

POSITION PAPER 3: MARINE ENERGY PRIORITIES



**National Hydropower
Association
Marine Energy
Council
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I. EXECUTIVE SUMMARY

The purpose of this Position Paper 3 is to provide an update on the priorities of marine energy technology development and demonstrations in the United States to an audience of key stakeholders including Marine Energy Council (MEC) members, funding agencies, research organizations, standards committees, and other marine energy sector participants. With significant support from the U.S. Department of Energy (DOE) and the U.S. Navy, technology developers are conducting full-scale and reduced-scale demonstrations in open water sites moving marine energy technologies closer to commercialization. This document contains results of a survey of key stakeholders which identified the need for additional funding for macro- and meso-scale deployments, and additional research, development, and demonstration (RD&D) for power takeoff components and anchoring/mooring systems to help developers achieve key milestones along the commercialization pathway. The key recommendations in this paper include increased federal funding levels, stage-gated awards funded over multiple years, elimination of cost-share requirements for industry participants, and assistance with certain regulatory matters. The desired outcome of this report is greater awareness of the needs of technology and project developers amongst key government and industry stakeholders and research organizations so that there is greater convergence in the effort towards marine energy demonstrations and commercialization in the United States.

II. Key Recommendations

- Substantially increase federal funding for private sector technology developers
- Increase the number of FOAs and issue them on a more regular schedule
- Establish a continuum of funding among multiple DOE offices
- Eliminate cost share requirements in FOAs
- Implement stage-gated funding from small systems up to large system development
- Increase component and subsystem RD&D funding
- Improve and simplify regulatory processes

III. Background and Motivation

The MEC established the Marine Energy Priorities Working Group (hereinafter Working Group) in early 2021 to identify and prioritize specific needs and knowledge gaps wherein federal RD&D funds could be most effectively applied to advance the marine energy sector leading to commercialization as rapidly as possible. To date, the MEP WG has met monthly to debate the issues associated with industry priorities.

A number of technology developers have deployed full- and sub-scale marine energy systems in open waters over the past three years with significant past funding support from DOE as detailed in the 2023 Ocean Energy Systems Annual Report. The industry is poised at a critical stage where several promising technologies are ready to be demonstrated at scale.

The Working Group first polled MEC members in 2021 to identify and prioritize the needs and knowledge gaps that are most critical to achieve the sector’s technology and project development goals. A second survey was circulated to MEC developers and stakeholders in 2022. The results of the third survey from 2023 are shared in this paper.

This report summarizes the methods the Working Group used to obtain and analyze the poll and survey results by segregating the highly diversified marine energy stakeholders into distinct categories that include device size, Technology Readiness Level (TRL), commercial application, and priority ranking. The purpose of this exercise was to determine how broadly the knowledge gaps applied across all categories, which can be used as a proxy for the ‘criticality’ of needs and specific knowledge gaps. This report will be updated regularly based on additional input obtained from marine energy industry stakeholders in future polls and surveys.

In summary, the objective of this report is to communicate the most critical needs of the marine energy sector to a broad audience and recommend funding initiatives focused on RD&D that will be the most effective in reducing the time to commercialization.

For the purposes of this document, the Working Group has used the following size scales:

- **Macro-scale:** Systems that are intended to be installed in arrays to provide commodity power to a distribution network (i.e., grid-connected).
- **Meso-scale:** Systems that could be installed individually to support a facility or community (may or may not be grid-connected).
- **Micro-scale:** Systems for powering isolated oceanographic instrumentation or similar Powering the Blue Economy (PBE) activities

IV. Target Audiences

At the start of the analysis, the Working Group identified several audiences that might benefit from the recommendations contained in this position paper. Audiences identified include:

- **Industry and NHA-MEC.** The results of this and subsequent reports will be used to develop and update a roadmap and lead to more widespread adoption of marine energy technologies and projects
- **Government funding agencies.** Based on the information contained in this position paper, the NHA MEC will present its recommendations to government funding and regulatory agencies.
- **Testing Expertise and Access for Marine Energy Research (TEAMER) and the University Marine Energy Research Community (UMERC).** Both programs have built a strong and diverse network of people who have expertise that is highly relevant to the marine energy sector. The Working Group and the information gathered in this position paper will be shared with both the TEAMER and UMERC groups. We expect that, in return, these two organizations will provide the Working Group with feedback on industry needs based upon their group discussions and surveys.

- **International Electrotechnical Committee (IEC).** International standards developed by IEC Technical Committee 114 (TC 114) and conformity assessment protocols established by the IECRE must be aligned with ME industry priorities to enable commercialization on an accelerated timetable.

The Working Group recognizes that there are other audiences that may be interested in this report and we will strive to include such audiences as they are identified.

IV. Industry Priorities

In late 2023 the Working Group conducted a survey amongst various stakeholders in the marine energy sector. A total of 22 participants responded to the survey, including 12 technology developers (6 wave energy and 6 current energy), 6 academic institutions, and 4 industry consultants.

The data was analyzed as follows:

- in the order of the particular priority and importance: Primary, Secondary, Tertiary; and,
- in the order of which scale the priority applies to: Macro, Meso, Micro.

NHA-MEC Priorities Working Group - 2024 Survey Results 2

Survey Structure

Survey Link: <https://form.jotform.com/232395775523161>
Results as of 02/19/2024

22 Total Participants:
6 x Academia Responses
6 x Current Energy Converter (CEC) Developer
6 x Wave Energy Converter (WEC) Developer
4 x Consultant

Structure:
31 Priority Survey Questions
Priority levels: Primary / Secondary / Tertiary
Scale Indicator: Macro / Meso / Micro / All

Example

Priority 2: Export cables; Anchoring; Mooring

Priority Ranking Please Select Scale Micro Meso Macro All

Please Select
Primary
Secondary
Tertiary

Scale Definitions

Macro: Utility scale, MW scale grid connected
Meso: Island/remote communities, microgrids
Micro: Reduced Scale Ocean Ops (AUV charging/other PBE)

Table 1: Extract from Survey

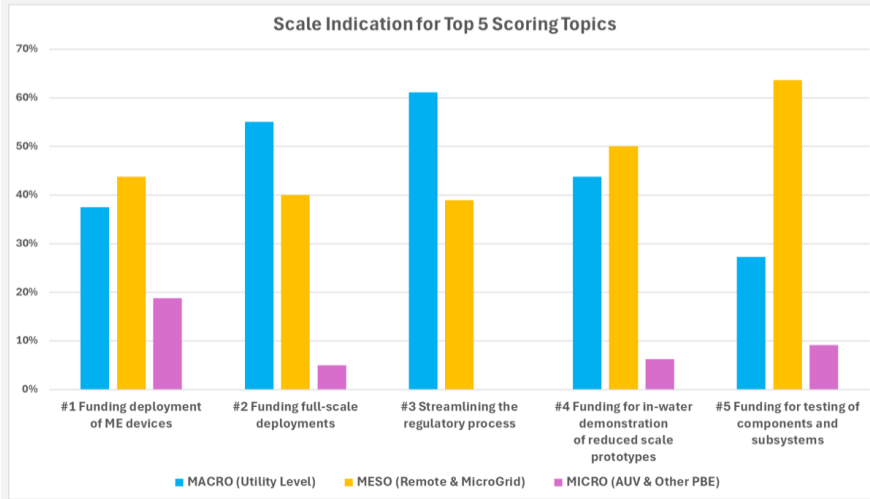
The survey results indicate that the four main priorities are:

1. Funding of pilot projects and deployments
2. Funding of RD&D
3. Array testing at Macro and Meso scale
4. Developing and adhering to IEC Standards

Detailed results of the survey are shown in Tables 2, 3, and 4 below.

NHA-MEC Priorities Working Group - 2024 Survey Results

Highest Scoring vs. Scale Indication



- Highest scoring topics are tied to Macro and Meso Scale
- Funding for testing and components and subsystems at Meso scale most important

Table 2: Survey Results for Preference of Scale

The first eight survey questions were related to funding and Table 2 clearly shows that increased funding is the top priority of all stakeholders.

SURVEY	NUMBER	QUESTION	PRIMARY	SECONDARY	TERTIARY	TOTAL VOTES	SCORE	
							# 1	# 2
1	1	Funding deployment of ME devices	16	6	1	23	61	99
9	21	Streamlining the regulatory process	15	7	1	23	60	97
1a	2	Funding full-scale deployments	16	4	3	23	59	95
1b	3	Funding for in-water demonstration of reduced scale prototypes	14	6	3	23	57	91
1c	4	Funding for testing of components and subsystems	12	9	2	23	56	89
5	12	Installation, Operation, Maintenance, and Decommissioning	14	5	4	23	56	89
6	13	Standards supported development suitable for utility-scale market	10	9	4	23	52	81
2	9	Export cables; Anchoring; Mooring	11	6	6	23	51	79
4	11	Controls/Power Take-off optimization	8	12	3	23	51	79
11	23	Power aggregation of multiple MECs	11	6	6	23	51	79
1e	6	Funding for testing of arrays	10	7	6	23	50	77
8	15	Cost Reducing Manufacturing Method Preferences	7	11	5	23	48	73
16	28	Workforce Development	8	9	6	23	48	73
3	10	Continued support of process that will retire environmental risk	7	10	6	23	47	71
1f	7	Funding of numerical modeling	8	7	8	23	46	69
1g	8	Funding for Expert & Consultant hiring/Purchase of Expertise for Deployments	8	7	8	23	46	69
1d	5	Funding for tank testing	7	8	8	23	45	67
7	14	Health monitoring of dynamic elements/predictive maintenance/digital twins	6	10	7	23	45	67
13	25	Advanced materials development such as thermoplastics, composites, etc.	7	8	8	23	45	67
12	24	Personnel/Electrical safety	7	7	9	23	44	65
10	22	Non-electrical applications: e.g. direct desalination, direct drive/mechanical PTO	7	6	10	23	43	63
17	29	Technology Qualification at earlier TRLs	5	10	8	23	43	63
19	31	Data issues in late TRLs	7	5	11	23	42	61
8e	20	Steel manufacturing	4	10	9	23	41	59
14	26	Alternative power carriers to eliminate the export cable	4	9	10	23	40	57
15	27	Basic Research	5	7	11	23	40	57
8b	17	3D Printing additive manufacturing	5	5	13	23	38	53
8a	16	Robotic subtractive manufacturing/machining	4	5	14	23	36	49
8c	18	Composite molding	2	9	12	23	36	49
18	30	Hybrid systems in early TRLs	3	5	15	23	34	45
8d	19	Injection molding	1	5	17	23	30	37

Table 3: Survey Results - Priority Rankings

Stakeholders were asked to identify which components and subcomponents are most in need of further development. Their responses are summarized in Table 4.

NHA-MEC Priorities Working Group - 2024 Survey Results **(Sub-)Components most in need of development**

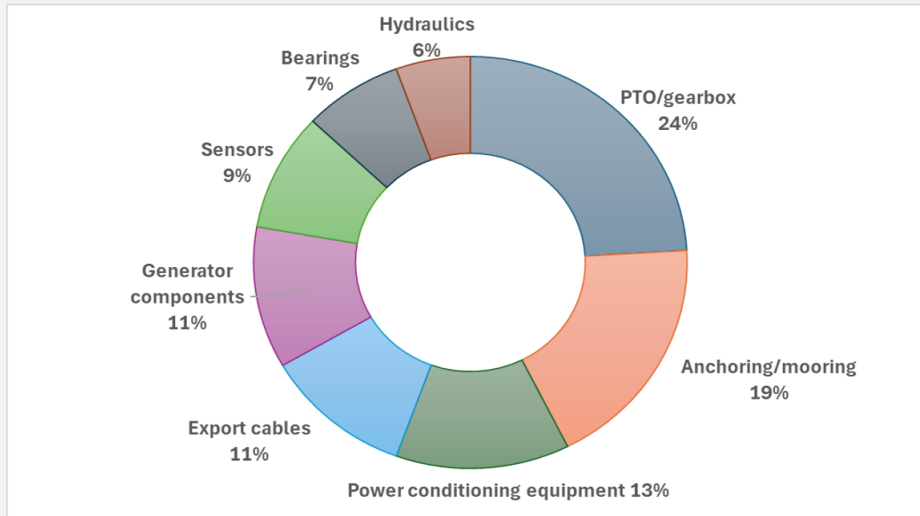


Table 4: Components & subcomponents most in need of further development

Note: the survey revealed that there is a clear and express need for component and subsystem RD&D funding. Component and subsystem RD&D is a high-level need that will accelerate the development of the marine energy sector.

Stakeholders were also asked to rank the importance of establishing a supply chain databank. The average response was 3 out of 5, with 1 being not very important and 5 being extremely important.

Importance of a 'Supply Chain Database'

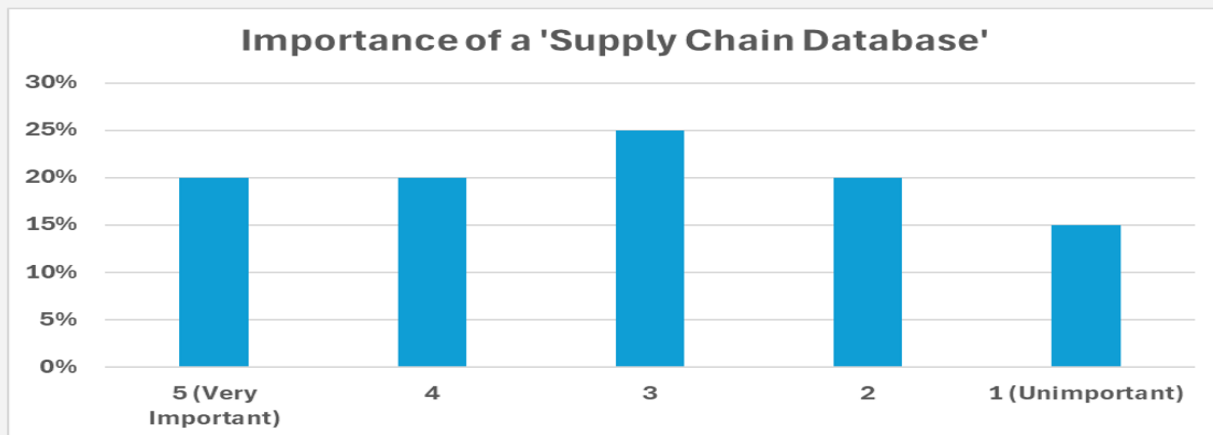


Table 5: Depicts the survey results of the necessity for a Supply Chain Database

V. Discussion

The Working Group acknowledges that industry priorities may differ based on the end-use or target market of a device or project. One essential finding that remains true for all stages of development within marine energy is the need for increased federal funding in the form of Funding Opportunities Announcements (FOA), or other sources of federal financial support, that help the sector reach commercialization. In addition, the frequency and consistency of such funding is extremely important because it helps technology and project developers plan more effectively and avoid funding gaps that threaten continuing operations.

FOAs are most important to support the middle portion of development projects, the so-called TRL 4-7 'Valley of Death.' Developers often manage to raise funding to finance the early stages of technology development and once a device reaches TRL 7, technology and project developers can often raise private capital more readily because a ROI for investors and lenders is much nearer at hand. The Working Group encourages the DOE to continue and increase funding for the TEAMER program because it is available to developers whose technologies fall within the TRL 4-7 range.

As mentioned in the methodology section, the Working Group had participants assign a development scale to a priority. It could be equally important that priorities be examined at the system TRL versus the target development scale. Therefore, breaking down individual needs into specific development and system size categories may help prioritize the needs of the sector.

Detailed breakdown of KEY RECOMMENDATIONS:

- Substantially increase federal funding for private sector technology developers
The survey has shown that this is clearly the top priority of technology developers and all other stakeholders. The Working Group is aware that this is a matter of Congress increasing available funding and would like to point out how important it is for developers and stakeholders to write letters to their congressional representatives to increase funding for WPTO.
- Increase the number of FOAs and in predictable increments
Developers and stakeholders would greatly appreciate it if FOAs could be released at regular consistent intervals, perhaps quarterly or semiannually.
- Establish a continuum of funding among multiple DOE offices
Developers and stakeholders would very much appreciate it if the different government agencies such as WPTO, ARPA-E, WETO, OCED, DOD, NOAA, and NSF could communicate and coordinate the announcement of funding opportunities.
- Eliminate cost share requirements in FOAs
Cost share requirements have been a hardship and a burden on grant recipients for a long time. In particular, developers with technologies at TRL 3 to TRL 7 find it is exceedingly

difficult to raise 10% or 20% of awarded funds. The elimination of cost share would accelerate development and deployment.

- Stage-gated funding from small systems up to large system development
All marine energy developers agree that funding should be stage-gated with clear goals to be met facilitating Go/No-Go decisions.
- Component and subsystem RD&D funding
The funding of component and subsystem R&D is extremely important for technology developers and an excellent opportunity to collaborate and utilize the resources of national laboratories, academic institutions, and private industry.
- Improve and simplify regulatory processes
The regulatory process can be very burdensome for a developer wanting to deploy marine energy devices for long term operations. Discussions, Working Groups, and panels at conferences have identified the need for FERC to develop a separate streamlined regulatory process for marine energy devices that is different from traditional hydro permits which contemplate deployments for 100-120 years unlike ME deployments that have typical durations of 20-30 years. Especially since marine energy devices will not stay deployed for years like some conventional hydro facilities have.

Another issue identified is that priorities are likely to differ between wave technologies and current technologies. Therefore, the Working Group identified common challenges and overlaps between the different technologies when developing the priorities list. For instance, export cables, and mooring systems are cross-cutting components that are a high priority for both wave and current technologies. Similarly, decreasing the time and cost of IOM&D by developing best practices and adopting best practices from other relevant sectors such as floating offshore wind could help accelerate the sector to commercialization.

Comparison with Commercialization Strategy

In 2021, NHA's Marine Energy Council issued the 'Commercialization Strategy for Marine Energy' which outlined ten federal actions needed to meet the 50 MW by 2025, 500MW by 2030, and 1GW by 2035 targets set by the strategy. This section provides a comparison of the federal actions identified in commercialization strategy to the industry priorities identified through the Working Group.

Table 6 below shows the alignment between the federal actions identified in the MEC's 2021 commercialization strategy and the Working Group's 2024 industry priorities survey:

Commercialization Strategy for Marine Energy	10 Top Priorities Concluded from MEC Survey
1. System Design, Fabrication and Demonstration –captured as several higher priority items.	P1) Funding for development and testing
2. Fostering Distributed Generation Capabilities – captured as several higher and medium priorities.	P7) Installation, operation, maintenance and decommissioning
3. Emerging Opportunities for Off-Grid Power – captured as higher and medium priorities.	P9) Controls/PTO optimization
4. Foundational Research and Engineering Assistance –captured as a medium priority. See additional information regarding UMERC	P2) Array testing and higher TRL's
5. Testing Infrastructure and Validation – captured as a medium priority. See additional information regarding TEAMER below.	P3) Export cables, anchors, mooring
6. Financial Incentives for Deployment – as a higher priority.	P10) Support to retire environmental risk
7. Leveraging International Experience and Standards – captured as a higher priority.	P4) Standards supported development
8. Streamlining Permitting and Reducing Regulatory Barriers – captured as a higher priority.	P8) Streamline the regulatory process
9. Workforce Development – captured as a medium priority.	P6) Workforce development
10. Federal Planning, Staffing and Industry Engagement – captured as a higher priority.	P5) Robust federal staffing

Table 6: Alignment of 2021 MEC Commercialization Strategy with 2024 Working Group Industry Priorities survey

We can see that the 2024 Working Group industry priorities align well with the federal action requirements in the 2021 commercialization strategy. It is worth noting that several of the top 10 priorities are being funded through programs including TEAMER and UMERC.

Integration with TEAMER and UMERC

As can be seen in the priorities list, development and testing is a high priority and basic research is a medium priority.

The Testing Expertise and Access for Marine Energy Research (TEAMER) program, which is managed by the Pacific Ocean Energy Trust (POET), provides funding support for marine energy system developers to test their systems at facilities around the U.S. TEAMER gives marine energy system developers access to experts and test resources that may otherwise be cost prohibitive which streamlines the product development and validation process. Developers can test whole systems or components. TEAMER is enormously beneficial to the industry and must continue to be funded far into the future.

The TEAMER network consists of national labs, university, and private-industry facilities with expertise and capabilities including numerical modeling, bench testing, and tank, basin, flume, and tunnel testing. TEAMER has also added select open-water facilities to the network. While the PacWave and WETS test sites help address higher-TRL, larger scale testing, a significant lack of facilities remain for current energy converter testing at, or near, full-scale.

The WPTO awarded funding to POET in August 2021 as the coordinator of the University Marine Energy Research Community (UMERC) program. The aim of this program is to facilitate

communication between university researchers, national labs, and industry by identifying and communicating the capabilities of researchers and institutions, expanding the number of individuals and institutions that are involved in the Marine Energy industry, and ensuring that Marine Energy research needs are being met... The goal is to create more alignment between research stakeholders and make sure that short, medium, and long-term research needs are met.

UMERC is working with technology developers to identify common research challenges and link them with the priorities described in this report. The working group encourages UMERC to use this information when scheduling workshops, seminars, and its annual summit that it will share information with as broad an audience as possible.

VI. Appendix A: Survey Methodology

As in previous years, the Working Group first identified current needs and gaps within the industry. The 2022 survey was the starting point for the current survey. Over several monthly meetings the group discussed the questions asked in previous surveys and decided to add several new questions and to expand/elaborate in more detail the previous questions. A list of 31 questions on separate subject line items relevant to all marine energy sectors was developed. This list was then placed within a survey for ranking of each item by priority of **Primary, Secondary, and Tertiary**. The survey also requested that participants assign an associated development scale – **Macro** (utility), **Meso** (small communities) or **Micro** (ocean observation/PBE), The survey was sent to the Working Group participants and marine energy developers and stakeholders end of September 2023 and was completed on December 7, 2023. The results of the survey are shown in Table 2 and Table 3.

Additionally, three questions were asked and their responses to questions 1 and 2 are shown in Table 4 and Table 5. The questions were: :

1. Which components and subcomponents are most in need of development?
2. How important is a supply chain databank for you?
3. Other subjects not covered?

VII. Appendix B: Mission of the Working Group

The mission of the Marine Energy Priorities Working Group is to support the NHA-MEC in providing a common voice and platform regarding the needs of the Marine Energy industry in the United States. The Working Group will identify common priorities for technology and project developers across the range of marine energy resources and provide direct feedback to the MEC regarding technical areas in need of funding, development, and/or clear gaps in knowledge.