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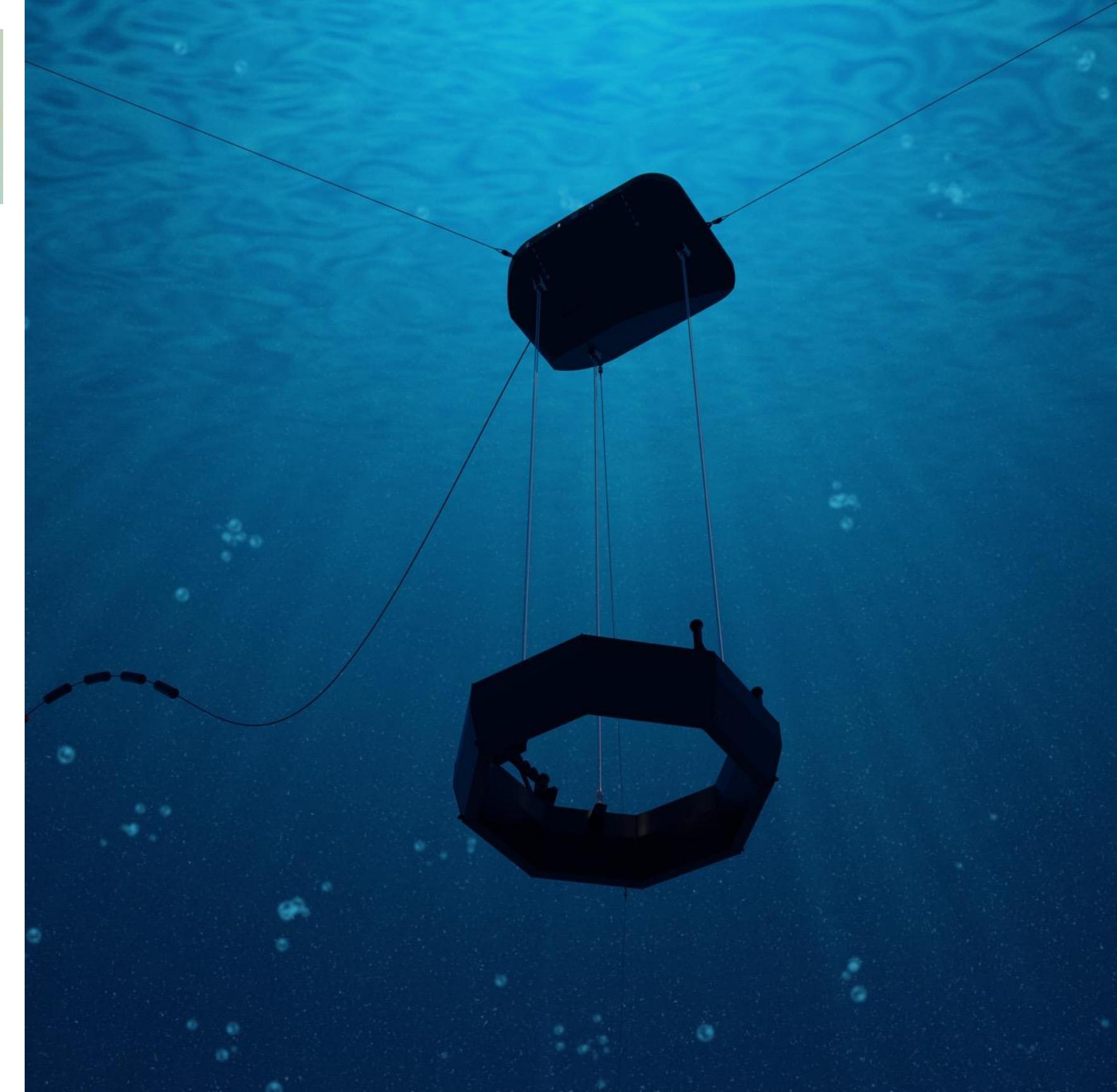


# Addressing Place-Based Environmental Questions to Enable Marine Energy Deployments

**Lenaïg Hemery**

Andrea Copping

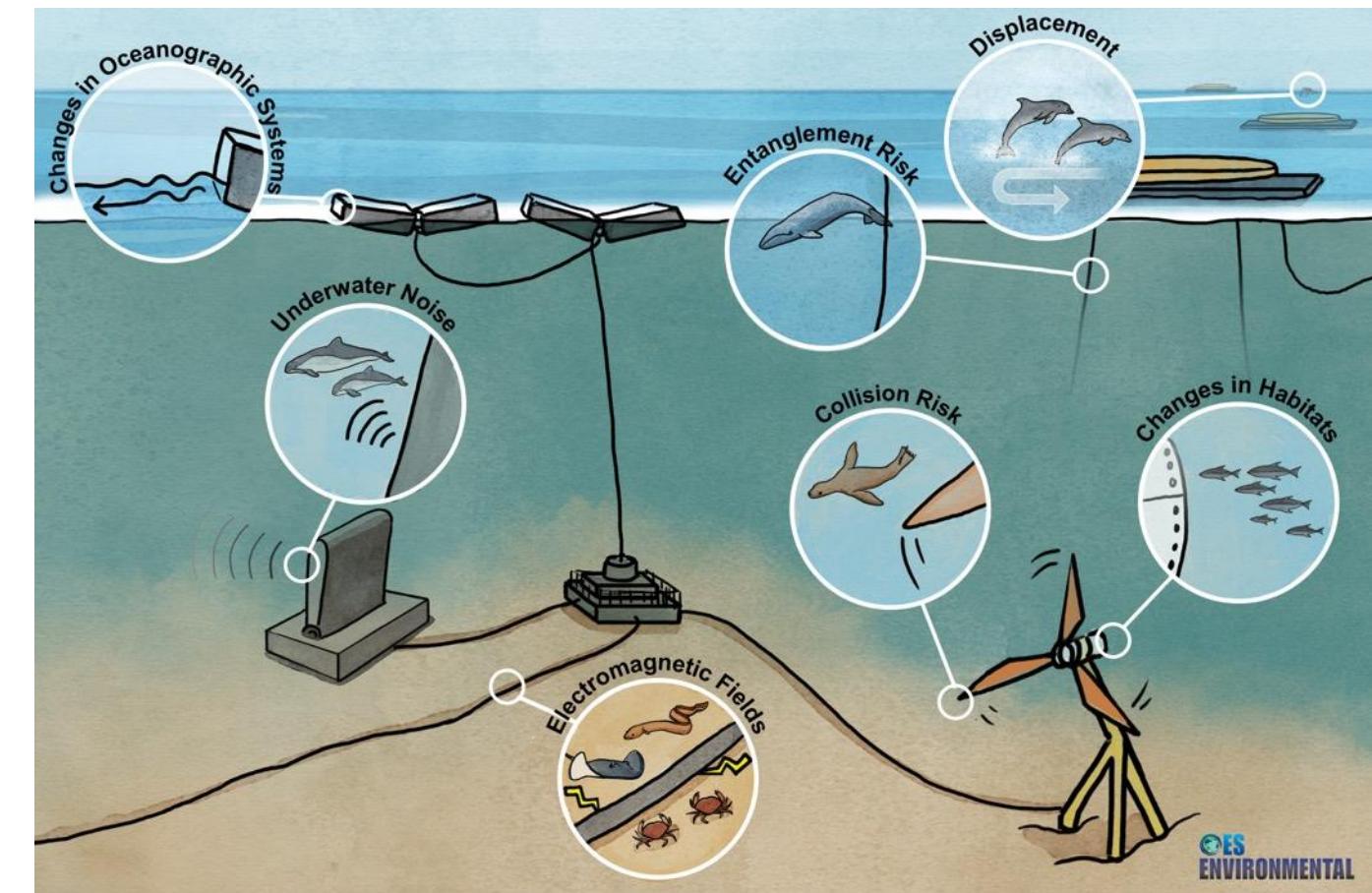
Kristin Jones



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

# Why Environmental Effects of Marine Energy?

- Uncertainties around the effects of marine energy cause concerns among regulators and stakeholders
  - Species and/or populations at risk
  - Habitat alteration or loss
  - Effects on water quality and oceanographic systems
  - Effects on social and economic systems (including cultural and historic uses)
- Concerns can be driven by novel technologies, new uses of ocean space, unclear regulatory process, etc.
- Educated and engaged stakeholders can
  - Separate perceived risks from actual risks
  - Distinguish issues specific to marine energy
  - Participate in decision-making processes

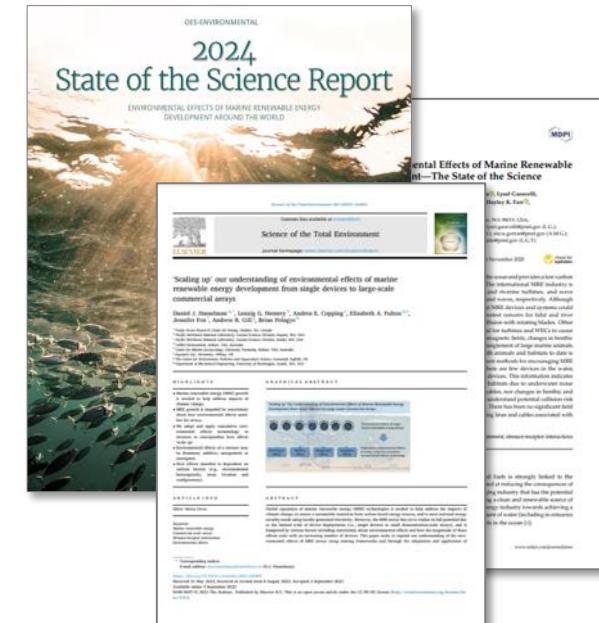
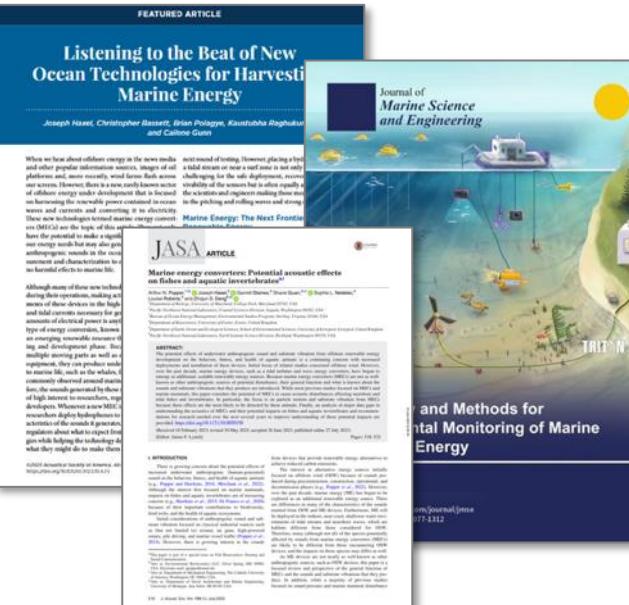


# Marine Energy Environmental Research at PNNL

- OES-Environmental
  - International initiative (16 countries) that examines environmental effects of marine energy
  - Mobilizes information and practitioners to coordinate research that can progress the industry in an environmentally responsible manner
- Triton Initiative
  - Researches and develops monitoring technologies and methods to understand potential environmental effects of marine energy
  - Aims to reduce costs and provide valuable data to inform the U.S. marine energy industry's environmental permitting processes

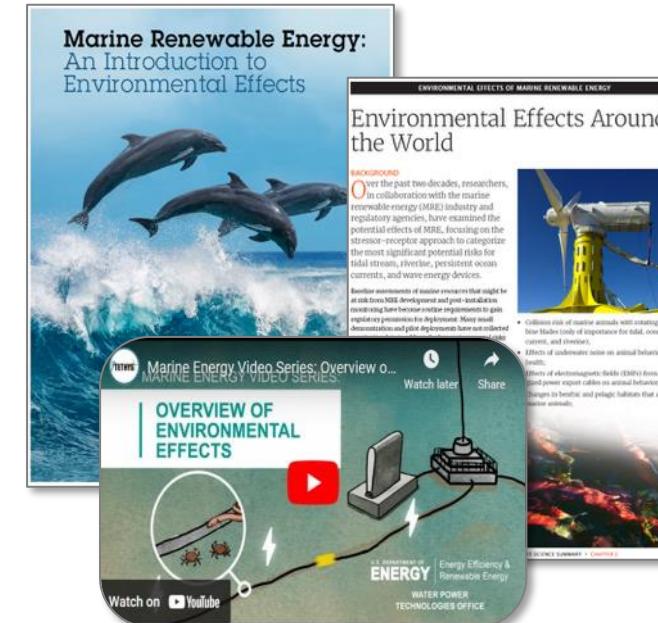


# Product Development with Stakeholders in Mind

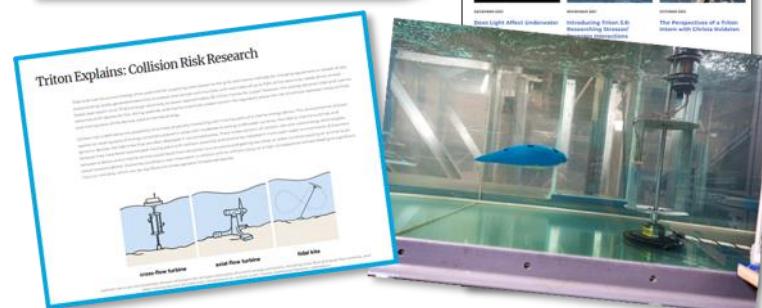


## Scientific publications

## Outreach material



## Stakeholder involvement



### Particle Motion, Fishes, & Invertebrates: What We Know and Don't Know!

Arthur N. Popper  
and  
Anthony D. Hawkins

apopper@umd.edu; Ahukini.net  
a.hawkins@btconnect.com

### Purpose

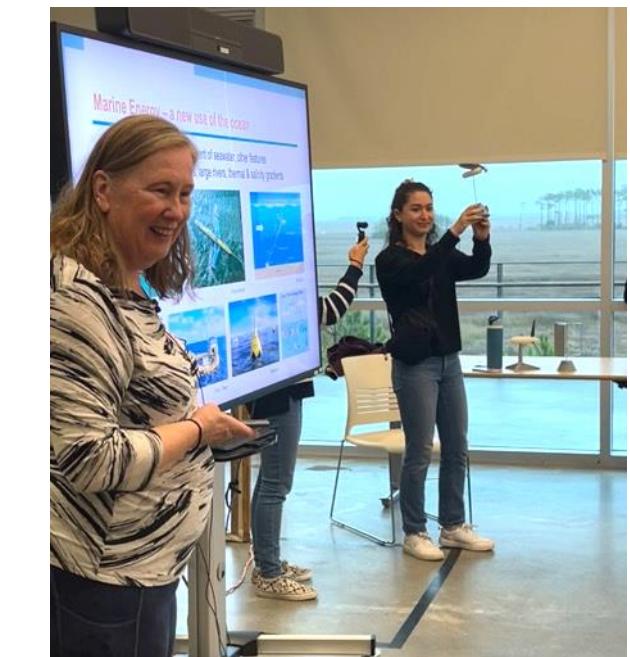
- Provide broad overview of issues needed to appreciate and understand PM
- Goals:
  - Introduce basic ideas about particle motion (PM)
  - Introduce the issue of substrate vibration (SV) and aquatic animals
  - Share my thoughts on gaps in understanding role(s) of PM, especially as related to tidal and wave energy
  - While I primarily mention fishes, keep in mind that many aquatic invertebrates hear and even make sounds



# PNNL and AMEC

PNNL supports the AMEC “Marine Energy Stakeholders Engagement-Systems approach” task, led by the Coastal Studies Institute

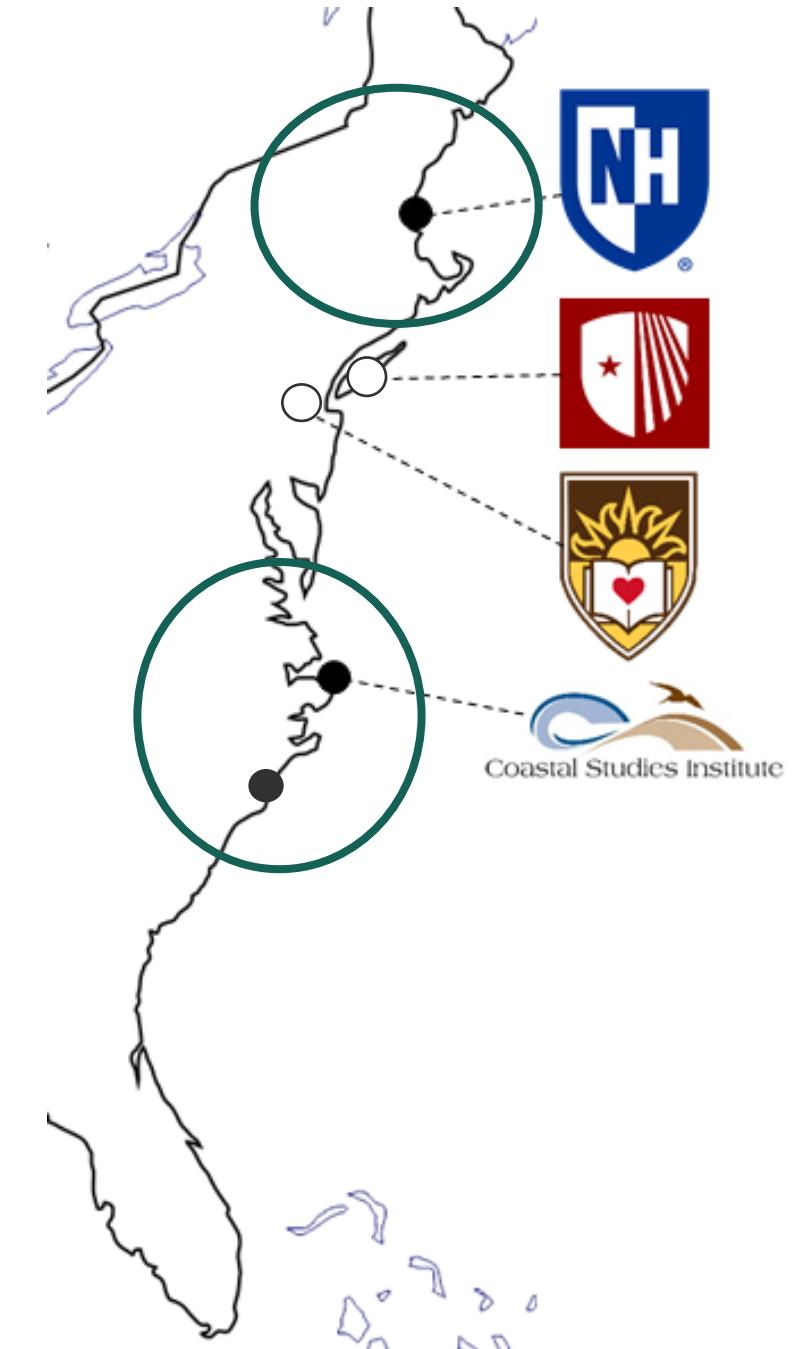
- University-led consortium that addresses research needs in support of marine energy development on the Atlantic coast
- AMEC is involved in:
  - Interdisciplinary research relevant to marine energy & the blue economy
  - Marine energy device and component testing
  - Stakeholder connections with researchers, industry, communities, etc.
  - Educational opportunities for all ages



PNNL/AMEC presentation at K-12 renewable energy event

# PNNL / AMEC Workshops – Goals & Approach

- **3 workshops:** Portsmouth, NH; Wanchese, NC; Beaufort, NC
- **Goals:** Engage with a wide spectrum of stakeholders on the U.S. Atlantic coast to
  - Increase awareness of marine energy and its environmental and social effects
  - Create local support for the developing industry
  - Learn more about local stakeholder concerns
- **Approach:** Environmental and social effects of marine energy
  - Address similarities and differences between marine energy and offshore wind
  - Familiarize stakeholders with extensive resources available on environmental effects and permitting
  - Leverage local use cases
  - Focus on discussion and feedback from stakeholders



# PNNL / AMEC Workshops – Implementation

- **Attendees:**

- NH: local tribe, marine conservation, advocacy business, federal agency
- NC: research institutions, outreach organizations, marine conservation, state & federal agencies, offshore wind developer, concerned citizens

- **Use cases:**

- Small tidal array for NH
- Single wave device for coastal NC
- Single ocean current turbine for offshore NC

- **Workshop content:**

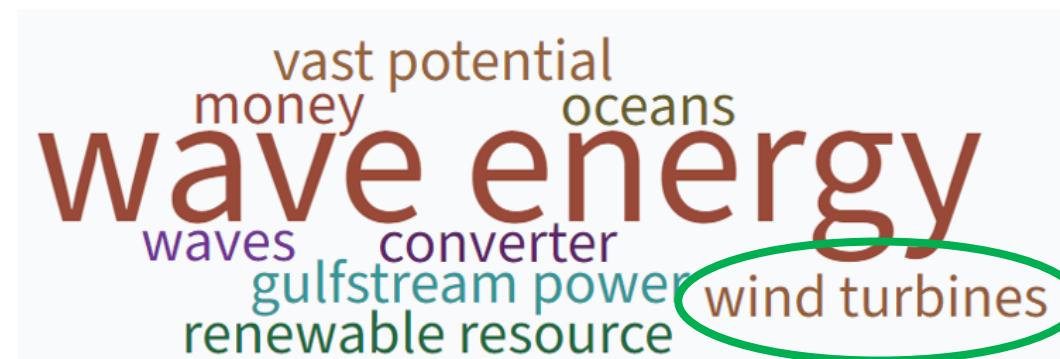
- Presentation on marine energy, environmental effects, and helpful educational resources
- Used marine energy device props to show diversity
- Interactive discussions leveraging the use cases
- Focus on participants' concerns and providing answers



# PNNL / AMEC Workshops – Implementation

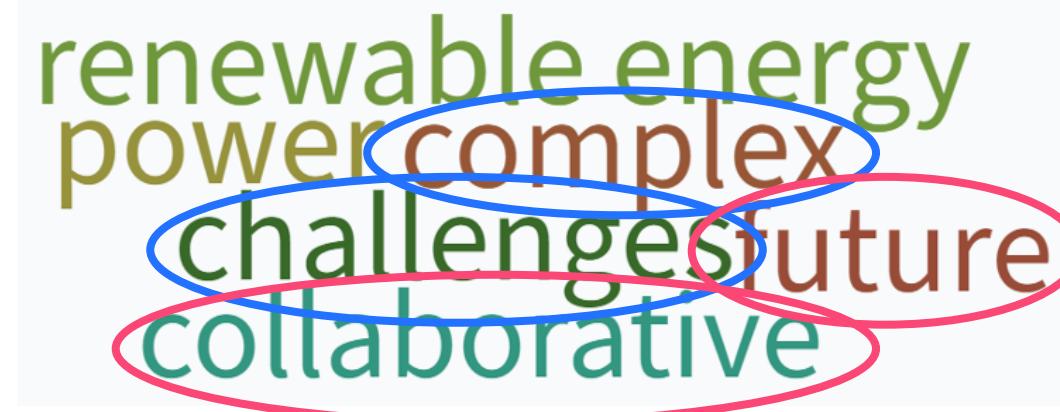
Words that came to the participants' mind when mentioning marine energy, at beginning and end of workshop:

Beginning

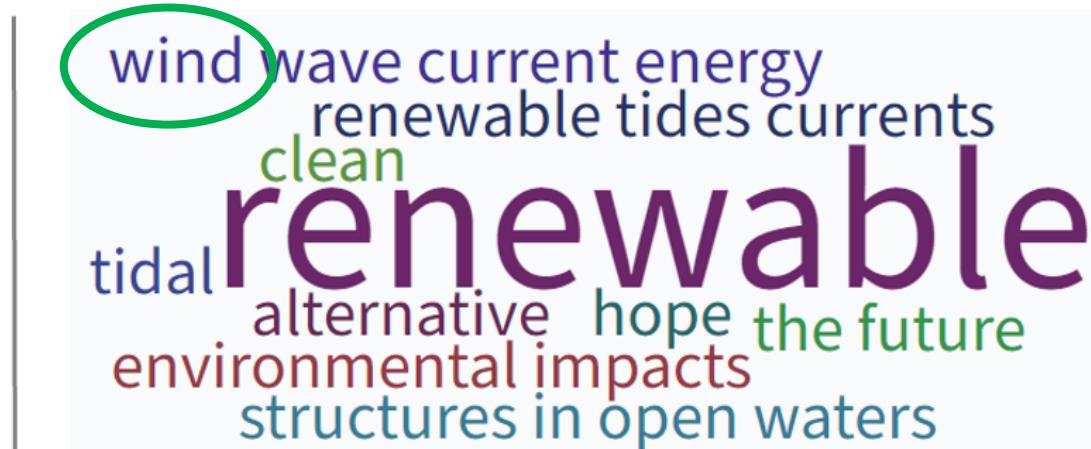


word cloud showing terms related to wave energy at the beginning of the workshop. The most prominent words are 'wave energy' in large red font, 'oceans' in green, 'renewable resource' in green, 'gulfstream power' in blue, 'converter' in purple, 'waves' in purple, 'money' in brown, 'vast potential' in brown, and 'wind turbines' in brown, which is circled in green.

End



word cloud showing terms related to marine energy at the end of the workshop. The most prominent words are 'renewable energy' in green, 'power' in brown, 'complex' in brown, 'challenges' in green, 'future' in brown, and 'collaborative' in green, which are circled in blue, red, and pink respectively.



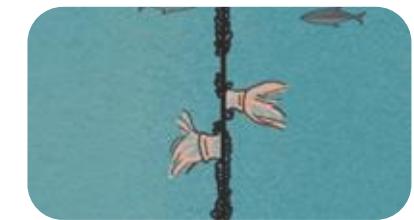
word cloud showing terms related to marine energy at the end of the workshop. The most prominent words are 'renewable' in purple, 'wind wave current energy' in blue, 'tidal' in blue, 'environmental impacts' in brown, 'structures in open waters' in blue, 'hope the future' in green, 'alternative' in brown, 'clean' in green, and 'wind turbines' in brown, which is circled in green.



word cloud showing terms related to marine energy at the end of the workshop. The most prominent words are 'future' in brown, 'power' in brown, 'hope for the future' in blue, 'nascent' in green, 'early days' in green, 'complicated' in brown, 'potential' in blue, 'buoys' in green, 'lesser evil' in brown, and 'renewable' in blue, which are circled in red, blue, and pink respectively.

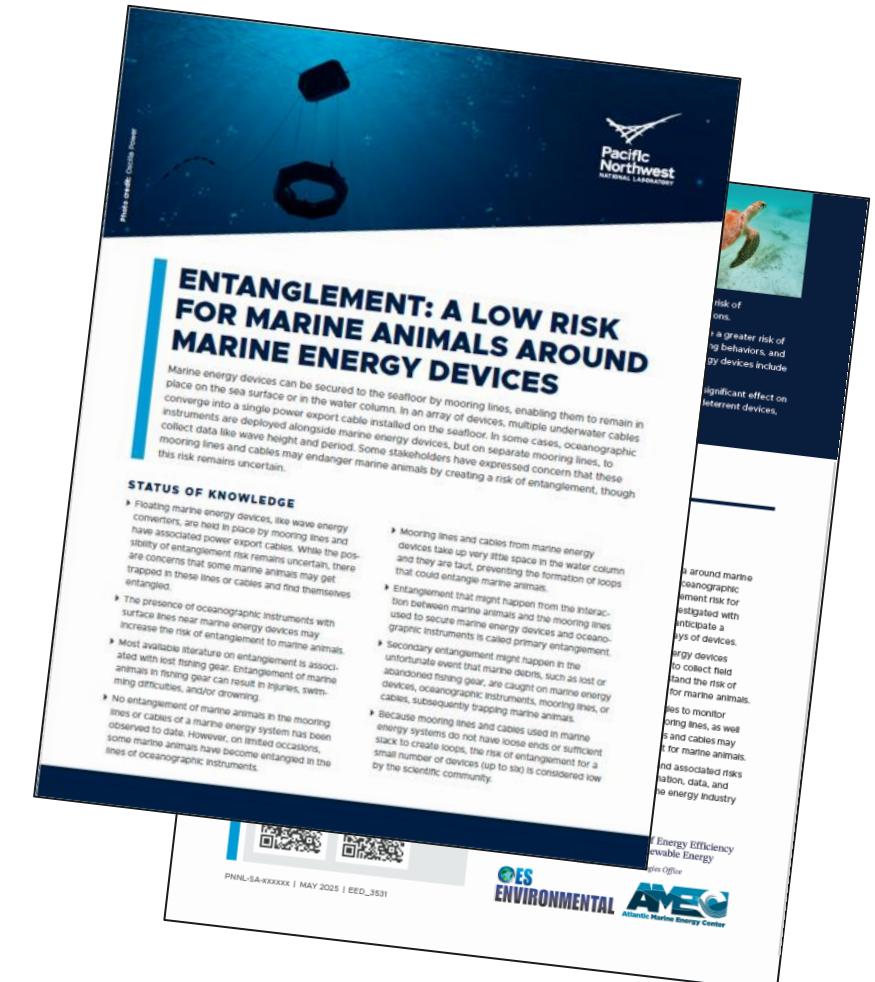
# PNNL / AMEC Workshops – Main Takeaways

- **Greatest environmental concerns:**
  - Impacts to habitats of protected species
  - Interactions/overlap with fisheries
  - Scale of projects/arrays and cumulative effects
  - Entanglement risk with mooring lines and draped cables
- **Other topics of interest:**
  - Economic feasibility, benefits, energy equity
  - Device viability, project lifetime, decommissioning plan
- **Asks from participants:**
  - Learn from offshore wind missteps
  - Involve coastal communities as early as possible
  - Information dissemination and outreach material



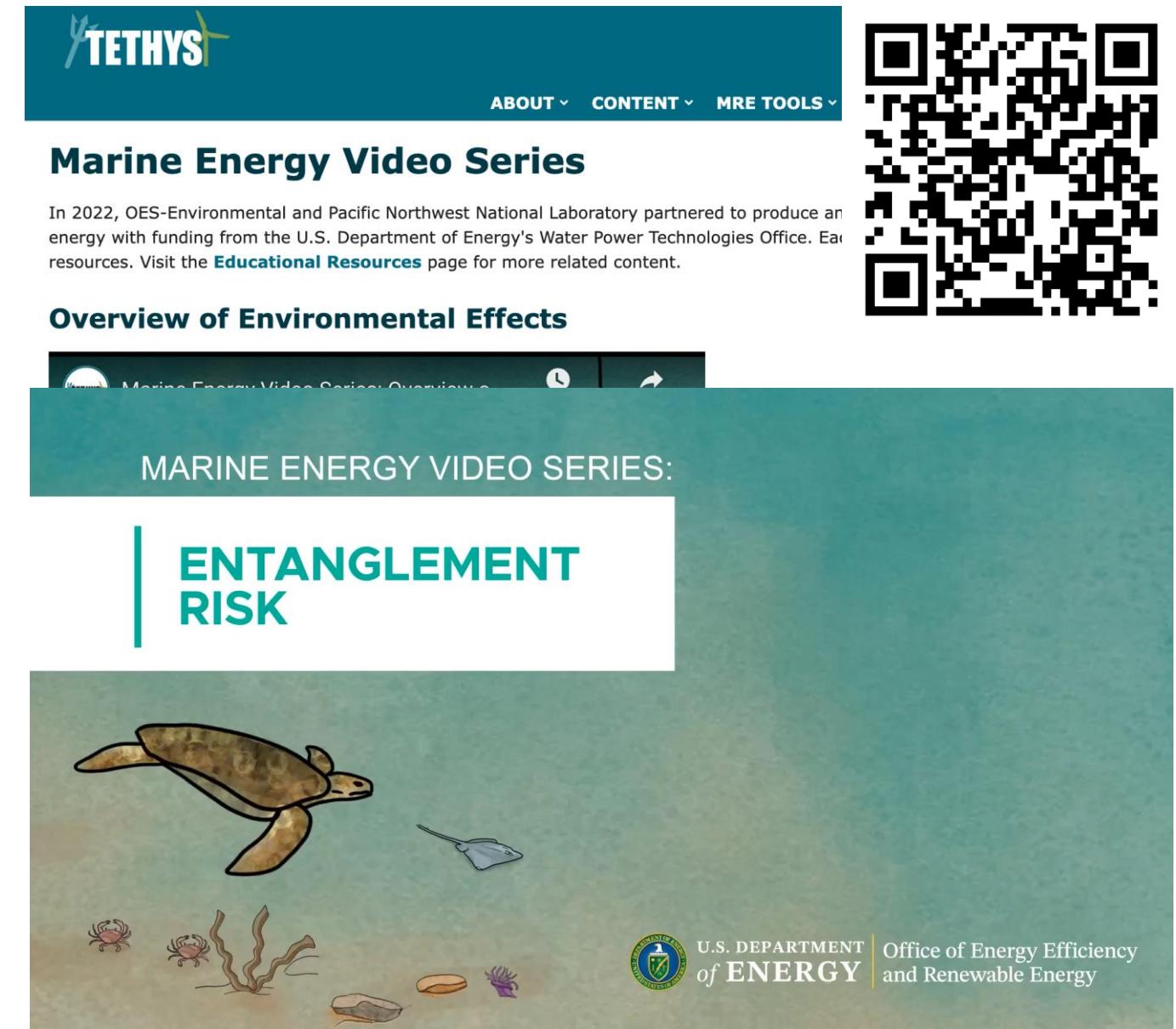
# Stakeholders concern – Entanglement Risk

- **Concern:** Entanglement of marine animals with the mooring lines and draped cables of marine energy devices and oceanographic instruments
- **Entanglement factsheet:**
  - Status of knowledge
  - Potential influencing factors
  - Remaining uncertainties
  - Important considerations looking forward
- **In-depth white paper:**
  - Expand on entanglement literature
  - Explore risk around various mooring types and for different animal groups
  - Discuss possible strategies for mitigation



# Stakeholders concern – Entanglement Risk

- **Marine energy video series:**
  - Overview of environmental effects
  - Underwater noise
  - Electromagnetic fields
  - Changes in habitat
- **Entanglement video overview:**
  - Description of risk around marine energy devices and oceanographic instruments
  - Status of scientific knowledge
  - Animals at risk and potential consequences

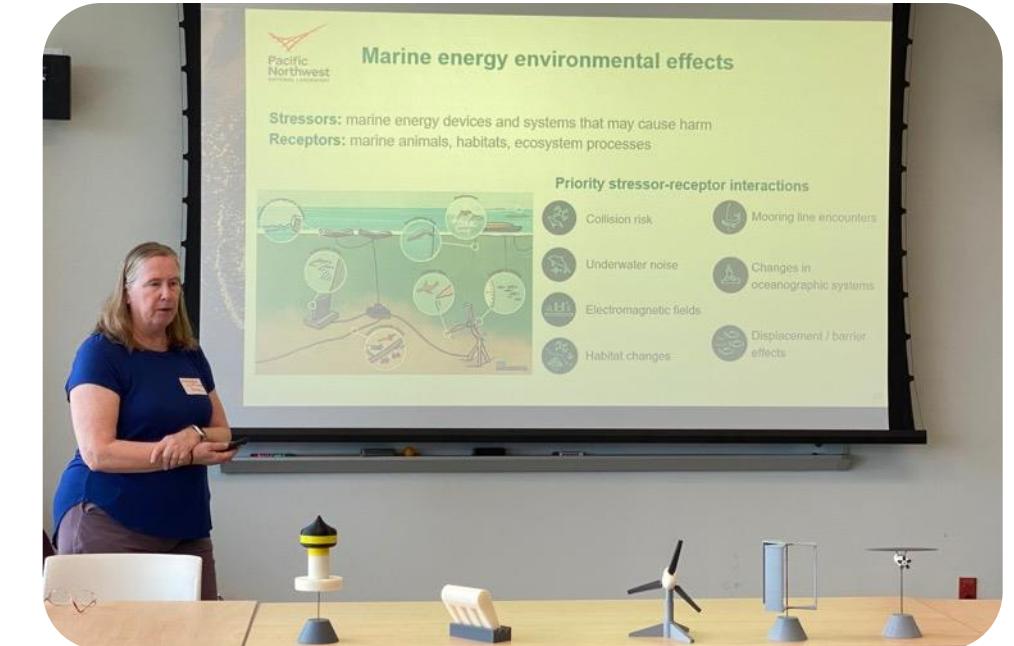


The screenshot shows the TETHYS website with a teal header. The header includes the TETHYS logo, a navigation menu with links for 'ABOUT', 'CONTENT', and 'MRE TOOLS', and a sub-section for 'Marine Energy Video Series'. Below the header, a text block states: 'In 2022, OES-Environmental and Pacific Northwest National Laboratory partnered to produce an energy with funding from the U.S. Department of Energy's Water Power Technologies Office. Each resources. Visit the [Educational Resources](#) page for more related content.' A video thumbnail for 'Overview of Environmental Effects' is visible. The main content area features a large image of a turtle swimming in the ocean, with the text 'MARINE ENERGY VIDEO SERIES: ENTANGLEMENT RISK' overlaid. At the bottom, there is a logo for the U.S. Department of Energy and text for 'Office of Energy Efficiency and Renewable Energy'.



# Conclusion

- In-person stakeholder engagements enabled to learn about specific place-based concerns, such as sea turtle entanglement risk
- Stakeholders and concerned citizens were eager to learn about marine energy
- Feedback from target audience on outreach material was essential for efficient communication





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# Thank you

[lenaig.hemery@pnnl.gov](mailto:lenaig.hemery@pnnl.gov)

