DOE's Water Power Technologies Office (WPTO)



Energy Efficiency & <u>Renewable Energy</u>



Overview of WPTO & the Marine and Hydrokinetics (MHK) Program

Tim Ramsey WPTO Peer Review October 8, 2019

Thank you to our MHK reviewers

ENERGY Energy Efficiency & Renewable Energy

Foundational R&D, Technology Design, and Validation Panel

- Elaine Buck, European Marine Energy Centre (MHK Chair/Panel Lead)
- Alex Fleming, iMetalx Group LLC
- Andy Hamilton, Monterey Bay Aquarium Research Institute
- Henry Jeffrey, The University of Edinburgh
- Jim Bretl, Korvis Automation
- Mike Muglia, University of North Carolina













Reducing Barriers to Testing and Data Sharing Panel

- **Chris Bassett**, University of Washington (Panel Lead)
- Anu Kumar, U.S. Navy, Living Marine Resources Program
- Gayle Zydlewski, University of Maine
- Jason Wood, SMRU Consulting
- Martin Wosnik, University of New Hampshire
- Whitney Hauer, BOEM Pacific OCS Office













Water Power Technologies Office – Topline Numbers

FY 2013 Enacted FY 2015 Enacted FY 2016 Enacted FY 2017 Enacted FY 2018 Omnibus FY 2019 Appropriations FY 2014 Enacted Program МНК 41,275,000 \$ 41,100,000 \$ 35,456,000 \$ 45,000,000 \$ 59,000,000 \$ 70,000,000 \$ 70,000,000 \$ Hydro \$ \$ \$ \$ 19,231,000 17,290,000 19,200,000 25,000,000 \$ 25,000,000 \$ 35,000,000 \$ 35,000,000 Total \$ \$ 60,300,000 \$ 84,000,000 4,687,000 58,565,000 \$ 70,000,000 \$ \$ 105,000,000 \$ 105,000,000



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Financial Assistance

- Funding Opportunity Announcements (FOAs) result in financial assistance to industry and academia through <u>cooperative agreements</u>. Cooperative agreements are similar to grants but provide for more involvement between the Federal awarding agency and the awardee. DOE requires at least a 20% cost share from these recipients (some exceptions – e.g. for universities)
- The <u>Small Business Innovations Research (SBIR) and Small Business</u> <u>Technology Transfer (STTR) programs</u> provide grants to small businesses or individuals who can form a small business within the required application timeline. This program is Congressionally mandated.

Prizes and Competitions

<u>Prizes and Competitions</u> are organized to achieve defined goals in a defined timeframe. They often use cash prizes and other incentives to reach beyond the "usual suspects" and increase the number of problem-solvers addressing a critical issue.

Annual Operating Plans (AOPs)

Annual contracts with national labs which define the scope, schedule, milestones, and cost for work. This is how WPTO funds national lab partners to conduct research, analysis, and develop tools and resources for the benefit of the MHK field. Ongoing, multi-year efforts require merit review.

Lab Support to Industry

- "FOA support" or payment to lab staff to support a FOA awardee
 - Labs are ineligible to apply for FOAs but they may be requested by a FOA recipient to partner on an awarded project. In these cases, WPTO pays the lab directly.
- <u>Small Business Vouchers (SBV</u>) has funded national labs' support to small businesses to help test, develop, and validate their innovative products.
- The <u>Technology Commercialization Fund (TCF)</u> enables industry to obtain a license to lab-developed technologies. This is a Congressionally mandated program which comprises .9% of annual program budgets and requires cost share.

Other

Additional program-led work including analysis, communications, stakeholder engagement, and dissemination activities.

FY17-FY19 budget by funding mechanism





WPTO budget planning

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Federal fiscal years (FY) run October – September. At any time, WPTO is working on budgets for three FYs:

- Executing the current fiscal year (e.g. implementing the budget appropriated by Congress for the current FY)
- Formulating or developing for the next fiscal year (e.g. justifying the President's budget request for the next FY by outlining how WPTO would use requested funds)
- Planning for the fiscal year after next (e.g. outlining funding needs/priorities for the FY after next)

WPTO is currently executing FY19, formulating FY20, and planning for FY21.

The simplified flow diagram below typically takes an entire year in practice.



WPTO's Outreach and Engagement Strategy

GOAL ONE – TRANSPARENCY: Demonstrate good stewardship of taxpayer funds by persistently and transparently communicating how WPTO funds are being utilized and evaluate project impacts

GOAL TWO – FEEDBACK: Get feedback from stakeholders to inform and improve WPTO projects and strategy

GOAL THREE – DISSEMINATION: Maximize the impact of WPTO-supported research by effectively disseminating results of projects and tracking usage of various products

GOAL FOUR – OBJECTIVE AND ACCURATE INFORMATION: Provide access to accurate and objective information and data that can help to accelerate industry development and inform decision-makers

Development of a multiyear strategy and value of RFI

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The MHK Program Strategy:

- provides an ultimate vision for the U.S. MHK industry
- discusses **DOE's mission** in relation to the vision
- identifies core challenges that the industry currently faces
- presents **WPTO's approaches** to address these challenges
- was developed and refined through multiple rounds of stakeholder feedback, including discussion with industry, academic institutions, national laboratories, federal agencies, international partners, and other stakeholders
- is intended to be a living document that is updated every 4-5 years and used as a tool to continually discuss and disseminate research needs, priorities, and industry challenges
- nominally covers the time period from the present to 2035, though it is expected that additional research would be needed beyond that point as well.

"WPTO's ultimate vision is a U.S. marine and hydrokinetic industry that expands and diversifies the nation's energy portfolio by responsibly delivering power from ocean and river resources"



Challenges to developing marine energy technologies

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WPTO's R&D approaches to address challenges

MHK technologies are at an early stage of development due to the fundamental **challenges of generating power from dynamic, low-velocity and high-density resource while surviving in corrosive marine environments**. These challenges are intensified by **high costs and lengthy permitting processes associated with in-water testing**.



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FY17-FY19 budget by activity area/program approach



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Foundational and crosscutting R&D

- Drive early-stage R&D focused on components, controls, manufacturing and materials
- Develop and validate numerical modeling tools
- Improve resource assessments and characterizations



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MHK Program's Strategic Approaches			
Foundational and Crosscutting R&D	Technology- Specific Design and Validation	Reducing Barriers to Testing	

Data Sharing and Analysis





Sandia National Lab: wave energy control systems research ENERGY Energy Efficiency & Renewable Energy



Sandia testing @ the Navy's Maneuvering and Sea Keeping (MASK) basin in Carderock, MD

From May 2018 to June 2019, Sandia completed three different rounds of wave tank testing to investigate the performance of different closed-loop wave energy converter power take-off controllers.



DOE MHK Program Strategy

MHK Program's Strategic Approaches			
Foundational and Crosscutting R&D	Technology- Specific Design and Validation	Reducing Barriers to Testing	

Data Sharing and Analysis

MHK Graduate Student Research Program

This program will provide graduate students access to the expertise, resources, and capabilities available at the DOE laboratories, industry, and other approved facilities while working on their MHK related thesis

This program will enhance education and training in WPTO-related fields, developing and encouraging the next generation of <u>marine</u> energy researchers to help advance the WPTO mission.

Accepting applications until December 6th!

orise.orau.gov/mhk-research-program







Technology-specific design and validation

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- Validate performance and reliability of systems
- Improve cost-effective methods for installation and operations and maintenance (O&M)
- Support the development and adoption of international standards
- Evaluate current and potential future needs for marine energy-specific infrastructure



INTERNATIONAL LEVELISED COSTOF ENERGY FOR OCEAN ENERGY TECHNOLOGIES

An analysis of the development pathway and Levelised Cost Of Energy rajectories of wave, tidal and OTEC technologies



Data Sharing and Analysis



35-meter wave energy converter funded by WPTO & Irish counterpart is en route to test in Hawaii







DOE MHK Program Strategy			
MHK Program's Strategic Approaches			
Foundational and Crosscutting R&D	Technology- Specific Design and Validation	Reducing Barriers to Testing	

Data Sharing and Analysis

November 1, 2010 – estimated arrival at the Wave Energy Test Site in Hawaii

Reducing barriers to testing

• Enable access to world-class testing facilities

- Focus research to reduce the cost and complexity of permitting and environmental monitoring
- Ensure that existing data is accessible and used by regulators
- Support scientific research focused on retiring or mitigating environmental risks





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DOE MHK Program Strategy			
MHK Program's Strategic Approaches			
Foundational and Crosscutting R&D	Technology- Specific Design and Validation	Reducing Barriers to Testing	

Data Sharing and Analysis





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In 2019, OSU applied for a FERC license for PacWave South

Milestone reached in permitting with the submission of the final license application for PacWave South

In June of 2019, Oregon State University submitted the final license application to the Federal Energy Regulatory Commission (FERC) for the grid-connected wave energy test site DOE is helping to establish off the Oregon coast.



Notice



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DOE MHK Program Strategy			
MHK Program's Strategic Approaches			
Foundational and Crosscutting R&D	Technology- Specific Design and Validation	Reducing Barriers to Testing	

Data Sharing and Analysis







A Notice by the Federal Energy Regulatory Commission on 06/11/2019

U.S TEAMER Program

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The **Pacific Ocean Energy Trust** (POET) has been competitively selected as the Network Director for the Program



Anticipated Features of U.S. TEAMER Program

- \$16M program up to 100 projects
- 3 years
- 20+ facilities involved
- 15,000+ hours technical assistance to be provided
- Targeting TRL 1-5 technologies, including
 - Bench Testing
 - Tank Testing
 - Open-water Testing
 - Testing of devices or cross-cutting areas, such as power take-off systems, grid integration, environmental effects, materials, or moorings
- National Labs and Marine Centers would have access to data to validate models as well as cost and performance
 - Aggregated data would be widely distributed publically

2018 brought first 'NoiseSpotter' testing

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Integral Consulting, Inc. and the Pacific Northwest National Laboratory performed a sequence of tests using a new sensor package, NoiseSpotter, which is designed to record and localize sound generated by marine energy devices.

Distinguishing sound from marine energy devices from other sounds will provide important information related to any potential environmental effects of these devices to marine animals.







DOE MHK Program Strategy MHK Program's Strategic Approaches Foundational Technologyand Specific Barriers to

Validation Data Sharing and Analysis

Design and

Testing

This work is part of the Triton Initiative which supports the development of advanced and cost effective environmental monitoring technologies for marine renewable energy applications.

Crosscutting

R&D

Data sharing and analysis

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Marine and Hydrokinetic Data Repository U.S. DEPARTMENT OF ENERGY

Q search MHKDR data Search Wave Energy Prize River Energy Current Energy Wave Energy



- Assess potential marine energy market opportunities, including those relevant for the blue economy
- Aggregate, analyze and disseminate data on MHK performance and technology advances
- Leverage methods and lessons from the international marine energy community and other offshore sectors

DOE MHK Program Strategy			
MHK Program's Strategic Approaches			
Foundational andTechnology- SpecificReducing Barriers to TestingCrosscutting R&DDesign and ValidationTesting			
Data Sharing and Analysis			

PRIMRE: a portal to all DOE-funded marine energy databases

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The Portal and Repository for Information on Marine Renewable Energy (**PRIMRE**) provides centralized access, standardization, community building, and integration of WPTO-funded marine energy data repositories and knowledge bases.

By bringing key databases together knowledge will be increased by reducing redundancy and improving search and analysis efficiencies.

PRIMRE.org



WPTO launched a research effort into maritime markets in 2018

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WPTO's *Powering the Blue Economy* report is informing our engagement with potential coastal and ocean energy end users to understand how marine energy could be uniquely suited to meet energy innovation needs to power growth in at-sea applications that make up the blue economy.

Key Messages

- Potential market opportunities where marine energy may hold a unique value proposition to meet the energy needs of the blue economy.
- Technology attributes of marine energy beneficial to many blue economy markets:
 - o the ability to provide both electrical and mechanical power
 - minimal surface expression improving storm survivability
 - opportunities for co-design and integration with other infrastructure;
 - o the ability to leverage existing maritime supply chains
 - marine energy devices are inherently designed to remove energy from ocean resources instead of fight against them.



Exploring Coastal and Offshore Markets

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In 2019, WPTO announced two prizes and one collegiate competition under PBE

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Marine Energy Collegiate Competition U.S. DEPARTMENT OF ENERGY

University and graduatelevel teams will develop technical business plans focused on near-term blue economy market opportunities for marine energy technologies.

90

days

90

days

180

180

davs



Application Required

Due October 18th

For more info:

PRIMRE.org

In 2019, WPTO announced two prizes and one collegiate competition under PBE

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WPTO and the NOAA-led Integrated Ocean Observing System are launching a **\$3 million prize** to integrate marine renewable energy with ocean observation systems.





Join the Challenge

americanmadechallenges.org/oceanobserving



Learn more about WPTO through our Water Wire and projects map



The Water Wire

- Monthly e-newsletter from WPTO
- Get updates on funding opportunities, events, publications, webinars, R&D successes and more

ENERGY.GOV Office of ENERGY EFFICIENCY &	
The Water Wire	
October 1, 2019	
Energy Department Announce Marine Energy Research and	<u>s Network Director for</u> Testing Program
The Water Power Technologies Office has select support testing and research for marine energy and Access for Marine Energy Research (TEAM capabilities from universities and the national lat developers ready-access to unique, world-class network of facilities and testing protocols, the pr of testing for MHK technology developers – ensu- the appropriate time.	ted a network director for a new program to technologies—the U.S. Testing Expertise IER) Program. TEAMER will bring together poratory system to provide marine energy testing facilities and expertise. Through its ogram will simplify access and reduce costs uring access to the appropriate facilities at
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https://www.energy.gov/eere/water/water-power-news-events

Interactive Projects Map



- Features multiple filters to isolate specific details on DOE hydropower and marine energy projects
- Contains historical information on completed projects with research findings, and publication links

https://energy.gov/eere/water/water-power-technologies-office-projects-map



Save the Date: WPTO Semiannual Stakeholder Webinar

The second installment of WPTO's semiannual stakeholder webinar is on **November 5th from 3pm-5pm EST**. The first one was held in February 2019.

On the agenda for November 5th:

- Peer Review recap and key takeaways
- Overview of new awards
- 2019 activities and accomplishments
- Upcoming 2020 priorities

Email questions ahead of the webinar to <u>WaterPowerTechnologiesOffice@ee.doe.gov</u>

Want **periodic updates** on water power funding opportunities, events, and publications?



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Thank You!

WPTO Support to Testing – Panel Discussion

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



Moderated by: Tim Ramsey, Marine and Hydrokinetic Program Manager, WPTO

Featuring:

Ryan Coe, Senior Research Engineer, Sandia National Laboratories

Grand Ballroom

- Jonathan Colby, Director of Technology Performance, **Verdant Power**
- Steve DeWitt, Technology Manager, WPTO
- Lauren Moraski Reudy, Technology Manager, WPTO
- Brian Polagye, Director, Pacific Marine Energy Center



Tethys: DOE resource for offshore renewable energy environmental information

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- The premier resource for information on the potential environmental effects of marine energy.
- Thousands of documents; searchable, sortable, tagged, with metadata.
- Active dissemination tools: webinars, news feed, calendar of events, project metadata and information, links to external websites.
- WPTO recently launched "Tethys Engineering" – a website similar to Tethys that will serve as a knowledge based for engineering reports



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In pursuing its objectives, the Water Power Technologies Office always endeavors to:

- Catalyze **innovation** in technology and science
- Steward natural resources and support the public good
- Expand access to affordable, reliable and secure energy
- Invest taxpayer funds wisely and to drive the greatest **impact**
- Collaborate and actively seek **input** from stakeholders and partners
- Be transparent and share results widely



<u>Challenges</u>			
Difficult Engineering	Installing and Operating Reliable Systems	Prolonged Design and Testing Cycles	Technology / Market Information and Supply Chains
 MHK resources have large ranges in intensity and present other fundamental difficulties for designing systems to efficiently capture usable energy, due to the unique physics of the systems. There are open scientific and engineering questions about how devices interact with these complicated resources or with other devices, and efforts to develop validated methods to measure, model, and predict these interactions are ongoing. Commonly-accepted performance metrics are not well established to evaluate the wide range of existing technologies and drive early-stage designs toward performance 	 Developing effective and efficient methods for installation, testing, O&M, and environmental monitoring are difficult due to the nature of high-energy and corrosive marine / riverine systems, and there have been limited opportunities to improve through experiential learning. Ships and other infrastructure necessary to deploy MHK devices and support other operations in high-energy and sometimes deepwater environments where devices will be deployed are limited and/or have not been optimized for MHK applications. 	 Access to test infrastructure required for rapid iterative design improvements is limited and facilities do not exist at all necessary scales Permitting processes are expensive and time consuming due to: Extensive requirements for environmental monitoring driven by high perceptions of risk, Limited transferability and utilization of accurate information about siting and deployment of MHK technologies, and The need for sometimes complicated coordination with numerous other existing users of ocean spaces and waterways 	 Many high-value opportunities for utilizing MHK technologies are unclear due to the limited availability of information and analysis on the potential of MHK technologies in the electric sector and other maritime markets There is a lack of validated, publically-available data on the performance, costs and reliability of new MHK systems and the unique benefits which can be realized in developing these resources Manufacturing and supply chains for MHK applications are not well- developed and may result in long lead times and high-costs for materials and components

competitiveness

<u>Challenges</u>			
Difficult Engineering	Installing and Operating Reliable Systems	Prolonged Design and Testing Cycles	Technology / Market Information and Supply Chains
	<u>Appro</u>	aches	
Foundational & Crosscutting R&D	Technology-specific System Design and Validation	Reducing Barriers to Testing	Data Sharing and Analysis
 Drive innovation in components, controls, manufacturing, materials and systems with early-stage R&D specific to MHK applications Develop, improve, and validate numerical and experimental tools and methodologies needed to improve understanding of important fluid-structure interactions Improve MHK resource assessments and characterizations needed to optimize devices & arrays, and understand extreme conditions Collaboratively develop and apply quantitative metrics to identify and advance technologies with high ultimate techno-economic potential for their market applications 	 Validate performance and reliability of systems by conducting in-water tests of industry-designed prototypes at multiple relevant scales Improve methods for safe and cost efficient installation, grid integration, operations, monitoring, maintenance, and decommissioning of MHK technologies Support the development and adoption of international standards for device performance and insurance certification Evaluate current and potential future needs for MHK-specific IO&M infrastructure (vessels, port facilities, etc.) and possible approaches to bridge gaps 	 Enable access to world-class testing facilities that help accelerate the pace of technology development Work with agencies and other groups to ensure that existing data is well-utilized and identify potential improvements to regulatory processes and requirements Support additional scientific research as needed, focused on retiring or mitigating environmental risks and reducing costs and complexity of environmental monitoring Engage in relevant coastal planning processes to ensure that MHK development interests are equitably considered 	 Provide original research to assess and communicate potential MHK market opportunities, including those relevant for other maritime markets (e.g., desalination, powering subsea sensors, charging for underwater vehicles) Aggregate and analyze data on MHK performance and technology advances, and maintain information sharing platforms to enable dissemination Support the early incorporation of manufacturing considerations / information into design processes Leverage expertise, technology, data, methods, and lessons from the international MHK community and other offshore scientific & industrial sectors (e.g., offshore wind_oil and gas)

Vision

Unlocking opportunities for ocean science, security, and maritime industries by exploring new applications for marine renewable energy.

Goals

- 1. Understand and quantify the value of marine energy in emerging ocean markets uniquely suited to MHK technology attributes. (Prioritize markets where MHK has a unique advantage)
- 2. Address energy limitations and **contribute to national goals** for growth in the blue economy. (Collaboration required!)
- 3. Accelerate marine energy grid-readiness through near-term opportunities, supporting WPTO MHK strategy and mission. (Learn from past program experience!)







Look out for RFIs and WPTO-organized events

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You can subscribe to our Water Wire or visit our events page online for information on WPTO-organized events and webinars. WATER POWER TECHNOLOGIES OFFICE \sim

Home » News & Events » Water Power Events

WPTO often utilizes a public **Requests for Information** (RFI) to solicit feedback from stakeholders on WPTO's programmatic strategy and industry's research and development needs.

RFIs – as well as funding opportunities – are publicly posted on **EERE Exchange.**

Below is an industry calendar with meetings, conferences, and webinars of interest to the conventional hydropower and marine and hydrokinetic technology communities.

Webinar: Introduction to the Marine Energy Collegiate Competition

October 3, 2019 12:00PM TO 1:00PM EDT

Pitch Day: FAST Commissioning for Pumped-Storage Hydropower Prize October 7, 2019 12:00PM TO 4:00PM EDT

 $\leftarrow \rightarrow C \triangle$ https://eere-exchange.energy.gov

EERE Funding Opportunity Exchange

MHK System Advisor Model Demonstration

October 7, 2019 12:30PM TO 2:00PM EDT

EERE » Financial Opportunities » Funding Opportunity Exchange