



Powering the Blue Economy™

# OCEAN OBSERVING

P R I Z E



U.S. DEPARTMENT OF ENERGY

# DISCOVER COMPETITION

Official Rules

NOVEMBER 2019



## Preface

This is the Official Rules Document that establishes the rules and requirements for the U.S. Department of Energy (DOE) Powering the Blue Economy: Ocean Observation Prize DISCOVER Competition by which the competition will be governed and adjudicated. The Prize Administrator and DOE reserve the right to modify this Official Rules document if necessary and will publicly post any such notifications as well as notify registered Prize competitors.

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# 1. Executive Summary

The U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy Water Power Technologies Office (WPTO), in partnership with the National Oceanic and Atmospheric Administration (NOAA)-led U.S. Integrated Ocean Observing System (IOOS), have announced a \$3 million **Powering the Blue Economy™: Ocean Observing Prize** (the Prize). Through two competitions, DISCOVER and DEVELOP, the Ocean Observing Prize seeks to advance the state of the art for marine energy-integrated ocean observing systems.

Through energy innovation, more persistent and pervasive ocean observing is possible, which could have a growth multiplier effect in other blue economy sectors, including marine energy. To achieve these goals, the Prize will provide cash awards, access to testing assets, and leverage partnerships that will accelerate the advancement of concepts into real prototypes.

The various activities that make up the blue economy<sup>1</sup> can be grouped into sectors, such as ocean observing, fisheries, offshore energy, and aquaculture. Some of these sectors have cross-cutting impacts across the blue economy, perhaps none more so than ocean observing. The data and information collected through exploration and monitoring of the ocean supports a myriad of activities, making it an important sector upon which many markets rely. However, collecting ocean data is challenging due to a number of factors such as cost, accessibility, technology constraints, and energy limitations. Many ocean observing technologies would benefit from an on-site energy generation source which could reduce the need for costly energy replenishments. Such innovations would enable longer duration monitoring as well as the ability to collect new ocean data.

WPTO supports the research and development (R&D) of marine energy systems, defined as devices that harvest energy from ocean currents, waves, tides, as well as salinity and thermal gradients. In addition to R&D for electric grid-scale marine energy systems, WPTO also supports R&D of non-grid applications where marine energy is uniquely suited to provide a source of power. In April 2019 the office released a report, [Powering the Blue Economy™: Exploring Opportunities for Marine Renewable Energy in Maritime Markets](#). The report identifies several potential benefits from integrating marine energy systems with various blue economy activities, including ocean observing.

The Ocean Observing Prize builds off this prior work. It will attempt to accelerate the conceptualization, design, and testing of innovative systems that integrate ocean observing and marine energy technologies. This Prize seeks to enable more persistent and pervasive ocean observing, which could have a growth multiplier effect in other blue economy sectors and simultaneously accelerate the maturation of the marine energy sector.

The goals of the Prize are to:

- **Enable collection of valuable new data.** Proposed innovations should increase the spatial coverage, temporal resolution, and/or types of ocean and atmospheric variables that can be observed, collected, processed, and transmitted leading to improved understanding, monitoring, and management of the ocean.

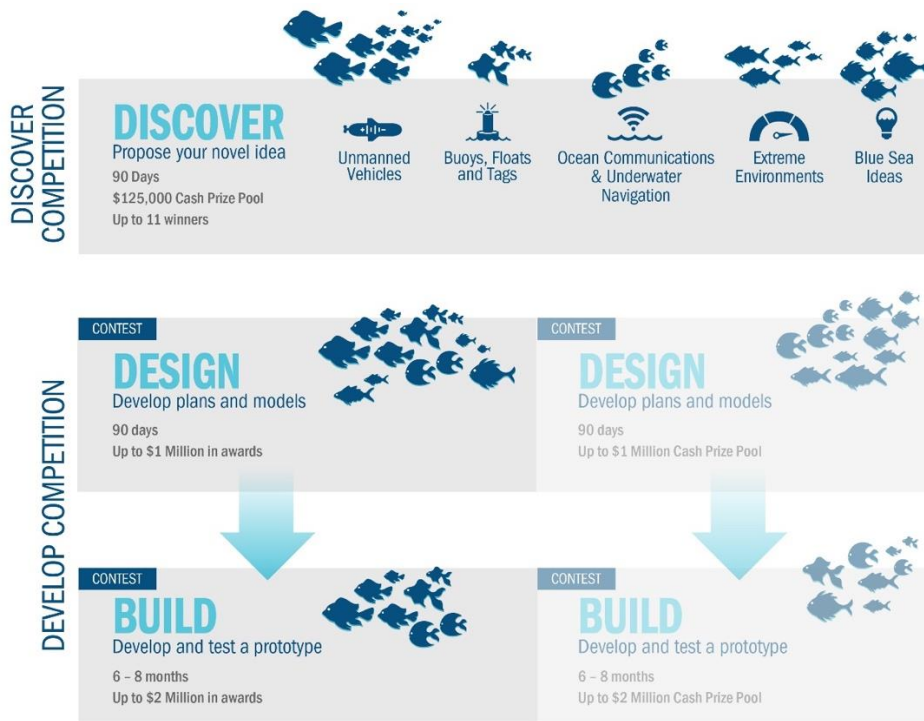
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<sup>1</sup> The blue economy is defined as sustainable use of ocean resources for economic growth, improved livelihoods and jobs, while preserving the health of ocean ecosystems.

- **Generate sufficient power from co-located marine resources.** Solutions must be able to generate sufficient power to meet the energy needs of end users from the ocean observing community and prove the viability of marine energy to power ocean observations.
- **Accelerate commercialization of marine energy systems.** Traditional development timelines of marine energy devices for the electrical grid can take many years to design, build, and test. By working at smaller scales and addressing ocean observing system energy needs, marine energy may find a faster path to commercialization.
- **Grow a community of innovators.** This Prize will help bring new innovators into the marine energy and ocean observations space. It will also help form new partnerships and collaborations between industry, academia, and government in order to create innovative ocean observing technologies.

The first competition in the Ocean Observing Prize is the DISCOVER Competition, which will be followed by the DEVELOP Competition(s). The DISCOVER Competition offers \$125,000 in cash prizes and casts a wide net to attract concepts across five ocean observing themes:

1. Unmanned Vehicles;
2. Buoys, Floats, and Tags;
3. Ocean Communications and Underwater Navigation;
4. Extreme Environments; and
5. Blue Sea Ideas.



Submissions across the five DISCOVER Competition themes will be evaluated based on three criteria:

1. Impact of the innovation;
2. End-user market potential; and
3. Technical feasibility.

The subsequent DEVELOP Competition(s) will narrow in on a subset of the themes and offer up to \$3 million in prizes to competitors who successfully design, build, and test their systems.

This document serves as the Official Rules Document for the first competition, the DISCOVER Competition. Official Rules for the DEVELOP Competition will be released after this competition closes.

## DISCOVER Competition Prizes

The DISCOVER Competition has up to \$125,000 in cash awards for high-scoring submissions. Up to 11 awards will be made, they include:

- **Explorer Prizes:** The Explorer Prizes are awarded to the top-ranked submissions across all themes. Up to ten Explorer Prizes will be awarded at up to \$10,000 each. Some themes may have multiple winners, or none at all.
- **Nautilus Grand Prize:** The Nautilus Grand Prize winner will be awarded to the single highest-scoring submission and receive a \$25,000 award.

## Key Dates

- **Submission Open:** November 14, 2019
- **Submission Close:** February 12, 2020 at 11:59 pm EST
- **Judging and Review Complete:** Anticipated March 5, 2020
- **Winner Notification:** Anticipated March 20, 2020
- **Winner Announcement and Awards:** Anticipated March 26, 2020

## Applications Not of Interest

The DISCOVER Competition encourages competitors to submit unique ideas and novel concepts; however, submissions with the following technical characteristics are not of interest and will not be scored:

- Systems that do not receive a portion of their overall energy needs from one of the following marine energy resources: wave, tidal, ocean current, river, salinity gradients, or thermal gradients. Other renewable energy technologies may be incorporated into the design, but one or more of the aforementioned marine energy resources must play a role in powering, propelling, or otherwise providing a useful form of energy to the overall system.

## Eligibility and Teams

The competition is open only to: (a) citizens or permanent residents of the United States; and (b) private or non-federal 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 the Prize. Federal entities and federal employees, acting within the scope of their employment, are also not eligible to participate in any portion of the Prize. DOE national laboratory employees cannot compete in any stage of the Prize.

In keeping with the goal of growing a community of innovators, competitors are encouraged to form multidisciplinary teams while developing their concept. The HeroX platform provides a space where parties interested in collaboration can post information about themselves and learn about others who are also interested in competing in this contest.

## 2. Background

### 2.1 The Blue Economy and Energy

Activities in the blue economy are frequently grouped into sectors such as offshore aquaculture, maritime defense, offshore energy, ocean observing, and shipping. All of these sectors require energy: fuel for ships, batteries for underwater vehicles, or high-pressure seawater for desalination systems. While some activities have access to cheap and reliable sources of energy, others do not.

Energy challenges limit operations and add costs to many blue economy activities. Removing or reducing these energy constraints through energy innovation could open new pathways for sustainable economic development.

In 2017, WPTO began investigating the potential for blue economy activities to serve as markets for marine energy technologies. The potential markets were found to align with two themes:

1. Providing power at sea to support offshore industries, science, and security activities.
2. Meeting the energy and water needs of coastal and rural island stakeholders in support of resilient coastal communities.

The [Powering the Blue Economy™ report](#) detailed possible energy solutions that could be applied to these two themes. Technologies that address these non-grid energy demands may prove to be economically viable opportunities in the near-term for the marine energy industry. By pursuing such opportunities, there is expected to be a spill-over effect that advances marine energy technology readiness for more traditional utility-scale electrical grid markets, and potentially other unforeseen opportunities. Both ocean observing and underwater vehicle charging were identified as potential markets in the report.

### 2.2 The Challenge for Ocean Observations

The ocean covers more than 70 percent of our planet and is, on average, deeper than one mile. It is so large that it controls and tempers global weather patterns, provides half the oxygen we breathe, and supports the fisheries that feed billions of people. Yet due to its immensity we struggle to effectively monitor and measure it on both temporal and spatial scales, hindering our ability to systematically manage the most critical resource on the planet. With a greater understanding of the world's oceans we could better predict and track tropical storms that jeopardize lives; monitor fish stocks that communities depend on for sustenance; alert coastal areas of deadly tsunamis that can destroy towns and villages; or detect threats to servicemembers.

Improved management of marine resources and the maritime space can be accomplished through more persistent ocean monitoring and data collection, referred to as ocean observing. Ocean observing systems may consist of sensors that collect environmental data, platforms to host and power the sensors, and communication technologies that send the collected data to ship or shore where it is processed into useful information.



The technologies used for ocean observing are numerous and vary significantly in terms of function, size, cost, and power consumption. Examples include autonomous underwater vehicles, buoyancy gliders, profiling floats, weather and drifter buoys, and electronic tags on marine animals. Nearly all of these systems rely on batteries, but batteries are meant to be temporary energy sources and must be recharged periodically. For systems that are operating far offshore or deep underwater for sustained periods, recharging a battery becomes a challenging and costly endeavor.

Such energy limitations force ocean scientists to make tough choices between what sensors they can host on a platform, how much data they can collect, and how often they can communicate with the system or relay the data back to shore. Trying to balance these priorities often comes at a significant financial cost, especially when vessels are required for deploying, maintaining, and recovering the observing system.

Ultimately, the Ocean Observing Prize will incentivize new solutions that integrate ocean observing and marine energy to reduce or eliminate the energy constraint that limits our ability to monitor the ocean. Improved ocean observations will promote sustainable growth in the blue economy and help us better understand the ocean and its value to humankind.

## 2.3 Market Opportunity

Ocean observing is a large market that involves a myriad of technologies and businesses. In 2013 NOAA commissioned a study to characterize the U.S ocean observing market. The analysis discovered approximately 400 businesses in the United States which collect approximately \$7 billion in annual revenues.<sup>2</sup> Considering a more broad view, global sales of navigational and ocean survey instruments nearly doubled between 2001 and 2011, from \$7.5 billion to \$16 billion.<sup>3</sup> These numbers are approximations and the true market size will depend on the specific application being pursued, however they do provide an order-of-magnitude estimate of the opportunity space.

As part of the Prize, competitors are encouraged to do their own customer discovery and market research through interviews, surveys, or other methods that help to understand the market for their concept and how it can help end users avoid or offset costs in collecting oceanographic data.

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<sup>2</sup> NOAA Ocean Enterprise Study; <https://ioos.noaa.gov/project/ocean-enterprise-study/>

<sup>3</sup> Maritime Technology News. 2012. *Market and Technology Trends in Underwater Sensors & Instrumentation*. [https://www.researchgate.net/publication/292981347\\_Market\\_and\\_Technology\\_Trends\\_in\\_Sensors\\_and\\_Instrumentation](https://www.researchgate.net/publication/292981347_Market_and_Technology_Trends_in_Sensors_and_Instrumentation).

# 3. DISCOVER Competition Rules and Requirements

## 3.1 Introduction and Purpose

The Ocean Observing Prize DISCOVER Competition solicits novel concepts that integrate ocean observing technologies with marine energy systems.<sup>4</sup> By using marine energy to address the power limitations of

ocean observing technologies, the Ocean Observing Prize will seed innovation that enables more pervasive ocean observing, advances technologies that support blue economy sectors requiring persistent monitoring, and simultaneously accelerates maturation of the marine energy sector.

<b>Explorer Prize</b>	Up to ten awards of \$10,000 each given to the top-ranked submissions.
<b>Nautilus Grand Prize</b>	One award of \$25,000 will be given to the highest-scoring submission.

## 3.2 How to Enter

Go to <https://www.herox.com/OceanObserving> and follow the instructions for registering and submitting all required materials before the deadline in the Key Dates section above or as displayed on the HeroX website. Competitors also have the ability to form teams or find partners through the HeroX platform.

## 3.3 Themes

The potential ocean observing platforms and technologies that are believed most likely to pair with marine energy systems have been partitioned into five distinct categories, or themes. These themes were developed through stakeholder interviews and analysis and are believed to encompass the vast majority of potential applications. When submitting, competitors should select one of these themes that they think most closely aligns with their idea. DOE, in its sole discretion, may assign a submission to a theme other than the theme designated by a competitor. There are four themes that focus on particular ocean observing technologies or mission spaces, and a fifth theme which is included to accommodate novel ideas that do not align with the other four themes. Each theme is presented briefly below, more information and examples of concepts for each can be found in **Appendix 2**. DOE may award prizes in all theme areas, however, depending on submission scores, some themes may receive no awards. Individual themes may have multiple awards.

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<sup>4</sup> See glossary for what qualifies as a marine energy system.

The five themes of the DISCOVER Competition are:

### 1. Unmanned Vehicles



Unmanned vehicles may include aerial, surface, or underwater mobile vehicles used for ocean observing, monitoring, or exploration. This theme includes, but is not limited to, ideas that use marine energy as a means of propulsion, to recharge batteries, or more generally to increase the range, duration or performance of the vehicle.

### 2. Buoys, Floats, and Tags



Buoys, floats, tags, drifters, and other similar ocean observing platforms are typically stationary or mobility-constrained systems used for long-duration observations. They may be surface or subsurface and can host one or many instruments. This theme includes, but is not limited to, ideas that use marine energy to increase platform longevity, energy availability, or other similar performance characteristics.

### 3. Ocean Communications and Underwater Navigation



Methods of offshore communications typically rely on radio waves at the surface and acoustics underwater. These communication methods are essential for transmitting data from remote locations back to shore or providing navigational points of reference for underwater vehicles, but are often limited in their functionality by low energy availability. This theme includes, but is not limited to, ideas that use marine energy to improve the performance of systems using electromagnetic waves or acoustics to conduct or transmit ocean observations.

### 4. Extreme Environments



There are marine environments such as the deep sea and polar regions which are extremely challenging to measure, monitor, and explore due to extreme environmental conditions and limited accessibility. This theme includes, but is not limited to, ideas that use marine energy to provide a power source in inhospitable locations characterized by extreme temperatures and pressures, sea ice, high seas, or other extreme environmental conditions.

### 5. Blue Sea Ideas



The first four themes are designed to encompass the majority of potential applications or mission spaces that could benefit from the integration of marine energy and ocean observing technologies. In keeping with “blue sky ideas”, this theme is for those concepts that don’t align with any of the other themes.

In your submission, you are required to select the theme most relevant for your solution. More details and examples of ideas for each theme can be found in **Appendix 2**.

## 3.4 What to Submit

There are four items that make up a complete submission package and must be submitted through the HeroX platform. Each is described in more detail below. Competitors may provide multiple submission packages for review, however each must be materially different in content and topic to be considered. If

multiple submissions from the same competitor are too similar, only one will be scored and considered for award at the DOE’s sole discretion.

Item	Will Be Made Public <sup>5</sup>	Scored Item
<b>Cover Page</b>	Yes	No
<b>Technical Submission</b>		
• <b>Written Narrative</b>	No	Yes
• <b>90-Second Video Pitch</b>	Yes	Yes
<b>Summary Slide</b>	Yes	No
<b>Resources Document</b>	No	No

## Cover Page Content

Cover Page—List basic information about your submission

- Title
- Theme area
- Team name
- Team members
- Short description
- Link to your 90-second video online
- Key project members (names, contacts, and links to their professional online profiles)
- Other partners (if any)
- Your city and state

## Technical Submission

The Technical Submission includes a Written Narrative and 90-second Video Pitch. Both parts of the Technical Submission will be scored. There are three criteria questions that need to be addressed in the Technical Submission:

1. What is the impact of the proposed concept?
2. What is the end-user market potential?

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<sup>5</sup> Competitors who do not want the Technical Submission or other documents to be made public will need to mark them according to the instructions in Paragraph 10 of Appendix 1.

### 3. What is the technical feasibility?

Each criteria question is composed of four statements that judges will use to review submissions. Details on the scoring method and weighting are provided below. Both pieces of the Technical Submission should collectively describe the idea and address all three criteria questions.

## Technical Submission: Written Narrative

Write a detailed narrative describing your solution. There is a template on the HeroX platform (<https://www.herox.com/oceanobserving/resources>) to use in drafting the Written Narrative. The total length of the Written Narrative cannot exceed 2,500 words. You may include up to five supporting visualizations or graphics. The Written Narrative must be submitted as a PDF onto the HeroX platform along with the other submission documents. Information contained in hyperlinks to external sources will not be reviewed or considered by the reviewers or judges.

## Technical Submission: 90-Second Video Pitch

Produce a 90-second video that will help the judges and general public understand your concept. Be creative and convey your information in a fun and engaging way, but do not expend time on labor-intensive activities that only improve production quality (i.e., technical elements such as décor, lighting, and cinematic techniques). Judges will focus on content, not the quality of video production. Upload your video online to a publicly accessible platform (e.g., YouTube, Vimeo, etc.).

## Technical Submission Scoring

The Written Narrative and Video Pitch will be scored against 12 statements across the 3 criteria (4 scored statements for each criteria question). The highest possible score to receive on the Technical Submission is 72 (6 on all 12 statements), the lowest is 12 (1 on all 12 statements).

Each statement will be scored on a 1–6 point scale, as shown below.

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

Criteria Questions	Number of Scored Statements	Weighting	Total Possible Points
What is the impact of the innovation?	4	33%	24
What is the end-user market potential?	4	33%	24

What is the technical feasibility?	4	33%	24
TOTAL	12	100%	72

## Technical Submission Criteria Questions and Scored Statements

The criteria questions against which submissions will be scored is provided in the table below. The right-hand column contains the scored statements that the reviewers will be using for each of the three criteria questions. Individual reviewers will assign a 1–6 score for each scored statement after reviewing the Technical Submission. The left-hand column is suggested content for each criteria question. The suggested content provided is not mandatory and you will not be judged against it, these are examples of details to include to help guide your responses, you are welcome to use other information as you see fit.

Criteria 1: What is the impact of the innovation?	
<p><b>Suggested Content You Provide</b></p> <ul style="list-style-type: none"> <li>• Identification of the relevant ocean or atmospheric data collected by the proposed solution.<sup>6</sup></li> <li>• How the solution increases the spatial coverage, temporal resolution, and/or types of variables that can be observed.</li> <li>• Identification of the priorities that your system will address. Priorities can include general blue economy goals identified above or other federal (e.g., NOAA, Navy, USCG, BOEM, etc.), state, or local agency ocean science priorities.</li> <li>• Explanation of how new data streams enabled by the proposed concept could improve understanding of the earth system and/or be used to add direct value through applications such as weather forecasting navigation or resource management. This could include how the proposed concept helps to meet United Nations (U.N.) Sustainable Development Goals<sup>7</sup> or the</li> </ul>	<p><b>Scored Statement on 1–6 Scale</b></p> <ul style="list-style-type: none"> <li>• The solution is novel and enables new capabilities and/or data streams to be collected, processed, and/or transmitted.</li> <li>• The solution addresses ocean observing needs of local, regional, or national ocean priorities of public or private stakeholders.</li> <li>• The applicant shows a clear positive impact as a result of the innovation that benefits the health, safety, or security of human society or the environment.</li> <li>• The innovation will have little or no impact on the environment in which the technology will be operating.</li> </ul>

<sup>6</sup> For a list of Essential Ocean Variables, please see [Appendix 2](#). Please note that other data can be suggested by competitors.

<sup>7</sup> More information on the U.N. Sustainable Development Goals can be found in [Appendix 2](#).

<p>U.N. Decade of Ocean Science for Sustainable Development objectives.<sup>8</sup></p> <ul style="list-style-type: none"> <li>● Description of possible environmental risks and mitigation strategies to ensure that the idea will not have an adverse impact on the marine environment.</li> </ul>	
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## Criteria 2: What is the end-user market potential?

<b>Suggested Content You Provide</b>	<b>Scored Statement on 1–6 Scale</b>
<ul style="list-style-type: none"> <li>● Provide evidence of customer research in the form of: <ul style="list-style-type: none"> <li>○ Names of end users interviewed and relevant details from the interviews.</li> <li>○ Relevant literature review.</li> <li>○ Any first-hand field experience.</li> <li>○ Potential customer commitments.</li> </ul> </li> <li>● If applicable, provide evidence of avoided costs, e.g., ship time, maintenance costs, etc.</li> <li>● The estimated price for each unit.</li> <li>● The estimated cost to manufacture each unit.</li> <li>● Identification of IP strategy, existing IP related to the technology.</li> <li>● Explanation of why the proposed concept has the potential to scale, including expected demand quantified by number of units.</li> <li>● An estimate of the geographic and temporal applicability of the proposed system.</li> </ul>	<ul style="list-style-type: none"> <li>● Applicant has identified end-user needs and requirements.</li> <li>● Applicant has identified a target market and provided evidence of market demand.</li> <li>● Applicant has presented a defensible value proposition for the proposed concept.</li> <li>● The solution has market scalability.</li> </ul>

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<sup>8</sup> More information on the U.N. Decade of Ocean Science for Sustainable Development can be found in [Appendix 2](#).

### Criteria 3: What is the technical feasibility?

#### Suggested Content You Provide

- Justification for why marine energy is the appropriate energy source for this application, including resource considerations.
- Conceptual drawings (e.g., images of 3D CAD drawings, etc.) of your system.
- Supporting body of knowledge that provides confidence that the solution is capable of operating as intended.
- Demonstration that the power generation potential meets the end-user needs, including a table or list of key design requirements for the application as defined by the ocean observing end user(s).
- Identification of physical traits of the system such as size, weight, materials, etc.
- Explanation of how the system will be built, deployed, maintained, and recovered and/or decommissioned at the end of its useful life.
- Explanation of how the system will address key operating constraints, like biofouling, corrosion, or long-term calibration.
- Estimated life expectancy of the system.
- Description of the method of energy storage and power management, if applicable, and associated specifications on the storage system (capacity, charge and discharge rate, etc.).

#### Scored Statement on 1–6 Scale

- The solution represents an innovative approach built on reasonable assumptions, valid technical foundations, and lessons learned from other notable efforts in this space.
- The applicant justifies the method of power generation and has sufficiently explained its principles of operation.
- The energy produced meets or exceeds end-user requirements.
- The applicant has identified credible methods for manufacturing, installing, operating, and maintaining the proposed system.

## Submission Slide Summary

Make your own public-facing, one-slide submission summary. There is no template, present the information as you see fit. Please use a text with a font size no smaller than 14 pt. and ensure that any graphics are of sufficient resolution to be visible on a projection screen or print-out.



## Resources Needed Document

Help us help you be successful by identifying what resources you will need to see your idea come to life. You can be as specific or general as you like. Resources could include investment amounts, introductions and connections to key stakeholders, testing facilities, specialized manufacturing equipment, engineering expertise, research vessels, or any other relevant services, infrastructure, or partners that you think you will need. Limit responses to 250 words. This will not be made public, nor will it be included in the cumulative score; however, as DOE and NOAA prepare for the DEVELOP Competition, we are seeking to better understand how to best support competitors in the designing, building, and testing of their ideas.

## 3.5 How We Determine Winners and Make Awards

The Prize Administrator screens all completed submissions and, in consultation with DOE and NOAA, assigns subject matter expert reviewers to independently score the content of each submission. The reviewers will be composed of federal and non-federal subject matter experts with expertise in areas relevant to the competition. Reviewers will review technical narrative submissions according to the evaluation criteria described in Section 3.4.

**Reviewer Panel Scoring:** The scoring of submissions will proceed as follows:

- Reviewers will review the Technical Submission (technical narrative and video) individually and assess the competitors' response to each statement for all the three criteria questions.
- Reviewers will score each statement between one and six depending on the degree to which the reviewer agrees that the Technical Submission (technical narrative and video) reflects the statement.
- Each statement score will be added together to generate a total score for the submission, ranging from 12 to 72.
- The total scores from each reviewer will be averaged to develop a final score for the applicant. This score will inform the judges' decisions on awarding prizes.

**Interviews:** NOAA and WPTO may decide to interview a subset of competitors. The interviews would be held prior to the announcement of winners and would serve to help clarify questions the reviewers may have. Participating in interviews is not required and interviews are not an indication of winning.

**Final Determination:** The Director of the DOE's Water Power Technologies Office and the Director of NOAA's Integrated Ocean Observing System are the final judges of the competition and will make award determinations. Determination of winners by the final judges will take the reviewers' scores and the interview findings (if applicable) into account. The judges will set a technically meritorious line at a specific score based on the scores of all submissions. DOE and NOAA intend to award at least one Explorer prize in each theme; however, an overall minimum score will be established for the selection of winners. Should a theme not have a minimum score, as set by the judges, the theme will not have an Explorer prize winner.

**Announcement:** Approximately 30 days after the contest closes, the Prize Administrator will notify winners and request the necessary information to distribute cash prizes. The Prize Administrator will then publicly announce winners.

## 3.6 Administrative Requirements

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

- The proposed solution uses marine energy to power ocean observing platforms or associated systems.
- The proposed solution represents an innovation that will move the ocean observing industry beyond its current state.
- The proposed solution does not involve the lobbying of any federal, state, or local government.
- The proposed solution is based on sound technical principles.

Submissions that do not agree with the above statements will be rendered ineligible for the competition.

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

# Appendix 1— Additional Terms and Conditions

## 1. Requirements

Your submission for the **Powering the Blue Economy™: Ocean Observing Prize** is subject to the following terms and conditions:

- You must post the final content of your submission or upload the submission form online at <https://www.herox.com/OceanObserving> before the DISCOVER Competition closes. Late submissions or any other form of submission may be rejected. Check the website for the most up-to-date information on the closing deadline.
- All submissions that you wish to protect from public disclosure must be marked according to the instructions in section 10 of Appendix 1. Unmarked or improperly marked submissions will be deemed to have been provided with unlimited rights and may be used in any manner and for any purpose whatsoever.
- 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.
- Your submission must be in English and in a format readable by Microsoft Word or Adobe PDF. Scanned hand-written submissions will be disqualified.
- Submissions will be disqualified if they contain any matter that, in the sole discretion of DOE or the Prize Administrator, 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 proceed to register for any of the Stages described in this document, these rules will form a valid and binding agreement between you and the U.S. Department of Energy and are in addition to the existing HeroX Terms of Use for all purposes relating to this contest. You should print and keep a copy of these rules. These provisions only apply to the contest described here and no other contest on the HeroX platform or anywhere else.
- The Prize Administrator, when feasible, may give competitors an opportunity to fix non-substantive mistakes or errors in their submission packages.

## 2. Verification for Winner Payments:

The Prize Administrator will verify the identity of a competitor that is selected to receive the 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 after the date that results are announced. Each competitor will be required to sign and return to the Prize Administrator, within 30 days of the date the notice is sent, a completed NREL Request for ACH Banking Information form, and a completed W9 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 cannot be contacted; (ii) the person/entity fails to sign and return the required documentation within the required time period; (iii) the notification is returned as undeliverable; or (iv) the submission or person/entity is disqualified for any other reason.

### 3. Teams and Single Entity Awards

The Prize Administrator will award a single dollar amount to the designated primary submitter whether consisting of single or multiple entities. The primary submitter is solely responsible for allocating any prize funds among its team of competitors as they deem appropriate.

### 4. 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, permission to use the submission consistent with the Rules of this Prize. Portions of submissions that are marked as protected from public disclosure according to Section 10 will be treated accordingly. Potential uses of submissions include posting or linking to the non-protected portions of the submission on the Prize Administrator or HeroX platforms, 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, administrator, reviewers and judges for purposes of the contest 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 competitor's name and, as applicable, the names of competitor's team members and organization, and the abstract for their idea at the CONCEPT Stage on the contest website indefinitely.

By entering, Competitor represents and warrants that:

1. Competitor has not included third-party content (such as writing, text, graphics, artwork, logos, photographs, dialogue from plays, 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 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 or others acting on its behalf 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. Competitor is not and will not conduct any activity pertaining to this prize competition that would infringe upon any intellectual property right of any third party, such as any patent, copyright, trade secret, or other intellectual property right; and that it has exercised reasonable efforts and diligence in making this representation and warranty. The foregoing representation and warranty shall be ongoing during the course of this competition and will be considered to have been made again and as of the date of each subsequent stage of the competition in which Competitor participates.
4. 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 Competitor their express written consent to submit the submission for exhibition and other use 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 their parent or legal guardian) and Competitor may be asked by Prize Administrator to provide permission in writing;

## 5. 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 upon any other third-party rights of which the Competitor is aware; and that the submission is free of malware.

## 6. Contest subject to applicable law

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

## 7. 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.

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. Competitors and potential winners may be required to show proof of being the authorized account holder.

## 8. Publicity

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

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.

## 9. Liability

Upon registration, all competitors agree to assume and, thereby, have assumed any and all risks of injury or loss in connection with or in any way arising from participation in this contest or development of any submission. Upon registration, except in the case of willful misconduct, all competitors 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 related entities 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 Technology Office, the Director has determined that no liability insurance will be required of

Competitors to compete in this competition per 15 USC 3719(i)(2) in the DISCOVER Competition. The Director will evaluate possible activities in the rest of the Prize and make additional determinations. Competitors may be required to obtain liability insurance in future stages.

## 10. Submission Marking and FOIA

All materials submitted to DOE as part of a submission become DOE records. Any confidential commercial information contained in a submission should be designated in writing at the time of submission.

Competitors are required to employ protective markings in the following manner:

The cover sheet of the submission must be marked as follows and identify the specific pages containing trade secrets or commercial or financial information that is privileged or confidential:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets or commercial or financial information that is privileged or confidential and is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

The header and footer of every page that contains trade secrets or commercial or financial information that is privileged must be marked as follows: "May contain trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure."

In addition, each line or paragraph containing trade secrets or commercial or financial information that is privileged or confidential must be enclosed in 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.

## 11. 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.

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

## 12. 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 contest, as determined by DOE in its sole discretion, DOE may cancel the contest.

Although DOE indicates in the Powering the Blue Economy™: Ocean Observing Prize that it will select up to several winners for each competition, 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 winners and will award no prize money.

### **13. Prize Administrator**

The Prize Administrator is the Alliance for Sustainable Energy, LLC operating in its capacity as the Managing and Operating Contractor for the National Renewable Energy Laboratory (NREL). The U.S. Department of Energy, Water Power Technologies Office (WPTO) is the Federal Agency sponsor of the Prize.

### **14. National Environmental Policy Act (NEPA) Compliance**

DOE's administration of the Powering the Blue Economy™: Ocean Observing 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, competitors in DEVELOP Competition 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 competition. Competitors 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.

### **15. Judge Conflict of Interest**

The judge of this prize may not (a) have personal or financial interests in, or be an employee, officer, director, or agent of any entity that is a registered participant in the Prize; or (b) have a familial or financial relationship with an individual who is a registered participant.

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

## Appendix 2 - Theme Descriptions

### 1. Unmanned Vehicles

Advances in robotics led to the creation of unmanned systems which have revolutionized ocean exploration and monitoring. Aerial drones, unmanned surface vehicles (USVs), and unmanned underwater vehicles (UUVs) have allowed us to probe deeper, farther, and longer than we ever could with manned vehicles.

Underwater vehicles encompass a wide variety of vehicle types, such as buoyancy gliders, hybrid remotely operated vehicles, autonomous underwater vehicles (AUVs), or any other similar systems. These vehicles are meant to operate underwater, sometimes at extreme depths. Such vehicles are generally self-propelled, free-diving, and in the case of AUVs, possess the ability to make onboard decisions in response to their environment. Underwater vehicles spend most of their operating life underwater where energy generation from the environment is currently limited. Because of limited energy resources, many underwater vehicles are designed to carry enough energy for their intended mission. However, this limits range and duration of the vehicle to the capacity of the batteries or onboard fuel, typically a week at most without some type of recharging or refueling.

Unlike UUVs, USVs are typically constrained to surface operations. This class of vehicles have the benefit of being able to utilize multiple renewable energy resources such as solar, wind, and wave. By utilizing these energy resources at the surface USVs have demonstrated the ability to last upwards of a year at sea. USVs can possess the same levels of autonomy as underwater vehicles and are also self-propelled.

Aerial drones are increasingly being integrated into ocean research for such applications as marine animal tracking and species identification; vessel emission monitoring; identifying marine debris; or even collecting whale spout samples for DNA analysis. Like UUVs, aerial drones are limited in their range and duration by their batteries. Although drones are generally used in the marine environment only when close to a human operator, many mission applications could become automated provided the drone has a place to dock and recharge between missions.

Marine energy technologies could be used to power a charging station at which unmanned vehicles can dock, transfer data and recharge their batteries. Such a platform is applicable to surface, subsurface, and even aerial unmanned vehicles, though the unique advantages to using marine energy are likely to be in the subsea domain, particularly at depth. Marine energy technologies can also be integrated into unmanned vehicle designs allowing them to recharge during periods of inactivity or even as a means of propulsion.

### 2. Buoys, Floats, and Tags

Platforms such as buoys, floats, drifters, bottom landers, and animal tags are either stationary, or mobility-constrained systems that are commonly used for long-duration ocean observation. They may be mounted on the seafloor or to the body of a marine animal, attached to the end of a mooring line or allowed to drift freely in ocean currents. The platforms collectively cover the full range of the water column, from the warm surface waters to the near-freezing ocean bottom. Some platforms, such as profiling floats, can move between the surface and depths by adjusting their buoyancy or utilizing wave action, allowing them to collect unique measurements on ocean chemistry at different depths. Because these platforms stay out at sea for so long, the hosted sensors are optimized for minimum power



consumption and maximum longevity. This forces oceanographers to make tough trade-offs in duty-cycles, transmission rates, and sensor payload selection.

Marine energy technologies may extend the longevity of these buoys, floats, tags and drifters through novel designs that utilize the ocean resource in which they operate and measure. Specific use cases could include, for example: redesign of the popular Argo Float to include a marine energy powered recharge capability; surface buoys utilizing wave energy for weather measurement, powering cabled arrays, or even high-frequency radar; more powerful moored profiling floats that use wave or ocean current energy to conduct water column profiles along a mooring cable; and miniaturized thermal energy converters for electric animal tags.

### 3. Ocean Communications and Underwater Navigation

Underpinning any ocean observation system is a method for data storage, recovery, and delivery from the observation location. The preferred communication method in subsea environments is acoustics, but this method is slow in comparison to the other forms of wireless communications like satellite, Wi-Fi, and cellular used at the surface. While acoustic communication is effective in transferring data underwater, it has limited ability to transfer large data packages over long distances. This is due in part to the power demands to operate an acoustic modem (which converts the acoustic signal into a digital one and vice versa) and its associated acoustic transducer which sends and receives the signal. Better acoustic, and thus underwater, communication can be obtained with more power.

For remote systems near the surface that are relatively inaccessible, the traditional method of communication is via satellite, most commonly with Iridium short burst data. Satellite communications are tried and true for offshore use, but are relatively expensive, have high latency, and are bandwidth limited.

On shore, Wi-Fi and cellular networks are more commonly used than satellite. Presently, telecommunication providers are moving towards deployment of fifth generation cellular networks that could all but eliminate existing bandwidth limitations. Offshore, a robust first-generation network is still missing. Advanced cellular networks could be developed offshore, if given a cheap and omnipresent energy source.

Extending existing Wi-Fi networks offshore would fundamentally change ocean observation communications. With a reliable network far from shore, platforms would be able to communicate in near real-time with scientists on shore and transmit vast amounts of data. A crucial challenge in developing any cellular or Wi-Fi offshore network would be ensuring that a constellation of buoys can relay a shore-based signal far offshore and maintain coverage over a specified area without disrupting ocean biological systems.

High-speed broadband offshore communication using cellular, Wi-Fi, or acoustic networks would enable new capabilities in ocean observation. Marine energy could be integrated in ocean communication system designs, such as wave-powered Wi-Fi repeater floats, wave-powered offshore cell-tower spar buoys, or ocean current-powered subsea acoustic modem networks.

These systems would likely need to be digitally linked together into arrays to ensure the collective system provides sufficient service coverage area.

## 4. Extreme Environments

Providing a reliable power supply for ocean observing platforms at high latitudes or in the deep sea (depths of 300 meters or more) can be challenging. These areas are typically characterized as difficult to access and frequented by foul weather, which are some of the reasons why they are so poorly understood. However, polar regions and the deep sea play critical roles in oceanic and atmospheric circulation and marine biological productivity, and data collected here is invaluable to many ocean scientists and researchers.

Extreme conditions require reliable power sources that can ride out long spells of harsh weather and minimize expensive maintenance visits. Solar PV and small-scale wind turbines are typically well suited to provide power at ocean surface locations in the tropics and mid-latitudes, but at high latitudes (beyond 60° North or South) these technologies perform poorly due to harsh weather or long periods without sunlight. To complicate matters, seasonal sea ice prohibits operation of surface devices during large portions of each year which means that energy generation must be done under the ice and in the dark,

The deep sea is recognized by NOAA as the ocean region beyond 300 meters deep, however the average depth of the ocean is more than 3,000 meters and the maximum depth is nearly 11,000 meters. Even at modest depths in the deep sea the environmental conditions are characterized by extreme pressure, near-freezing water temperatures, and complete darkness making energy generation extremely difficult.

Marine energy technologies, like wave energy converters or ocean current and tidal turbines, may be a better alternative to solar or wind energy in these subsurface and/or deep environments. Specific use cases could address such topics as high-powered high-frequency radar surface buoys designed for polar conditions, below-ice ocean current energy converters for powering AUV recharge stations, or high-power communication systems.

## 5. Blue Sea Ideas

The themes identified above were determined through extensive outreach activities, surveys, and workshops with the ocean observing community. The majority of applications where marine energy and ocean observing technologies could be integrated should align to at least one of the themes presented in this section. This final theme, Blue Sea Ideas, is to allow for any applications that may not align with the provided themes, but still fall within the context of ocean observing integrated with marine energy systems.

## Appendix 3—Glossary

**End User:** In the context of this DISCOVER Competition an end user is considered to be a person, organization, or similar entity that uses, manages, builds, designs, or pays for ocean observing platforms, sensors, or other related instruments.

**EOVs:** Essential Ocean Variables are standardized parameters that are considered to be of high impact and relevance to characterizing climate, operational ocean services, and ocean health but also feasible to collect. Essential Ocean Variables are identified by Global Ocean Observing System (GOOS) Expert Panels. A list of the current thirty-one different EOVs is in the graphic below.

Physics	Biogeochemistry	Biology and Ecosystems
Sea state	Oxygen	Phytoplankton biomass and diversity
Ocean surface stress	Nutrients	Zooplankton biomass and diversity
Sea ice	Inorganic carbon	Fish abundance and distribution
Sea surface height	Transient tracers	Marine turtles, birds, mammals abundance and distribution
Sea surface temperature	Particulate matter	Hard coral cover and composition
Subsurface temperature	Nitrous oxide	Seagrass cover and composition
Surface currents	Stable carbon isotopes	Macroalgal canopy cover and composition
Subsurface currents	Dissolved organic carbon	Mangrove cover and composition
Sea surface salinity		Microbe biomass and diversity (*emerging)
Subsurface salinity		Invertebrate abundance and distribution (*emerging)
Ocean surface heat flux		
Cross-Disciplinary		
Ocean colour	Ocean Sound	

**Global Ocean Observation System (GOOS):** A program executed by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO).

**The Integrated Ocean Observation System (IOOS):** A national-regional partnership led by NOAA working to collect ocean data to provide new tools and forecasts to improve safety, enhance the economy, and protect our environment. Focus of this system includes Great Lakes, coastal areas, as well as the world's ocean. The IOOS is a national-regional network led by NOAA focused on gathering observation data and developing tracking and predictive tools to benefit the economy, the environment, and public safety at home, across the nation, and around the globe. IOOS's mission is to produce, integrate, and communicate high-quality ocean, coastal, and Great Lakes information that meets the safety, economic, and stewardship needs of the nation.

**Marine Energy, Marine Energy System, Marine Renewable Energy (MRE), Marine Hydrokinetic Energy (MHK):** All of these terms refer to a system that converts the energy contained in ocean wave, tidal, ocean current, river, salinity or thermal gradients into useful energy.

**The National Oceanic and Atmospheric Administration (NOAA):** An agency within the U.S. Department of Commerce that focuses on the conditions of the oceans, major waterways, and the atmosphere.

**Ocean Observing:** The act of observing or monitoring the physical, biological, chemical, acoustic, or optical properties of the marine environment through direct or indirect means.

**Ocean Observing Platform:** A device or system designed to host one or more sensors or instruments for observation or monitoring of the marine environment.

**The Sustainable Development Goals (SDG):** A collection of 17 global goals set by the United Nations General Assembly in 2015 for the year 2030. Several are relevant to ocean monitoring, especially number fourteen: "Life Below Water".

**Theme:** In the context of this Ideation Competition a theme refers to one of the five prize ocean observing categories to which applicant ideas should align. For more details on the different themes see [Appendix 2](#).

**United Nations Decade of the Ocean:** On December 5, 2017, the United Nations proclaimed a Decade of Ocean Science for Sustainable Development, to be held from 2021 to 2030. This Decade will provide a common framework to ensure that ocean science can fully support countries' actions to sustainably manage the ocean.

**The Water Power Technologies Office (WPTO):** An office within the U.S. Department of Energy's Energy Efficiency and Renewable Energy Program. WPTO is committed to researching, developing, and deploying a portfolio of innovative technologies for clean, domestic power generation from resources such as hydropower, waves, and tides.