



American-Made Water Prize

WAVES TO WATER



U.S. DEPARTMENT OF ENERGY

CREATE STAGE

Official Rules

FEBRUARY 2021

The U.S. Department of Energy (DOE) Waves to Water Prize CREATE STAGE will be governed by this Official Rules document, which establishes the rules and requirements for the Waves to Water Prize. The Prize Administrator and DOE reserve the right to modify this Official Rules document and will publicly post any such notifications as well as notify prize participants.

Table of Contents

Executive Summary	5
Technology Development Goals	5
Prize Stages	6
CLOSED—STAGE I: CONCEPT	6
CLOSED—STAGE II: DESIGN	7
CLOSED—STAGE III: ADAPT	7
STAGE IV: CREATE	8
STAGE V: DRINK	8
Applications Not of Interest	8
Participant Eligibility	9
Background	9
Wave Power: An Energy Opportunity	10
Stage I: CONCEPT—Closed	11
Stage II: DESIGN—Closed	11
Stage III: ADAPT—Closed	11
Stage IV: CREATE Stage Rules and Requirements	12
Introduction to the CREATE Stage	12
How to Enter	13
Important Dates	14
What to Submit	14
CREATE Stage Plan	15
Milestone Reports Content	15
Cover Page Content	16
Submission Summary Slide	16
Final Documentation Submission Package	16
3-Minute Video	17
Technical Narrative	18
Letters of Commitment or Support	21
How We Determine Winners	21
Additional Terms and Conditions	22
Stage V: DRINK Stage Rules and Requirements	23
Overview	23
Prizes	23
Grand Prize	23
Metrics Prizes	25

Important Dates	26
Appendix 1— Additional Terms and Conditions	26
Universal Contest Requirements	26
Verification for Payments	27
Teams and Single-Entity Awards	27
Submission Rights	27
Copyright	28
Contest Subject to Applicable Law	28
Resolution of Disputes	28
Publicity	29
Liability	29
Records Retention and Freedom of Information Act	29
Privacy	30
General Conditions	30
Program Policy Factors	30
National Environmental Policy Act (NEPA) Compliance	31
Appendix 2: MONTHLY CHECK-IN NEPA INFORMATION	32
Appendix 3: Required Tables	36
Minimum System Technical Requirements	36
Reporting Key Findings	37
Appendix 4: Risk Assessment Table	40

Executive Summary

Offering competitors up to \$500,000 in cash prizes, the CREATE Stage represents the fourth stage of the Waves to Water Prize. The CREATE Stage asks competitors to build a functional prototype or proof of concept of their system and develop a plan to build and deliver their technology for the DRINK Stage.

In June 2019, the U.S. Department of Energy (DOE) Water Power Technologies Office (WPTO) launched a prize to develop wave energy-powered desalination systems. The Waves to Water Prize is a five-stage, \$3.3M contest to accelerate the development of small, modular, wave-powered desalination systems capable of providing potable drinking water in disaster relief scenarios and remote coastal locations.

In June 2020, WPTO announced that the final DRINK Stage of the competition will culminate at Jennette's Pier test site in Nags Head, North Carolina. This test will be conducted and coordinated by WPTO, the National Renewable Energy Laboratory (NREL), the North Carolina Aquarium (manager of Jennette's), and the Coastal Studies Institute (CSI). The Coastal Studies Institute is a multi-institutional research and education partnership led by East Carolina University, in collaboration with North Carolina State University, the University of North Carolina at Chapel Hill, the University of North Carolina Wilmington, and Elizabeth City State University. CSI's interdisciplinary research focuses on pressing coastal issues, including renewable ocean energy development. For almost a decade, the state-funded North Carolina Renewable Ocean Energy Program, a collaboration between CSI and the colleges of engineering at North Carolina State University, the University of North Carolina at Charlotte, and North Carolina Agricultural and Technical State University, have been researching and developing new ways to bring ocean energy technologies to market sustainably while working with private industry to test devices in the waters off the Outer Banks. CSI operates a renewable energy testing site in partnership with Jennette's Pier, a North Carolina Aquariums' operated facility. The research experience, technical expertise, and infrastructure available for deployment and testing make CSI and Jennette's Pier an optimal location and partnership for the DRINK Stage of the Waves to Water Prize.

The Prize aims to attract dedicated teams of highly capable individuals and provide them with sufficient incentives to advance their technologies through completion of the prize. While the technology development goals of the prize are specifically tailored to address the unique circumstances around disaster response or remote coastal community water needs, the purpose is also to advance technologies that could have broader applications for wave energy and desalination technologies. Through the competition, participants will develop skills and knowledge that will contribute to general improvement and proliferation of wave power and desalination technologies.

Technology Development Goals

The purpose of this program is to incentivize the creation of wave-powered desalination systems that meet the following goals:

- **Flexibility in Varied Wave Conditions:** Competitors must develop systems that can survive harsh wave conditions and operate under different wave conditions and different sites without major tuning to ensure operation at a wide variety of locations. All solutions that make it to the DRINK Stage will be evaluated at an open-water test at Jennette's Pier, which experiences average- to low-energetic wave resources.

- **Easily Deployed:** Systems must be able to be deployed in less than 48 hours, addressing the ability to deploy quickly and easily in a disaster response scenario where there is large uncertainty around site conditions.
- **Ship in a Standard Container:** Technologies must fit into a predefined container. The internal dimensions of the container are approximately 41 x 44 x 35 inches—to standardize the shipping constraints that face many disaster response and recovery scenarios.
- **Operate without Environmental Degradation:** Brine discharge, or other salt concentration issues from the process of desalinating water, will need to be managed without creating environmental issues.
- **Deliver Minimum Water Quality:** The maximum total dissolved solids (TDS) quantity for this competition is 1,000 mg/L.

Prize Stages



CLOSED—STAGE I: CONCEPT

90 DAYS: June 13, 2019 to September 11, 2019



Competitors described how their proposed solution meets the goals of the program, as described in the Technology Development Goals of this document. Submissions detailed the functionality of their wave energy generation technologies, desalination technologies, and their proposed integration methods. This included describing the risks and difficulties of their system and proposed solutions to their issues. Competitors were evaluated based on the level of innovation of their proposed idea, the feasibility of their system, the ability to scale-up and other benefits, and their team. On November 14, 2019, DOE announced the [20 winners](#) that received a \$10,000 prize.

CLOSED—STAGE II: DESIGN

120 DAYS: November 14, 2019 to March 13, 2020



Competitors developed a technical plan and supporting analysis of their wave-powered desalination system. Submissions had two major components: (1) Modeling Documentation—modeling results to justify supporting claims of performance if a prototype of the system is built; and (2) Technical Narrative—a detailed design of their wave-powered desalination system and a plan to build a prototype of their system, including how major risks will be addressed if the submission wins and the team advances to the CREATE Stage. Teams that demonstrated they had the technical capability and sufficient plans to build a functional or proof-of-concept prototype were awarded a cash prize. There were [17 winners](#) that each received a \$47,000 prize.

CLOSED—STAGE III: ADAPT

180 DAYS: May 18, 2020 to November 13, 2020



Competitors in this stage had 180 days to document a thorough and robust design of a system specific to testing at Jennette’s Pier, but that can be scaled for similar environments for disaster relief or remote community water access. This was done through a combination of thorough engineering analysis, design drawings and documentation, and developing a plan to build their technology in the CREATE Stage. Teams that demonstrated the technical capability and detailed plans to build a functional or proof-of-concept prototype were awarded a cash prize and invited to compete in the CREATE Stage. There were 10 winners that received a \$80,000 prize.

STAGE IV: CREATE

180 DAYS: February 9, 2021 to August 9, 2021



Competitors in this stage have 180 days to provide evidence of a viable system and develop a plan to build and deliver their technology for the DRINK Stage. This should be done through a combination of thorough engineering analysis, design drawings and documentation, and physical builds and tests of critical or novel components and subsystems. Up to 7 winners will be awarded equally from a total prize pool of up to \$500,000, but not to exceed \$150,000 each, even if less than 4 winners are selected. Only winners of the ADAPT Stage will be eligible to compete in the CREATE Stage.

STAGE V: DRINK

180 DAYS: September 2021 to April 2022



Winners of the CREATE Stage will have up to 180 days to build and ship their systems to Jennette's Pier in Nags Head, North Carolina to conduct a test for up to 5 days. Competitors will compete on efficiency, logistics, and system integration metrics, and will be scored on the ability to meet minimal thresholds, and how they performed against the defined metrics. Only winners of the CREATE Stage can compete in the DRINK Stage.

- **Grand Prize:** A grand prize in the amount of \$500,000 will be awarded to the competitor with the best overall score.
- **Individual Metrics Prizes:** There will be other prizes awarded to the competitors for a total prize pool of \$500,000.

The details of the Stage V: DRINK are still under development. Detailed rules for this stage will be released before the start of this stage. More details about Jennette's Pier and additional DRINK Stage information can be found in Appendix 2.

Applications Not of Interest

The Prize Administrator must conclude that all of the following statements are true when applied to your submission:

- The proposed solution utilizes wave energy to create drinking water.
- The proposed solution represents an innovation that will move the industry beyond its current state.
- The proposed solution is based on sound fundamental technical principles.

- The proposed solution does not target larger desalination systems (e.g., small municipal or community scale).
- The proposed solution does not involve the lobbying of any federal, state, or local government.

If your proposed solution does not meet the above requirements, it will not be subjected to additional review, will not receive scores from the reviewers, and will not be considered for a prize under this program.

Participant Eligibility

This stage of the prize is only open to winners of the ADAPT Stage. The competition is open only to: (a) citizens or permanent residents of the United States; and (b) private or nonfederal public entities, such as townships, tribes, corporations, or other organizations that are incorporated in and maintain a primary place of business in the United States. Individuals can compete alone or as a member of a group.

A representative of a private entity can register the entity to compete. So long as an entity is legally formed under the laws of a state or the laws of the United States, individuals working under that entity may participate regardless of immigration status.

DOE employees, employees of sponsoring organizations, members of their immediate families (i.e., spouses, children, siblings, or parents), and persons living in the same household as such persons, whether or not related, are not eligible to participate in this prize. Federal entities and federal employees, acting within the scope of their employment, are also not eligible to participate in any portion of this prize. DOE national laboratory employees cannot participate in any stage of the prize.

Background

From 2017 through early 2019, WPTO conducted analysis and stakeholder engagement to identify and study the range of potential applications and markets for marine energy technologies, beyond a focus on grid-scale power applications. This work resulted in the release of a report in April 2019, entitled [*Powering the Blue Economy: Exploring Opportunities for Marine Renewable Energy in Maritime Markets*](#). The report identifies potential opportunities and challenges for marine energy in eight different ocean markets, including those far out at sea—like ocean observation and mining—and those near shore, like desalination and coastal resilience.

The *Powering the Blue Economy* report identifies wave-powered desalination as a potential growth market for marine energy technologies, particularly targeting isolated coastal/island communities with high energy costs. Wave energy-powered desalination systems could help to address coastal challenges such as resilience, disaster recovery, and water scarcity, especially if systems are competitive on price, water production, and reliability when compared to conventional alternatives. However, even given its theoretical advantages, wave-powered desalination is still an early-stage technology with significant market and technical challenges.

Through this prize, WPTO seeks to accelerate innovation in both wave energy devices and desalination systems and create the incentive for teams to build interdisciplinary approaches to integrate wave power and desalination. WPTO aims to leverage the expertise and creativity of academia, industry, government,

and other partners engaged in marine energy and desalination technologies through this prize. Due to its interdisciplinary challenges, the Prize seeks to unite the water technology community, the marine renewable energy industry, and the set of experts and stakeholders working to address water security challenges in remote or island communities. It is WPTO's hope that by supporting competitors to demonstrate initial viability through this contest, it will provide a spark for additional private sector investment.

While the focus of this prize is specific to remote communities and disaster response, WPTO seeks to uncover innovation to advance marine energy technology readiness for cost-competitive applications of both small-scale and municipal-scale water production or other technological advancements that could advance the state of wave energy for other market applications.

In addition to the work being explored by WPTO, DOE is deeply invested in a variety of technology solutions to solve many challenges related to freshwater, as its availability is a big, multifaceted challenge.

Wave Power: An Energy Opportunity

Desalination is an energy-intensive process, where, typically, energy is used for a variety of purposes, which could include driving fluid through a membrane, providing heat for a distillation or evaporation process, and/or hybrid configurations. The high energy costs (in many cases electricity costs) of these systems have economic implications for their owner/operators, as fuel costs can be variable and leave operators with little predictability of the operational costs to run these systems. Additionally, unlike capital expenditures (i.e., buying the equipment), operational costs cannot be amortized over the life of the project. The ability to bypass these energy costs—either by producing off-grid, decentralized electricity to directly power the system or by eliminating the need for electricity through direct pressurization—could be critical for development, driving significant cost savings and reducing the risk or sensitivity of technologies to dynamic energy prices. Companies and technology developers in the marine energy space believe wave-powered desalination may help address these issues.

NREL has researched and modeled wave-powered concepts that directly pressurize reverse-osmosis (RO) seawater desalination systems. NREL's simulation results suggest that a wave-pressurized RO application could be more cost competitive when producing water than a wave energy system producing electricity, given current cost estimates.¹ This finding signals a near-term market opportunity for wave energy, requiring smaller cost reductions before the technology is commercially competitive with grid-power applications.

The United States has one of the most compelling and varied wave resources across its coastline, where integrating wave energy and seawater desalination could have specific advantages:

- **Wave energy can produce clean water without any electricity.** Many desalination processes, such as RO, traditionally require a reliable grid-connected power supply to provide continuous energy input (e.g., pressure across a membrane). However, with many wave energy converter designs

¹ Yu, Yi-Hsiang, and Dale Jenne. 2017. "Analysis of a Wave-Powered, Reverse-Osmosis System and Its Economic Availability in the United States." 36th Annual International Conference on Ocean, Offshore and Arctic Engineering. Trondheim, Norway. June 25–30. <https://www.nrel.gov/docs/fy17osti/67973.pdf>.

operating as oscillatory pumps, they can be used to directly pressurize an RO system, potentially eliminating the need to purchase electricity.

- **Wave-powered desalination is more than just an economic challenge, it's a technical challenge.** Both the capture of energy from waves and the application of water treatment technologies are valuable areas of innovation. A marine energy-powered system might have inherent system attributes and capabilities that go beyond existing requirements or incumbent technologies. Technical innovations are still needed to achieve a level of economic competitiveness.
- **Desalination without electricity consumption is a compelling technological challenge with potential benefits beyond drinking water.** Many of the advances from this competition could find integration in other applications for marine energy technologies. For example, directly pressurizing a system might be an attribute of an aquaculture or marine algae farm, or it could be applied to direct seawater adsorption systems. The efforts undertaken in the Prize might have broad application across many new opportunities for marine renewable energy.
- **Wave-powered desalination could shift costs from variable to fixed.** Either by directly supplying electricity via wave energy, or by eliminating the need for electricity through pressurizing, the variable costs of grid-scale or diesel-based systems could be eliminated, which would allow operators to better control and predict operational costs.

Stage I: CONCEPT—Closed

On November 14, 2019, DOE announced the winners of the CONCEPT Stage. The winners of the first stage can be found [HERE](#).

Stage II: DESIGN—Closed

On June 8, 2020, DOE announced the winners of the DESIGN Stage. The winners of the second stage can be found [HERE](#).

Stage III: ADAPT—Closed

On February 9, 2021, DOE announced the winners of the ADAPT Stage. The winners of this stage can be found [HERE](#).

Stage IV: CREATE Stage Rules and Requirements

CREATE Stage Prizes

- Prize pool up to \$500,000
- Up to 7 Prize Winners split prize pool equally, with a maximum prize of \$150,000
- Prize Winners advance to the DRINK Stage

Introduction to the CREATE Stage

The Waves to Water Prize is a five-stage contest seeking to accelerate the development of modular, flexible, and easily transportable systems using wave power to desalinate ocean water, providing clean water in areas of the world facing disaster relief and recovery scenarios, or providing water to remote, high-cost, and water-scarce coastal and/or island locations with little infrastructure support. The purpose of the CREATE Stage is to challenge competitors to further validate their proposed designs, build a functional prototype to de-risk and demonstrate potential success, and refine their plans for deployment in the DRINK stage at Jennette's Pier.

Feasibility and risk assessment perspectives will frame the review process to evaluate the engineering design of the proposed device and any prototyping and testing work done so far. Specifically, reviewers will evaluate the degree to which the proposed system can perform wave-powered desalination, as well as survive the environmental conditions at Jennette's Pier.

Competitors in the CREATE Stage will have 180 days to produce and present a robust system that demonstrates attention to sound engineering principles and provides confidence in the contestants' abilities to produce a deployable unit for the DRINK Stage; and develop a plan to participate in the DRINK Stage of the prize. The DRINK Stage open water competition will take place at Jennette's Pier in Nags Head, North Carolina in April 2022. Details on the test site setup, including equipment that will be provided, standard mooring systems, and other key details on the DRINK Stage are provided in Appendix 2 of this document.

Requirements for this stage will include:

- **CREATE Stage Plan (Not to be Made Public, Not Scored):** Not later than 30 days after the start of the CREATE Stage, competitors are required to submit a milestone plan, which includes a short description of the proposed system and monthly milestones proposed for the CREATE Stage that are necessary for delivering a robust system.
- **Mandatory Milestone Check-Ins (Not to be Made Public, Not Scored):** Competitors are required to participate in four Milestone Check-ins. Each Milestone Check-In consists of a written Milestone Report and a Milestone Call with WPTO, CSI, and the Prize Administrator. While these reports and check in calls will not be scored, should a competitor fail to submit milestone reports or

participate in any call, they will be ineligible to submit a Final Documentation Submission Package.

- **Final Documentation Submission Package:** At the end of the CREATE Stage, eligible competitors are required to submit the following information and documentation to be considered for the prize. The following are mandatory:
 - *Video Documentation (Not to be Made Public, Scored):* A 3-minute video demonstrating the key operating principles of the system and any prototypes or physical testing of high-risk components and subsystems, such as novel power take-off (PTO) systems or deployment techniques.
 - *Technical Narrative (Not to be Made Public, Scored):* A technical narrative that demonstrates the feasibility of the system, how the system functions, and a plan for how the full-scale system will be developed, delivered, assembled, and disassembled for testing at the DRINK Stage.
 - *Required Tables/Minimum System Requirements Table (Not to be Made Public, Not Scored):* Competitors must detail meeting the minimum system requirements and anticipated production of water and energy. Information can be found in Appendix 3.
 - *CREATE Stage Prototype Risk Assessment Table (Not to be Made Public, Not Scored):* To support WPTO in selecting the final competitors for the DRINK Stage, during the Monthly Milestone Check-Ins, WPTO will be evaluating risks reduced through prototyping. The final submission will include details on major components of the system, outstanding and associated risks, and any modifications needed in the DRINK Stage in order to deliver a final device at the open-water test. This table can be found in Appendix 4.
 - *Final NEPA Report (Not to be Made Public, Not Scored)*
- **Interview Panel:** WPTO will hold virtual interviews with CREATE Stage competitors. All finalists will be invited to present, explain, and answer questions pertaining to the functioning system and key operating principles. This will be done in a virtual format. The interviews will be held prior to the announcement of winners and will serve to help clarify questions the reviewers, WPTO, CSI, or judges may have.

The following rules are for competitors in the CREATE Stage. “You” and “your” reference competitors in this stage. There are no limits on the number of submissions from any one team.

How to Enter

Complete a submission package online at <https://www.herox.com/WavestoWater> before the contest closing date.

Important Dates



Opening of CREATE Stage: February 3, 2021

CREATE Stage Plan: March 5, 2021

Monthly Milestone #1: March 30, 2021

Monthly Milestone #2: April 27, 2021

Monthly Milestone #3: May 25, 2021

Monthly Milestone #4: June 29, 2021

Close of CREATE Stage: August 9, 2021

Expected Winner Notification: August 2021

What to Submit

The following items constitute the submissions package and must be submitted through the HeroX platform:

DUE March 5, 2021

- CREATE Stage Plan (not to be made public, not scored)

DUE March 30, 2021

- First Monthly Milestone report (not to be made public, not scored)

DUE April 27, 2021

- Second Monthly Milestone report (not to be made public, not scored)

DUE May 25, 2021

- Third Monthly Milestone report (not to be made public, not scored)

DUE June 29, 2021

- Fourth Monthly Milestone report (not to be made public, not scored)

DUE August 9, 2021

- Cover Page Content (to be made public, not scored)
- Submission Summary Slide (to be made public, not scored)
- 3-Minute Video (not to be made public, scored)
- Technical Narrative (not to be made public, scored)
- Required Tables/Minimum System Requirements Table (not to be made public, not scored)
- CREATE Stage Prototype Risk Assessment Table (Not to be Made Public, Not Scored)
- Final NEPA Report (Not to be Made Public, Not Scored)
- Optional: Letters of Commitment or Support.

CREATE Stage Plan

Competitors are required to submit a CREATE Stage Plan by March 5, 2021. The following information is required to populate the template on HeroX:

- **Project Title:** Title of the project.
- **Team Members:** A list of team members.
- **System Detail:** A short description of your system (less than 1,000 words).
- **CREATE Stage Goal and Milestones:** A specific, measurable, achievable, relevant, and timely Goal to be achieved by the end of the CREATE Stage, and four interim Milestones for the CREATE Stage. Use only outcome-based goals, not activity-based, so that a neutral third party can validate them (if possible). The four Milestones developed by competitors and articulated in this CREATE Stage Plan serve as the key milestones to be reported to WPTO and the Prize Administrator for the four Monthly Milestone Reports and calls. The Milestone Reports will demonstrate progress towards de-risking your technology and demonstrating system feasibility.
- **CREATE Stage Prototype Risk Assessment Table:** Competitors will need to complete a table detailing key components of their systems, the risks associated, and a test plan—if necessary—to reduce risks of these components. The table and template can be found in Appendix 4. This table should be updated with every Monthly Milestone Report.

Milestone Reports Content

To be eligible for CREATE Stage prizes, including an invitation to the DRINK Stage, competitors are required to submit four Monthly Milestone Reports and participate in four Monthly Milestone calls. After the team submits its report, WPTO and the Prize Administrator will work with competitors to schedule a 30-minute call to discuss the Milestone Report.

The following information is required to populate the Milestone Report templates on HeroX:

- **Project Title:** Title of the project.
- **Team Members:** A list of team members.
- **Milestone Title:** Title of the individual milestone being addressed in the report. The title should be pulled directly from the Create Stage Plan.
- **Milestone Progress:** A short description on how your team has met or exceeded its targeted milestone. This should not exceed 500 words.
- **CREATE Stage Prototype Risk Assessment Table:** Updated table after each month. Table can be found in Appendix 5.
- **Monthly National Environmental Policy Act (NEPA) Report:** The questions can be found in Appendix 3. Competitors must provide this information, or their final submission will be deemed ineligible.

These reports will not be scored. But, should a competitor fail to submit a Monthly Milestone Report or fail to participate in a Monthly Milestone call, you will no longer be eligible for CREATE Stage prizes.

Cover Page Content

Cover Page—Basic information about your submission (will be made public)

- | | |
|--|--|
| <ul style="list-style-type: none"> • Title • Short description | <ul style="list-style-type: none"> • Key project members (names, contacts, and links to their other professional online profiles) • Your city and state • Other partners (if any) |
|--|--|

Submission Summary Slide

Submission Summary Slide (will be made public)

Make a public-facing, one-slide submission summary that contains technically specific details but can be understood by most people. There is no template, so competitors are free to present the information in any format. Any text must be readable in a standard printout and conference room projection.

Final Documentation Submission Package

At the end of the CREATE Stage, competitors are required to submit the following information and documentation to be considered for the prize. The following are mandatory, should any of the following documentation fail to be submitted, an application will be deemed ineligible:

- **3-Minute Video:** Competitors are required to submit a 3-minute video demonstrating the key operating principles of the system. This should include a discussion of key components, demonstration of operation of the system, and any prototypes or physical testing of high-risk components and subsystems, such as novel PTOs or deployment techniques. There are five statements used to evaluate the Video Documentation.
- **Technical Narrative:** Technical document that demonstrates the feasibility of the system, and how the system functions and a plan for how the full-scale system will be developed, delivered, and assembled for testing at the DRINK Stage, and disassembled. There are 16 statements used to evaluate the Technical Narrative.
- **Required Tables / Minimum System Requirements Table:** The table of Minimum System Requirements needs to be populated. The table can be found in Appendix 3.
- **CREATE Stage Prototype Risk Assessment Table:** Competitors must provide an updated risk assessment table.
- **Final NEPA Report:** A final report detailing all of the questions for NEPA.

Each statement for the Final Submission Package will be scored based on a 1–6 scale, as shown below.

1	2	3	4	5	6
Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree

The scoring will be used to calculate the final score. The table below explains the manner in which the final scores for each submission will be calculated:

Item	Number of Scored Statements	Total Possible Points
3-Minute Video	5	30
Technical Narrative	16	96
Criteria 1: Validated Design and Analysis	4	24
Criteria 2: System Build and Deployment Feasibility	6	36
Criteria 3: Functional Demonstration	4	24
Criteria 4: Plan	2	12
TOTAL	21	126

3-Minute Video

You will have 3 minutes in a video format to demonstrate key components of your system. Your video should explain the functional requirements of your system, key operating principles, and demonstrate its pumping functions and the components' functionality. This video will not be made public.

Be creative and produce a video that conveys the suggested content listed below or any other information that will help the reviewers and judge understand your technology in an exciting and interesting way, but do not focus on time-consuming activities that only improve production values (i.e., technical elements such as décor, lighting, and cinematic techniques). The reviewers will score the video based on the content you provided and each statement is equally weighted. Every video should have narrated sound.

3-Minute Video Criteria	
<p>Suggested Content You Provide</p> <ul style="list-style-type: none"> • Demonstration of lab prototypes and testing • Any prototypes or physical testing of high-risk components and subsystems, such as novel PTOs or deployment techniques • Explanation of how the system produces clean water from wave power • Describe outstanding research challenges that will need to be addressed before the DRINK Stage 	<p>Each Statement Scored on 1–6 Scale</p> <ul style="list-style-type: none"> • The video clearly explains the functioning key subsystems of the prototype. • There is a strong explanation of how risks have been mitigated through testing and prototyping. • The video shows how the system will use wave power to desalinate seawater. • The video details how the prototype will be finalized for the DRINK Stage. • The video presents a knowledgeable and skillful team.

- Document any testing which validates how the system functions
- Description of the team and how you are uniquely suited to compete in the DRINK Stage.

Technical Narrative

There are four criteria you will be evaluated against for your Technical Narrative. You can use up to 7,500 words and up to 15 supporting images, figures, or graphs to populate the template provided on HeroX.

- **Criteria 1: Validated Design and Analysis**—Are your modeled assumptions and designs feasible and validated? Is there robust evidence the prototype development and system design are guided by modeling and simulations?
- **Criteria 2: System Build and Deployment Feasibility**—Do you demonstrate that off-the-shelf components of your system have been identified and/or purchased, and for novel system components have you demonstrated adequate design and detail of your system?
- **Criteria 3: Functional Demonstration**—Can you provide testing results or other documentation that you have de-risked your system through lab builds and prototypes of critical components and subsystems?
- **Criteria 4: Plan**—What are your goals for the DRINK Stage, and what is your plan to achieve your goals?

The table below suggests content for you to provide and the statements used to evaluate your Technical Narrative. The content bullets are only suggestions to guide your responses; you decide where to focus your response.

Criteria 1: Validated Design and Analysis

Suggested Content You Provide

- Updated modeling documentation tables that show any major design changes made to the system since the ADAPT Stage submission
- Demonstration that the system as designed can meet the minimum system requirements
- Calculations required to show how the design functions
- Mechanical design analysis such as stress calculations or FEA
- Demonstration that adequate safety factors or load factors have been applied to critical components
- Design strategies relevant to survivability and a wide range of wave resource conditions

Each Statement Scored on 1–6 Scale

- There is sufficient evidence that the proposed system design is guided by the modeling and simulations.
- The proposed system is free of major design flaws.
- Notable or high-risk failure modes have been adequately documented and mitigation plans are in place.
- The proposed system can be expected to operate as intended at Jennette’s Pier.

<ul style="list-style-type: none"> • The wave energy principles, desalination system, and any integration systems necessary • Outline of major risks and failure modes and proposed or planned mitigations. • Description of how the system will perform in conditions such as changing tides, winds, ocean currents, and imperfectly aligned waves • Wave energy systems must include mooring and/or foundation assumptions that are required. Standard single-point mooring systems (per Appendix 2 and in the Test Site Detail Requirements Table) will be provided at the test. Should a competitor choose not to use a standard connection, detail is needed on the mooring and/or foundation assumptions. 	
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Criteria 2: System Build and Deployment Feasibility

<p>Suggested Content You Provide</p> <ul style="list-style-type: none"> • Design drawings and bill of materials (including piping and instrumentation diagram) • Design drawings of the following: <ul style="list-style-type: none"> ○ Overall system including dimensions ○ Power takeoff, including mechanisms and assembly ○ Frame and structure. • Specifications of off-the-shelf parts (e.g., suppliers, part serial numbers, interfaces, performance, etc.) • Describe any specific fabrication methods required, including identification of outsourcing or external partnerships/contracts necessary for fabrication or build • Describe how the system and any additional tooling and/or equipment will be packaged within the specified shipping container • Deployment and installation plan, including major assumptions for time to deploy the system at a test site and description of realistic device standby modes for limited or shutdown operations • Describe specific installation strategies including any special equipment that is needed for installation, in a narrative of how the device will be installed in a near-shore location (less than 500 meters from shore) 	<p>Each Statement Scored on 1–6 Scale</p> <ul style="list-style-type: none"> • The submission demonstrates that all necessary equipment and materials can be obtained before the test at the DRINK Stage. • Through design drawings, the proposed system is thoroughly described and documented. • The fabrication plan and methods are well described and align with the team capabilities. • The submission provides evidence that the entire system, including all necessary equipment needed to assemble and operate the system, fits in the shipping container. • The submission demonstrates a feasible delivery, deployment, and installation approach, and can be practically unpacked, assembled, and deployed in less than 48 hours given the constraints of deploying at Jennette’s Pier, including consideration of low visibility and crane deployment. • The seawater intake, discharge (brine, seawater, etc.), and desalinated water delivery system is adequately described and able to meet the required metrics.
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<ul style="list-style-type: none"> ● Strategy/Design for installing system with common mooring ● Describe how the device will survive at Jennette's, given the sandy bottom conditions and anticipated sediment movement during the five-day test period. ● How the desalinated water will be delivered at Jennette's Pier considering site specific conditions outlined in Appendix 2. This should include any retrieval methods, and/or water delivery methods. ● Describe system standby mode(s) for limited or shut-down operations in the water. ● Describe any systematic perspectives on the replacement, modification, or flexible repair of COTS components or sub-systems. 	
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Criteria 3: Functional Demonstration—Can you provide testing results or other documentation you have of lab builds or prototypes of critical components and subsystems?

<p>Suggested Content You Provide</p> <ul style="list-style-type: none"> ● Description of prototypes and physical testing of components and subsystems that are high-risk (e.g., novel PTO or deployment techniques) ● Any physical demonstration of the PTO system ● Any testing results that demonstrate the system will be able to meet the minimum requirements ● Any experimental or laboratory validation ● Any testing results that validate your modeled claims, including water production or energy generated ● Has the build demonstrated the device will produce water over a 5-day test period with minimal intervention? ● Any data on reliability, system performance data, or other useful measurements of something ● Any physical demonstration of strategy for installing system with common mooring. 	<p>Each Statement Scored on 1–6 Scale</p> <ul style="list-style-type: none"> ● The prototypes and physical tests are well documented. ● Tests and prototype builds demonstrate that the most high-risk elements of the system have been addressed. ● Tests provide validation that the system is capable of meeting the prize requirements. ● The demonstration or testing adequately de-risks the final DRINK Stage prototype.
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Criteria 4: Plan—What is your plan to compete in the DRINK Stage?

<p>Suggested Content You Provide</p> <ul style="list-style-type: none"> • Describe your SMART goals for the DRINK Stage, which should include the delivery of your prototype for the open-water test. • In defining your SMART goals, include quantified, risk-reducing, meaningful, practical, and testable interim milestones. • Describe your strategy to develop your technology in the DRINK Stage; providing fabrication plan, diagrams, or other materials is encouraged but not required. • Provide a high-level budget and plan to meet your goals between the conclusion of the CREATE Stage and the DRINK Stage, including how you will leverage program resources or other entities (include references to letters of support/commitment if applicable) and a schedule. • Describe your team’s readiness to meet your goals and if additional talent and resources are needed. • Commitment to travel for duration of competition and any alternative plan/personnel 	<p>Each Statement Scored on 1–6 Scale</p> <ul style="list-style-type: none"> • The team adequately describes how they reach the CREATE stage goals and did they mitigate any risks/issues. • The stated goals are ambitious, systematic, reduce risks and show a commitment to demonstrating their system at the conclusion of the DRINK Stage.
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Letters of Commitment or Support

Letters of Commitment or Support (Optional)

Attach one-page letters (of support, intent, or commitment) from other relevant entities (e.g., potential users of the proposed innovation) to provide context. This could include letters of support from partners or others that you believe are critical to the success of your proposed solution. Please do not submit multipage letters.

How We Determine Winners

The Prize Administrator screens all completed submissions and, in consultation with DOE, assigns reviewers to independently score the content of each submission. The reviewers will be composed of federal and nonfederal subject matter experts with expertise in relevant areas. Reviewers will review CREATE Stage submissions according to the described evaluation criteria.

The Prize Administrator will tally the scores based on the scoring criteria described in the Section above.

- **Virtual Interview:** WPTO, at its sole discretion, may decide to hold virtual interviews with a subset of the CREATE Stage competitors. Selected finalists will be invited to present, explain, and answer questions pertaining to the functioning system and key operating principles. This will be done in a virtual format. The interviews will be held prior to the announcement of winners and will serve to help clarify questions the reviewers or judges may have.
- **Final Determination:** The Director of WPTO is the judge of the competition and will make the final determination. Final determination of winners by the judge will take the reviewers' scores, any interview findings, and the judge's review into account.
- **Announcement:** Approximately 45 days after the contest closes, the Prize Administrator notifies winners and requests the necessary information to distribute cash prizes. The Prize Administrator will then publicly announce winners.

Additional Terms and Conditions

See Appendix 1 for additional requirements. COMPETITORS THAT DO NOT COMPLY WITH THE ADDITIONAL REQUIREMENTS IN APPENDIX 1 MAY BE DISQUALIFIED.

MORE DETAILS ON RULES FOR EACH STAGE WILL BE PROVIDED PRIOR TO THE OPENING OF EACH SUBSEQUENT STAGE.

Stage V: DRINK Stage Rules and Requirements

DRINK Stage Prizes

- Prize Pool Up to \$1,000,000
- 1 Grand Prize \$500,000 Winner
- Metrics Prizes Up to \$500,000 With Multiple Winners

Overview

Winners of the CREATE stage will have up to 180 days to build and ship their systems to conduct a test for up to 5 days at an open ocean testing environment. The competition will culminate in a demonstration, to include up to 5 days of testing, to demonstrate their solutions at an ocean test site and compete on efficiency, logistics, and system integration metrics. The prize competition will be held at Jennette's Pier in Nags Head, North Carolina. DRINK competitors will be evaluated against the plan they propose at the end of the CREATE Stage.

Systems will be uncrated and assembled using available equipment (standard toolbox to be provided) and will be timed. The systems will be deployed by certified divers and staff from the Coastal Studies Institute with a Spydercrane.

The systems will be required to operate for 5 days. During the 5 days, teams will also be evaluated on the amount of time they intervene (e.g., cleaning, water delivery, tuning, etc.) in the contest. Interventions will only be allowed at the Pier, and a preapproved list of defined interventions will be provided prior to the competition. Ideally, competitors should minimize interventions and expect only a limited set of tools. A 55-gallon collection tank for each competitor will be provided.

Additional details for the DRINK Stage can be found in Appendix 2.

Prizes

At the end of the testing period, the devices will be evaluated based on the requirements and metrics and a Grand Prize winner will be awarded. Multiple winners will be selected, including:

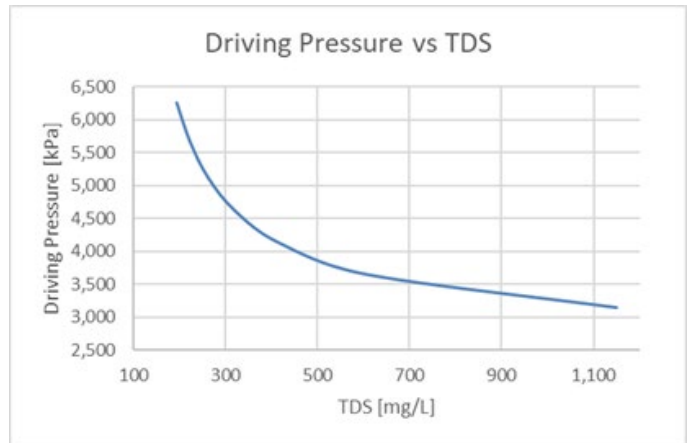
- **Grand Prize:** A Grand Prize in the amount of \$500,000 will be awarded to the competitor with the best overall score.
- **Metrics Prizes:** Four separate prizes ranging from \$100,000–200,000.

Grand Prize

A metric has been developed to serve as a proxy for energy utilization. Desalination systems are by nature hydraulic, or fluid-power, systems. Therefore, the energy consumption of a desalination system can be

thought of as the product of the amount of water produced over a given period of time (i.e., flow rate) and the driving pressure, or the force required to drive the system. Measuring the water production at the end of the prize serves part of this need; however, it is not enough to inform energy utilization. Given that reverse osmosis (RO) is the current state of the art, we have chosen to use total dissolved solids (TDS) as a proxy for driving pressure. For a single-pass RO system with a given recovery rate, and appropriate pre-treatment, one can approximate driving pressure by measuring TDS. Of course, some assumptions have to be made, but if a known set of membranes are used (i.e., constant surface area and constant permeability coefficient) then the driving pressure will correlate to the produced water TDS. Leveraging DuPont’s WAVE (Water Application Value Engine) software, the following relationship between pressure and TDS can be produced for a single-pass system.

Curve-fitting this data can be used to approximate what driving pressure is needed for a given TDS output assuming a single-pass RO system with a 10% system recovery. Using this empirical relationship between TDS and driving pressure along with the volume produced serves as a proxy for the amount of energy utilized by the wave powered desalination system. At the end of the 5-day competition, the total quantity of water delivered to the collection vessel will be measured and the average salinity will be recorded, and the two values will be input into the following equation:



$$Score = \frac{2800 + \frac{6,500,000,000}{1 + \left(\frac{TDS}{0.002}\right)^{1.26}}}{1,300,000} \times Volume$$

Where:

- TDS: is the average total dissolved solids (i.e., salinity proxy) over the 5-day competition in mg/L.
- Volume: is the total water produced over the 5-day competition in L.

Measurements of TDS and volume will be rounded to the nearest integer value (e.g., 192.3 mg/L will be rounded to 192 mg/L) and the final scores will be rounded to the first decimal place (e.g., 1.05 will be rounded to 1.1). The right-hand side of the equation has been divided by 1,300,000 to normalize the scores so that the minimum score possible given the prize thresholds (Volume of 400L, and TDS of 1,000 mg/L) will be 1. Increasing production and/or decreasing salinity will result in a higher score. A visual representation of the scoring is provided in the following figure (TDS range of 150–1,000 mg/L and produced volume between 400–3,000L):

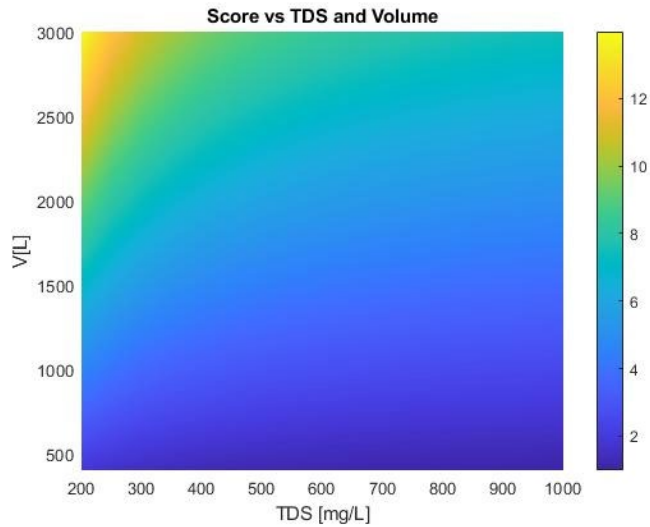
There is no limit to the maximum score that will be awarded. The ranges provided above are only intended to provide insight into how the individual metrics will be evaluated.

In the event of a tie, the team that produces the most water will be awarded the grand prize of \$500,000.

There will be no on-device measurements for wave conditions per device; no analysis will be conducted to control for wave conditions experienced for each device. The purpose of this prize is to compete in a variety of wave conditions.

Metrics Prizes

There will be other prizes awarded to the competitors for a total prize pool of \$500,000. The four other prizes are as described:



Cleanest Water \$200,000	Awarded for the team that produces the cleanest water, as benchmarked against WHO standards. This can include demonstration by the team of a thorough understanding of what steps are needed to deliver water that ultimately would be at acceptable WHO standards.
Lowest Weight \$100,000	Awarded for the team that has the lightest container delivered to the test site.
Most Water \$100,000	Awarded to the team that produces the most water that does not exceed the 1,000 mg/L TDS threshold.
Simplest Assembly/Deployment \$100,000	Awarded to the team that has the fastest and simplest assembly and deployment method.

Assessment—WPTO will select the winners of this stage based on the performance of the systems from the 5-day test period.

Announcement—The Prize Administrator and WPTO intend to announce the winners at the end of the open-water testing period.

Important Dates



Expected Start: September 2021

Expected Close: April 2022

Expected Testing at Demonstration Site: April 2022

Expected Winners Announced: April 2022

Appendix 1— Additional Terms and Conditions

Universal Contest Requirements

Your submissions are subject to following terms and conditions:

- You must post the final content of your submission or upload the submission form online at <https://www.herox.com/WavestoWater> before the relevant contest closes. Any other form of submission will not be accepted. Late submissions will not be accepted.
- By clicking Submit in HeroX, the competitor is agreeing to make their video and cover page public.
- The narrative, modeling documentation, letters of commitment/support, and résumés are not intended to be made public, however, see Additional Terms & Conditions regarding the Records Retention and Freedom of Information Act.
- You must include all the required submission's elements. The prize administrator may disqualify your submission after an initial screening if you fail to provide all required submission elements. Competitors may be given an opportunity to rectify submission errors due to technical challenges or to fix non-substantive mistakes or errors in their submission packages.
- Your submission must be in English and in a format readable by Microsoft Word or a PDF viewer. Handwritten submissions will be disqualified.
- Submissions and competitors will be disqualified if any engagement with the Waves to Water Prize—including but not limited to the submission, the HeroX forum, or emails to the prize administrator—contains any matter that, in the sole discretion of DOE or NREL, is indecent, obscene, defamatory, libelous, lacking in professionalism, or demonstrates a lack of respect for people or life on this planet.
- If you click "Accept" on the HeroX platform and register for any of the contests described in this document, you are agreeing to be bound by these rules in addition to the existing HeroX Terms of Use for all purposes relating to these contests. You should print and keep a copy of these rules. These provisions apply only to the contests described here and no other contests on the HeroX platform or anywhere else.

Verification for Payments

The prize administrator will verify the identity and role of all competitors before distributing any prizes. Receiving a prize payment is contingent upon fulfilling all requirements contained herein. The prize administrator will notify winning competitors using provided email contact information for the individual or entity that was responsible for the submission. Each competitor will be required to sign and return to the prize administrator, within 30 days of the date on the notice, a completed NREL Request for ACH Banking Information form and a completed W-9 form (<https://www.irs.gov/pub/irs-pdf/fw9.pdf>). In the sole discretion of the prize administrator, a winning competitor will be disqualified from the competition and receive no prize funds if: (i) the person/entity does not respond to notifications; (ii) the person/entity fails to sign and return the required documentation within the required time period; (iii) the notification is returned as undeliverable; (iv) the submission or person/entity is disqualified for any other reason as specified in eligibility Section I.5 or universal content Section VI.1.

In the event of a dispute as to any registration, the authorized account holder of the email address used to register will be deemed to be the competitor. The "authorized account holder" is the natural person or legal entity assigned an email address by an internet access provider, online service provider, or other organization responsible for assigning email addresses for the domain associated with the submitted address. All competitors may be required to show proof of being the authorized account holder.

Teams and Single-Entity Awards

The prize administrator will award a single dollar amount to the designated primary submitter, whether consisting of a single or multiple entities. The primary submitter is solely responsible for allocating any prize funds among its member competitors or teammates as they deem appropriate. The prize administrator will not arbitrate, intervene, advise on, or resolve any matters or disputes between team members or competitors.

Submission Rights

By making a submission and consenting to the rules of the contest, a competitor is granting to DOE, the prize administrator, and any other third parties supporting DOE in the contest, a license to display publicly and use the parts of the submission that are designated as "public" for government purposes. This license includes posting or linking to the public portions of the submission on the prize administrator or HeroX applications, including the contest website, DOE websites, and partner websites, and the inclusion of the submission in any other media worldwide. The submission may be viewed by the DOE, prize administrator, and judges and reviewers for purposes of the contests, including but not limited to screening and evaluation purposes. The prize administrator and any third parties acting on their behalf will also have the right to publicize competitors' names and, as applicable, the names of competitors' team members and organization, which participated in the submission on the contest website indefinitely.

By entering, the competitor represents and warrants that:

1. Competitor's entire submission is an original work by competitor and competitor has not included third-party content (such as writing, text, graphics, artwork, logos, photographs, likeness of any third party, musical recordings, clips of videos, television programs or motion pictures) in or in connection with the submission, unless (i) otherwise requested

- by the prize administrator and/or disclosed by competitor in the submission, and (ii) competitor has either obtained the rights to use such third-party content or the content of the submission is considered in the public domain without any limitations on use.
2. Unless otherwise disclosed in the submission, the use thereof by prize administrator, or the exercise by prize administrator of any of the rights granted by competitor under these rules, does not and will not infringe or violate any rights of any third party or entity, including, without limitation, patent, copyright, trademark, trade secret, defamation, privacy, publicity, false light, misappropriation, intentional or negligent infliction of emotional distress, confidentiality, or any contractual or other rights;
 3. All persons who were engaged by the competitor to work on the submission or who appear in the submission in any manner have:
 - a. Given the competitor their express written consent to submit the submission for exhibition and other exploitation in any manner and in any and all media, whether now existing or hereafter discovered, throughout the world;
 - b. Provided written permission to include their name, image, or pictures in or with the submission (or, if a minor who is not competitor's child, competitor must have the permission of the minor's parent or legal guardian) and the competitor may be asked by the prize administrator to provide permission in writing;
 - c. Not been and are not currently under any union or guild agreement that results in any ongoing obligations resulting from the use, exhibition, or other exploitation of the submission.

Copyright

Each competitor represents and warrants that the competitor is the sole author and copyright owner of the submission; that the submission is an original work of the competitor or that the competitor has acquired sufficient rights to use and to authorize others, including DOE, to use the submission, as specified throughout the rules; that the submission does not infringe upon any copyright or any other third-party rights of which the competitor is aware; and that the submission is free of malware.

Contest Subject to Applicable Law

All contests are subject to all applicable federal laws and regulations. Participation constitutes each participant's full and unconditional agreement to these Official Contest Rules and administrative decisions, which are final and binding in all matters related to the contest. This notice is not an obligation of funds; the final award is contingent upon the availability of appropriations.

Resolution of Disputes

The U.S. Department of Energy is solely responsible for administrative decisions, which are final and binding in all matters related to the contest.

Neither the U.S. Department of Energy nor the prize administrator will arbitrate, intervene, advise on, or resolve any matters between team members or among competitors.

Publicity

The winners of these prizes (collectively, "winners") will be featured on the DOE and NREL websites.

Except where prohibited, participation in the contest constitutes each winner's consent to DOE's and its agents' use of each winner's name, likeness, photograph, voice, opinions, and/or hometown and state information for promotional purposes through any form of media worldwide, without further permission, payment, or consideration.

Liability

Upon registration, all participants agree to assume any and all risks of injury or loss in connection with or in any way arising from participation in this contest. Upon registration, except in the case of willful misconduct, all participants agree to and, thereby, do waive and release any and all claims or causes of action against the federal government and its officers, employees, and agents for any and all injury and damage of any nature whatsoever (whether existing or thereafter arising, whether direct, indirect, or consequential, and whether foreseeable or not), arising from their participation in the contest, whether the claim or cause of action arises under contract or tort.

In accordance with the delegation of authority to run this contest delegated to the director of the Water Power Technologies Office, the director has determined that no liability insurance naming DOE as an insured will be required of competitors to compete in this competition per 15 USC 3719(i)(2). Competitors should assess the risks associated with their proposed activities and adequately insure themselves against possible losses.

Records Retention and Freedom of Information Act

All materials submitted to DOE as part of a submission become DOE records and are subject to the Freedom of Information Act. The following applies only to portions of the submission not designated as public information in the instructions for submission. If a submission includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for review of the application or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Submissions containing confidential, proprietary, or privileged information must be 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. Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

The submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes. [End of Notice]

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

Competitors will be notified of any Freedom of Information Act requests for their submissions in accordance with 29 C.F.R. § 70.26. Competitors may then have the opportunity to review materials and work with a FOIA representative prior to the release of materials.

Privacy

If you choose to provide HeroX with personal information by registering or completing the submission package through the contest website, you understand that such information will be transmitted to DOE and may be kept in a system of records. Such information will be used only to respond to you in matters regarding your submission and/or the contest unless you choose to receive updates or notifications about other contests or programs from DOE on an opt-in basis. DOE and NREL are not collecting any information for commercial marketing.

General Conditions

DOE reserves the right to cancel, suspend, and/or modify the contest, or any part of it, at any time. If any fraud, technical failures, or any other factor beyond DOE's reasonable control impairs the integrity or proper functioning of the contests, as determined by DOE in its sole discretion, DOE may cancel the contest.

Although DOE may indicate that it will select up to several quarterfinalists, semifinalists, finalists, and winners for each contest, DOE reserves the right to only select competitors that are likely to achieve the goals of the program. If, in DOE's determination, no competitors are likely to achieve the goals of the program, DOE will select no competitors to be quarterfinalists, semifinalists, finalists, or winners and will award no prize money.

Program Policy Factors

While the scores of the expert reviewers will be carefully considered, it is the role of the prize judge to maximize the impact of contest funds. Some factors outside the control of competitors and beyond the independent expert reviewer scope of review may need to be considered to accomplish this goal. The

following is a list of such factors. In addition to the reviewers' scores, the below program policy factors may be considered in determining winners:

- Geographic diversity and potential economic impact of projects.
- Whether the use of additional DOE funds and provided resources are non-duplicative and compatible with the stated goals of this program and the DOE mission generally.
- The degree to which the submission exhibits technological or programmatic diversity when compared to the existing DOE project portfolio and other competitors.
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers.
- The degree to which the submission is likely to lead to increased employment and manufacturing in the United States or provide other economic benefit to U.S. taxpayers.
- The degree to which the submission will accelerate transformational technological, financial, or workforce advances in areas that industry by itself is not likely to undertake because of technical or financial uncertainty.
- The degree to which the submission supports complementary DOE funded efforts or projects, which, when taken together, will best achieve the goals and objectives of DOE.
- The degree to which the submission expands DOE's funding to new competitors and recipients who have not been supported by DOE in the past.
- The degree to which the submission enables new and expanding market segments.
- Whether the project promotes increased coordination with nongovernmental entities for the demonstration of technologies and research applications to facilitate technology transfer.

National Environmental Policy Act (NEPA) Compliance

DOE's administration of the American Made Challenges: Waves to Water Prize is subject to NEPA (42 USC 4321, et seq.). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at <http://nepa.energy.gov/>.

While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all participants in the ADAPT Stage will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their participation in the prize competition. Participants may be asked to provide DOE with information on fabrication and testing of their device such that DOE can conduct a meaningful evaluation of the potential environmental impacts.

ALL DECISIONS BY DOE ARE FINAL AND BINDING IN ALL MATTERS RELATED TO THE CONTEST.

Appendix 2: MONTHLY CHECK-IN NEPA INFORMATION

Teams should submit answers to the following questions for every monthly check in. Information that is the same as the previous submission should be included in **black text**. Information that is changed or added from the previous submission should be included in ~~striketrough red text~~ to indicate deletions and **red text** to indicate additions.

Comments/questions requesting clarification or additional conversation should be included in **blue text**.

Please include a drawing of how you envision your device in the water. The drawing should include enough information to convey how the device and associated mooring components may interact with fish, marine mammals, sea turtles (e.g., to identify entanglement or pinch-point risks), and the seabed. Also include a drawing of the pier-based system for RO and/or water collection to provide a sense of your entire RO/WEC system.

The following questions are from the Environmental Questionnaire that must be completed by the Prize coordinators as part of the NEPA process. Questions not included here (e.g., 1, 2a, 2b) will be completed for the Waves to Water Stage V: DRINK project in general; competitors do not need to address the omitted questions.

- 2c. Please identify and describe: (1) any known or potential health and safety hazards (physical or chemical) the public or project workers that may result from or are associated with your proposed project; and (2) any efforts that will be taken to mitigate these hazards. Please describe them individually for the staging area (parking lot), pier, and in-water locations.
- 2f. Please list the estimated quantities of materials used and produced by the project. Please describe them individually for the staging area (parking lot), pier, and in-water locations.
3. Would the proposed project use, result in, or require the management, storage, transport, or disposal of radioactive, toxic, or hazardous chemicals, waste, or other materials that require special handling? Hazardous chemicals and materials include those that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may increase the risk of mortality or pose a substantial threat to human health or the environment when improperly stored, transported, disposed of, or otherwise managed. If yes, provide detailed description of the (1) materials; (2) approximate quantity; (3) their role in the project; and (4) storage, transport, and disposal procedures for each material.
4. Please describe: (1) all nonhazardous wastes that would be generated by the proposed project; and (2) the method of their disposal. Nonhazardous waste is any garbage, refuse or trash, including solid, liquid, semi-solid, or contained gaseous material. It is presumed every project will generate solid wastes, so applicants answering “none” must explain why no waste will be generated.
6. Does the project involve the use of any nanoscale materials or nanotechnology? If yes, please describe: (1) the nanoscale materials used; (2) potential risks those materials may pose; and (3) how they will be disposed of. Nanotechnology is defined as research and technology development

at the atomic, molecular, or macromolecular levels using a length scale of approximately one to one hundred nanometers in any dimension; the creation and use of structures, devices and systems that have novel properties and functions because of their small size; and the ability to control or manipulate matter on an atomic scale.

7. Describe how the project activities may affect Sensitive Resources.

Sensitive Resources for Waves to Water Stage V: DRINK at Jennette's Pier include:

- Cultural/historic resources (Jennette's Pier)
- Threatened or endangered species (whether proposed or listed by state or federal governments), including their habitat
- Marine mammals or essential fish habitat
- Coastal zones
- Migratory birds, Golden or Bald Eagles.

8. Does the proposed project involve any of the following activities or areas of concern?

Dredge and/or Fill

Any shore activity with the potential for runoff to waters of the United States. Waters of the United States are all interstate waters, and intrastate lakes, rivers, streams, mudflats, wetlands, sloughs, plays, or natural ponds.

Polychlorinated Biphenyls (PCBs)

PCBs are a family of manmade organic chemicals that were domestically manufactured from 1929 until banned in 1979 due to their toxicity and persistence in the environment. Given their non-flammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were largely used as dielectric and coolant fluids in transformers, capacitors, electric motors, etc. Manufacture, processing, transport, use, marking, storage, and disposal of PCBs are regulated in accordance with the Toxic Substances Control Act (TSCA). Some states also regulate PCBs as hazardous waste. The presence or absence of PCBs should be ascertained.

If the proposed project involves replacement or removal of:

- Capacitors
- Transformers
- Voltage regulators
- Circuit breakers
- Switches
- Cables
- Electromagnets
- Other electrical equipment.

If yes, please indicate (1) the anticipated concentration and quantity of PCB oil, and (2) intended method and location of disposal.

10. Please quantify, to the extent possible, all emissions into the ambient air resulting from project activities. Please describe them individually for the staging area (parking lot), pier, and in-water locations.

Potential emissions include:

- Greenhouse gas emissions
- Particulate matter
- Airborne pollutants (hazardous pollutants?).

Sources of emissions can include:

- Stationary sources:
 - Boilers
 - Process heaters
 - Generators
 - Solvent usage
 - Fume hoods.
- Mobile sources:
 - Vehicles.

12. Would the proposed project result in a discharge of any type of wastewater, pollutant, or contaminant to a sewer system, stormwater system, soils, retention ponds, or any water resources (e.g., surface water, including lakes, rivers, creeks, and wetlands, and ground water)?

If yes, please quantify and characterize the wastewater or pollutants, including thermal discharges. Provide a detailed description of the:

- Wastewater, pollutants, or contaminants to be released
- Water resources that may be affected.

Under federal law:

A pollutant is any of the following items in the table below, discharged into water:

- Sewage sludge
- Munitions
- Chemical wastes
- Biological materials
- Radioactive materials
- Heat
- Wrecked or discarded equipment
- Rock
- Sand
- Cellar dirt
- Industrial waste
- Municipal waste
- Agricultural waste.

A contaminant is any physical, chemical, biological, or radiological substance or matter in water.

For Waves to Water, please include: expected brine concentration, rate of brine production, and location of brine discharge (at the WEC or pier).

- 13.** Would the proposed project have the potential to generate noise impacts to sensitive receptors (such as hospitals, schools, daycare facilities, and elderly housing), adjacent communities, employees working at the project site, and/or wildlife?

If yes, please provide a description of:

- Receptors that may be impacted and their estimated distance from the project activities
- The level of noise generated in A-weighted decibels (dB(A)) to each receptor
- Anticipated duration.

Example: On-site emergency notification system

- 15.** Please provide a detailed description of how the project will be decommissioned, including the disposition of equipment and materials.

Appendix 3: Required Tables

Minimum System Technical Requirements

The Minimum System Technical Requirements Table needs to be filled out with relevant details in each category. Please state the technical requirements.

Minimum System Technical Requirements	
Water Quality	Must be able to produce water with a maximum TDS level of 1,000 mg/L.
Produced Volume	At least 400 liters of water over the 5-day testing period.
Shipping Weight	Systems cannot exceed 650 kg.
48-Hour Setup	Systems must demonstrate that they can be set up in under 48 hours.
Storage Capabilities	Batteries are not a requirement of the system; however, no more than .5 kWh of batteries can be included. Once these batteries are discharged, the batteries must ONLY be powered by wave energy.
Other Energy Sources	All energy for desalinating water must come from wave energy. No other renewable sources will be allowed for the primary function of desalination (i.e., tidal, solar, wind, etc.). However, other energy sources can be used for ancillary purposes.

- Total water production must be estimated for a 5-day test period using the distribution of wave conditions listed below in the Wave Conditions Table. The specified “Time for Each Wave Condition [hours] [%]” should be used in order to estimate total water production over the 5-day (120-hour) test period.
- In order to ensure consistent modeling during the DESIGN Stage, each system must be analyzed using a time-domain model assuming a Bretschneider spectrum, as defined below:

$$S = 516m^4 5H_s^2 e^{-5m^4 44}$$

- Where ω is the wave frequency, in radians per second, and ω_m is the most likely frequency of any given wave and H_s is the significant wave height in meters. Here, significant wave height means the average height of the highest one-third of all waves measured.
- For all wave conditions, regardless of spectra used, the simulation must be performed for a duration of at least 2,000 seconds to ensure the statistical average and peak values are adequately captured in the time-domain model. The production from each sea state will then be

calculated using the average of the 2,000 second simulation multiplied by the time defined in the last column of the Wave Conditions Table.

- The modeling methodology must be described in adequate detail for reviewers to evaluate whether the modeling techniques are appropriate for the given wave and desalination technologies. This must include how the technologies are coupled, linked, or integrated.

Wave Conditions Table			
Sea State	Significant Wave Height [m]	Energy Period [sec]	Time for Each Wave Condition [hours] [%]
W1	0.5	6	26.4 (22%)
W2	0.5	10	6 (5%)
W3	1.0	6	33.6 (28%)
W4	1.5	7	26.4 (22%)
W5	2.0	7	26.4 (22%)
W6	3.0	7	1.2 (1%)

Reporting Key Findings

Water Production Results

The results of the model must include, at a minimum, the following:

- Intake rates (L/min)
- Clean water production rates (L/min) and Total Dissolved Solids (TDS)—Proxy for salinity (mg/L)
- Brine discharge rates (L/min) and TDS (mg/L) for each wave condition.

Results must be calculated for each wave condition and submitted into the **Water Production Results Table** template provided below. Additional parameters are encouraged to demonstrate that the model(s) being used are at a high enough level of fidelity to understand the operating principles of each device. If

additional parameters are included, please include them in a different table for simplified judging and review.

Additionally, competitors have up to 1,000 words to describe how modeling results changed between the ADAPT and CREATE Stages, if they changed.

Water Production Results Table							
Sea State	Avg Intake Rates [L/min]	Avg Desalinated Water Production [L/min]	Avg Desalinated Water Salinity [mg/L]	Avg Brine Discharge Rates [L/min]	Avg Brine Discharge Salinity [mg/L]	Total 5 Day Production [L]	Total 5 Day Salinity of Desalinated Water [mg/L]
W1							
W2							
W3							
W4							
W5							
W6							

Wave Energy Converter Modeling Results

The wave energy device should be modeled and must include the following parameters for each wave condition as listed in the **Wave Conditions Table**. The model outputs should be modeled for all six sea states listed in the Wave Conditions Table:

- **Average Absorbed Power:** The average absorbed power for the defined sea state prior to integration with the desalination system [kW].
- **Peak Absorbed Power:** The instantaneous peak absorbed power for the defined sea state prior to integration with the desalination system [kW].

- **Peak Mooring and/or Foundation Loads:** The instantaneous peak forces or reaction loads associated with mooring lines, anchor systems, or foundation systems [N].

Results must be calculated for each sea state and submitted in the Wave Energy Converter Modeling Results Table provided below:

Wave Energy Converter Modeling Results Table			
Sea State	Avg Absorbed Power [Watts]	Peak Absorbed Power [Watts]	Peak Mooring and/or Foundation Loads [N]
W1			
W2			
W3			
W4			
W5			
W6			

The above model outputs should be modeled for each specified irregular sea state.

- Assumed losses due to pumping or other parasitics (e.g., RO pump efficiencies, water delivery, etc.) must be described and/or quantified in the submission.


Appendix 4: Risk Assessment Table

Example Risk Assessment Table

Risk Assessment Table

Fill out each table with risks. For example, if there is a performance risk, is it a "power output" or is there a "performance degradation" risk?
For each risk, please provide additional details in the column to the right to explain what the risk is, and how your team plans to mitigate or eliminate this risk.

Submission Name: HERO WEC
Team Name: Example Team



WEC Risk Assessment						
Component #	Component Name	COTS or Custom	Risk Level [L/M/H - Dropdown]	Type of Risk [Dropdown]	Risk Mitigation Strategy	Additional Details
WEC Risks						
1	Hydrodynamic Body					
1.1	Frame and Joints	CUSTOM	H	Failure Mode	FOS, Load testing	Reliability
1.1.1	Structural Members	CUSTOM	M	Performance		
1.2	Float(s)		M	Performance	Coupon testing	Bond Strength
1.2.1	Inflatables	CUSTOM	H	Performance		
1.3	Float to Frame connections		M	Other	Component Mock-up	Scale components will be built to test loading and DOF
2						
2.1	Pump	CUSTOM	M	Performance	Bench Testing	Pump flow and leakage will be quantified at low speed
2.2	Plumbing	COTS	M	Performance	Design Guidelines	Follow OEM design guidelines for normal operation
3						
Mooring						
3.1	Cable	COTS	L	Safety	FOS, Overdesign	Design for significantly larger static load than anchor weight
4	Anchor	PROVIDED	M	Performance		

Process Risk Assessment				
Process #	Process Name	Risk Level [L/M/H - Dropdown]	Risk Mitigation Strategy	Additional Details
Logistics/Delivery Risks				
1	Device Delivery	M		
1.1	WEC built on time	M	Time buffer	Covid-19 Impacts: Due to limited availability of vendors and ship time there is a risk that the system will not be finished in time. Therefore a simplified system and accelerated timeline will be proposed
1.2	Delivery delay	L	Accept	Delivery Route: Delivery delays are possible but minimal mitigation is available.
Assembly/Installation Risks				
1	System Assembly	M		
2	Installation	L		
2.1	Crane Lift	M		
2.2	Anchor tie in	M		
Operational Risks				
1	System Assembly	M		
2	Installation	L		
2.1	Crane Lift	M		
2.2	Anchor tie in	M		
3	Watch Circle	L		
4	Startup/Shutdown	H		
Other Risks				
1				Please include any additional risks that your team feels are critical here