

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

water

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WATER POWER TECHNOLOGIES OFFICE

Innovating Distributed Embedded Energy Prize (InDEEP)

April 12, 2023

Webinar Logistics

- Everyone is joined in listen-only mode
- Audio Issues?—Try connecting over the phone
- If that doesn't work, visit the [Zoom Help Center webpage](#)
- Q&A—Submit your questions using the chat box

Agenda

1. Introductions
2. WPTO and InDEEP Overview
3. Prize Phases and Awards
4. Submission Package and Scoring Criteria
5. Q&A

Questions you may have about InDEEP:

Why should I participate?

- Tap into the unrealized power of the ocean's waves
- Be on the forefront of wave energy technology development
- Join the clean energy revolution

How will I be supported?

- Innovators inside and outside the marine energy industry will have access to marine energy training and industry experts
- Teaming platform will be available to build interdisciplinary **teams**

What could I win?

- \$2.3M total prize purse and other support for reimagining the engineering challenges associated with wave energy

WPTO enables research, development, and testing of emerging technologies to advance **marine energy** and **next-generation hydropower** and **pumped storage systems** for a flexible, reliable grid



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



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



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

Innovating Distributed Embedded Energy Prize



U.S. DEPARTMENT OF ENERGY

Innovating Distributed Embedded Energy Prize



- \$2.3M prize pool
- Three phases over two years
- Incentivize progress in early-stage research
- Help solve technical challenges that could be applied to wave energy

Prize Goals

- **Leverage WEC innovation to systematically develop DEEC-Tec concepts** that could bring value to the ocean wave energy industry
- **Build a solver community** by engaging and facilitating collaboration between diverse innovators in the marine energy industry and related DEEC-Tec disciplines
- **Encourage development of novel DEEC-Tec with high potential** relevance to WECs by supporting an interdisciplinary set of competitors from ideation to design
- **Refine WEC innovation methods** to incorporate ideas beyond the field of wave energy based on feedback from the prize



WPTO's desired outcome for InDEEP is an understanding of the landscape of innovators and potential DEEC-Tec solutions that could be applied to wave energy devices.

marine energy | challenges

Marine energy technologies are at an early stage of development due to the **fundamental challenges of generating power from a dynamic, low-velocity, and high-density resource** while withstanding corrosive marine environments

These challenges are intensified by **high costs and lengthy permitting processes associated with in-water testing**

To address these challenges, the Marine Energy Program conducts **transformative early-stage research** that advances the development of reliable, cost-competitive marine energy technologies and reduces barriers to technology deployment



Setting the Stage: Example of Design Paradigm Shift

- Concentrated Energy Conversion
- Example: Thermal solar power
- Energy field interception with direction to focus point for multi-stage & high load power conversion to electricity

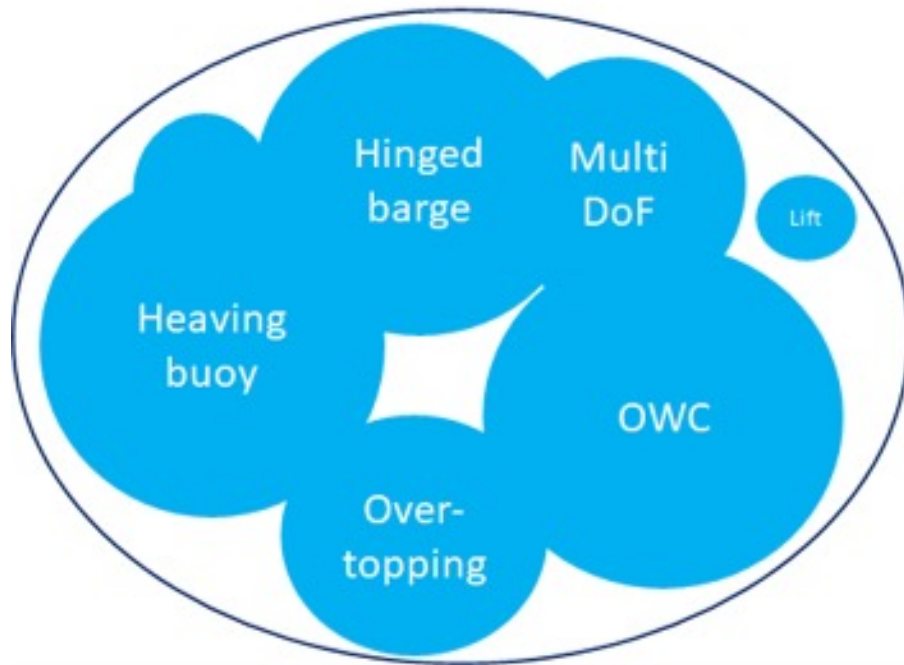


- Distributed Energy Conversion
- Example: Photovoltaic solar power
- Energy field interception with local conversion to high aggregation of electricity

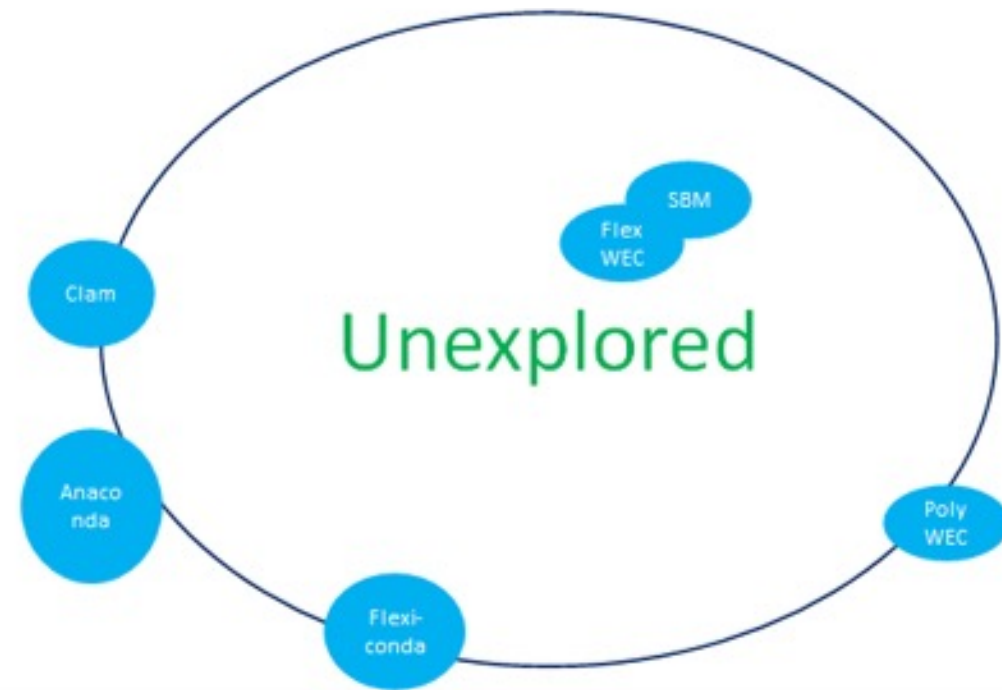


Innovation and Design Spaces – Technology Opportunities

- Concentrated Energy Conversion
- Conventional Technology Approach
- Extensively explored Solution Space



- Distributed Energy Conversion
- Innovative Technology Approach
- Underexplored Solution Space

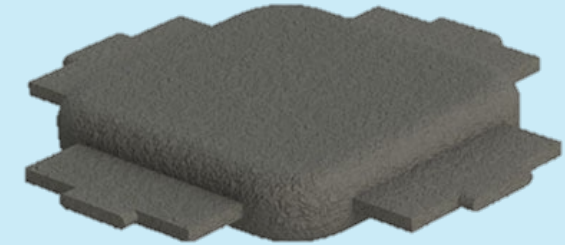


Distributed Embedded Energy Converter Technologies

DEEC-Tec

Distributed Embedded Energy Converter (DEEC)

- Small energy transducer with ability to interconnect with others; often has *characteristic lengths of a few centimeters*
- Could leverage any number of physical phenomena for energy conversion; e.g., variable capacitance, Faraday's Law of Induction, piezoelectric effect, hydraulics, pneumatics



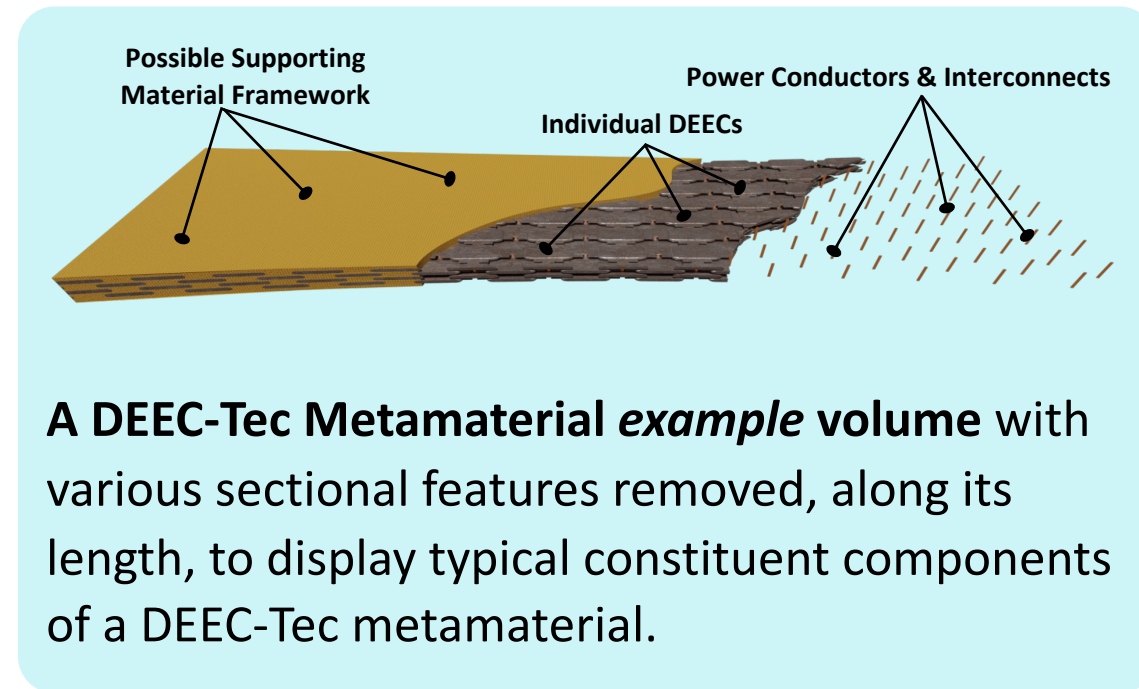
Pictorial representation of **an individual DEEC**. A relatively small energy transducer (often less than a few centimeters long) used to convert one or more form(s) of energy into another (via some form of physical law of energy transfer) while also serving as a structural mechanism for the joining and/or interconnection to other DEECs for the creation of DEEC-Tec metamaterials.

Distributed Embedded Energy Converter Technologies

DEEC-Tec

DEEC-Tec Metamaterials

- Structural frameworks that are made from the interconnections and combining of many DEECs
- Frameworks making up the metamaterials could be made of different configurations of DEECs; lattices, weaves, layers, etc.

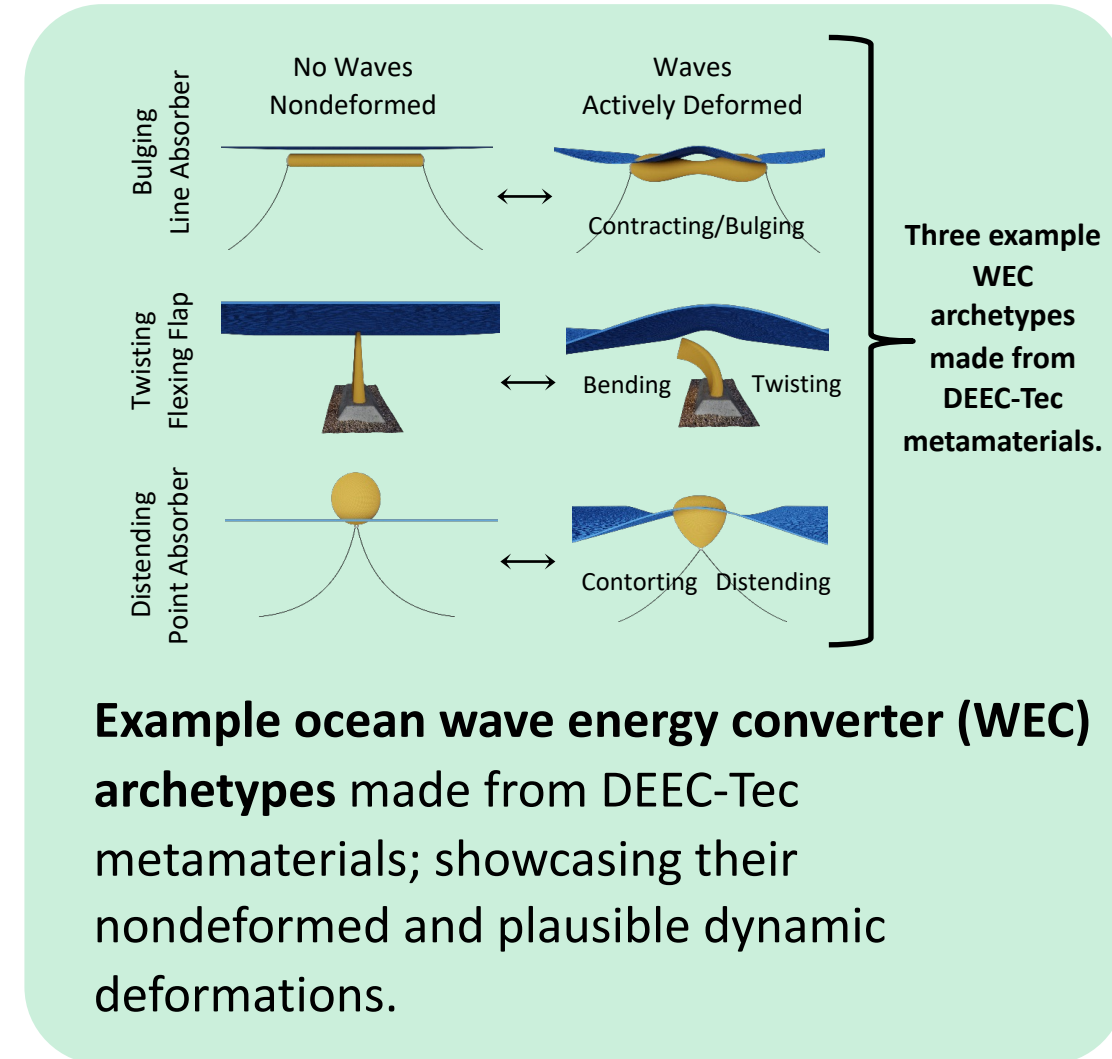


Distributed Embedded Energy Converter Technologies

DEEC-Tec

WECs can be Made from DEEC-Tec Metamaterials

- WECs can be constructed and fabricated through the assemblage of one or several DEEC-Tec metamaterials types
- Has multiple degrees of freedom enabling an inherent compliant interaction with the various frequencies of ocean waves



Distributed Embedded Energy Converter Technologies

DEEC-Tec

WECs can be Made from DEEC-Tec Metamaterials

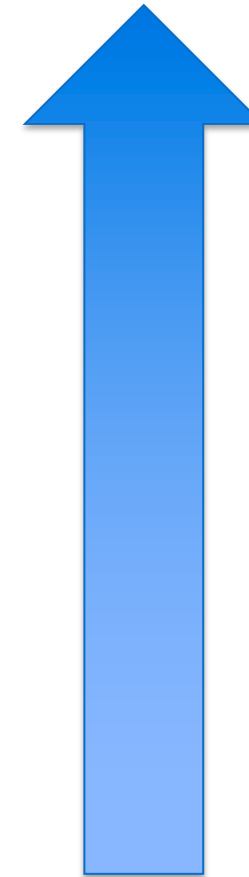
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Distributed Embedded Energy Converter (DEEC)

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“Technology Levels” build upon each other to, ultimately, create an ocean wave energy converter (a WEC)

Distributed Embedded Energy Converter Technologies

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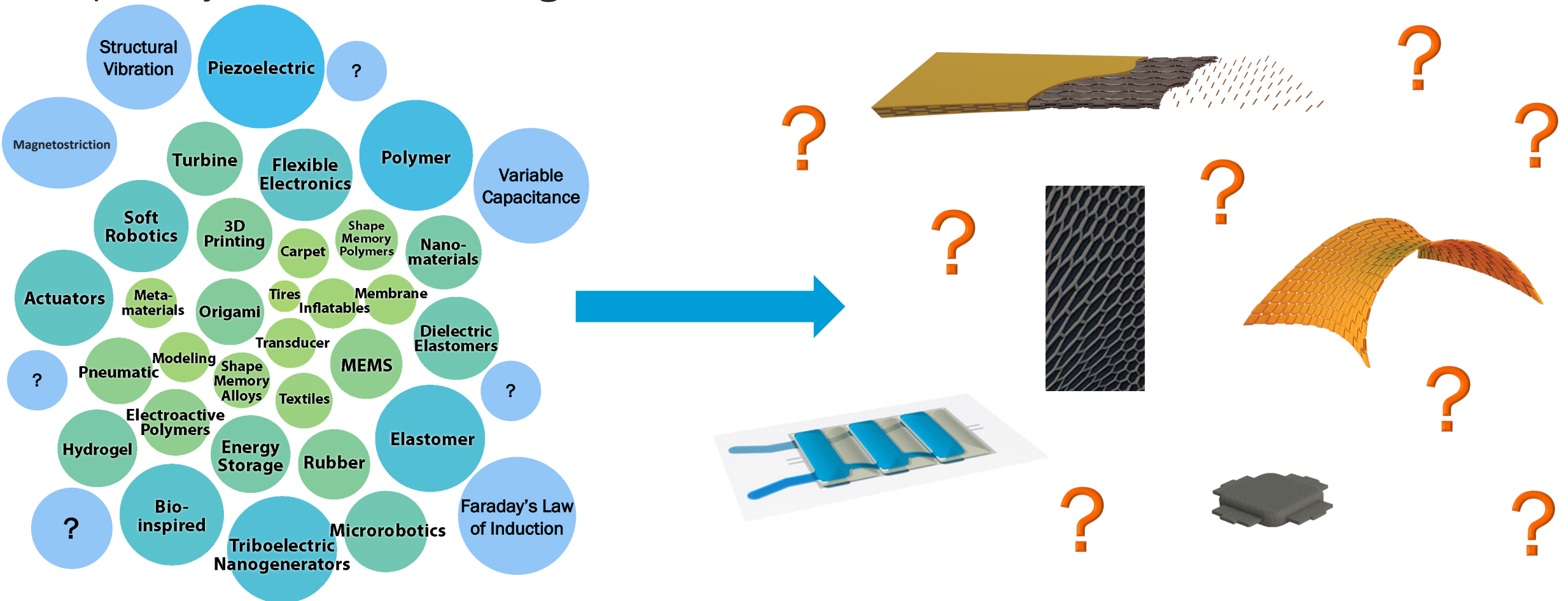
Prize, however, only gives focus to:

- The innovating of individual DEECs
- The innovating of corresponding DEEC-Tec Metamaterials



The DEEC - Tec Domain is Vast!

- The prior DEEC-Tec slides only illustrates a very small number of ‘obvious’ WEC archetypes, types of DEEC-Tec metamaterials, and types of individual DEECs.
- There are many unknown possibilities leveraging any number of technology domains—especially in terms innovating DEECs and DEEC-Tec metamaterials:



InDEEP Timeline



PHASE I

Concept development and team engagement

- 120 days
- Up to 20 winners
- \$300,000 in prizes



PHASE II

Build and test single DEEC

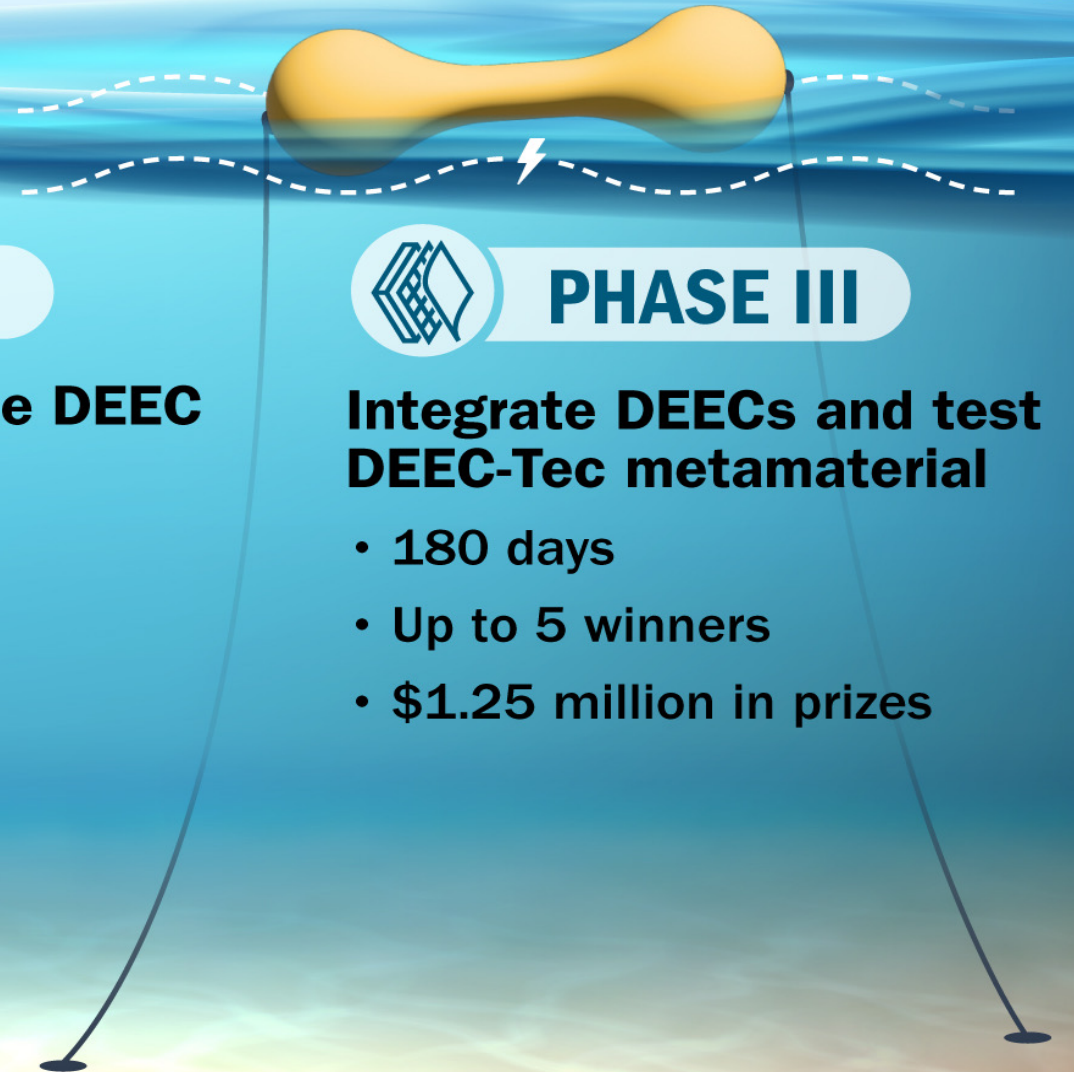
- 180 days
- Up to 15 winners
- \$750,000 in prizes



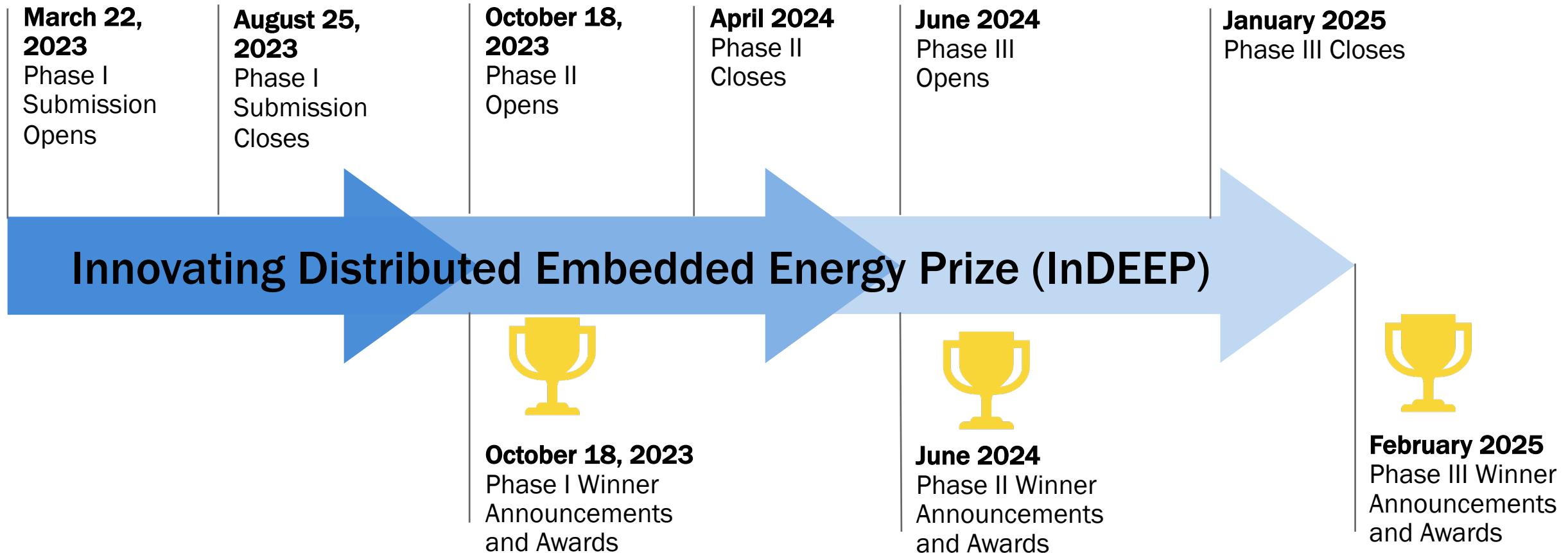
PHASE III

Integrate DEECs and test DEEC-Tec metamaterial

- 180 days
- Up to 5 winners
- \$1.25 million in prizes



Important Dates (subject to change)



Competitor Support Mechanisms

- Save the Dates!
Upcoming Training Sessions:
 - April 26: Wave energy
 - May 3: DEEC-Tec
 - May 10: Innovation methods
 - July 5: TPL assessment
- Teaming Platform
- Submission Feedback
- Mentorship in Innovation Methods and TPL Assessment
- *Resources linked in Appendix C of the Rules Document*



Submission Package & Scoring Criteria



Submission Requirements

Item	Description	Will Be Made Public	Scored Item
Summary Slide	Individual slide representing public-facing concept and team description.	Yes	No
Phase I TPL Assessment	Read, review, and complete a simplified version of the TPL Assessment.	No	No
Technical Narrative	Up to 5,000 words in length. Teams may also include up to 5 supporting drawings, images, or graphics.	No	Yes
Leaderboard Submissions	Continuous engagement activities scored for application period. Opportunities provided on HeroX platform.	Yes	Yes

Submission Requirements - Unscored

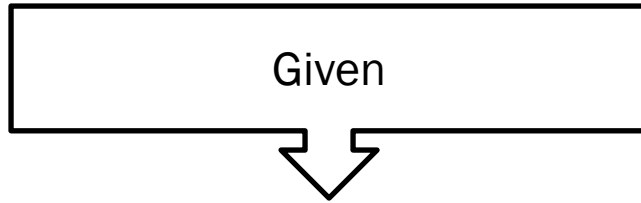
Submission Summary Slide

- Public-facing, one-slide submission summary.
- Technically specific details, but can be understood by general audiences.

Phase I TPL Assessment

- The competitor must complete a simplified TPL assessment.
- Template with 12 questions provided.
- The scores are not factored in the overall evaluation of the submission for Phase I.
- The strengths and weaknesses identified through the TPL assessment should be discussed in the technical narrative, which is scored.
- Upcoming webinar to introduce teams to TPL Assessment.

Phase I TPL Assessment – Question Format



Question:

Assuming your concept has shown functionality during benchtop testing, what, if any, additional improvements will it need to function in the intended ocean deployment environment?

Question guidance:

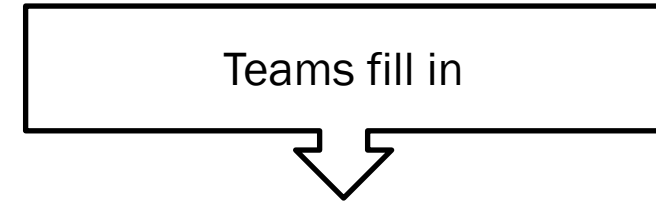
This question is intended to motivate an appraisal of anticipated challenges in scaling up the technology to, ultimately, create an ocean wave energy converter. An understanding of the challenges and a plan to address them are sufficient at this stage.

Scoring guidance:

High: DEECs can be designed to have safety margins for extreme load and motion conditions, and fatigue lives equaling or exceeding WEC design life, typically 20-25 years.

Med: DEEC failures can be addressed by building in redundancy and/or designing components to be easily replaceable.

Low: Fundamental breakthroughs are required for DEECs to be able to operate long term (20-25 years).



Score:

Choose an integer from 1 thru 9; 1 being the lowest and 9 the highest

Confidence:

Indicate how confident you are about the score you selected. Choose from high/medium/low.

Justification:

Provide justification or background information to support your score.

Submission Requirements - Scored

Technical Narrative

- Primary description of the solution and proposed concept.
- Should provide responses to the scoring statements outlined in the evaluation criteria in the rules document.
- Competitors can use up to 5,000 words and up to five supporting images, figures, or graphs.
- Template with page number suggestions and a fillable Gantt chart will be provided.

Leaderboard Scoring

- Hosted on HeroX, public-facing.
- Representation of engagement through Phase I.
- Final scores will contribute directly to the final numerical score a competitor receives on their submission.

Scoring Criteria


Technical Narrative and Leaderboard are scored on how well they address the scoring statements:

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

There are four criteria that need to be addressed in the technical narrative and leaderboard. Each statement in the four criteria will be scored 1–6. Specific scoring statements are included in the rules.

Criteria	% of Total Score
Criterion 1: Team Characteristics and Excellence	25%
Criterion 2: Innovation Process	25%
Criterion 3: Viability of the Concept	40%
Criterion 4: Planned Development for Phase II	10%
TOTAL	100%

Template for Technical Narrative

- Team Information (Team name, team members, and team lead)
 - A **short** description of your team/organization that is clear and concise [50-200] words, does not count towards 5,000 word limit]
 - **Up to 5,000 Words to populate the following information**
 - Team Characteristics & Excellence
 - Innovation Process
 - Viability of Concept
 - Planned Development for Phase II
- 
- Suggested content will be provided but competitors decide where to focus responses

Leaderboard Scoring Processing

Teams can earn points by leveraging educational tools and support mechanisms provided by Prize administrators to better understand key prize elements.

Activities are pre-scored on public-facing leaderboard.

**We anticipate the
Leaderboard will be
updated weekly**

- Specific engagement activities will be offered on the HeroX platform directly and updates will be shared on the leaderboard as teams complete these activities
- Teams can receive up to 6 points per scoring criteria, for a maximum of 18 additional points
- The final scores represented on the public-facing leaderboard will contribute directly to the final numerical score a competitor receives on their submission.

Wrap Up & Next Steps



HeroX Platform

AMERICAN MADE CHALLENGES American-Made Challenges

1,339 **Share** **Follow (50)**

Innovating Distributed Embedded Energy Prize

Let's forge a wave-powered future together! New wave energy technologies have the potential to power much of the nation's grid.

Energy, Environment & Resources Technology

Stage: **Enter**

SOLVE THIS CHALLENGE

Summary **Timeline** Forum Teams ⁵⁰ Entries **Resources** FAQ **Upcoming Webinars and Recordings** More ▾

Share & follow the prize

Stay up-to-date

Communicate with the prize administration team

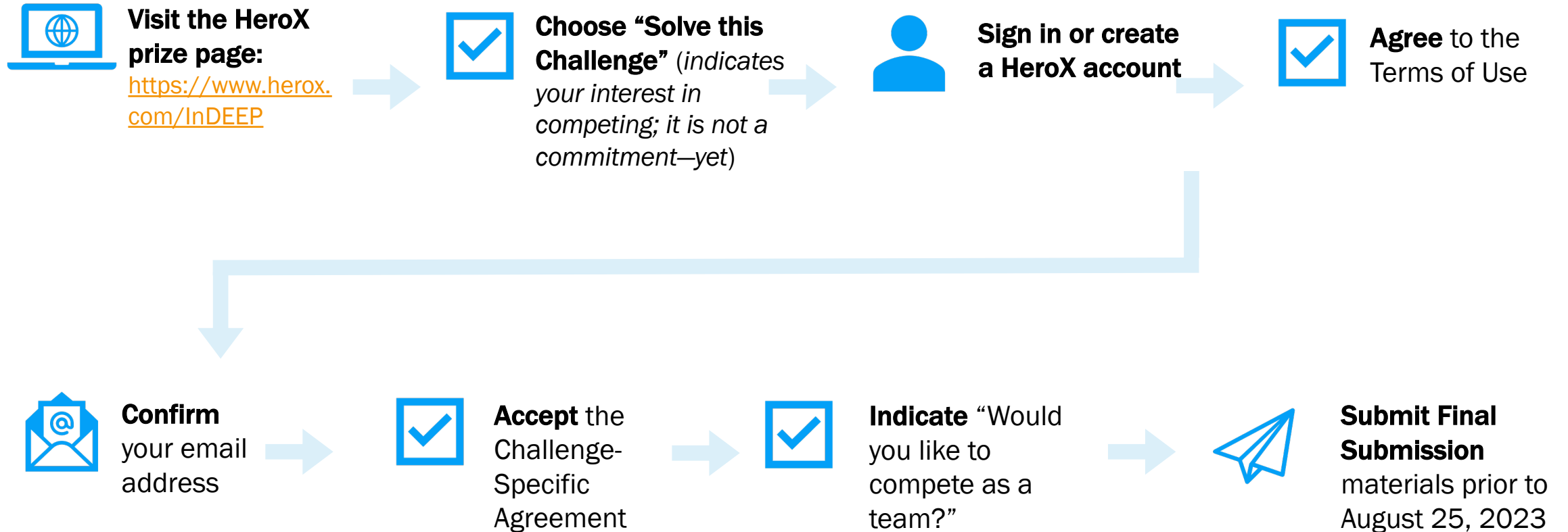
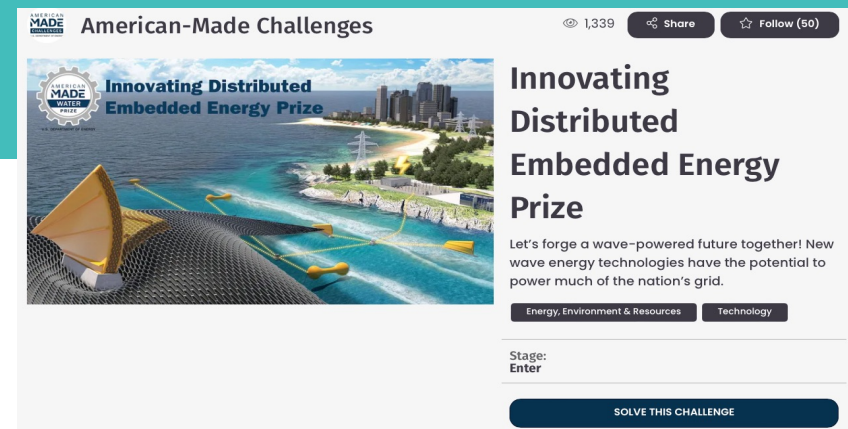
Build a team

Access valuable resources like the rules and templates!

Submit your idea!

Register for upcoming Webinars and trainings

Register and Compete

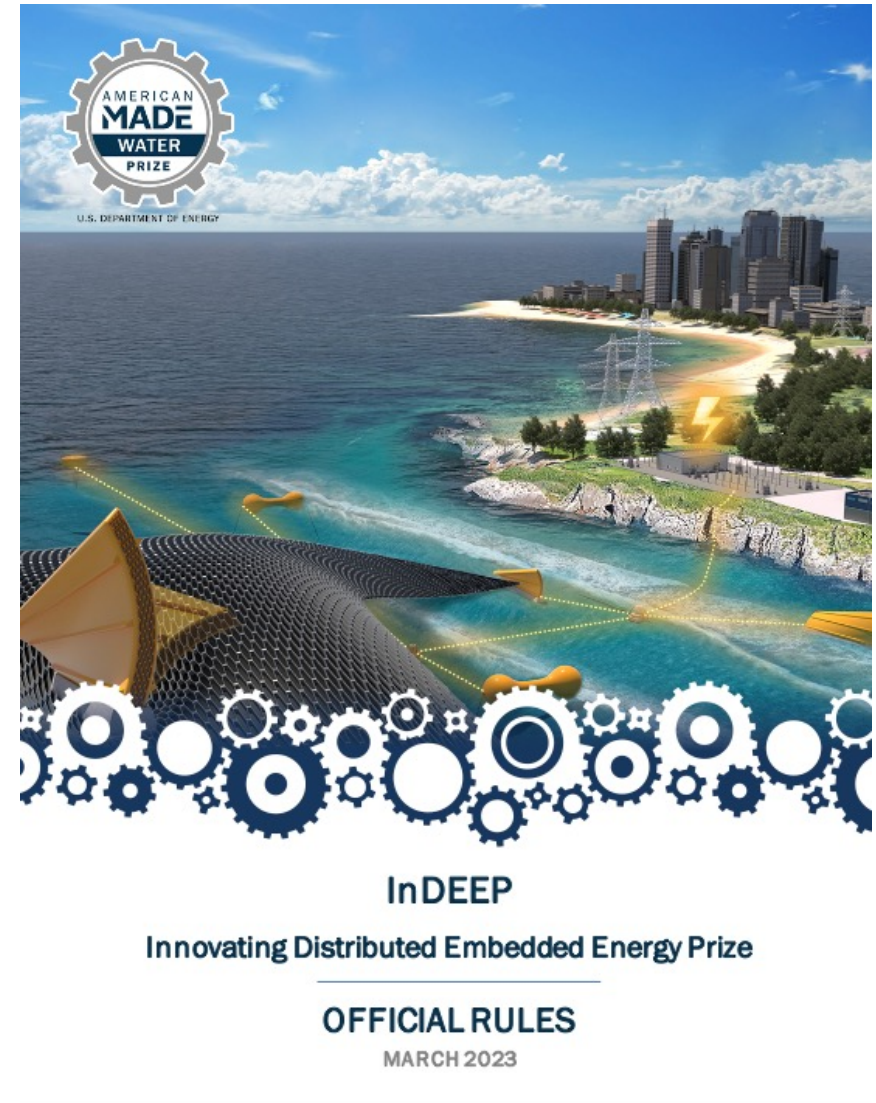


Read the Rules

Topics covered in today's presentation can all be found in the Official Rules Document.

For a more in-depth look at these topics, please read the rules document, which is available here:

<https://americanmadechallenges.org/challenges/indeep/docs/InDEEP-Prize-Rules.pdf>



A scenic sunset over the ocean with a teal banner across the middle containing the word 'Questions'. The sun is low on the horizon, casting a golden glow across the sky and reflecting on the water. The foreground shows rocky terrain with some sparse vegetation.

Questions