



Pacific Marine Energy Center (PMEC)

Connecting People to the Power of the Ocean

2020 Strategic Plan

Center Overview

Introduction and Background

The Pacific Marine Energy Center (PMEC) is a National Marine Renewable Energy Center (NMREC) established in 2008 by the U.S. Department of Energy's Wind & Water Power Technologies Office (DOE WPTO). Since its establishment PMEC has grown, with activity now supported by a range of federal, state, and private sources and a large set of students, faculty, and staff engaged across three partner institutions: the University of Washington (UW), Oregon State University (OSU), and the University of Alaska Fairbanks (UAF).

The keys to PMEC's ongoing success are:

- Fostering a common and consistent vision across its partners;
- Maintaining a trusted, objective voice;
- Securing funding at levels that allow substantive progress and critical mass of activity;
- Engaging in research that clearly and directly translates to applications in the industry;
- Collaborating with partners, including industry, National Laboratories, universities outside of PMEC, coastal communities, ocean users, and federal and state governments; and
- Effectively educating the next generation of workforce with the skills needed to advance marine energy sectors.

The purpose of this strategic plan is to ensure, to the greatest extent possible, PMEC's continued sustainability, relevance, and impact.

Vision, Mission and Values

PMEC's **vision** is: **Connecting people to the power of the ocean.**

This breadth of vision mirrors the broad span of marine energy sources and our aspiration to bridge gaps to an array of end-uses.

PMEC's **mission** speaks to the pursuit of that vision:

Responsibly advancing marine energy by expanding scientific understanding, engaging stakeholders, and educating students.

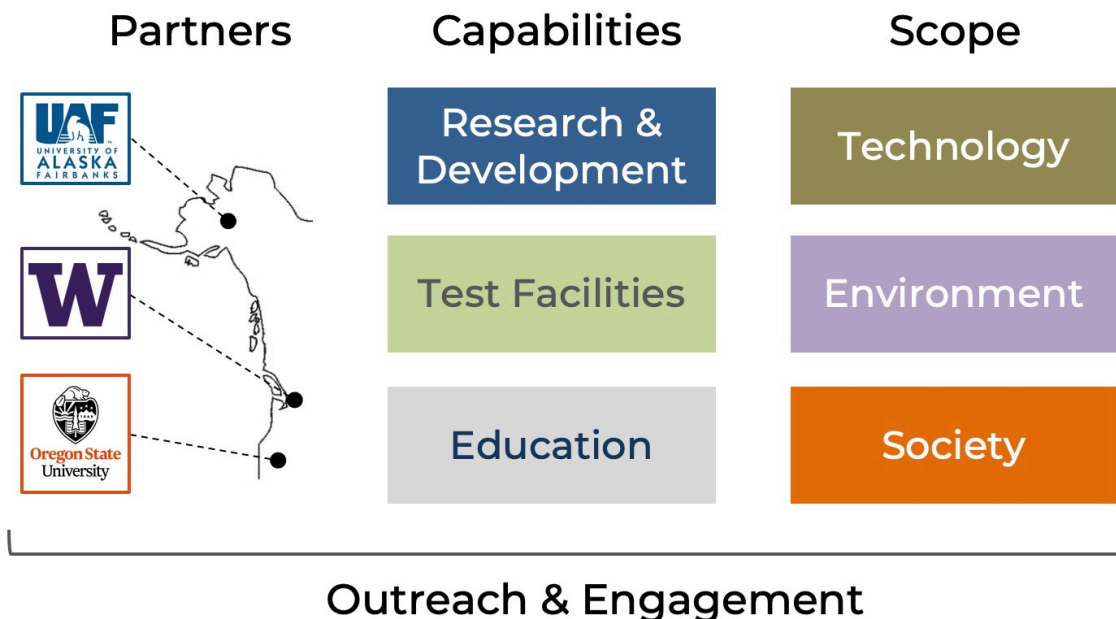


In doing so, PMEC holds five *values* in highest regard:

- **Visionary:** Accelerating the emergence of marine energy **requires long-term, bold and innovative** thinking. We take on critical marine energy challenges and we embrace all stages of the innovation process.
- **High-Impact:** We strive to make the strongest possible positive impacts to the environment, society, the nation, and the planet. Our research aims to make measurable progress towards a more **sustainable** and **resilient** future.
- **Objective:** We believe that **rigorous, impartial, and evidence-based** approaches are the only way to provide credible results regarding the opportunities, capabilities, and effects of marine energy.
- **Collaborative:** **Teamwork, mentorship and collaboration** are fundamental to PMEC's success. Our greatest achievements are the result of interdisciplinary teams working collectively to solve meaningful problems.
- **Inclusive:** We value a **diversity of thought, background, perspective, and identity**. We consider the strongest PMEC community to be one that includes an entire spectrum of cultures and populations.

Organization

PMEC is an umbrella organization that unifies research & development, test facilities, and educational programs in marine energy-related activities across its partner institutions. The Center's spectrum of activity is comprehensive, with acknowledged expertise in technological, environmental, and societal dimensions of marine energy. Individual projects often cross-cut these partners, capabilities, and scope.





Involvement with P MEC is by affiliation: the Center does not, itself, direct research, operate testing facilities, or confer degrees. Rather, research is conducted by groups of investigators affiliated with P MEC, testing is carried out at facilities affiliated with P MEC, and students receive degrees in departments affiliated with P MEC.

P MEC's function is to coordinate these activities and help create new opportunities for its affiliates.

Governance

P MEC has a shared governance structure with the Director at the designated lead institution and co-Directors leading each partner institution. The Director and co-Directors are responsible for setting the strategic direction for the Center. The leadership team also includes Associate Directors, who support the Director and co-Directors. P MEC's leadership is overseen by an Advisory Board drawn from DOE National Laboratories and regional/state organizations that is convened face-to-face once a year and engaged on an *ad hoc* basis for critical strategic advice.

More detailed governance roles, responsibilities, and expectations are described in a set of bylaws adopted by P MEC early in 2019. The bylaws establish the timeline and mechanism for rotation of the lead institution and guidance for adding or removing an institution from P MEC. The bylaws also establish an expectation for decisions on strategic direction and governance to be reached by consensus.

Research & Development

The breadth of research and development from affiliated Principal Investigators (PIs), staff, and students promotes an understanding of marine energy *systems* and the interactions between technology, environment, and society. P MEC's researchers regularly produce publications in scientific journals and are respected leaders in their disciplinary fields.

Direction

Future research efforts will continue to leverage the Center's strength working at the nexus of marine energy technology, its interactions with the marine environment, and role in society. Efforts are likely to continue to benefit from the Center's access to open water and real-world conditions, as well as world-class experimental facilities. Control systems, instrumentation, power integration, robotics, and related ocean engineering topics will continue to be concentrations of strength.

Recognizing the breadth of potential marine energy applications, P MEC research will increasingly intersect with the Blue Economy. The scope of the Blue Economy (e.g., aquaculture, mineral recovery, ocean observing, vessel decarbonization), and associated financial resources, also presents opportunities to engage new researchers in the Center's mission and grow involvement from environmental, societal, and economic disciplines. Some of this growth will likely come from existing researchers at the partner institutions who are not currently affiliated with P MEC and whenever possible P MEC should work to recruit a diverse generation of new researchers into our institutions.



Testing Facilities

PMEC's affiliated testing facilities range from laboratory to field scale. While these facilities are generally available to external users, their proximity to PMEC's research and education activities provides the Center with a competitive advantage. Specifically, these facilities allow faculty, staff, and students to conduct experimental research in an iterative manner, without the cost and logistical constraints of mobilizing equipment and personnel over long distances.

Key PMEC testing facilities include the O.H. Hinsdale Wave Research Laboratory (OSU), Wallace Energy Systems and Renewables Facility (OSU), PacWave wave energy test sites (OSU), Harris Hydraulics Laboratory (UW), R/V Russell Davis Light research vessel (UW), Power Systems Integration Laboratory (UAF), and Tanana River Test Site (UAF). More information about PMEC test facilities can be found in Appendix A and online at pmec.us/testing.

Direction

A continued emphasis on lab and field scale experimentation will remain central to PMEC's identity and strength in the coming years. This requires nurturing the project pipeline of high-impact research and development for affiliated test facilities.

Expanding access to test facilities by partner institutions and industry will be a primary strategic focus for the Center. The Center will engage with and support efforts like the Testing Expertise and Access for Marine Energy Research (TEAMER) program, which will help to unify test facilities on a national level.

Additionally, PMEC must continue to develop and improve the standards and capabilities of resident test facilities to remain globally competitive, without becoming fiscally unsustainable. Facility planning will be responsive to the research priorities of the Center's academic and industry partners and thoughtful about coordination with adjacent and complementary national facilities. For example, a growing network of dual appointments between Pacific Northwest National Laboratory and PMEC institutions may allow for greater fluidity and economies of scale in operating laboratory and field test sites throughout the Pacific Northwest.

Education

Students affiliated with PMEC receive their degrees, undergraduate and graduate, from academic departments. Similarly, faculty affiliated with PMEC often incorporate marine energy into their teaching. PMEC has a track record of attracting a high caliber of students, including a disproportionate number of graduate students who are National Science Foundation Graduate Research Fellows. Former PMEC students have gone on to careers in academia, at National Labs, and in industry, including several who have founded companies spun off from their graduate research.

Direction

PMEC must continue to provide the highest quality of opportunities for students to have relevant, hands-on experiences that cut across technological, environmental, and societal considerations. Their experiences in PMEC will prepare them with high-value skills and knowledge for meaningful careers, and, in turn, their success will ensure that high-caliber students continue to be drawn to the Center.



PMEC's students seek a broad and real-world perspective on marine energy as part of their education and the Center will work to expand student opportunities for collaborations between institutions, with National Laboratories, and with industry. Increased contact and knowledge exchange between students, industry, and National Laboratories will be an inevitable and positive byproduct of TEAMER. In addition, the U.S. Department of Energy is piloting a research internship program for graduate students that will provide opportunities for them to integrate their research with National Laboratories, industry, and other universities. PMEC will continue to advocate for expansion of these type of opportunities.

Outreach & Engagement

Disseminating PMEC's results and working with a broad set of stakeholders is critical to PMEC's success. PMEC's researchers have a professional expectation to publish and present their work to maximize its impact and value, but several non-traditional mechanisms also play an important role.

PMEC is, at its core, a strategic engagement between universities. The existing partner institutions represent the largest cluster of marine energy research in the Americas and have a scale of activity comparable to the largest research networks in Europe and Asia. As such, cohesion across the PMEC partner institutions is essential. Currently this cohesion is accomplished through uniform communications, regular meetings of the PMEC directors and the prominence of the annual PMEC All-Center Meeting. Centralized communications include a website (pmec.us), branded materials, social media, email lists, and the use of digital collaboration platforms.

Engagement with strategic partners in government, academia and industry is also central to PMEC's mission. PMEC's leadership emphasizes contact with program managers at multiple federal agencies, including those that do not currently fund substantial marine energy research. These dialogues allow PMEC to rapidly communicate recent successes and help to identify new pathways for investment.

In 2014, PMEC formally established an Industry Partner Network that is invited to participate in the All-Center meeting. This has enabled industry partners to play a role in PMEC's research direction at a low opportunity cost.

Direction

Learning from past experience, PMEC needs to carefully balance the desire to engage with external partners against the effort required to do so effectively, as diffuse engagement has the potential to draw attention away from maintaining internal cohesion and relationships with existing partners. Increasing internal cohesion and continuing to build capacity, unity and quality at the three partner institutions remains the top priority for the Center.

Translating engagement to research funding typically requires sustained, multi-year relationship building and fortuitous timing. In order to maintain existing strategic partnerships and grow new ones, PMEC leadership continues to develop communication pathways between individual investigators and agency staff. As the scope of marine energy broadens and with it the diversity of potential funding sources, these pathways will be important conduits for dialog.

Communication infrastructure has improved but gaps persist. The Center will continue to raise the visibility of its accomplishments through an integrated communications strategy that includes active use of the



PMEC.us website, social media and partner channels, while also leveraging the communications resources available at the partner institutions.

Engagement is fundamental to PMEC's mission, and the Center remains eager to seek, consider and build new strategic partnerships and partnership mechanisms. This includes discussions with potential university partners, joint research with National Labs, global student exchanges, and efforts to expand and add substance to the Industry Partner Network.

Opportunities & Goals

Opportunities

As society grapples with the rising threats of human impacts on the Earth, PMEC's critical mass and prior success will also enable new opportunities. These include programs at NSF at the food/energy/water nexus, applying instrumentation and methods to support environmental monitoring at the Bureau of Ocean Energy Management (BOEM), engaging with private foundations engaged in renewable energy development or provision of services that can be enabled by marine energy (e.g., desalination for coastal communities), and aggressively pursuing support at the state level. Other significant opportunities for PMEC in the coming years include:

- *Powering the Blue Economy*: PMEC's research has the potential to grow several areas of the Blue Economy. Such growth would likely lead to increased institutional engagement in these sectors, diversifying PMEC's research capabilities. This is also an opportunity to translate technologies and capabilities developed for the marine energy space to adjacent sectors (e.g., oceanographic instrumentation). These opportunities must be balanced against potential dilution of focus in areas of traditional strength.
- *Renewed interest in university programs by the U.S. DOE WPTO*: This has led to three initiatives that can contribute solutions to structural challenges facing PMEC: (1) the Testing Expertise and Access for Marine Energy Research (TEAMER) program, which may help to unify test facilities on a national level, (2) Oak Ridge Institute for Science and Education (ORISE) fellowships for graduate students to engage with industry, National Laboratories, and other universities, and (3) infrastructure funding to address gaps in capabilities. PMEC is appreciative of the willingness of DOE to engage in new and creative approaches to providing research funding to advance marine energy. However, we also note that while these initiatives complement research led by faculty and graduate students, they do not create the foundational research capacity that is critical to PMEC's productivity.
- *Memorandums of Understanding and short-term researcher exchanges with international partners*: These collaborations can help to support critical mass and expose researchers and students to new ways of thinking and the potential for marine energy to meet global challenges. However, there remain few opportunities for funding to cross national borders, except in the case of specific bilateral agreements, such as those between U.K., Irish, and U.S. science organizations. For this reason, international collaborations can strongly complement, but not replace, sources of domestic support.



5-Year Goals

PMEC's vision is to connect people to the power of the ocean because we see the ways that marine energy can contribute to society's developing needs. This includes addressing climate change by deploying low-carbon power generation at large scale, expanding the Blue Economy, improving the resilience of coastal communities, and enabling new ocean exploration capabilities.

Over the next five years, PMEC has five strategic goals:



Build momentum behind a credible vision for the future of marine energy in the United States.

PMEC's work will help to show the unique value of marine energy sources in a clean energy economy, as well as highlight the ways in which marine energy is complementary to other renewable energy sources. This includes offshore wind, Blue Economy infrastructures, and grid-scale integration. Recruiting new faculty to support the Center's mission in this space is essential to maintain a vibrant, dynamic culture of exploration and discovery.



Support a pipeline of companies stretching from early stage developers to mature technology suppliers.

This involves traditional engineering development, as well as an understanding of the importance of societally and environmentally conscious technology development and deployment. Expanding the breadth of the Industry Partner Network, as well as increasing points of engagement between this network and PMEC personnel will facilitate this goal. The TEAMER program is an excellent catalyst for this strategic thrust and should directly benefit industry and academia.



Lead disruptive innovation in installation, operation, and maintenance.

This is among the major remaining "green field" areas unique to marine energy systems and must be addressed before marine energy systems can be deployed at large-scale. This goal is supported by adjacent activity in robotics and autonomy, which have additional potential applications in ocean exploration and environmental research.



Ensure a positive experience for students engaged in PMEC's mission.

Through a robust communications strategy, ensure that students at the graduate and undergraduate level are able to take full advantage of the Center's capabilities as they develop professionally and move into their own careers. The Center will seek out opportunities for regional and national coordination that emphasizes the student experience, including support for INORE in North America.



Diversify funding and identify pathways for faculty to build careers focused on advancing marine energy.

Through dialogue with existing and new sources of support, increase the diversity of research funding opportunities in marine energy to address pressing technological, environmental, and societal challenges.



Appendix A: Testing Facility Descriptions

Key testing facilities affiliated with PMEC include:

Waves

- *O.H. Hinsdale Wave Research Laboratory (OSU)*: The largest nearshore wave experimental facility at an academic institution in the U.S., including the Large Wave Flume and Tsunami Basin, supports scaled testing of wave energy converters and arrays.
- *PacWave (OSU)*: Once operational, PacWave will host two field testing locations for marine energy-related research. The PacWave South site features four 5-MW berths for grid-connected device testing, while the PacWave North site is an autonomous site with roughly 100 kW of power absorbing capacity. The North site is undergoing renovations to allow for subsurface AUV/ROV recharge and environmental monitoring capability. PacWave South plans to be operational in 2021/2022, while the North site will be operational in 2020.

Tides/Currents

- *Tanana River Test Site (UAF)*: A facility for testing and demonstrating river energy converters and related technologies in an Alaska village setting. A mid-river single point anchor system and barge can support up to 50,000 lbs. River velocities at the site range from 1.5 m/s to over 3 m/s.
- *Harris Hydraulics Laboratory (UW)*: An experimental high bay with a high-speed current flume equipped with flow-field imaging systems and a combined wind-wave-current flume. These flumes are suitable for testing small-scale current turbines and WECs, respectively.
- *R/V Russell Davis Light (UW)*: A 65-foot catamaran vessel designed specifically for testing and optimizing field-scale current turbines. The purpose-built watercraft includes a test platform that can be lowered below the hulls and driven forward into clean flow or moored in position to generate turbulent inflow.

Power Systems

- *Power Systems Integration Laboratory (UAF)*: Mimics a 500-kW hybrid-diesel microgrid that is typical of many Alaskan villages. The adaptable lab can be configured for testing a wide range of islanded microgrid and distributed generation scenarios, as well as the performance of individual components, including marine energy technologies.
- *Wallace Energy Systems and Renewables Facility (OSU)*: Provides research, testing and consulting services related to motors, generators, adjustable speed drives, power electronics, power supplies, power quality, industrial process equipment, power systems and renewables.

