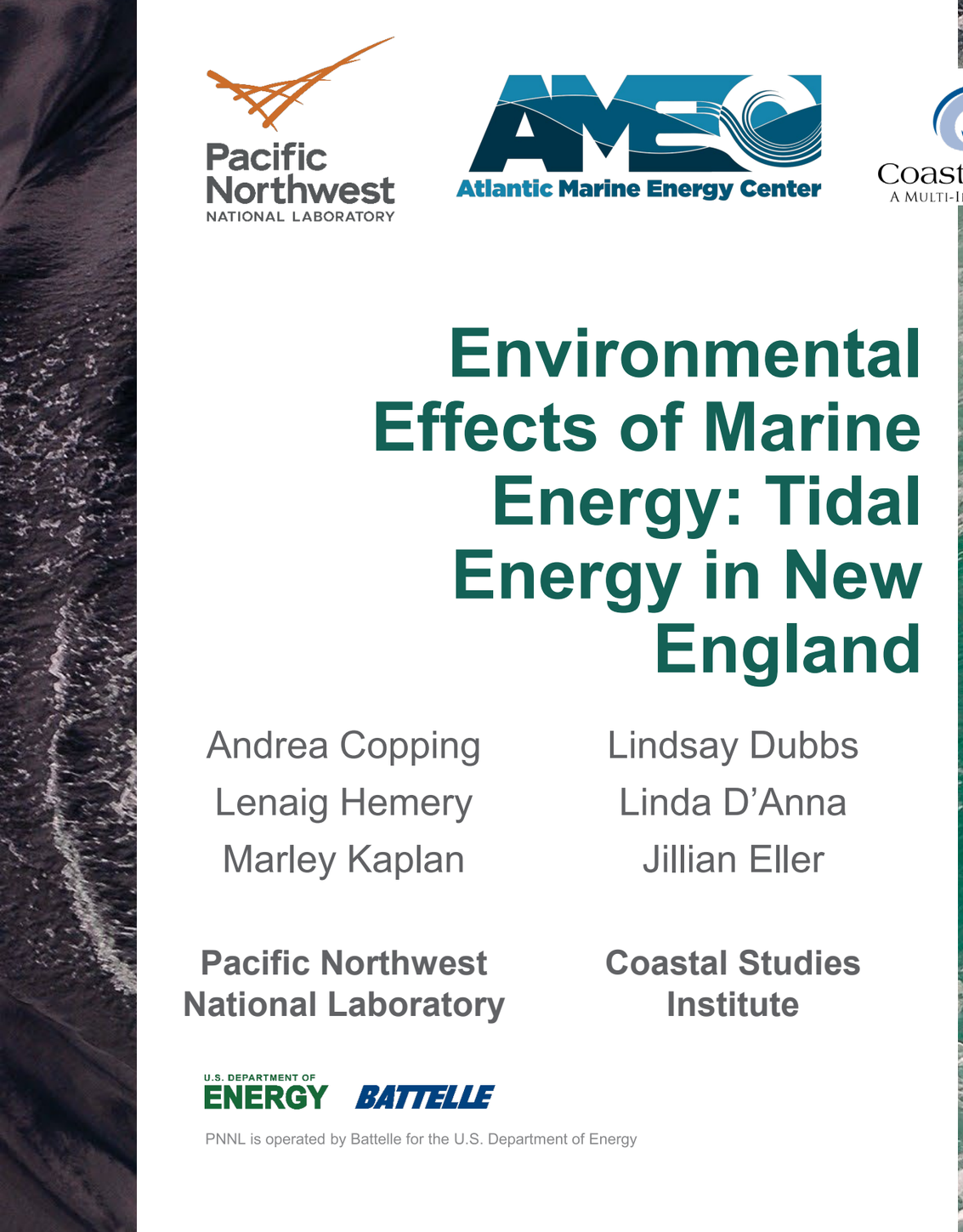

Environmental Effects of Marine Energy: Tidal Energy in New England

Andrea Copping
Lenaig Hemery
Marley Kaplan

Lindsay Dubbs
Linda D'Anna
Jillian Eller

Pacific Northwest National Laboratory

Coastal Studies Institute

U.S. DEPARTMENT OF ENERGY BATTELLE

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Introductions

Please download the PollEverywhere app

What brought you to this workshop?

What word comes to mind when you think of Marine Energy?

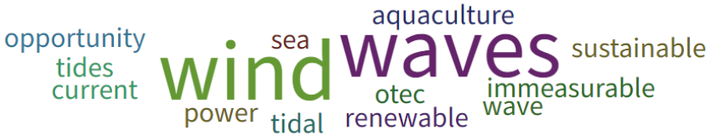
Activities

Visual settings

Edit

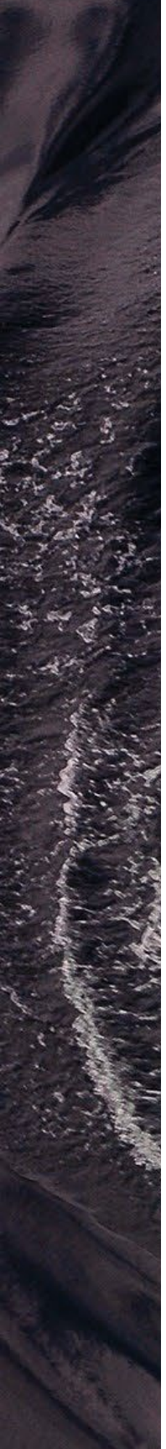
When poll is active respond at **PollEv.com/marleykaplan533**

What word comes to mind when you think of marine energy?



Objectives of the Workshop

1. Describe environmental and social effects of marine energy and how they differ from those of offshore wind
2. Walk through a fictional tidal energy use case in Massachusetts
3. Answer questions and discuss marine energy projects



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Agenda

Start Time	Agenda Topic
1:00	Arrivals
1:15	Introductions, objectives of the workshop
1:30	Marine energy environmental effects, and stakeholder engagement
2:30	Break
2:45	Tidal use case presentation
3:00	Group discussions
4:15	Conclusion

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Introduction to marine energy

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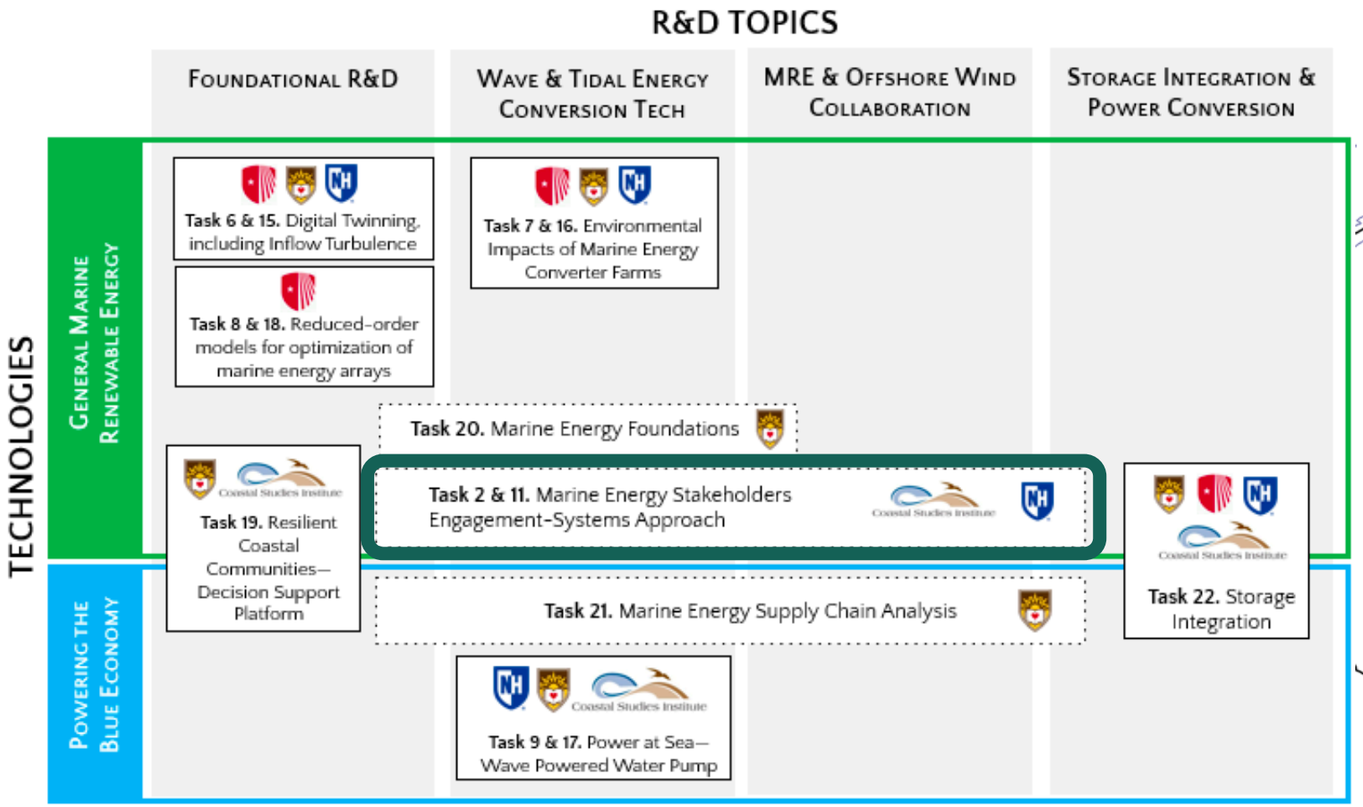
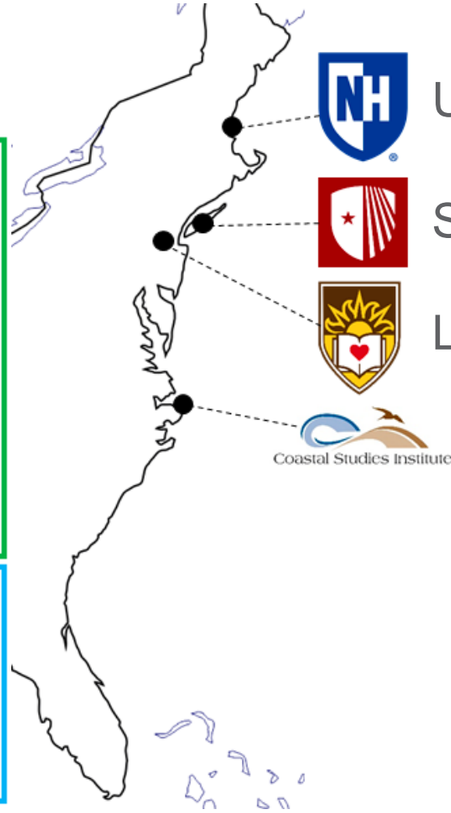
Atlantic Marine Energy Center





University of New Hampshire

Stony Brook University

Lehigh University

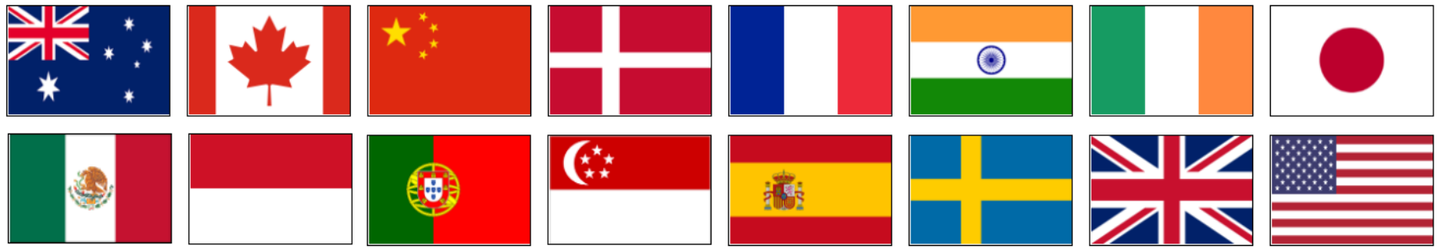
Coastal Studies Institute

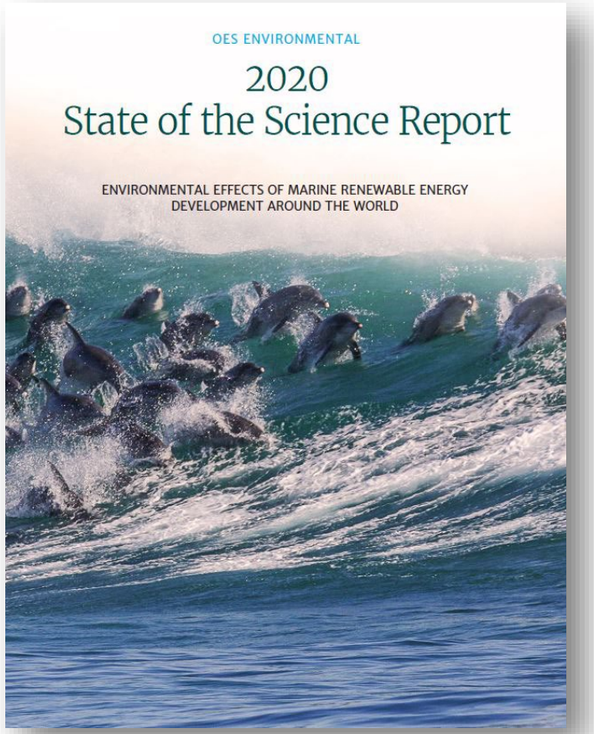
Develop a focused outreach and engagement process around the science of what we know about environmental and social effects of marine energy development

Atlantic Marine Energy Center

OES-Environmental

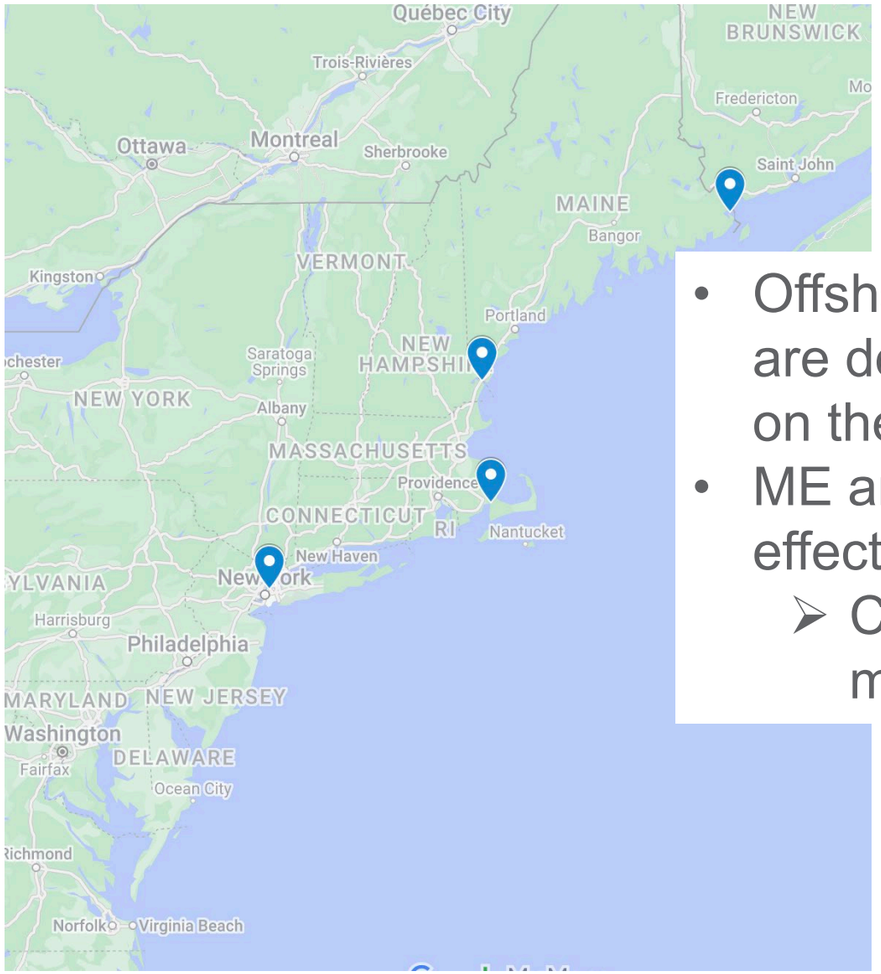
- Established by the IEA - Ocean Energy Systems in 2010
- Led by the U.S. DOE Water Power Technologies Office and implemented by Pacific Northwest National Laboratory
- 16 member countries for Phase 4
- Examines environmental effects of marine energy development to advance the industry in a responsible manner
- Publishes syntheses of the current available knowledge on environmental effects (e.g., State of the Science reports)





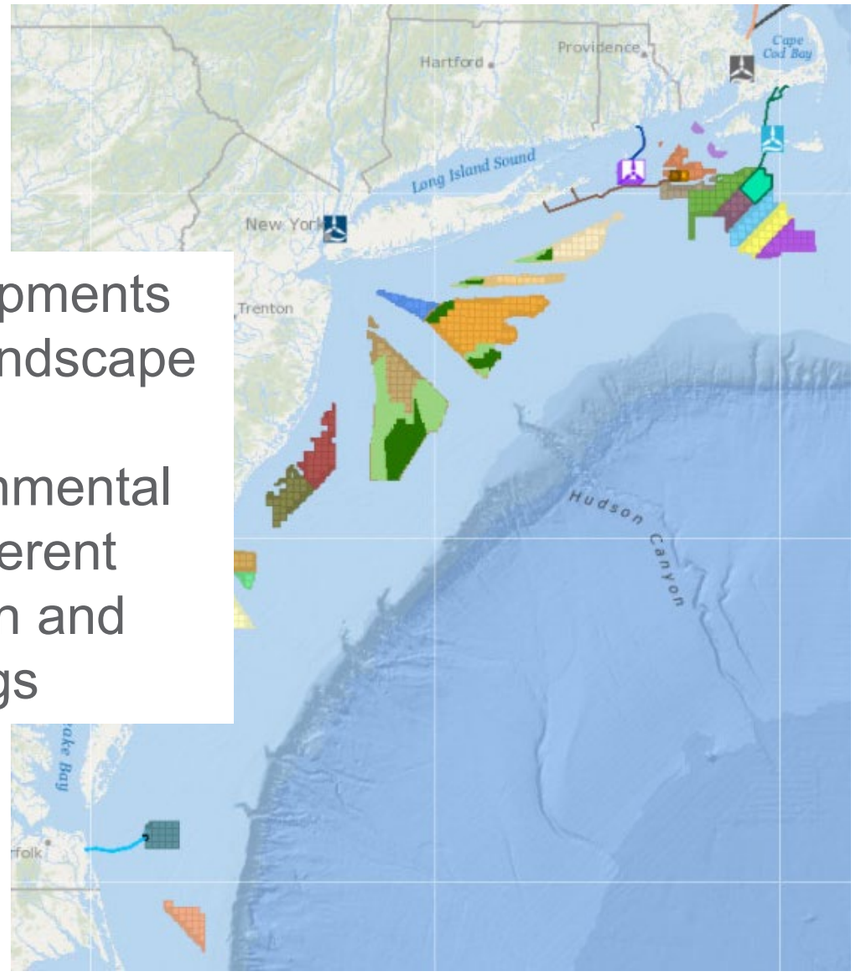
U.S. East Coast offshore energy context

Existing marine energy (ME) sites

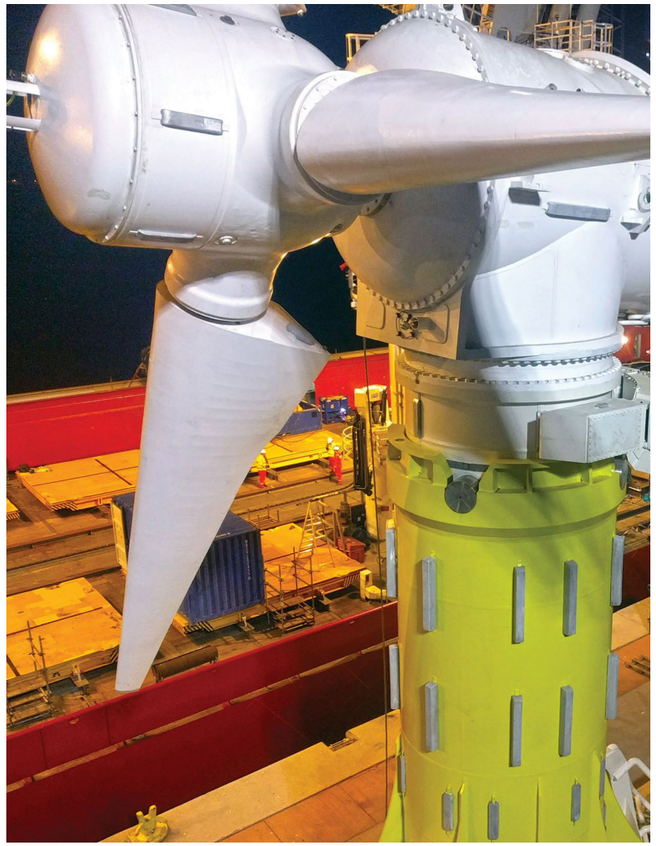


- Offshore wind developments are dominating the landscape on the East Coast
- ME and OSW environmental effects similar but different
  - ➢ Creates confusion and misunderstandings

Offshore wind (OSW) lease areas



Marine Energy



- Energy harnessed from the movement of ocean water or large rivers and from ocean gradients:
  - ✓ Waves
  - ✓ Tides
  - ✓ Ocean currents
  - ✓ River flow
  - ✓ Temperature gradients
  - ✓ Salinity gradients
- Early stages of development, deployment, and commercialization
- Environmental concerns continue to slow permitting processes worldwide
- Marine energy does not include offshore wind

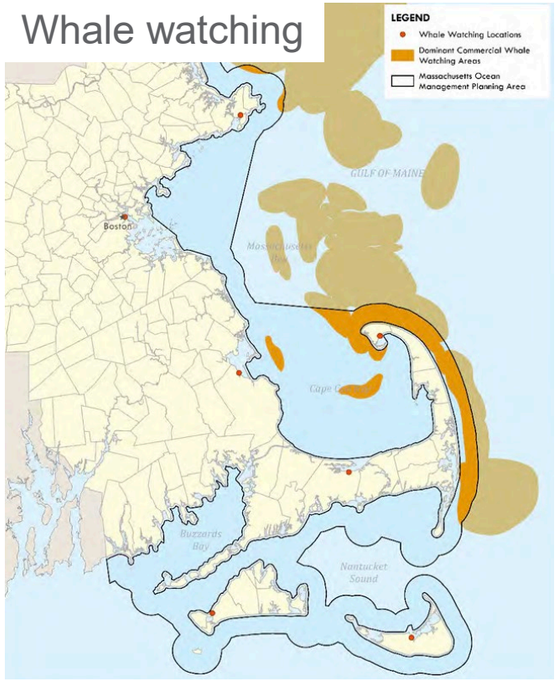
Challenges for marine energy development

The ocean is a busy space

- Lots of human activities at sea
- Often overlapping, sometimes conflicting uses
- Increase in ocean activities with potential for new interactions or conflicts

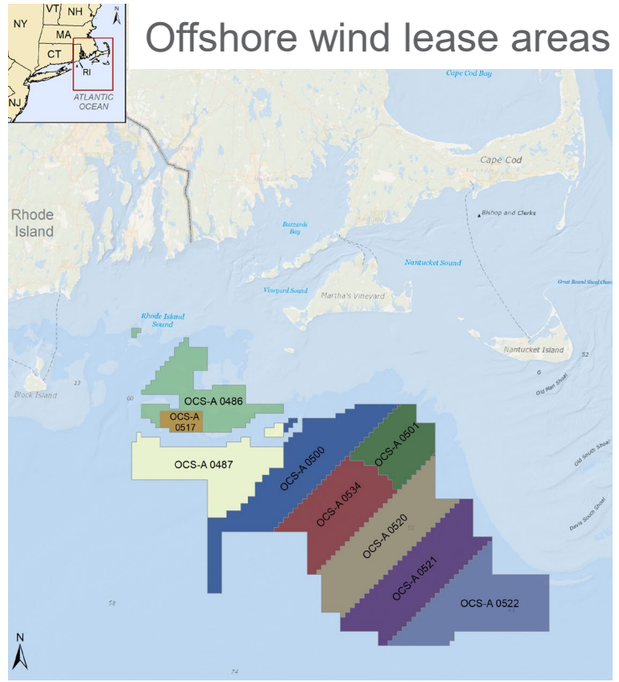
Recreational fishing

Whale watching



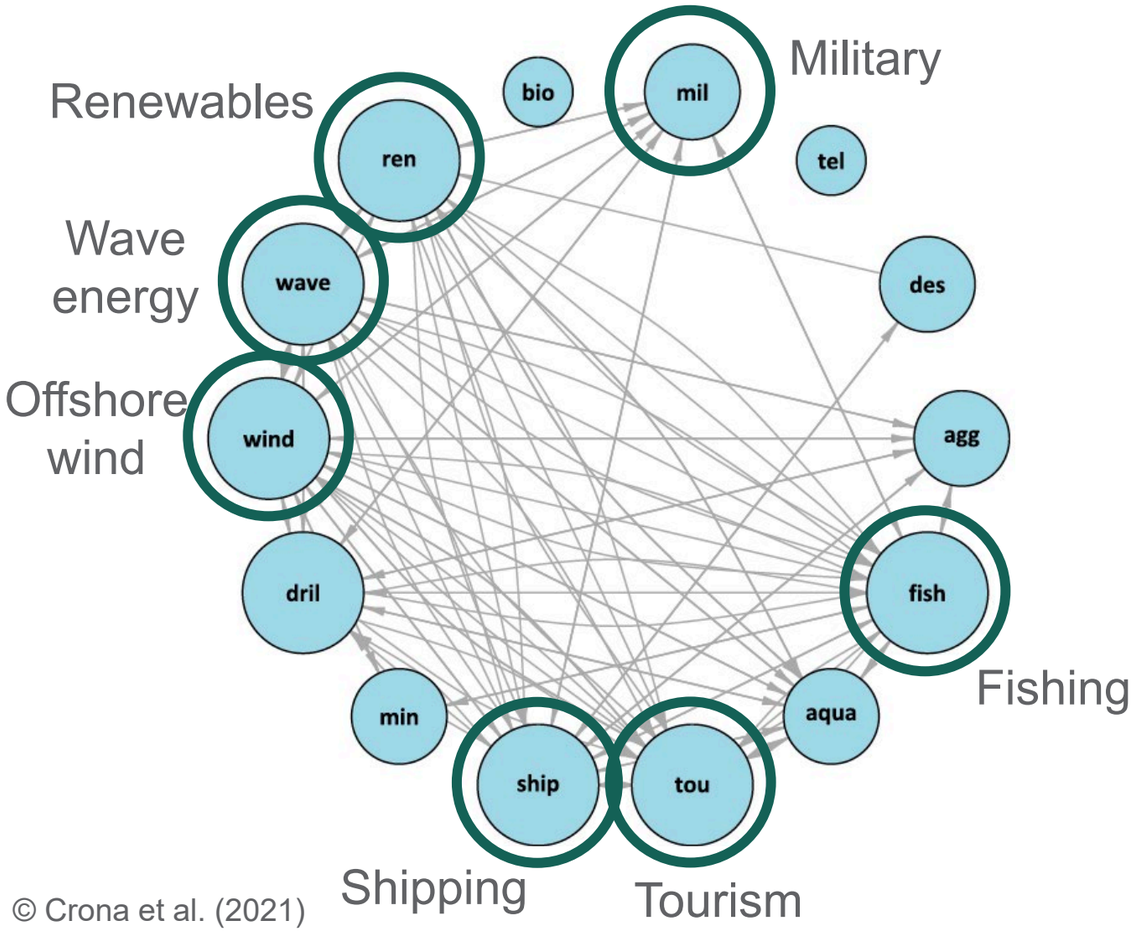
Recreational boating

Offshore wind lease areas



Challenges for marine energy development

The ocean is a busy space



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Engaged communities can

- Separate perceived risks from actual risks
- Distinguish issues specific to marine energy
- Participate in decision-making processes

Important to disseminate relevant and accessible information

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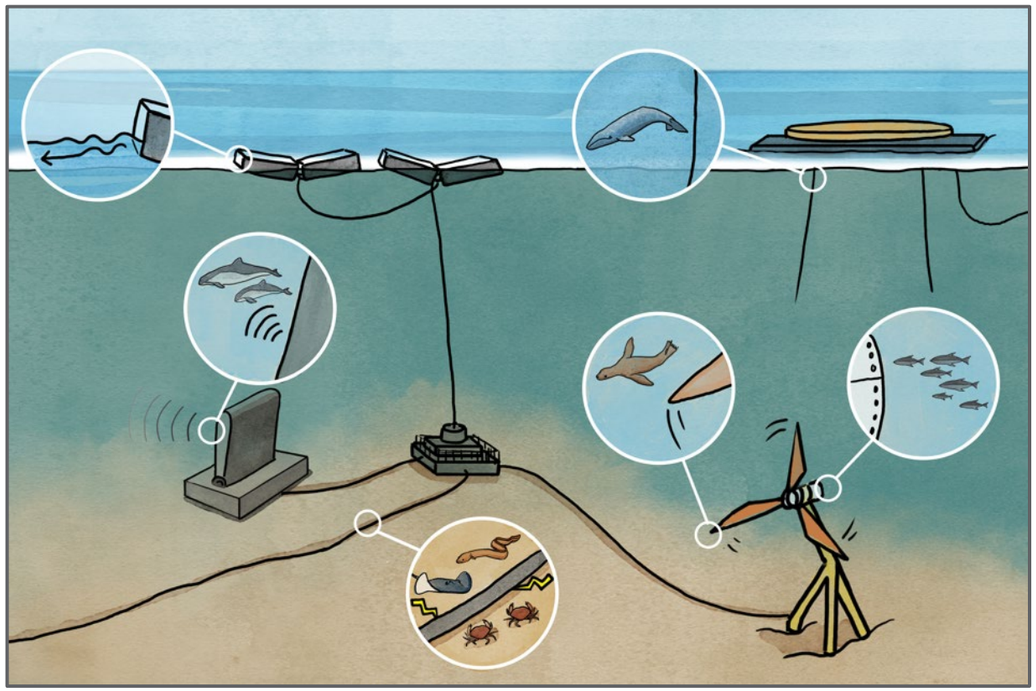
Marine Energy Environmental and Social Effects

Marine energy environmental effects

Stressors: marine energy devices and systems that may cause harm

Receptors: marine animals, habitats, ecosystem processes



Priority stressor-receptor interactions

- Collision risk
- Underwater noise
- Electromagnetic fields
- Habitat changes
- Mooring line encounters
- Changes in oceanographic systems
- Displacement / barrier effects

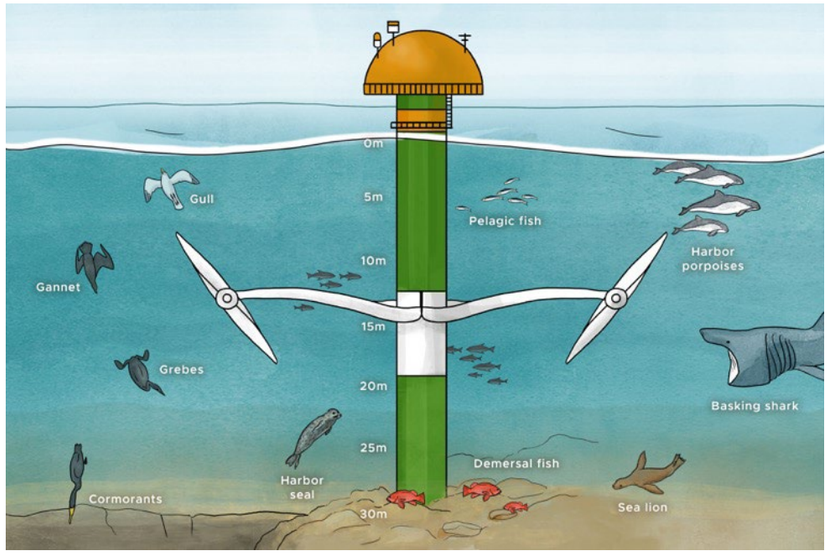
Collision Risk

CONCERN:

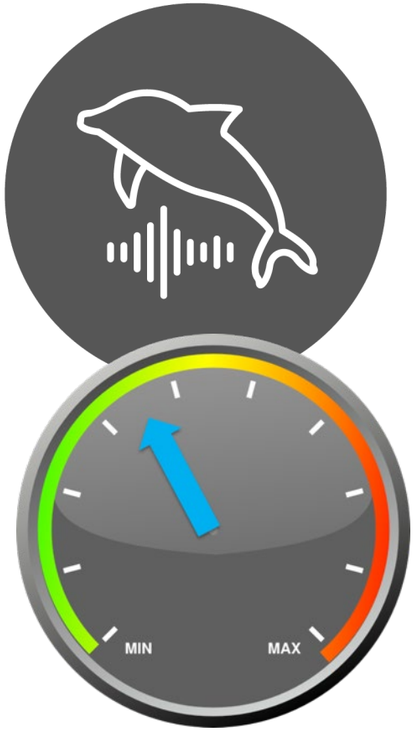
- Risk of tidal turbines' rotating blades causing injury and/or death to marine mammals, fish, sea turtles, and diving seabirds

KNOWLEDGE:

- No observations of marine mammal or seabird colliding with a device
- Observations of fish interactions have shown no harm
- Technologies to observe collision not well developed, difficult to operate in high-energy environments
- Collision risk examines individual animals, but need to put in context of risk to populations



Underwater Noise

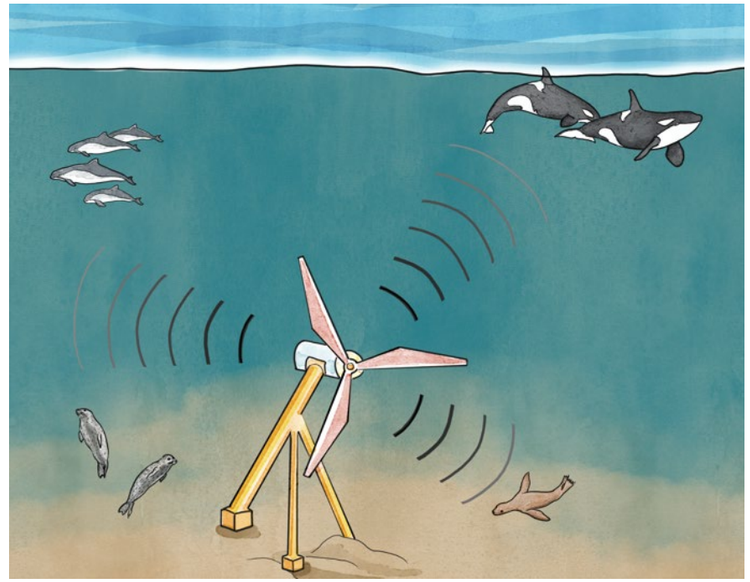


CONCERN:

- Potential disruption of marine animal navigation, communication
- Could cause physical harm and/or behavioral changes
- Marine mammals and certain fish species

KNOWLEDGE:

- Marine energy devices may add to anthropogenic sounds and disturb animals
- Have international specification for measuring marine energy device noise
- So far noise from turbines and wave energy converters fall below U.S. underwater noise thresholds
- Noise propagation models not validated in high energy environments



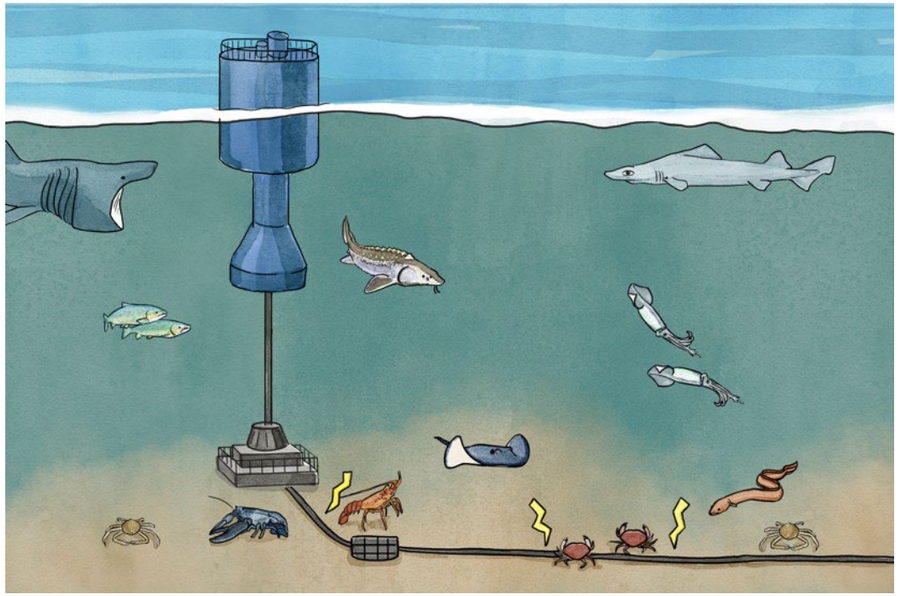
Electromagnetic Fields (EMF)

CONCERN

- EMF from cables may affect organisms that use natural electric or magnetic fields for orientation, navigation, and/or hunting

KNOWLEDGE:

- Marine energy-related EMFs come from power cables, devices' moving parts, substations/transformers
- Power cables can be buried in sediment, separating animals from EMF
- Lab and field studies have shown little evidence of behavioral effect on aquatic species, no expected harm



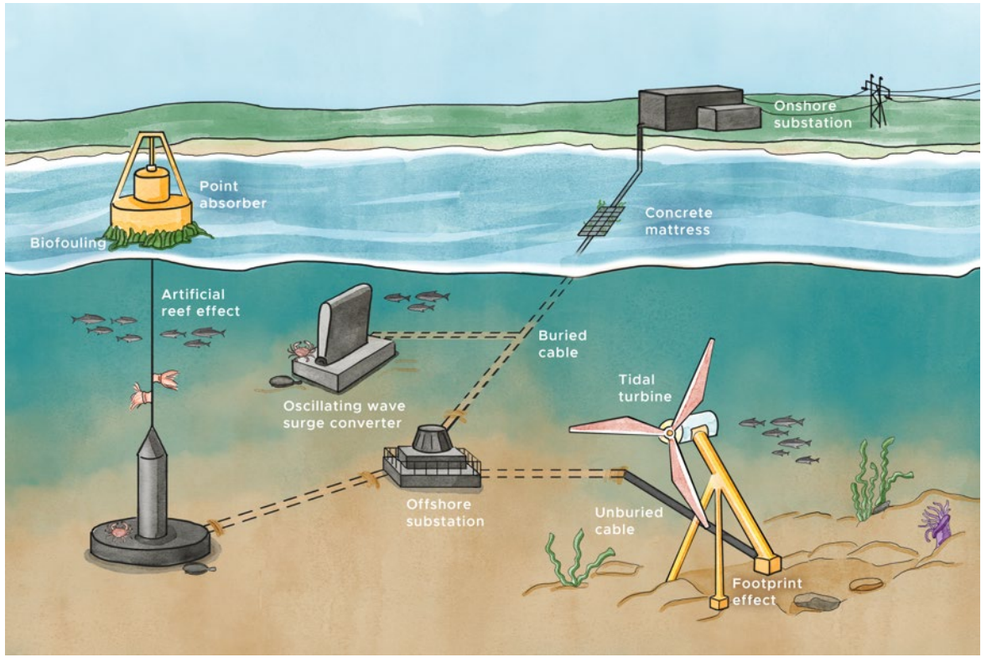
Habitat Changes

CONCERN:

- Changes in benthic and pelagic habitats, artificial reef effect, colonization or patterns of species succession due to presence of marine energy devices and parts

KNOWLEDGE:

- Can learn from other offshore industries
- Footprint of devices and anchors are small on seafloor
- Mooring lines and floats in water column
- Devices attract fish and invertebrates, but no mechanism of harm
- Careful siting of devices can minimize risk



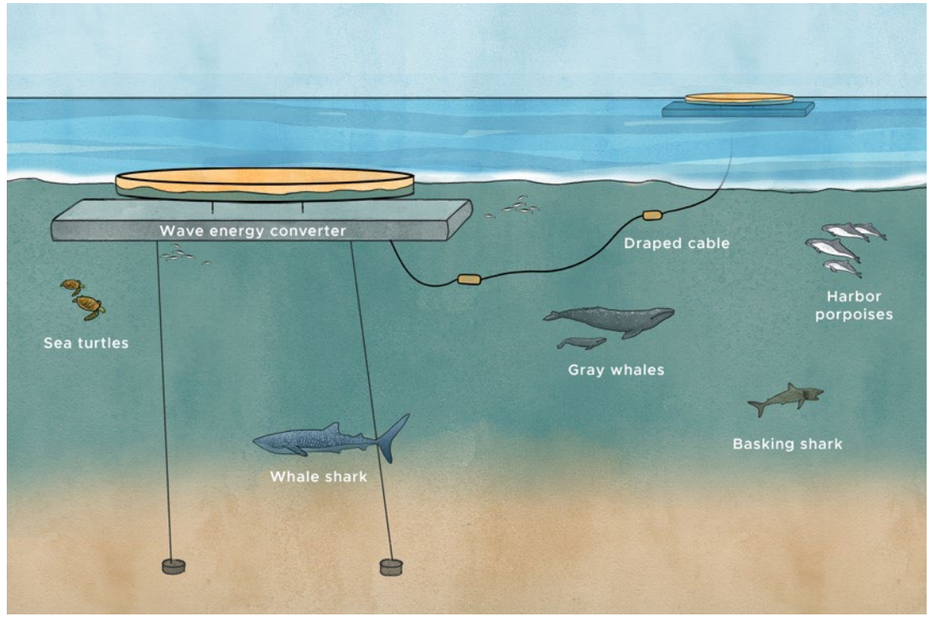
Mooring Line Encounters

CONCERN:

- Entanglement or entrapment of animals (marine mammals, sea turtles) with mooring lines/cables
- Potential to entangle fishing gear, further entanglement of animals

KNOWLEDGE:

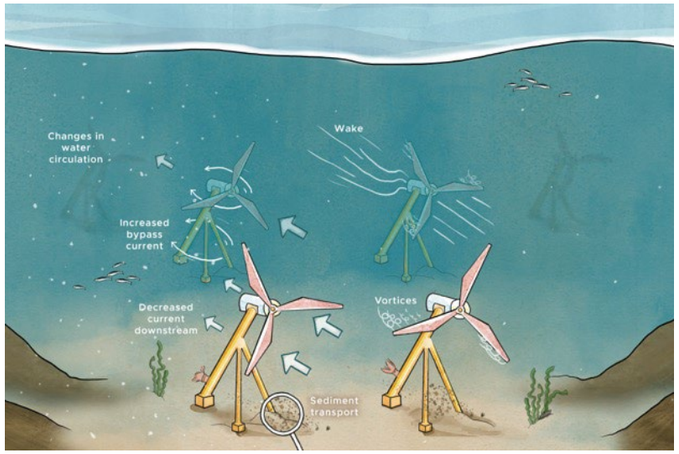
- Concerns arise due to entanglement in lost fishing gear
- No free end of lines, insufficient slack to allow looping
- Scales do not match, entanglement highly unlikely

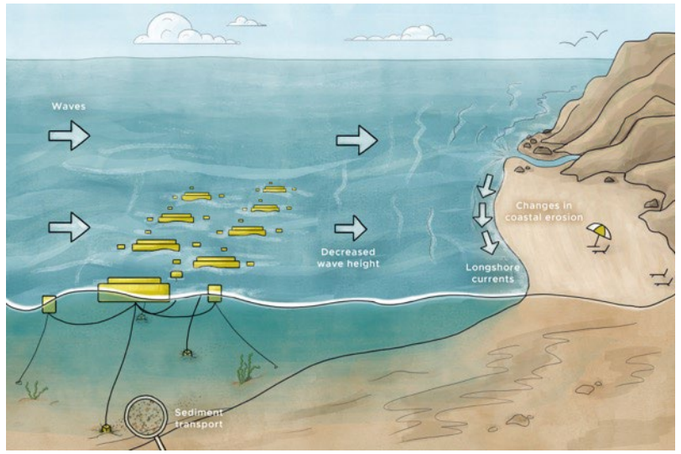


Changes in Oceanographic Systems

CONCERN:

- Changes in circulation, wave height, sediment transport
- Secondary changes in water quality, ecosystem processes

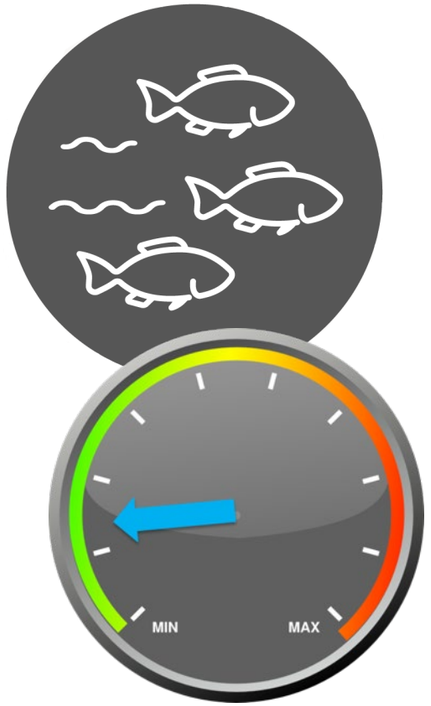




KNOWLEDGE:

- Changes from single devices or small arrays appear immeasurably small
- Numerical models suggest changes may be measurable only with very large arrays

Displacement

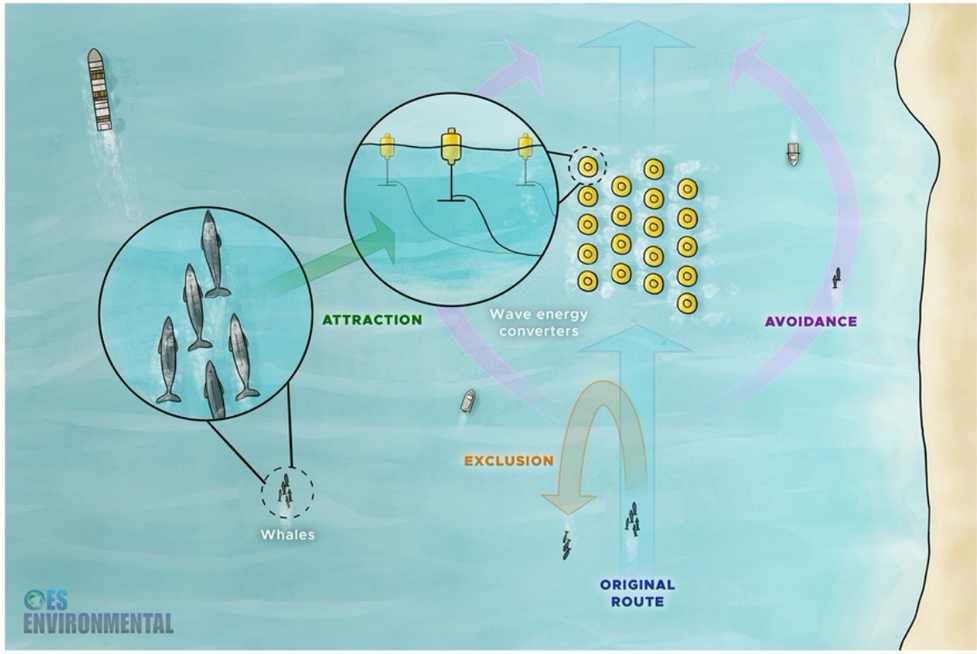


CONCERN:

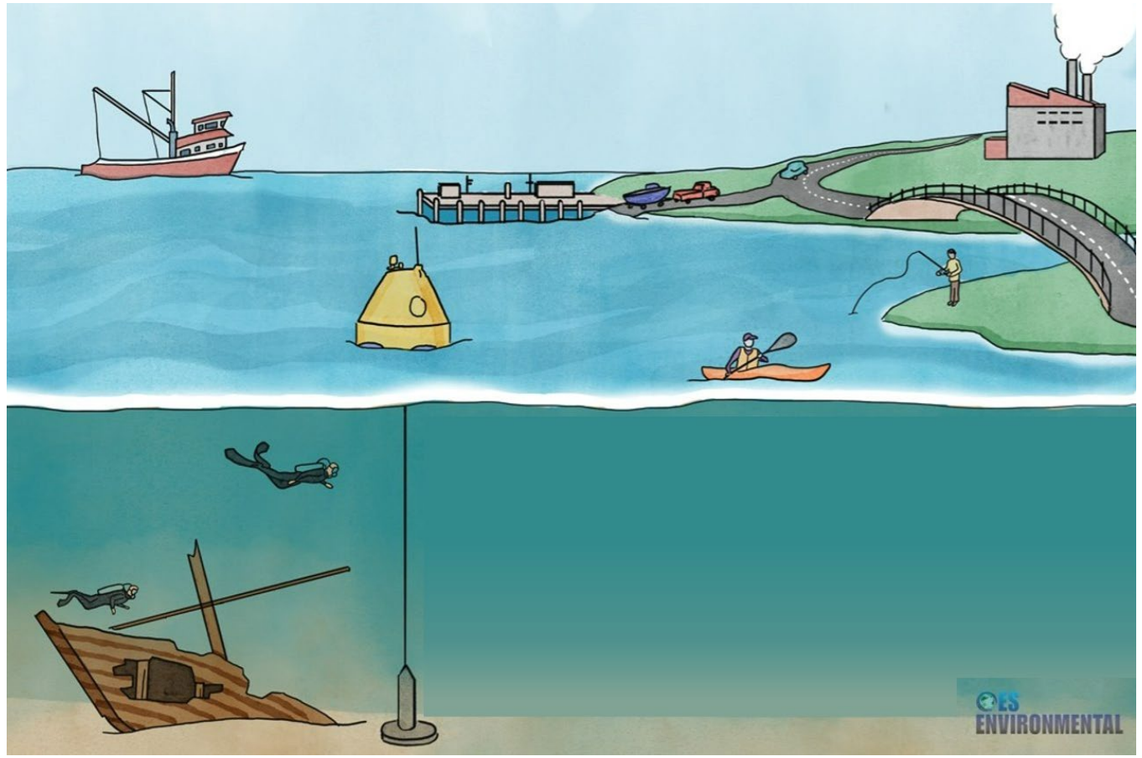
- Arrays of devices may displace marine animals from migration routes or essential (feeding, rearing, mating, etc.) habitats
- Potential for a range of consequences, from effects on individuals to populations

KNOWLEDGE:

- Outcome of 1 of 3 mechanisms (i.e., attraction, avoidance, and exclusion) triggered by a receptor's response to one or more stressors
- No field studies that address displacement of marine animals around marine energy arrays
- Identification of species potentially at risk of displacement is important during project planning



Socio-economic Effects



- Any potential social and economic impacts of MRE development
- Often overlooked during planning, permitting, and developing processes
- Need for more social and economic data collection
- Lack of information on methodology

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Marine Energy Permitting and Stakeholder Engagement

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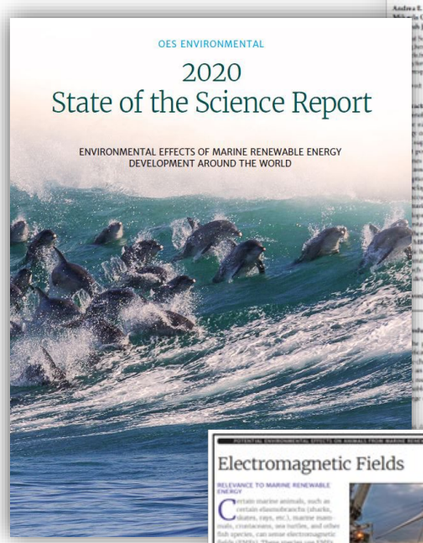
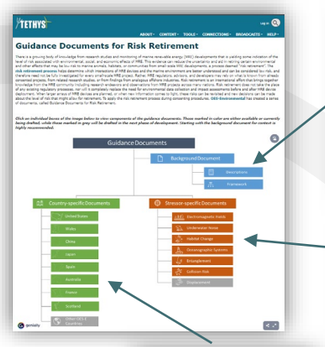
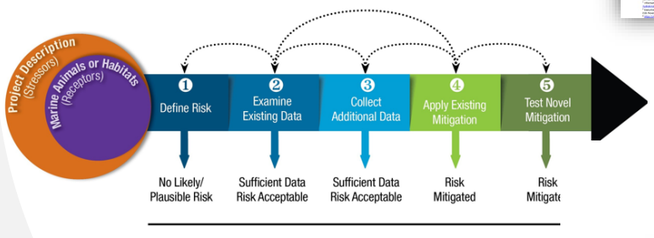
Scientific Support for Permitting

Relevant Agencies: NH Dept of Environmental Services, NH Dept of Energy, BOEM, NOAA, USFWS

Scientific information

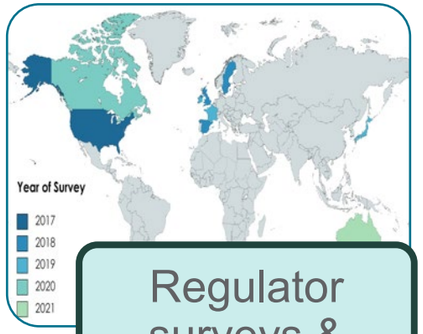






Useful formats, approaches and tools for application

Scientific Support for Permitting

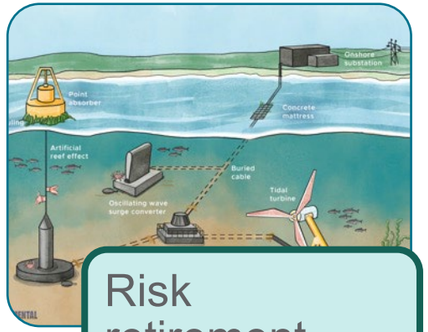


Regulator surveys & webinars

Regulators' needs

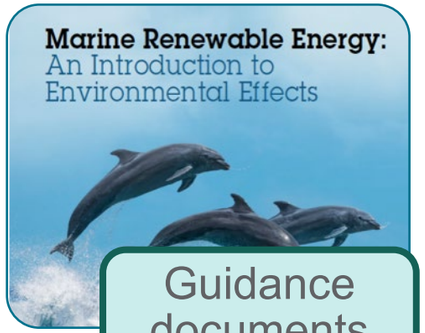
Available data & information

Regulators' input & feedback



Risk retirement

- Evidence bases
- Data transferability

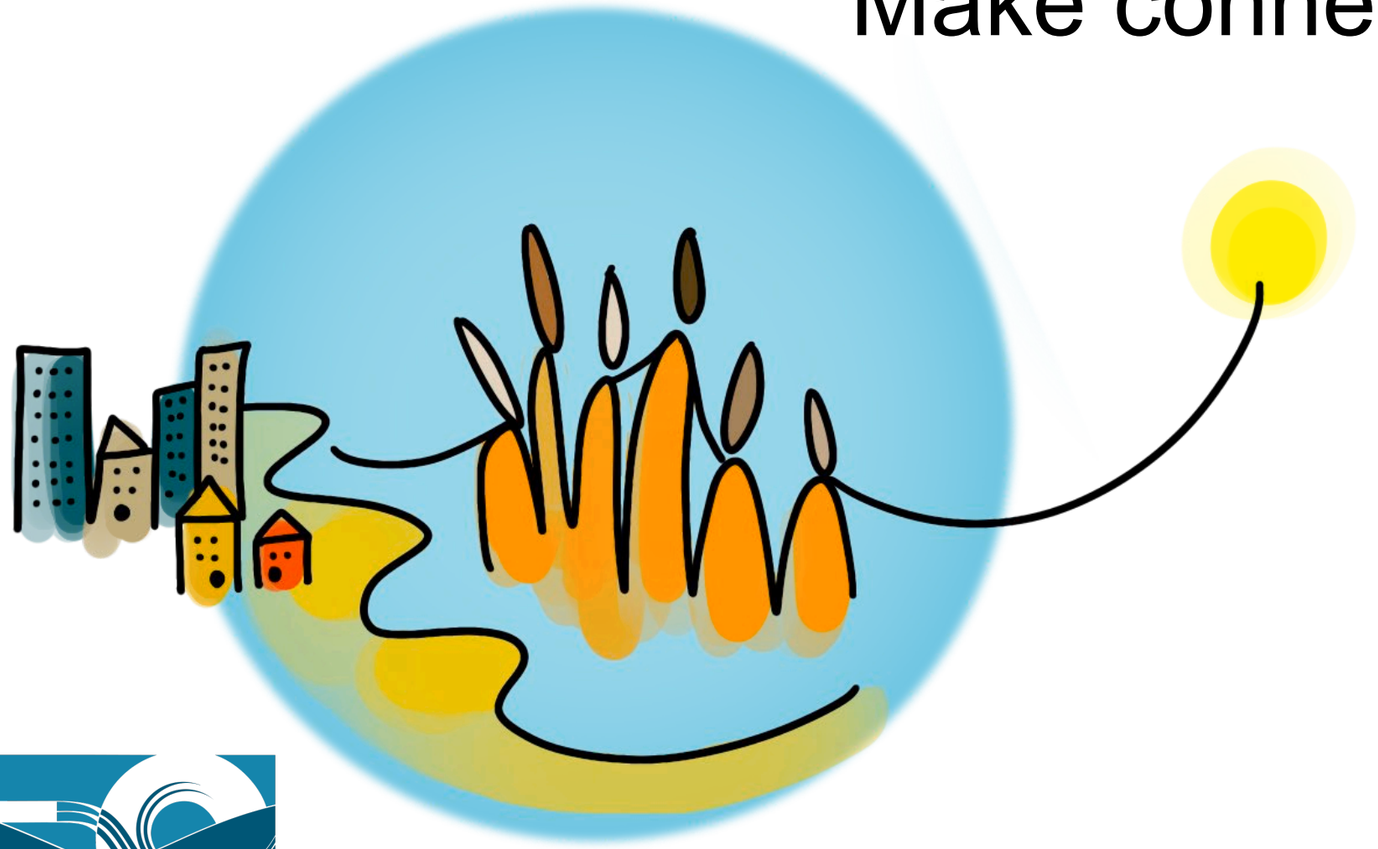


Guidance documents

MRE Brochure

Marine energy community feedback

Identify and connect
Engage
Make connections



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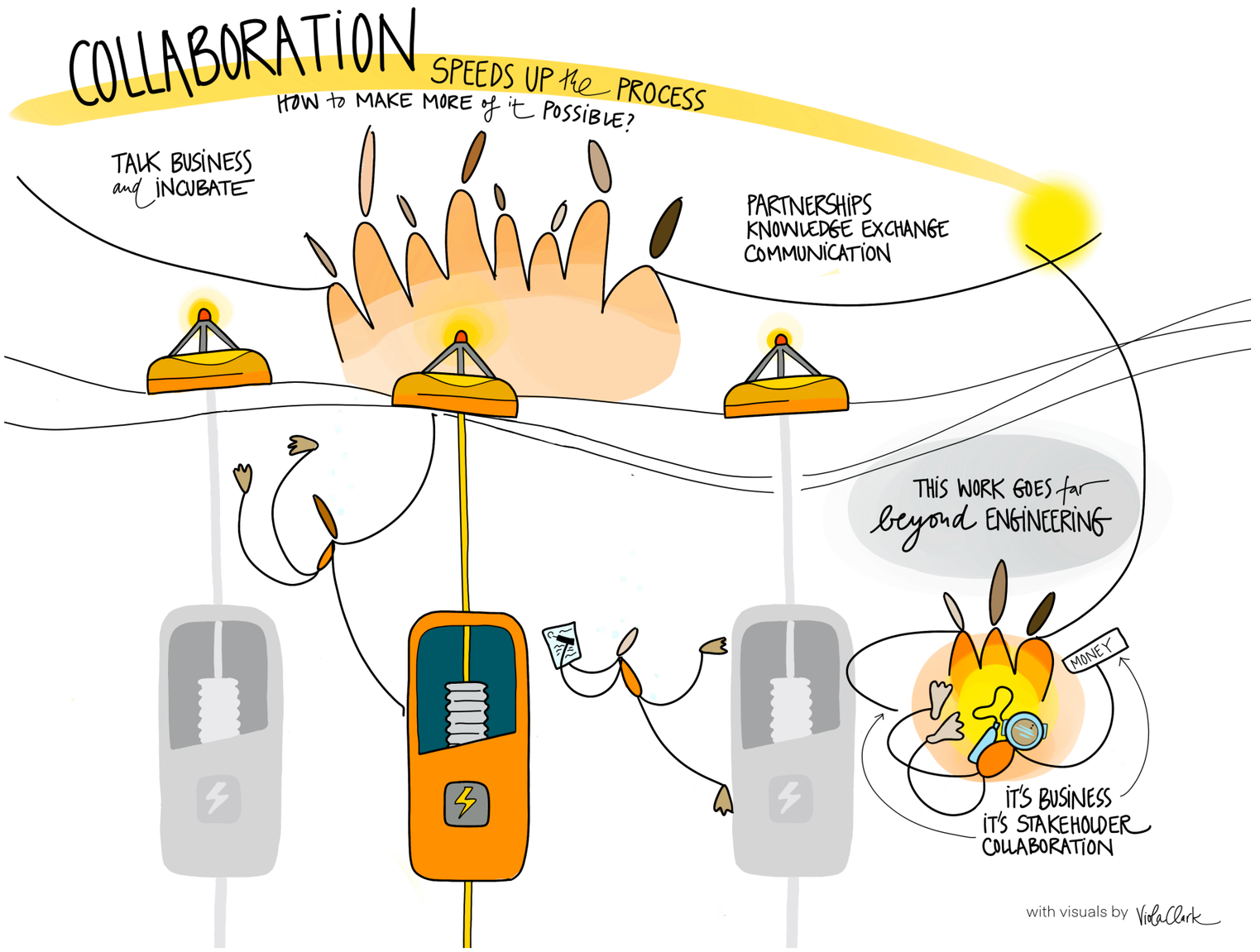
Coastal Studies Institute
A Multi-Institutional Research Partnership
Stony Brook University
LEHIGH UNIVERSITY
University of New Hampshire
POWER the BLUE ECONOMY and RESILIENT COMMUNITIES
the "AMEC UNIVERSE" – an INVITATION to ENGAGE
WHERE DO YOU SEE YOURSELF in this AMEC UNIVERSE?
CLICK all the BUBBLES you are INTERESTED in
R&D for ENERGY DEVICES and TECHNOLOGY
COASTAL COMMUNITIES
WORKING WATERFRONTS
MARITIME ECONOMIES
EDUCATION
DEVICE or DEVICE COMPONENT TESTING
INVESTMENT and FINANCING
INFRASTRUCTURE DEVELOPMENT
OFF-GRID ENERGY SUPPLY
SERVICE SUPPLY
MATERIAL SUPPLY
SOMETHING ELSE?
PUBLIC OUTREACH
GRID-SCALE ENERGY SUPPLY
WORKFORCE
ECOLOGICAL and BIOPHYSICAL INTERACTIONS
VISUALS by Viola Clark



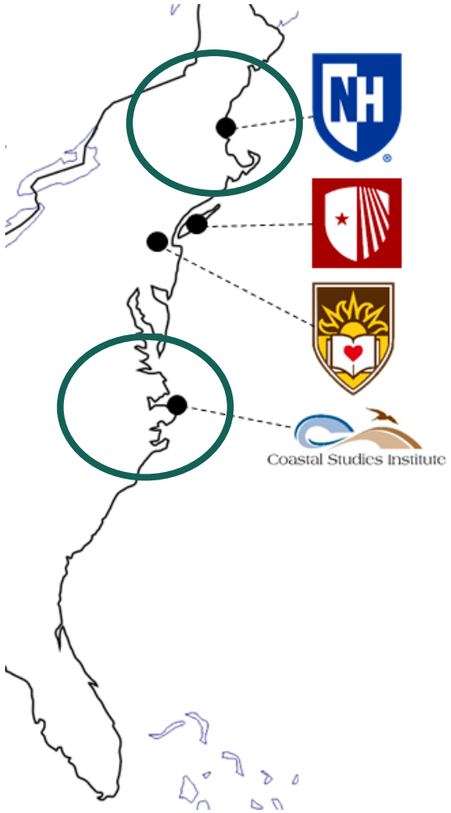
Dive in with us!

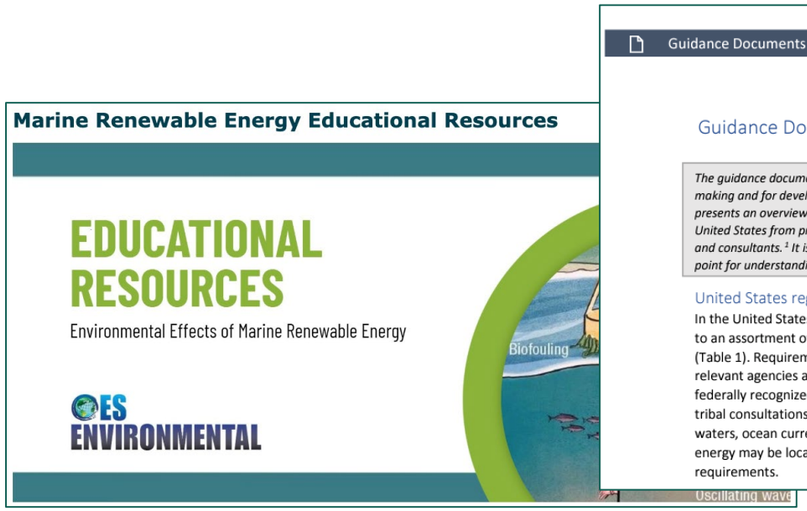
Atlantic Marine Energy Center

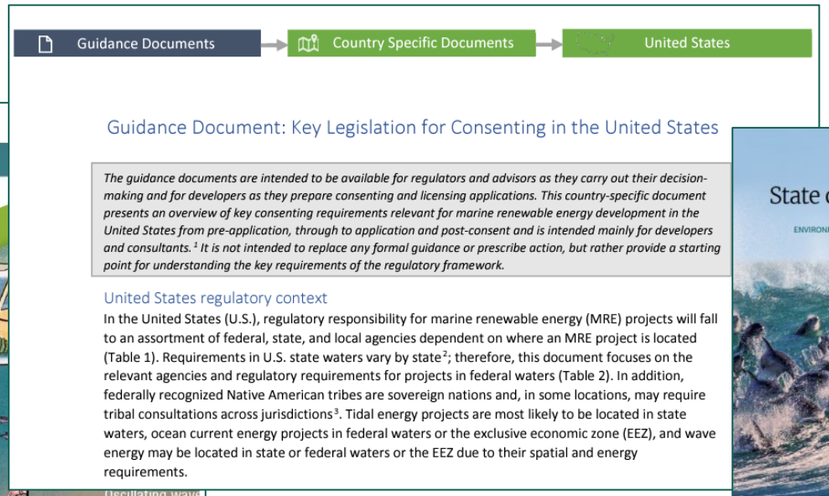
Information for stakeholder engagement

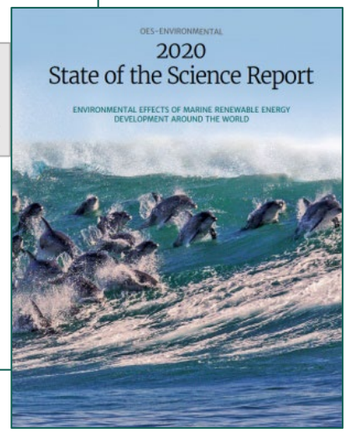
For the AMEC region:

- Develop use cases in New England and North Carolina
- Hold in-person and virtual workshops and webinars to foster discussion amongst stakeholders
- Address similarities and differences between marine energy and offshore wind environmental effects
- Highlight extensive resources available on marine energy environmental effects and permitting









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Break

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Tidal Use Case

Leveraging marine energy use cases

Objectives

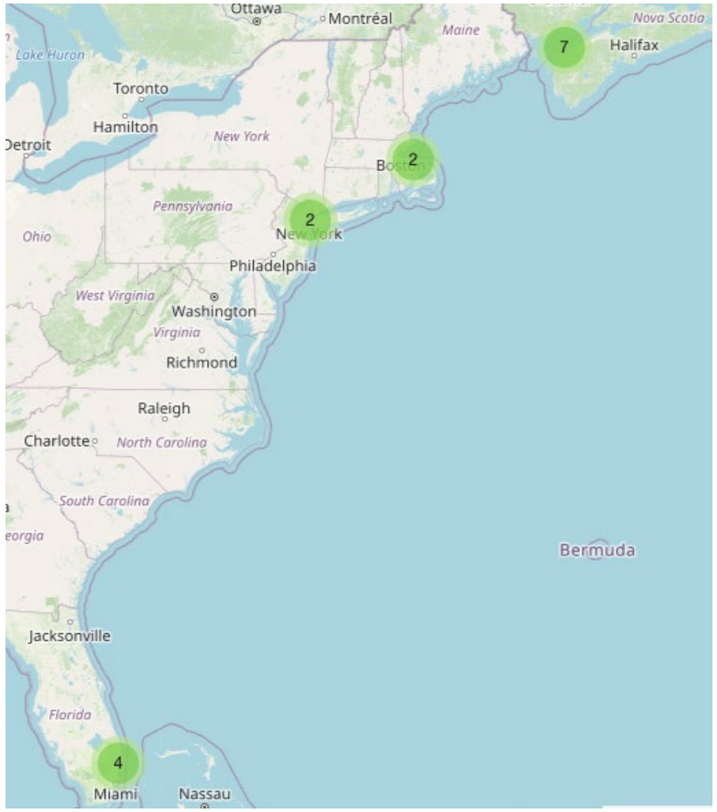
- Understand the marine energy landscape on the U.S. Atlantic coast
- Share targeted information with the stakeholders

Process

- Review of past, present, and planned projects
- Identification of stakeholders involved in planning and permitting processes
- Identification of environmental issues
- Identification of user/stakeholder concerns

Results

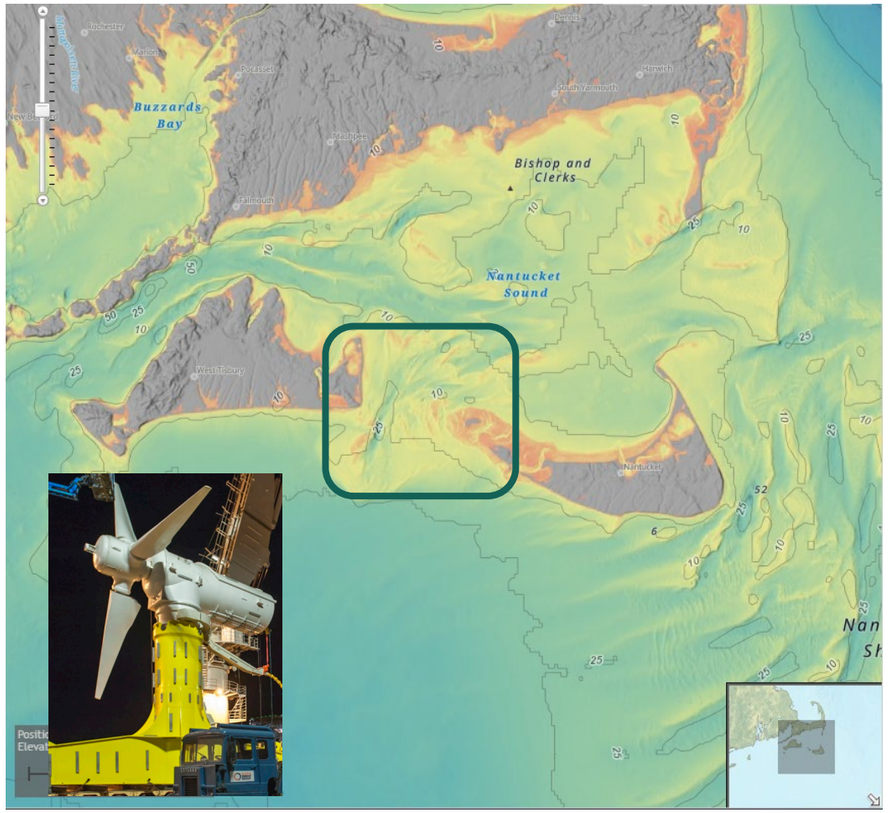
- Tidal energy use case in New England
- Wave energy use case in North Carolina



New England marine energy use case

Hypothetical array of 6 bottom-mounted tidal turbines in Muskeget Channel, MA

- Channel with strong ebb-dominated tidal flows
- Mainly gravel seabed
- Grid connection on Martha's Vineyard
- 1 MW turbines with tip speed 15 m/sec
- Underwater noise emission 50-1000 Hz



Use case receptors of concern

North Atlantic Right Whales

Harbor Seals

Grey Seals

Eelgrass and Microalgae Beds

Harbor Porpoises

Sea Turtles (Leatherback, Loggerhead, Green, Kemp's Ridley

Basking Sharks

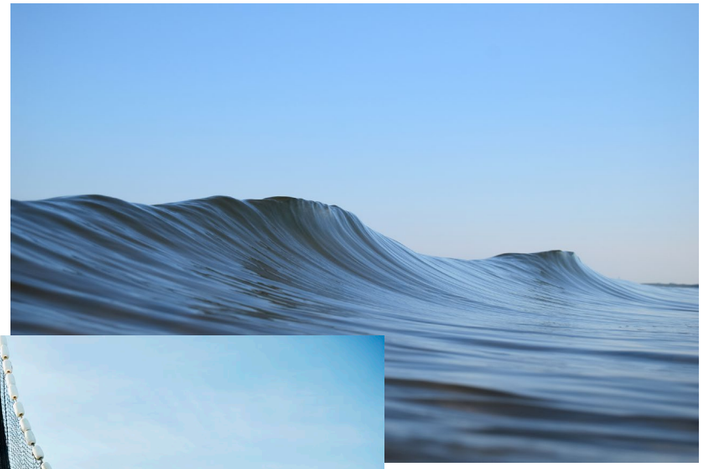
Killer whales

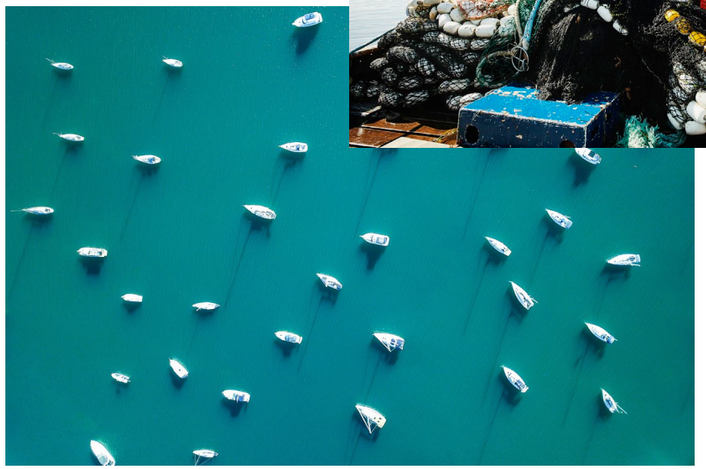
Ocean Sunfish

Great White Sharks

Use case stakeholder concerns

- Fishers' access to traditional fishing sites
- Disrupting vessel navigation and traffic
- Potential disturbance of cultural artifacts
- Collision risk
- Underwater noise
- Electromagnetic fields





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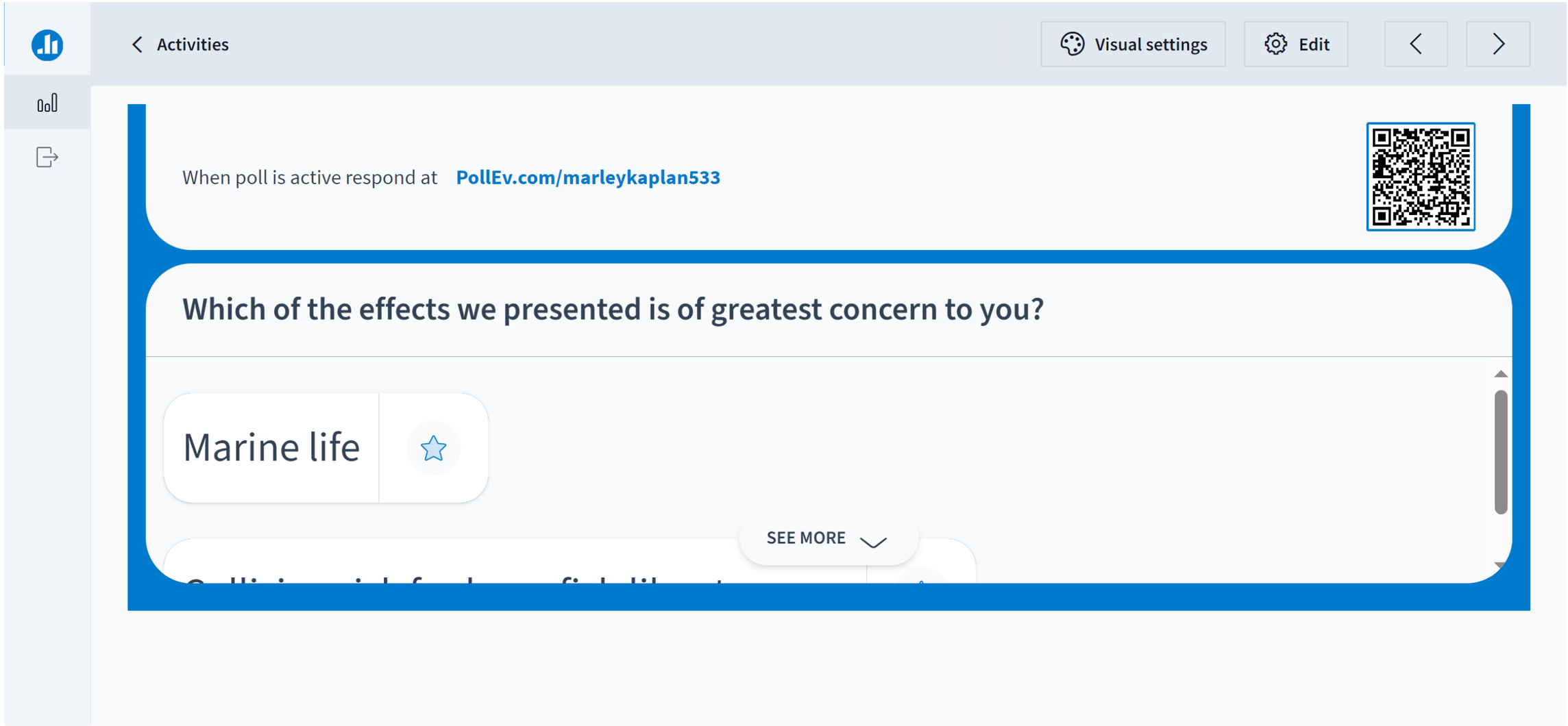
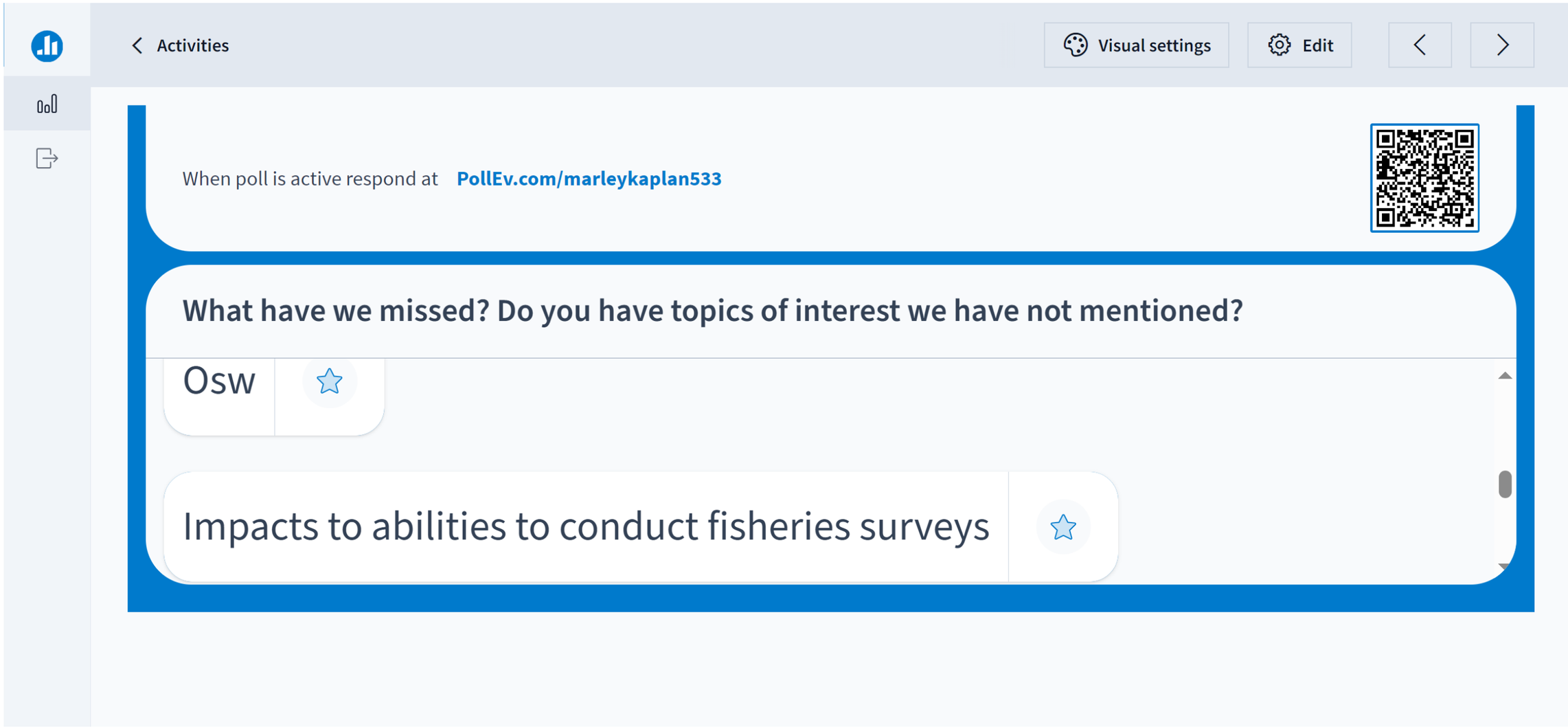
Discussion

Which of the effects we presented is of greatest concern to you?



What have we missed? Do you have topics of interest we have not mentioned?



Pacific Northwest
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Breakout groups

Report Out

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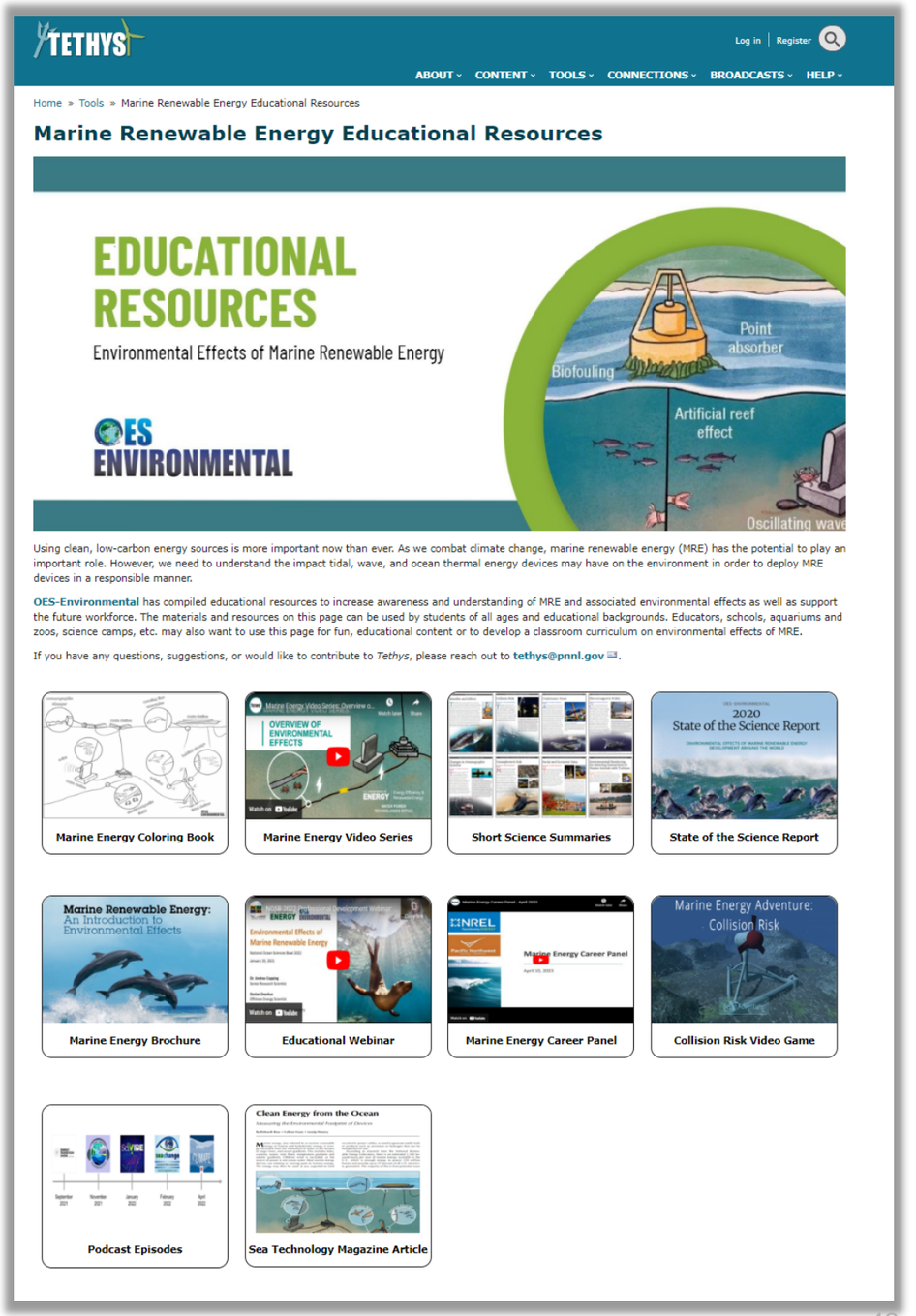
Wrap Up

MRE Educational Resources

- Provide resources for students of all ages to increase understanding of environmental effects of MRE
  - Updated in 2023

- New resources added:
  - Marine energy videos
    - ✓ Overview of Environmental Effects
    - ✓ Underwater Noise
    - ✓ Electromagnetic Fields
    - ✓ Changes in Habitat
  - Marine Energy Adventure: Collision Risk Game available
    - ✓ Play as fish to navigate collision risk!



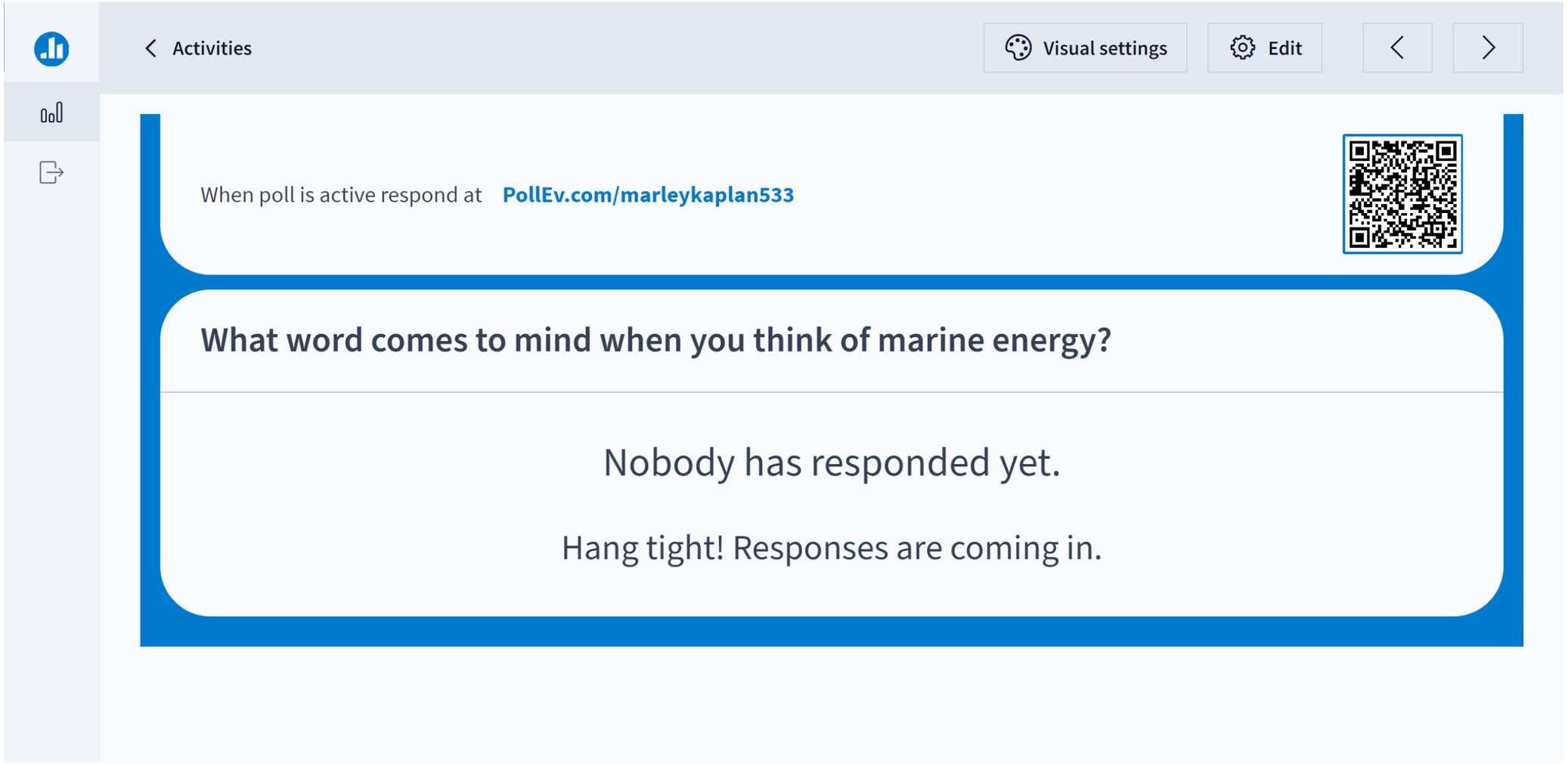
https://tethys.pnnl.gov/marine-renewable-energy-educational-resources

Outreach tool:
Choose your Own Collision Risk Adventure

https://tethys.pnnl.gov/marine-energy-adventure-game

- Currently for fish
- Spring/summer 2024: new version with marine mammals and floating tidal turbine

What word comes to mind when you think of Marine Energy?

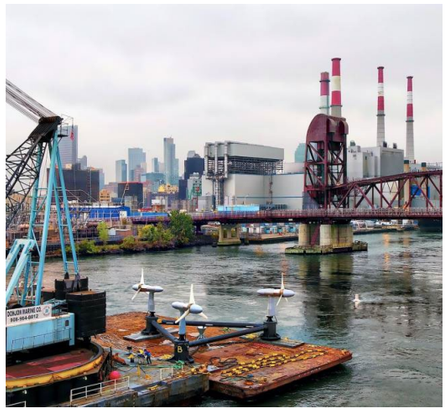


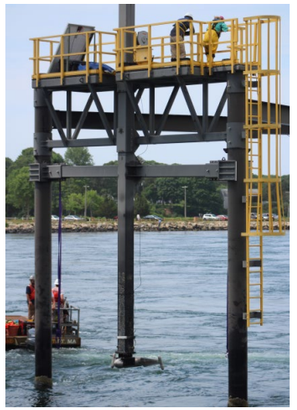
Next steps and conclusions

North Carolina wave energy stakeholder workshop in early 2024

Engaging with a wide spectrum of stakeholders on the U.S. Atlantic coast to:

- **increase awareness** of marine energy and its environmental and social effects
- **hear concerns** from stakeholders about marine energy
- **improve local knowledge** of marine energy
- **create local support** for the developing industry





Thank you

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Workshop webpage

Survey