ERM

Gulf of Maine Research Institute

Exploring approaches to fisheries' coexistence with floating offshore wind

FEBRUARY 2025

Funding from the Maine Offshore Wind Research Consortium through the Governor's Energy Office

Sustainability is our business

Agenda

Context

State Planning Processes

OCTOBER 2020
Maine secures federal funding for the OSW Roadmap

NOVEMBER 2020
State announces Maine Research Array Proposal

DECEMBER 2020– OCTOBER 2021
State-led stakeholder engagement to identify Proposed Research Array Lease Site and Research Framework

JULY 2021 – JANUARY 2023
OSW Roadmap planning process, including 78 Advisory Board and Working Group meetings.

FEBRUARY 2023
Maine OSW Roadmap Report Released

JULY 2023
LD1895 Authorizes 3GW OSW Procurement

AUGUST 2024
BOEM and the State reach agreement on Research Array Lease

Federal Planning Process

MAY 2022
BOEM releases Gulf of Maine Planning Area

AUGUST 2022
BOEM releases RFI for Public Comment

JANUARY - APRIL 2023
BOEM Releases Draft Call Area for Public Comment, hosts in-person and virtual meetings to inform Final Call Area

JULY 2023 – MARCH 2024
BOEM Releases Draft WEAs for Public Comment, hosts in-person and virtual fisheries meetings to inform Final WEAs

MAY 2024
PSN published for Public Comment

SEPTEMBER 2024
FSN published

OCTOBER 2024
BOEM Holds Lease Auction

Maine OSW Research Consortium

JULY 2021
Legislature establishes the ME OSW Research Consortium

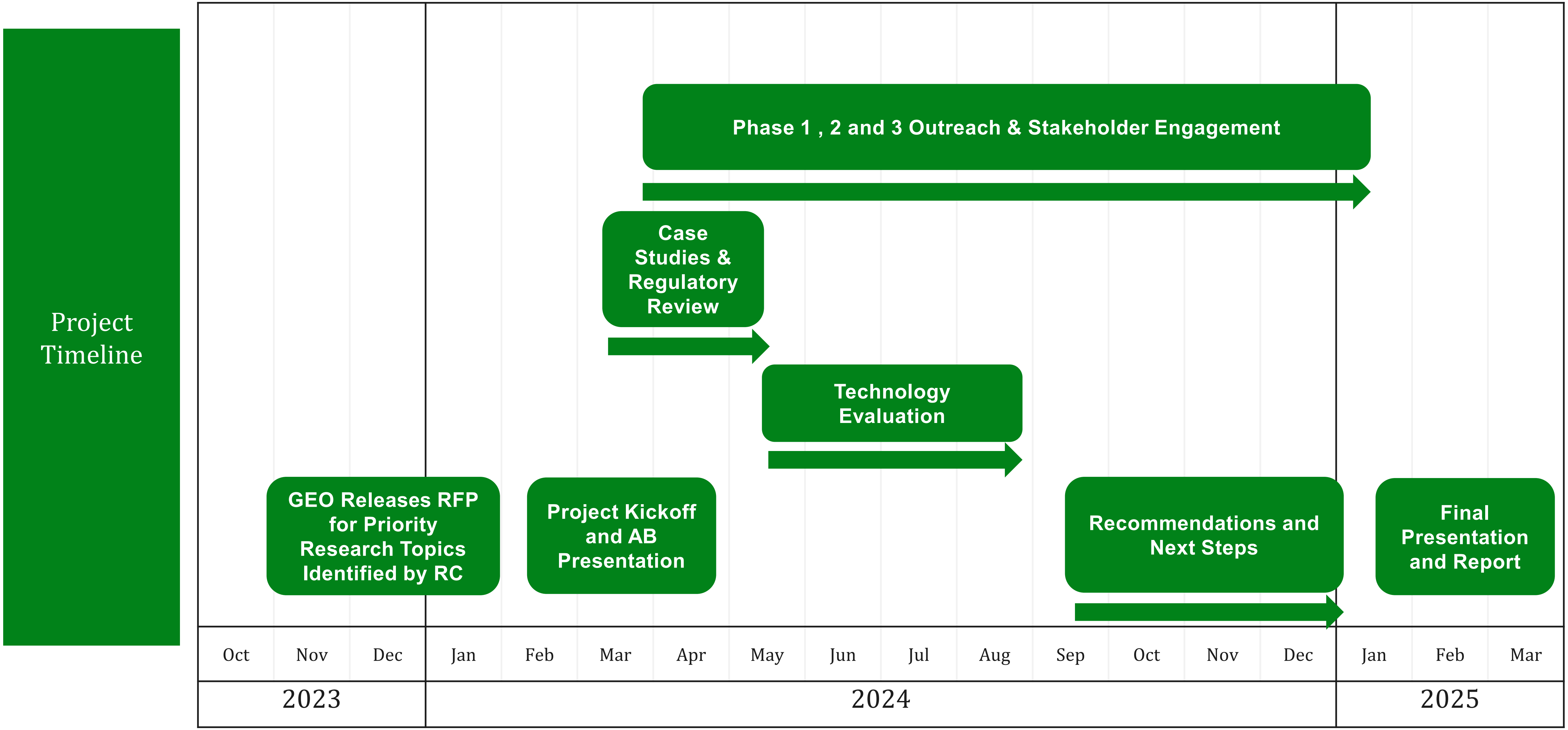
JANUARY – SEPTEMBER 2023
AB Identifies priority research questions and strategy

MARCH 2024 – FEBRUARY 2025
Fisheries Co-existence Project Timeline (see next slide)

2020	2021	2022	2023	2024

OSW = Offshore Wind, BOEM = Bureau of Ocean Energy Management, RFI = Request for Information, AB = Advisory Board, WEA = Wind Energy Area, PSN = Preliminary Sale notice, FSN = Final Sale Notice

Timeline



GEO = Governor's Energy Office, RFP = Request for Proposal, RC = Research Consortium, AB = Advisory Board, FOW = Floating Offshore Wind

Project Team

Sustainability is our business

About ERM

ERM is the world's largest pure play sustainability consultancy

Founded in 1971, we are the largest advisory firm in the world focusing solely on sustainability, offering unparalleled depth and breadth of expertise.

We shape a sustainable future with the world's leading organizations

Our purpose guides everything we do. We create a better future by helping the world's biggest brands address today's sustainability imperatives.

We are the recognized market leader in sustainability services

Numerous industry benchmarks attest to our market leadership and the majority of our work is sole-sourced, reflecting trusted partnerships we build with our clients.

ERM OVERVIEW

8000+
Professionals

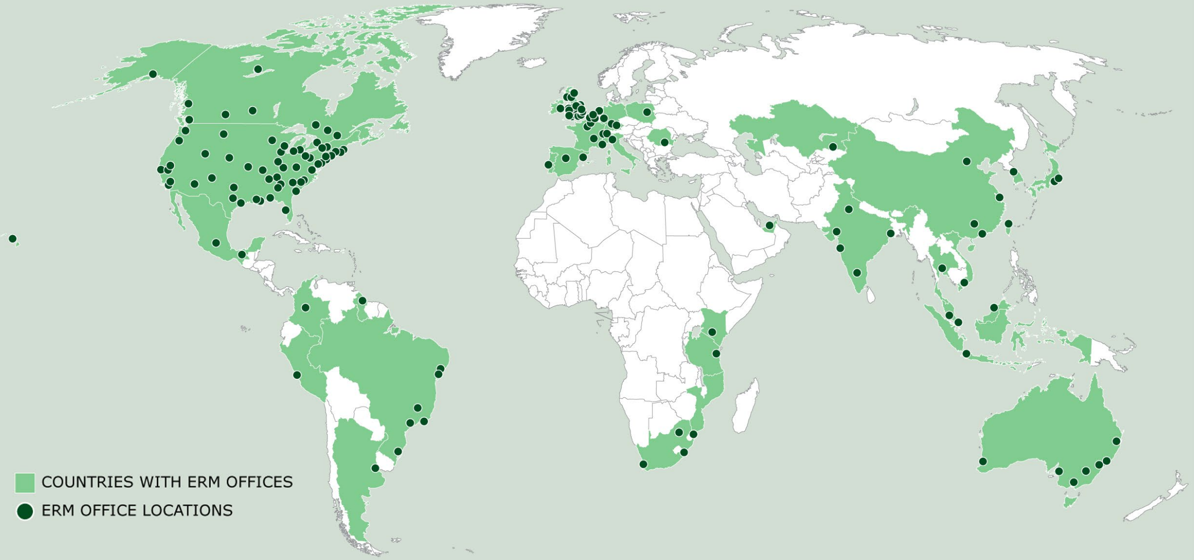
40
Countries & territories

Climate change consulting Leader
Verdantix Green Quadrant 2023

150+
Offices

50+
Years of experience

#1
Sustainability service provider – HFS 2022



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70%
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About GMRI

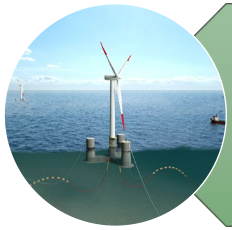
What is the Gulf of Maine Research Institute?

We are an **independent**, **non-partisan marine non-profit** that supports the Gulf of Maine **ecosystem** and the **communities** that depend on it.

Gulf of Maine Research Institute

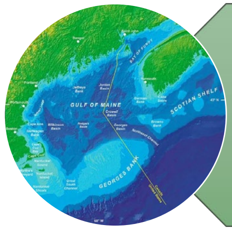
Scope of Work

Objectives



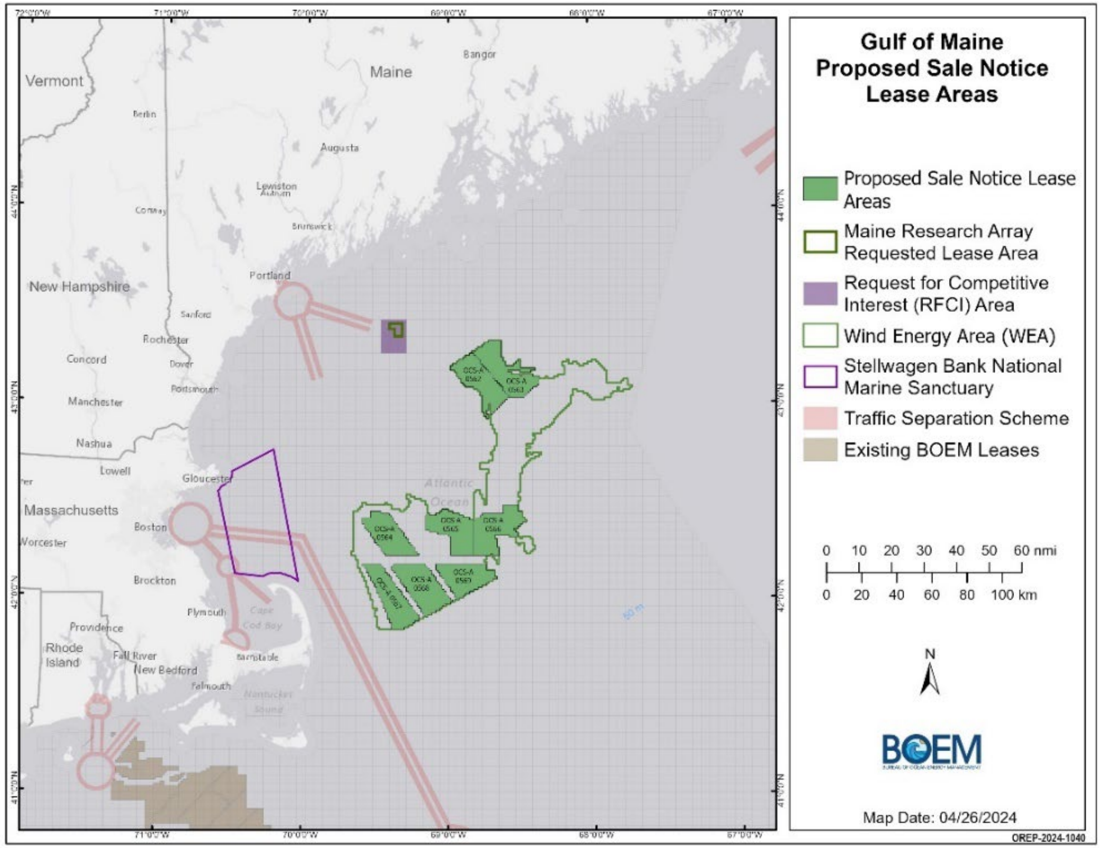
1. This study complements ongoing efforts by the state, BOEM, and the Research Consortium, by addressing critical data gaps.

2. The research will build on existing resources and data for greater efficiency and immediacy of results.



3. The Project will allow decision makers and stakeholders to make sensible predictions for other regions/species/ applications/scales

4. The Project will provide collaborative research opportunities with community members.



Methodology

Case Studies and Regulatory Review

Technology Evaluation

Recommendations and Next Steps

Stakeholder Engagement

Stakeholder Engagement Approach

Phase 1
Discuss initial understandings, curiosities, and concerns regarding general operability around FOW arrays.

Phase 2
Evaluate and discuss how different gear types and fisheries may operate within various FOW technology concepts summarized by ERM, including platform, mooring, anchoring, and cabling designs.

Phase 3
Present ERM's initial recommendations for best practices on coexistence to previously engaged stakeholders and receive feedback. Incorporate feedback into the final report.

Engagement Methods

- GMRI and ERM developed an Engagement Plan in consultation with a subset of the **Maine Offshore Wind Research Consortium** Advisory Board.
- The subset of the Advisory Board approved the plan in which they recommended an initial set of stakeholders to engage, as well questions to ask.
- GMRI engaged fishermen, organization leaders, and relevant stakeholders through semi-structured **in-person conversations**, **phone conversations**, **surveys**, and **focus groups**.
- Employed a 'snowball' sampling approach throughout all phases of engagement
- **Prioritized flexibility**, engaged stakeholders on their terms in a style that works for them.
- Thematically summarized stakeholder input into three engagement reports.

Case Studies and Regulatory Review

DEFINING COEXISTENCE

Methodology

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Stakeholder Engagement

Literature Review – Case Studies

Academic literature identifies **four key types** of coexistence:

Multipurpose

Users occupy the same area, at the same time, and share core infrastructure and services

Symbiotic Use

Users occupy the same area, at the same time, and share peripheral infrastructure or services

Colocation

Users occupy the same area at the same time

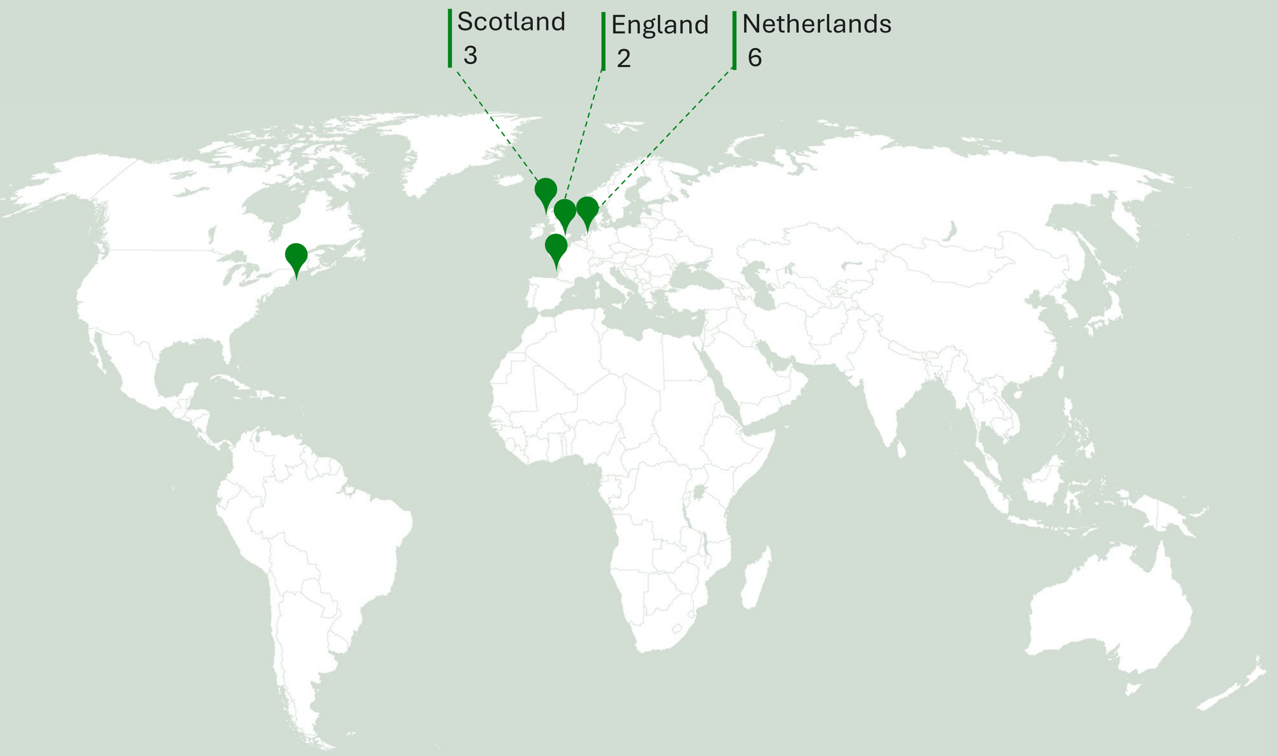
Repurposing

Users occupy the same area, but sequentially (one after the other) rather than at the same time

Literature Review – Case Studies

Research **gaps** indicate that future studies of operational and developed projects are needed:

1. **Nascent industry** – Floating technology is a relatively new industry and systematic documentation of data is needed as projects are coming online in different countries (e.g., Norway and Portugal)
2. **Limited existing FOW case studies and academic literature** – Supplemented academic case study review, including relevant insights from fixed-bottom OSW and other marine industry, with publicly available project information and news articles.
3. **Lack of geographic diversity of existing case studies** – Lack of geographic diversity limits the lessons learned.



Offshore Wind Case Studies

Literature Review – Case Studies

Key findings from Case Study review:

Coexistence First Project Design
Selecting sites with minimal disruption; burying cables for protection.

Language Clarity
Different meanings exist; use specific language types

Communication Matters
Early stakeholder engagement builds trust

Local Benefits
Compensation, new business opportunities, and share facilities

Cooperation is Key
Success involves industry, government, and non-governmental organizations

Literature Review - Regulatory and Legal

Desktop review identified **three key** themes, which are addressed by regulations in different ways (in the U.S. and globally).

Marine Environment Impacts

- **Concern:** potential habitat changes (e.g., creation of artificial reefs, impacts of exclusion zones)
- **Relevant U.S. Regulations:** For example, National Environmental Policy Act (NEPA), Outer Continental Shelf Lands Act (OCSLA) and Endangered Species Act

Access to Wind Energy Area

- **Concern:** potential restricted access to fishing grounds, potential navigational route changes, safety concerns
- **Relevant U.S. Regulations:** OCSLA

Financial Considerations

- **Concern:** costs for navigation, insurance consideration, need for compensation programs
- **Relevant U.S. Regulations:** Multi-state (including Maine) OSW Fisheries Compensation Fund in development, but no fund analogous to the Fishermen's Contingency Fund established under OCSLA for oil & gas developments

Terms and Conditions of **Lease Agreements** address some key themes not covered by regulations, for example:

- Compensatory mitigation
- Survey mitigation (e.g., when NMFS surveys overlap with wind energy development area)
- Survey requirements (e.g., seasonal restrictions, methods)
- Data sharing requirements
- Navigation equipment and training funding

Phase 1: Stakeholder Engagement - Defining Coexistence

Discuss initial **understandings**, **curiosities**, and **concerns** regarding general operability around FOW arrays.

Coexistence: Questions

- How do you define "coexistence" ?
- What is your current understanding of FOW technology?
- When you hear the word, "coexistence," what does that mean to you?

General Operability: Questions

- What do you foresee being a challenge with your current fishing operation and with FOW technology?
- What is unique about the way that you fish that might make operating within wind arrays challenging?
- What should we be looking into to determine whether fishing in a FOW array is possible?

Phase 1: Stakeholder Engagement - Defining Coexistence

Key themes emerged from the engagement period.

Coexistence

- Spatial conflict
- Economic, social, and environmental concerns
- Coexistence should encapsulate the fishing industry at large

Coexistence described as:

"Getting to a compromise, where both sides are respecting the other side's perspectives and needs"

"Coexistence requires adaptation on both sides. Adaptation has to be a two-way street."

"Multiple entities existing in the same space or at the same time."

General Operability

- Operational concerns
  - Gear entanglement
  - Navigational challenges
  - Reduced fishing efficiency
- Safety/insurance concerns
  - Inclement weather
  - Lack of information
- Other concerns
  - Skeptical of sustained job creation
  - Cost concerns for ratepayers
    - Siting further offshore to avoid key fishing areas has cost implications
  - Shoreside dealer/processor implications

Technology Evaluation

Methodology

Case Studies and Regulatory Review

Technology Evaluation

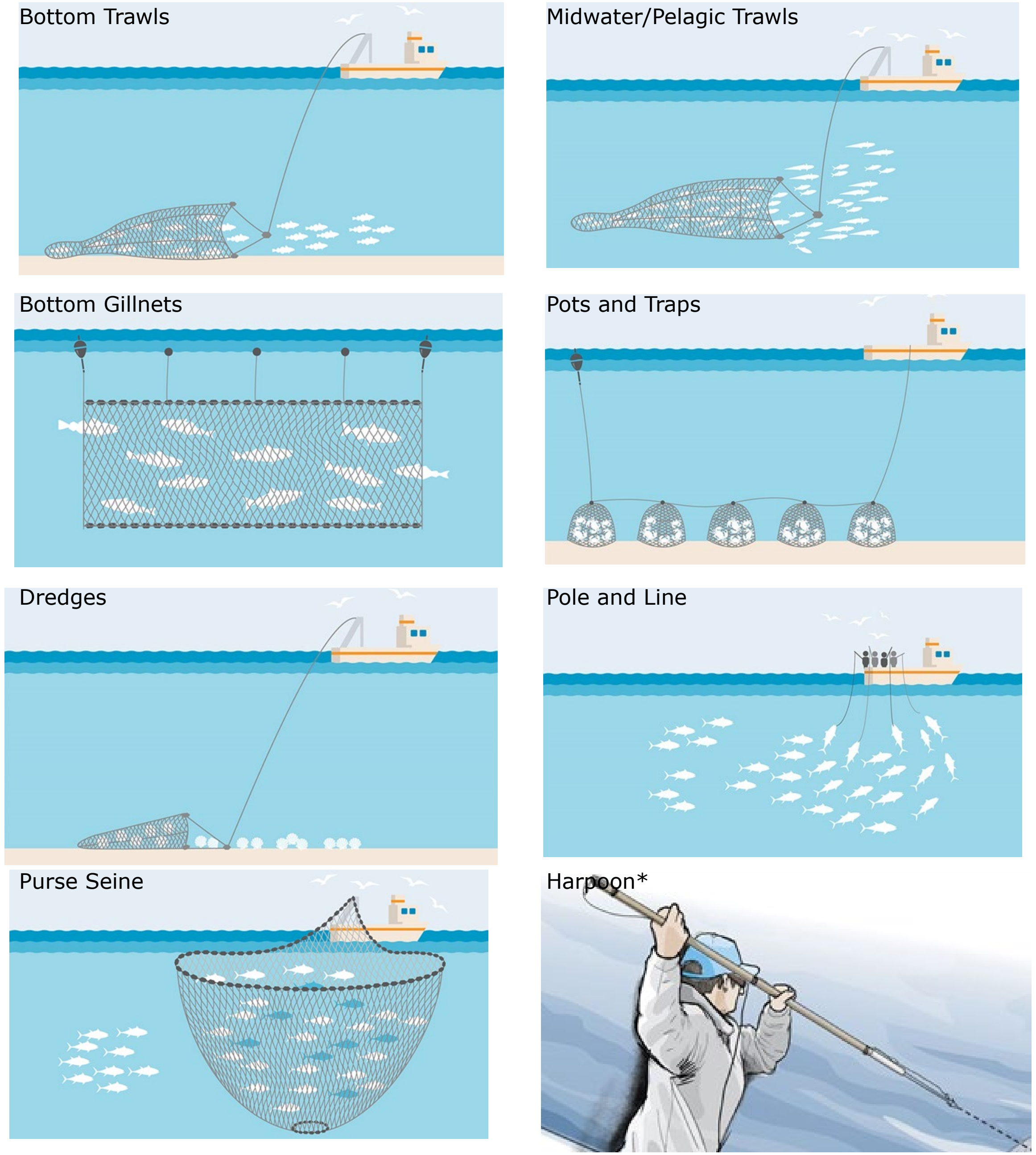
Recommendations and Next Steps

Stakeholder Engagement

Technology Evaluation – Fishing Gear

Top Species by Value (Lease Areas)	Gear Type
Haddock	Bottom Trawl, Bottom Gillnet
Pollock	Bottom Trawl, Bottom Gillnet
Cod	Bottom Trawl, Bottom Gillnet
Monkfish	Bottom Trawl, Bottom Gillnet
Redfish	Bottom Trawl
American Lobster	Pots and Traps
Sea Scallop	Dredge
White Hake	Bottom Trawl, Bottom Gillnet
American Plaice Flounder	Bottom Trawl
Witch Flounder	Bottom Trawl, Bottom Gillnet
Atlantic Herring (bait)*	Pelagic Trawl, Purse Seine
Bluefin Tuna*	Hook and Line, Harpoon

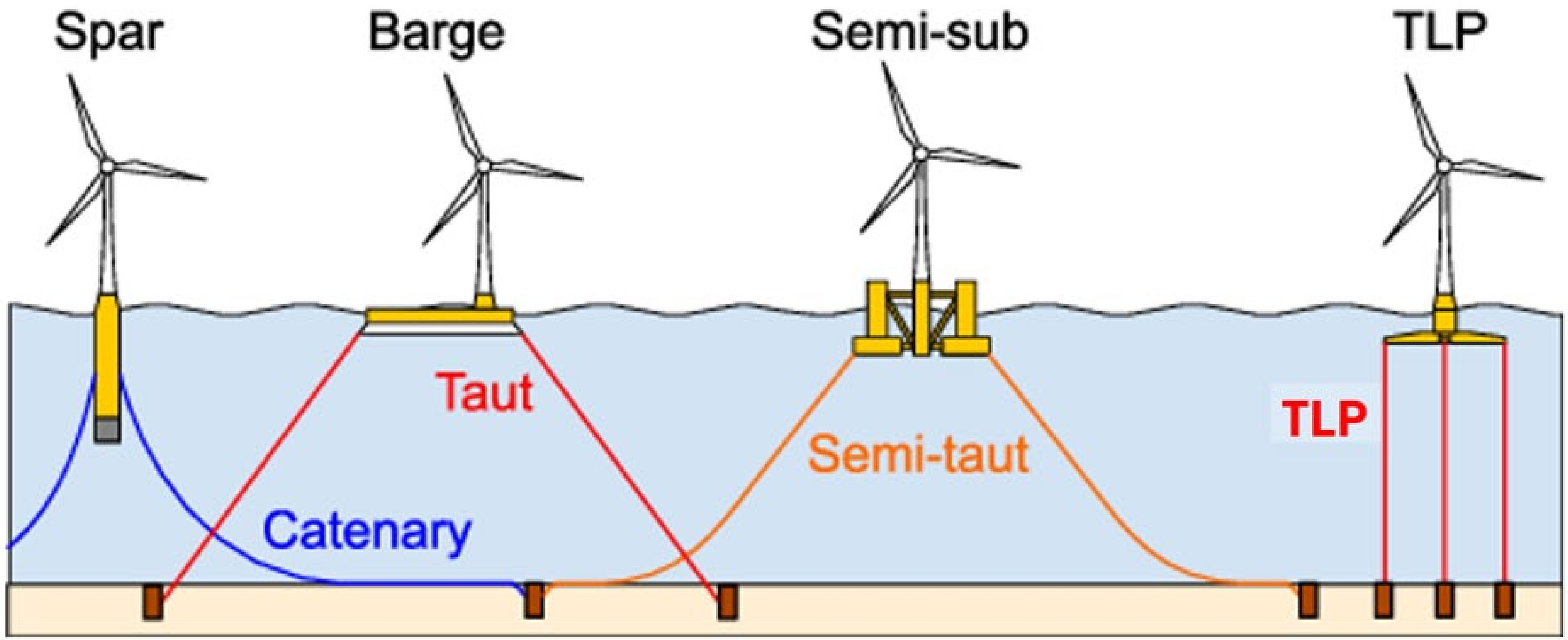
Identified by local stakeholder



Technology Evaluation – FOW Technology

ERM evaluated FOW **technical components**:

- Platform
  - Spar
  - Barge
  - Semi-submersible
  - Tension-leg platform (TLP)
- Mooring systems
  - Catenary
  - Taut
  - Semi-taut
  - TLP
- Electrical cables (inter-array)
- Anchor design



The **mooring system** influences the **cabling** and takes up the most space, so the fishing technical compatibility assessment focused on the **mooring system**.

Phase 2: Stakeholder Engagement - FOW Technology

Evaluate and discuss how different gear types and fisheries may operate within various FOW technology concepts including **platform**, **mooring**, **cabling**, and **anchoring** designs.

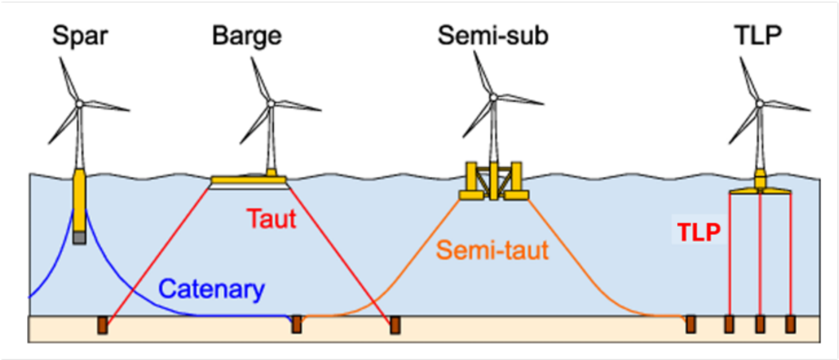
Engagement Questions

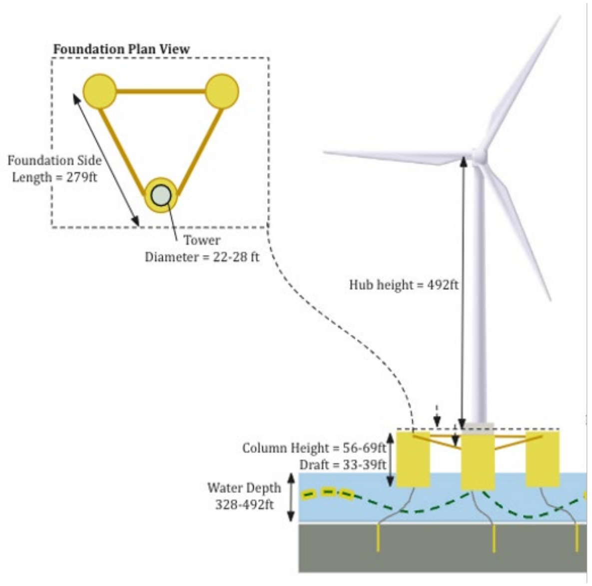
- What is your reaction to this design?
- Based on these designs, what do you see as the most challenging with your fishing practice?
- Which design do you see being the least challenging?
- What parameters could be put in place to make coexistence a possibility?
- What is your comfort level (not comfortable at all, nervous, or comfortable) with navigating around this technology?
- What is your comfort level (not comfortable at all, nervous, or comfortable) with fishing around this technology?
- What – if anything – could be changed to enable you to fish/navigate with a greater sense of comfort?

Hywind Spar - Equinor

Phase 2: Stakeholder Engagement - FOW Technology

Platform Systems





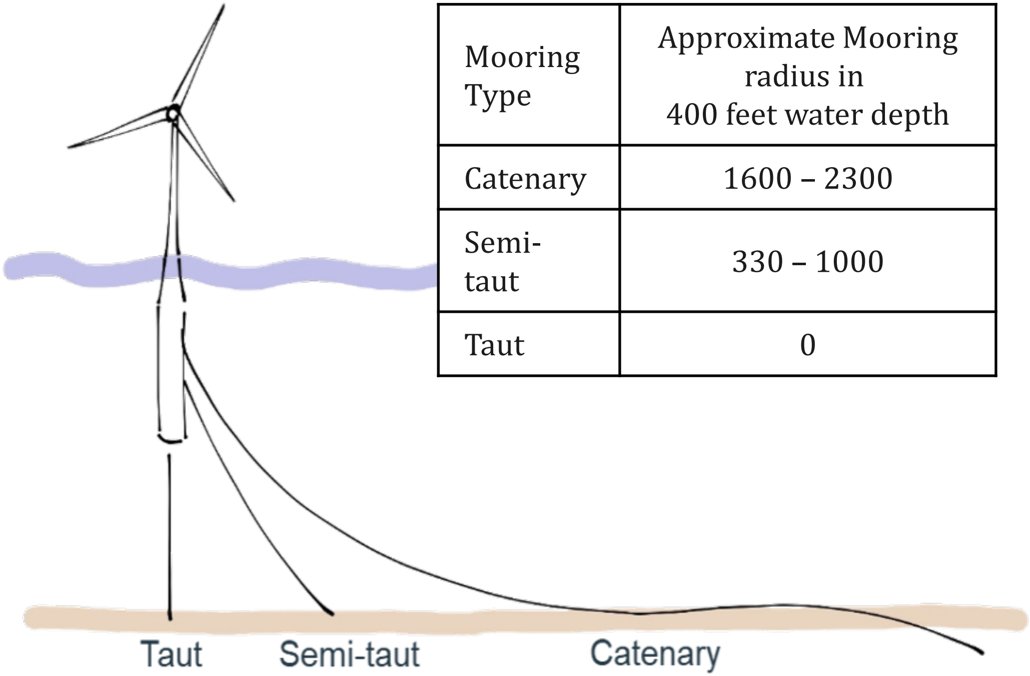
Key Takeaways

- Discomfort fishing and navigating around all platform types (both fixed & mobile gear types)
- Preference for concepts with the smallest spatial footprints
- Safety concerns:
  - Unpredictable platform movement
  - Potential radar interference
  - Potential overcrowding
  - Potential vessel issues (e.g., power loss)
  - Inclement weather
  - Implications for search & rescue operations
- Technical and operational uncertainties:
  - Size of platform's watch circle
  - Lack of context-specific precedent (i.e., commercial-scale FOW arrays)

Phase 2: Stakeholder Engagement - FOW Technology

Mooring Systems

Mooring Type	Approximate Mooring radius in 400 feet water depth
Catenary	1600 – 2300
Semi-taut	330 – 1000
Taut	0

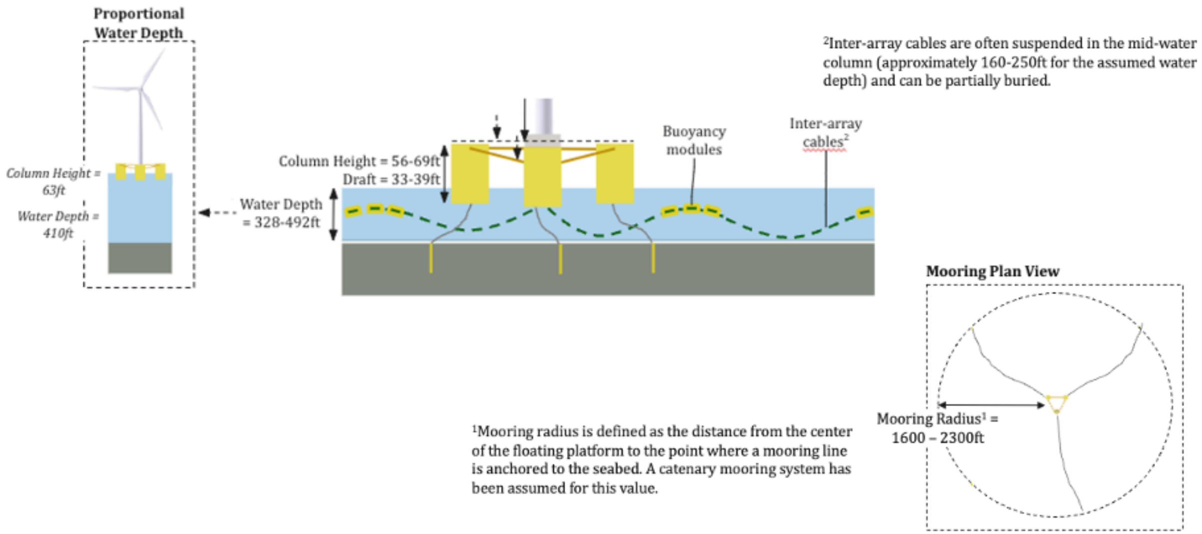


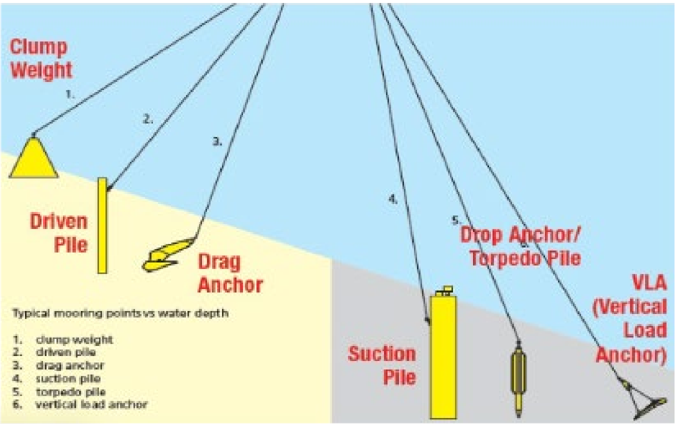
Key Takeaways

- Preference for concepts with smaller spatial footprints (i.e., taut/TLP)
- Discomfort fishing and navigating around all concepts (both fixed & mobile gear types)
- Concerns with gear entanglement:
    - *"FOW is like an iceberg“*
    - Catenary moorings described as *"frightening," "a nightmare,"* and *"too scary"* to operate around
    - Taut/TLP described as potentially "*least impactful to fishing operations"* and *"least challenging"*

Phase 2: Stakeholder Engagement - FOW Technology

Cabling and Anchoring Systems





Key Takeaways

- Concerns with **gear entanglement**
  - Concern with combination of suspended inter-array cables and mooring lines
  - Potential for unpredictable movement of inter-array cables due to ocean currents
- Preference for buried inter-array **cables** over suspended cables for both fishing & navigating.
  - Worried cables may be become unburied over time
  - Skeptical that existing cable burial methods would be effective
- Preference for "least impactful" **anchoring systems**
  - Environmental concerns with drag anchor and driven pile anchor
- **Environmental** concerns
  - Potential impacts of electromagnetic fields (EMFs)
  - Potential for secondary entanglement

Recommendations and Next Steps

PRELIMINARY

Methodology

Case Studies and Regulatory Review

Technology Evaluation

Recommendations and Next Steps

Stakeholder Engagement

Preliminary Assessment and Recommendations

Preliminary **technical compatibility** assessment based on currently available technology[1]

	Bottom Trawls	Midwater / Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Mooring Type								
Catenary	X	~	~*	~*	X	~	~*	✓
Semi-Taut	X	~	~*	~*	X	~	~*	✓
Taut	X	X	~*	~*	X	~	~*	✓
TLP	~*	~	✓*	✓*	X	~	~	✓

✓ = Expected to be technically compatible throughout most of the farm	~ = May be technically compatible in certain areas in certain circumstances[2]	X = Not expected to be technically compatible

*Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines
[1]FOW technology and fishing gear continue to evolve.
[2]For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array.

Preliminary Recommendations

Engineering recommendations

- Optimize spacing and layout to promote coexistence
- Leverage technology opportunities

Regulatory and Case Study recommendations

- Follow data-driven siting processes
- Incorporate preventative measures to reduce risks
- Leverage technology to mitigate key risks
- Implement regulations to ensure coexistence, where feasible

Other recommendations

- Engage and communicate with fishermen
- Establish clear protocols for compensation
- Collect and share data
- Mitigate impacts on fishing

Phase 3: Stakeholder Engagement – Preliminary Assessment and Recommendations

Preliminary Assessment & Recommendations

- Preliminary technical compatibility assessment
- Engineering recommendations
- Regulatory and Case Study recommendations
- Other recommendations

→

Solicit feedback

- Presentation to Research Consortium in November
- Focus group, Google survey, conversations, phone calls

→

Final Assessment & Recommendations

- Revised technical compatibility assessment
- Engineering recommendations
- Regulatory and Case Study recommendations
- Other recommendations

Phase 3: Stakeholder Engagement – Preliminary Assessment and Recommendations

Preliminary **technical compatibility** assessment based on currently available technology[1]

	Bottom Trawls	Midwater / Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Mooring Type								
Catenary	X	~	~*	~*	X	~	~*	✓
Semi-Taut	X	~	~*	~*	X	~	~*	✓
Taut	X	X	~*	~*	X	~	~*	✓
TLP	~*	~	✓*	✓*	X	~	~	✓

✓ = Expected to be technically compatible throughout most of the farm	~ = May be technically compatible in certain areas in certain circumstances[2]	X = Not expected to be technically compatible

*Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines
[1]FOW technology and fishing gear continue to evolve.
[2]For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array.

Stakeholder feedback (fishing industry and Advisory Board)

- General agreement, but with recommended adjustments to dredges and harpoon categories
- Desire to incorporate fishermen's perceived risk of operating in/around FOW technology
- Requests to recognize weather and oceanographic conditions
- Concern that inter-array cable burial may be "unrealistic"
- Notes that compatibility determinations are site-specific
- Requests for greater clarity on size of exclusion zones and array layout configurations

Phase 3: Stakeholder Engagement – Preliminary Assessment and Recommendations

Outputs from a focus group session:

Compatibility assessment that considers perceived risk

<table>
<tr><th></th><th>Bottom Trawls</th><th>Midwater / Pelagic Trawls</th><th>Bottom Gillnets</th><th>Pots & Traps</th><th>Dredges</th><th>Pole & Line</th><th>Purse Seine</th><th>Harpoon</th></tr>
<tr><td colspan="9">Mooring Type</td></tr>
<tr><td>Catenary</td><td rowspan="4">4+ miles between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4+ miles between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4+ miles between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4+ miles between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4+ miles between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">1+ mile between mooring anchors*</td><td rowspan="4">4+miles between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4"><1 mile between mooring anchors with recognition that species may "run" when harpooned*</td></tr>
<tr><td>Semi-Taut</td></tr>
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<tr><td>TLP</td></tr>
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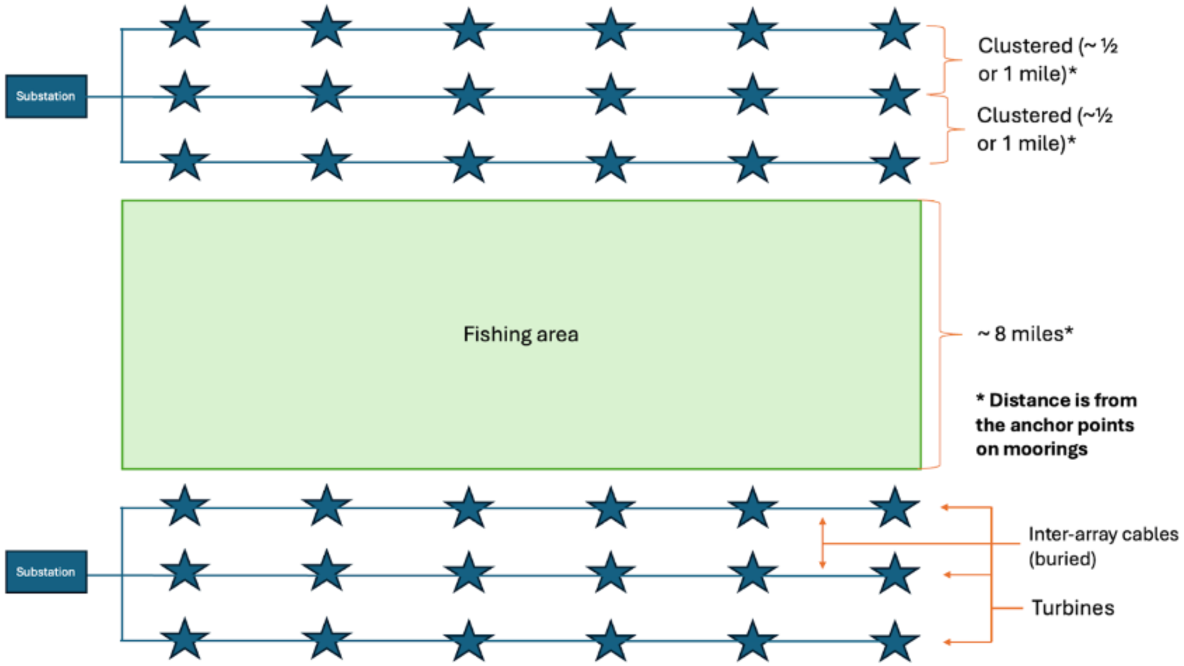
Draft layout



*The figures above were developed by a focus group of five fishermen and do not represent all fishing industry stakeholders' perspectives.

Final Assessment and Recommendations

Preliminary technical compatibility assessment

	Bottom Trawls	Midwater / Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Mooring Type								
Catenary	X	~	~*	~*	X	~	~*	✓
Semi-Taut	X	~	~*	~*	X	~	~*	✓
Taut	X	X	~*	~*	X	~	~*	✓
TLP	~*	~	✓*	✓*	X	~	~	✓

Revised technical compatibility assessment

	Bottom Trawls	Midwater / Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon **
Mooring Type								
Catenary	X	~	~*	~*	X	~	~*	~
Semi-Taut	X	~	~*	~*	X	~	~*	~
Taut	X	X	~*	~*	X	~	~*	~
TLP	~*	~	✓*	✓*	~*	~	~	~

✓ = Expected to be technically compatible throughout most of the farm	~ = May be technically compatible in certain areas in certain circumstances	X = Not expected to be technically compatible

* Technical compatibility depends on the cable being buried to sufficient depth (at least 1.25 meters) and an established exclusion zone around the WTGs. Required standards would need to be developed for the site by regulators, in addition to existing standards such as DNV-ST-0119, and approved from an engineering perspective.

** Harpooning tuna or swordfish might involve chasing the catch after it is struck, increasing the risk of gear entanglement with moorings.

Recommendations and Next Steps

Recommendations and Considerations - Engineering

Example **engineering** recommendations and considerations

Spacing & Layout

- Consider site-specific conditions and fishing activities; microsite to minimize conflicts and maximize operations efficiency
- Fishermen want input in the layout design, which may be optimized to promote coexistence (e.g., consider bathymetry)

Mooring & Platform

- TLP platform and mooring may be most compatible with fishing
- Fishermen want input in the design process

Technology

- New technologies may be leveraged to optimize design, reduce conflicts and improve knowledge of underwater equipment locations
- Fishermen do not want technology adoption to be a financial burden

Recommendations and Considerations – Regulatory and Case Studies

Example **case study** recommendations and considerations

Data Driven Siting

- Lease areas are determined by BOEM's data-driven and stakeholder-informed siting process
- Fishermen want developers to microsite within the lease areas

Use Preventative Measures

- Consult fishermen in the design process to avoid areas with high-snag/collision risk
- Leverage technology to mitigate key risks, noting that fishermen do not want technology adoption to pose a financial burden

Consider Navigational Impacts

- Adopt coexistence-first project designs
- Use mitigation and compensation measures when impacts are unavoidable, noting that fishermen do not want to be paid not to fish

Consider Regulations

- Though regulations exist to promote coexistence, fishermen want regulatory language that gives the fishing industry greater influence in the decision-making process

Recommendations and Considerations - Others

Engage Fishermen

- Throughout surveys to reduce conflicts (e.g., planning and staffing)
- On decisions (e.g., technology, micrositing)
- On communication protocols (e.g., apps, text alerts)

Clear Compensation Protocols

- Provide details
- Gear and technology uptake should not be a financial burden

Collect and Share Data

- Conduct comprehensive monitoring before, during, and after FOW construction
- Map fishing activities, and habitats, and continuously monitor trends
- Make data easy to access

Adaptive Management Frameworks

- Adapt to new data and minimize fishing impacts
- Create adaptive compensation mechanisms

Mitigate Impacts on Fishing

- Create guidelines and buffer zones
- Microsite to avoid sensitive habitats and fishing areas
- Establish transit lanes and fishing corridors

Next Steps

Gaps	Proposed Next Step
Empirical Data	• Pilot coexistence zones and demonstration scale projects to test compatibility. • Fill species distribution data gaps, conduct pre-construction surveys, and monitor ecosystem changes over time.
Modeling Studies	• Model climate related changes to evaluate future species distributions. • Model hydrodynamics and ecosystems to evaluate the impact of FOW arrays on species distribution and to inform layout design. • Model socioeconomic impacts to evaluate how restricted fishing zones may alter community livelihoods to promote equitable compensation.
Economic Impact Assessment	• Engage with the insurance industry to understand the potential insurance implications for fishermen who fish within a FOW array. • Design adaptive compensation models that represent all gear types and account for direct and indirect economic impacts.
Stakeholder Engagement Frameworks	• Evaluate the regulatory framework to ensure all stakeholders are represented. • Evolve current engagement frameworks to further promote communication and collaboration between the fishing industry and FOW developers, while minimizing stakeholder fatigue.

Questions and Discussion

Thank you

Please direct any questions to:

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Alice.Sandzen@erm.com