



Semiannual Stakeholder Webinar
February 7, 2019

Alejandro Moreno, Director

Tim Welch, Hydropower Program Manager

Tim Ramsey, Marine and Hydrokinetics Program
Manager

Hoyt Battey, Strategy and Analysis Program Manager

- If you have issues with the webinar, please send a private chat to Jenny, who will be able to assist you.
- The webinar will be recorded, transcribed, and shared in a future edition of the Water Wire.
- The webinar will conclude with a Q&A session. Please send questions by 4:00pm ET to WaterPowerTechnologiesOffice@EE.DOE.GOV.
 - We will try to answer as many questions as we can.
 - Names of individuals submitting questions will remain anonymous to our listeners.

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

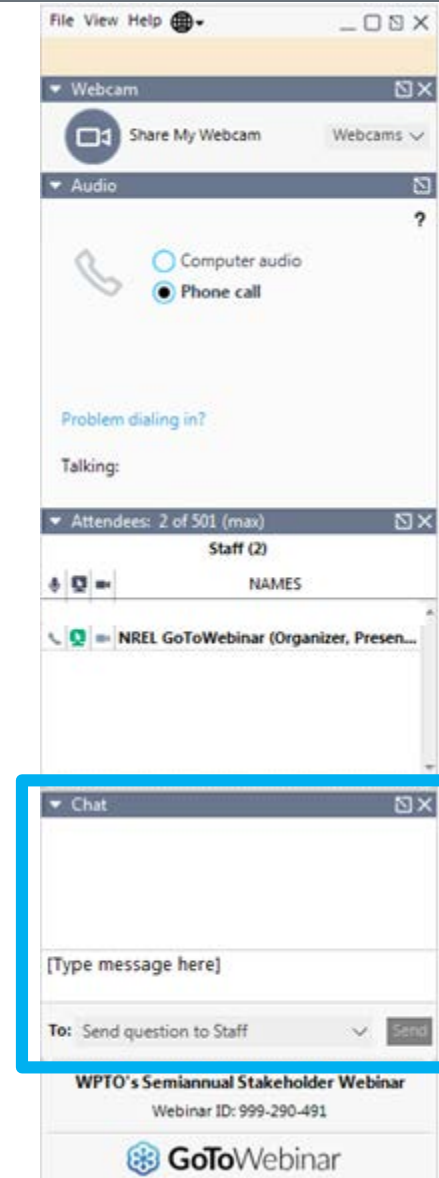


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- Introduction – Alejandro Moreno (3:00 – 3:15)
 - What is the Water Power Technologies Office (WPTO)?
 - How can you work with WPTO?
 - 2018 highlights for the Office and the Department of Energy
- Hydropower Program – Tim Welch (3:15 – 3:35)
 - Program overview & 2018 highlights
- Marine and Hydrokinetics Program – Tim Ramsey (3:35 – 4:00)
 - Program overview & 2018 highlights
- Outreach and Engagement – Hoyt Battey (4:00 – 4:10)
 - Upcoming events and how to learn more about water power research
- Questions & Answers (4:10 – 4:30)
 - Please submit questions by 4:00pm to WaterPowerTechnologiesOffice@ee.doe.gov

About the Water Power Technologies Office (WPTO)



WPTO invests in **early-stage research** to accelerate development of innovative water power technologies while **ensuring that long-term sustainability and environmental issues are addressed.**



WPTO supports efforts to **validate performance and grid-reliability** for new technologies, develop and increase accessibility to **necessary testing infrastructure**, and evaluate **systems-level opportunities and risks.**



WPTO aggregates, analyzes and disseminates **relevant, objective, technical information** on water power technologies and related issues to stakeholders and decision-makers.

Emerging priorities: In 2018, WPTO focused efforts on **two new research portfolios** within our hydropower and marine energy programs:

- **A hydropower-grid** research portfolio focused on current conditions as well as potential future value drivers
- Analysis of marine energy technologies' potential to power **the blue economy** (ocean industries & missions)

- DOE received a full year of appropriations for fiscal year 2019, including **\$70M for marine energy R&D** and **\$35M for hydropower R&D**.
- Secretary Rick Perry led a White House event about the use of prizes and challenges to drive innovation. **The Secretary was joined by AquaHarmonics** who won WPTO's Wave Energy Prize in 2016.
- DOE launched **the Water Security Grand Challenge** to advance transformational technology and innovation to meet the global need for safe, secure, and affordable water.
- **Under Secretary of Energy Mark Menezes delivered a keynote at Waterpower Week 2018** on the role of water power in the Administration's energy strategy.
- **Daniel Simmons was confirmed and sworn in as DOE's Assistant Secretary for Energy Efficiency and Renewable Energy (EERE)**. He previously held this role in an acting capacity.



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

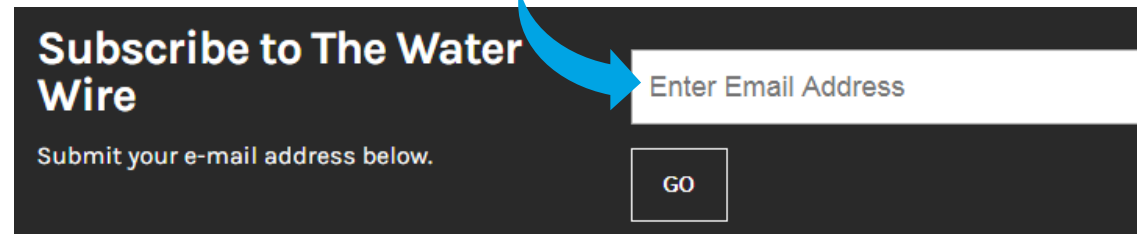
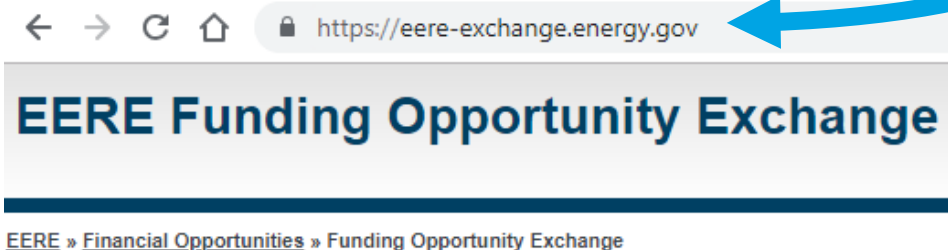
Ways to work with WPTO & stay in the know

- **Competitive funding opportunities** through which organizations can apply for financial support. These projects, established through cooperative agreements, generally require some level of cost-share from the awardee.
- Innovative funding mechanisms such as **prizes and challenges** are also being used more frequently across DOE and other federal agencies.
- The **Small Business Innovations Research (SBIR) and Small Business Technology Transfer (STTR) Programs** are competitive programs targeted to small businesses.
- WPTO and other DOE offices often utilize a public **Requests for Information (RFI)** to solicit feedback from stakeholders on WPTO's programmatic strategy and industry's research and development needs.
- DOE's **National Laboratories** have research centers that can help water power researchers and manufacturers (there are a number of different options for working with Labs).

Most of these opportunities are publicly posted on **EERE Exchange** (*SBIR and STTR can be found on <https://science.energy.gov>*).

You can **reach out to WPTO** to ask a question, offer feedback, or request a meeting by writing to WaterPowerTechnologiesOffice@EE.DOE.GOV

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



Water power research programs and contacts at DOE's national laboratories



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Peter Kobos

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WPTO organizational structure

Director
Alejandro Moreno



**Strategy & Analysis
Program Manager**
Hoyt Battey



Operations Supervisor
Matthew Grosso



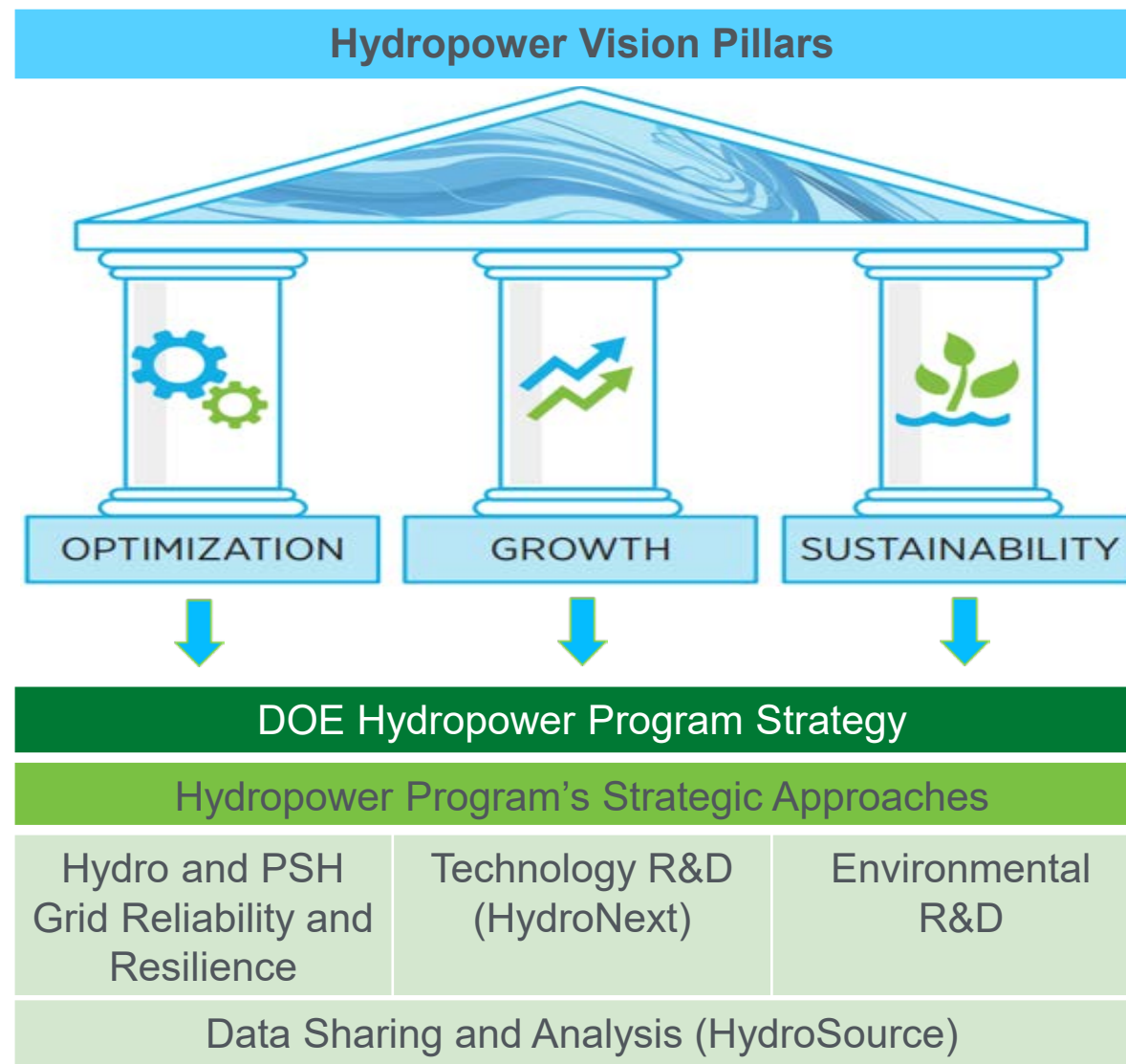
**Hydropower
Program Manager**
Timothy Welch



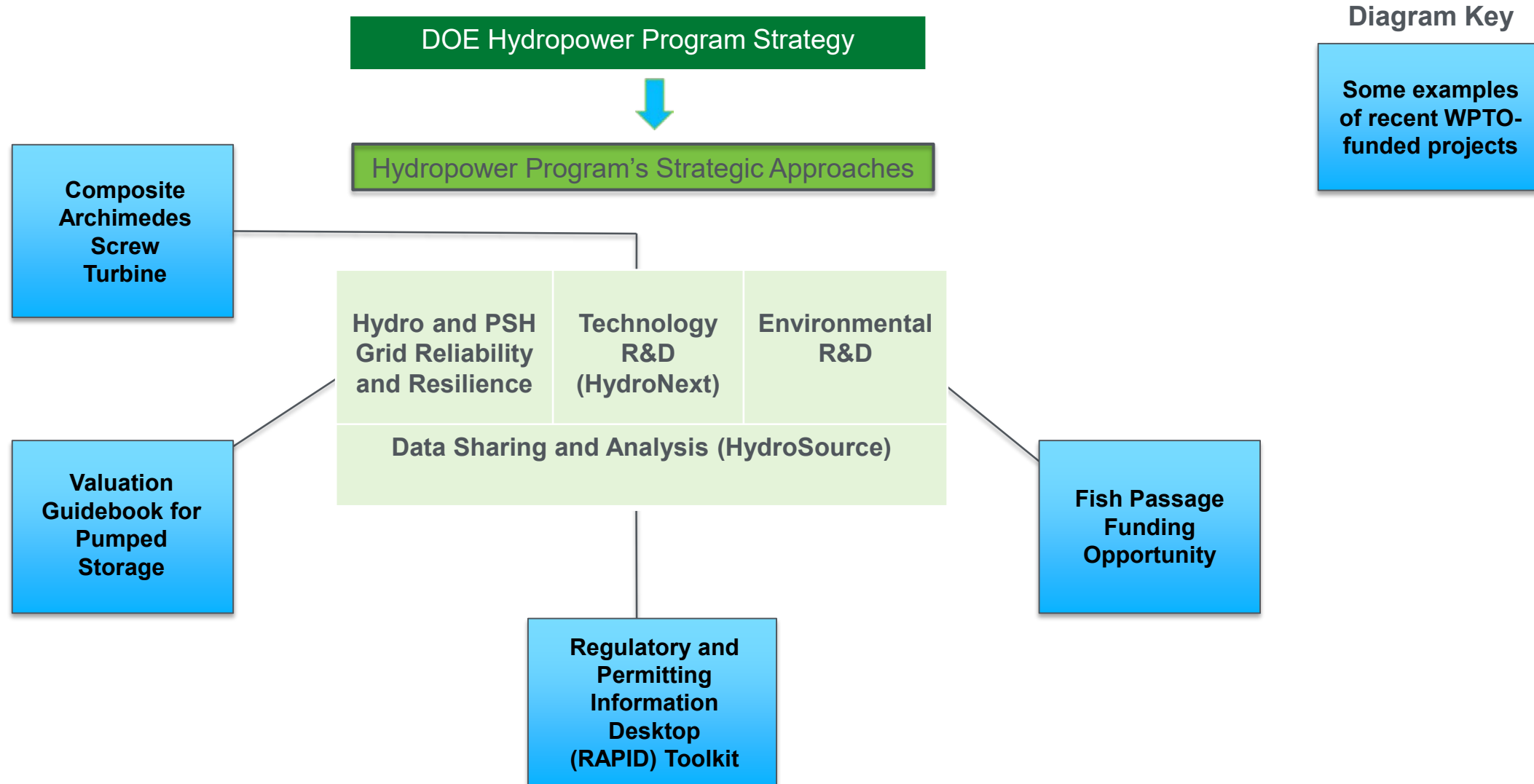
**Marine & Hydrokinetic
Program Manager**
Tim Ramsey



The Hydropower Vision: connections with the DOE Hydropower Program's strategic framework



DOE Hydropower Program's strategic approaches and project examples



Technology R&D for Low-Impact Hydropower Growth (HydroNEXT)

- Early-stage research in **technologies and systems** to reduce costs and unlock new resources
- Leverage **advanced manufacturing and materials**
- **New design paradigms** for hydropower project development for multiple environmental and social benefits

DOE Hydropower Program Strategy

Hydropower Program's Strategic Approaches

Hydro and PSH Grid Reliability and Resilience	Technology R&D (HydroNext)	Environmental R&D
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Data Sharing and Analysis (HydroSource)



Upgrades for Existing Hydropower

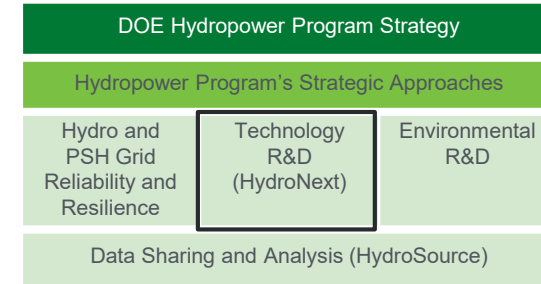


Non-Powered Dams and Conduits



New Stream-Reach Development

Composite Archimedes Hydrodynamic Screw (CAHS) turbine



35kW prototype testing at Utah Water Research Laboratory

Courtesy of Percheron Power and Utah State University

- Lower installed costs and improved hydraulic efficiencies compared to steel
- Individual blade segments produced using advanced manufacturing techniques
- Prior to testing, Percheron received assistance from Pacific Northwest National Laboratory to optimize and validate the CAHS shape and design

Hydro and pumped storage grid reliability and resilience

Five national laboratories have been organized into a hydropower grid research initiative that investigates **the contribution of hydropower resources to the reliability and resiliency of the national electric power system**. The research has four domains:

DOE Hydropower Program Strategy		
Hydropower Program's Strategic Approaches		
Hydro and PSH Grid Reliability and Resilience	Technology R&D (HydroNext)	Environmental R&D
Data Sharing and Analysis (HydroSource)		

Value Under Evolving System Conditions:
What Will the Grid Require?
OUTPUT: Future Conditions, Services, and Value



Operations and Planning:
How Can We Plan and Operate the Hydropower Fleet to Best Take Advantage of Capabilities?
OUTPUT: Competitive Position and Contribution to System Attributes



Capabilities and Constraints:
What Can the Hydropower Fleet Do, and Why, in Today's and the Emerging Grid?
OUTPUT: Technology Characterization

Technology Innovation:
What Achievable Innovations are Needed to Enable or Preserve Hydropower's Critical Contribution to the Electric System of the Future?
OUTPUT: New Technology Designs to Create New Capabilities or Remove Barriers

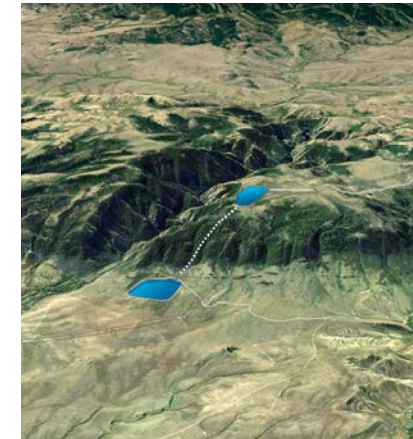
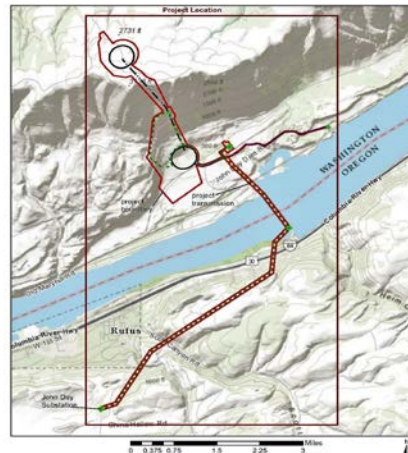
In 2017, Congress directed WPTO to analyze the value of pumped-storage hydropower at two U.S. sites with high-levels of intermittent renewable energy generation.

WPTO has since initiated the development of **an advanced valuation methodology for pumped storage hydropower** that can be used by pumped storage developers, plant owners and operators, and other stakeholders to assess the economic value of existing or planned pumped storage projects.

We then developed and issued a Notice of Opportunity for Technical Assistance (NOTA) to competitively select two sites to focus our analysis – **a detailed valuation analysis of the economic value of each project based on the market, location, and plant characteristics.**

Goldendale

GridAmerica Holdings, Inc.
*Closed loop, variable speed,
1.2 GW project in the
WA/OR border*



Banner Mountain

Absaroka Energy, LLC
*Closed loop, ternary, 400
MW project in central
Wyoming*

DOE Hydropower Program Strategy

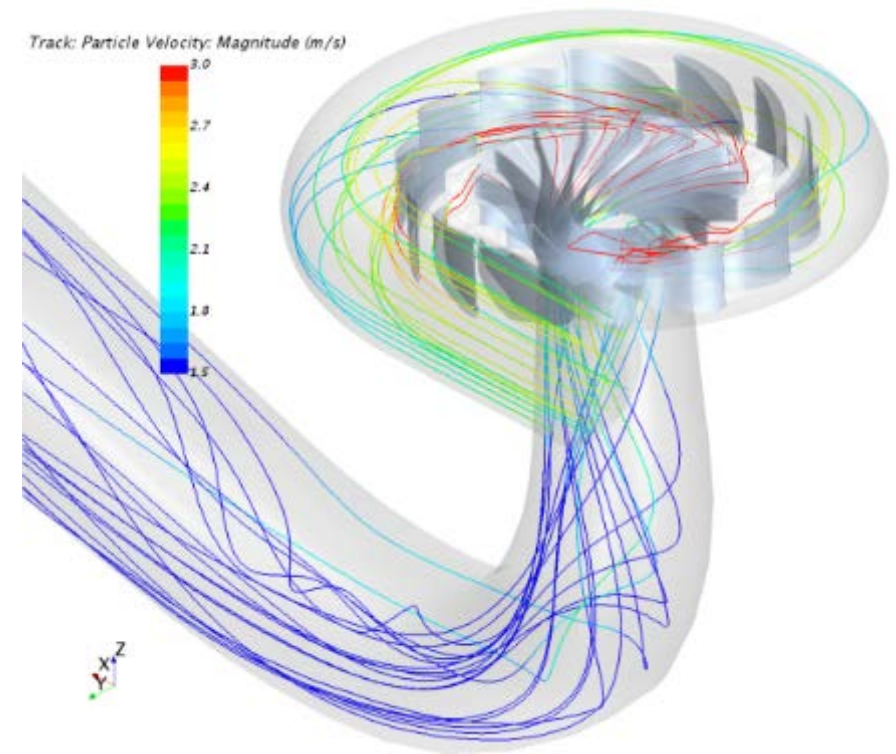
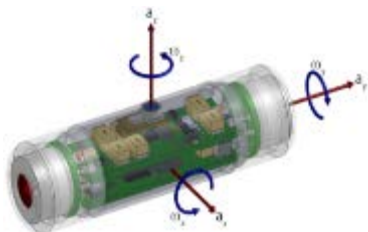
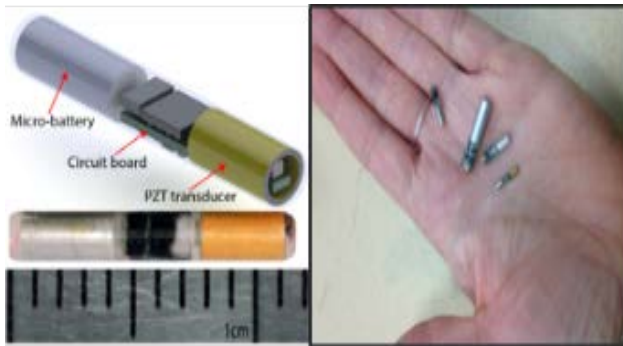
Hydropower Program's Strategic Approaches

Hydro and PSH Grid Reliability and Resilience	Technology R&D (HydroNext)	Environmental R&D
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Data Sharing and Analysis (HydroSource)

- Research to **improve environmental performance** for existing and new hydropower technologies
- Develop **monitoring and measurement strategies** for evaluating environmental impacts
- Develop **metrics for evaluating environmental sustainability** for new hydropower developments and facilities
- Assess **impacts of long-term hydrologic variations**

DOE Hydropower Program Strategy		
Hydropower Program's Strategic Approaches		
Hydro and PSH Grid Reliability and Resilience	Technology R&D (HydroNext)	Environmental R&D
Data Sharing and Analysis (HydroSource)		



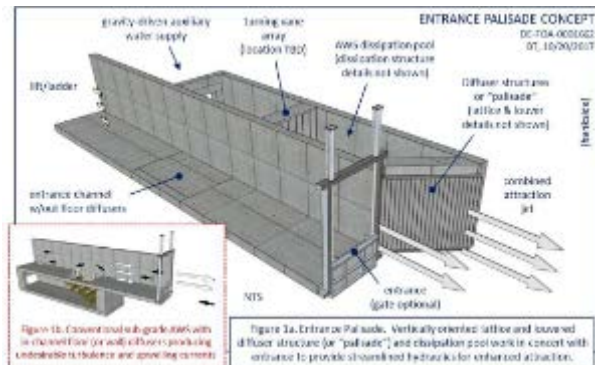
Testing the Effects of Innovative Fish Passage Technologies

- Alden Research Laboratory, Inc.:
 - **Modular and Scalable Downstream Passage Systems for Silver American Eels**
- University of Massachusetts Amherst
 - **Fishway Entrance Palisade**

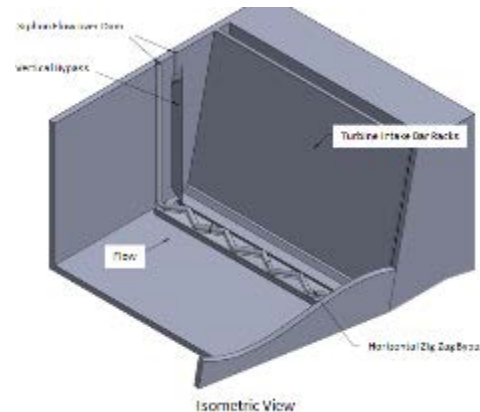
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Hydropower Program's Strategic Approaches		
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Data Sharing and Analysis (HydroSource)		

Advancing Innovative Methods and Technologies to Improve Fish Passage

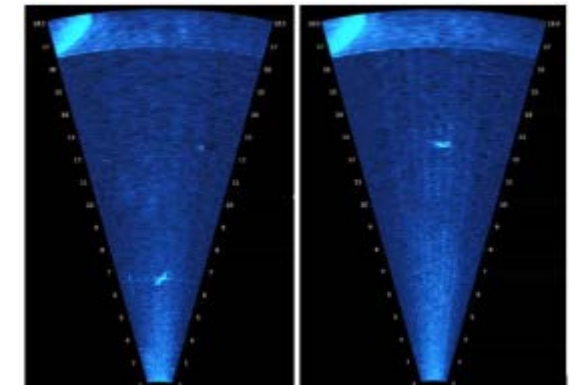
- Electric Power Research Institute
 - **Machine Learning and Data Analytics for Automated Detection, Identification, Enumeration, and Tracking of Migrating Adult Eels from Sonar Data**



University of Massachusetts Amherst



Alden Research Lab

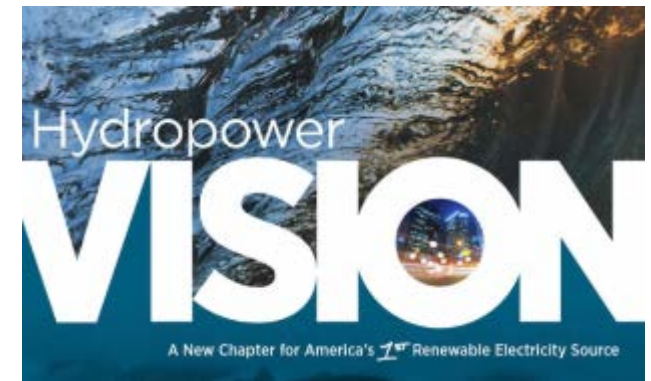


Electric Power Research Institute

Data sharing and analysis

- Supply objective **data and analysis**, often based on information collected over the course of other WPTO research efforts, to decision makers and hydropower industry stakeholders
- Document and **disseminate successful regulatory process practices**
- Develop opportunities and collaborative mechanisms to **increase coordination among permitting agencies**

DOE Hydropower Program Strategy		
Hydropower Program's Strategic Approaches		
Hydro and PSH Grid Reliability and Resilience	Technology R&D (HydroNext)	Environmental R&D
Data Sharing and Analysis (HydroSource)		



HydroSource

Regulatory & Permitting Information Desktop Toolkit (RAPID) for hydropower & pumped storage

The RAPID Toolkit is designed to **increase transparency, decrease uncertainty and reduces time and costs** of developing and re-licensing hydropower projects.

DOE Hydropower Program Strategy

Hydropower Program's Strategic Approaches

Hydro and
PSH Grid
Reliability and
Resilience

Technology
R&D
(HydroNext)

Environmental
R&D

Data Sharing and Analysis (HydroSource)

RAPID

Regulatory and Permitting
Information Desktop Toolkit



RAPIDToolkit.org



Regulations and Permitting Database

Regulatory and permitting information by
jurisdiction, including comparisons between
jurisdictions



Reference Library

A collection of links to regulatory and permitting
documents, regulations, and tools available on
other websites



Best Practices

A collection of best practices for efficiently
permitting renewable energy and bulk
transmission projects

- **Real-time, Autonomous Water Quality Monitoring System** – Pacific Northwest National Laboratory (PNNL) will advance state-of-the-art dissolved oxygen measurement platforms to support monitoring and improve the environmental performance of hydropower systems.
- **Irrigation Modernization** – Idaho National Laboratory (INL) and PNNL will partner to evaluate hydropower’s potential to enable and enhance the modernization of U.S. agricultural irrigation systems.
- **Nontoxic Coatings for Invasive Organisms at Hydropower Facilities** – PNNL will conduct research into durable, economical, and nontoxic coatings that will prevent invasive mussels and other organisms from growing on hydropower structures.
- **Advanced Manufacturing for Hydropower** – PNNL will identify hydropower components that could be suitable for advanced manufacturing techniques like additive systems (e.g. 3D printing), advanced welding techniques, robotics and automation, and embedded sensors.

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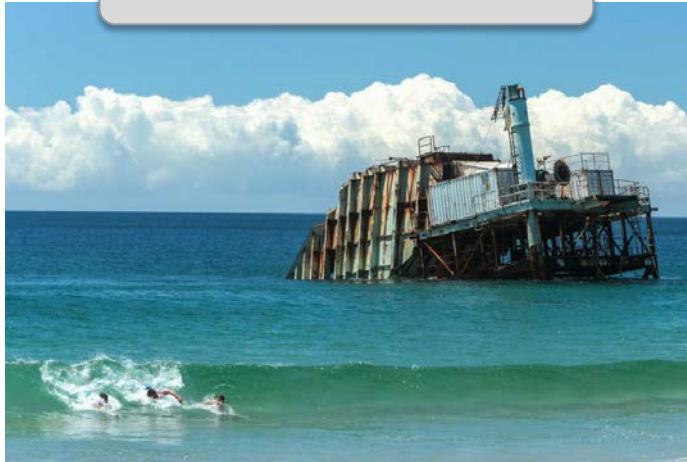
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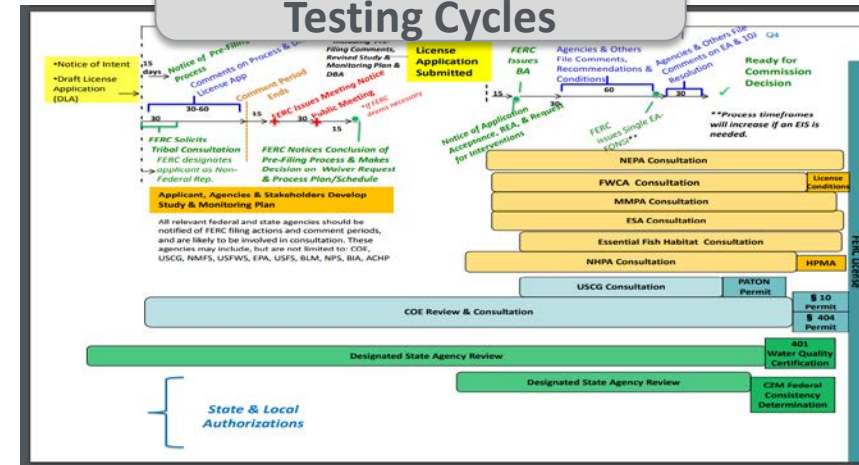
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Challenges to developing marine energy technologies

Difficult Engineering



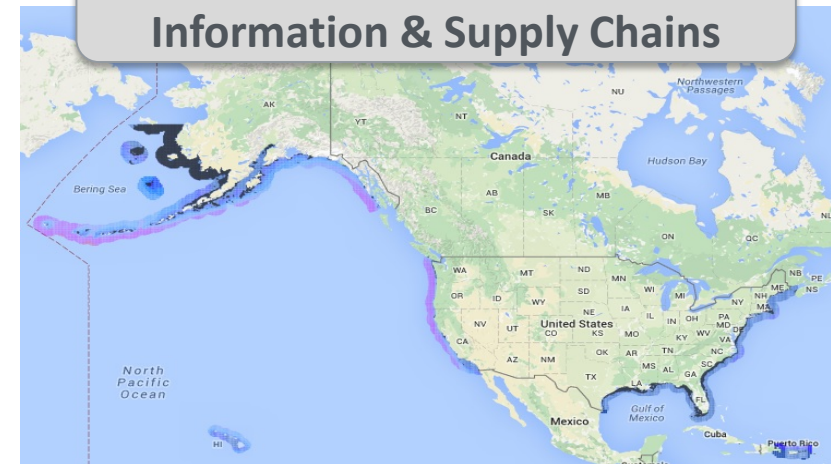
Prolonged Design and Testing Cycles



Installing and Operating Reliable Systems

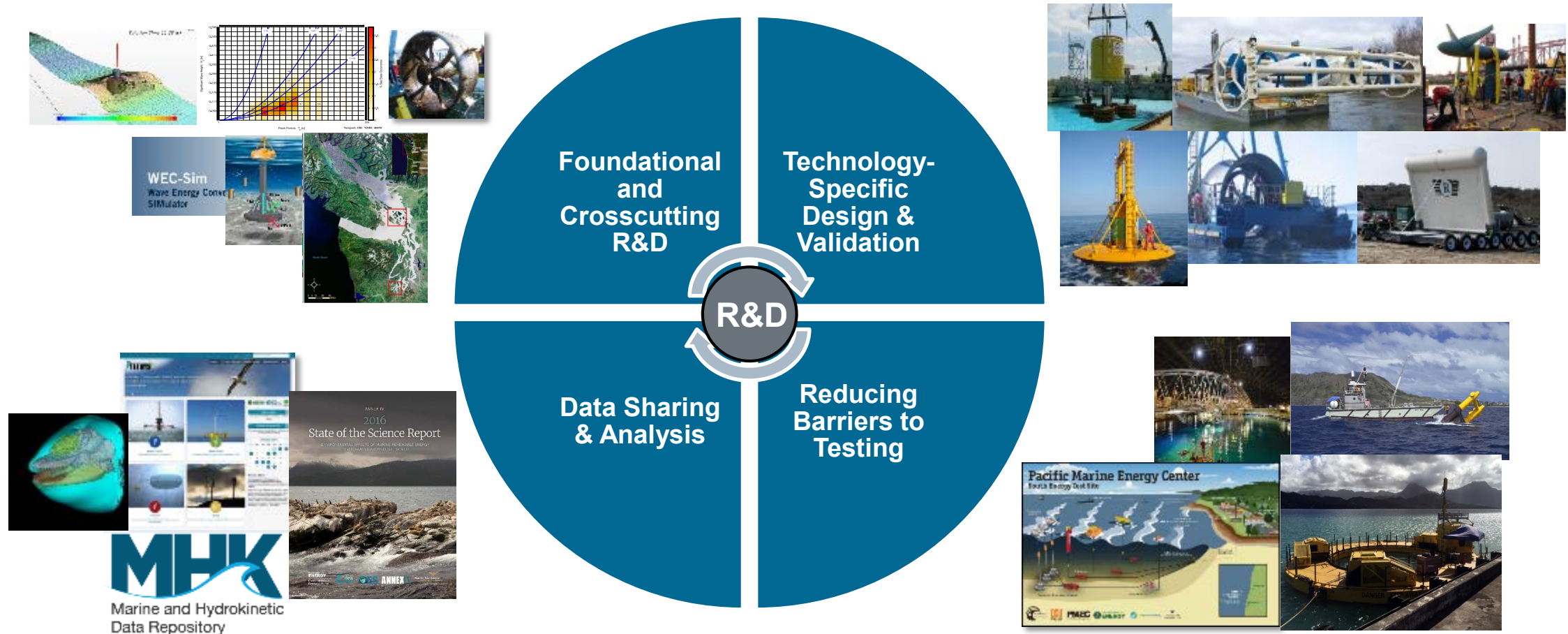


Technology / Market Information & Supply Chains



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 currents while surviving in corrosive marine environments. These challenges are intensified by high costs and lengthy permitting processes associated with in-water testing.



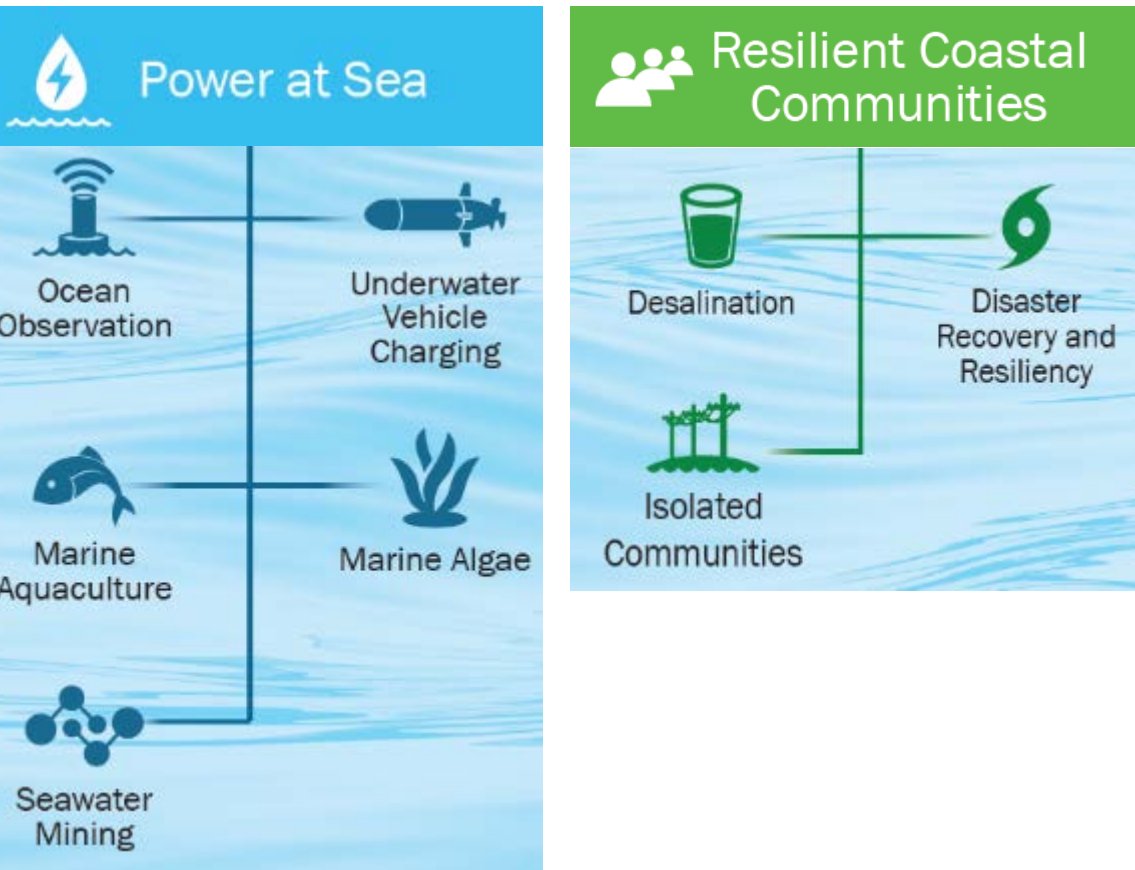
POWERING the BLUE ECONOMY™

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

Marine renewable energy presents a novel and innovative suite of technologies that could help remove power constraints for coastal end users or those out at sea.

By helping to address the needs of these sectors, marine energy could:

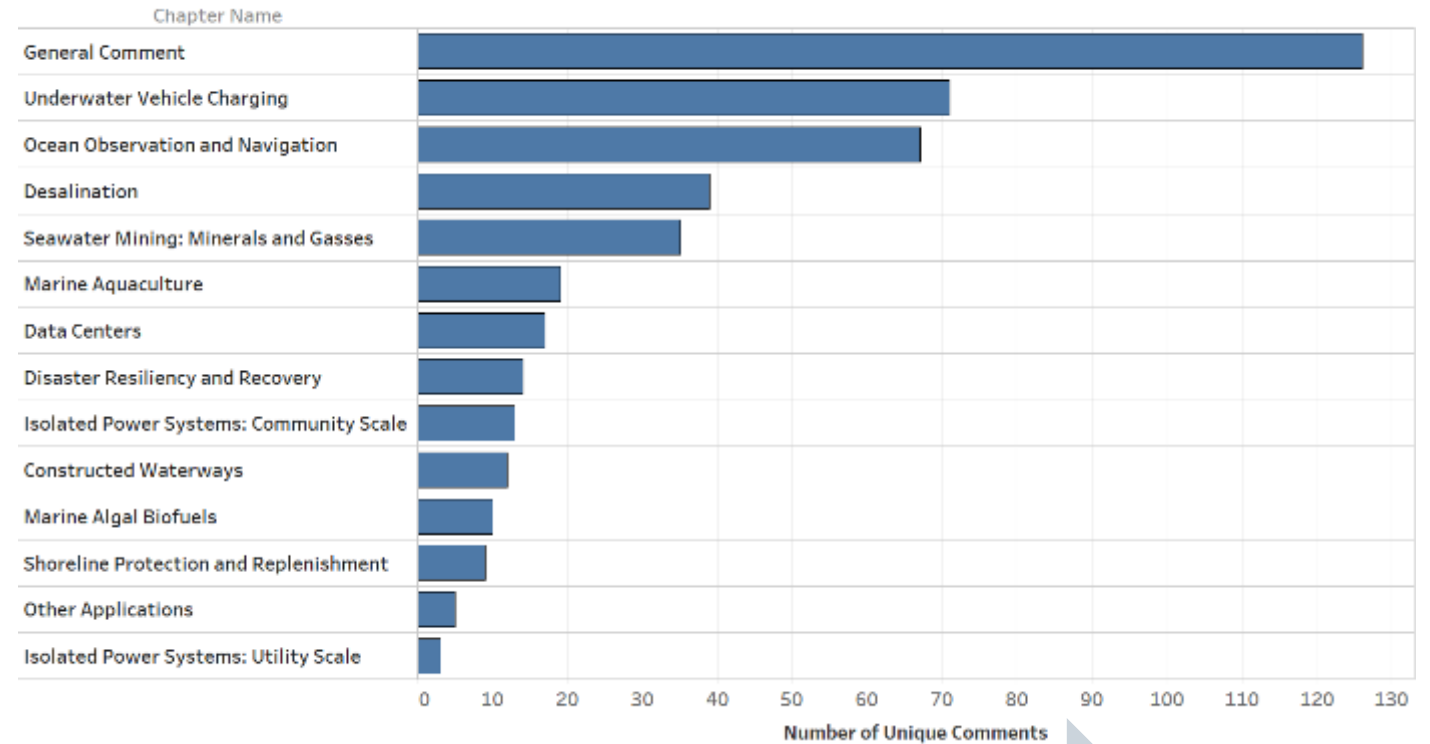
- Accelerate growth in the blue economy
- Create new opportunities for sustained economic development



In 2018, DOE released a draft report on this topic along with a request for public input.

- Received over 400 comments
- Currently refining report based on stakeholder feedback
- Final report to be released within the quarter
- Analysis will inform future work

Public Comment Results on Draft Maritime Markets Report



Opportunity Discovery

Distributed and Alternate Applications Forum

Draft Report Published

Report Comment Period

Final Report

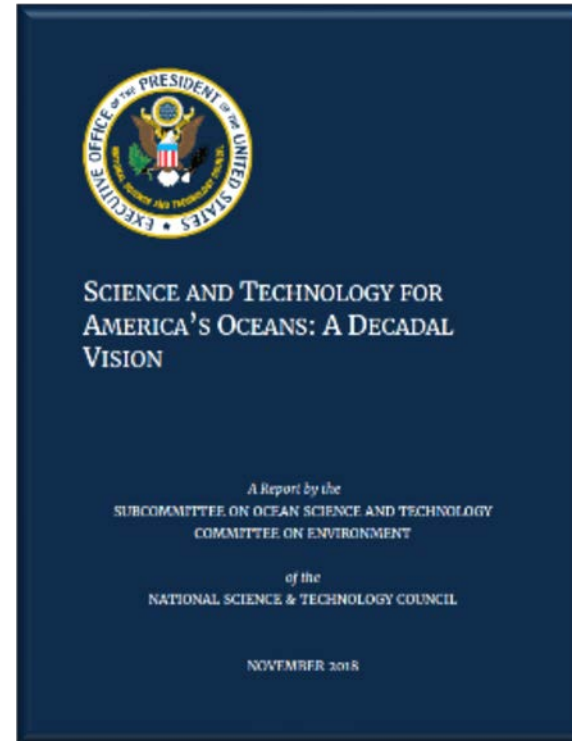
Executive Order Regarding the Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States

— LAND & AGRICULTURE | Issued on: June 19, 2018



Ocean Policy Committee created through Executive Order & WPTO is engaged.

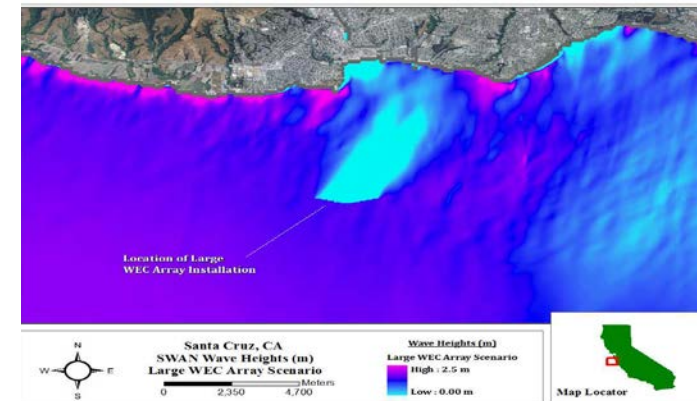
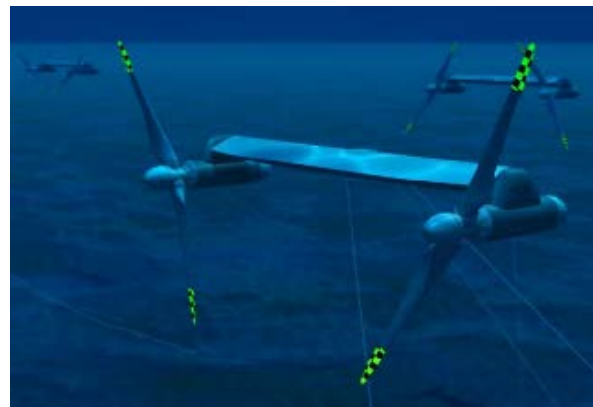
- The Order also gave guidance to DOE and other agencies enabling continued involvement in regional ocean planning groups. WPTO has historically engaged with the Northwest, West, and Northeast regional groups.



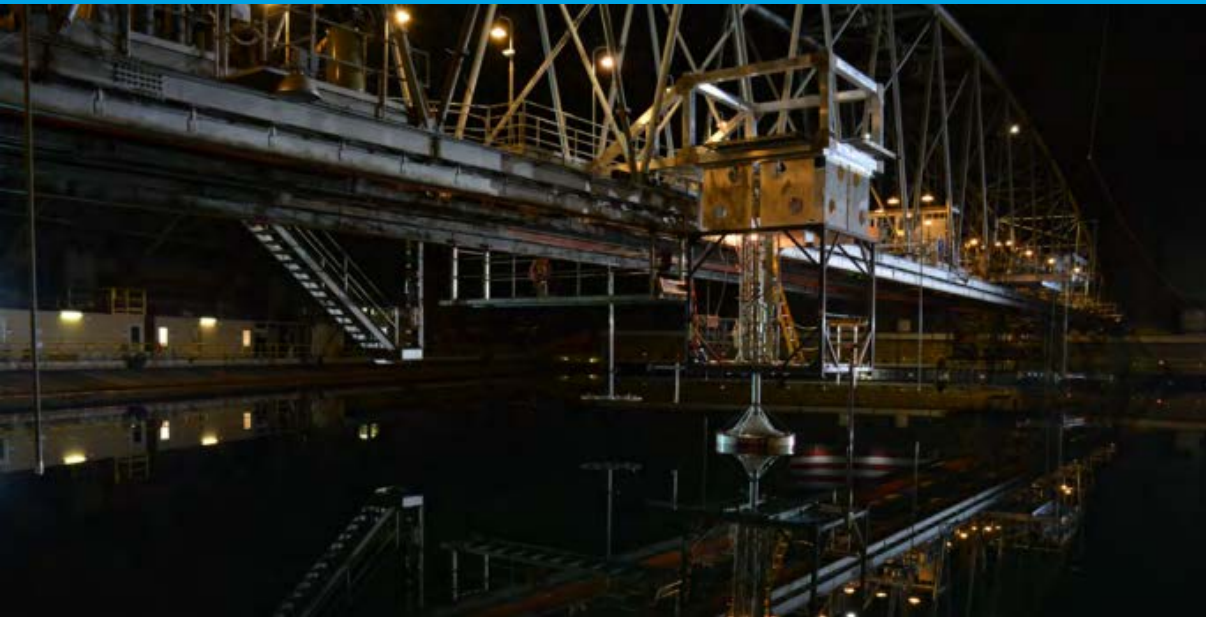
The National Science & Technology Council released *Science and Technology for America's Oceans: A Decadal Vision* in November 2018.

"In addition to generating electricity for use on-shore, power generated at sea (from waves, currents, or wind) could be used to serve the needs of other existing or emerging ocean industries (aquaculture, ocean mineral mining, oceanographic research, or military missions)."

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



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		



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

In May, Sandia completed wave tank testing to investigate the performance of different closed-loop wave energy converter power take-off controllers.

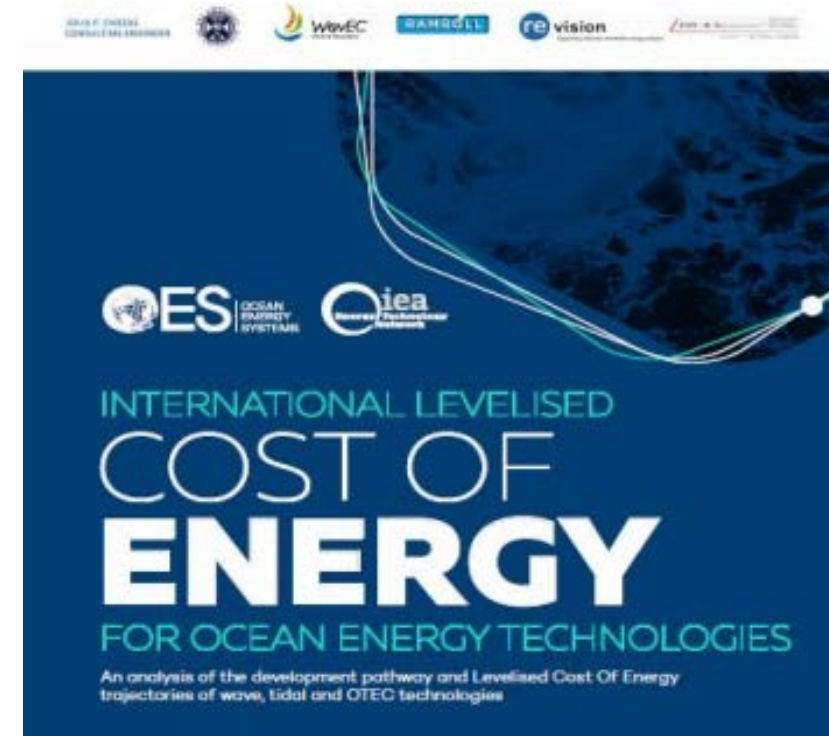
Further testing is planned for the first half of 2019.



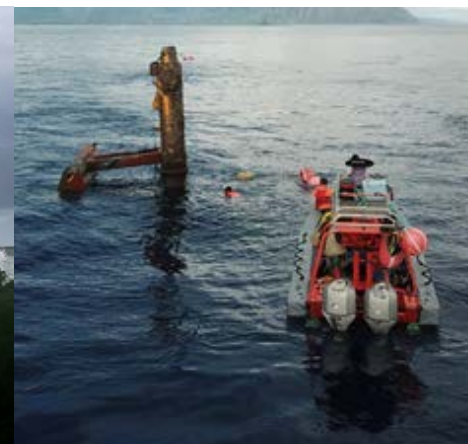
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MHK Program's Strategic Approaches		
Foundational and Crosscutting R&D	Technology-Specific Design and Validation	Reducing Barriers to Testing
Data Sharing and Analysis		

Technology-specific design and validation

- 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



DOE MHK Program Strategy		
MHK Program's Strategic Approaches		
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35-meter wave energy converter funded by WPTO & Irish counterpart nears completion



- A U.S. subsidiary of Irish-based Ocean Energy Ltd., Vigor, Siemens, and others are collaborating to build a 35-meter wave energy converter at Vigor's fabrication facility in Portland, OR.
- Ocean Energy received WPTO funding in 2013 to research alternative manufacturing methods for its OceanEnergy Buoy hull.
- The device will have a 500-kilowatt HydroAir turbine designed by Dresser Rand. The turbine has its own controls system and has already been successfully tested at sea in Galway Bay, Ireland.

DOE MHK Program Strategy

MHK Program's Strategic Approaches

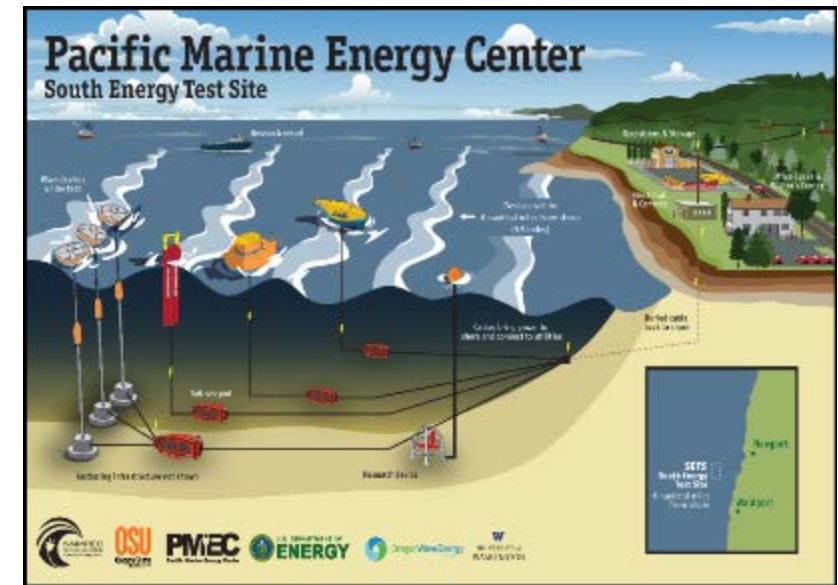
Foundational and Crosscutting R&D	Technology-Specific Design and Validation	Reducing Barriers to Testing
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Data Sharing and Analysis

WPTO and Ireland's Sustainable Energy Authority are both providing research funding that will support the in-water testing of the new OceanEnergy Buoy.

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



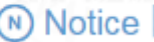
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MHK Program's Strategic Approaches		
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Milestone reached in PacWave permitting with the submission of a Draft License Application (DLA)

In April, Oregon State University submitted the DLA to the Federal Energy Regulatory Commission (FERC) for the wave energy test site DOE is helping to establish off the Oregon coast. The plan outlines construction and operation details as well as measures to avoid and mitigate any potential environmental effects.



FEDERAL REGISTER
The Daily Journal of the United States Government



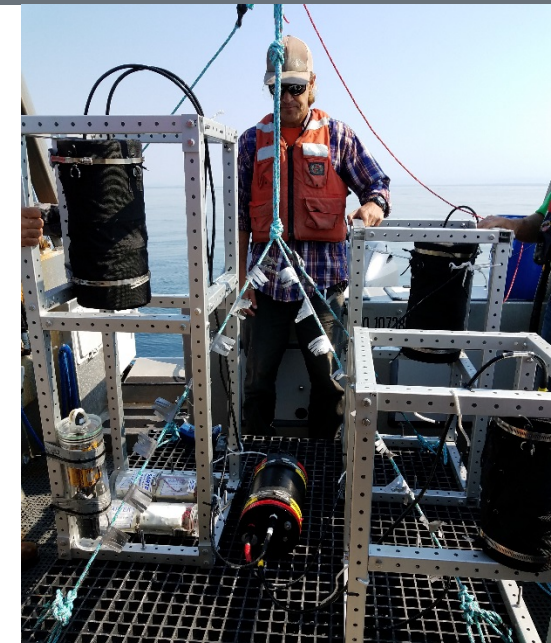
Notice of Draft License Application (DLA) and Draft Preliminary Draft Environmental Assessment (PDEA) and Request for Preliminary Terms and Conditions: Oregon State University

DOE MHK Program Strategy		
MHK Program's Strategic Approaches		
Foundational and Crosscutting R&D	Technology-Specific Design and Validation	Reducing Barriers to Testing
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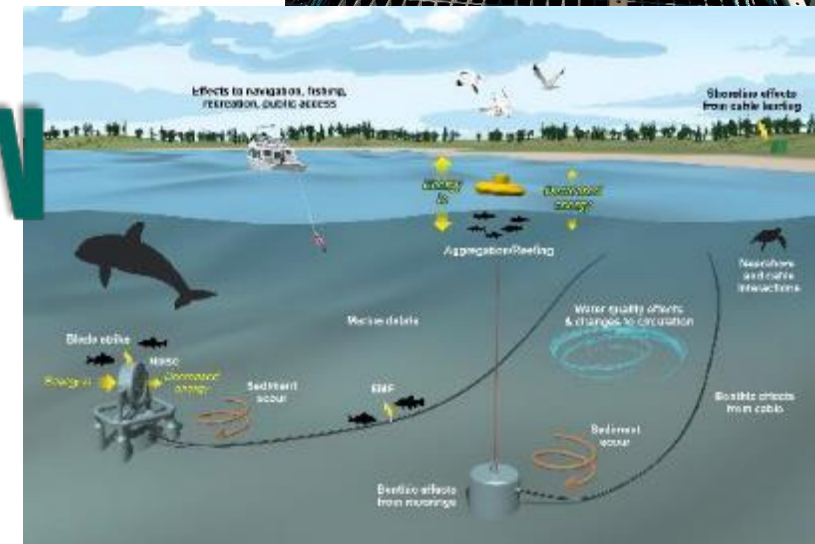
2018 brought first ever 'NoiseSpotter' testing

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.

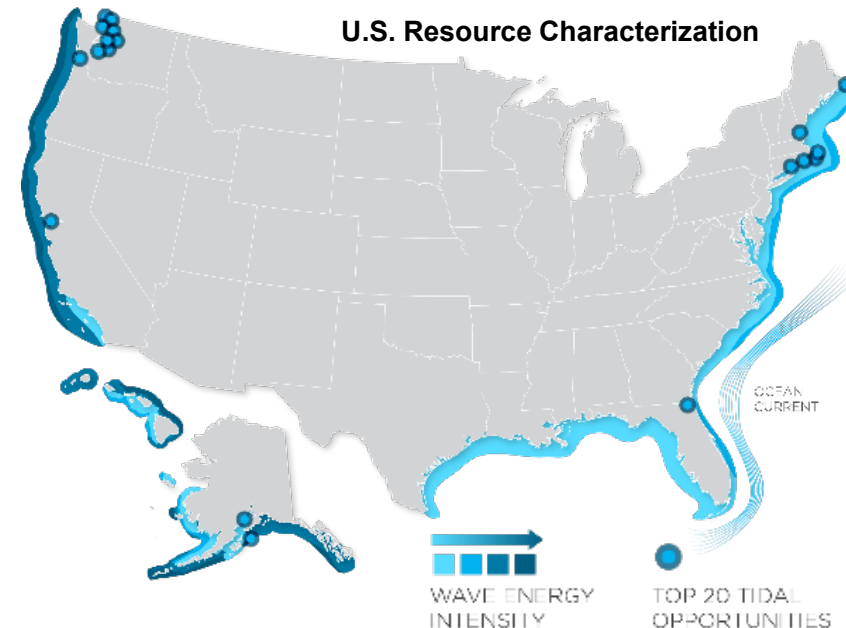


This work is part of the Triton Initiative which supports the development of advanced and cost effective environmental monitoring technologies for marine renewable energy applications.



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		

- 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		
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Tethys: DOE resource for offshore renewable energy environmental information

- 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.
- In 2019, WPTO will work on creating “Tethys Engineering” – a website similar to Tethys that will serve as a knowledge based for engineering reports

The screenshot displays the Tethys website interface. At the top, there is a navigation bar with 'Log In', 'Register', and a search box labeled 'Enter your keywords'. Below this is a main banner featuring the Tethys logo and a news item: 'An Annex IV Environment Webinar was held on Information Collection and Consenting Processes. A video recording is available [here](#).' The main content area is divided into four category tiles: 'Marine Energy' (Generating electricity from the sea), 'Wind Energy' (Generating electricity from wind on land and at sea), 'Annex IV' (Addressing environmental effects of marine energy internationally), and 'WREN' (Resolving conflicts between wind and wildlife internationally). To the right of these tiles is a sidebar with a 'NEW USER' button, a 'KNOWLEDGE BASE' button, a calendar for 'NOVEMBER 2017', and a 'Tethys Story' section titled 'Electromagnetic Field Impacts on Elasmobranch and American Lobster Movement and Migration from Direct Current Cables'.

January 2019: WPTO announced the selection of twelve new marine energy R&D projects

Department of Energy

U.S. Department of Energy Awards \$25 Million for Next-Generation Marine Energy Research Projects

JANUARY 8, 2019

“Advancing next-generation marine energy will help the U.S. ensure a secure, reliable, and enduring supply of American energy. These early-stage research and development projects are key to the development of water power as part of DOE’s ‘all-of-the-above’ energy strategy.”

- Under Secretary of Energy Mark Menezes

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Early Stage Device Design Research

- Oscilla Power
- Atargis Energy Corporation
- Columbia Power Technologies
- Littoral Power Systems
- University of Hawaii at Manoa
- North Carolina State University
- Texas A&M University
- Florida Atlantic University

Controls and Power Take Off Design Integration and Testing

- Portland State University
- CalWave Power Technologies
- AWS Ocean Energy

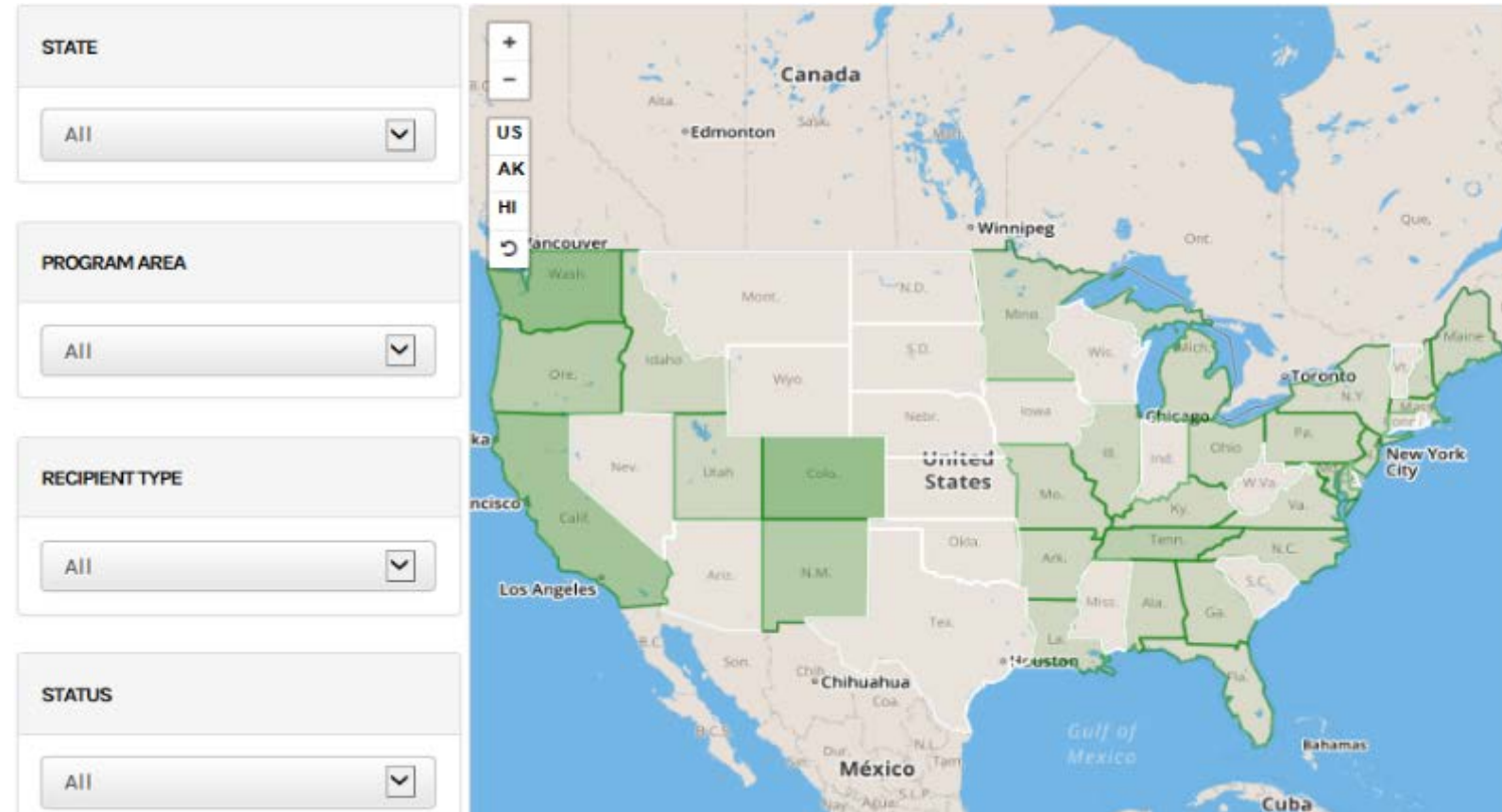
Dissemination of Environmental Data and Analyses to Facilitate the Marine Energy Regulatory Process

- Kearns and West

- **Load Analysis for Variable Geometry Wave Energy Converters (WEC)** – The National Renewable Energy Laboratory (NREL) will investigate next-generation power maximizing, load-shedding wave energy converters with variable geometry control strategies that reduce costs of handling powerful waves.
- **WEC Array Power Management and Output Simulation Tool** – NREL will create a publicly accessible numerical modeling toolset to help wave technology developers optimize plant performance (compatible with different power systems and wave conditions).
- **Grid Value Proposition of MHK** – NREL and the Pacific Northwest National Laboratory (PNNL) will explore different benefits that marine hydrokinetic developments could have on grid reliability and resiliency, on an intermediate-to long-term horizon.
- **Environmental Data Analysis and Coding Competition** – PNNL will develop a competition to find solutions that reduce the time and costs associated with analyzing environmental monitoring data of marine energy technology deployment and operations.
- **WEC Design Optimization** – Sandia National Laboratory will create a hybrid optimization system that simultaneously improves design approaches and controls of existing WEC concepts to overcome costly iterative design/build/test approaches.
- **Umbilical Cable Design Requirements and Best Practices** – NREL and PNNL will accelerate the development of robust and cost effective umbilicals (medium voltage power and communication lines that connect floating WECs to subsea transmission lines).
- **Instrumentation Guidance and Open Source Processing Software Tools** – NREL, PNNL, and SNL will develop tools that can be adopted by the marine energy industry to secure high quality data and reduce costs and timelines for lab and field scale testing.
- **Flexible Material WEC** – NREL will identify, verify, and provide a pathway to achieve economic viability and competitiveness of wave energy, demonstrated by a wave energy converter archetype applied to the large-scale continental grid electricity market.

Learn the specifics at WPTO's projects map

- Interactive map
- Provides information on WPTO's R&D portfolio
- Features multiple filters to isolate specific details on DOE hydropower and marine energy projects throughout the U.S.
- Contains historical information on completed projects with associated materials, research findings, and publication links



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

Meet WPTO staff at these upcoming events

Event	Date	Location
Northwest Hydroelectric Association	February 20 - 22	Portland, OR
Oceanology International Americas	February 25 - 27	San Diego, CA
Waterpower Week	April 1 - 3	Washington, DC
Offshore Technology Conference	April 30 - May 3	Houston, TX
Capitol Hill Oceans Week	June 4 - 6	Washington, DC
Hydrovision International	July 23 - 25	Portland, OR
Ocean Renewable Energy Conference	September 11 - 12	Portland, OR
Ocean Obs	September 16 - 20	Honolulu, HI
WPTO Peer Review	October 7 - 11	Alexandria, VA
The International Conference on Ocean Energy	Spring of 2020	Washington, DC

2019 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
WATER POWER TECHNOLOGIES OFFICE




This Q&A session will conclude the webinar.

The webinar will be recorded, transcribed, and shared in a future edition of the Water Wire.

Thank you for joining us today! We hope to stay in touch.

You can **reach out to WPTO** to ask a question, offer feedback, or request a meeting by writing to WaterPowerTechnologiesOffice@EE.DOE.GOV

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