

# I AM Hydro Prize

· INNOVATIONS IN ADVANCED MANUFACTURING ·  
AMERICAN MADE WATER PRIZE

**Official Rules**  
JUNE 2020



U.S. DEPARTMENT OF ENERGY

# Preface

The U.S. Department of Energy’s Innovations in Advanced Manufacturing for Hydropower (I AM Hydro) Prize will be governed by this Official Rules document, which establishes the prize rules and requirements. The Prize Administrator reserves the right to modify this Official Rules document if necessary and will publicly post any such notifications as well as notify registered prize participants.

MODIFICATIONS	DATE
1. Amended prize timeline	September 17, 2020

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# Executive Summary

The U.S. Department of Energy (DOE) Water Power Technologies Office (WPTO) invites manufacturers, not-for-profit entities, research institutes, academic institutions, and all innovators to participate in a prize competition titled *Innovations in Advanced Manufacturing for Hydropower (I AM Hydro)*. The prize seeks to identify opportunities to use advanced manufacturing in the hydropower sector and offers a pool of up to \$250,000 in cash prizes for the best ideas.

The goals of the I AM Hydro Prize are to:

1. **Catalyze the use of advanced manufacturing to drive down levelized costs of hydropower** by seeking solutions that can dramatically lower initial capital costs and/or increase annual energy production
2. **Inform future investments** by identifying targeted, high-impact opportunities to apply advances in manufacturing to address hydropower's critical challenges, which may be used to inform future funding opportunities
3. **Bring new innovators into the hydropower sector** and help form new partnerships and collaborations between industry, academia, and government to accelerate innovative advanced manufacturing technologies for hydropower.

## Prizes

The I AM Hydro Prize consists of a single stage in which innovators will submit a package that includes a detailed description of the problem being addressed and its relevance to hydropower, a proposed advanced manufacturing solution that will address the problem, and evidence of the concept's feasibility and commercialization potential. Applicants will also submit a video pitch. Cash prizes will be awarded in the following categories:

**Innovator Prizes:** These prizes are awarded to the top submissions across all technology areas. Up to 15 Innovator Prizes will be awarded at up to \$15,000 each. Some technology areas may have multiple winners, or none at all.

**Grand Prize:** One Grand Prize winner will be awarded \$25,000 for the most innovative and impactful submission.

## Key Dates

- **Submission Open:** June 30, 2020
- **Submission Close:** October 30, 2020 at 5:00 p.m. Eastern Standard Time
- **Judging and Review Complete:** December 2020
- **Winner Announcement and Awards:** December 2020.

## Applications Not of Interest

The I AM Hydro Prize 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:

- Concepts that are only relevant to marine or in-river hydrokinetic devices, as opposed to hydropower applications. Hydrokinetic devices are placed directly in a river, current, or tidal current to extract the kinetic energy from moving water. Hydropower facilities—the focus of this prize—use structures to create hydraulic head and a turbine to convert the potential and kinetic energy of falling water into electricity.
- Concepts that involve the lobbying of any federal, state, or local government.
- Concepts not based on sound technical principles.

## Eligibility and Teams

The competition is open only to:

- Private entities (for-profits and nonprofits), non-federal government entities such as states, counties, tribes, and municipalities, academic institutions, and individuals subject to the following requirements:
  - Private entities must be incorporated in and maintain a primary place of business in the United States with majority domestic ownership and control. If an entity seeking to compete does not have domestic ownership and control but otherwise meets the eligibility requirements, the DOE Office of Energy Efficiency and Renewable Energy may consider issuing a waiver of that eligibility requirement. Details on this can be found in Appendix D.
  - Academic Institutions must be based in the United States.
  - An individual prize competitor (who is not competing as a member of a group) must be a United States citizen or a legal permanent resident.
  - A group of individuals competing as one team may win, provided that the online account holder of the submission is a United States citizen or a legal permanent resident. Individuals competing as part of a team may participate if they are legally allowed to work in the United States.
  - All participants comply with the foreign involvement requirements contained in Appendix D. 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 the prize.
- Entities and individuals publicly banned from doing business with the U.S. government such as entities and individuals debarred, suspended, or otherwise excluded from or ineligible for participating in Federal programs are not eligible to compete.

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.



# Background

## Advanced Manufacturing and Energy

Over the last decade, advanced manufacturing has revolutionized the energy sector, boosting the U.S. manufacturing industry and opening pathways to increased American competitiveness. Advanced manufacturing can offer numerous benefits over conventional manufacturing techniques, such as enhanced design flexibility, decreased energy consumption, lower costs, and reduced time to market. Some clean energy manufacturers use innovative technologies to improve manufacturing products or processes by reducing energy use and waste. Others use cutting-edge advanced manufacturing techniques like additive manufacturing to save time and energy required to build renewable energy technologies like wind turbines and solar panels.

While these novel applications of advanced manufacturing have ushered in benefits in other energy sectors, the potential benefits for hydropower applications remain largely unexplored. This presents an opportunity to leverage the rapid innovations enabled by advanced manufacturing to solve hydropower's challenges. The Innovations in Advanced Manufacturing for Hydropower (I AM Hydro) Prize is designed to spark innovation and pursue these opportunities. In particular, the U.S. Department of Energy (DOE) Water Power Technologies Office (WPTO) is interested in exploring the potential hydropower applications in the following Advanced Manufacturing Technology Areas:



**1. Joining, Coating, and Repair:** Integration of materials in structures by joining, application of a coating for improved performance of a material, as well as innovative, new repair methods or improvements to existing methods. Examples include automated and robotic welding, mechanical joining, adhesive bonding, reinforced epoxy coating, thermal spray coating, and patch repair.



**2. Additive Manufacturing:** Additive manufacturing (also known as three-dimensional [3D] printing) of components involves the deposition of materials layer by layer or point by point to fabricate complex components directly from computer-aided design models, in contrast to conventional subtractive manufacturing methods that involve the removal of material from a starting work piece. Examples include metallic, nonmetallic, and concrete deposition; tooling and molds; and embedded sensors.



**3. Casting, Forming, and Machining:** The use of a mold for casting, bulk deformation processes to induce shape changes for forming (e.g., forging, rolling, extrusion, drawing), and controlled material removal from a workpiece for machining. Examples include stamping and dies, and hybrid systems machining.



**4. Advanced Materials:** Novel or modified materials with unique or improved properties relative to the existing material in one or more characteristics that are critical for the application under consideration. Examples include polymers (fiber-reinforced, shape memory), ceramics, metal matrix composites, reinforced and precast concrete, and thermoplastic composites.

# Hydropower Challenges

## Existing Facilities

With 102 gigawatts of installed capacity, hydropower—including pumped storage—comprises 7% of total energy generation, 41% of renewable energy generation, and 95% of all utility-scale storage in the United States. Hydropower plays an important role in the evolving grid by providing storage, flexibility, and other grid services that can enable integration of variable renewables and ensure reliability and resilience. However, recent changes in hydropower operations and the maturity of related assets present challenges for the existing hydropower fleet. Some of these challenges include, but are not limited to:

- Machine wear and tear caused by operating in rough zones as they are traversed during more frequent cycling or ramping, which may lead to turbine fatigue failure
- Erosive wear of concrete dam and metal components (e.g., turbine, guide vanes) caused by water and abrasive sediments
- Cost and time associated with fabricating replaceable parts that are no longer available
- Failure of the generator's insulation system caused by aging effects and contamination of winding by dust and humidity
- Cavitation on metal components caused when vapor bubbles form and collapse because of rapid pressure changes and then generate shock waves that create pits on metal surfaces.

## New Hydropower Development

Nearly 1.5 gigawatts of hydropower capacity was added in the last decade, but, overall, new hydropower development has slowed down, especially compared to the rapid growth of other renewable energy sources. While there is significant resource potential that remains untapped, hydropower developers have to overcome many challenges, including:

- Large capital costs associated with the construction process, such as ground excavation and other civil engineering works
- Site-specific design and customized facilities
- Environmental impacts associated with conventional hydropower designs, which are often uncertain, complex, and require difficult or expensive mitigation measures
- Lack of infrastructure and capabilities to test and validate new technologies and designs
- Dependence on traditional manufacturing technologies, such as machining turbines out of traditional metal materials (e.g., stainless steel and aluminum).



## Levelized Cost of Energy

The previously mentioned factors create challenges in fully exploiting hydropower’s potential and remaining competitive with other renewable resources. This is most easily illustrated by comparing the levelized cost of energy (LCOE)<sup>1</sup> of hydropower against wind and solar (Figure 1). Unlike hydropower, solar and wind resources have benefitted from higher economies of scale as a result of mass production and build out, thanks, in part, to advanced manufacturing.

I AM Hydro Prize competitors will be asked to demonstrate how their solutions will lead to reductions in hydropower’s LCOE to increase its competitiveness. The key factors that impact hydropower’s LCOE include the following:

- 1. Annual Costs:** These are the annual costs associated with building and operating a facility. There are two main components of annual expenditures associated with a hydropower plant. The first component is the Initial Capital Costs, defined as the construction and equipment costs that are incurred during project planning, engineering, and construction, and which are financed over a specified amount of years. The second component is Operations and Maintenance (O&M) costs, or the costs associated with operating and maintaining the facility every year.
- 2. Annual Energy Production:** How much energy is produced annually by a hydropower facility depends on two factors: the performance characteristics of the plant (e.g., turbine efficiency), and the availability of water resources (e.g., projects constructed on an irrigation canal are only able to produce power when flows are scheduled to meet water demands and may operate on a seasonal basis).

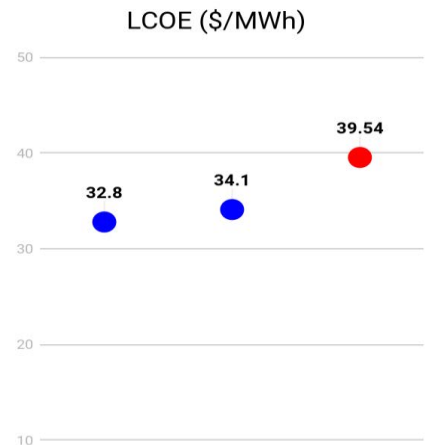


Figure 1. Estimated LCOE (in dollars per megawatt-hour [MWh]) of various generation technologies. Source: Energy Information Administration (2020)

A simplified hydropower LCOE equation is illustrated in Figure 2.

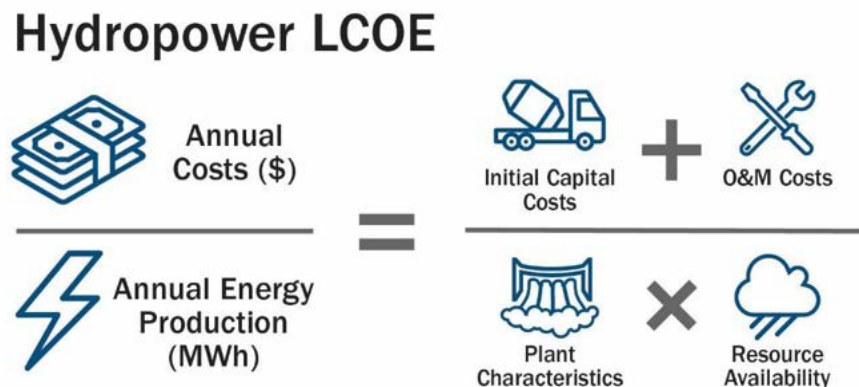


Figure 2. Key factors in levelized costs of hydropower

<sup>1</sup> LCOE is a convenient metric used to compare the overall competitiveness of different generating technologies regardless of their differences in project size, capacity factor, capital cost, and project lifetime. In general, LCOE measures the average annual costs of building and operating a generating plant divided by annual energy production over an assumed project lifetime, and is measured in dollars per unit energy, or \$/MWh.

# Advanced Manufacturing Opportunities for Hydropower

Whether applied to the existing hydropower fleet or the development of new facilities, advanced manufacturing can lead to reductions in hydropower’s LCOE by targeting innovations that reduce annual costs and/or increase annual energy production. Through the I AM Hydro Prize, WPTO hopes to identify high-impact opportunities to apply advanced manufacturing to address hydropower’s critical challenges, which may result in future funding opportunities. These opportunities are further described in Appendix C.

## I AM Hydro Prize Rules and Requirements

### Introduction and Purpose

The I AM Hydro Prize solicits novel concepts for leveraging advanced manufacturing to lower the levelized costs of hydropower by targeting reductions in initial capital costs and/or increases in annual energy production.

The I AM Hydro Prize offers up to \$250,000 in prizes to support the identification of novel applications of advanced manufacturing for the hydropower industry. Participants will have 120 days to submit their concept, including a detailed description of the problem being addressed and its relevance for hydropower, compelling information to demonstrate that the proposed concept is the right solution and would advance the state of the art, and evidence of the concept’s feasibility and commercialization potential. Ideas will be evaluated based on three criteria: (1) impact, (2) innovation, and (3) feasibility. From the submissions, up to 15 Innovator Prize winners will be selected to receive \$15,000 each, and the most innovative and impactful submission will be selected as the Grand Prize winner and receive \$25,000.

<b>Innovator Prizes</b>	Up to 15 awards of \$15,000 will be awarded to the top submissions across all technology areas
<b>Grand Prize</b>	One award of \$25,000 will be awarded to the most innovative and impactful submission

### How to Enter

Go to and follow the instructions for registering and submitting all required materials before the deadline in the Key Dates section in the Executive Summary or as displayed on the [HeroX website](#). Competitors also have the ability to form teams or find partners through the HeroX platform.

### Important Dates

- **Opening of I AM Hydro Prize:** June 30, 2020
- **Closing of I AM Hydro Prize:** October 30, 2020
- **Expected Winner Notification:** December 2020.

### What to Submit

The following items comprise the submissions package for the I AM Hydro Prize and must be submitted through the HeroX platform. Each is described in more detail in the following table. Competitors may

provide multiple submission packages for review; however, each submission must be materially different in content and the topic to be considered. If multiple submissions from the same competitor are too similar, only one will be scored and considered for an award at DOE's sole discretion.

Item	Will Be Made Public <sup>2</sup>	Scored Item
Cover Page	Yes	No
Summary Slide	Yes	No
90-Second Video Pitch	Yes	Yes
Technical Narrative	No	Yes
Resources Needed Documentation (Optional)	No	No

## Cover Page Content

Cover Page - List Basic Information About the Submission (Will Be Made Public)
<ul style="list-style-type: none"> <li>• Title</li> <li>• Team name</li> <li>• Short description</li> <li>• Link to 90-second video online</li> <li>• Key project members (names, contacts, and links to their professional online profiles)</li> <li>• Other partners (if any)</li> <li>• City and state</li> </ul>

## Submission Summary Slide

Submission Summary Slide (Will Be Made Public)
<p>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 and should have a font size of at least 14 pt.</p>

<sup>2</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 Appendix A.

## Scored Items: 90-Second Video Summary and Technical Narrative

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

- **Criteria 1: Impact** – What is the challenge the proposed solution is addressing, and why is solving it important?
- **Criteria 2: Innovation** – How will the advanced manufacturing solution improve the state of the art?
- **Criteria 3: Feasibility** – What is the technical feasibility of the proposed solution?

Both pieces of the Technical Submission should collectively describe the idea and address all three criteria questions.

The 90-Second Video Summary and Technical Narrative scoring will be used to calculate the final score, and related statements will each be rated on a score of 1–6, as shown in the following table.

1	2	3	4	5	6
<b>Strongly Disagree</b>	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree

The following table explains the manner in which the final scores for each submission will be calculated.

Criteria Questions	Number of Scored Statements	Percentage of Total Score	Total Possible Points
<b>90-Second Video Summary</b>	<b>1</b>	<b>10%</b>	<b>6</b>
<b>Technical Narrative Total</b>	<b>9</b>	<b>90%</b>	<b>54</b>
Criteria 1: Impact	3	30%	18
Criteria 2: Innovation	3	30%	18
Criteria 3: Feasibility	3	30%	18
<b>TOTAL</b>	<b>10</b>	<b>100%</b>	<b>60</b>

## 90-Second Video

Each team must produce a 90-second video that will help the reviewers and general public understand the concept. Be creative and convey 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). Reviewers will focus on content, not the quality of video production. Upload your video online to a publicly accessible platform (e.g., YouTube, Vimeo).

The reviewers will score the video based on the content provided.

Scoring: Online Public Video—Describe the Solution in 90 Seconds	
<p><b>Suggested content you provide:</b></p> <ul style="list-style-type: none"> <li>• Concise summary of the problem your concept addresses, the specific innovation, and technical feasibility</li> <li>• Introduction to your team</li> </ul>	<p><b>Each Statement Scored on 1–6 Scale</b></p> <ul style="list-style-type: none"> <li>• The proposed solution presents a clear and concise summary of the concept and introduces the project team</li> </ul>

## Technical Narrative

Write a detailed narrative describing your solution. There is a template on the HeroX platform to use in drafting the Technical Narrative. The total length of the Technical Narrative cannot exceed **2,500** words. You may include up to **five** supporting visualizations or graphics. The Technical 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 judge.

The scoring criteria for the Technical Narrative are as follows:

- **Criteria 1: Impact** – What is the challenge the proposed solution is addressing, and why is solving it important?
- **Criteria 2: Innovation** – How will your advanced manufacturing solution improve the state of the art?
- **Criteria 3: Feasibility** – What is the technical feasibility of the proposed solution?

The following table below describes the content that should be provided in the narrative to successfully address each criteria question. 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 includes suggested content for each criteria question. The suggested content provided is not mandatory and competitors will not be judged against it; these are examples of details to include to help guide your responses, but you are welcome to use other information as you see fit.

**Criteria 1: Impact – What Is the Challenge the Proposed Solution is Addressing, and Why Is Solving It Important?**

**Suggested Content You Provide**

- Description of the problem, including a quantification of its significance with relevant metrics, and a compelling argument for why solving the problem is particularly urgent or critical
- Demonstration of the problem’s relevance for hydropower with supporting evidence (e.g., interviews with users, case studies, literature)
- Description of the current state of the art, including estimates for costs and performance
- Explanation of how advanced manufacturing presents a viable solution pathway

**Each Statement Scored on a 1-6 Scale**

- The competitor identifies a critical problem with clear linkage and relevance to the hydropower industry using compelling analysis
- The competitor’s assessment shows a strong understanding of the current state of the art
- The competitor shows a strong understanding of how incorporating advanced manufacturing can provide a viable solution pathway

**Criteria 2: Innovation – How Will the Advanced Manufacturing Solution Improve the State of the Art?**

**Suggested Content You Provide**

- Description of how the solution wholly or partially incorporates advanced manufacturing into the fabrication of a tool, component, or equipment directly relevant to hydropower
- Description of the solution’s unique value proposition, and identification of the advanced manufacturing category it corresponds with
- Supporting drawings (e.g., images of 3D CAD drawings) of the proposed concept
- Identification of the hydropower plant component(s) and scale(s) that the technology is applicable to (see *Appendix B for reference*)
- Explanation of how the proposed solution will lead to reductions in levelized costs of hydropower, and provide supporting data, calculations, and/or analysis

**Each Statement Scored on a 1-6 Scale**

- The solution is innovative and compelling and demonstrates promising new manufacturing approaches for the hydropower industry
- The solution is built on reasonable assumptions, valid technical foundations, and lessons learned from other notable efforts in this space
- The solution has the potential to drive down levelized costs of hydropower by reducing annual costs and/or increasing annual energy production

**Criteria 3: Feasibility – What Is the Technical Feasibility of the Proposed Solution?**

**Suggested Content You Provide**

**Each Statement Scored on a 1-6 Scale**



<ul style="list-style-type: none"> <li>• Description of the expected costs, performance, and scalability of the proposed solution</li> <li>• Supporting body of knowledge that demonstrates the solution is capable of performing as intended</li> <li>• Explanation of how the system will be built, deployed, maintained, and recovered and/or decommissioned at the end of its useful life</li> <li>• Description of the commercialization pathway for the proposed solution, including resources needed for realization (e.g., testing infrastructure, estimated financial support, potential partners, and end users)</li> </ul>	<ul style="list-style-type: none"> <li>• Cost and performance goals and metrics are reasonable, ambitious, and attainable</li> <li>• The competitor has identified credible methods for manufacturing, installing, operating, and maintaining the proposed system</li> <li>• The competitor shows a strong understanding of the critical path to commercializing the proposed solution</li> </ul>
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## Resources Needed Documentation (Optional)

We invite competitors to submit supporting documentation that identifies resources needed for the prototyping and deployment of your ideas. There is a suggested template on HeroX for this documentation. Examples of resources needed include:

- Testing facilities
- DOE user facilities, like the Manufacturing Demonstration Facility at Oak Ridge National Laboratory
- Specialized manufacturing equipment
- Specialized materials
- Software licenses for modeling and simulation
- Technical expertise from DOE National Labs
- Other engineering expertise
- Investment amounts
- Introductions and connections to key stakeholders in the hydropower industry, manufacturing sector, and other relevant sectors
- Any other relevant services, infrastructure, or partners that you think you will need.

Please limit responses to 1,000 words. This documentation will not count toward the submission's word limit and will not be made public, nor will it be included in the cumulative score; however, as DOE prepares for future funding opportunities, including future iterations of prizes for advanced manufacturing, we are seeking to better understand how to best support competitors in the designing, building, and testing of their ideas.

## How We Determine Winners and Make Awards

The Prize Administrator screens all completed submissions and, in consultation with DOE, assigns subject matter expert reviewers to independently score the content of each submission. The reviewers will comprise federal and nonfederal 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 3.4.3.

## 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 of the three criteria questions.
- Reviewers will score each statement between 1 and 6, 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 10 to 60.
- The total scores from each reviewer will be averaged to develop a final score for the competitor. This score will inform the judge's decisions on awarding prizes.

## Interviews

WPTO may decide to interview a subset of competitors. These 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 is the judge of the competition and will make the final determination of winners. Final determination will take into account the reviewers' scores, application of program policy factors, and the interview findings (if applicable).

## Announcement

Approximately 30 days after the contest closes, the Prize Administrator will notify winners and request the necessary information to distribute the in-kind prizes. The Prize Administrator will then publicly announce winners.

# Additional Terms and Conditions

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

# Appendix A. Additional Terms and Conditions REQUIREMENTS

Your submission for the I AM Hydro Prize is subject to the following terms and conditions:

- You must post the final content of your submission or upload the submission form online before the prize closes. Late submissions or any other form of submission may be rejected.
- All submissions that you wish to protect from public disclosure must be marked according to the instructions in Section 10. 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 NREL, is indecent, obscene, defamatory, libelous, lacking in professionalism, or demonstrates a lack of respect for people or life on this planet. This includes any materials or comments posted on the HeroX platform.
- If you click "Accept" on the HeroX platform and proceed to register for any of the contest described in this document, these rules will form a valid and binding agreement between you and the U.S. Department of Energy and is 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 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.
- As part of your submission to this prize program, you will be required to sign the following statement:

I am providing this submission package as part of my participation in this prize. I understand that I providing this submission to the Federal Government. I certify under penalty of perjury that the named competitor meets the eligibility requirements for this prize competition and complies with all other rules contained in the Official Rules document. I further represent that the information contained in the submission is true and contains no misrepresentations. I understand false statements or misrepresentations to the Federal Government may result in civil and/or criminal penalties under 18 U.S.C. § 1001.

## 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 W9 form (. 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.

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; and
  - 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 technologies office running this prize, 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. DOE does intend to keep all submission materials private except for those materials designated as "will be made public."

## 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. Any performance towards contest goals is conducted entirely at the risk of the competitor and DOE shall not compensate any competitors for any activities performed in furtherance of this prize. Although DOE may indicate that it will select up to several 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 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.
- Whether submission content sufficiently confirms the competitor's intent to commercialize early-stage technology and establish a viable U.S.-based business in the near future.

## NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

DOE's administration of this 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 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.

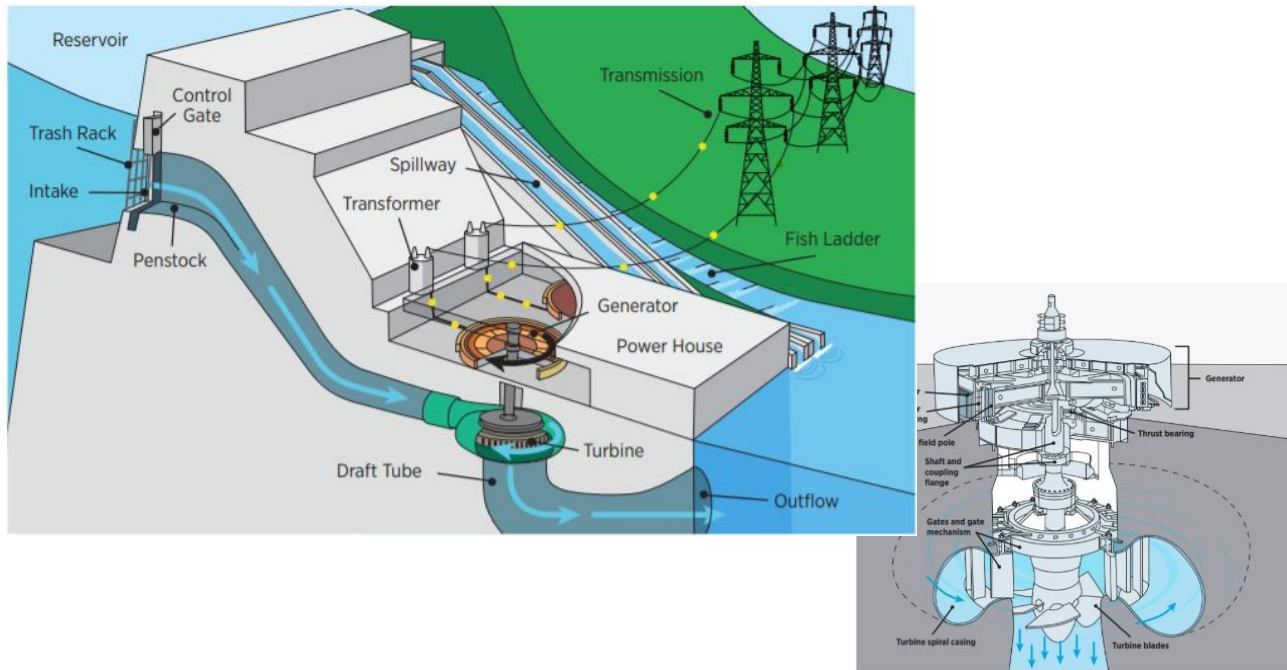
## **RETURN OF FUNDS**

As a condition of receiving a prize, competitors agree that if the prize was made based on fraudulent or inaccurate information provided by the competitor to DOE, DOE has the right to demand that any prize funds or the value of other non-cash prizes be returned to the government.

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

# Appendix B. Overview of a Hydropower Plant

Hydropower facilities generally include civil structures; turbines; electrical components; governors; and instrumentation, control, and monitoring equipment. Brief explanations and potential advanced manufacturing applications for relevant components are discussed as follows.



## Civil Structures

Hydropower dams impound water by forming an impervious barrier across a channel. The civil structures associated with hydropower developments are commonly the most extensive and costly components of a project, often 50% of total project costs. They are, however, essential to hydropower generation. “Civil structures” (sometimes also called “civil works”) are loosely defined to include dams, spillways, powerhouses, water conveyance systems, and, where appropriate, facilities to protect or allow the passage of fish.

Common opportunities for improvement to hydropower civil structures include but are not limited to reduced initial investment cost, minimized construction time, increased strength and life span of materials, and increased resistance to corrosion and cavitation in the water conveyance system. Improvements are needed for watertight seals & reduced friction interaction in coatings and bearings, and embedded sensors (potentially in polymers) for monitoring structural and environmental health and conditions of the facility. Heavy gates are a pain point and could be solved by looking at advanced materials to reduce the weight and improve modularity to reduce the cost. Additionally, legacy parts are not always available and must be reproduced for repair.

Advanced manufacturing techniques, such as modular and segmental design of a standardized facility, precast systems, smart and reinforced concrete, and cold spray repair are being researched for implementation to help reduce the cost of civil structures and minimize construction and repair time. Additionally, mitigation of environmental and ecological impacts should always be considered when utilizing advanced manufacturing for hydropower civil structures.

# Turbines

In a hydropower facility, turbines harness the kinetic energy in flowing water. To do so, water is channeled into and through the turbine, which drives an electrical generator or other mechanical device (e.g., pump, grinding machine, saw, or grist mill). The power captured depends on the head and the flow rate (volume per unit time) of water through the turbine. Water passing through the turbines forces the rotational movement of turbine blades, which are attached to a shaft. This movement causes the shaft to rotate. The shaft is typically connected to a generator, which transforms kinetic energy into electricity.

Turbines usually consist of four parts:

- The inlet portion, or penstock, bringing water into the turbine
- The turbine casing with flow regulation, which surrounds the runner
- The runner being the moving part inside the turbine, which rotates a shaft
- The water conveyance or draft tube that returns water to the river below the dam.

Turbine technology has evolved because of advanced computer-based design, analysis, manufacturing, and control methodology. Performance advancements include increased operating efficiency, effective control of cavitation as a wear mechanism, and improved operating range, operational quality (smoothness), and reliability. For waters with high levels of silt, special turbine designs have been developed to minimize erosion of components. A common challenge that should always be considered when utilizing advanced manufacturing for hydropower turbines is mitigation of environmental and ecological impacts.

Common opportunities for improvement to turbines at a hydropower facility include but are not limited to reduce cavitation and erosion in wicket gates/guide vanes and turbine blades, corrosion resistance in the main shaft, seals, and external casing, biofouling in the wicket gates/guide vanes and external casing, and overall improved life span and resistance to fatigue in the turbine. Additionally, the need for site-specific and customized facilities increases cost.

Research on advanced manufacturing techniques holds promise for fast and efficient production of modular structures and turbine components. The term “modular” refers to precast, preassembled, and/or standardized components that would otherwise be site customized in traditional hydropower design. Additive manufacturing of modular components has the potential to reduce time and costs associated with fabrication and installation. Furthermore, composite materials used in additive manufacturing have the ability to make turbine components lighter and add a variety of properties, such as increasing material strength. Coatings and the use of advanced materials should be considered for increased resistance to fatigue, corrosion, cavitation, and biofouling of relevant components.

## Electrical Components

As water passes through turbines, the energy from the moving water is converted to a usable form, electrical energy. These components include generators, exciters, and step-up transformers. Small, low-head hydropower projects have historically relied either on low-efficiency induction generators that usually require some type of speed increaser or a synchronous generator. Both induction and synchronous generators have efficiency problems, because they operate at fixed speeds, whereas turbines need to operate at varying speeds at different heads to remain efficient. Variable-speed permanent-magnet generators offer higher efficiency over the entire range of optimum turbine speeds. These generators were developed for the wind industry but are also being adapted and introduced into the small hydropower market. The use of improved materials, improved ventilation, and cooling system, and advanced manufacturing technologies could further improve generators for hydropower.

The use of advanced materials can also be applied to insulating fluids. Sulfur-hexafluoride (SF<sub>6</sub>) is being used as an alternative to insulating fluid, and custom insulation systems with temperature ratings to Class H<sup>68</sup> (180 degrees Centigrade total temperature) have also been developed. These custom systems allow self-cooled installations for sites with high ambient temperature. Industry is also designing shell form three-phase transformers that can be shipped in four disassembled packages. This allows for remote locations that would otherwise incur a cost penalty for use of single-phase tanks for a generator step-up transformer to use a three-phase installation.

## Governors

The speed governor is responsible for two critical functions in a hydropower facility. First, it controls the speed of the turbine-generator unit during startup and shutdown, and automatically increases or decreases turbine output when the unit is online to respond to grid-frequency fluctuations (“grid responsiveness”). Second, it protects the power facility’s civil and mechanical structures by controlling the opening and closing times of the wicket gate to limit under-pressure on startup and over-pressure on shutdown, respectively. Governors can be mechanical, analog, or digital.

Though mechanical governors are the dominant type of governors in service at hydropower plants, they are no longer manufactured because of their high cost. Analog governors have more functionality over mechanical governors but still have more hardware components than a modern digital governor. As a result, digital governors—with their lower cost and versatility through software programmability—are the default governors for new installations or replacements. The key factors in governor selection relate to the location of the software algorithms (whether they are standalone controllers or integrated into a larger unit/plant controller) and the arrangement of the feedback devices to the controllers (whether they are direct wired to the controller or wired to a remote input/output module that communicates to the controller indirectly over a plant communication network). Critical parameters like speed signals and position feedback signals must be direct wired to eliminate signal latency and ensure that the governor algorithms are working with the most current speed, position, and turbine output data.

For additional information regarding hydropower, see the WPTO “[Hydropower Vision](#)” report.

# Appendix C. Advanced Manufacturing Opportunities for Hydropower

Whether applied to the existing hydropower fleet or the development of new facilities, advanced manufacturing can lead to reductions in hydropower’s LCOE by targeting innovations that reduce annual costs and/or increase annual energy production. Through the I AM Hydro Prize, WPTO hopes to identify high-impact opportunities to apply advanced manufacturing to address hydropower’s critical challenges, which may result in future funding opportunities. At the conclusion of the prize, WPTO expects to produce an internal document—such as the sample matrix illustrated in Figure C-1—that aligns opportunities in the advanced manufacturing technology areas with their potential impact on annual costs and energy production.

	Hydropower LCOE Components			
Advanced Manufacturing Technology Area	Annual Costs		Annual Energy Production	
	Initial Capital Costs	O&M Costs	Plant Performance	Resource Availability
Joining, Coating, and Repair		Innovative repair techniques in harsh conditions to reduce outages and keep service and maintenance costs down	Cold spray allows cavitation and erosion repairs without disturbing the turbine blade shape that commonly occurs through melting and degradation	Penstock joining techniques to reduce or eliminate water losses
Additive Manufacturing	Printing pre-cast molds to reduce labor time and manufacturing time	Printing smart material (such as piezoelectric) for better condition monitoring	Printing complex turbine shapes that allow for better energy capture	Embedded sensors to improve flow measurement
Casting, Forming, and Machining	Hybrid machining to combine the manufacturing and machining processes in same machine to reduce production time			
Advanced Materials	Replace metal or concrete parts with lightweight, high-strength composite components to decrease the installation and transport cost	Advanced material with good fatigue strength and endurance limits and with enough factor of safety may be considered during the design stage.		

Figure C-1. Sample hydropower advanced manufacturing opportunity matrix



# Appendix D. Additional Foreign Involvement Requirements and Request to Waive the “Domestic Ownership and Control” Eligibility Requirement

Additional foreign involvement requirements:

- Entities identified on a Department of Homeland Security (DHS), Binding Operational Directives (BOD) as an entity publicly banned from doing business with the United States government are not eligible to compete. See <https://cyber.dhs.gov/directives/>;
- Entities and individuals using “covered telecommunications equipment or services,” as defined in Section 889 of Pub. L. 115-232, National Defense Authorization Act of 2019<sup>3</sup> are not eligible to compete; Entities and individuals identified as a restricted party on one or more screening lists of Department of Commerce, State and the Treasury are not eligible to compete. See Consolidated Screening List;
- This prize is expected to positively impact U.S. economic competitiveness. Participation in a foreign government talent recruitment program<sup>4</sup> could conflict with this objective by resulting in unauthorized transfer of scientific and technical information to foreign government entities. Therefore, individuals participating in foreign government talent recruitment programs of foreign

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<sup>3</sup> Pub. L. 115-232, Section 889 (f) provides the following definitions:

(3) Covered telecommunications equipment or services. The term "covered telecommunications equipment or services" means any of the following:

(A) Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

(B) For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

(C) Telecommunications or video surveillance services provided by such entities or using such equipment.

(D) Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

<sup>4</sup> In general, foreign government talent recruitment programs include any foreign-state-sponsored attempt to acquire U.S. scientific-funded research or technology through foreign government-run or funded recruitment programs that target scientists, engineers, academics, researchers, and entrepreneurs of all nationalities working or educated in the United States. These recruitment programs are often part of broader whole-of-government strategies to reduce costs associated with basic research while focusing investment on military development or dominance in emerging technology sectors.

Distinguishing features of a foreign government talent recruitment program include:

a) Compensation provided by the foreign state to the targeted individual in exchange for the individual transferring their knowledge and expertise to the foreign country. The compensation can take several forms, such as cash, research funding, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration.

b) Recruitment in this context refers to the foreign-state-sponsor's active engagement in attracting the targeted individual to join the foreign-sponsored program and transfer their knowledge and expertise to the foreign state. The targeted individual may be employed and located in the United States or in the foreign state. Recruitment would not necessarily include any invitation for engagement extended by the foreign state, for example, an invitation to attend or present work at an international conference.

c) Many, but not all, programs aim to incentivize the targeted individual to physically relocate to the foreign state. Of particular concern are those programs that allow for continued employment at U.S. research facilities or receipt of U.S. Department of Energy research funds while concurrently receiving compensation from the foreign state.

countries of risk<sup>5</sup> are not eligible to compete. Further, teams that include individuals participating in foreign government talent recruitment programs of foreign countries of risk are not eligible to compete.

## Waiver

If an entity seeking to compete does not have domestic ownership and control but otherwise meets the eligibility requirements, EERE may consider issuing a waiver of that eligibility requirement where the entity submits a compelling justification. Entities seeking a waiver should include a justification along with their submission. EERE may require additional information before making a determination on the waiver request. There are no rights to appeal DOE's decision on the waiver request.

The justification must address the following waiver criteria and content requirements:

### *Waiver Criteria*

Entities seeking a waiver must demonstrate to the satisfaction of EERE that its participation: (1) has a high likelihood of furthering the objectives of this prize competition and (2) aligns with the best interest of the U.S. industry and U.S. economic development.

### *Content for Waiver Request*

A waiver request must include the following information:

- a. Entity's name and place of incorporation;
- b. The location of the entity's primary place of business;
- c. A statement describing the extent the entity is owned or control by a foreign government, agency, firm, corporation, or person who is not a citizen or permanent resident of the United States, including the applicable percentage of ownership/control;
- d. A compelling justification that addresses the waiver criteria stated above;
- e. A description of the project's anticipated contributions to the U.S. economy;
- f. A description of how the entity's has benefitted U.S. research, development and manufacturing, including contributions to employment in the United States and growth in new U.S. markets and jobs; and
- g. A description of how the entity has promoted domestic manufacturing of products and/or services.

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<sup>5</sup>Currently, the list of countries of risk includes Russia, Iran, North Korea, and China.