
- There is a need to get an idea of the validity of the studies and consensus/strength of information. There is a big difference in knowing if the information provided is from one study or 10 studies from a different area. (MA)
- Summary tools are important. Sometimes details are needed, but time is an issue and need efficiency in a resource too. (MA)
- Not all of the information will be site specific or local. However, there will be information on stressors/receptors, other MHK information that might be relevant, monitoring and adaptive management plans, etc. This will allow users to see what has been done elsewhere and apply it to their area. (D.C.)
- Getting fisheries data from state agencies would be useful. (FL)
- The Toolkit will focus on environmental effects but will have some engineering information. (FL)
- It is important to include a temporal element. (AK)
- Need to dig into the underlying data to vet out information. (OR)

Is qualitative summary information related to environmental effects useful? Is the color coding ranking useful, if qualified?

- The color coding useful for summarizing information, but the voracity of the data and scale of strength of the risk would be useful to include in the table. (MA)
- The color coding is populated with suggested color coding. Bounds on strength of risk and uncertainty could be incorporated. Suggested values can be put in and then updated by users. This would allow users to self-rank the environmental risks and be a tool for discussion, which is also important for adaptive management. (MA, D.C.)
- The table of stressors is helpful; however, the magnitude rating requires project specific assessment and should not be generalized by the Toolkit. A list of references that support those conclusions would be helpful. (D.C.)
- The relative order of impacts is useful. (D.C., CA)
- For the stressor table, it is helpful if it is customizable so it can serve as a discussion and communications tool that can be modified and updated. (MA, D.C.)
- The qualitative review of environmental interactions is a useful tool but is subjective. It may be useful as a planning tool or for regulatory agencies coordination. (AK, OR)

- The qualitative review will be helpful for developers/applicants as they plan their projects; this will give them an idea of all the considerations needed to successfully permit an MHK project. (AK, OR, CA)
- The narrative behind this and other Toolkit apps must be carefully crafted and demonstrate a high level of confidence in the data. (OR)
- This tool will help identify uncertainties in the project development process, thus highlighting where additional studies are needed. (OR)
- The tool will help in outlining and writing the BiOps. (OR, CA)
- Consider linking the apps to all the existing literature used to produce the qualitative ranking so that a user can easily access literature relevant to the stressor and receptor interaction they are observing in the tool. (CA)

What component of the Toolkit would you use in the permitting/licensing process?	Response	East Coast	West Coast	Total
	Data Catalog & Mapper	40%	34%	36%
	Engagement and Communication Tools	11%	8%	9%
	Searchable Documents	43%	36%	39%
	Guidelines and Flowcharts	6%	22%	15%

- Communication tools would be useful to share internally with agency colleagues to see if people came up with the same level of risk. (MA, CA)
- From a developer standpoint, it would be useful to share information before permitting to help select sites. The more information about a site the more confidence we can have about approaching regulators. (MA)
- Maps are helpful to visualize where things are when trying to plan or assess a project.
- Communication tools are helpful to gear up for consultation as a framework for initial discussions between stakeholders. (D.C.)
- A concern about the Toolkit is developers assuming all of the information required in the permitting process is there, then they are surprised during consultation when local studies are required. For example, Ocean Reports does not have the ability to assess impacts to commercial fisheries. A disclaimer may be necessary, so users are well informed about the tool and its abilities/limitations. (D.C.)
- Guidelines and flowcharts help stakeholders understand and see the regulatory process and feel comfortable with it. (OR)
- Searchable documents are a key element of the Toolkit. Having all documents in one place will save a lot of time, especially since regulators want to know what has been done with new technologies and are looking for data in the scientific literature that can

support the impacts analysis for federal and state environmental review laws. It would especially be nice if the Toolkit linked to documents in the FERC E-Library. (AK, OR, CA)

- Engagement and communication tools are not much different than the standard FERC hydropower process, therefore are not a priority compared to the other Toolkit features. (AK)
- The data catalog and mapper will help regulators easily find geographically relevant data. (OR, CA)
- Regulators already have the tools, so the guidelines and flowcharts are the most useful. (OR)
- Developers will pull data from existing projects and access university research relevant to their region/stressor receptor interaction. (AK, CA)
- The communication and engagement portion will help developers present easily digestible information to stakeholders. (CA)

Additional Discussion:

- PNNL will tag documents through the Tethys database this Toolkit will be following the DOE tagging system and will already be tagged when it is pulled into the Toolkit. (MA)
- The information is linked from already curated databases, who are responsible for updating the information. There may be slight delays when pulling from some databases, but OpenEI databases will be updated live in real time. (MA)
- When this project is over, DOE will have the ability to add new databases. There will also be a contact area for people to use if a database needs to be added or is out of date. OpenEI links can be directly uploaded. (MA)
- Some estuarine projects and areas with high tidal velocities, as well as riverine systems, might be included in the Toolkit at a later date. There may be overlap in these projects when it comes to hydro and EFH. For now, the Toolkit will start with current and wave, with the aim of expansion. (D.C.)
- Non-energy related projects (ex. sand mining) would be relevant for benthic environment concerns, as information might be transferable from a technical standpoint. Much of this information is in Marine Cadastre, and U.S. Geological Survey (USGS) has a seabed database. Some gray literature may also be included, as will state databases. (D.C.)
- The permitting and environmental process is what hurts technology development the most. Early consultation with regulatory agencies helps speed up the process. Choosing sites with less sensitivity also helps speed up the process. Having a well-defined project description is helpful but can be difficult if the project is phased and a developer is unsure what exactly comes next. (FL)
- Need to include metadata so users can personally investigate the reliability of the information included in the Toolkit. (AK)

- The Toolkit will help developers prepare more complete and well-informed applications. (OR)

Toolkit Synthesis and Data

Sharon Kramer, H.T. Harvey, presented an overview of the regulatory process for permitting and licensing grid-connected MHK projects, environmental interactions addressed by the Toolkit, and conceptual models of interactions of marine species and MHK devices.

FERC, BOEM, and U.S. Army Corps of Engineers (USACE) all potentially have roles in the permitting process as lead or coordinating agencies. Other agencies such as NOAA, U.S. Fish and Wildlife Service (USFWS), and state agencies, may also play a role in the permitting process to fulfill the requirements of environmental regulations found in the National Environmental Policy Act (NEPA), MMPA, Migratory Bird Treaty Act, ESA, and others.

The State of the Science report summarizes what we know for MHK regarding stressor and receptor interactions, risks, severity of risks, links to the stressor and receptor, etc. These topics were addressed by some of the subject matter experts during these workshops and will be a key part of the Toolkit. For each stressor and receptor conceptual model presented (Figure 3), the left contains the stressors for a particular species group that may interact with an MHK device (for example, sound) and what the how the exposure level of that stressor could be measured. While right side of the model contains the receptors (species, behavior, use of area, etc.) and any developed thresholds. These stressors and receptors come together to as the extent of potential effects an MHK device may have on a species or habitat.

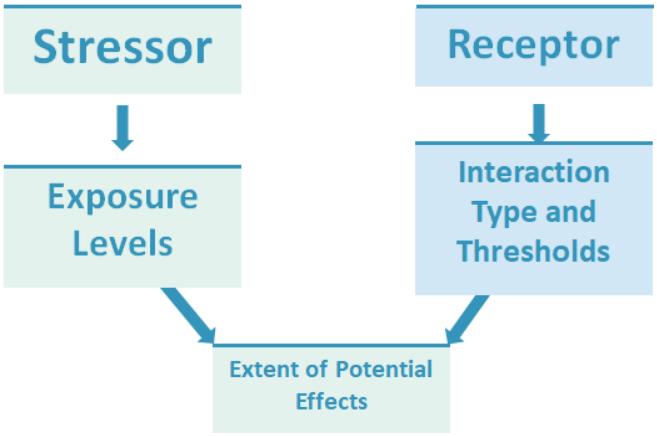


Figure 3: Conceptual model of key interactions

Environmental Interactions

- Marine mammals and acoustics
- Electromagnetic fields
- Benthic interactions
- Fish interactions
- Marine mammal interaction

Feedback Exercises and Poll Everywhere Discussions:

Are the top environmental interactions correct?

- Need to include shellfish under one of the environmental interaction groupings. (AK)
- This will be more of a value add if the tool focuses on universal aspects, especially when discussing stressors. (OR)
- Need to add anthropomorphic interaction that addresses how current human uses impact different receptors. (OR, CA)
- Include a conceptual model for avian species. (MA, OR)
- Include oceanographic elements such as the physical flow of water, thermal conditions and others. (CA)

During which regulatory phases would you use the Toolkit?	**Response**	**East Coast**	**West Coast**	**Both**
	Licensing/Permitting	59%	47%	53%
	Monitoring and Compliance	9%	27%	18%
	Decommissioning	13%	13%	13%
	Other	19%	13%	16%

- Regulators will rely on the Toolkit during the licensing/permitting phase since all major project decisions occur at that point. (AK, OR, CA)
- The Toolkit might be useful for monitoring and compliance. (MA, AK)
- The Toolkit would be very useful during the pre-consultation phase prior to the ESA consultation. (OR)
- This will be useful during the permitting and licensing process to regulators and developers understand the degree of impact on stressors. (CA)
- The tool can be used to develop an environmental monitoring plan, to see what impacts and the severity, and to try to develop thresholds for standards. The tool could help mediate the risk uncertainty. (MA)
- The Toolkit might be helpful for all phases – decommissioning, relative impacts, what the gear was, etc. (MA)
- The tool could be used for research, MHK test sites. (MA)
- The tool touches on monitoring and compliance and decommissioning. It empowers the developer to introduce new information that might be useful for impacts throughout the process. (MA)
- The tool could be used as a way to develop coordination between federal and local agencies, particularly in identifying education tools and activities to mitigate impacts on receptors. (CA)

Subject Matter Expert Presentations

Two subject matter experts presented at each workshop. For each subject, the experts were asked to present on:

- Potential interactions between the MHK project and resource of concern,
- What is known about their topic,
- What should be measured,
- How to measure metrics,
- What roles do models play in the permitting process,
- What gaps remain, and
- What conclusions can be drawn or what the next steps are.

Fish Collision *– Gayle Zydelewski, University of Maine (Danvers workshop)*

Dr. Zydelweski presented on fish collision and direct and indirect interactions of fish with turbines. There are potential direct and indirect interactions for fish and the MHK device, even during fast moving currents. What to measure depends on the specific research question – do fish collide with a turbine, are fish likely to collide, are fish likely to collide with moving parts? Sonar or acoustics and underwater cameras can be used to monitor metrics. Models have been used for Cobscook Bay applications and the data could be used for other models for rough behavioral effects. Modelling helps understand probability of interaction. Questions remain about the regionality and transferability in understanding fish interactions. Gaps include the amount of direct interaction data and knowing the best tool to capture interactions.

Discussion:

- Monitoring is a challenge due to the cost for collecting data. The adaptive management framework helped regulators identify what questions researchers should answer, which helps target the data to collect.
- Long-term data and having a suite of information is helpful and allows regulators to focus in on issues and answer questions.
- Engaging researchers and stakeholders provided a great process for transparency to discuss concerns and issues. It helped refine questions, ground truth models, allowed for predictions for when monitoring would be difficult or provide the most information, and helped learn the limitations of the technology.
- Transferability is an issue. Not everything transferred, though the technology or approach might be. Site-specific information is important but can be expensive. There is a lack of consistency in regulatory monitoring requirements.
- Cumulative effects is a looming question. If multiple installations are present, at what point does fish avoidance get overwhelmed by alternative pathways of movement? ORPC is doing work in the Western Passage (adjacent to Coobscook Bay) with an eye of

multiple devices and collecting information to look at this broadly. There is also work being done in Alaska rivers that will look at two devices.

- Cultural data is important to help quantify effects. Having an understanding of the cultural importance of fish communities and devices is important.

Benthic Interactions *– Emma Sheehan, University of Plymouth (Danvers workshop)*
Dr. Sheehan presented an overview of ecological interactions of the benthic environment and fish communities with offshore artificial structure related to marine renewable energy. Offshore development has the potential to act as a *de facto* marine protected area, but species have different responses to noise, structure, and disturbance, and how an area is managed effects seabed habitat restoration, biodiversity, and species abundance. What is not known is the varying effects of technology and maintenance, habitat types, and previous impact. What should be measured includes, long-term, large array monitoring; focus sites; cumulative interactions, the potential for co-location of devices with other uses; functional groups, and ecosystem processes services. Gaps remain in appropriate permitting, management and enforcement, and shared data.

Discussion:

- Offshore developments may become *de facto* Marine Protected Areas (MPAs) even if not officially designated. There is an incentive for fisherman to not use the area if a risk is lost gear. Working with the fishing industry to allow for spacing between devices may allow for co-location of MHK devices with fishing grounds.
- Long-term data with interspersed controls is important for studying the effects of climate change.
- Transferability of studies from Europe to the U.S. is also a concern. The use of these studies can help build a case for the U.S. and helps build the body of knowledge. There is work being done in Maine on the Cobscook Bay project that might be more transferable over time. Aquaculture studies may also transfer to effects from MHK projects.

Acoustics and Wave Energy Converters *– A. Michael Macrander, Integral (Washington, D.C. workshop)*
Dr. Macrander presented an overview of acoustics in the marine environment and sound generation by MHK devices. Sound is a pressure wave of energy that propagates well in water, but the energy is dissipated as it moves outward from the source. Marine resources (fish, mammals, invertebrates) can be sensitive to these sounds depending on frequency and other factors and there are different types of effects on species (physical and behavioral). Sound propagation is influenced by physical factors, as well as ambient sounds. There are several regulatory processes for sound, including the ESA (BiOps), MMPA (IHA), and NEPA

(coordination and consultation requirements). Sound sources need to be identified, as do potential sources receiving the sound, character and extent of exposure, potential effects, and population level effects.

Discussion:

- Some sounds are additive and amplify the energy of the sound wave. Other sounds will dampen the sound wave if frequencies interfere.
- The more moving parts there are to an MHK device, the more sound there will be. Flow noise and how the device is deployed will also impact sound generation.
- Putting a device in a noisy environment may not have much added effect due to the level of ambient noise already present in the ocean; however, knowing the acoustic environment (baseline sound level) is important before deployment. Characterizing sound will become a best practice as technologies grow. Spreading models, thresholds, etc. are useful to help predict sound levels and mitigate for sound.
- Knowing behavior of animals in an area and what the area is used for also helps understand responses (ex. a whale may tolerate one level for sound feeding but may be more sensitive if the area is used for mating or caring for young).
- Measuring sound from a device also helps detect when a device has a mechanical problem.
- Sound suppressing technologies, design goals, and mitigation can reduce noise from a device.

Fish Collision and Tidal Energy Converters *– Ana Couto, University of Aberdeen (Washington, D.C. workshop)*

Ms. Couto presented on fine scale physics to animal behavior focusing on fish collision with tidal turbines. It is important to understand collision risk and placement impacts on species, including foraging and behavioral change related to predator prey relationships. Simultaneous data should be collected so relationships are not missed, as should multiple hydrodynamic variables. Active acoustics can provide presence and abundance metrics, and boat surveys can provide overall information about the area. Data collection should move from fine scale (hydrodynamics, information regarding fish species, bird numbers and distribution) to ecosystem level effects.

Discussion:

- It is important to note that the information may be relevant, regardless of where it is collected, the biggest difference is in the permitting requirements being different in different locations. What can be the same is consistency in monitoring, data collection, etc. That can help people talk about the same things.
- The research was driven by gaps in policy, which is a good model.

- Bayesian models may be something the Toolkit project core team will want to collaborate on.

Acoustics and Cetaceans *– Joshua Lawrence, European Marine Energy Centre (Boca Raton workshop)*
Mr. Lawrence presented on marine mammals, collision risk, and acoustic sampling techniques. Co-occurrence of marine mammals with MHK devices leaves the potential for interactions, including collision, entanglement, noise, and disruption of foraging opportunities. Those interactions may be resource specific, device specific, species specific, and location specific. Site-specific information (species assemblages, abundance, habitat use, and distribution) and contextual information (hydrodynamic features, impacts of features on foraging success, mobility, prey distribution and behavior) should be measured. Knowing this information, as well as the device characteristics, will allow for the use of encounter risk models. After installation, noise, behavior responses to the device and noise, and alterations of hydrodynamics should be measured with active and passive acoustics. Gaps that remain include broad scale avoidance behavior, fine scale evasion behavior, acoustic monitoring technologies, population level effects models, and further understanding of marine mammal use of potential MHK sites.

Discussion:

- The research presented is being conducted in Scotland.
- ORPC is also conducting research on probability of interaction. It is difficult to assess risk and interactions due to the different technologies that are used in MHK projects.
- For onshore wind, there is modeling and mitigation. If a bird or bat is killed, that is visible. No one has observed a marine mammal being killed from MHK. That is difficult to detect. If models say there is a high risk to collision, then mitigation must be conducted and must lean towards the conservative side. Sometimes this means shutdown if an animal is detected, no matter the behavior observed. This approach does not allow for additional monitoring or learning about potential interactions. The use of MHK devices as fish aggregating devices is in the pipeline to be studied for the wave site.

Electromagnetic Fields *– Stephen Kaijura, Florida Atlantic University (Boca Raton workshop)*
Dr. Kaijura presented on electromagnetic fields (EMF) from a biological perspective. The current from subsea cables generates a magnetic field around the cable, which then induces an electric field. Some commercially important species and species with special conservation status (threatened or endangered) can detect these magnetic and/or electric fields. Sharks and other species use the changes in magnetic anomalies as their internal navigation system. This can potentially be disrupted by the EMF generated by subsea cables. Researchers can model the potential EMF in a lab and then ground truth the potential size of the field with sensors in the water. Field studies using acoustic telemetry can help understand if shark movement/behavior

is altered due to these fields, and can collect abundance, seasonality, and density of sharks. Enclosure studies can help understand behavioral response to EMF stimuli. While the EMF generated from cables is often in the detectable ranges for species, there is potential mitigation. Future research could include a census for electro and magneto-receptive organisms around installations, empirical measurements of magnetic fields around sub-sea cables, experiments to determine thresholds, and behavioral trial to determine EMF responses.

Discussion:

- AC transmission cables may be above what most biological organisms will respond to.
- Smaller cables (33-38kV) may not need to be looked at; however, larger cables will need to be studied.
- There are hundreds of cables in the ocean that are not unique to MHK and those should be learned from, though this may require special equipment.
- Cables can act as aggregators since it provides substrate. Burying the cables one to two meters deep can give spatial separation and protects the cables from failure (ex. getting snagged in fishing gear).
- Eels may also need to be studied, as the females migrate.
- Published literature on blacktip reef shark and stingray seasonality movements are on Tethys.
- The National Science Foundation has nodes of observational data. Monterey Bay has a monitoring station offshore that became an artificial reef.

Fish Interactions *– Andrew Seitz, University of Alaska, Fairbank (Anchorage workshop)*
Dr. Seitz presented on fish interactions with MHK devices and other marine analogues, which can happen either directly through strikes and collisions, or indirectly through changes to habitat, behavior, or migration patterns. The field is in its infancy, therefore not much is known about how fishes would interact with WECs or TECs. To analyze direct impacts, it is necessary to observe fish density and mortality pre-installation to establish a baseline, and then monitor interactions and their outcomes once the turbines are in the water. To analyze indirect impacts, it is necessary to compare pre- and post-installation migration patterns, aggregation of prey, and aggregation of predators. Given the infancy of the field and lack of concrete examples there is not standard approach to measuring effects. Options include field studies (with cameras), lab/flume studies, and models. Field studies have found that fish can avoid turbines, turbine entry is higher during the nighttime, and there is no evidence of passage delay for migrators or of obvious injuries for fish passing through the turbine. Flume studies, which are scaled-down experiments to inform in situ studies, have found that avoidance is common, and that harm and mortality rate depends on fish species, age, entry angle, and turbine characteristics. Generally, more research is needed to determine monitoring approaches, and identify project specific impacts like effects on mass migration, strike effects, and others.

Discussion:

- Technology for measuring baseline data depends on specific characteristics of the MHK device.
- Scientists rely on existing cultural and historical knowledge on how bodies of water are used. In addition, communities often help aid in the development of infrastructure for studies.
- Pilot projects in the water are essential for scientists to begin gathering data on population dynamics and changes due to TECs.

Electromagnetic Fields (EMF) *– Andrew Gill, Centre for Environment Fisheries and Aquaculture Science (CEFAS) (Salem workshop)*

Dr. Gill presented on the potential effects of EMF fields generated from MHK projects on sensitive receptors. Conveniently, EMF Studies are transferable and not regional, meaning studies done on the west coast are still applicable for projects on the east coast. While subsea cables, both direct current (DC) and alternating current (AC) have shown to emit EMF fields that are detectable by E-M sensitive animals, there is not enough evidence to suggest whether effects can be considered a significant impact. For example, while some studies have shown that there EMF does change behavior for some individuals, there is no data indicating whether changes in behavior have positive or negative impacts on physical, physiological, or social well-being of these animals. Some remaining questions include understanding if effects are apparent at the biologically relevant unit such as the species population, what are the cumulative effects of multiple EMF encounters for an individual.

Discussion:

- A lot of the questions regarding the impacts and effects of EMF in different geographies have not been asked and studied.
- Need to study how different species' physiological characteristics affect their responses to EMF.
- Not much is known about how juveniles experience EMF
- There is data demonstrating the effects of EMF on individuals, however there are not enough recorded responses to determine if there are effects on populations.

Acoustics *– Brandon Southall, Southall Environmental Associates, Inc. (Salem workshop)*

Dr. Southall presented on the potential effects of sound emitted by MHK devices on marine mammals. Generally, marine mammals make and receive sound for key life functions such as reproduction, rogation, predator avoidance, and spatial orientation. Therefore, it is important to understand how sounds generated from MHK turbines might impact some of these life functions. Noise can interfere with marine mammal communication, elicit behavioral changes, and cause physiological effects. To evaluate these effects, scientists have used threshold-based methods, probabilistic methods, and analytical paradigms/frameworks. The substantial body of

research has increasingly revealed complexities in evaluating effects of noise on marine mammals. Based on existing data, sounds generated by MHK turbines will not have large impacts on marine mammals because they are largely low-frequency and of low source level, which research demonstrate shas lees impacts on marine mammals.

Discussion:

- Studies have not focused much on the differing effects of noise on younger vs. older marine mammals.

Benthic Interactions *– Sarah Henkel, Oregon State University (Sacramento workshop)*
Dr. Henkel discussed the potential interactions between MHK projects/devices and benthos. Like fish interactions, effects can be direct and indirect and can occur during construction, operation, or decommissioning of an MHK project. These interactions occur in the form of the artificial reef effect, mechanical sea-floor disturbance, or changes to energy (sound, EMF, wave/current energy). The common approaches to measuring these effects have tended to focus on macrofaunal species richness, epibenthic megafaunal cover, and epibenthic megafaunal diversity. Because they are usually assessed at arbitrary spatial scale and are not linked to ecosystem-service provision studies have not collectively contributed to understanding of cause and effect relationships behind oversized changes, which requires research, not just monitoring as is the most common. Metrics to be measured include measuring the loss off or changes to specific organisms that are determined to be drivers or indicators of ecosystem function. Looking ahead, it is important to determine which ecosystems are important to track and which species are drivers of ecosystem functions or indicators of ecosystem conditions. In addition, pilot MHK Projects in the water are important to help quantify habitat alteration and changes to the abundance or distribution of key species and ecological processes.

Discussion:

- Changes to an environment are inevitable when you are building something, therefore, it is crucial to make monitoring plans that can evaluate the changes and determine if they can negatively impact the existing ecosystem. To do this it is crucial for pilot projects, such as PacWave South, to get MHK machines in the water so effects can be studied.

Fish Interactions *– Daniel Pondella, Occidental College (Sacramento workshop)*
Dr. Pondella discussed fish interactions with offshore structures including MHK devices as well as offshore wind turbines and oil and gas platforms. Studies have documented artificial reef effects that shift baseline conditions for species composition and biodiversity and impact population habitat and connectivity by facilitating invasive species. Generally, artificial reefs created by renewable energy installations can both attract and produce fish. Generally, fish prefer surfaces that are not smooth, therefore, renewable energy devices can try to create

technologies that provide some attractive features to fish, who can use it as an artificial reef. However, there needs to be a balance to make sure that these artificial reefs are not attracting animals or predators who would not otherwise be there.

Discussion:

- Fish are moving further north due to warming sea temperatures.
- EFH is the main regulatory concern, especially those related to commercial species such as abalone. However, it is not yet clear whether the attraction of certain species may be a positive or negative consequence. More studies are necessary to understand the implications for the habitat.
- It will be interesting to observe how renewable energy technologies impact the production of fish.

Appendix I – Attendees

First Name	Last Name	Organization	Participation
Danvers			
Sara	(not provided)	(not provided)	Remote
David	Bean	NOAA	Remote
Jay	Clement	USACE	Remote
Joshua	Dub	FERC	Remote
Tay	Evans	MA Division of Marine Fisheries (DMF)	Remote
Melissa	Grader	USFWS	Remote
Whitney	Hauer	BOEM	Remote
Mike	Johnson	NOAA	Remote
Shana	Kinsey Carlson	FL Department of Environmental Protection (DEP)	Remote
Sean	McDermott	NOAA	Remote
Denis	Nault	Maine Department of Natural Resources	
Frank	Pendelton	BOEM	Remote
Hanna	Willey	NY Dept. State	Remote
Subject Matter Experts			
Emma	Sheehan	University of Plymouth	
Gayle	Zydelweski	University of Maine	
Washington, D.C.			
Amy	(not provided)	(not provided)	Remote
Kyle	Baker	BOEM	Remote
Stephen	Bowler	FERC	
Ingrid	Brofman	FERC	Remote
Jeff	Browning	BOEM	Remote
Shana	Carlsen	FL DEP	Remote
Robin	Cleland	(not provided)	
Allan	Creamer	FERC	
Devin	DeMario	Fish Wildlife Association	Remote
Yuak	Desta	FERC	
Joshua	Dub	FERC	
Cathie	Dunkel	BOEM	Remote

First Name	Last Name	Organization	Participation
Danielle	Elefritz		Remote
Lisa	Gilbane	BOEM	Remote
Whitney	Hauer	BOEM	Remote
Joe	Haxel	NOAA	Remote
Allison	Johnson	DOE	
Julia	Kolberg	FERC	Remote
Joshua	Lawrence	EMEC	Remote
Pat	Leary	FERC	Remote
Amber	Leasure-Earnhardt	Virginia Coastal Policy Center	Remote
Ian	Lundgren	NOAA	Remote
Candace	Nachman	NOAA	Remote
Shannon	O'Neil		Remote
Dusty	Pate	NPS	Remote
Adam	Peer		Remote
Justin	Pierce	BOEM	Remote
Sara	Salazar	FERC	Remote
Brandi	Sangunett	BOEM	Remote
Beth	Scott	University of Aberdeen	Remote
David	Turner	FERC	
Michael	Tust	FERC	Remote
Laura	Washington	FERC	Remote
Benjamin	Williamson		Remote
Frank	Pendleton	BOEM	Remote
Subject Matter Experts			
Ana	Couto	University of Aberdeen	Remote
Michael	Macrander	Integral	
Boca Raton, FL			
Gabe	Alsenas	FAU	
Nasser	Alshemaimry	Ocean Based Perpetual Energy	Remote
Mike	Bornstein	City of Lakewood Beach	
Shana	Carlsen	FL DEP	Remote

First Name	Last Name	Organization	Participation
Lindsey	Dubbs	UNC	Remote
Laurie	Gam	Ocean Based Perpetual Energy	Remote
Sarah	Henkel	Oregon State University	Remote
David	House	Ocean Based Perpetual Energy	
Tim	Rach	FL DEP	Remote
Peter	Stricker	Aquantis	Remote
David	Wesley Sutherland	USFWS	Remote
Subject Matter Experts			
Stephen	Kaijura	FAU	
Joshua	Lawrence	EMEC	Remote
Anchorage, AK			
Sean	Eagan	National Oceanic & Atmospheric Administration	Remote
Kevin	Keith	Alaska Department of Fish and Game	
John	Wiley	US Fish and Wildlife Service	Remote
Subject Matter Experts			
Andrew	Seitz	University of Alaska, Fairbanks	
Salem, OR			
Latonia	Batiste	Ecology and Environment, WSP	Remote
Dennis	Clark	WDNR	Remote
Lindsay	Dubbs	North Carolina Renewable Ocean Energy Program	Remote
Bill	Foster	National Marine and Fisheries Service	Remote
Whitney	Hauer	BOEM	Remote
Dan	Hellin	OSU	
Sarah	Henkel	OSU	Remote
Allison	Johnson	Department of Energy	
Delia	Kelly	Oregon Department of Fish and Wildlife	Remote
Alan	Mitchnick	FERC	Remote
Carrie	Noonan	DOE	
Patty	Snow	State of Oregon, OCMP	
Stefanie	Stavrakas	US Fish and Wildlife Service	Remote
Kris	Wall	National Oceanic & Atmospheric Administration	Remote

First Name	Last Name	Organization	Participation
Jeff	Young	National Oceanic & Atmospheric Administration	
Subject Matter Experts			
Andrew	Gill	CEFAS	
Brandon	Southall	Southall Environmental Associates, Inc.	
Sacramento, CA			
Jalal	Abedi	California State Lands Commission	Remote
Sam	Blakesley	California State Lands Commission	
Christine	Day	California State Lands Commission	Remote
Bill	Foster	National Oceanic & Atmospheric Administration	
Whitney	Hauer	BOEM	Remote
Christopher	Huitt	California State Lands Commission	Remote
Allison	Johnson	Department of Energy	
Delia	Kelly	Oregon Department of Fish and Wildlife	Remote
Karen	Kramer		Remote
Allan	Laca	California State Water Resources Control Board	Remote
Ann Marie	Ore	California State Water Resources Control Board	Remote
Frank	Pendleton	BOEM	Remote
Gene	Revelas	Integral	Remote
Marina	Voskanian	California State Lands Commission	Remote
Eric	Wilkins	California Department of Fish and Wildlife	
C	Woody		Remote
MS			Remote
Subject Matter Experts			
Sarah	Henkel	OSU	
Daniel	Pondella	Occidental College	

Project Team Members			
First Name	**Last Name**	**Organization**	**Participation**
Elaine	Buck	EMEC	DC
Caitlin	Long	EMEC	MA, DC, FL
Paul	Jacobson	EPRI	DC, FL

Sharon	Kramer	H.T. Harvey	MA, DC, FL, AK, OR, CA
Grace	Chang	Integral	MA, DC, FL, AK, OR, CA
Craig	Jones	Integral	MA, DC, FL, AK, OR, CA
Zach	Barr	Kearns & West	MA, DC, FL, AK, OR, CA
Kirsten	Hauge	Kearns & West	AK, OR, CA
Sharon	Hu	Kearns & West	DC, FL
Jorge	Kalil	Kearns & West	AK, OR, CA
Erica	Wales	Kearns & West	MA, DC, FL
Anna	West	Kearns & West	MA, DC, FL
Nate	Johnson	ORPC	MA, DC, FL, AK
Kerry	Strout Grantham	ORPC	MA, DC, FL, AK
Justin	Klure	Pacific Energy Ventures	DC, OR, CA
Will	Peplinski	Sandia National Laboratory	MA, DC, FL,AK, OR, CA

Appendix II – Feedback Exercises Results by Workshop

East Coast Workshops	Response	Danvers, MA	Washington, DC	Boca Raton, FL
Does the flow and use of information make sense?	Strongly Agree	44%	14%	0%
	Agree	56%	86%	80%
	Neutral	0%	0%	20%
	Disagree	0%	0%	0%
	Strongly Disagree	0%	0%	0%
What component of the Toolkit would you use in the permitting/licensing process?	Data Catalog & Mapper	40%	38%	44%
	Engagement and Communication Tools	0%	14%	11%
	Searchable Documents	60%	43%	33%
	Guidelines and Flowcharts	0%	5%	11%
During which regulatory phases would you use the Toolkit?	Licensing/Permitting	100%	48%	80%
	Monitoring and Compliance	0%	13%	0%
	Decommissioning	0%	17%	0%
	Other	0%	22%	20%

West Coast Workshops	Response	Anchorage, AK	Salem, OR	Sacramento, CA
Does the flow and use of information make sense?	Strongly Agree	0%	30%	30%
	Agree	100%	70%	70%
	Neutral	0%	0%	0%
	Disagree	0%	0%	0%
	Strongly Disagree	0%	0%	0%
What component of the Toolkit would you use in the permitting/licensing process?	Data Catalog & Mapper	25%	35%	35%
	Engagement and Communication Tools	0%	9%	9%
	Searchable Documents	50%	35%	35%
	Guidelines and Flowcharts	25%	22%	22%
During which regulatory phases would you use the Toolkit?	Licensing/Permitting	100%	43%	43%
	Monitoring and Compliance	0%	29%	29%
	Decommissioning	0%	14%	14%
	Other	0%	14%	14%

MARINE ENERGY
ENVIRONMENTAL TOOLKIT FOR PERMITTING AND LICENSING

Round 2 Workshop Summary
February - March 2021

This document summarizes the presentations, discussions, and feedback exercises conducted during the second round of workshops for the Marine Energy Environmental Toolkit for Permitting and Licensing project. Discussions between the project team and participants are summarized in bullet points after each section.

For the full presentations, workshop recordings, and other materials from each workshop please see the following folder:

- Marine Energy Environmental Toolkit – YouTube Channel
- Marine Energy Toolkit Presentations - Google Drive

Background and Project Objectives

Zach Barr, Kearns & West facilitator, welcomed participants, led introductions, reviewed the agenda, presented workshop ground rules and goals, as well as the objectives for the toolkit project, which are:

- Increase regulators' understanding of marine and hydrokinetic (MHK) projects and their potential environmental effects;
- Reduce the amount of time to permit MHK projects by developing a useful Toolkit for all stakeholders; and
- Help decrease time and resources for permitting MHK projects.

Barr provided an overview of Project Components using an illustration and highlighted the supporting projects and updates of the marine energy community.

Round 1 Workshops Review

Barr provided an overview of the first round of workshops that took place in Winter 2020 and primarily focused on engaging federal and state regulators. The purpose of the first round of workshops was to share the overall project and Toolkit concepts, gather pointed feedback on the functionality and user interface of the Toolkit, share subject matter expertise related to environmental interactions of regional significance, and create buy-in on the usefulness and applicability of the Toolkit in a permitting and licensing process.

Initial feedback on the Toolkit was positive. Participants indicated the Toolkit would be important for facilitating project planning, risk assessment, interagency coordination, and information sharing with stakeholders. Participants also highlighted key focus areas for the Toolkit's development, including accurate data tagging, the availability of local data and the ability to save reports. The recommendations were incorporated into the Toolkit development process.

Toolkit Purpose and Intended Users

Craig Jones, Integral Consulting, presented the Toolkit purpose, intended users, data sources and information flow. The Toolkit is targeted toward regulators and developers as an easily accessible portal for information relevant to the permitting and licensing process that pulls several sources of information maintained on existing informational and spatial databases. Users are able to search for documents and data, search by keywords/tags (stressors, receptors, technologies, locations, etc.), save search results, and find the latest information available related to Marine Energy. Data sources will include community generated content from the National Renewable Energy Laboratory's (NREL) OpenEI tagged literature from the Tethys Knowledge Base maintained by Pacific Northwest National Laboratory (PNNL), and spatial data catalogues from MarineCadastre Ocean Reports maintained by the National Oceanic Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM).

The Toolkit is developed to address specific challenges facing the marine energy community during the permitting and licensing process by compiling all the key information from the different databases that are available with logical process. Some key challenges are:

- Multiple devices, configurations, and functionality;
- Environmental interactions are often complex with multiple aspects to ongoing research;
- Limited regulatory precedent; and
- No consistent forum for information sharing.

Dr. Sharon Kramer, H.T. Harvey, presented an overview of the conceptual models of interactions of marine species and marine energy devices, the environmental interactions addressed by the Toolkit, and tagging structure applied to permitted documents from the Federal Energy Regulatory Commission (FERC) E-Library.

The Toolkit is designed to understand and navigate interactions between a proposed marine energy project and potentially affected organisms or habitats. The interaction is broken into a stressor (noise, electromagnetic field, etc.) being exposed to a receptor (fish, marine mammal etc.) that has a potential effect. The project team used specific definitions of stressors and receptors from the Tethys glossary to make sure the information is consistently tagged. For each stressor and receptor conceptual model presented (Figure 1), the left contains the stressors for a particular species group that may interact with a marine energy device (for example, noise) and what the how the exposure level of that stressor could be measured. While the right side of the model contains the receptors (species, behavior, use of area, etc.) and any developed thresholds. These stressors and receptors come together to as the extent of potential effects a marine energy device may have on a species or habitat.

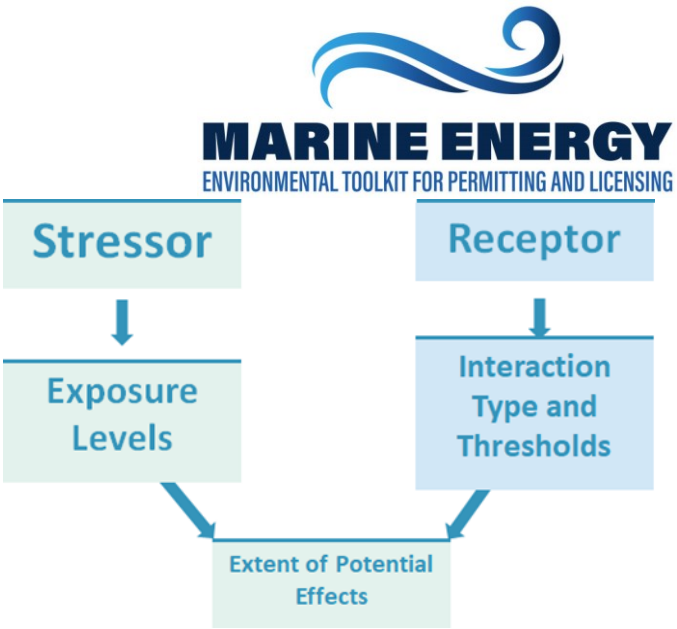


Figure 1: Conceptual model of key interactions

Dr. Kramer reviewed potential applications such as the issues matrix (Figure 2) that will allow users to obtain or input their own qualitative analysis of environmental impacts by easily accessing data and information on stressor-receptor interactions. The template will assist with the identification and discussion of the magnitude of impacts between regulators and developers of a specific marine energy project.

Biological Effects			Receptor							
Developmejnt phase	Activity	Stressor	Benthic Communities		Fish & Turtles		Marine Mammals		Birds	
			Key Effect	Mag	Key Effect	Mag	Key Effect	Mag	Key Effect	Mag
Preparation	Surveying	Sampling: coring, boring and grab sampling	Loss of biodiversity		NK		NK		NK	
		Noise from Vessels and sonar/seismic surveys	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Site preparation	Dredging Activities	Productivity reduction; loss of biodiversity; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	
Construction	Transport of wave device and support structures	Vessel activity; Presence of machinery/equipment	Disruption of behaviour		Disruption of behaviour		Disruption of behaviour		Disruption of behaviour	
		Noise from vessels	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
	Installation of wave device and support structures	Installation of WEC; Piling/drilling activities	Productivity reduction; Loss of Biodiversity; Food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour	
		Noise from piling/drilling activities	Disruption of behaviour; Potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
Operation	Device deployment	Physical presence of WEC device and structural components	Reef effects; Food web promotion; increase in productivity and biodiversity		Fish aggregation; food web promotion		Food web promotion		Food web promotion	
			Risk of harmful biofouling; Invasive species		Risk of collision, entanglement, entrapment		Risk of collision, entanglement, entrapment		Risk of collision, entanglement, entrapment	
		Noise generation	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	
		EMFs	Disruption of behaviour		Disruption of behaviour		Disruption of behaviour		NK	
Accidental events	Chemical / oil / fuel spill	Chemical and oil pollution	Potential toxic response		Potential toxic response		Potential toxic response		Potential toxic response	
	Loss of equipment / structural components	Physical presence of sinking/floating equipment	Disruption of behaviour; potential harm through		Disruption of behaviour; potential harm through		Disruption of behaviour; potential harm through		Potential harm through ingestion/entanglement	
			ingestion/entanglement		ingestion/entanglement		ingestion/entanglement			
Decommissioning	Removal of device and structural components	Vessel activity; Presence of machinery/equipment	Loss of biomass and biodiversity locally enhanced; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications		Disruption of behaviour; food web implications	
		Noise from vessels and removal	Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour; potential harm		Disruption of behaviour	

Magnitude of Impact	Description
Major	Degradation to the quality or availability of habitats and/or wildlife with recovery taking more than 2 years
Moderate	Change in habitats or species beyond natural variability with good recovery potentially within 2 years
Minor	Change from baseline conditions measurable but within scale of natural variability
Negligible	Change in habitats or species within scope of existing variability and difficult to measure or observe
Positive	An enhancement of ecosystem or popular parameter
No Interaction	None

Figure 2: Qualitative analysis of environmental impacts for Wave Energy Converters Source: WavEC: Identifying key environmental effects of wave energy deployments - SINTEF.com blog

Toolkit Demonstration:

Dr. Ben Best, EcoQuants, provided a high-level demonstration of the Toolkit and its various components. Commentary supplemented the demonstration on the utility of each component for developers during the General Webinars and for regulators during the Regulatory webinars. During the General Webinars, Kerry Strout Grantham, ORPC provided information on the Toolkit's utility in the preliminary phase of the process, while Justin Klure provided information from the perspective of a more mature project. During the regulatory webinars, Dr. Kramer proposed an example wave project seeking permitting and licensing off the coast of Hawaii. Maria Carnevale acted as the state coordinator for Hawaii and explained the utility of each component of the Toolkit.

The 'Projects' tab provides an interactive map and timeline of marine energy projects in the United States, allowing users to select a specific project and find information on its range of dates, status, phase, technology, and the relevant FERC documents available online. From a developer's perspective, this tool could be helpful in quickly sourcing preliminary permits and studies, which could provide useful environmental data and information on the environmental effects of specific technology or project components in an area.

The 'Regulations' tab provides a flow diagram prompting developers to the most relevant regulatory pathway based on their project's characteristics. Once the correct description has been selected, users are taken to a road map of the permitting and licensing process. Users can also access resources related to specific state and federal regulations relevant to marine energy permitting. For developers, this tool provides a general overview of the process, highlighting required documents, important entities to engage, and approximate timeframes.

Tabs such as 'Environmental Interactions', 'Documents', and 'Management Measures' quickly provide users with a summary of, and links to, available documents which reference specific stressors, receptors, stressor-receptor interactions, phases, technology, management measures and their implications from existing online resources like Tethys Knowledge Base and the FERC E-library. These tools can assist developers when preparing permitting documents, using documents from older projects as precedence, and when approaching permitting agencies to negotiate.

The 'Documents' tab, specifically, draws information from tagged FERC E-library permitting documents, allowing users to filter searches using keywords associated with stressors, receptors, technology types and project phases, along with a series of true/false prompts and an additional search field. This search generates a Document ID and link that will take users to relevant documents matching their search criteria. The list of documents and their associated tags that inform the Documents tab are stored on a Google Sheet and users can suggest edits to improve accuracy.

The Reporting Tool allows users to create a custom report with information based on user-defined stressor-receptor interactions and location. Users first navigate to the 'Configure' tab to select a location for the report using an interactive map in the 'Location' sub-tab. The user

then defines the stressor, receptor, and technology of interest in the 'Tags' sub-tab. A summary of the literature from the Tethys Knowledge Base and spatial datasets from MarineCadastre's Ocean Reports is viewable in the 'Literature' and 'Spatial' tabs, respectively. The final report is generated under the 'Report' tab which allows users to name the report, select its file format, and view the final report generated. This information is helpful for developers as they prepare for their discussions with regulators and identify consultants for studies.

Discussion:

- The user-defined polygon is the spatial query that helps identify relevant spatial information on the MarineCadastre's Ocean Reports. The project team is also working on including other components (projects, etc.) in the reporting tool, which will also utilize the user-defined polygon.
- To access information about potential environmental interactions that are likely to occur in an area, you would navigate to the configure tab and depending on the potential interactions choosing the stressor/ receptor tag, which in this case was fish and Invertebrates / Electro Magnetic Fields (EMF).
- To find what are the relevant state and federal regulations, you would navigate to the regulations tab, which hosts the Open-Ai information on the regulatory process by the state.
- To generate information for a specific area, navigate to the 'Location' sub-tab in the 'Configure' tab, locate that area on the map and draw a polygon around it. Once the polygon has been drawn, configure the tags and generate the report.
- The Toolkit seems like a great resource, particularly for early developers getting to grips with regulatory landscape.

Future Application Development:

Barr introduced the issue matrix (Figure 2) being as a potential future application to organize information into the different development phases with activities, stressors, list of receptor and key effects in a user-defined magnitude. Dr. Best, EcoQuants, followed with a walk-through of the usability of the two applications, the siting application tool, and the user-defined issue matrix. Participants were asked to provide additional feedback on future application development through the post-webinar survey form.

Discussion:

- The Toolkit will be available for pilot testing April-June.
- The sitting application incorporates data from multiple receptors and displays it in several ways. In the example shown, multiple birds' species sensitivity, based on a framework examining collation and displacement, endangered species status, and maneuverability, and marine mammal seasonal use were shown together on an interactive map.

An International Perspective on MRE

Paul Tait, European Marine Energy Centre (EMEC), introduced EMEC, the world's first and leading facility for demonstrating and testing wave and tidal energy converters–technologies that generate electricity by harnessing the power of waves and tidal streams–in the sea.

EMEC provides international knowledge and expertise to the Toolkit project team that has been acquired over the last 20 years. Through their years of expertise, EMEC has worked on 32 devices, with 20 developers and in 11 countries. From 2009 to 2015, proved to be the period with the highest number of developers coming to the waves and tidal sites with a range of different technologies. EMEC is also involved in up-and-coming green technologies and renewable energy such as wave energy, tidal energy, floating wind, energy systems, and hydrogen technologies and uses.

In 2021, EMEC will work on the following projects:

- Magallanes Acoustic and performance assessment.
- Orbital Marine Power is expected to be the most powerful tidal turbine in the world.
- Wave Devices: AWS Ocean & Mocean
- Green Aviation hub
- Hydrogen Infrastructure/Market development

As part of their work, EMEC has identified 5 environmental concerns on a national level in Scotland:

- Collision
- Displacement
- Noise Emission
- Leisure and Commercial Activity
- Navigational Safety

The intent of sharing this information is seeking consistency to enable accurate comparison and commercial development at an international level. This can be achieved by standardizing environmental, monitoring, and testing procedures. EMEC uses programs such as International Waters to foster collaboration, identify issues, and share knowledge between different centers across the globe.

Discussion:

- The regulatory process comparison between UK and US, is that in Scotland, the UK has done a good job at honing-in the regulatory process. It takes about 8-9 months to get a device in the water. There are still some issues on the financial side with decommissioning, which could be a lesson to learn for other countries that are developing their processes.
- Tait provided the link for EMEC's Wildlife Observation Project data: http://www.emec.org.uk/projects/ocean-energy-projects/environmental-

Subject Matter Expert Presentations

Several subject matter experts, project developers, academic researchers, and government or lab-led initiatives, were invited to present on specific topics relevant to permitting and licensing marine energy projects during the Regulatory Webinars. A summary of each presentation is provided below.

Approaches to Adaptive Management: A Comparison of Wave and Hydrokinetic Projects– *Kerry Grantham, Ocean Renewable Power Company and Justin Klure, Pacific Energy Ventures*

Kerry Strout Grantham gave an overview of the Igiugig Hydrokinetic Project in the context of adaptive management. The goal of adaptive management for the Igiugig Hydrokinetic Project (Project) is to determine acceptable levels of fish monitoring that are proportional to the risk. The Project team developed the Adaptive Management Team (AMT), a team of stakeholders within the project which includes regulators, licensee and additional stakeholders in the project area who were interested in joining. The AMT effectively applied adaptive management when in early 2020, both upstream and downstream fish monitoring cameras installed on the ORPC RivGen® device were inoperable due to apparent damage to a fiber optic cable. The final approach recommended by the AMT and implemented by the Project team was to repair the fiber optic cable, swap out the upstream and downstream cameras, and adjust the fish habitat permit. The fiber optic cable was repaired, and the cameras were swapped after the two priority monitoring periods in September 2020. For March 15, 2021- April 1, 2022, the Alaska Department of Fish and Game issued a new Title 16 Fish Habitat Permit that allows for the operation of the RivGen device during the two priority fish monitoring periods with a minimum of the upstream cameras operating if all other components of the Fish Monitoring Plan are executed as described.

Justin Klure gave an overview of PacWave South in the context of AM and the several ways the concept was used during the permitting and licensing process. One significant use of AM during permitting and licensing was during the environmental review process and consultation with state and federal resource agencies where AM provided regulators and reviewers flexibility in how to manage uncertainty. The need to develop an AM framework derives from the remaining risk and uncertainty after applying other tools such as monitoring plans and best management practices. Justin concluded his presentation by reviewing protection mitigations and enhancement (PM&E) measures, thresholds and response measures and actions, and the collaborative process in which they were developed.

Discussion:

- The most significant advantage of the FERC Alternative Licensing is the flexibility over time.
- PacWave experienced some expected issues with some agencies, but communication has been maintained.

- The Igiugig project had frequented an open dialogue with the agencies, and the only issues encountered were because of a federal shutdown at the end of the statutory period.

Fish Collision with Instream Turbines
Current State of the Science
Pacific Northwest National Laboratory (PNNL), Triton Initiatives, *– Garrett Staines, PNNL*
Triton Field Trials (TFiT) and other Fish Collision research
Garrett Staines presented an overview of the state of the science on fish collision and the fish collision concentration of the Triton Initiative Field Trials (TFit). The few papers on fish collision that were published in the past year since the OES-IEA State of the Science Report are characterized by including more collision risk variables such as fish behavior. Staines highlighted Triton Tasks including underwater video camera software, collision risk modeling approaches, technology development for evaluating collision risk in situ, and upcoming field trials to test effectiveness of technologies. Overall, TFit aims to assist the Marine Energy industry and permitting process by reviewing and field-testing metrics protocols, instrumentation, models and field testing for 4 specific environmental stressors: collision risk, changes in habitat, EMF, and underwater noise. A final report on the initial round of TFit will be available by the end of the year.

Discussion:

- For the project, the team is looking into different construction projects, such as the deployment of anchors.
- Most developers are pro-transferability. if there are interactions in an area, transferring that over is useful.
- Transferability of data or information on an environmental interaction does not eliminate risk of said action during the permitting and licensing phase.

Permitting Tidal Technologies:
Roosevelt Island Tidal Energy (RITE) Project
International Electrotechnical Commission (IEC) Acoustic Standards –*Jonathan Colby, Verdant Power*
Jonathan Colby provided an overview of Verdant Power's Roosevelt Island Tidal Energy (RITE) Project and the permitting and licensing process. Verdant Power recently installed an array of three tidal power turbines at its RITE Project site in the East River, New York. The RITE Project is a demonstration of Verdant Power's fifth-generation tidal power system and its novel TriFrame™ mounting system. Verdant is developing the RITE project in three phases. The initial phase included prototype testing carried out between 2002 and 2006. Based on the first phase results, FERC granted permits for phase two demonstrations which were carried out 2006-2009. The project includes an environmental plan: RITE Monitoring of Environmental Effects (RMEE) Plan which includes:

- tagged species detection,
- bird observation,
- acoustic characterization,
- recreational use and navigational safety, and
- adaptive management

Colby further explained that the RITE Project will address specific questions through adaptive management as well as explore opportunities to scale back monitoring efforts if monitoring shows a reduced risk of certain environmental interactions. Colby also discussed the IEC TC-114 Marine energy - Wave, tidal and other water current converters Part 40: Acoustic characterization of marine energy converters that provides technical specifications to ensure consistency and accuracy in the measurement and analysis of acoustical emissions from marine energy converters. Acoustic monitoring at RITE is using the IEC technical standards.

Discussion:

- An avoidance of 1 for the Turbine Strike Probability Model is very conservative. However, an Oak ridge paper suggests that avoidance can be reduced to below 1 based on findings. Verdant has kept the avoidance parameter at 1 as a company decision.
- Active acoustics in determining avoidance rates will be crucial in helping retire collision risk for smaller projects (if the avoidance of animals is as high as hypothesized) to get to the commercial array stage.
- Navigational risk also applies to open water sites — different scales, but an issue for tidal projects worldwide.
- Currently, the project has not experienced issues with flow noise for acoustic work. The standard shows how to accommodate flow noise, and it doesn't require to be that high in the water column.

Pacific Northwest National Laboratory (PNNL) Triton Initiative Field Trials (TFiT) – Acoustic Monitoring *–Dr. Joe Haxel, PNNL*

Dr. Joe Haxel, PNNL, provided an overview of the Triton Initiative, focusing on the TFiT underwater noise stressor. Triton's research supports industry partners, innovates technology, and performs tests to explore the best methods and technology for environmental monitoring around marine renewable energy devices with support by DOE's Water Power Technologies office. Four stressor areas will be the focus of field research to create industry recommendations on underwater noise, EMF, collision risk and changes in habitat. To monitor the underwater noise stressor, Triton uses International Electrotechnical Commission (IEC) technical specifications for measuring underwater noise and will perform underwater noise data collection and analysis at a tidal turbine and a wave energy device. Data and analysis from these field trials will help fill information gaps and reduce some uncertainty related to underwater noise generated by the marine energy devices.

Discussion:

- In terms of the costs of deploying and testing, TFiT is making it as cost-effective and efficient as possible.

Update Electromagnetic fields (EMF)– *Dr. Andrew Gill, Centre for Environment Fisheries and Aquaculture Science (Cefas)*

Dr. Andrew Gill, Cefas, provided an update to his EMF presentation provided at the Salem Oregon Workshop held in early 2020. EMF is a stressor that must be reviewed during permitting and licensing, therefore understanding EMF and it's characteristics is key. Three essential aspects when considering

interactions between Marine Energy-generated EMF and receptors are: transferability, regionality, and that EMF is emitted directly when generating electricity. EMF will be emitted into the environment but there is a low level of confidence in understanding of the interaction and impact on sensitive receptors. Remaining questions and gaps include the need to quantify sources and intensity of EMF, dose-response studies, population effects, and cumulative effects.

Discussion:

- The graphics seemed to suggest that there is a distance at which the EMF/IE would diminish detectability. If so, is it plausible to consider that there might be a threshold for burial depth to prevent EMF being transmitted into the water column? Considering that it is still a concern for sub-bottom critters.
    - Yes, distance diminishes, but as measurement has shown, the electric field component of the EMF extends over much greater distances. No matter how far it is buried, there is going to be some of it in the water.
- If there were $2 million to be spent in either developing instruments, behavioral studies in mesosomes or in the laboratory, the presenter would do a combination of using, 1-measure a variety of cables in the field to capture variability in the EMF environment - relatively cheap; 2- set up studies that use the field data (from 1) which expose key life history stages of target species where physiological and behavioral change is predicted to translate to a biologically significant effect (e.g. elasmobranch embryos in eggs exposed for many weeks may have respiration/metabolism change, which may lead to lack of success of hatching or small size at hatching OR lobster settling juveniles that are site attached and exposed for extended periods may result in stress that decreased growth and hence potential survivability). This is all driven by knowledge of the EMF environment and a REAL encounter scenario for a key life history period.

Acoustic Pressure and Particle Velocity Measurements Using NoiseSpotter*–Dr. Kaus Raghukumar, Integral Consulting*

Dr. Raghukumar presented an overview of the NoiseSpotter, a cost-effective, real-time acoustic characterization and localization system that was sponsored by DOE's Water Power Technologies Office. The specific environmental risk the NoiseSpotter seeks to characterize is underwater sound from marine energy devices. The four major project goals are:

- Sound source verification and characterization,
- Particle motion measurements,
- Marine renewable energy sound characterization, and
- Passive acoustic monitoring in exclusive zones.

The NoiseSpotter systems have been deployed in various locations as case studies, including Washington and California, to measure underwater sound generated by above and below water sources. The ultimate goal is to use this technology to make a wide set of measurements to start acoustic risk assessments on spatial scales. Future studies include the CalWave device deployment offshore of the Scripps Institution of Oceanography, characterization of particle motion from cutting of conductor pipes, and characterization of behavioral response to particle motion from seismic surveys.

Discussion:

- In terms of the sensors, they have an in-built accelerometer for the particle motion measurement. They also wouldn't be limited by the spacing between sensors that limit pressure gradient measurements to a narrow frequency band.
- Flow noise removal of > 3 dB–is quantified regarding to units of pressure.

Assessing Acoustic Impacts on Marine Mammals: Current understanding and future directions *– Dr. Brandon L. Southall*

D***r.*** Southall gave an overview of the current and future directions of acoustic impact on marine mammals. Sound is vitally, centrally important to marine life. Underwater noise can have negative effects, but it depends on:

- Species- and individual-specific characteristics
  - Frequency-specific hearing (spectral, temporal)
  - Auditory, behavioral, physiological sensitivity and compensatory ability
- Noise-specific characteristics
  - Noise type (impulsive/non-impulsive, familiar/novel) and level
  - Frequency and duration/phase (spectral, temporal)

Although there has been a great deal of research on acoustic effects of sound on marine mammals, there remain major gaps. Research and monitoring are increasingly revealing complexities in evaluating effects of noise on marine mammals because of species- and individual-differences in sensitivity, context-dependent behavioral responses (spectral-temporal-spatial), and challenges in quantifying effect significance on broad scales. However, every possible outcome or complexity does not have to be represented–some generalizations are possible such as marine mammal hearing groups and weighting functions, simple probability functions for behavioral sensitivity categories, and common-sense, risk-assessment type methods for decision-making.

Q&A Session (March 15th 12-3pm PST)

Dr. Ben Best gave an overview of the toolkit updates made since the last general webinar focusing on reports and navigation bar. These updates are the following:

- Completed:
  - Regulatory Diagrams
  - Help language.

- In progress (complete by mid-April 2021)
  - Login via Google
  - Save, update, and share reports.
  - Separatee user interface for gathering parameters from generating the report.
  - Fold exploratory menus into report generation
  - Simplify menus and navigation: including the configuration of tags (stressor, receptor, technology).

    - Harmonize hierarchical tags across sources.
    - Star and comment on entries (e.g., Literature)
    - Spatially query Tethys literature.
    - Develop interoperable interfaces.

After Dr. Bests presentation, participants were asked to share feedback via a Miro Board Activity where different areas of the Miro Board represented different components of the Toolkit for sticky notes to be posted to. Below is a summary of participants' feedback.

- Projects
    - Include offshore wind project information on the timeline.
    - It would be helpful to include the permitted capacity.
    - It would highlight the timeline plot project and vice versa to merge map and timeline when clicking a marker on the map.
    - FERC has many options for the regulatory process (ILP, ALP, TLP). Should the one selected be noted on the timeline?
    - Preliminary permits were of value for tidal applications.
    - Add an option that, when a project is selected, pulls all documents in the toolkit to know which projects went through which permitting (ILP, ALP, TLP) processes.
    - It will be beneficial to include a way to filter each tab based on the selected project.
    - Including BOEM regulatory work on the map would be useful.

- Regulations
    - Add an option to click individual boxes in regulatory diagrams to highlight in the report.
    - A link to the FERC MOU page that includes all MOUs listed by name and title would help users explore those resources more broadly.

- Documents
    - Explain True / False options with help text or simplify it to a checkbox.
    - PG&E WaveConnect is on our project list and tagged in the FERC documents.
    - Include a list of MOUs (including states) for comparison. Likely Ten states w/MOUs
    - Include Resource Agency reviews/authorizations.
    - Agency responses to applications have additional monitoring, etc.
    - Add annual reports e.g., documents that give project context and updates.
    - Adding the ability to flag (i.e., star) and comment on Tethys literature will help narrow hundreds of results to a few important ones.

- Spatial
    - Show spatial layers available and on the map.
    - Use Marine Energy study by Borja Reguero from UC Santa Cruz as a resource.

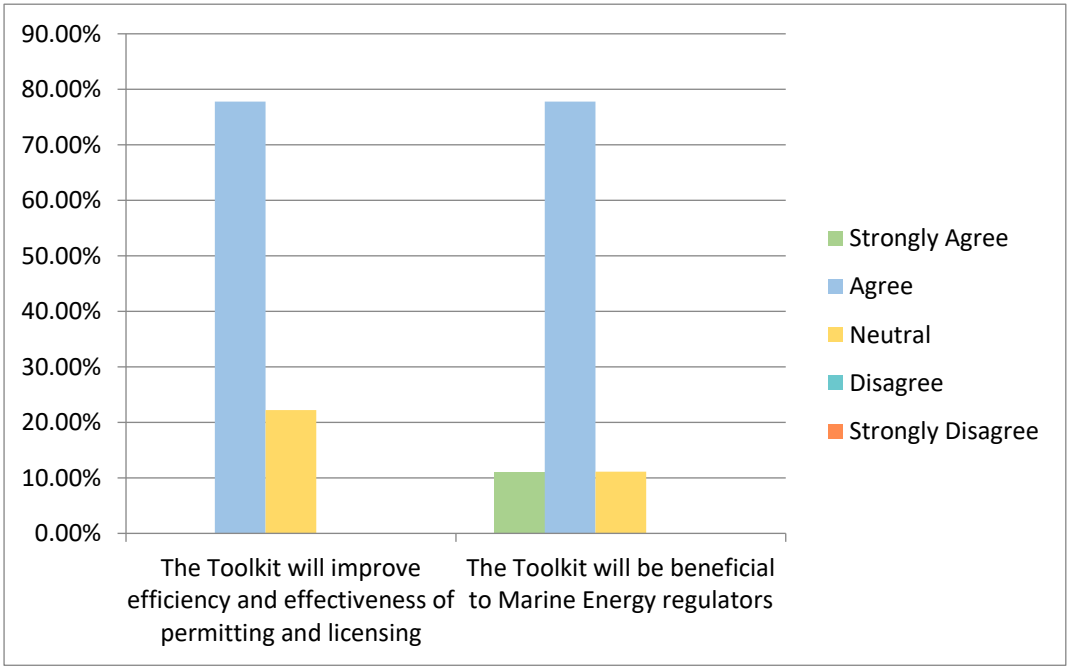
- Report
    - Save, edit, update, and share a link to configured reports.

  - The word gathering document is helpful for references to use in permitting or licensing documents.

- Overall
  - At the home page the cards should be replaced with more intuitive graphics of data sources and processes using ME.app on the home page.
  - Is there a plan to include OSW information in the future?
  - It could be helpful to post when the last update was, i.e., when the last paper/data grab was done.
  - Create a suggestion box to gather new sources of information that might be missing on the toolkit.
  - Include instructions on how to submit papers to TETHYS.
  - Create tags and filter options from section to section to filter based on projects previously selected.
  - Include a verification process when logging-in to the Open AI platform.

Post-Workshop Survey

For the following statements, please indicate the extent to which you agree or disagree.

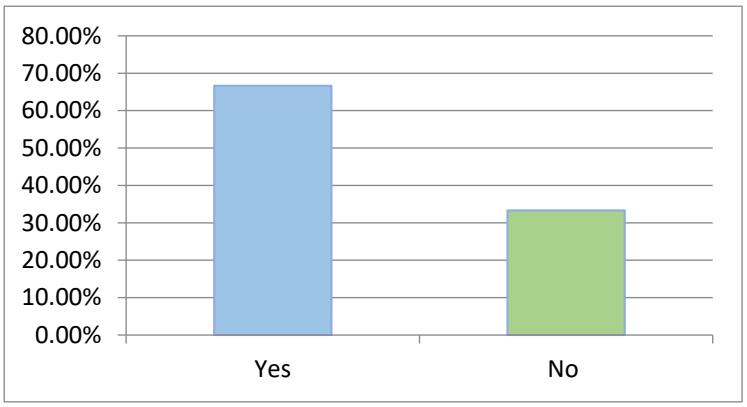


- Additional comments:
  - It may be helpful in some higher management level as an oversight, but I rarely handle the process at that level. I work more than a subject matter expert and deal with the analyses' technical details and how to obtain those results, interpret them, and apply

mitigation and other techniques to minimize impacts. To me, this tool does not have the resolution to do that.

- Having participated in the Toolkit process as a "consumer" since the inception, I can see a great deal of good work has been done to supply helpful information. What is less clear is how much demand is out there for this info? From my limited view in Washington State, I fear not much. MHK would seem to have great potential given the physics. Still, the environmental constraints and operational challenges (and in Washington, Treaty-reserved rights) make wind look like a snap in comparison. I have been waiting with fading hopes for seven years for someone to follow SnoPUD and take a stab at MHK in Washington State. Perhaps the toolkit will make it easier/faster for the next proponent and increase the odds for success. Meanwhile, the planet keeps heating up.

Would you find this Toolkit useful in the permitting and licensing process?



- If yes, how?
  - It seems like an excellent scoping tool and will be useful in directing further review efforts.
  - The ability to access studies and reports based on the location will facilitate the permitting processes if the literature database is robust.
  - Three ways: 1) making sure we are asking all the questions we as regulators/proprietary agencies should be asking, 2) understanding the science state, so we know what questions are reasonable to ask, and 3) take advantage of existing information to avoid re-inventing the wheel. I could also see it help permit/licensing by facilitating better proposals from proponents in the first place, thereby making the review process more efficient.
  - It provides access to information that needs to be considered (including environmental) in the licensing process.
  - The clickable regulatory roadmap is cool and does a fantastic job at clearly conveying the complex US regulatory process. I know there is like a 4-year cycle between those PEV regulatory reports - I'm hoping that you all maintain regular interactions with FERC/BOEM/ACE/states as regulations change in the meantime.

- If not, what would make it useful?
    - It would need to dive deeper into the details. However, doing so across the board on all subject matters would significantly increase this project's size. Plus, there are many issues associated with making a universal solution to even a single subject area. It would be challenging to make it foolproof and capable of anticipating future regulatory changes, technology changes, analysis changes, etc...
    - More examples of projects that have made it through the entire process are needed. I think right now we are a 2: Verdant and Igiugig. It will take more projects to work out the kinks.
    - I can see the benefits of this toolkit for a developer or a stakeholder; I am not sure I understand how it would help a regulator and thus expedite the permitting process.

Based on what you know to date, would you recommend or support the use of this Toolkit for other regulators, developers, or other stakeholders?

- Absolutely
- Not necessarily.
- I would tell them to look at it, to see if and to what extent it fit their needs.
- Yes. I think it has the potential to be a valuable tool if its use becomes widespread.
- Absolutely. I'd characterize it as the closest thing to "one-stop shopping" that's out there for all three groups.
- Yes
- Yes, the primary tool where users select a region and pull all the information associated with that region is beneficial. I also love seeing the Tethys documents as a valuable input to the tool and the consistency in the language (stressors/receptors) between Tethys and the toolkit.
- I will take a wait-and-see attitude. When it's been successfully used, then I may start recommending it.
- I think it's an excellent jumping-off point to identify what is known relative to potential sites.
- It gives a lot of reference material to developers and stakeholders.

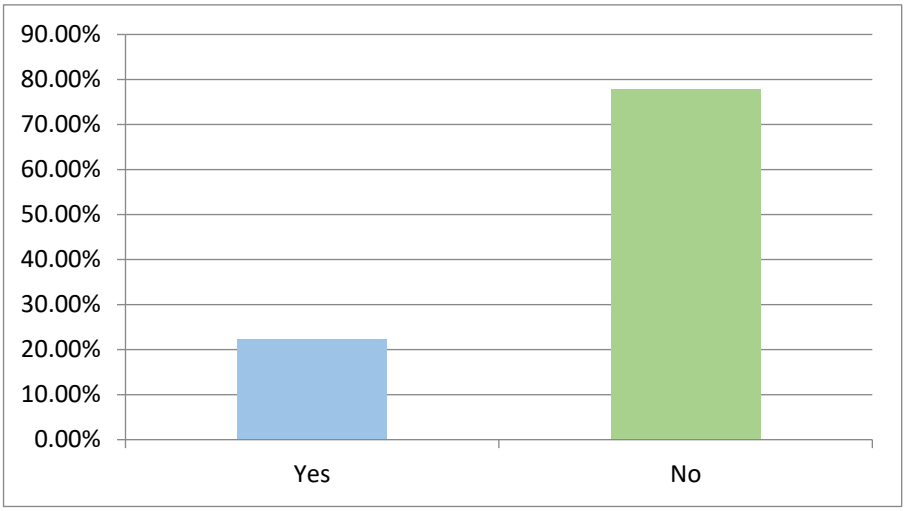
What improvements or applications would you like to be developed?

- With all the intelligent minds to work on this, there is nothing obvious missing or flawed. Once people go through the toolkit, they will find ways it can be improved. Consider strongly soliciting feedback to the toolkit developers/custodians. I often encounter websites that would benefit from input but am stymied by no obvious way to provide it.
- I was curious how you populate your list of projects. It seems some minor projects from years ago are omitted (Astoria Tidal Energy, Deception Pass Tidal, etc.) - I have a list of old projects from back when Tethys tracked FERC licenses, we did this until. The main navigation menu felt a little sporadic. Making more focus on the location selection tool that generates a report would be helpful, as that seems to be the critical tool provided. The "Management Measures" seems like an exact copy of the Tethys tool. I am very supportive of sharing data and information from Tethys to the toolkit and pulling results from the Management Measures tool

into a location report would be fine. Still, an exact copy of an existing tool seems inappropriate. We also periodically update this table, so assuming you pulled in this information statically, it will become outdated at some point.

- Please get more Marine Energy in the water.

Are you interested in piloting the Toolkit?



Are you currently or plan to be engaging in the permitting and licensing process?

- I am currently coming to the end of an 8-year permitting process.
- OES-Environmental created a monitoring dataset discoverability matrix on Tethys to support international data transferability to support regulatory processes where pre-existing data is not available. OES-Environmental has also been involved in risk retirement activities to streamline the permitting process for single devices and small arrays. Here is the link to the matrix: https://tethys.pnnl.gov/monitoring-datasets-discoverability-matrix

Are there upcoming research papers or studies related to Marine Energy that our team should be aware of to include in the Toolkit?

- Probably, but you are probably better aware of them than me. I watch Tethys, and the news feeds, but there are better sources that I do not have time for.
- Unsure.
- If you receive any documents not yet in Tethys during your presentations, please send them our way to be added.
- No
- No

Please share any additional data sets that may be publicly available.

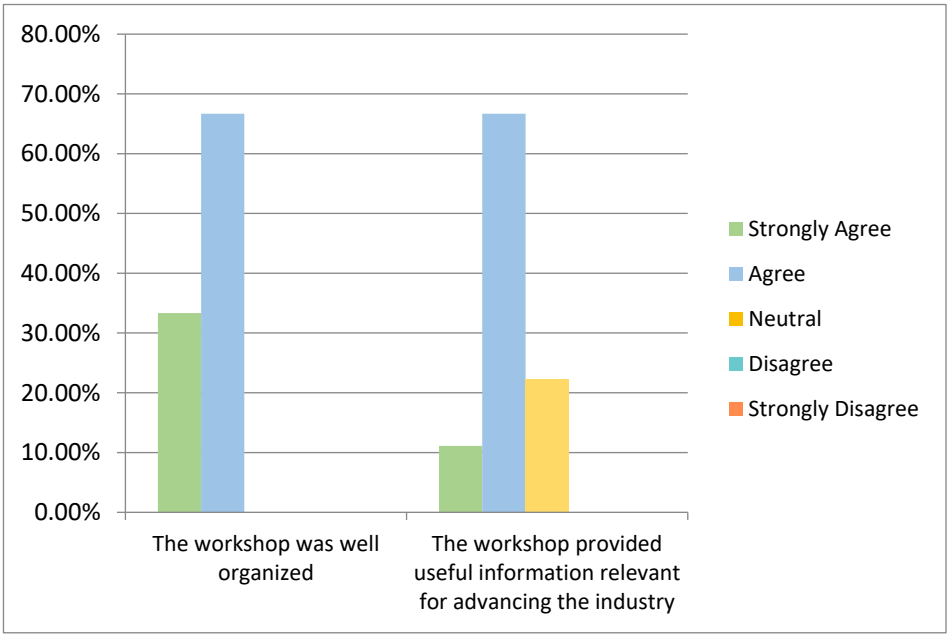
- None come to mind.

- I am just checking - are you coordinating with Jon Weers at NREL about the storage of datasets in MHKDR?

Were the expert presentations useful? Please explain why?

- Yes Somewhat.
- It is difficult to understand the underlying data and lack of data without digging in and using a system. Until I can do that, I naturally do not fully trust a system. I think it would be hard to do that here.
- Yes. Presentations from experts help ground the application of the toolkit. There can be a danger that tools work in theory but are not easily applied.
- The demonstration of how to query the data was convenient.
- Yes, they provided additional anecdotal information that is hard to capture in a written form.
- I am not clear what this question is about - maybe I missed something?
- I like the EMEC presentation.
- Yes, the toolkit explanation was valuable and easy to follow.

For the following statements, please indicate the extent to which you agree or disagree.



Appendix I–Attendees

First Name	Last Name	Organization
Abigail	Ryder	CA Energy Commission
Aldine	Reynolds	BOEM AK
Allison	Johnson	Office of Energy Efficiency & Renewable Energy
Amanda	Cousart	California Coastal Commission
Ana	Cuoto	University of Aberdeen
Antal	Szijj	U.S. Army Corps of Engineers
Brandon	Southall	Southall Environmental Associates
Brian	Hooker	BOEM
Caleb	Grant	Integral
Cassie	Bauer	University of Maine
Chiharu	Mori	NOAA
Chris	Potter	California Dept. of Fish and Wildlife
Chris	Bartlett	University of Maine
Crystal	Huerta	US Army Corps of Engineers
Dan	Hellin	Oregon State University
David	Sutherland	FWS Bio
David	Turner	FERC
Deanna	Caracciolo	Department of Land Conservation and Development
Debbie	Rose	Pacific Northwest National Laboratory
Delia	Kelly	Oregon Department of Fish and Wildlife
Denis-Marc	Nault	Maine Department of Marine Resources
Dennis	Clark	Washington State Department of Natural Resources
Desray	Reeb	BOEM
Diane	Brandt	Oregon State University
Doug	Davy	Jacobs
Dusty	Pate	DOI-NPS
Elaine	Buck	EMEC
Erica	Staaterman	BOEM
Greg	Shipley	BioEnergy Design
Gregory	Sanders	U.S. Navy
Heidi	Leighton	Maine Department of Marine Resources
Herb	Gazeley	Beaver Marine Services LLC
Ian	Lundgren	NOAA Fisheries

First Name	Last Name	Organization
Ioana	Bociu	Pacific Northwest National Laboratories
Isabel	Kaubisch	ENBW North America
Jaclyn	Daly	NOAA
Jason	Ramos	California State Lands Commission
Jean	Thurston-Keller	BOEM
Jean	Keller	BOEM
Jeff	Browning	BOEM
Jeff	Young	Pacific Northwest National Laboratory
Jennifer	Bothwell	Shell
Jennifer	Mattox	California State Lands Commission
Jim	Beyer	Maine Department of Environmental Protection
Jonathan	Whiting	Pacific Northwest National Laboratory
Jonathan	Colby	Verdant Power
Jordan	Carduner	NOAA
Josh	Ahmmann	Parametrix
Josh	Brekken	Alaska Department of Fish and Game
Karen	Gaidasz	NYSDEC
Kate	Harper	Alaska Department of Fish and Game
Kate	Huckelbridge	CA Coastal Commission
Kathryn	Ford	Massachusetts Division of Marine Fisheries
Katie	Morrice	Office of Energy Efficiency & Renewable Energy
Kayla	Toy	Alaska Department of Fish and Game
Laura	McLean	Oregon State University
Lei	Zuo	Virginia Tech
Lenaig	Hemery	Pacific Northwest National Laboratory
Lia	Protopapadakis	CorPower Ocean, Sweden
Linnea	Weicht	Pacific Northwest National Laboratory
Lysel	Garavelli	Pacific Northwest National Laboratory
Maria	Carnevale	H.T. Harvey and Associates
Maria	Eggett	Maine Department of Environmental Protection
Marie	Odile Fortier	University of California, Merced
Mark	Woythal	New York State Department of State
Matt	Folley	LiftWEC
Matthew	Wypych	Alpha Technologies

First Name	Last Name	Organization
Matthew	Wypych	Alpha Technologies
Matthew	Porter	Office of Energy Efficiency & Renewable Energy
Megan	Treml	Lynker in support of NOAA Office for Coastal Management
Michael	Bahleda	Bahleda Management and Consulting, LLC
Michelle	Fogarty	NREL
Mikaela	Freeman	Pacific Northwest National Laboratory
Mirko	Musa	Oak Ridge National Laboratory
Moriel	Arango	Blade Runner Energy
Natalia	Ivanova	CorPower Ocean, Sweden
Neil	Swanson	Integral Consulting Inc.
Nick	Sisson	NOAA Fisheries
Nicole	Cain	Oregon Department of Fish and Wildlife
Pace	Wilber	NOAA
Parker	Gassett	University of Maine
Paul	Michel	NOAA, Sanctuaries, West Coast Region
Rebekah	Padgett	WA Department of Ecology
Richard	Ainsworth	EMEC
Rick	Williams	Portland State University
Rob	Flynn	EMEC
Ronald	Smith	California State Lands Commission
Samantha	Eaves	Department of Energy
Sara	Bellafronte	City of Pittsburg - Pittsburg, CA
Sarah	Henkel	Oregon State University
Sean	Eagan	NOAA Fisheries
Shana	Hirsch	University of Washington
Shana	Carlsen	Florida Dept Environmental Protection
Shane	Guan	Bureau of Ocean Energy Management
Shelaine	Curd	Oak Ridge National Laboratory
Stanley	Labak	BOEM
Stefanie	Stavrakas	USFWS
Stephen	Barrett	Barrett Energy Resources Group

First Name	Last Name	Organization
Stephen	Bowler	FERC
Susan	Zaleski	BOEM
Tina	Fahy	NOAA-NMFS
Ursula	Howson	Pacific Northwest National Laboratory
Whitney	Hauer	BOEM
William	Foster	NOAA

Appendix I – Project Team Attendees

First Name	Last Name	Organization
Ben	Best	Eco Quants
Elaine	Buck	EMEC
Paul	Tait	EMEC
Paul	Jacobson	EPRI
Maria	Carnavale	H.T. Harvey
Sharon	Kramer	H.T. Harvey
Grace	Chang	Integral
Craig	Jones	Integral
Anna	West	Kearns & West
Briana	Moseley	Kearns & West
Jennifer	Vazconcelo	Kearns & West
Kai	Walcott	Kearns & West
Zach	Barr	Kearns & West
Abby	Fullem	Kearns & West
Natalie	Raymores	Kearns & West
Kerry	Strout Grantham	ORPC
Nathan	Johnson	ORPC
Justin	Klure	Pacific Energy Ventures
Will	Peplinski	Sandia National Laboratory
Jesse	Roberts	Sandia National Laboratory

Appendix G.

Additional Marketing Materials

MHK Environmental Toolkit for Permitting and Licensing

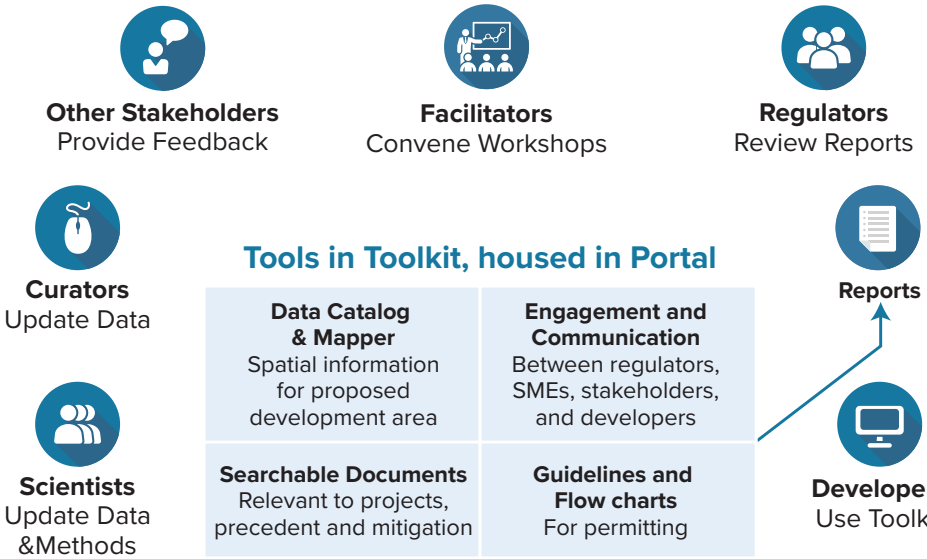
Project **Overview**

The goal of this effort is to increase regulators' understanding of Marine and Hydrokinetic (MHK) projects and their potential environmental effects to reduce the amount of time to permit and decrease costs to develop MHK projects. A Toolkit will be developed that compiles and distills existing spatial, regulatory, and scientific data and complements other DOE efforts such as the Portal and Repository for Information on Marine Renewable Energy (PRIMRE). The current state of science on key topics associated with MHK permitting, (e.g., marine mammals, collision, etc.) starting from the 2016 Annex IV State of the Science report, will be synthesized in the Toolkit with live links to existing resources. The Toolkit will be developed collaboratively with regulators to ensure usefulness in the permitting and licensing process. The project team will host two rounds of 6 workshops in California, Oregon, Alaska, Washington D.C., Massachusetts, and Florida to gather feedback from regulators for the development of the Toolkit and provide the latest scientific information from subject matter experts on environmental topics associated with MHK permitting.

Project **Objectives**

1. Distill scientific knowledge from a team of world-class experts into an Assessment Framework and Status Reports — revealing the most current understanding of risk and methods for environmental studies (collision, fish and fisheries, marine habitat, EMF, etc.) mitigation and monitoring.
2. Develop an easily accessible online MHK Environmental Permitting Toolkit, integrating relevant regulatory, scientific, and spatial MHK data that, through its usage, results in reduced permitting times and costs.
3. Conduct in-person meetings and webinars with relevant regulators from federal and state agencies to share and gather input on the Toolkit, and to share experts' understanding of potential impacts and the state of science for MHK projects. This review of the Toolkit with regulators will ensure that the Toolkit provides the necessary scientific information in a usable format to decrease the time and resources required to complete MHK permitting documents and environmental assessments.
4. Pilot the Toolkit and lessons learned through a specific project permitting process or processes.

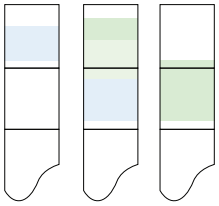
Toolkit and Stakeholder Use



Information Flow of Documents and Data Through the Toolkit

DOCUMENTS

Sources
Tethys, FERC eLibrary, ...



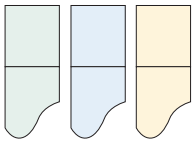
Digest ⟷ Search

Document Library

Tags
Receptors, Stressors, Technology, Place
(with page numbers, status, etc.)

Marine Mammals	Collision	Tidal
Fish	EMF	Wave
Habitats	Noise	Riverine

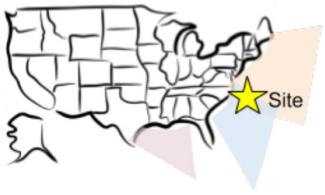
Status Reports
Summary guidance documents on latest Receptor / Stressor / Technology: Precedents, Mitigations, Monitoring



Status Reports

DATA

Spatial
MarineCadastre, regulatory, ...



Tabular
Sensitivities, regulations, ...

RECEPTOR	SENSITIVITY COLLISION	SENSITIVITY NOISE
Species A	1	2
Species B	3	0
Habitat A	1	NA

Analysis Modules
Community-vetted functions using open-source code to extract data by site & device configuration, analyze based on available data, and summarize out

Digest ⟷ Search

Energy	Protected Areas	Marine Mammals
Shipping	Siting App	
Military	...	Fish

Data Catalog

Site Report
Customized report with best available data, science and guidance on best practices

Reports/ Permits

Assessment Framework

Documents are uploaded and tagged (down to relevant page numbers) for later searching in the Document Library. Experts will create Status Reports accumulating best practices and state of knowledge across combinations of receptors, stressors and technologies. The information within the Status Reports are then fed into the appropriate portions of an environmental Assessment Framework report based on user-centered site and technology specifications with the Siting App, which is composed of topical modules that synthesize spatial and tabular information. For example, spatial distributions will be combined with tables on species sensitivities to produce risk maps. Furthermore, site-specific environmental analyses for the permitting regulatory steps (studies needed, mitigation/ monitoring and adaptive management plans) will be incorporated through the Assessment Framework.

Contact Us

If you have any questions, please contact:
Zach Barr (zbarr@kearnswest.com) or **Erica Wales** (ewales@kearnswest.com)

MARINE ENERGY
ENVIRONMENTAL TOOLKIT FOR PERMITTING AND LICENSING

ME Environmental Toolkit for Permitting and Licensing

Project **Overview**

The goal of this effort is to increase regulators' and developers' understanding of Marine Energy (ME) projects and their potential environmental effects to reduce the time and costs required to permit and develop ME projects. A Toolkit is being developed that compiles and distills existing environmental, spatial, regulatory, and scientific data and complements other DOE efforts such as the Portal and Repository for Information on Marine Renewable Energy (PRIMRE). The current state of science on key topics associated with ME permitting, is being synthesized in the Toolkit with live links to existing resources.

The project has four main objectives:

1. Distill scientific knowledge into an Assessment Framework and Status Reports.
2. Develop an easily accessible online ME Environmental Permitting Toolkit.
3. Conduct in-person meetings and webinar with relevant regulators from federal and state agencies to share and gather input on the Toolkit and to share experts understanding of potential impacts and the state of science for ME projects.
4. Pilot the Toolkit and gather lessons learned from the permitting process.

Tools in **Toolkit**

DATA CATALOG & MAPPER

Spatial and tabular information for proposed development areas will be synthesized. For example, spatial distributions will be combined with species sensitivity tables, producing maps with layers of environmental data that can enable users to evaluate risks.

ENGAGEMENT AND COMMUNICATION

Login capabilities will allow users to to save searches, export reports and import external documents.

GUIDELINES AND FLOW CHARTS

Guidelines and flow charts on applicable regulations, example documents, best practices, and other resources will be provided for federal (FERC, USACE, and BOEM) and state (AK, CA, FL, HI, OR, MA, ME, NY, RI, WA) processes.

SEARCHABLE DOCUMENTS

Documents relevant to projects, precedent and mitigation from various academic research and regulatory sources, including references from Tethys and tagged FERC permitting documents, will be stored in the document library. Summary documents will be created across selected combinations of stressors and receptors.

MARINE ENERGY
ENVIRONMENTAL TOOLKIT FOR PERMITTING AND LICENSING

Workshops

The Toolkit is being developed collaboratively with regulators and developers to ensure usefulness in the permitting and licensing process. To this end, a series of in-person workshops were held in California, Oregon, Alaska, Washington D.C., Massachusetts, and Florida in Winter of 2020. Regulators were invited to learn more about the Toolkit, share their needs and feedback on the project concept, and hear from subject matter experts on various environmental interactions. The project team received positive feedback on and helpful recommendations for the concept including:

- A list of additional regional databases;
- Suggestions for improving user friendliness such as drag and drop functionalities and summary tools;
- Validation of the usefulness of components such as mapping and engagement tools; and
- Requests for additional content pertaining to data gaps, validity of studies, cumulative impacts, site specific information and fisheries data among others.

You can access full presentations, workshop recordings, and other materials from each workshop **here**.

With the feedback received from the first round of workshops, the project team has begun to develop the Toolkit. In Winter 2021, a round of virtual workshops will be held to build on the first, with the following objectives:

- Showcase and demonstrate the Toolkit to verify feedback from the last round of workshops and solicit additional feedback;
- Engage stakeholder groups, including federal and state regulators, and industry/technology developers;
- Solicit additional feedback from all groups to be incorporated in the final round of Toolkit updates before pilot testing; and
- Provide stakeholders the opportunity to hear from SME's in relevant environmental interaction fields.

After the second round of workshops, the project team will begin pilot testing, by identifying and collaborating with interested project specific developers to incorporate the Toolkit into their new or ongoing projects.

Pilot Testing Process

01

Training
An initial meeting will be conducted to review the components of the Toolkit with the piloting team. During this meeting, a questionnaire and packet of materials for use during piloting will be provided and reviewed.

02

Testing
The piloting team will use the Toolkit to support the siting, permitting, licensing, or monitoring and compliance phase of their marine energy project. The piloting team will record their experience with the Toolkit via the questionnaire provided.

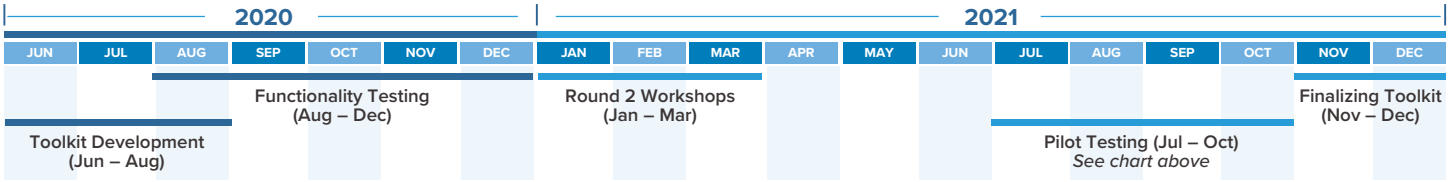
03

Feedback
After the submittal of the questionnaire, a second meeting will be scheduled to debrief the piloting team's experience using the Toolkit, and discuss potential improvements.

04

Documentation
Feedback from the piloting team will be recorded via the questionnaire and interviews and compiled on an ongoing basis. Periodic reports will be made available to DOE and the Toolkit development team until the end of the piloting process, and then compiled into a final report.

Timeline



Contact Us

If you have any questions or are interested in piloting the Toolkit, please contact: **Zach Barr** (**zbarr@kearnswest.com**)

MARINE ENERGY
ENVIRONMENTAL TOOLKIT FOR PERMITTING AND LICENSING

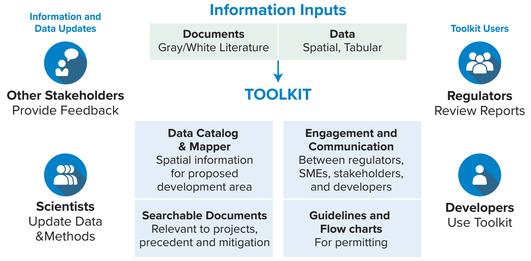
Marine Energy Environmental Toolkit for Permitting and Licensing

Project Overview

The Marine Energy Environmental Toolkit for Permitting and Licensing aims to increase regulators' and developers' understanding of Marine Energy projects and their potential environmental effects to reduce the time and costs required to permit and develop Marine Energy projects. Existing environmental, spatial, regulatory, and scientific data is compiled and distilled into an easy to navigate one-stop-shop webpage. Existing open-source information is used to make the Toolkit a transparent and sustainable tool for developers and regulators in the permitting and licensing process.

Intended Users

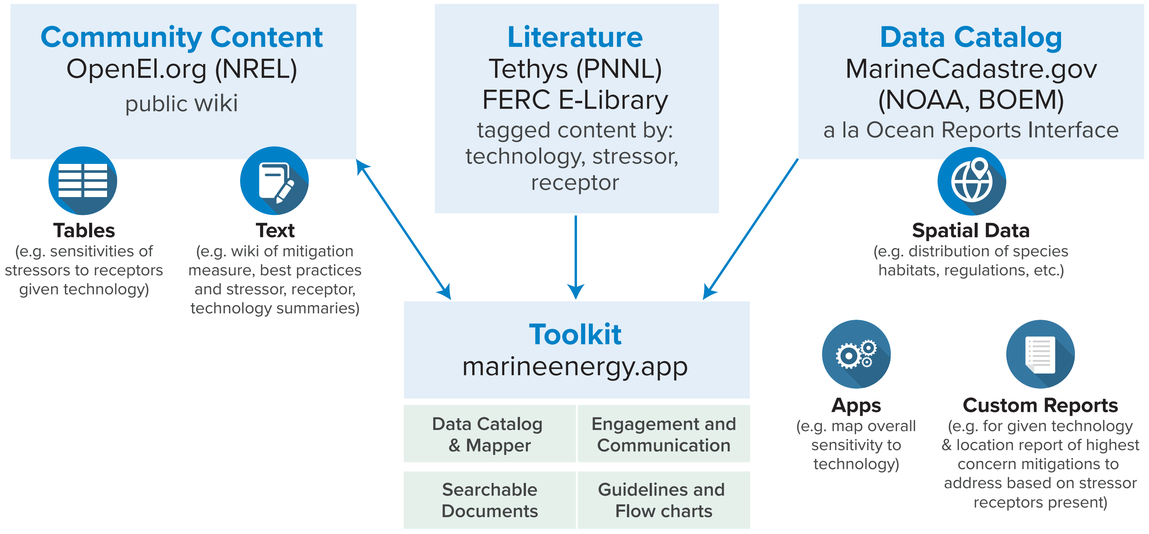
While Marine Energy developers and regulators are the primary intended users, scientists and other stakeholders play an important role in the process. The Toolkit is intended to be a long-lasting sustainable tool that can be updated automatically from the existing sources of information as well as include and develop future applications to address stakeholder needs.



Contact Us!

Thank you so much for viewing our poster! The Toolkit is currently in beta form and can be accessed by visiting https://marineenergy.app/. The project team is currently seeking nominations and interest for pilot testing the Toolkit and is very excited to hear from you. If you are interested in a demonstration or pilot testing the Toolkit please contact Zach Barr at zbarr@kearnswest.com. We would love to hear from you! Our team.

DATA SOURCES



Toolkit Development

A key concept in developing the Toolkit was to engage regulators specifically throughout the process to ensure that the information and interface would be relevant during a permitting and licensing process. Feedback gathered from regulators and developers through a series of one-on-one interviews and workshops informed the project team as the Toolkit was developed. Recordings of the workshop are available on YouTube. The Toolkit will continue to be refined as pilot testing begins. A major contribution of the Toolkit is the tagging of FERC E-library documents by stressor, receptor, and technology to be included in user-generated reports.

Toolkit Concept

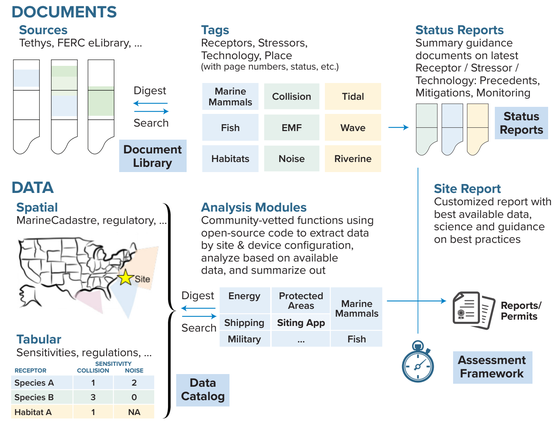
The Toolkit aims to address 4 key challenges:

- Multiple devices, configurations, and functionality,
- Environmental interactions are often complex with multiple aspects to ongoing research,
- Limited regulatory precedent, and
- No consistent forum for information sharing.

Relying on existing open-source information allows us to leverage years of work done by multiple organizations in completing and maintaining large catalogs of relevant information. Primary sources of information are:

- OpenEI
- Tethys
- MarineCadastre

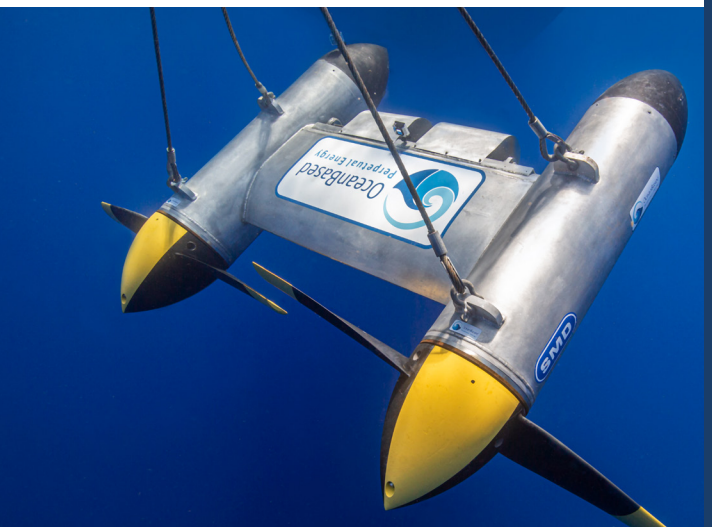
A tagging system of stressor, receptor, and technology (based on the Tethys glossary) as well as location is utilized to help organize information from several data and literature sources. Documents are uploaded and tagged for later searching in the Document Library.



Users will create Status Reports accumulating best practices and state of knowledge across combinations of receptors, stressors and technologies. These are then fed into appropriate portions of an environmental Assessment Framework report based on user-centered site and technology specifications with the Siting App, which is composed of topical modules that synthesize spatial and tabular information. Furthermore, site-specific environmental analyses for the permitting regulatory steps (studies needed, mitigation/monitoring and adaptive management plans) can be incorporated through the Assessment Framework.

Marine Energy Environmental Toolkit Development

A key concept in developing the Toolkit was to engage regulators specifically throughout the process to ensure that the information and interface would be relevant during a permitting and licensing process. Feedback gathered from regulators and developers through a series of one-on-one interviews and workshops informed the project team as the Toolkit was developed. Once an initial Toolkit was developed, additional feedback was sought through small group discussions. Additional feedback will be collected from regulators and developers involved in pilot testing projects.



MARINE ENERGY ENVIRONMENTAL TOOLKIT FOR PERMITTING AND LICENSING

MARINE ENERGY
ENVIRONMENTAL TOOLKIT FOR PERMITTING AND LICENSING

How would access to the latest academic, regulatory, and spatial information facilitate the permitting and licensing of Marine Energy in the U.S.?

What is the Marine Energy Environmental Toolkit?

The Toolkit is a one-stop shop for academic, regulatory, and spatial information to facilitate the permitting and licensing of Marine Energy in the U.S. The Toolkit aims to address 4 key challenges:

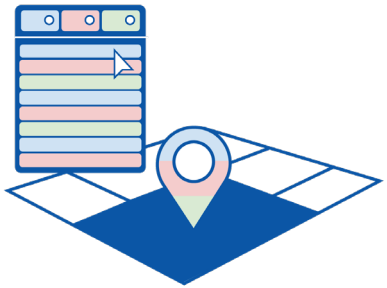
- Multiple devices, configurations, and functionality,
- Environmental interactions are often complex with multiple aspects to ongoing research,
- Limited regulatory precedent, and
- No consistent forum for information sharing.

Relying on existing open-source information allows us to leverage years of work done by multiple organizations in completing and maintaining large catalogs of relevant information. Primary sources of information are:

- OpenEI
- Tethys
- MarineCadastre

Information within the Toolkit is organized by a set of tags that users can use to develop reports on certain environmental interactions of interest.

1 Choose your site and topics of interests (query location and stressor-receptor interactions)



2 View selected content based on site and topics of interest

3 Develop and share reports

What's next?

Check the Toolkit out at marineenergy.app!

If you have comments, questions, feedback, or are interested in a demonstration or becoming a pilot testing project, please contact: Zach Barr at zbarr@kearnswest.com.

Our team would love to share more and learn about your *experience* with the Toolkit!