Technology Impacts, Community Futures: Engaging Marine Energy Researchers on Community Concerns

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Introduction

Marine energy is an emerging renewable energy with the potential to support more sustainable energy futures. However, the success of marine energy research and development also depends on how project leaders understand, communicate with, and respond to the communities they may affect. Community concerns around environmental impact, local livelihoods, cultural values, trust, and decision-making power can shape whether renewable energy projects are accepted, resisted, or meaningfully co-developed.

This research brief summarizes a project executed by a directed research group from the Human Centered Design and Engineering Program at the University of Washington, focused on how marine energy researchers and engineers can more effectively consider community perspectives in their work. Our team conducted a literature review of 53 published papers across marine energy, renewable energy engagement, environmental impacts, community acceptance, and co-design practices. We also conducted four interviews with marine energy researchers to better understand how community engagement currently appears in their research practices.

In our findings, we identified a gap between the community-engagement resources available in the literature and the ways these resources are accessed or applied by researchers and engineers. In response, we developed a publicly accessible web toolkit that organizes relevant literature and engagement tools for marine energy researchers, helping make human-centered and community-engaged approaches more visible and usable.

Methods

Literature Review

- This project took place over three academic quarters, with the following schedule:

Timeline	Tasks
September - December 2025	• Systematic literature review of 53 papers
January - March 2026	• Literature Review analysis and coding • Formulate interview questions for researchers • Begin conducting interviews • Design a webpage for the PMEC website, displaying the literature review findings
March - June 2026	• Continue conducting and analyzing interviews • Compile research brief and handoff documents

Each week, students reviewed papers that covered community engagement and marine energy. During our weekly meeting, each student presented a 5-minute presentation to the rest of the group, including information from the following template:

- Research questions answered in the study
- Methods
- How is this useful to us?
- Questions for group discussion

Interviews

We first developed an interview guide to learn more about how each researcher engaged with communities and what communication strategies they used when sharing their research. From January to April 2026, we conducted four interviews with marine energy researchers involved in a Task 3 project.

Results

Literature Review Analysis:

The literature review our team conducted consisted of a broad survey of considerations in community perspectives and engagement, both within co-design practices and the renewable energy research sector. While there were limited articles in marine energy, the literature review revealed community engagement patterns within the renewable energy research sector and how we can adapt co-design to marine energy research. Through case studies, we learned lessons from other renewable energy projects and how community perspectives shape the acceptance of these projects. Factors such as trust, community values, culture, and psychology affect opinions and acceptance of marine energy research, meaning community engagement and transparent communication are vital to project

success. Literature on marine energy and the environmental impacts of renewable energy provided the background knowledge we needed to understand the issues and the concerns that marine energy can cause in communities. These concerns are why community engagement tools are important for researchers to implement in their projects. Human-centered design tools, such as co-design, can be especially invaluable to researchers who want to ensure project acceptance within communities. Through interviews with marine energy researchers, we identified a gap between available community engagement resources and how they are currently accessed and applied in research, inspiring our team to create a toolkit for community engagement resources from our literature review. The toolkit is a publicly accessible webpage on the PMEC website that categorizes the literature review based on the following categories:

- Community Perspectives
- Acceptance
- Overviews of Marine Energy
- Environmental Impacts
- Engagement Tools

There are many tools available to support community engagement in research, but for them to be effective, researchers must find them accessible and practical. The goal of the website toolkit is to make these engagement methods more visible to researchers and engineers.

Interview Analysis

From interviews with four experts who research marine energy sources, our group found how community engagement manifests in marine energy research and how researchers deliver complex technical material to various communities. Even though every researcher had engaged themselves in different projects related to riverine turbine installation, wave energy prediction, grid integration, and offshore test facilities, there were some common aspects revealed during the interviews.

One of the aspects is the use of different definitions of “community,” depending on whether the project was related to fieldwork, infrastructure and systems, or technologies. Researchers conducting fieldwork tended to perceive communities as people living in the area of deployment sites, as tribal nations, as fishermen, or as regulatory agencies. On the contrary, researchers dealing with technology development perceived their communities as utility companies, politicians, developers, planners, and other researchers. Thus,

community engagement within marine energy is quite a diverse phenomenon and does not represent one particular process or group of stakeholders.

Trust and relationship building were stressed as key considerations for engaging with communities through research processes. Researchers noted that engagement involved more than just formal interactions but also informal conversations, attentiveness to concerns, and presence within the community over time. Many researchers noted the importance of local collaborators or community-engaged researchers who were able to establish trust and reduce perceptions of exploitative research practices.

Communications issues were an important area of discussion as well. Many researchers used analogies, demonstrations, and visuals when explaining complex systems to less-technical audiences. Examples included demonstrations with wave tanks, comparisons to beaches for understanding wave dynamics, and discussing systems in terms of fish population or other environmentally relevant concepts already familiar to community members. Researchers working on grid integration talked about the challenge of communicating such large-scale and abstract systems.

Misconceptions and fears about the environmental impact of marine energy projects, fears regarding fish population decline, and misunderstanding the difference between tidal and wave power were additional barriers to effective communication found by researchers during the interviews. The study results showed that the communication gap exists because of not only the complicated technological background of marine power but also the existing environmental concerns, values of the community, and political narratives.

Last but not least, the role of co-designing and collaboration was analyzed in the interviewees' opinions. While some researchers used community participation in their work to determine location and address concerns of local stakeholders, others cooperated mostly with interdisciplinary groups. Researchers emphasized the gap between the amount of community engagement resources available and their practical usage. This information was useful in creating the PMEC toolkit, which is to provide marine energy specialists with relevant communication tools.

Next steps

This project opens three directions for continued work. First, the toolkit should expand as new literature and engagement frameworks emerge, particularly as marine-energy-specific research matures and more case studies become available. Second, future research should

evaluate how engineers actually use the toolkit in practice, assessing whether it changes how community engagement is incorporated into project workflows. Finally, deeper investigation is needed into how community-engaged methods can be embedded earlier in the research process, before design decisions are finalized and community concerns become harder to address.

Appendix

1. Affinity Map
2. Literature Review