U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Request for Information: Program Strategy to Advance Marine and Hydrokinetics

DATE: February 12, 2015

SUBJECT: Request for Information (RFI)

DESCRIPTION: Through a balanced portfolio approach, the U.S. Department of Energy (DOE) Wind and Water Power Technologies Office (WWPTO's) Water Power Program, herein referred to as the "Program", makes strategic investments in the Marine and Hydrokinetic (MHK) subprogram, including transformational technology innovations that seek to maximize generation from water power resources while addressing key market deployment and environmental impact challenges. The Program aims to achieve cost-competitiveness with local hurdle rates of 12 to 15 cents per/kWh by 2030. The Program addresses technology needs and opportunities in MHK, which would otherwise not be addressed by the private sector on its own. Prior to supporting an activity, the following five core questions are used to ensure that the work will contribute to achieving the Program's goals and that it is the proper role of government to support such an activity:

1. **Impact:** Is this a high impact problem?
2. **Additionality:** Will EERE funding make a large difference relative to existing funding from other sources, including the private sector?
3. **Openness:** Are we focusing on the broad problem we are trying to solve and open to new ideas, approaches, and performers?
4. **Enduring Economic Impact:** How will EERE funding result in enduring economic impact for the United States?
5. **Proper Role of Government:** Why is this investment a necessary, proper, and unique role of government rather than something best left to the private sector to address?

DOE invites input from the public to help inform and prioritize future Program activities. To find more information on the Program's existing MHK portfolio and strategy, please review the recently released FY16 Congressional Budget Justification (http://energy.gov/cfo/downloads/fy-2016-budget-justification) as well as the FY14 Water Program Peer Review Report (http://energy.gov/eere/water/downloads/2014-water-power-peer-review-report).

BACKGROUND: Marine and Hydrokinetic Technologies capture the energy of waves and currents (e.g., tides, ocean current, or in-stream river flows). A cost-effective MHK industry could provide a substantial amount of electricity for the Nation due in large part to its unique advantages as a source of energy, including its vast resource potential, its close proximity to major coastal load centers, and its predictability. The mission of the Program is to compress technology development timelines of MHK devices with the goal of reducing the levelized cost of energy (LCOE) for these devices. The Program will accomplish this through a series of core activities, including: technology advancement and demonstration; testing infrastructure and instrumentation; environmental research and risk mitigation; and resource characterization. This

RFI seeks to answer questions in the key activity areas listed below. Respondents may answer as many or as few questions as applicable.

1. Technology Advancement and Demonstration
    - Prove technical credibility and optimize performance
    - Computational modeling and analysis to catalyze device design evolution at reduced time and cost to developers

2. Testing Infrastructure and Instrumentation
    - Strengthen MHK device quality and reliability

3. Environmental Research and Risk Mitigation
    - Ensure long-term sustainability of newly developed technologies, boost investor confidence and reduce regulatory barriers

4. Resource Characterization
    - Quantify and classify physical conditions, inform designs for resource classes, and reduce siting and generation uncertainty

5. Crosscutting / Out of the Box Feedback / Other

PURPOSE: The purpose of this RFI is to solicit feedback from industry, academia, research laboratories, state energy offices, regulatory offices, related offshore engineering consultants/Original Equipment Manufacturers (OEMs), and other stakeholders on the Program's future strategy and priorities. EERE is specifically interested in information on each of the focus areas listed above. This is solely a request for information and not a Funding Opportunity Announcement (FOA). EERE is not accepting applications through this RFI. DOE will not respond to questions regarding this RFI.

DISCLAIMER AND IMPORTANT NOTES: This RFI is not a Funding Opportunity Announcement (FOA); therefore, EERE is not accepting applications at this time. EERE may issue a FOA in the future based on or related to the content and responses to this RFI; however, EERE may also elect not to issue a FOA. There is no guarantee that a FOA will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if EERE chooses to issue a FOA regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of EERE funded awards, will be subject to Congressional appropriations and direction.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. EERE will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. EERE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised

that EERE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind EERE to any further actions related to this topic.

PROPRIETARY INFORMATION: Because information received in response to this RFI may be used to structure future programs and FOAs and/or otherwise be made available to the public, **respondents are strongly advised to NOT include any information in their responses that might be considered business sensitive, proprietary, or otherwise confidential.** If, however, a respondent chooses to submit business sensitive, proprietary, or otherwise confidential information, it must be clearly and conspicuously marked as such in the response.

Responses containing confidential, proprietary, or privileged information must be conspicuously marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Federal Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

If your response contains confidential, proprietary, or privileged information, you must include a cover sheet marked as follows identifying the specific pages containing confidential, proprietary, or privileged information:

> **Notice of Restriction on Disclosure and Use of Data:**
> Pages [list applicable pages] of this response may contain confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for the purposes described in this RFI, DE-FOA-0001278. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source.

In addition, (1) the header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: “Contains Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure” and (2) every line and paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

EVALUATION AND ADMINISTRATION BY FEDERAL AND NON-FEDERAL PERSONNEL: Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to EERE providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

REQUEST FOR INFORMATION CATEGORIES AND QUESTIONS:

To inform future Program activities and priorities, the Program is specifically looking for feedback to the following questions. However, all input and comments will be accepted and reviewed. Respondents may answer as many or as few questions as they wish.

CATEGORY 1: Technology Advancement and Demonstration

In order to reach cost competitiveness goals, MHK devices must attain both cost reductions and increased energy capture. The MHK subprogram's Technology Advancement and Demonstration (TA&D) focus area will address these needs in FY 2016 through component advancement and system innovations. By pursuing technology improvements at the sub-system and system level through component and device research and demonstrations, the MHK subprogram can decrease the time scale for technology development and accelerate the integration of these improved components into more complex system deployments. To improve and build upon present efforts, the Program is requesting the following information with regard to technology advancement and demonstration:

1. The Program is developing a rigorous evaluation method to identify those technologies that have the attributes to be cost competitive with other energy generation technology. When implemented, the community can expect funding to shift to support only technologies that have the attributes, such as acceptability, power absorption, conversion and delivery, system availability, capital expenditure (CapEx), and operational expenditure (OpEx) to be techno-economically viable. Is there value to be gained from Program investments in demonstration of technologies that have just a few of the required attributes? Please explain the relevance of any such investments to advancing the sector.

2. The Program has developed a 1) risk and reliability framework (http://www.nrel.gov/water/) and 2) standardized cost and performance data reporting process (http://en.openei.org/community/node/655). These resources serve the Program by defining transparently uniform methods for evaluation and establishing frameworks by which to collect information consistently thus allowing for portfolio analysis to inform Program direction (e.g. common technology challenges). Is your company using or leveraging these resources? How could they be made more accessible and useful?

3. The Program requires detailed data collection to maximize learning from Program funded technology demonstrations and avoid repeating tests in the technology design cycle. Now, with an MHK Data Repository (https://mhkdr.openei.org) launching spring 2015, the Program will facilitate broad user access to the data when award data protection periods expire to catalyze technology advancement in the sector. What ideas or recommendations should the Program consider to ensure Program intentions to facilitate broad dissemination of data collected with government funds are fulfilled?

4. Computational device design tools are an efficient and cost-effective means of evaluating device designs in terms of power production, device reliability, and device survivability

in extreme conditions. Accurate, predictive design tools will allow developers to decrease costs if they can reduce the safety margins currently built into designs to account for uncertainties. Availability of these codes in open source (http://en.openei.org/wiki/Water click to explore "Water Power Development Resources") to both developers and the academic community allows for accelerated innovation of device designs through engagement of a broader user community. What partnerships/leveraging opportunities should the Program investigate/implement when continuing or initiating any new efforts in computational modeling and analysis? What additional capabilities should the Program consider developing?

CATEGORY 2: Testing Infrastructure and Instrumentation

The establishment of shared testing infrastructure will accelerate development and deployment of MHK technologies as they progress through Technology Readiness Levels by: (1) reducing technical and financial risks; (2) reducing the cost of testing for the industry; and (3) reducing the time-to-market. MHK testing infrastructure must be available to test designs across the span of technology readiness levels, and needs to include highly instrumented laboratory facilities capable of providing controlled and repeatable test conditions, drivetrain simulators for component testing, and open-water test berths testing individual devices and arrays. Currently, there are significant gaps to adequately support this emerging industry in a manner that best accelerates U.S. technology innovation, evolution, commercialization and deployment. Access to world-class test facilities and associated instrumentation will accelerate technology evolution while substantially reducing technology development and demonstration costs to the industry. To improve and build upon present efforts, the Program is requesting the following information with regard to testing infrastructure and instrumentation:

1. What unique capabilities or attributes should the program consider in the development of a full scale, grid connected wave test site in the U.S.?

2. What other test facilities may be needed, and in what timeframe?

CATEGORY3: Environmental Research and Risk Mitigation

DOE has a unique ability to help reduce environmental uncertainties and other deployment barriers for new MHK technologies. Lack of scientific information and monitoring costs can comprise a significant percentage of total early-stage MHK project cost. Program investments focus on addressing the most important barriers to the development, deployment, and evaluation of these systems to reduce the cost and time for developers. This includes undertaking research and developing new tools and monitoring instrumentation to accurately and cost-effectively identify, mitigate, and prioritize environmental risks; widely sharing timely and unbiased information to accelerate permitting time frames and drive down costs; and engaging in national and regional ocean planning processes to ensure that MHK is considered in the Nation's marine spatial plans. To improve and build upon present efforts, the Program is requesting the following information with regard to environmental research and risk mitigation:

1. In years past the Program has provided support for targeted environmental research in lab settings (e.g., flume studies to evaluate the safety of fish passing through current energy converters), for targeted environmental monitoring MHK devices in the field to help inform relative levels of risk, and for the collection and synthesis of environmental monitoring data from around the world. From your perspective, which of these efforts has been most helpful in reducing your barriers to deployment? What environmental questions do you think have greatest need for DOE support moving forward and why?

2. Recently, the Program awarded projects to develop and improve environmental monitoring instrumentation, informed in part by an experts' workshop that identified critical needs in this area (see: https://eere-exchange.energy.gov/#FoaId7b557d4f-c41d-4f1c-8183-79d792123dc5 and http://www1.eere.energy.gov/water/pdfs/monitoring_marine_converters.pdf). Is the advancement of environmental monitoring tools to reduce cost and increase monitoring capabilities a useful direction to focus future efforts and resources in coming years?

CATEGORY 4: Resource Characterization

The Water Power Program has released reports and maps that assess the resource potential of the nation's waves, tidal, ocean, and river currents, and ocean thermal gradients. These resource assessments are pivotal to understanding water power's potential for future electricity production. With more than 50% of the population living within 50 miles of coastlines, there is vast potential to provide clean, renewable electricity to communities and cities across the United States using marine and hydrokinetic technologies. The Water Power Program is committed to helping to identify new opportunities to accelerate the commercial scale deployment of MHK technologies. Additional research by industry stakeholders is needed to identify the practical resource potential at specific sites of interest to achieve commercial development of these resources. Specifically, DOE is working to identify early MHK deployment hotspots so that industry may have a clear picture of the most promising project development opportunities. In the next 1-2 years, a wave classification scheme will be created to inform device designs for resource classes that balance energy capture while reducing the risk due to expected resource conditions on the device. The vision for 3 years and beyond is to develop methodologies to aid quick and easy site--specific resource characterization for developers. To improve and build upon present efforts, the Program is requesting the following information with regard to resource characterization:

1. A series of resource assessments were conducted and included wave, tidal, ocean current. If the Program were to conduct additional research in this area, what information should be captured and for which resources?

2. The Program is considering focusing on more specific characterization of MHK resources in "hotspot" areas throughout the nation where there is high resource potential. What/where are the industry priority "hotspots" for more specific resource characterization?

3. What are the biggest challenges to the MHK industry regarding resource assessment and characterization in the near term? 2-3 years? And beyond?

4. Though utility scale deployments are a few years off, a role of the Program is to be forward thinking in conducting research to continue to buy down risk for the industry in the 2 to 10 year timeframe. In this regard, what will the next steps be to reduce the risk of offshore deployment of MHK devices and thus lower the costs of investing in the industry (e.g. new and cheaper technologies for measuring the resource, types of resource observations that will be required, time and spatial scales needed forecasting the resource, etc.)?

5. The Program is collecting information on the present state of the art for wave, tidal, river and ocean current resource characterization/assessment models and tools.

    a. What type of hardware and software are typical for MHK resource characterization and assessments?

    b. What items would be necessary to observe and at what levels and what time scales?

    c. Do these methods and technologies accurately characterize the MHK resource? If not, how can they be refined?

6. The Program is currently developing a wave classification scheme analogous to the resource classifications used by the wind industry. This will allow device developers to understand the operating conditions they will face in different regions, and which regions to target for deployment in order to capture the maximum amount of energy with the minimum amount of load on the MHK device, maximizing the lifetime of the device and reducing LCOE and investor risk.

    a. How would you use the classification system?

    b. Would a classification system be useful for resource types other than wave energy?

    c. How do you see this benefitting the MHK sector?

CATEGORY 5: Crosscutting / Out of the Box Feedback / Other

While MHK stakeholder input in categories 1 through 4 is important for Water Power Program strategy development, there may be valuable insight or information that does not fit into the defined categories. Please use this section to comment in more general areas or those that are not covered in categories 1 through 4. A few crosscutting questions are listed below.

1. What are proper metrics for measuring industry progress at its current level of maturity?
2. What are the biggest challenges that you face as an organization?
3. What are the largest cost drivers influencing techno-economic feasibility of MHK devices?
4. What are the highest need research areas for the MHK industry?
5. What is your projection of what will be the highest need research areas in future years?

REQUEST FOR INFORMATION RESPONSE GUIDELINES: Responses to this RFI must be submitted electronically to MHKRFI@ee.doe.gov no later than 5:00pm (ET) on March 20, 2015. Responses must be provided as .pdf or Microsoft Word (.docx) attachment to the email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. Only electronic responses will be accepted.

Please identify your answers by responding to a specific question or topic if possible. Respondents may answer as many or as few questions as applicable.

EERE will not respond to individual submissions or publish publicly a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

Respondents are requested to provide the following information at the start of their response to this RFI:

- Company / institution name;
- Company / institution contact;
- Contact's address, phone number, and e-mail address.

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.