



Navigating Consenting Processes for Environmental Effects of Marine Renewable Energy Regulatory and Industry Perspectives

13 October 2026



PNNL is operated by Battelle for the U.S. Department of Energy



Today's Webinar

- All participants will be **muted** throughout the webinar.
- Use the **Q&A box** to add your questions at any time. After all the presentations, we will answer questions.
- The **chat** can be used to contact organizers if you need help with Zoom, and we will use it to share links to resources throughout.
- The webinar will be **recorded**. The recording will be available on Tethys after the event, and the link will be sent to all registrants.
- We will share a **feedback survey** at the end.



Agenda

- **OES-Environmental International Regulator Survey Findings**

Mikaela Freeman

- **CorPower's Wave Energy Projects**

Quentin Geerinckx

- **Fundy Ocean Research Centre for Energy (FORCE) and Canada's Tidal Energy Task Force**

Lindsay Bennett

- **Q&A/Discussion**





International Marine Renewable Energy Regulator Survey

Mikaela Freeman, Deborah Rose
Pacific Northwest National Laboratory



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ES **ENVIRONMENTAL**



U.S. DEPARTMENT
of **ENERGY**

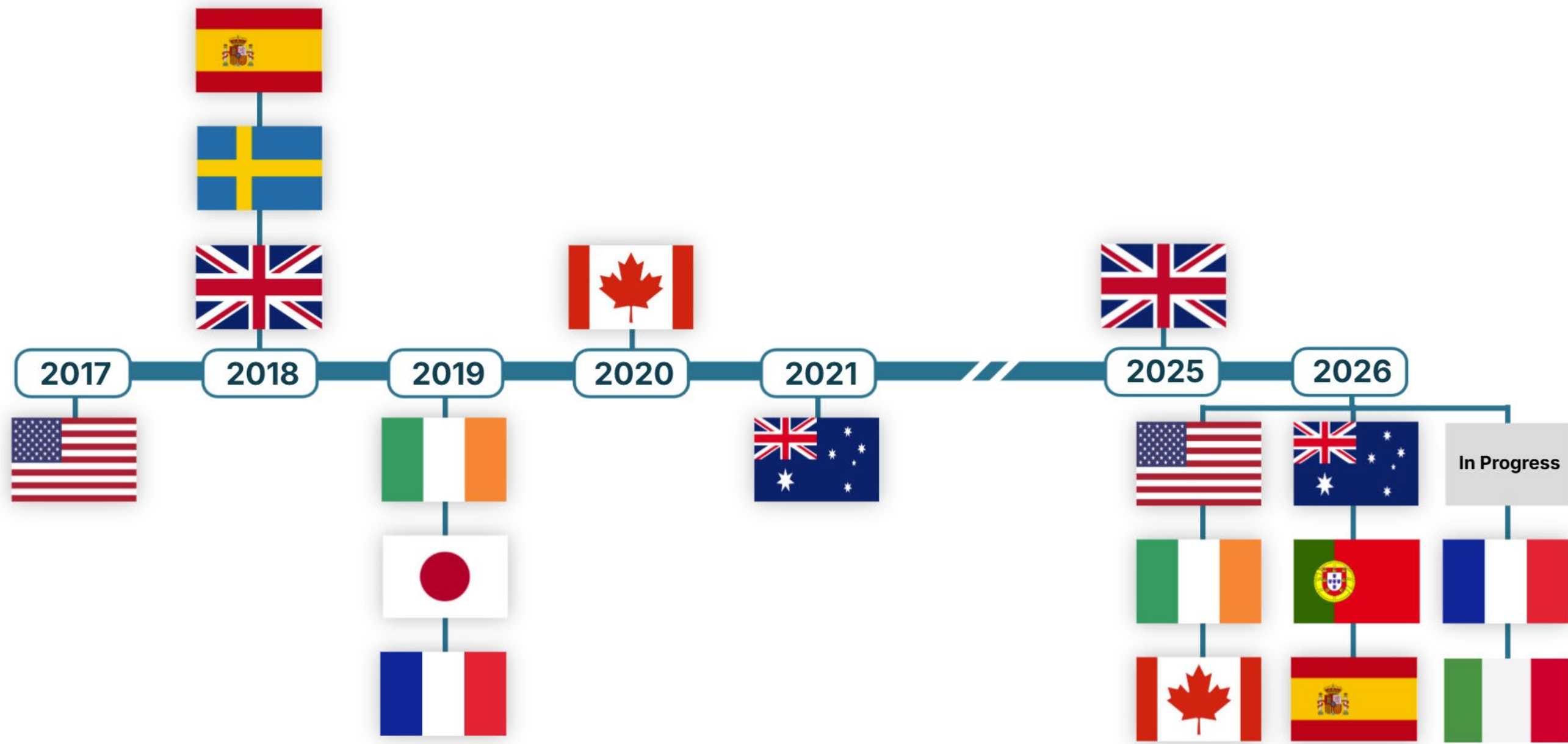


Background

- As MRE industry develops, understanding environmental effects of MRE has improved but some uncertainty remains
- Surveyed regulators and advisors involved in environmental consenting to:
 - Define remaining uncertainties
 - Understand challenges for consenting
 - Identify key needs and effective resources and information to fill knowledge gaps
- Goal:
Inform information sharing and development of resources to support environmental consenting processes and long-term needs of regulators and advisors



Timeline



Approach

- Updated 1st iteration survey questions to fit current state of the industry
- Collaborated with OES-Environmental country representatives
 - Identify regulators and advisors
 - Fit country contexts – ensure applicability while preserving consistency
 - Translate survey
- Used Survey Monkey
- Analyze results and produce summary report on each country

France Regulatory Needs Regarding Environmental Effects for Permitting Marine Renewable Energy – 2026 Survey

We invite you to participate in OES-Environmental's survey on regulatory needs related to potential environmental effects of marine renewable energy (MRE) projects. This survey is designed for regulators and advisors involved in permitting MRE projects (energy from waves, tides, ocean currents, rivers, and ocean thermal or salinity gradients). Offshore wind energy and floating solar are not included in this survey.

The purpose of this survey is to understand how regulators and advisors in France view the potential risks and challenges associated with environmental effects of MRE. We are also interested to understand approaches for reducing potential risks to marine animals, habitats, or ecosystem processes. Your responses will help us identify long-term needs of regulators and advisors and inform the development of resources to address remaining uncertainties and key information needs, particularly those that can support environmental permitting processes for MRE. Please do your best to answer every question with as much detail as you can provide. We look forward to your responses as they will help inform the ongoing efforts of the international [OES-Environmental](#) initiative, including supporting regulators and advisors in permitting MRE projects.

This survey should take approximately 20-25 minutes to complete.

Device photo credits: AZURA Wave Energy, NOVA Innovation



Prev

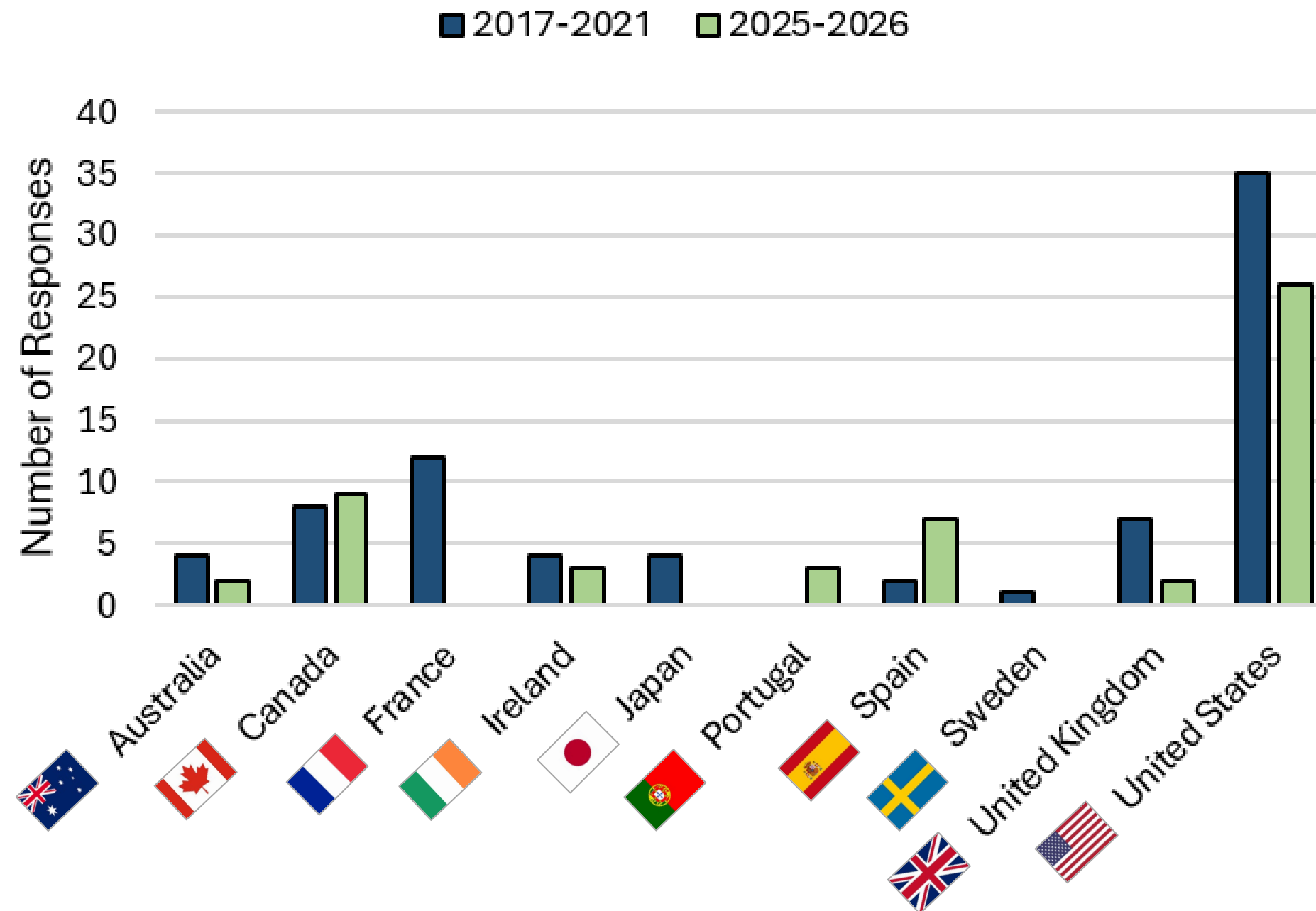
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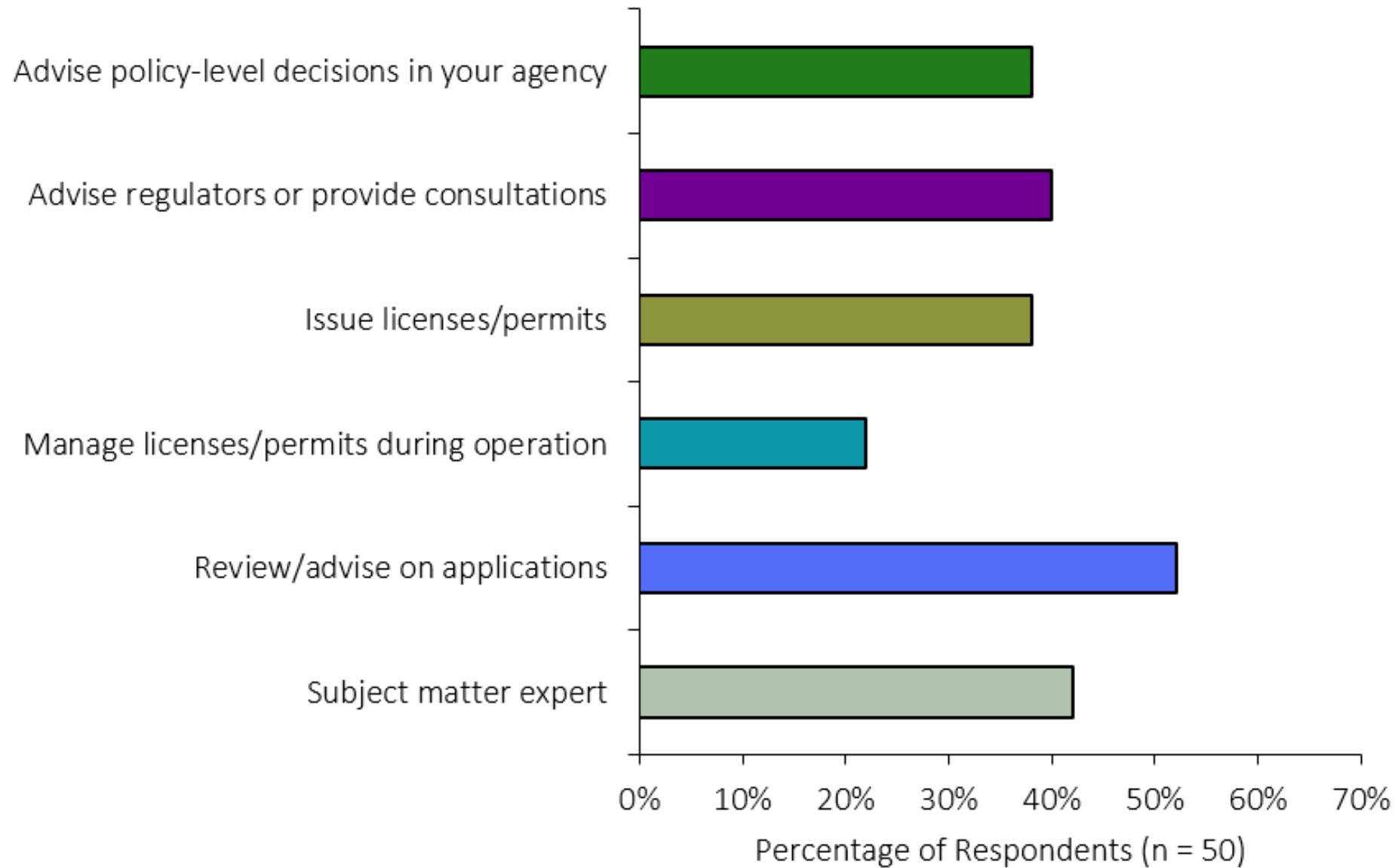
<https://tethys.pnnl.gov/regulator-surveys>

Responses



* The results from the 2017-2021 surveys have been previously published and discussed in a conference paper ([Freeman et al. 2020](#)) and a journal article ([Rose et al. 2023](#)).

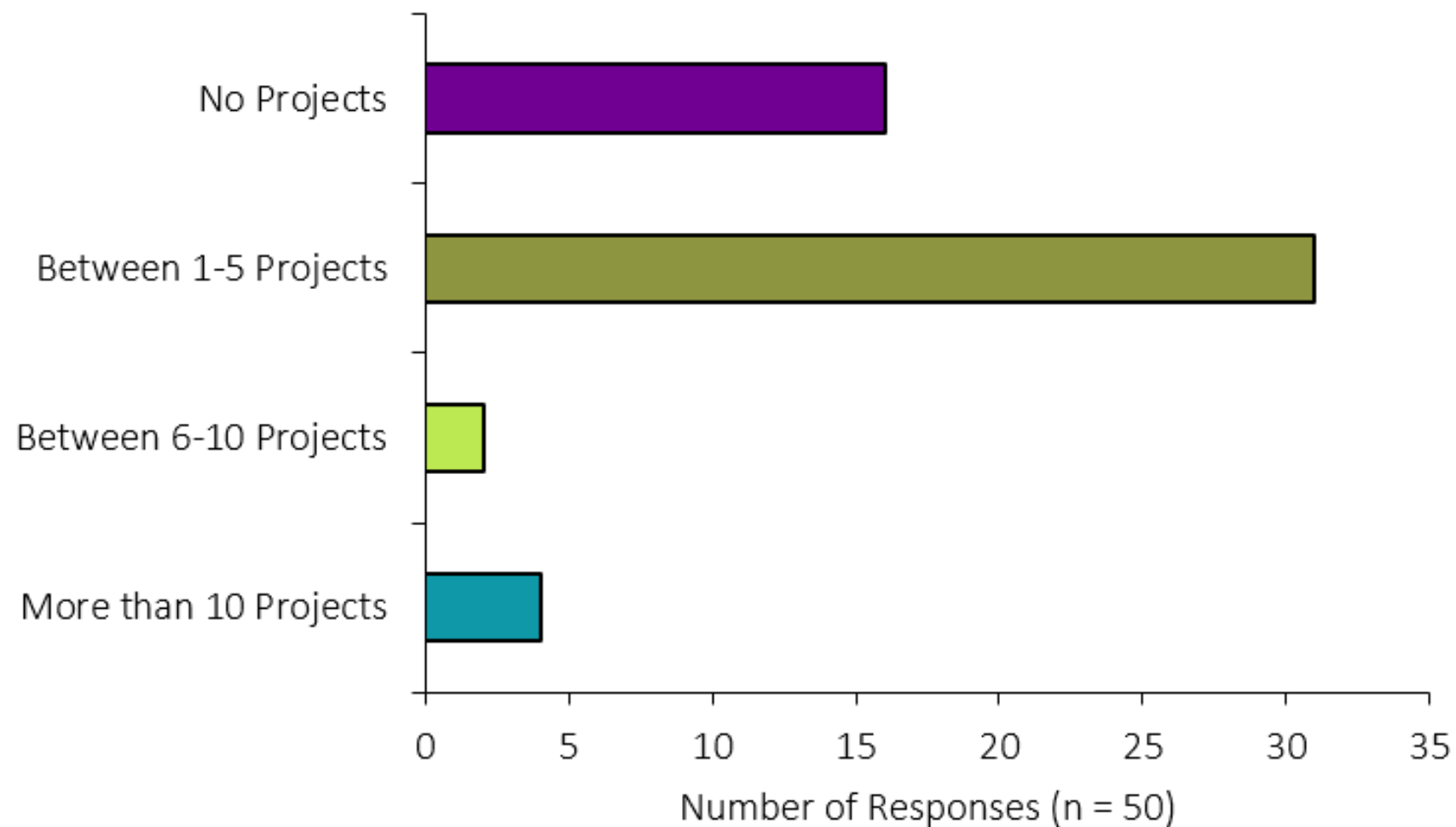
Participant Roles



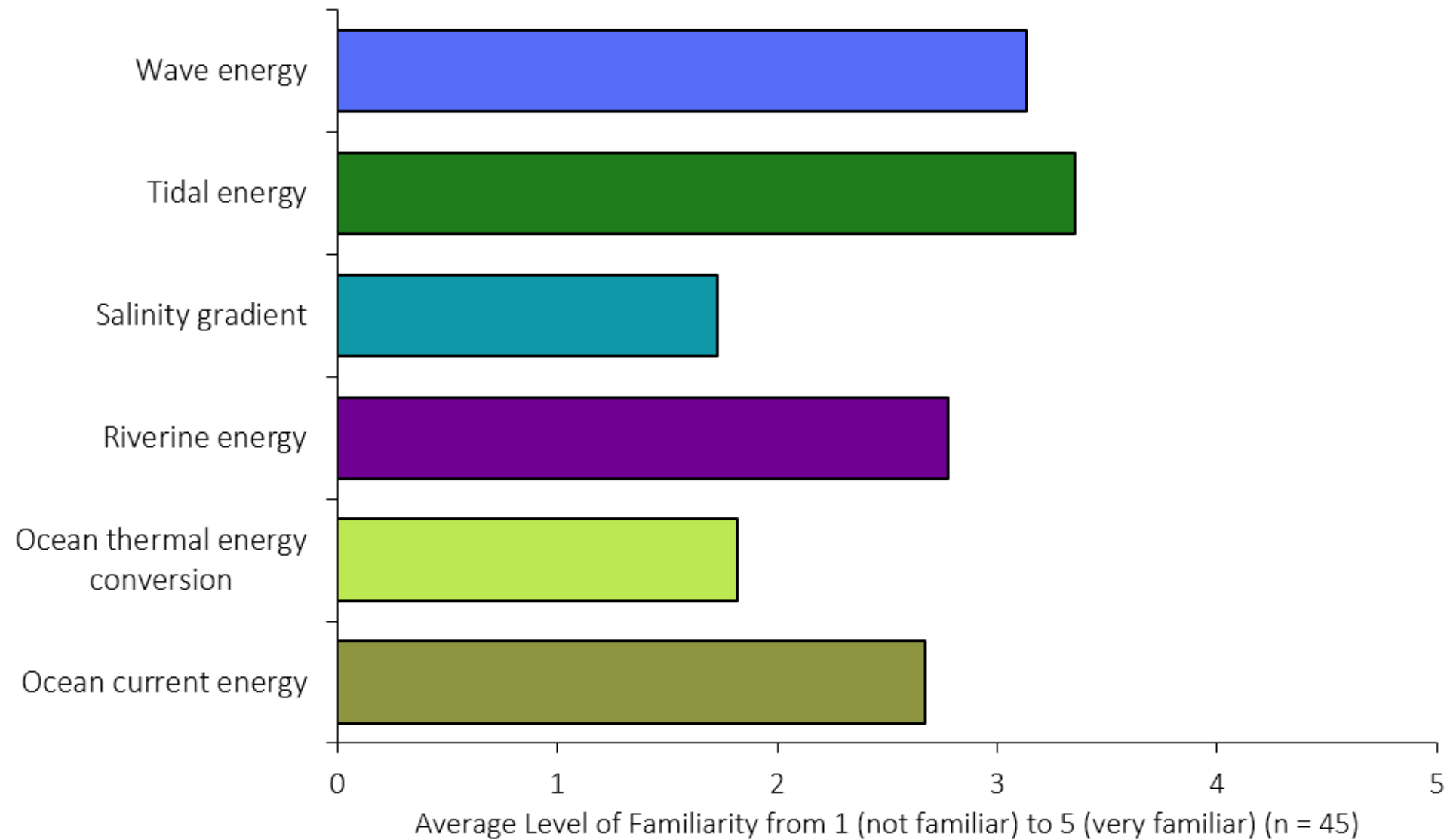
Status of Industry



How many planned, permitted, or operational MRE projects are in your jurisdiction?

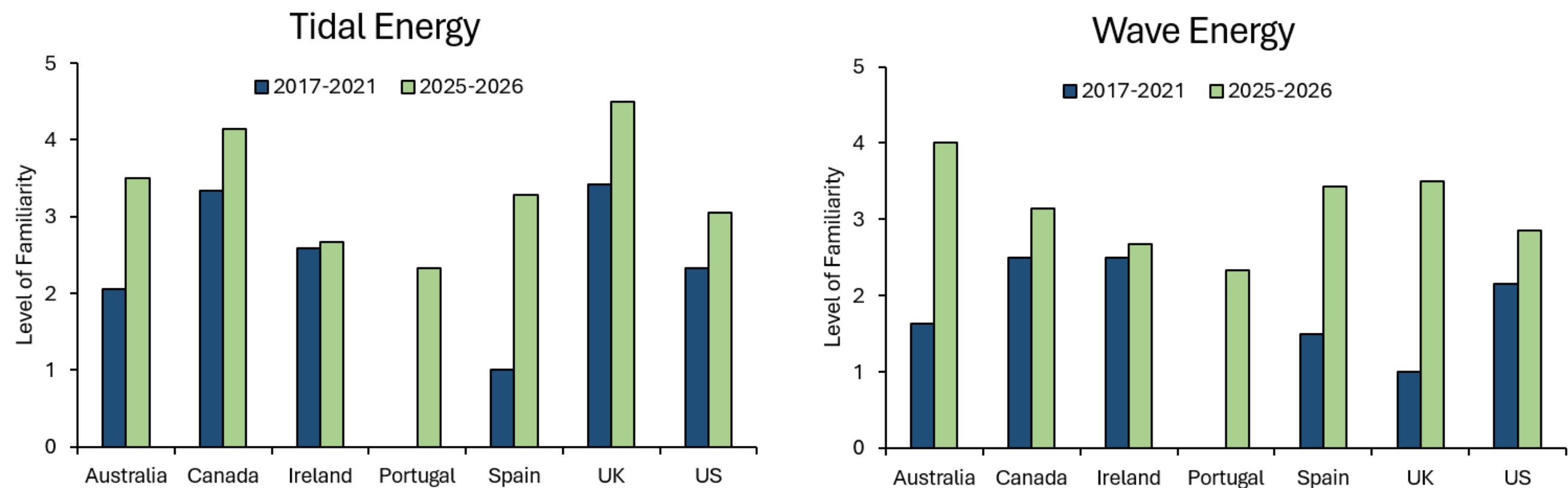


MRE Technology Familiarity



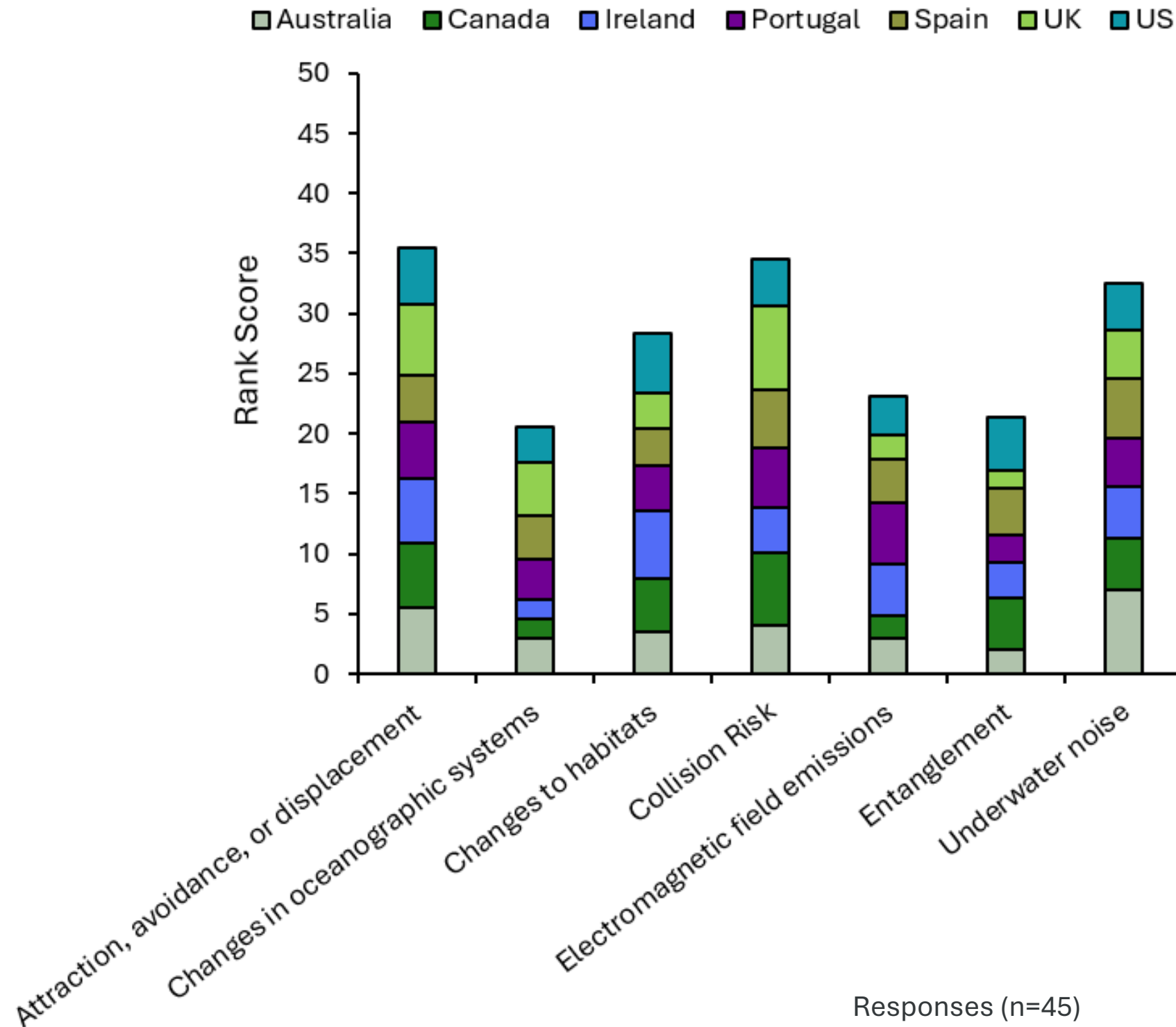
Comparison Over Time

MRE Technology Familiarity



Responses:
2017-2021: n=38
2025-2026: n=45

Challenges for Consenting Small Arrays (1-6 devices)



Top Challenges by Country

Attraction, avoidance, or displacement:



Collision risk:



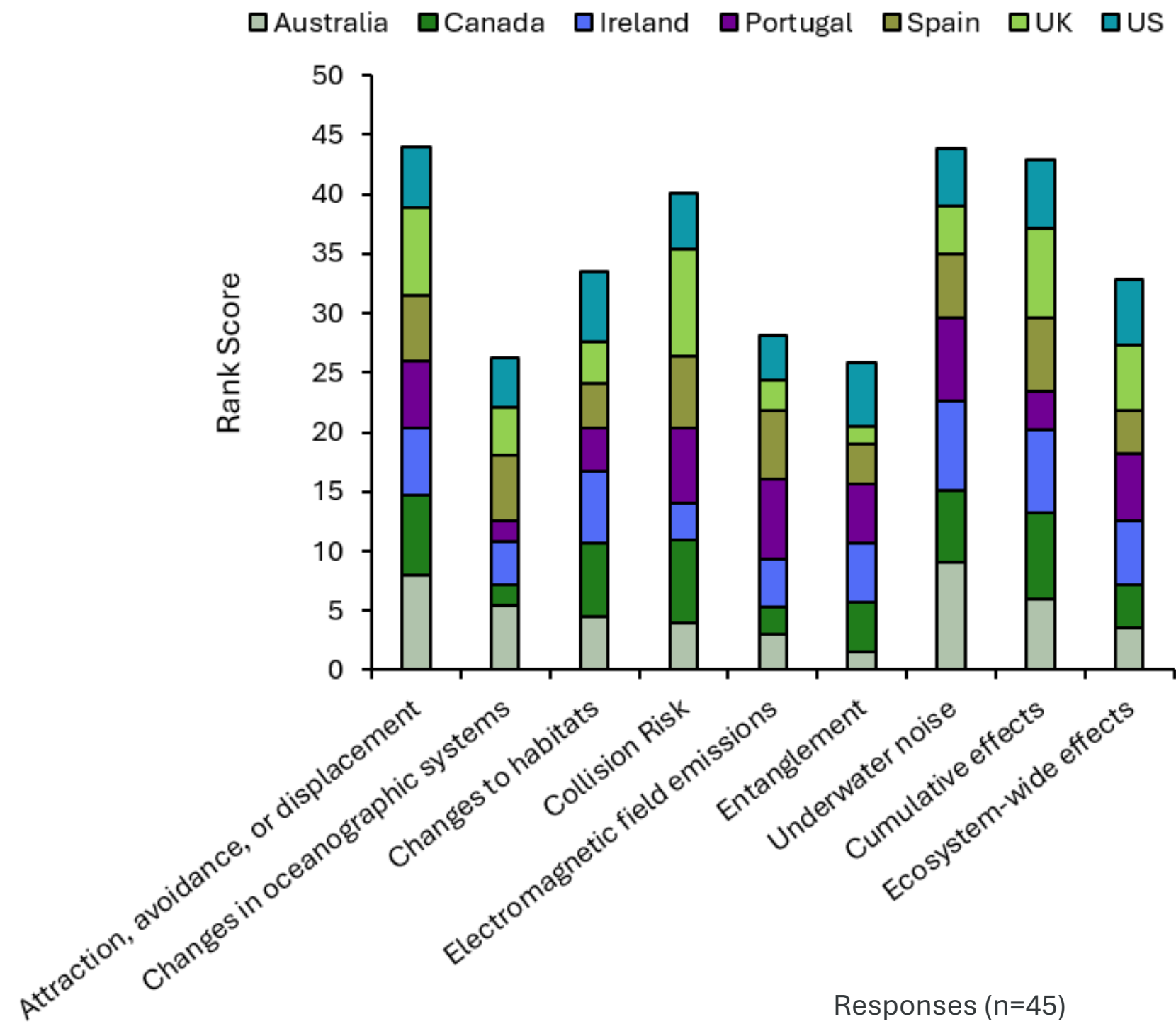
Changes to habitats:



Underwater Noise:



Challenges for Consenting Large Arrays (6+ devices)



Top Challenges by Country

Changes to habitats: 

Collision risk: 

Electromagnetic fields: 

Underwater noise:

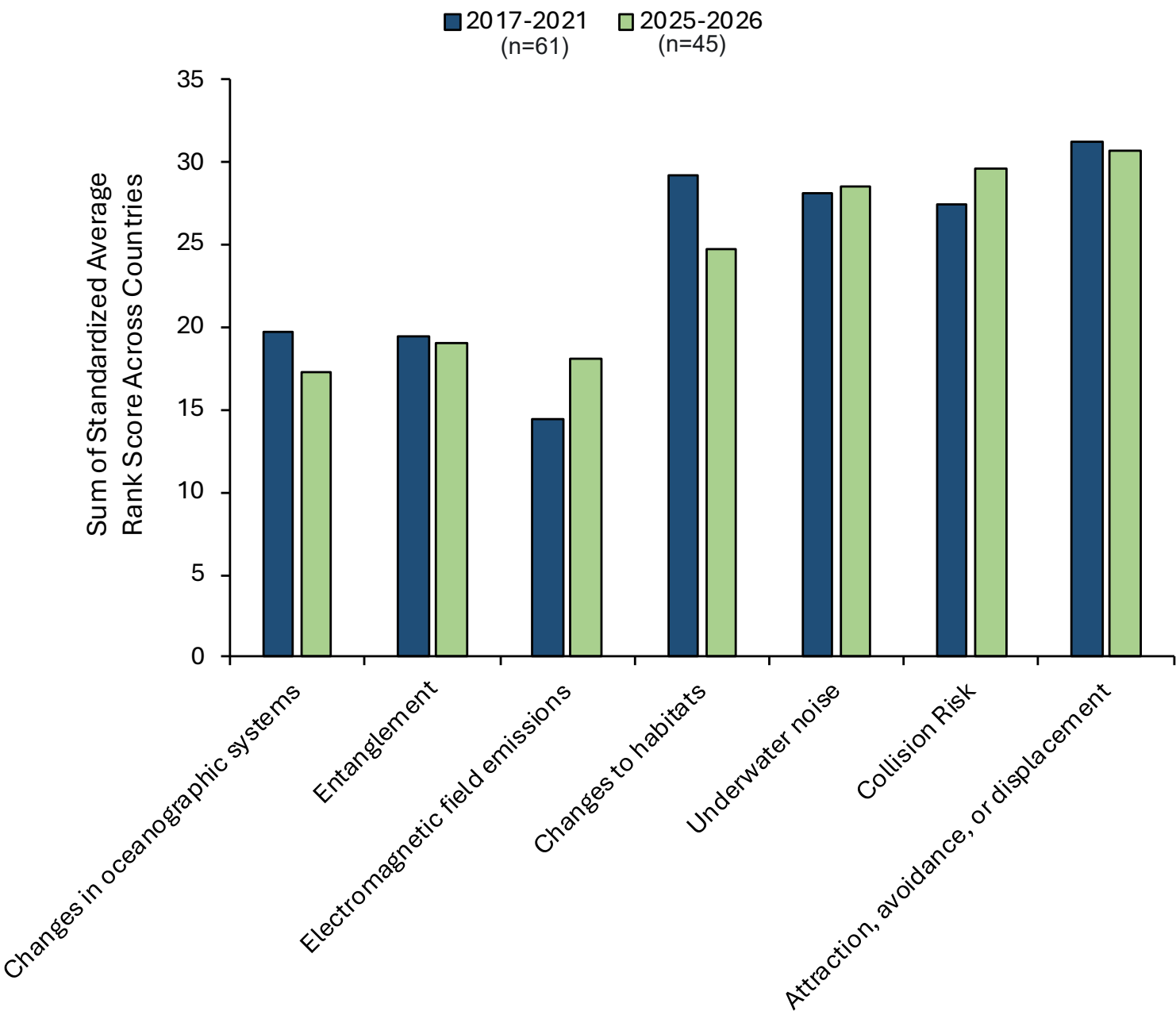


Cumulative effects:

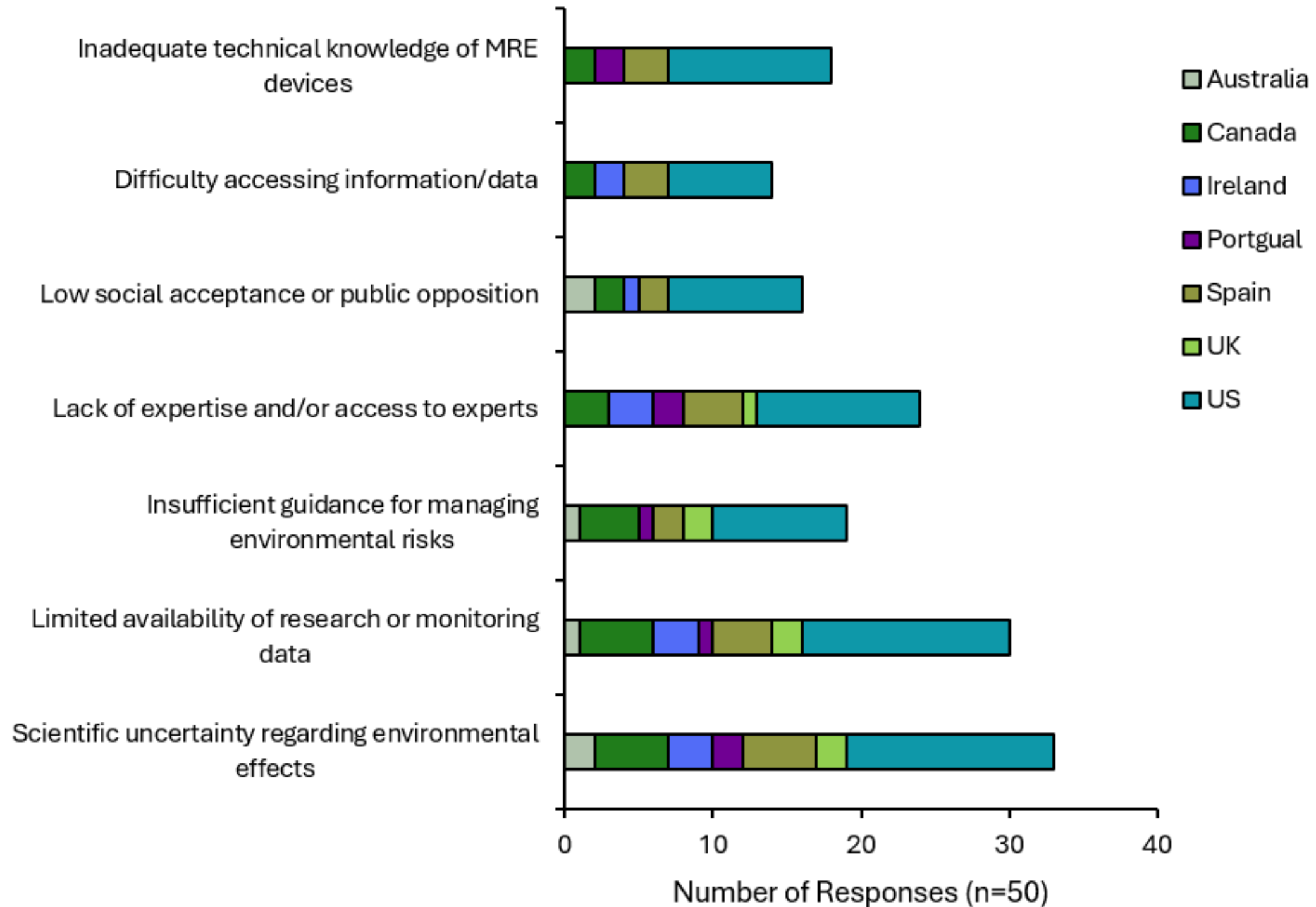


Comparison Over Time

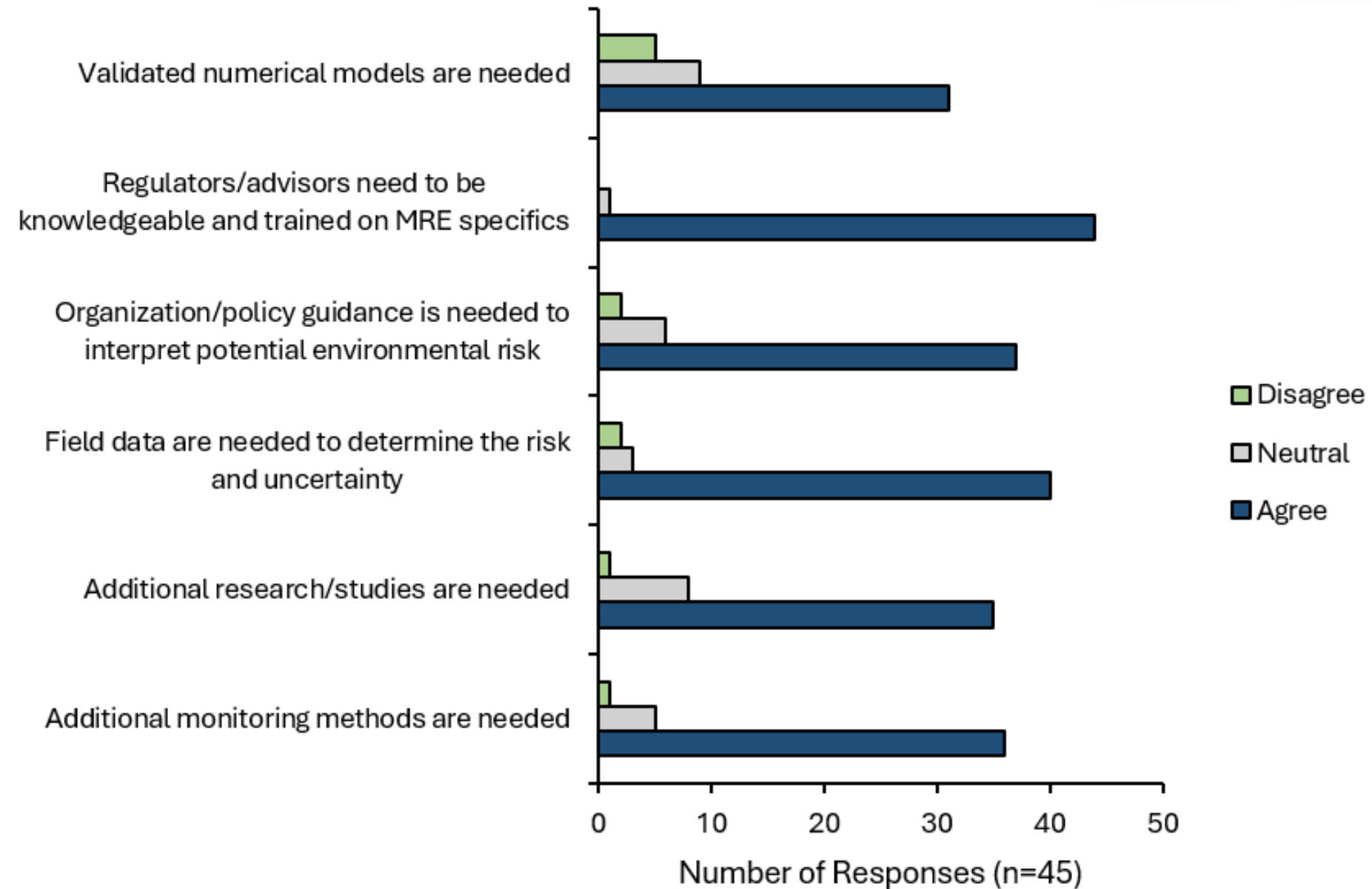
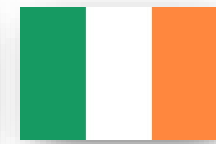
Challenges for Consenting Small Arrays



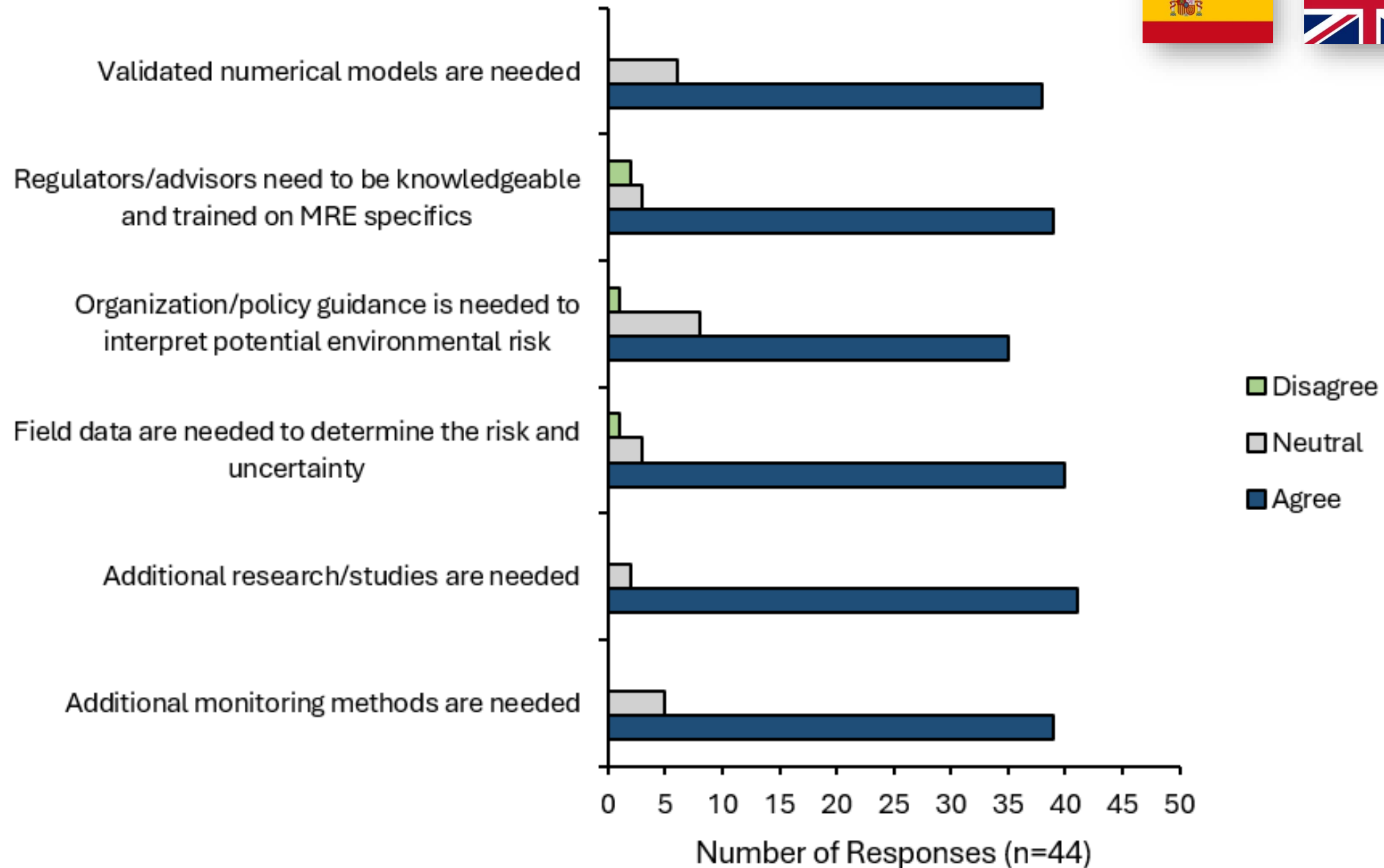
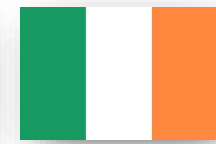
Barriers to Consenting



Consenting Needs for Small Arrays

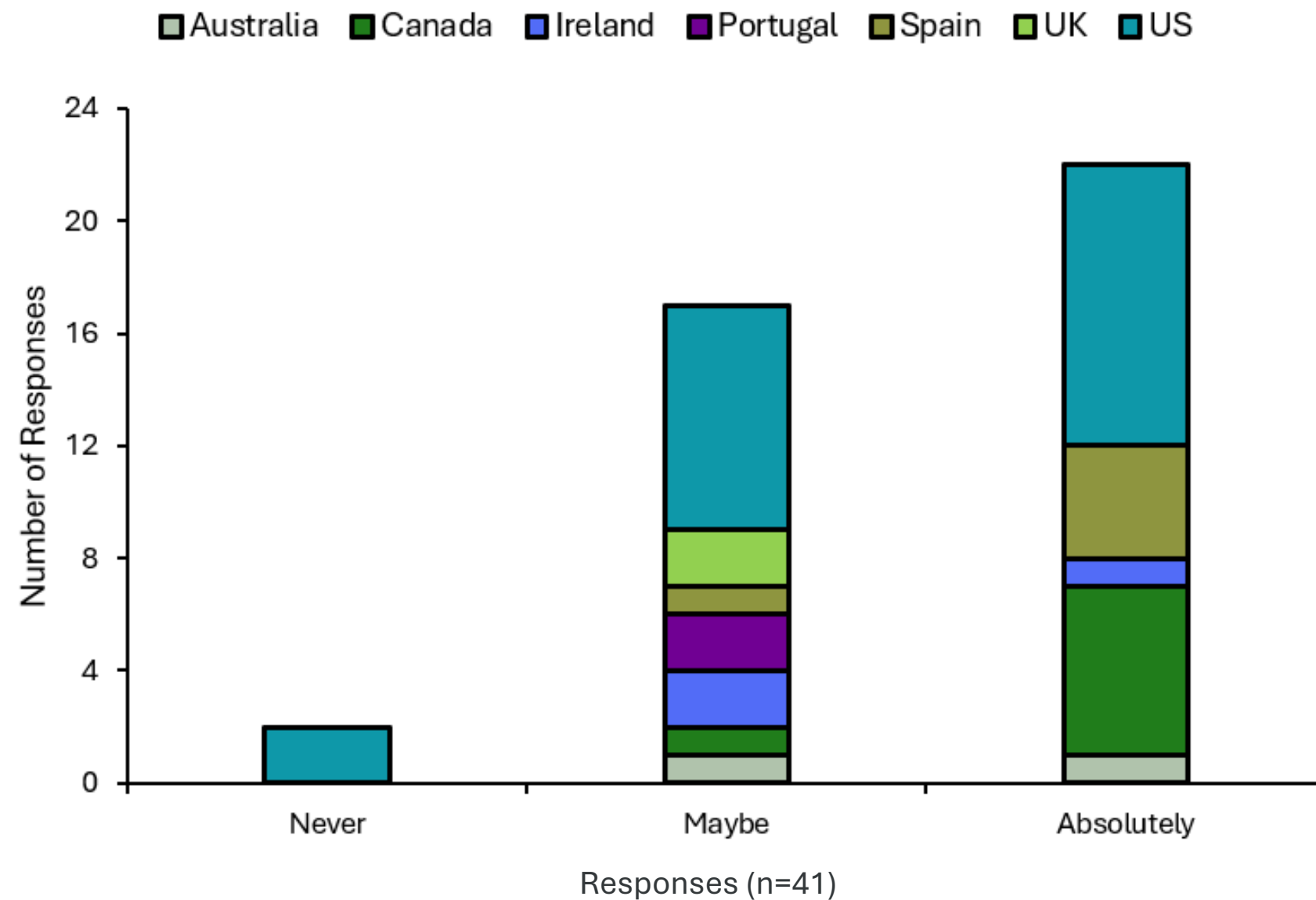


Consenting Needs for Large Arrays

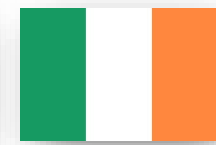


Data Transferability

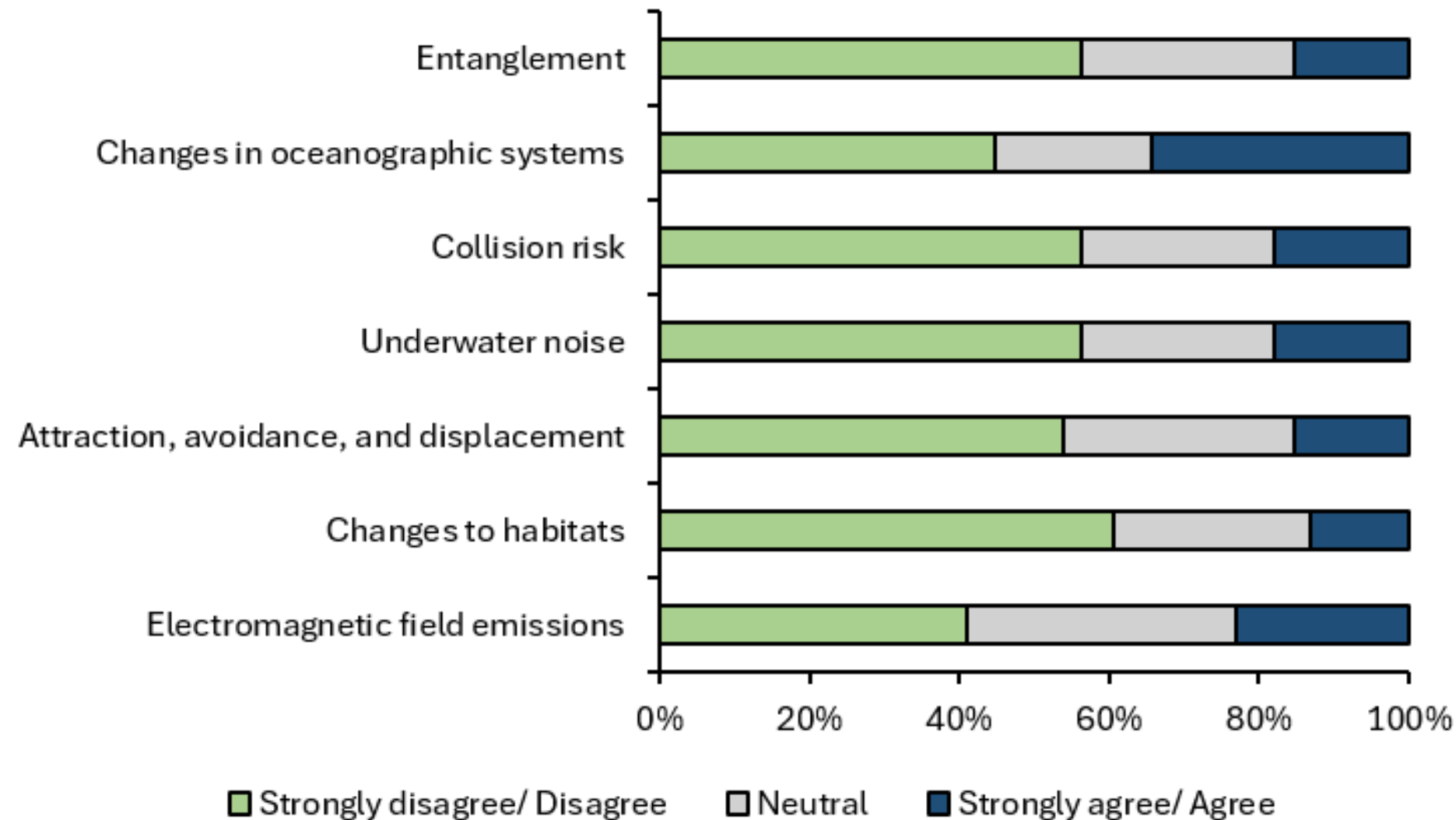
Can data collected at other locations be used to inform consenting processes for proposed MRE developments within your jurisdiction?



Risk Retirement



Can any of the following potential risks be retired for small arrays (1-6 devices) in your jurisdiction?



Responses (n=39)

Lessons Learned

- Regulators and advisors' roles evolving but limited experience consenting projects and low familiarity with MRE technologies
- Strong emphasis across on attraction, avoidance, and displacement as a key challenge
- Highest barrier to consenting remains uncertainty of environmental effects
- Key needs:
 - Research on environmental effects
 - Monitoring of devices and data collection
 - Regulator training and guidance
- Need for more outreach and engagement including on risk retirement

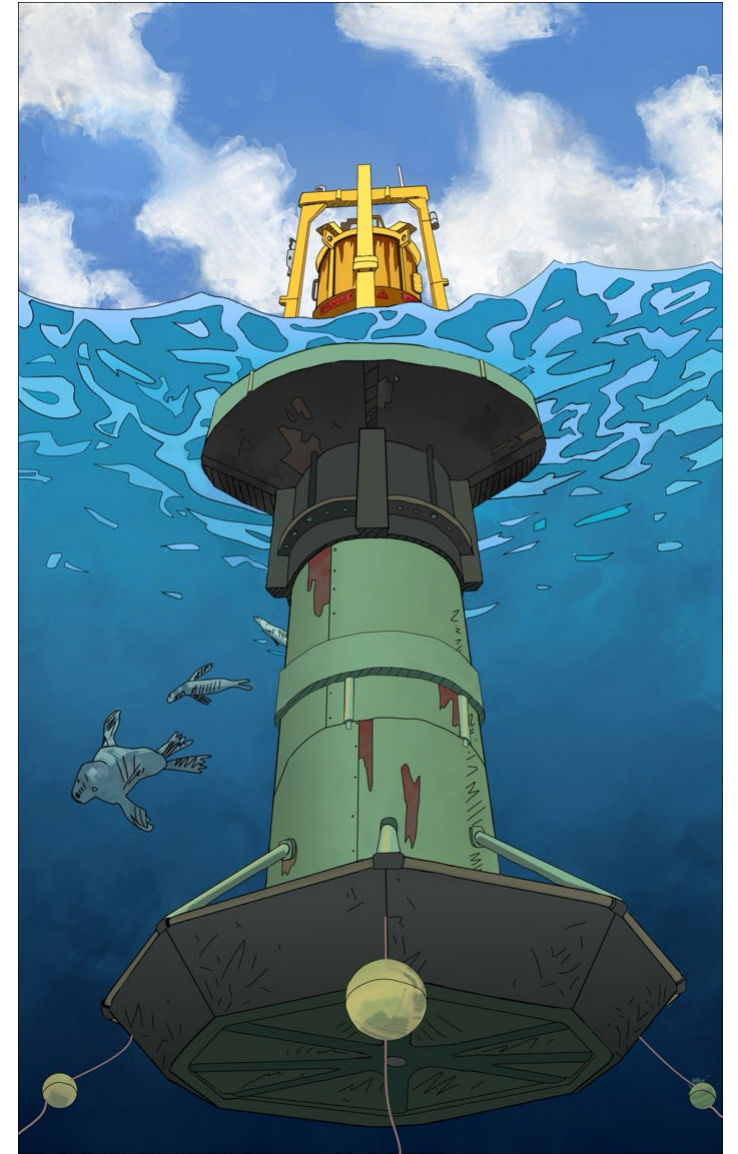
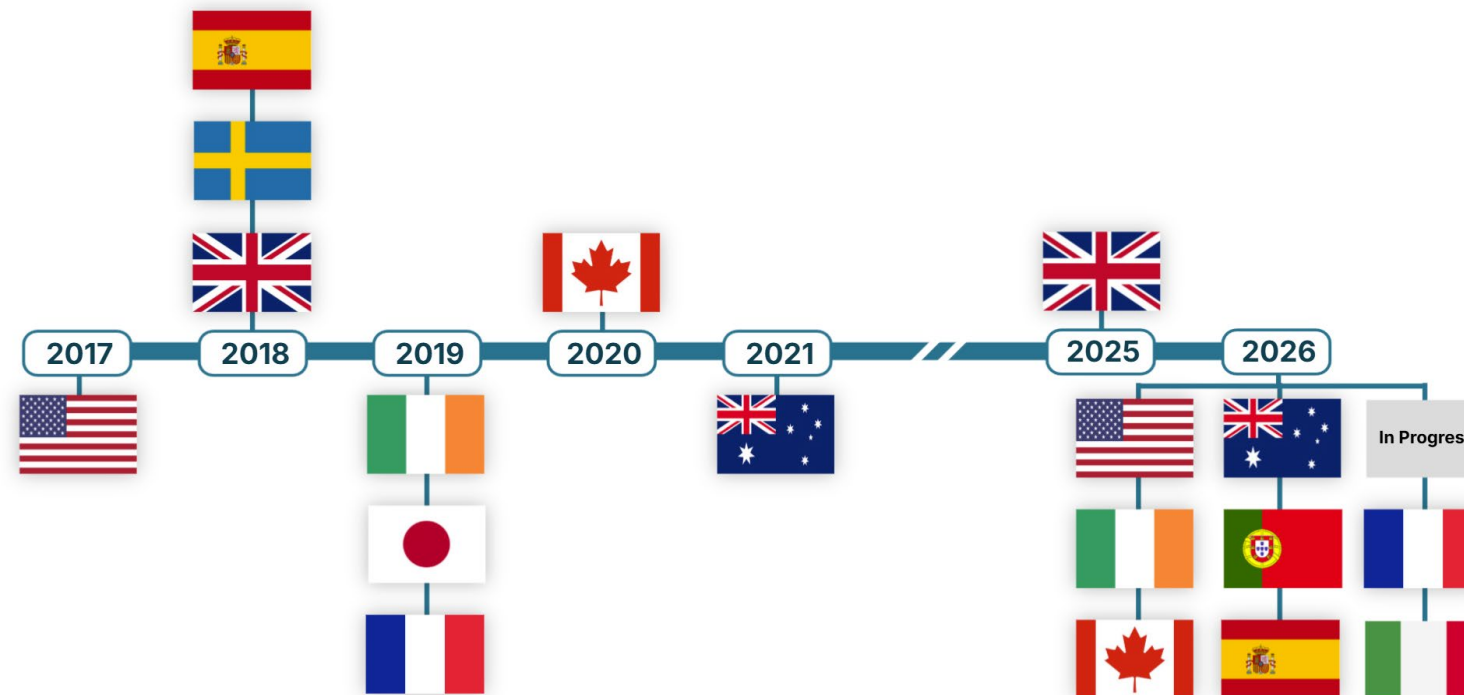


Illustration by Ian Hermanson, PNNL
Tethys Engineering Photo Library

Next Steps

- Continuing regulator surveys in additional OES-Environmental countries
 - Finalizing reports for Portugal and Spain – will be available online soon
 - France survey underway now
 - Italy will be next
- Planning report translations
- Plan to update, complete, and publish/report on synthesized analysis once all results are in



Thank you

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Special thanks to Ocean Energy Systems and the
U.S. Department of Energy Hydropower and
Hydrokinetic Office

Thank you to the OES-Environmental country
representatives who were integral in deploying the
regulator survey in each country.

OES-Environmental team at PNNL:
Lysel Garavelli, Deborah Rose, Andrea Copping,
Lenaig Hemery, Hayley Farr, Jacob McGrath,
Jason Gonsalves

Navigating Consenting Processes for Environmental Effects of Marine Renewable Energy – Regulatory and Industry Perspectives

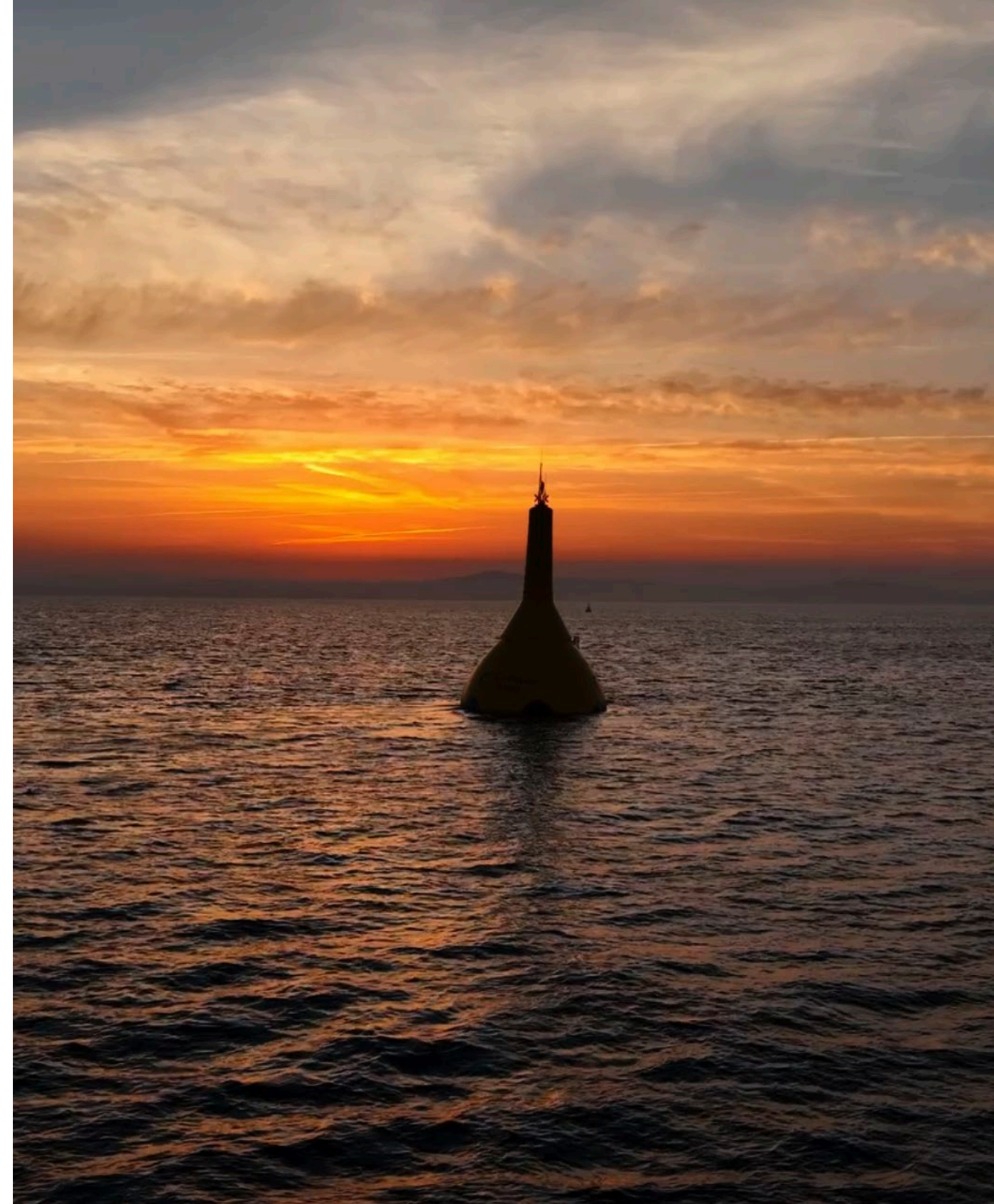
CorPower Ocean

Geerinckx Quentin
Senior Technical Project Manager

CorPower Ocean

A global leader in wave energy

- Developer (OEM) of turnkey wave energy systems
- Started in 2012. Offices in Sweden, Portugal, Norway, Scotland.
- Physics providing competitive LCOE, verified through step-by-step approach
- Traction with energy majors, including ESB, & Total Energies.
- Broad backing across Europe. 113 mEUR funding secured to date + 79mEUR customer project funding.
- CorPower Ocean secures **world-first DNV certification for wave energy technology**



The Opportunity: 500GW

10% of global electricity

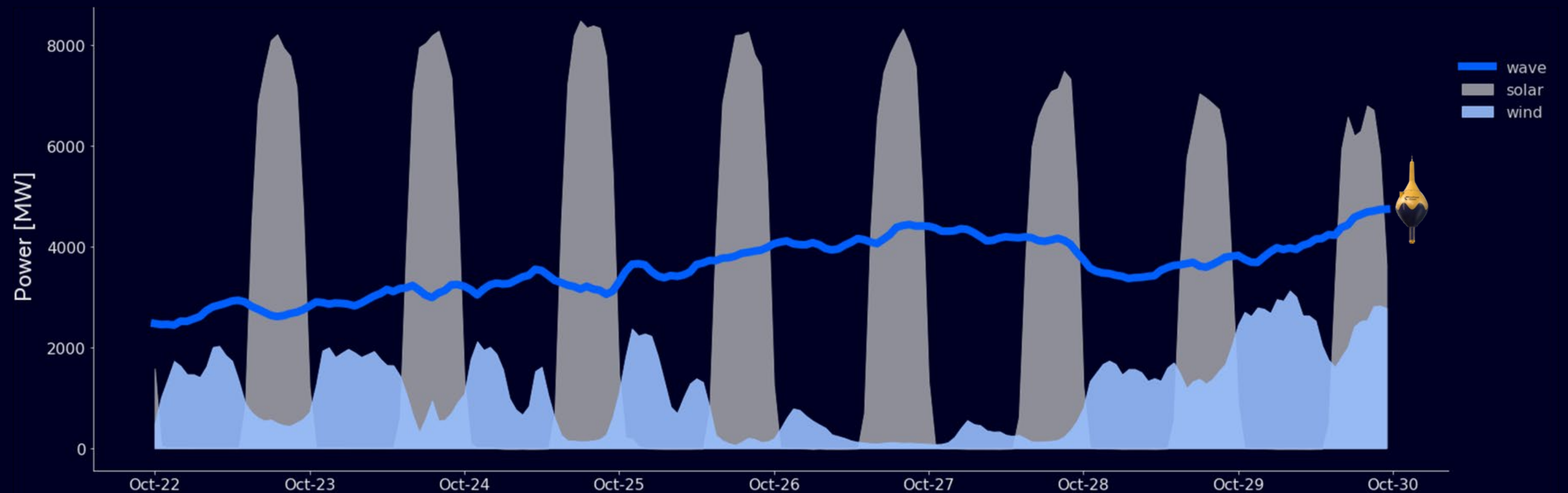
- 500-1800 GW | 2000-7200 TWh
- CO2 Reduction | 1 – 2.2 Gigaton / year (vs Gas - Coal)
- Production profile is more consistent and complementary to wind and solar, unlocking 24/7 clean electricity



■ 500GW exploitable @ highest energy site w >30kW/m resource. 1800GW total available market

Consistent production profile

Enabling 24/7 Carbon Free Energy



Wind (6.5 GW) and solar (13.5GW) production: Actual time series of the period Wave production (6.0 GW): Estimate based on measured wave data and CorPower power matrix 6 GW wave energy devices evenly distributed over four sites along the coast of California.

The ocean

A huge energy storage unit

Taking a stabilizing role, that fossil has had historically

Reducing cost of firm clean energy

Locally produced, resilient, secure

CorPower WECs

3-400 kW

Power Rating

10-30 MW

Wave Cluster Size

40-60%

Capacity Factor

>40 M

Installation Depth

15MW/km²

Spatial Density

0.25-6 m

Operational Range (Hs)



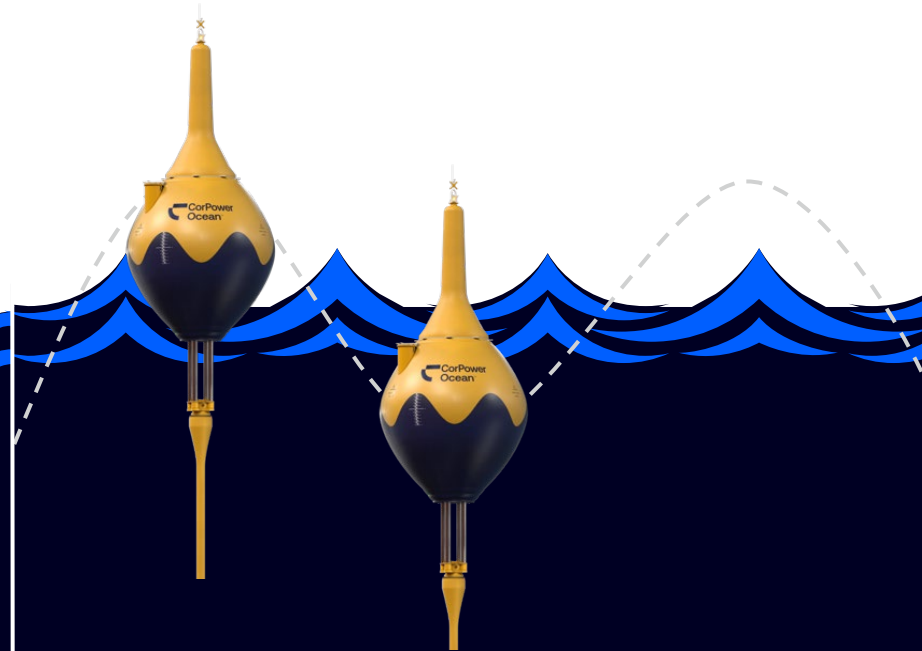
CorPower's WEC maximizes energy output and survivability



CorPower wave energy converter

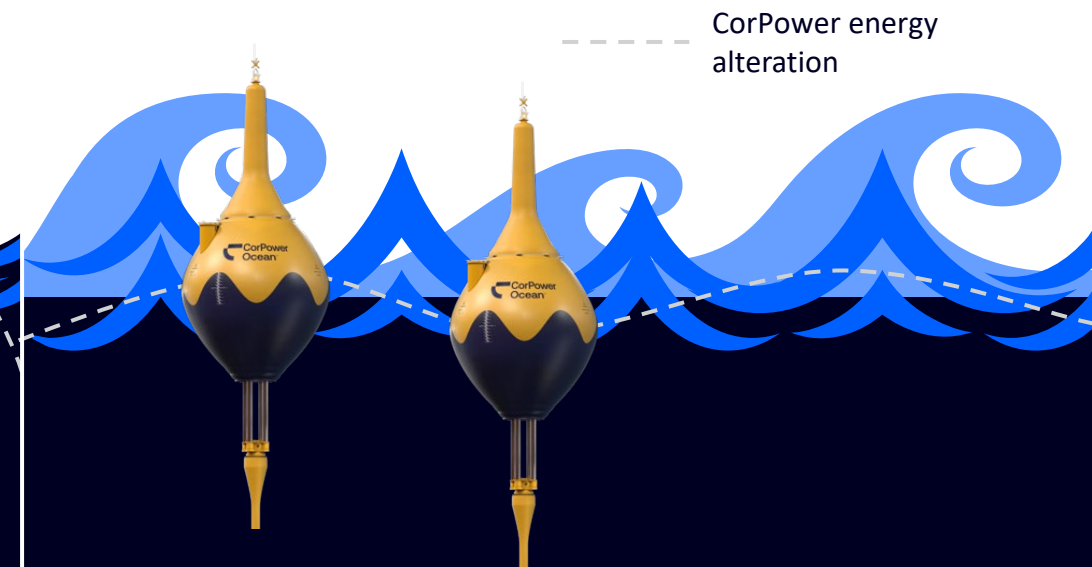
Wave energy system of point absorber type, **capturing wave energy from all directions**

- 1 Waves push the buoy upwards
- 2 The unit has a pretension system that pushes the buoy back down
- 3 Movement from waves drives a power takeoff, converting the energy into electricity



Amplifies motion to capture 3x more energy

Under normal conditions, the devices are tuned and set in optimal timing with each incoming wave, strongly amplifying the motion and power capture to enable **state-of-the-art efficiency**



Naturally transparent to protect from storms

CorPower's IP-protected technology makes the devices transparent to incoming waves in their default mode, enabling **natural protection during storms**

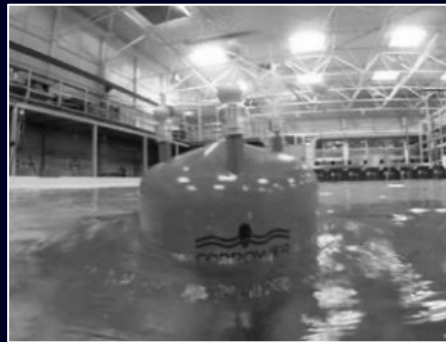
C4 operations in Agucadoura

Powering the Portuguese grid



Structured product verification in 5 stages

[IEA-OES framework for ocean energy technology](#)



2012—2013

Stage 1
Concept

Validation



2014—2015

Stage 2
Critical System tests

Dry and tank testing



2015—2018

Stage 3
1:2 scale device

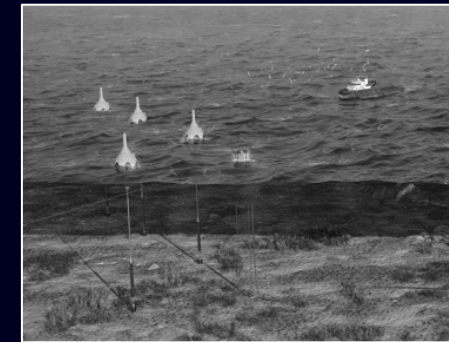
Dry and ocean testing



2018—2024

Stage 4 – TRL 7
Full scale device

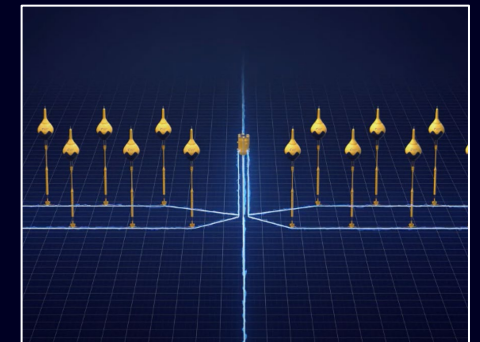
Dry and ocean operation



2024—2028

Stage 5 – TRL 8
4 device array

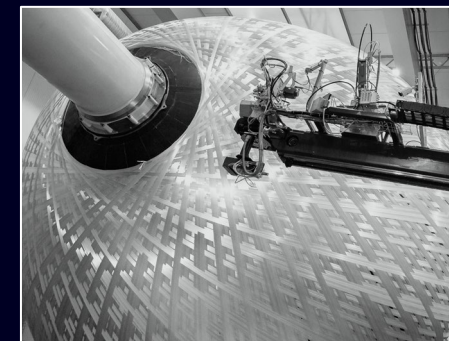
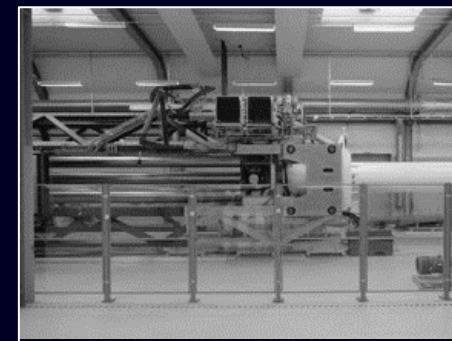
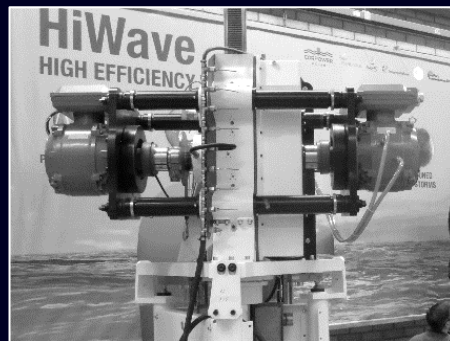
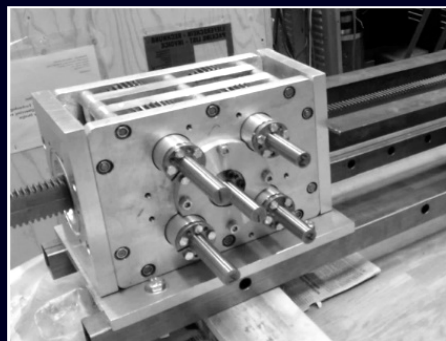
Pilot array (4 WECs)



2029 — Onwards

Commercial - TRL 9
Wave Farms

CorPack clusters (10-100s WECs)



CPO Wave farm projects

Permitting experience

- Scotland – Orkney Islands:
 - 1x C3 WEC – ½ scale prototype in 2018
 - 15x C6 WECs with Valiant Project in 2029-2030
- Portugal – Agucadoura:
 - 1x C4 WEC in Operation
 - 3x C5 WECs with EU-SCORES Project in 2027
 - 45x C6 WECs with VianaWave Project in 2029-2030



Consenting pathway

From Prototype to pre-commercial projects

Past Consenting regimes:

-  2018 – C3 WEC
 - Pre-consented site:
 - At EMEC Scapa Flow under the test centre's envelope consents – One Marine Licence
-  2023 – C4 WEC
 - Defined as research area:
 - Aguçadoura – TUPEM issued by DGRM – One point of contact

Array scale to commercial projects:

- Consenting possible but not streamlined:
 - ≠ regimes depending on the size of the project
 - No specific consenting or permitting routes for wave energy projects
 - Different WEC technologies with different working principles - Point absorbers (CPO), rotating mass, submerged, terminators, oscillating water column, attenuators, ...
 - Weak evidence base of environment impact → Lack of knowledge from the permitting authorities

Environmental Impact Study – MRE differences

Offshore Wind Farms (OWFs)

- Submerged and emerged infrastructure:
 - Wind blades
 - Heavy mooring requirements

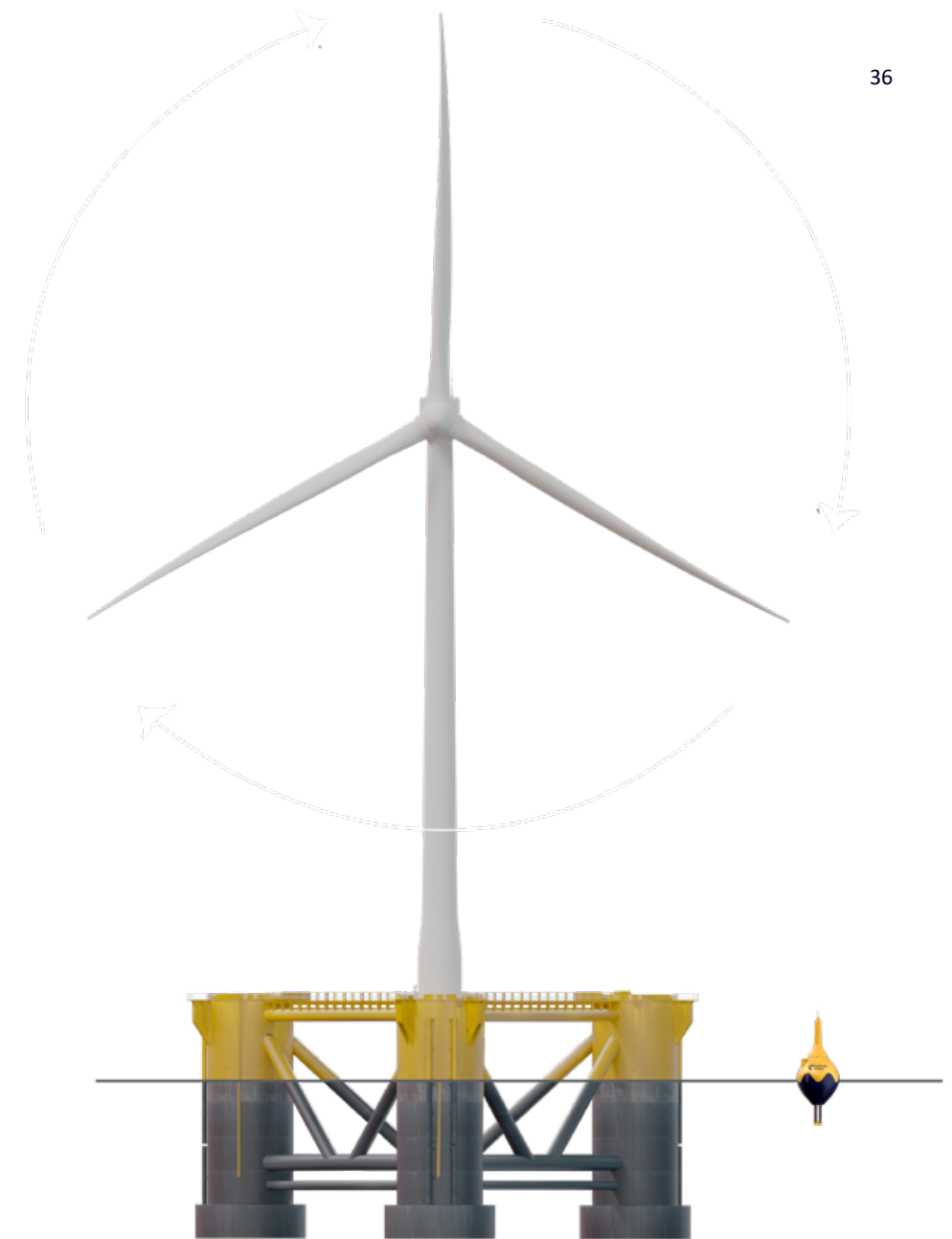
Tidal Energy

- Water blades
- Placed in strong currents locations

Wave Energy (WECs)

- Many different wave technologies exist and differ in their functioning:
 - Point absorbers (CPO)
 - Rotating mass
 - Submerged
 - Terminators
 - Oscillating water column
 - Attenuators
 - ...

→ Understanding how WECs differ from other renewable marine energy is crucial to accelerate and facilitate Licensing and Permitting processes for wave energy projects



Environmental Impact Monitoring and Mitigation

Example of Past and Ongoing Projects



jUMP Project:

- Catalogues of underwater noise and its sources in Portuguese marine waters, like maritime. Maritime traffic as the primary source of underwater noise.



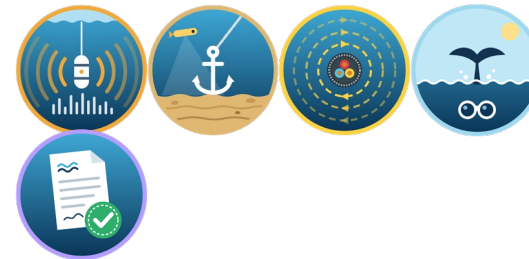
WESE Project:

- Wave Energy in Southern Europe, was dedicated to research on the non-technological barriers to the development of the wave energy sector.



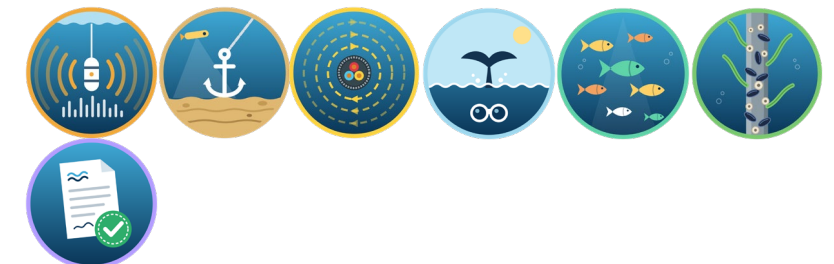
SafeWAVE Project:

- Continuity of WESE Project. Streamlining the assessment of environmental effects of wave energy systems.



EU-SCORES Project:

- European Scalable Offshore Renewable Energy Sources – Includes environmental tracking for WECs and focuses on minimizing the offshore footprint while assessing specific ecological risk areas: Acoustic, underwater noise, marine mammal activity, EMFs and benthic and seafloor integrity



Environmental Impact Analysis of WECs

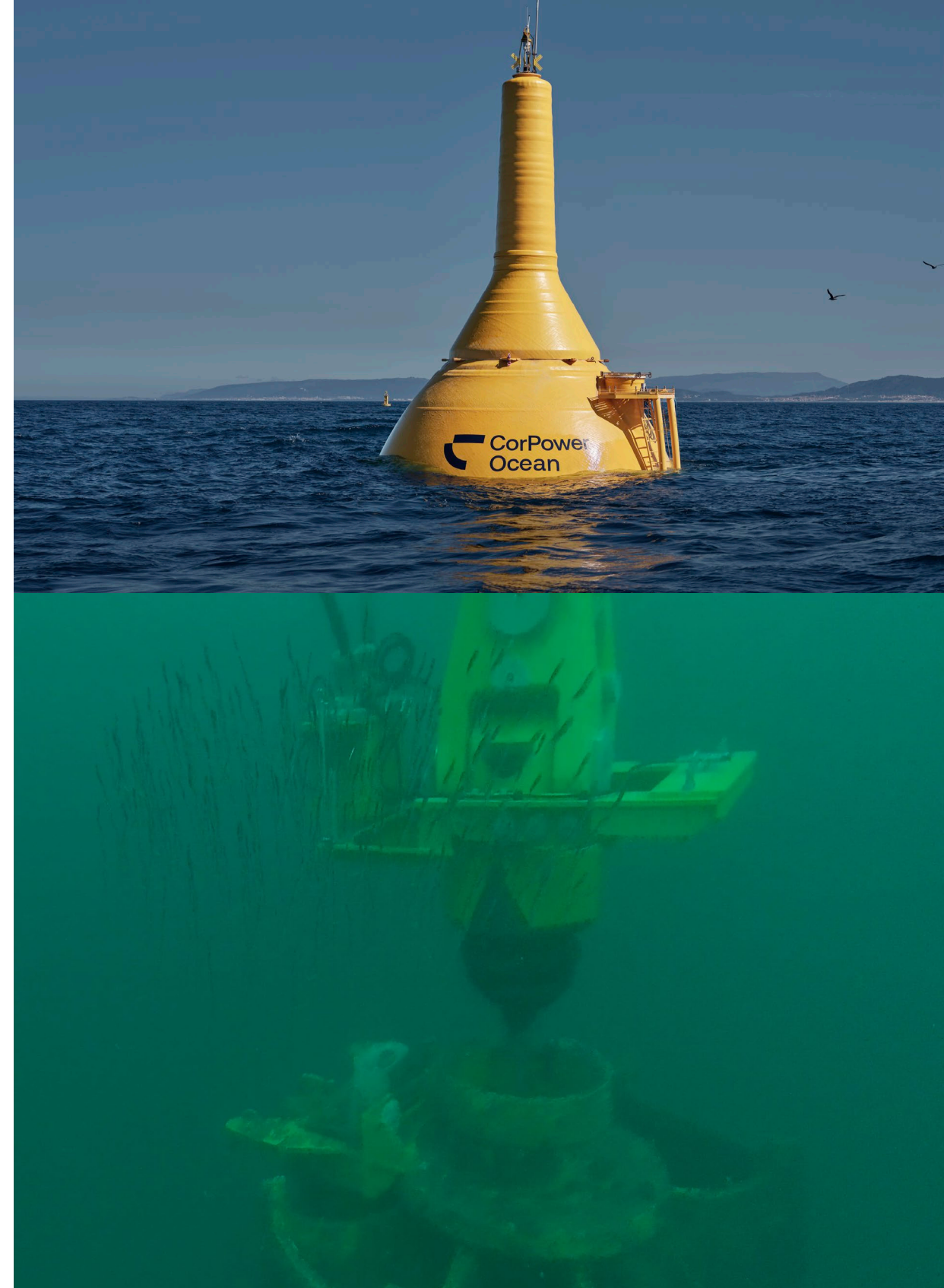
Potential Risks vs. Benefits

Low Collision risk with Marine Species

- Collision risk with rotating parts is **absent**.
- No entanglement risks nor collision of larger mammals – Depending on the WEC technology – for CPO: rigid mooring rod

Habitat Impact

- CPO WEC is a heaving buoy
 - Surface shelter effect limited
 - Artificial reef effect limited by low seabed footprint
 - Avoiding marine growth and biofouling for WEC performance
- ➔ **Low-risk habitat changes and entanglement risks with careful planning.**
- ➔ **Studies have not detected significant changes in benthic habitats or marine species communities surrounding WEC devices.**



Environmental Impact Analysis of WECs

Potential Risks vs. Benefits

Visual Impact:

- Minimal visual impact

Noise Disturbance:

- Minimal to no impact on the ambient noise.
- Significantly lower than other maritime activities

Limited ecological impacts from EMFs.

- No significant biological impacts detected.

→ Need for real-world long-term monitoring



Ocean Energy Development Strategies

A sustainable way forward

Minimal Ecosystem Risk:

- With careful planning and studies to ensure no significant threat to local marine ecosystems.

Consenting Process Challenges:

- Long procedures, monitoring requirements, and the need for dedicated legislation.

Proposed Actions:

- Financial support for research, simplified processes, and shared consenting experiences.

Recommendation for Monitoring:

- Importance of real-world, long-term monitoring to assess the actual impacts of ocean energy on marine environments (marine mammal observation, subsea acoustic, seabed condition, fish population, EMF, etc) .
- Continuous and comprehensive observations is needed to understand the behavior of marine animals around these installations better and assess potential stressors.



Wave power. To power the planet.

corpowerocean.com

Quentin Geerinckx

Snr. Technical Project Manager



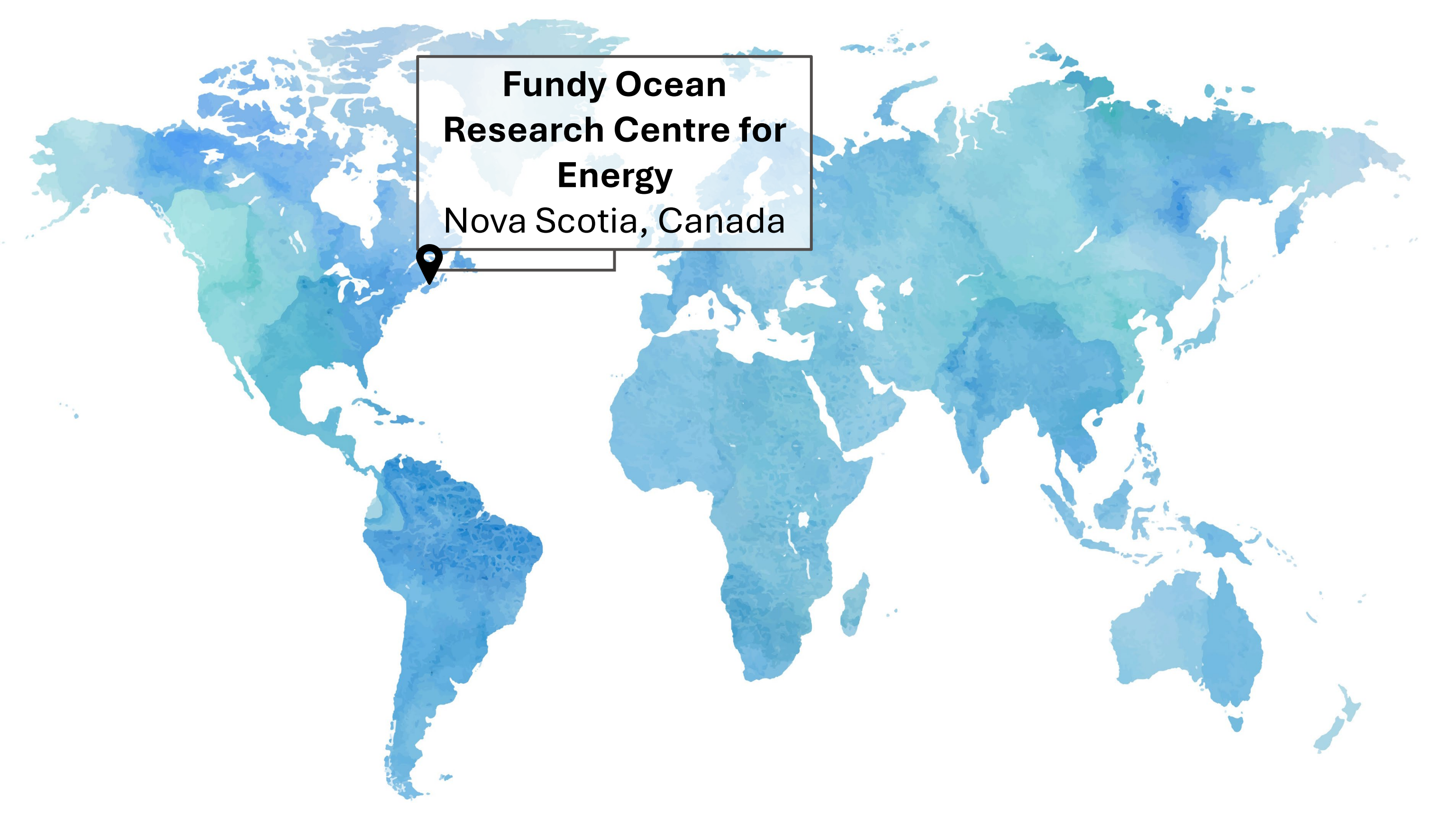
OES-Environmental Webinar | October 13, 2026

Navigating Consenting Processes for Environmental Effects of Marine Renewable Energy – Regulatory and Industry Perspectives



force

Fundy Ocean Research
Centre for Energy

A stylized world map with a blue and teal color palette. A black location pin is placed on the northeastern coast of North America, specifically in Nova Scotia, Canada. A white rectangular box with a thin black border is positioned above the pin, containing text.

**Fundy Ocean
Research Centre for
Energy**
Nova Scotia, Canada



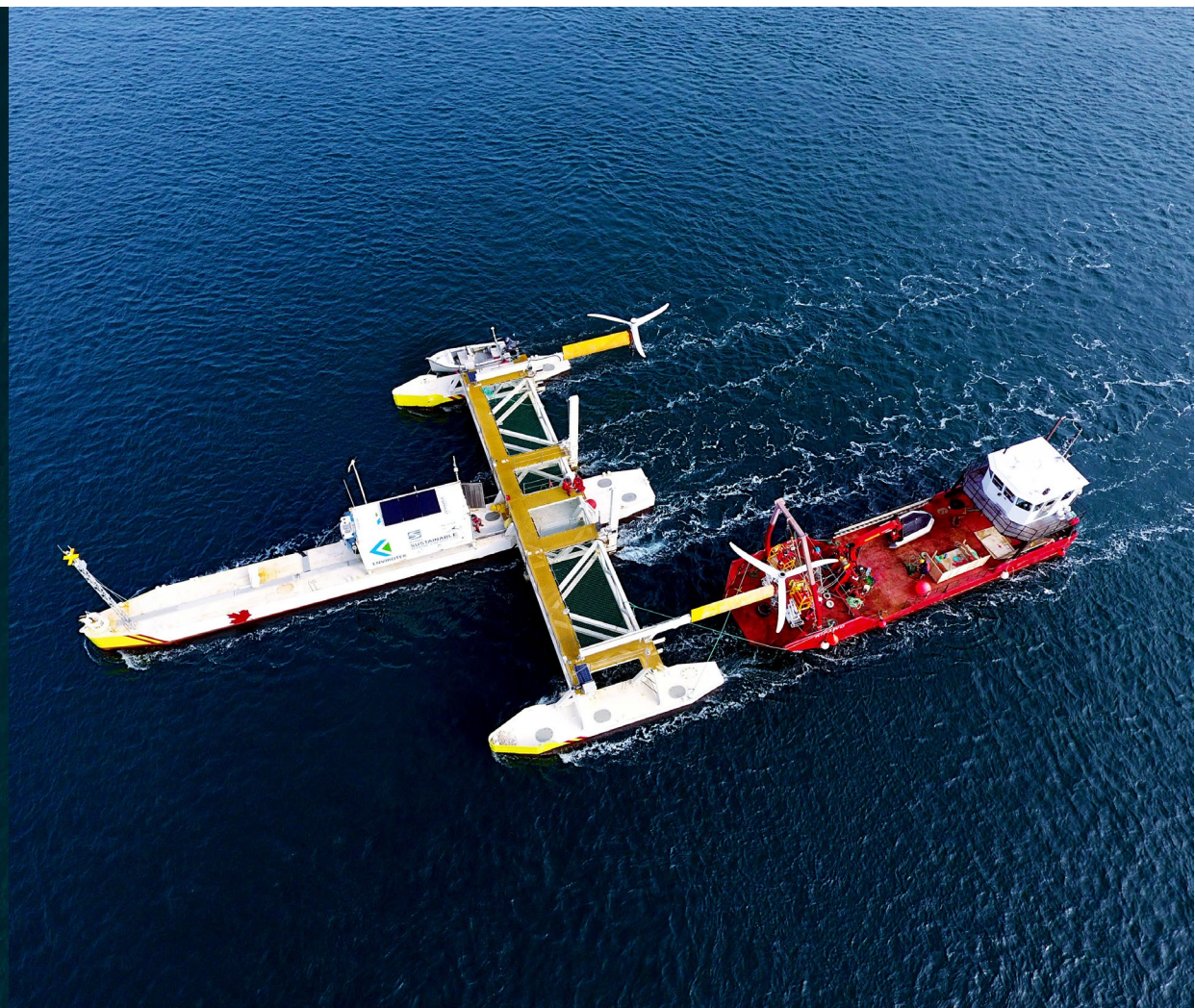
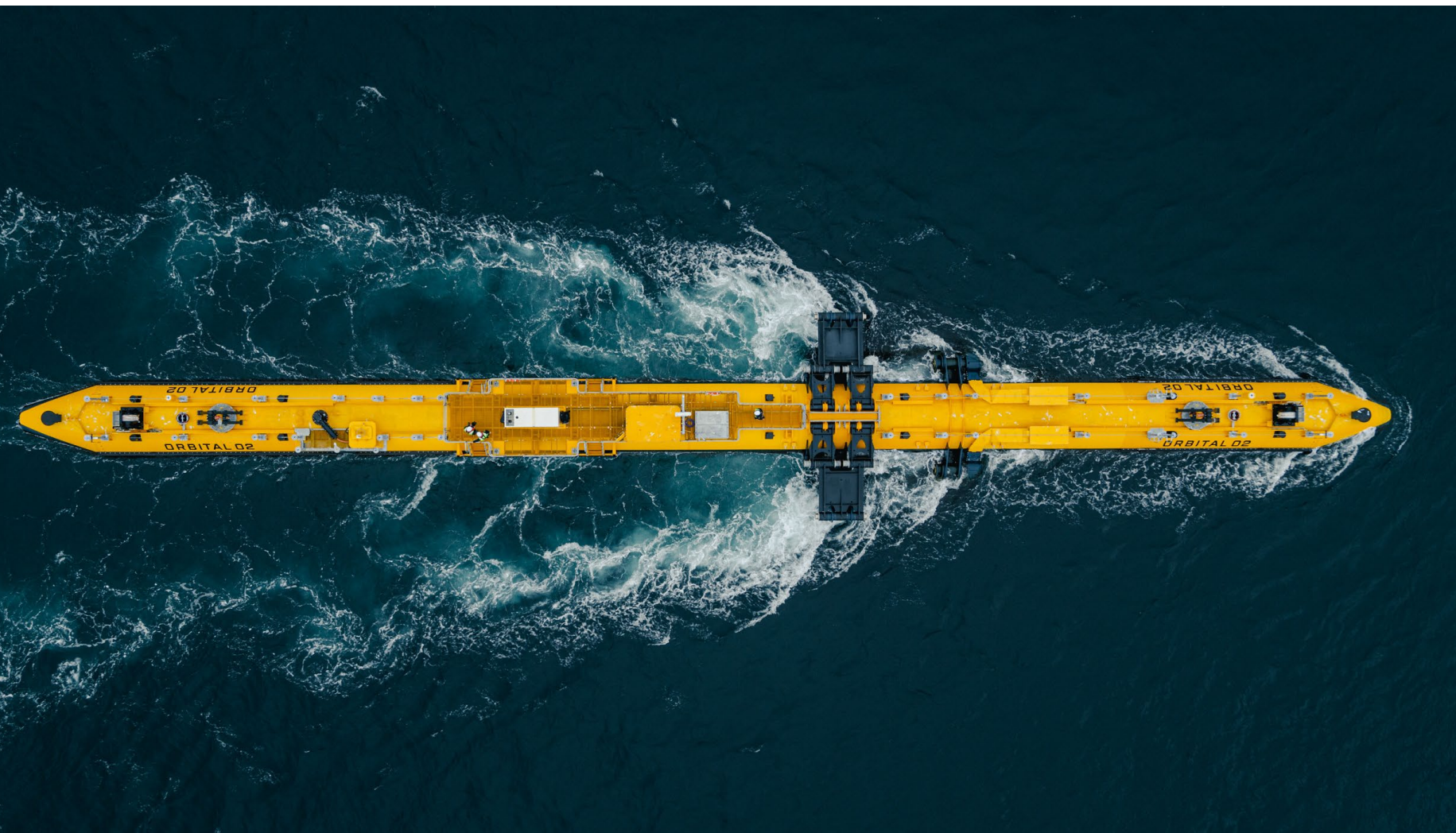
**Fundy Ocean Research
Centre for Energy**
Nova Scotia, Canada



Multi-Jurisdictional Regulatory Landscape

Level	Main Agency	Focus
Indigenous	Mi'kmaq of Nova Scotia	Rights holders
	Fisheries & Oceans Canada (DFO)	Fisheries Act, Species At Risk Act • Fish & fish habitat impacts / SARA species interactions
Federal	Transport Canada (TC)	Navigable Waters Act • Navigation and marine safety
	Environment & Climate Change Canada (ECCC)	Canadian Environmental Protection Act • Pollution / SARA species interactions
Provincial	Department of Energy (DOE)	Marine Renewable-energy Act • Licenses, permits & PPAs
	Department of Environment and Climate Change (NSECC)	Environment Act • Environmental approvals & assessments

Regulatory uncertainty



A turning point



2009-2023	Unclear regulatory framework: triggers, application process, and requirements were not well defined
2023	Breaking point: SME delivers electricity to grid then shuts down project, DP relinquished its licence, and investor confidence declined
2024	NRCan and DFO launch the Task Force on Sustainable Tidal Energy
Goal	Clarify the regulatory pathway and identify barriers to tidal energy development

 Fisheries and Oceans Canada Pêches et Océans Canada

Canada

Task Force on Sustainable Tidal Energy Development in the Bay of Fundy Final Report



New regulatory pathway



From uncertainty to greater clarity:

- **Staged approach:** single device → small array
- **Clear expectations:** monitoring requirements for each phase
- **Longer term:** 15-year authorizations aligned with provincial licensing
- **Innovation and science:** support for new research on monitoring and collision risk
- **Collaboration:** regulators and the international scientific community

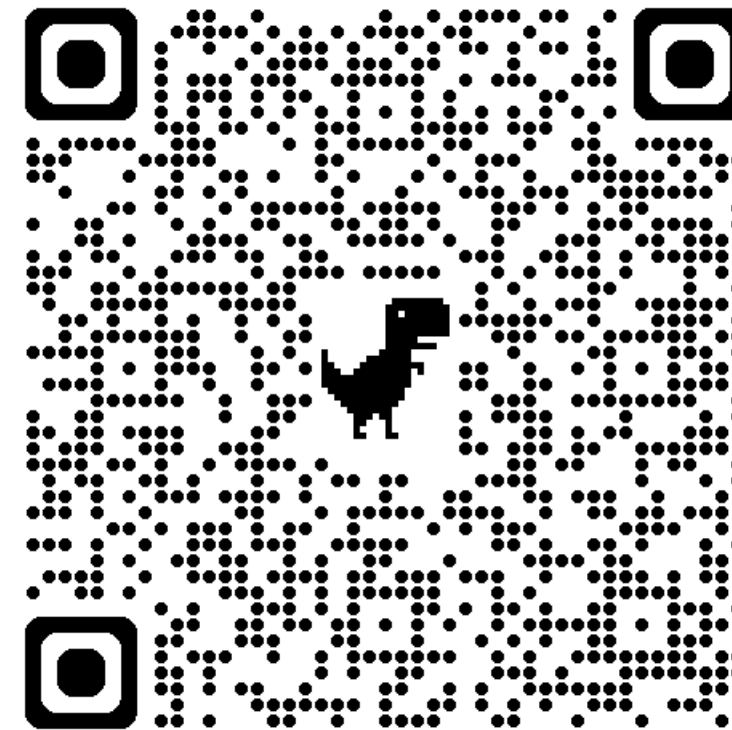


DFO's Bay of Fundy requirements



Published monitoring guidance for responsible development

- Monitoring scaled to project risk
- Assess fish movement and collision risk
- Capture day/night, tidal and seasonal variability
- Verify equipment and report regularly
- Adapt when data or equipment fall short

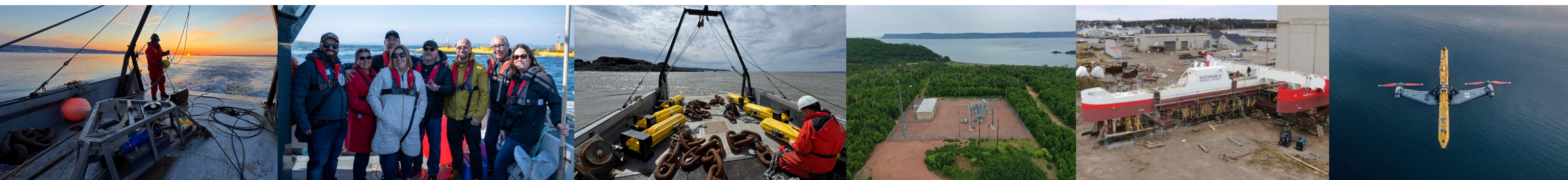


Source: <https://www.dfo-mpo.gc.ca/publications/pnw-ppe/tidal-energy-energie-maremotrice/bay-fundy-aeemp-baie-fundy-pasee-eng.html>

Recent progress



- **Technical capacity:** multi-sensor data integration, marine optics & acoustics, regulatory
- **Delegation of Mi'kmaq Chiefs:** 25+ people in Orkney, observed O2 in operation
- **Adaptive monitoring:** guidance and template content to support proponents
- **Governance reform:** FORCE Board → developers to independents
- **Acoustic receiver array:** 24-station array, year-round monitoring, encounter rate modelling
- **New research:** \$8.2 M Ocean Sensor Innovation Platforms (OSIP) project
- **Orbital progress:** first authorization under new regulatory path, more licensed capacity



Building evidence

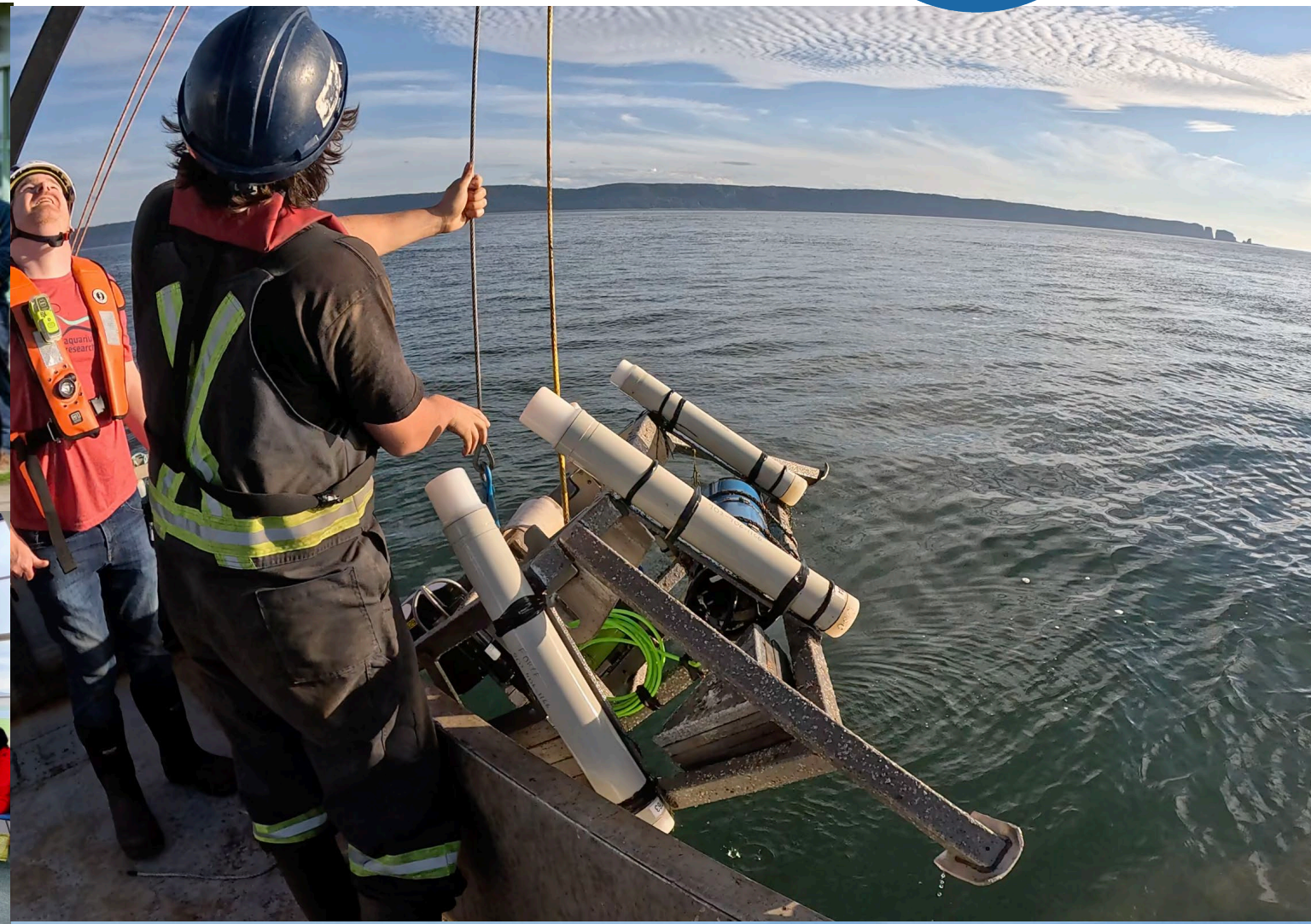
OSIP is designed to:

- Measure fish encounter rate probability
- Develop best practices for monitoring fish-turbine interactions
- Support regulatory decisions
- Build confidence in monitoring methods
- Encourage investment
- Help projects advance responsibly

Bringing together many tools, approaches and partners to tell a more complete story of marine life in Minas Passage



What's next

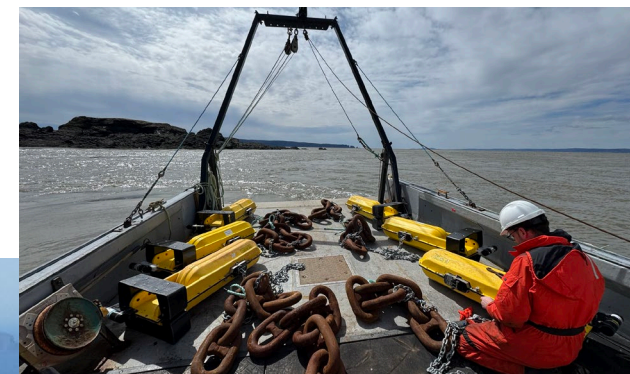


Summary



Regulatory landscape for tidal development in Nova Scotia

- Multi-jurisdictional: federal, provincial, First Nations governance
- Comprehensive and streamlined: improved permitting pathways provide clarity and predictability while maintaining rigorous oversight
- Science-based and adaptive: approvals grounded in best available science and continuous learning from FORCE, academia, and international projects/initiatives
- Inclusive and rights-respecting: meaningful engagement with Mi'kmaq communities and organizations



Wela'liog Thank you

Connect with us:
lindsay.bennett@fundyforce.ca
www.fundyforce.ca
@fundyforce

Question & Answer + Discussion

- Type your questions into the Q&A box at the bottom of the screen
- Moderated discussion with your questions
 - Presenters may also provide typed responses to questions



Share your feedback with us!



<https://www.surveymonkey.com/r/GVBTRPK>



Thank you

Special thanks to Ocean Energy Systems and the
U.S. Department of Energy Hydropower and
Hydrokinetic Office

