Wave Energy Prize: Testing and Data Analysis

DOE Wave Energy Prize

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Wave Energy Prize: Testing and Data Analysis

The DOE Water Power Program needed a Prize Administrator with expertise in prize competitions to collaborate with the DOE, PIP, and a wave tank testing facility in developing and implementing the Wave Energy Prize. Administration of the Prize included: Prize development, implementation of the Prize competition stages (e.g. design, build, and test and evaluation), and post-competition publicity and evaluation of impact of the Prize.

The Overall Challenge:

To drive rapid innovation for the newest renewable and evaluate technologies targeting an energy capture efficiency necessary to be cost competitive in large markets.

Challenges for the Prize and Prize Administration:

- First major prize competition for DOE Water Power Program
- Wave energy converter (WEC) devices are highly diverse in archetype, and span a large range of technology readiness
- No current standard metrics to evaluate different archetypes for this market
- Unknown interest and knowledge level of possible participants/public
- Test facility cost for scaled devices can be prohibitive for developers

Partners:

- Ricardo Inc. — Technical Program Management
- JZ Consulting LLC — Team/Challenge Management
- Polaris Strategic Communications LLC — Media Relations Management

Program Strategic Priorities

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

Increase MHK deployment in opportune markets

Technology Maturity

- **Test and demonstrate prototypes**
- Develop cost effective approaches for installation, grid integration, operations and maintenance
- **Conduct R&D for innovative MHK systems & components**
- Develop tools to optimize device and array performance and reliability
- **Develop and apply quantitative metrics to advance MHK technologies**

Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- Support research focused on retiring or mitigating environmental risks and reducing costs
- **Build awareness of MHK technologies**
- Ensure MHK interests are considered in coastal and marine planning processes
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

Market Development

- **Support project demonstrations to reduce risk and build investor confidence**
- Assess and communicate potential MHK market opportunities, including off-grid and non-electric
- Inform incentives and policy measures
- Develop, maintain and communicate our national strategy
- Support development of standards
- **Expand MHK technical and research community**

Crosscutting Approaches

- **Enable access to testing facilities that help accelerate the pace of technology development**
- Improve resource characterization to optimize technologies, reduce deployment risks and identify promising markets
- **Exchange of data information and expertise**

Legend:
- **Key Priorities for Prize Administration**
- **Key Priorities for Testing**
- **Key Priorities for Prize overall**
- **Additional Priorities covered by Prize**

Increase MHK deployment in opportune markets

Deployment Barriers

- **Build awareness of MHK technologies**

Technology Maturity

- **Develop and apply quantitative metrics to advance MHK technologies**

Crosscutting Approaches

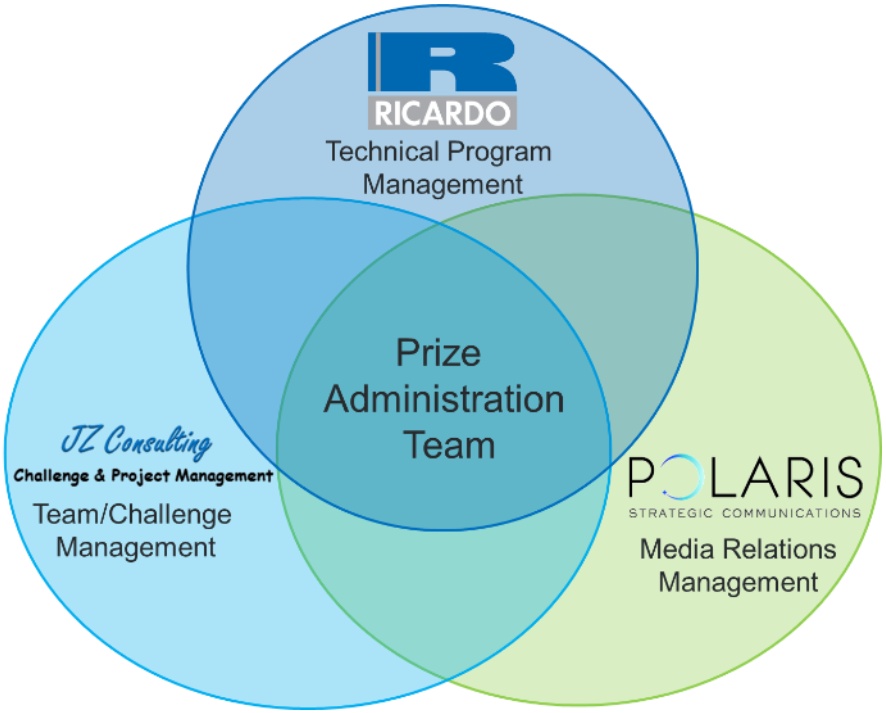
- **Enable access to testing facilities that help accelerate the pace of technology development**
- **Exchange of data information and expertise**

The Impact

- Build a community including known WEC developers, newcomers, and the general public to increase awareness and opportunities for WEC devices
- Develop a set of metrics in a sector that does not currently have clear early stage evaluation metrics them that can be applied equitably to highly diverse WEC archetypes that span a large range of technology readiness
- Enable a wide variety of MHK technology developers access to 1/50th-scale and 1/20th-scale test facilities in the United States
- Support exchange of information during and after the Prize that will benefit current developers, future newcomers, investors, the DOE, and the general public, including openly sharing all data collected during 1/50th – and 1/20th–scale testing

Technical Approach

- Right Team
  - Experience
  - Skills
  - Mindset



- Communication Tools:
  - Scheduled Teleconferences
  - Meetings
  - Webinars

- Program Management Tools:
  - Agendas
  - Meeting Notes/Actions
  - Action Tracking

Technical Approach

- Key Process and Metrics
  - TPL: **T**echnology **P**erformance **L**evel

1st Application

    - Complementary assessment metric to the Technology Readiness Level (TRL). TPL quantifies the techno-economic performance potential of the technology under development, whereas the TRL metric expresses the commercial readiness.
    - Used to down-select the Registered and Qualified Teams – Technology Gate (TG)1 and TG2
  - ACE: **A**verage Climate Capture Width per **C**haracteristic Capital **E**xpenditure Metric
    - Represents the energy captured per unit structural cost of WECs
    - Is a proxy metric for levelized cost of energy (LCOE)
    - 2014 State of the Art = 1.5m/$M
    - Prize Goal / Threshold: Double 2014 State of the Art = 3m/$M

New

  - HPQ: **H**ydrodynamic **P**erformance **Q**uality Metric
    - HPQ = ACE * (MF_{HPQ} * WC_{HPQ} * $AP_{P2A,HPQ}$ * ES_{HPQ} * RS_{HPQ} * AC_{HPQ})
    - Statistical peak of mooring watch circle (WC_{HPQ})
    - Statistical peak of mooring forces (MF_{HPQ})
    - Statistical peak-to-average ratio of absorbed power ($AP_{P2A,HPQ}$)
    - End-stop impact events (ES_{HPQ})
    - Absorbed power in realistic seas (RS_{HPQ})
    - Adaptive control effort (AC_{HPQ})

New

Accomplishments and Progress

Winners announced!

waveenergyprize.org

Grand Prize $1.5M

2nd Place $500K

3rd Place $250K

Accomplishments and Progress

Technical Accomplishments

- **79** Newcomer teams (goal: 5)
- **13** Teams from known developers (goal: 10)
- **25** States, plus Puerto Rico and U.S. citizens abroad (goal: 7)
- **66** Technical Submissions at TG1 (goal: 30)
- **16** 1/50th scale models tested at TG2 (goal: 10)
- **9** 1/20th scale models tested at TG4 (goal: 5)
- **4** Devices exceed ACE threshold (goal: 1)

Additional Recognition

- Government Accountability Office Open Innovation report (Oct 2016) highlights Wave Energy Prize as a leading example
- Challenge.gov Five Years of Excellence in Federal Challenge and Prize Competition Award for Best Public Engagement Strategy (October 2015)
- Federal Laboratory Consortium for Technology Transfer Mid-Atlantic Region Interagency Partnership Award (November 2015)

Project Plan & Schedule

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

Phase 1: Planning

2014 2015

TIMELINE

July
- **29th** Contact Negotiation begins

September
- **29th** Contract Awarded

October
- **23rd** Kick-Off Meeting at DOE

November
- **18th – 20th** Technical Workshop

December
- **18th** Interim Program Review

January
- **5th** Technical Section of Rules Started

March
- **2nd – 3rd** Metrics Meeting
- **19th** Go/No Go Meeting

OFFICIAL RULES

Project Plan & Schedule

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

Phase 2: Design

2015 2016

TIMELINE

April

1st
Wave Energy Prize registration opens on waveenergyprize.org

Jun

30th
Wave Energy Prize Registration closes.

Announcement of Official Registered Teams!

TECHNOLOGY GATE 1

July

15th
Technical Submission deadline for Teams.

16th through Aug. 13th
Technical Submissions are reviewed by an Expert Judging Panel and Qualified Teams are determined.

August

14th
Announcement of Qualified Teams!

TECHNOLOGY GATE 2

January

29th
Results of small scale testing and 1/20th Scale Model Design and Construction Plan due from Teams.

Project Plan & Schedule

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

2016 TIMELINE

Phase 3: Build

Phase 4: Test & Evaluation

March

1st
Announcement of Finalists and Alternates!

1st through July
Finalists and Alternates construct their 1/20th scale WEC device.

June

TECHNOLOGY GATE 3

15th
Finalists and Alternates submit build progress report for verification of test readiness.

July

1st
Finalists verified for testing in the MASK Basin announced!

18th
1/20th scale WEC models must be received by MASK Basin for testing.

August

TECHNOLOGY GATE 4

1st through Oct. 10th
Finalists' 1/20th scale WEC devices are tested at MASK Basin, and top ranking Teams determined.

November

Technology Showcase and winning Teams announced!

December

1st through Feb. 17th 2017
Distribution of Prize Funds
Data Transfer
MHD DR Upload
Final Report
DOE Peer Review

Project Budget

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

Budget History							
FY2014		FY2015		FY2016		FY2017	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$98.8K	$0K	$1,006K	$0K	$2,297K	$0K	$3,326K	$0K

The Administration of the Prize was a cooperative agreement, not a research and development project; it was a specific effort to aid the Water Power Program in administering a challenge to better the WEC community. America Competes Authority states that cost share is not mandatory.

Wave Energy Prize Budget Summary				
Budget Category	**Contract Award**	**Budget Review 1 (Go/No Go 1)**	**Budget Review 2 (Go/No Go 2)**	**Actual**
Administration	$ 2,000k	$ 2,250k	$ 2,476k	$ 2,518k
Prize Awards	$ 2,500k	$ 2,250k	$ 2,250k	$ 2,250k
Small Scale Testing	$ -	$ 750k	$ 682k	$ 682k
Seed Funding	$ 2,000k	$ 1,250k	$ 1,250k	$ 1,165k
Other subcontracts	$ -	$ -	$ 70k	$ 113k
TOTAL	**$ 6,500k**	**$ 6,500k**	**$ 6,728k**	**$ 6,728k**

* Because of the overwhelming positive response from the community to the Wave Energy Prize, the DOE approved an overall increased budget increase of 4% so that more devices could be tested, judged, and learned about.

Research Integration & Collaboration

Partners, Subcontractors, and Collaborators:

Prize Administration Team:

RICARDO

JZ Consulting
Challenge & Project Management

POLARIS
STRATEGIC COMMUNICATIONS

DOE and Program Identified Partners:

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Sandia National Laboratories

NAVSEA
WARFARE CENTERS
Carderock Division

Other Entities:

Cascadia Coast Research Ltd.
Ocean modeling and data analysis

1-800 PACK RAT
The simplest way to store or move your stuff.

Small Scale Test Facilities

THE UNIVERSITY OF MICHIGAN 1817

THE UNIVERSITY OF MAINE 1865

STEVENS 1870

THE UNIVERSITY OF IOWA ORGANIZED FEB. 25TH 1847

OREGON STATE UNIVERSITY 1868

WAVE ENERGY PRIZE
U.S. DEPARTMENT OF ENERGY

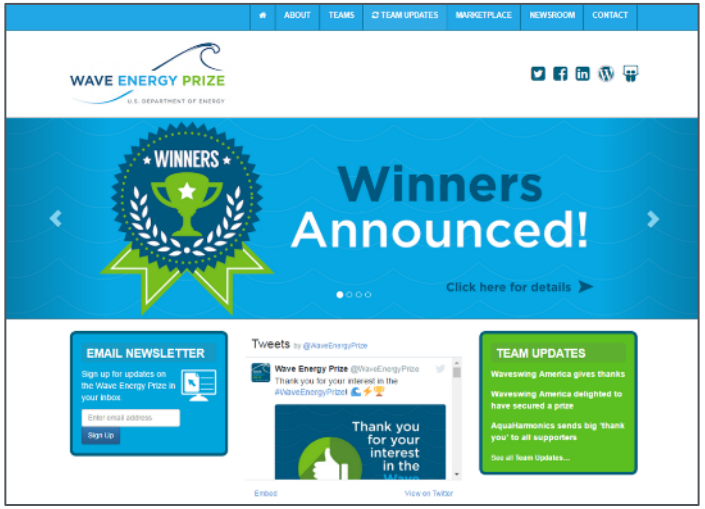
TEAMS

Partners, Subcontractors, and Collaborators:

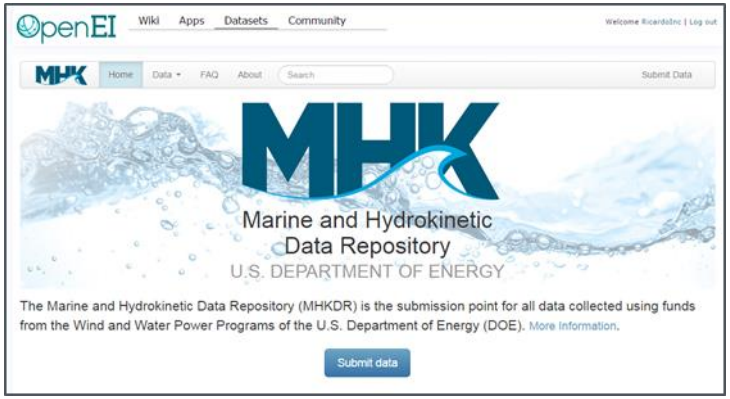
Wave Energy Prize photo taken at National Renewable Energy Laboratory during TG4 – back row, Scott Jenne (NREL), Wesley Scharmen (Ricardo), Rick Driscoll (NREL), Julie Zona (JZ Consulting), Scott Beatty (Cascadia Coast), Alison LaBonte (DOE), Darshan Karwat (DOE), Budi Gunawan (SNL); front row, Stephanie Hodge (DOE), Bob Thresher (NREL), Vince Neary (SNL), Phil Michael (Ricardo), Jochem Weber (NREL), Annie Dallman (SNL), David Newborn (NSWC), Lee Jay Fingersh (NREL)

Communications and Technology Transfer:

- WaveEnergyPrize.org



- MHK Data Repository



Communications and Technology Transfer:

- More than 170 news stories featured the Prize, including channels like Popular Science, The Weather Channel, and National Geographic

- Approximately one million social media impressions
  - Facebook: Followers = 385; Impressions/reach = 90k
  - Twitter: Followers = 625; Impressions/reach = 450k
  - LinkedIn: Followers = 370; Impressions/reach = 140k
  - WordPress and other: Followers = ~50; Impressions/reach = ~90,000

- Email marketing:
  - Subscribers = 704 (not including Prize Administration or DOE)
  - Average open rate = 52.92%
  - Average clickthrough rate = 24.91%

- 431 people viewed the live video stream of the Innovation Showcase Event

Next Steps and Future Research