



CABLE Conductor Manufacturing Prize

Official Stage 1 Rules

The CABLE Conductor Manufacturing Prize will identify, verify, and reward affordable breakthroughs in conductivity that will enable U.S. manufacturers to leapfrog to next-generation materials.

MAY 2021

OFFICIAL RULES: MODIFICATIONS SUMMARY

Modifications made to the rules are summarized below and highlighted in the text.

Date	Modifications
<p>Revision 1 5/28/2021</p>	<ul style="list-style-type: none"> • Page 5: Clarified type of emissions (Greenhouse gas) • Page 7: Defined units in Table 2. • Page 7: In Table 2, redefined significant enhancements to be in metric units and material-agnostic as the aspirational goals listed are significantly greater than the maximum value for any known conductor. (<i>*note: this summary bullet was updated on 6/3/2021</i>) • Page 7-8 and page 16: Clarified “the Electrical Conductivity Enhancement Goals” and reference to Table 2 (see below). • Page 7-9 and footnote 2: Lowered the minimum conductivity threshold and switched from IACS to SI units for greater transparency. The lower limit is now 10MS/m instead of 29MS/m). • Page 8: Amended classes of conductivity-enhanced materials to include those enhanced by processing innovations. • Pages 9: Contest stages updated to include a definition for the aforementioned material (referencing Table 2). • Page 10: Updated number of required material testing organizations in stage three of the competition to three instead of two. • Page 10-11: Extended Stage 1 deadline from June 8 to August 3, 2021 and subsequent deadlines accordingly. • Page 12: Affordability goal in Stage 1 Goals updated to include GHG emissions reduction as option along with energy cost savings. • Page 14: Provided example of “short description” needed on cover page of submission package (“e.g., slogan”) of Stage 1. • Page 15: Updated judging criteria in Conductor Material Breakthrough section of technical narrative in submission packet to note the baseline update to Table 2. • Page 17: Clarified that the Diversity and Inclusion Plan should be submitted as a separate element in the submission package, not part of the technical narrative. • Page 21: General submission requirements updated to match new minimum conductivity threshold and unit change (see above). • Page 30: APPENDIX A: Electrical Conductivity Table describing the electrical conductivity of common conductors.

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I. PROGRAM SUMMARY

1. INTRODUCTION

The CABLE Conductor Manufacturing Prize (“prize”) will award a total of up to \$4.5 million in cash prizes and vouchers for testing and technical assistance to competitors (see Table 1).

As electrification grows worldwide, so too will demand grow for conductivity-enhanced materials and applications. Unlike superconductors, such materials have reliable enhanced conductivity at room temperature and promise even more enhancement at elevated industrial process temperatures. Hence, there is a need to rapidly transition such enhanced conductivity materials for cables and everything else than conducts electricity from the lab to the marketplace. Enhanced conductivity materials support transformational technologies ranging from electric cars, trains, and planes, to smartphones, heat pumps, and everything else in our daily lives that involves the conduction of electric and thermal energy. For all these reasons, the U.S. Department of Energy (DOE) Advanced Manufacturing Office (AMO) launched the **C**onductivity-enhanced materials for **A**ffordable, **B**reakthrough **L**eapfrog **E**lectric and thermal applications (CABLE) Prize to help supercharge U.S. energy and manufacturing industries.

Building a clean energy economy and addressing the climate crisis is a top priority of the Biden Administration. This prize will advance the Biden Administration’s goals to achieve carbon pollution-free electricity by 2035 and “*deliver an equitable, clean energy future, and put the United States on a path to achieve net-zero **greenhouse gas** emissions, economy-wide, by no later than 2050*” to the benefit of all Americans.¹

This prize will push frontiers of science and engineering and drive American innovation for materials that can lead to the deployment of clean energy technology that is critical for climate protection. It also will catalyze clean energy jobs through the research, development, demonstration, and deployment (RDD&D) done by prize competitors.

In addition to their benefits for clean energy technologies, conductivity-enhanced materials can help deliver a clean energy future by enabling the grid expansion needed to deliver affordable, cleaner, lower-impact electricity that ensures environmental justice and inclusion of disadvantaged communities. The competitors’ activities supported under this prize will enhance the government-wide approach to the climate crisis by lowering the costs of conductors to advance the goals of carbon pollution-free electricity by 2035 and industrial electrification to achieve net zero greenhouse gas emissions by 2050.

¹ Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad,” January 27, 2021.

Table 1. CABLE Prize Stages Outline

CABLE Conductor Manufacturing Prize	
 <p>STAGE 1</p>	<p>Up to \$250,000 IN PRIZES</p> <ul style="list-style-type: none"> • Up to 10 winners, \$25,000 each • Stipend for Stage 2 conductivity testing
 <p>STAGE 2</p>	<p>Up to \$1,200,000 IN PRIZES</p> <ul style="list-style-type: none"> • Up to 6 winners, \$200,000 each • \$100,000 each in vouchers
 <p>STAGE 3</p>	<p>At least \$2,000,000 PRIZE POOL</p> <ul style="list-style-type: none"> • Up to 4 winners

In Stage 1, DOE will identify up to 10 awards of \$25,000 each; Stage 1 winners will receive a testing stipend to meet the Stage 2 electrical conductivity test requirement. Under Stage 2, DOE anticipates up to 6 awards of \$200,000 each. Under Stage 3, DOE anticipates up to 4 awards that split a total prize pool of at least \$2,000,000.

The prize aims to identify, verify, and reward new materials and manufacturing methods that **have the potential to achieve the Electrical Conductivity Enhancement Goals** (see [Table 2](#)). Competitors must also offer a pathway to produce the new conductivity-enhanced material affordably in applications that enable innovators to “leapfrog” the current state-of-the-art technology.

The International Annealed Copper Standard (IACS) was set in 1913 as 100% IACS = 58.1 MS/meter at room temperature (20 °C) (MS = 10⁶ Siemens). By comparison, the conductivity of an aluminum (Al) alloy conductor used widely in electrical applications, Al1350, is ~62% IACS, and the conductivity of most commercial copper (Cu) wires for electrical applications is 101% IACS. The highest-conductivity commercially available material, silver (Ag), achieves **108% IACS** but costs far more per gram than electrical-grade copper and is one-third its strength (0.1 GPa = 10⁸ Pascals). Because the **bulk** electrical conductivity of these and all conductors have improved negligibly over the past century, even a small percentage improvement in electrical conductivity **or electrical conductivity by density** would be notable. Any conductor **that exceeds the metrics in Table 2 at the microscale** would represent a true breakthrough. For this contest, microscale means one gram minimum sample size.

Table 2. Electrical Conductivity Metrics for Conductors

Electrical Conductivity Enhancement Goals
<ul style="list-style-type: none">• Conductivity-enhanced: >65 MS/m• Conductivity by density-enhanced²: >14 kSm²/kg

MS is 10⁶ Siemens, kS is 10³ Siemens, m is meters, m² is square meters, kg is kilogram.

2. BACKGROUND

Conductive materials are fundamental to nearly all energy use applications. Developing manufacturing processes for enhanced-conductivity materials would enable product manufacturers to lower costs, improve performance, and allow their customers to save substantial amounts of energy. The group developing this prize incorporated expert advice from several DOE programs, national laboratories, universities, and companies to better understand the current research status in this area and relevant prize parameters. The group noted the following:

- Greatly expanded electricity delivery systems (e.g., transmission cables) are needed to connect grids to the best renewable power resources—most of which are located far from electricity demand.
- Innovation in many CABLE-relevant fields, including metal matrix composites, nanoscience (especially carbon allotropes), and artificial intelligence/machine learning has exploded. There is a growing body of research evidence that macroscale electrical conductivity, once thought to have a maximum upper limit, can now be further increased.
- The private sector is reluctant to invest in many existing breakthrough conductivity-enhanced materials because they challenge the common belief that electrical conductivity cannot be further increased.
- There is an opportunity for prize winners to help lay the foundation of one or more new American-made material manufacturing industries.

3. CONDUCTOR MATERIAL CLASS

All conductor materials are judged for improvement over the state of the art. Table 2 shows the proposed goals for electrical conductivity enhancement for which competitors should aim. In Stage 1, competitors should classify their materials invention according to one of the following three technical classes of conductivity-enhanced materials:

1. **Metal enhanced with nanocarbon.** Metal-nanocarbon conductors are metals that also contain

² Baseline maximum conductivity by density—that for Al—was calculated to be 13.3 kSm²/kg by dividing the Al conductivity of 36 MS/m by an Al density of 2,700 kg/m³.

carbon nanotubes, single- or few-layer graphene, doped or undoped, or other carbon allotropes.

2. **Metal enhanced without nanocarbon.** These conductors—metal alloys or metal matrix composites—also contain other metals or non-nanocarbon compounds and/or are enhanced by processing innovations.
3. **Nonmetal enhanced with metal.** These conductors are primarily nonmetal (e.g., polymer or nanocarbon) but may also contain metal, such as nanoparticles of metallic elements, but no bulk metal components.

4. NONCONDUCTIVITY PROPERTIES

The ultimate CABLE Prize goal is to create an affordable, manufacturable, and usable conductor. Review criteria for Stage 1 submissions will include electrical conductivity enhancement goals outlined in Table 2 alongside other criteria in “What to Submit” (see 13). In stages 1 and 2, the judged properties of the conductor are affordability, electrical conductivity, and potential for breakthrough applications. In Stage 3, breakthroughs in conductivity must not be accompanied by a decline in other vital properties in the intended applications that enable manufacturers to outperform the current state of the art. For example, there is concern that mechanical properties could suffer because when the strength of an electrical conductor improves, electrical conductivity typically declines. In Stage 3, conductor materials entered for the prize will be tested and evaluated for these other application-specific properties. The rules for Stage 3 will include minimum values for key properties in specific applications. These other potentially relevant properties include but are not limited to:

- Mechanical-related properties, such as:
 - Tensile strength/tension
 - Yield strength/load factor
 - Fracture toughness
 - Creep resistance
 - Wear resistance
 - Conformality
 - Malleability.
- Thermal properties, such as:
 - Operational temperature range/maximum operating temperature
 - Heat transfer rate
 - Thermal conductivity, measured directly (e.g., via a guarded hot plate or heat flow meter)
 - Thermal diffusivity (for calculated thermal conductivity)
 - Specific heat capacity (at constant pressure for measuring conductivity)
 - Thermal capacity
 - Insulation.
- Electrical properties, such as:
 - Ampacity
 - Dielectric strength
 - Gravimetric power density
 - Operational voltage range/line voltage drop

- Operational current range/line current
- Discharge-related reliability issues
- Wildfire prevention
- Power losses/leakage
- Series resistance or shadowing
- Energy storage charging/discharging rate
- Energy storage density
- Energy storage round-trip efficiency.
- Other
 - Safety standards
 - Net cost
 - Sustainability
 - Regulatory compliance
 - Corrosion resistance
 - Ice/wind resistance
 - Resistance to animal and environmental damage
 - Density/specific weight (at constant pressure for conductivity measurement)
 - Size/dimensions/footprint/geometry
 - Ease of installation
 - Durability/reliability/lifetime
 - Stampability
 - Continuous manufacturing process
 - Product cleaning interval
 - Energy storage system cost.

5. CONTEST STAGES

This document includes the official rules for Stage 1. **The official rules for Stage 2 and Stage 3 will be released prior to each stage.**

The CABLE Prize comprises three stages:

1. **Stage 1.** Competitors will submit their breakthrough concepts for development and manufacture of a new, affordable, electrical conductivity-enhanced material. An “electrical-conductivity-enhanced material” is one that exceeds the minimum standard (10 MS/m) and potentially could be enhanced to or above the levels of the aspirational goals in Table 2. This stage of the prize will inform DOE about the minimum-conductivity enhancement and other property benchmarks, as well as the types of support that competitors will likely need from DOE national laboratories or other American-Made Challenge Network providers in the next two stages of the prize. Up to 10 winners will receive \$25,000 in cash awards and a stipend for third-party testing of their material in Stage 2 of the prize. DOE invites all registered prize competitors to the upcoming CABLE Big Idea Workshop during Stage 1. Prize competitors are encouraged to connect with the rest of the CABLE R&D innovation ecosystem.
2. **Stage 2.** Competitors must submit a microscale sample (1-gram minimum, other size

requirements to be provided in Stage 2 rules) of their material for electrical conductivity testing according to prize requirements. Note that only winners of Stage 1 will receive a testing stipend for Stage 2 (see [Table 4](#)). New competitors may enter the prize in Stage 2 but will need to self-fund required testing at an approved testing facility. Competitors will also provide preliminary plans to scale up and manufacture the material. Up to 6 competitors will win \$200,000 in cash awards and \$100,000 each in noncash voucher support to work with a DOE national laboratory or other American-Made Challenge Network providers to obtain testing services, technical assistance, and CABLE Conductor assessments.

- 3. Stage 3.** Only Stage 2 winners are eligible to compete in Stage 3. Competitors will develop a larger sample of their CABLE material. The Stage 3 rules will outline minimum weight and size requirements alongside other criteria, such as applicable ASTM International standards and specifications that would enable the material to meet real-world application requirements. Competitors must also provide substantial background information on how the sample was made and plans to commercialize the material. At least **three** testing organizations will evaluate each material sample for conductivity and other characteristics. Scores will be based, in part, on the conductivity enhancement (size and extent of breakthrough), other important material characteristics, and manufacturability and affordability. Up to 4 competitors will split a total prize pool of at least \$2,000,000.

To learn more and to sign up for the prize, go to <https://www.americanmadechallenges.org/cable>.

6. IMPORTANT DATES

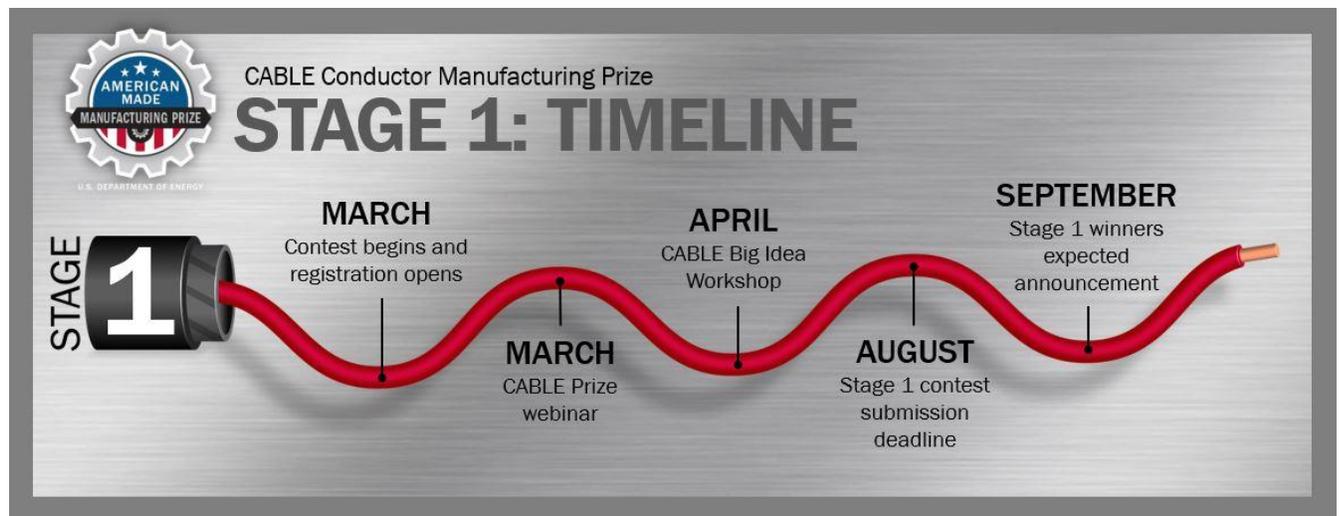


Figure 1. **Updated** Stage 1 timeline

Table 3. CABLE Prize Calendar

Date	Event
March 17, 2021	CABLE Conductor Manufacturing Prize announcement Stage 1 contest begins and registration opens
March 30, 2021	<u>Stage 1 contest webinar</u>
April 7-9, 2021	<u>CABLE Big Idea Workshop</u>
August 3, 2021, 5:00 p.m. ET	Stage 1 contest submission deadline
September 2021*	Stage 1 awards announcement
November 2021*	Stage 2 contest begins
August 2022*	Stage 2 contest submission deadline
September 2022*	Stage 2 awards announcement
November 2022*	Stage 3 contest begins
September 2023*	Stage 3 contest submission deadline
October 2023*	Stage 3 awards announcement

*Date anticipated

All dates are subject to change, including prize openings, deadlines, and announcements. Sign up for updates at <https://www.herox.com/cable>.

II. STAGE 1: CONCEPT DEVELOPMENT CONTEST RULES

The CABLE Conductor Manufacturing Prize is a three-stage, \$4.5-million prize competition designed to develop breakthrough concepts to manufacture new conductivity-enhanced materials suitable for electrical applications.

Table 4. Stage 1 Prize Outline

Stage 1 Contest Prizes
<ul style="list-style-type: none">• Up to 10 winners• Up to \$250,000 distributed among winners in cash prizes (\$25,000 per winner)• Stage 2 testing stipend

The following rules are for competitors participating in Stage 1. (“You” and “your” references prize competitors.)

1. GOALS

The CABLE Conductor Manufacturing Prize aims to recognize new materials and manufacturing methods to achieve the **Electrical Conductivity Enhancement Goals** in Table 2. These goals contribute to the development of **C**onductivity-enhanced materials for **A**ffordable, **B**reakthrough **L**eanfrog **E**lectric (CABLE) applications.

Affordability: While affordability is challenging to estimate in detail before your conductor is even fabricated, in Stage 1 you are expected to provide at least one widely applicable scenario of energy cost savings/**GHG emissions reductions** from the use of your enhanced conductivity material. Your energy cost **and other** savings should economically justify any of your projected manufacturing and operating costs.

Breakthrough Material: This prize also aims to identify a conductor material technological breakthrough that is manufacturable—the primary focus of the Stage 1 application. You are asked to document the science and engineering credibility of your material and the method used to create it and try to ensure that your material can overcome skepticism of enhanced conductivity.

Technical Readiness: You must also provide evidence of your readiness to fabricate the material and scale the manufacturing process to be able to produce the 1-gram sample required in Stage 2.

Application: The CABLE Prize aims to enable impactful applications into which the material can be made. You must provide one or more examples of how a product manufacturer using your material would leapfrog their competition in product performance in this particular application.

These Stage 1 goals set the stage for the overall CABLE Prize goals to create new domestic markets, business opportunities, and more manufacturing in the United States with a technology that also reduces climate impacts. In Stage 1, the CABLE Prize also aims to attract and introduce the conductivity (e.g., materials, especially nanocarbon scientists, electrical engineers, and metallurgists) and manufacturing (of metals, motors, generators, wires, electronics) communities to each other through a March webinar and an April workshop.

2. HOW TO ENTER

Complete a submission package online at <https://www.herox.com/cable>. To complete the submission package, you must create an account on HeroX and register for the challenge. Early registration is strongly encouraged to receive important updates and event invitations.

3. WHAT TO SUBMIT

All components of the submission package must be in English. Unless stated otherwise, all files must be in an unlocked, searchable PDF form and use the following file name format: **Team-Name_CABLEStage1.pdf**. For a submission package to be considered complete and eligible for this prize, the submission package for the Stage 1 contest must include the following **six** items:

- **Cover page**
- **Link to a 90-second video (publicly accessible online)**
- **Summary PowerPoint slide (will be made public)**
- **Technical narrative providing responses to four criteria (seven statements) that explain how your conductor concept is for an *affordable, breakthrough material* that is *technically feasible* to manufacture and enables impactful *applications*.**
- **Letters of commitment or support (optional)**
- **Diversity and Inclusion Plan.**

NOTE: Content that exceeds any word, page, or time limit will not be reviewed.

Cover Page – List basic information about your submission.

- Submission title
- Competitor or team name
- Team leader (point of contact)
- Short description (e.g., slogan)
- Material class of your conductor according to the three categories in “Conductor Material Class” (see [page 7](#))
- Link to your 90-second video online
- Key project members (names, contacts, and, if possible, links to online profile/resume)
- <100-word abstract. A cover page template can be found at:
<https://www.herox.com/cable/resources>

Online Public Video – What is your innovation, in 90 seconds?

Suggested content:

- Your proposed idea
- How your idea works
- Why your idea is innovative
- Who you are and why you have a competitive edge.

Make a 90-second (maximum) video showcasing your submission and emphasizing the novelty or advantage(s) of your idea and potential impact. Be creative and produce a video that conveys your information in exciting and interesting ways, but do not focus on time-consuming activities that only improve production values (i.e., technical elements such as décor, lighting, and cinematic techniques). The video will be made public. Post your video as “**Unlisted**” on YouTube and include the link in your submission. Note that your video will be made public on HeroX after the submission deadline for Stage 1.

Public PowerPoint Summary Slide

Make a public-facing, one-slide summary using PowerPoint containing technically specific details that can be understood by most people. The slide will be made public and should include (1) the competitor or team name and team leader, (2) submission title, (3) description of material, (4) fabrication approach, and (5) potential impact. Please make any text readable in a standard printout and conference room projection. A summary slide template can be found at: <https://www.herox.com/cable/resources>.

Technical Narrative: You should respond to each of the following four criteria. The content bullets are only suggestions to guide your responses; you decide where to focus your answers. Responses to these criteria statements must not exceed 5,000 words in total. You may also include up to 10 supporting images, figures, or graphs integrated into the narrative. The reviewers will score the questions based on the content you have provided in your narrative and your other submission elements.

Reviewers and the prize judge will evaluate submissions by agreeing or disagreeing with assigned statements on a 1–6 scale, as shown below. These statements are the review criteria. Appendices, references, annotations, and table/figure/image descriptions do not count against the word limit.

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

Technical Narrative	
1: Affordability	
<p>Suggested content:</p> <ul style="list-style-type: none"> Provide at least one scenario of energy cost savings and reduced climate impact from using the enhanced material. These savings should exceed any of the additional costs beyond manufacturing a state-of-the-art material. 	<p>Judging criteria (1–6 scale per statement):</p> <ul style="list-style-type: none"> The proposed material’s expected manufacturing and operating costs are economically justified by projected energy savings and reduced climate impact in at least one widely applicable scenario.
2: Conductor Material Breakthrough	
<p>Suggested content:</p> <ul style="list-style-type: none"> Describe the expected electrical conductivity and other properties of the proposed material and provide the scientific and engineering underpinnings of the enhanced conductivity in your conductor material. Include the stage of development, intellectual property, and any validation to date, as well as the competitive landscape. If the 	<p>Judging criteria (1–6 scale per statement):</p> <ul style="list-style-type: none"> The proposed material shows enhanced conductivity above the baseline for that material (e.g., in Appendix A) (preferably at or above goals in <u>Table 2</u>), and the explanation of its performance relies on sound scientific and engineering principles. Fabrication of the proposed material is technically feasible and relies on credible

<p>material represents a breakthrough, describe the new scientific understanding.</p> <ul style="list-style-type: none"> • Describe how you would fabricate the proposed enhanced conductivity material. • Include any and all assumptions and calculations and/or references supporting data and/or literature. It can include schematics, drawings, or sketches. 	<p>manufacturing technologies or approaches.</p>
<p>3: Technical Readiness</p>	
<p>Suggested content:</p> <ul style="list-style-type: none"> • Provide evidence that the fabrication technique could be scaled up to 1 gram. • Describe the operational principles of your proposed material fabrication system for Stage 2. • Show your readiness to begin fabrication in Stage 2. Include individual member biographies and team experience and qualifications, List external advisers (e.g., a board) or external sponsorship, if any. 	<p>Judging criteria (1–6 scale per statement):</p> <ul style="list-style-type: none"> • The plan to produce the material at the microscale (1 gram or more) in Stage 2 of the competition is credible. • The team has the requisite skill sets needed to produce the material in Stage 2. • The competitor will have access to facilities and financing to produce the material in Stage 2.
<p>4: Technology Application</p>	
<p>Suggested content:</p> <p>Provide example(s) of how a product manufacturer using your material would be able to significantly outperform (including lowering climate impacts) the current state-of-the-art technology in this particular application.</p>	<p>Judging criteria (1–6 scale per statement):</p> <ul style="list-style-type: none"> • The proposed material has the potential when fully scaled to significantly outperform (including lowering climate impacts) the current state-of-the-art technology in a widespread energy application.

Letters of Commitment and Support (Optional)

Competitors may also attach one-page letters of support or intent from other relevant entities (e.g., potential users of the proposed innovation). Letters of support from partners or others that are critical to the success of your proposed solution will likely increase your score. General letters of support from parties that are not critical to the execution of your solution will likely not factor into your score. Please do not submit multipage support letters. All letters must be combined into a single PDF document.

Diversity and Inclusion Plan

Per section 5 “Diversity and Inclusion” (see [page 17](#)), describe how diversity and inclusion objectives will be incorporated in your project. Specifically, the Diversity and Inclusion Plan must describe the actions that you and your team will take to foster a welcoming and inclusive environment, support people from underrepresented groups in STEM, and encourage the inclusion of individuals from these groups in the project. In addition, the plan should include the extent to which project activities will be located in or benefit disadvantaged communities as well as SMART [specific, measurable, attainable, relevant, and time-bound] milestones supported by metrics to measure the success of the proposed actions. The Diversity and Inclusion plan document should be a minimum of (1) page and not to exceed (3) pages.

Please read and comply with the additional submission requirements in the “Additional Terms and Conditions” (see [page 22](#)). COMPETITORS THAT DO NOT COMPLY WITH THESE REQUIREMENTS MAY BE DISQUALIFIED.

4. HOW WE SCORE

The scoring for each of the criterion statements within the categories is on a scale of 1 to 6; the maximum score is 42.

The scoring of submissions will proceed as follows:

- Each bullet listed in the review criteria above (see “What to Submit” on [page 13](#)) will receive a score between 1 and 6, taking into consideration the entirety of the submission package. The bullets have equal weight. The final score from an individual reviewer for a submission package equals the total sum of the scores for all the bullets. All reviewer scores will be averaged for a final reviewer score for the submission package. The final prize judge will consider reviewer scores

when deciding the winners of the prize.

Note: Expert reviewers will also provide comments on the submissions they review. The Prize Administrator intends to provide comments to competitors after the winners are announced. These comments are intended to help competitors continue to improve and iterate on their submissions. The comments are the opinions of the expert reviewers and do not represent the opinions of DOE.

- Interviews: The Prize Administrator, at its sole discretion, may decide to hold a short interview with a subset of the Stage 1 competitors. The interviews will be held prior to the winner announcement and will serve to help clarify questions the judge may have. Attending interviews is not required, and interviews are not an indication of winning.

The final determination of winners will take into account reviewer scores, interview findings (if applicable), and program policy factors listed in “Additional Terms and Conditions” (see [page 22](#)).

5. DIVERSITY AND INCLUSION

It is the policy of the Biden Administration that:

[T]he Federal Government should pursue a comprehensive approach to advancing equity for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality. Affirmatively advancing equity, civil rights, racial justice, and equal opportunity is the responsibility of the whole of our Government. Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments and agencies (agencies) must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity. By advancing equity across the Federal Government, we can create opportunities for the improvement of communities that have been historically underserved, which benefits everyone.³

As part of this whole of government approach, this prize seeks to encourage the participation of disadvantaged communities and underrepresented groups. As recognized in section 305 of the American Innovation and Competitiveness Act of 2017, Public Law 114-329:

(1) [I]t is critical to our Nation’s economic leadership and global competitiveness that the United States educate, train, and retain more scientists, engineers, and computer scientists; (2) there is currently a disconnect between the availability of and growing demand for science, technology, engineering, and math (STEM)-skilled workers; (3) historically, underrepresented populations are the largest untapped STEM talent pools in the United States; and (4) given the shifting demographic landscape, the United States should encourage full participation of individuals from underrepresented populations in STEM

³ Executive Order 13985, “Advancing Racial Equity and Support for Underserved Communities Through the Federal Government” (Jan. 20, 2021).

fields.

Competitors are highly encouraged to include individuals from groups historically underrepresented⁴ in STEM on their teams.⁵ As part of the prize application, competitors are required to describe how diversity and inclusion objectives will be incorporated in the project. Specifically, competitors are required to submit a Diversity and Inclusion Plan that describes the actions the competitor will take to foster a welcoming and inclusive environment, support people from underrepresented groups in STEM, and encourage the inclusion of individuals from these groups in the project. In addition, the plan should include the extent to which project activities will be located in or benefit disadvantaged communities as well as SMART [specific, measurable, attainable, relevant, and time-bound] milestones supported by metrics to measure the success of the proposed actions.

Further, Minority Serving Institutions, Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, or entities located in a disadvantaged community⁶ that meet the eligibility requirements (see section 6 below) are encouraged to apply. As described in section [III.13](#), the Selection Official may consider the inclusion of these types of entities as part of the selection decision.

6. COMPETITOR ELIGIBILITY

To compete in this prize, competitors must comply with the eligibility requirements provided here. Eligibility is subject to verification before prizes are awarded. The registered competitor is the individual or entity that registers to compete in HeroX. Once registered, any eligible competitor can participate in and provide a submission package (or more than one separate submission package) to compete in Stage 1 of the prize. Note that only winners of Stage 1 will receive a testing stipend for Stage 2 (see [Table 4](#)). New competitors may enter the prize in Stage 2 but will need to self-fund required testing at an approved testing facility.

- Private entities must be incorporated in and maintain a primary place of business in the United States with majority domestic ownership and control.
- If a private entity seeking to compete does not have domestic ownership and control, the DOE Office of Energy Efficiency and Renewable Energy (EERE) may consider issuing a waiver of that

⁴ Historically, minorities and women have been vastly underrepresented in the STEM (science, technology, engineering and math) fields that drive the energy sector. In the U.S., Hispanics, African Americans and American Indians make up 24 percent of the overall workforce, yet only account for 9 percent of the country's science and engineering workforce. DOE seeks to reverse this troubling trend by working to inspire underrepresented Americans to pursue careers in energy and supporting their advancement into leadership positions. <https://www.energy.gov/articles/introducing-minorities-energy-initiative>.

⁵ As recognized in section 305 of the American Innovation and Competitiveness Act of 2017, Public Law 114-329.

⁶ DOE defines "disadvantaged communities" to be areas that most suffer from a combination of economic, health, and environmental burdens, such as poverty, high unemployment, air and water pollution, and the presence of hazardous wastes as well as a high incidence of asthma and heart disease. Example include, but are not limited to: economically distressed communities identified by the Internal Revenue Service as Qualified Opportunity Zones; communities identified as disadvantaged communities by their respective States; communities identified on the Index of Deep Disadvantage referenced at <https://news.umich.edu/new-index-ranks-americas-100-most-disadvantaged-communities/>, and communities that otherwise meet the DOE definition of a disadvantaged community.

eligibility requirement where the entity: submits a compelling justification; demonstrates the entity is incorporated in and maintains a primary place of business in the United States; and the entity otherwise meets the eligibility requirements. 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. See "Request to Waive the 'Domestic Ownership and Control' Eligibility Requirement" for details and instructions on seeking a waiver ([page 29](#)).

- Academic and nonfederal government entities must be based in the United States.
- Individuals who worked at DOE (federal employees or support service contractors) within 6 months prior to the submission deadline of any stage of this contest are not eligible to participate.
- Non-DOE federal entities and federal employees are not eligible to win any prize contests in this program.
- Employees of an organization that cosponsors this program with DOE are not eligible to participate in any prize contests in this program.
- National Renewable Energy Laboratory (NREL) employees directly involved in the administration of this prize are not eligible to participate in any prize contest in this program; however, NREL and other national laboratory employees, including laboratory researchers, may participate. They can also win a prize contest, provided they are not competing in their official capacity.
- 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.
- Entities identified on a U.S. Department of Homeland Security Binding Operational Directive as an entity publicly banned from doing business with the United States government are not eligible to compete. See Cybersecurity Directives: <https://cyber.dhs.gov/directives/>.
- Entities and individuals identified as a restricted party on one or more screening lists of the departments of Commerce, State, and the Treasury are not eligible to compete. See Consolidated Screening List: https://2016.export.gov/ecr/eg_main_023148.asp.
- This prize competition is expected to positively impact U.S. economic competitiveness. Participation in a foreign government talent recruitment program⁷ could conflict with this objective

⁷ A foreign government talent recruitment program is defined as an effort directly or indirectly organized, managed, or funded by a foreign government to recruit science and technology professionals or students (regardless of citizenship or national origin, and whether having a full-time or part-time position). Some foreign-government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to physically relocate to the foreign state for the above purpose. Some programs allow for or encourage continued employment at U.S. research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct competitors not to disclose their participation to U.S. entities. Compensation could take many forms including cash, research funding, complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

by resulting in the unauthorized transfer of scientific and technical information to foreign government entities; therefore, individuals participating in foreign government talent recruitment programs of foreign countries of risk are not eligible to compete. Further, teams that include individuals participating in foreign government talent recruitment programs of foreign countries of risk⁸ are not eligible to compete.

- 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 am 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 and § 287.

- Submission content sufficiently confirms the competitor's intent to commercialize early-stage technology and to establish a viable U.S.-based business in the near future.

7. GENERAL SUBMISSION REQUIREMENTS

Only submissions relevant to the goals of this program are eligible to compete. The Prize Administrator must conclude that all of the following statements are **true** when applied to your submission:

- The proposed conductor material must have an electrical conductivity goal of at least **10 MS/m**.
- The proposed effort does not involve the lobbying of any federal, state, or local government office.
- The proposed effort is not dependent on new, pending, or proposed federal, state, or local government legislation, resolutions, appropriations, measures, or policies.
- The proposed effort is based on fundamental technical principles and is consistent with a basic understanding of the U.S. market economy.

8. ADDITIONAL REQUIREMENTS

Please read and comply with additional requirements in “Additional Terms and Conditions” (see [page 22](#)).
COMPETITORS THAT DO NOT COMPLY WITH THESE REQUIREMENTS MAY BE DISQUALIFIED.

III. ADDITIONAL TERMS AND CONDITIONS

⁸ Currently, the list of countries of risk includes Russia, Iran, North Korea, and China.

1. UNIVERSAL CONTEST REQUIREMENTS

Your submission for the Stage 1, Stage 2, and Stage 3 contest is subject to the following terms and conditions:

- You must complete registration at <https://www.americanmadechallenges.org/CABLE> to participate in the prize by the registration deadline.
- You must post the final content of your submission or upload the submission form online at <https://www.americanmadechallenges.org/CABLE> before the Stage 1, Stage 2, and Stage 3 contests close. Late submissions or any other form of submission do not qualify.
- The video submission, summary slide, and cover page will be made public.
- The technical narrative is not intended to be made public; however, see “Records Retention and FOIA” regarding the Freedom of Information Act (FOIA).
- You agree to release your submission video under a [Creative Commons Attribution 4.0 International License](http://creativecommons.org/licenses/by/4.0/) (see <http://creativecommons.org/licenses/by/4.0/>).
- You must include all the required submission package components; see “What to Submit.” 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, except for the video, in an unlocked, searchable PDF form. Scanned handwritten submissions will be disqualified.
- Submissions will be disqualified if they contain any matter that, in the sole discretion of 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 contests described in this document, these rules will form a valid and binding agreement between you and DOE and are 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 contests described here and no other contests 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 PAYMENTS

The Prize Administrator will verify the identity and the role of a competitor potentially qualified 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 (for a copy please email cableprize@nrel.gov) and a completed W-9 form (<https://www.irs.gov/pub/irs-pdf/fw9.pdf>). In the sole discretion of the Prize Administrator, a winning competitor will be disqualified from the competition and receive no prize funds if: (i) the person/entity 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 (team leader) whether a team consists of a single entity or multiple entities. The primary submitter is solely responsible for allocating any prize funds among member competitors as they deem appropriate. The Prize Administrator will not arbitrate, intervene, advise on, or resolve any matters between team members.

4. SUBMISSION RIGHTS

By submitting materials for the Stage 1 contest and consenting to the rules of the CABLE Prize, each competitor is granting a Creative Commons Attribution 4.0 International License (see <http://creativecommons.org/licenses/by/4.0/>) to the U.S. Government, the Prize Administrator, and any other third party supporting the contest for the U.S. Government or the Prize Administrator in the submission components intended to be public pursuant to the requirements and rules of the contest, including, but not limited to, the video submission, summary slide, and cover page.

To the extent not already provided for in the above Creative Commons License, each competitor is granting to the U.S. Government, the Prize Administrator, and any other third party supporting the prize for the U.S. Government or the Prize Administrator, a license to display publicly and use the submission components package that are intended to be public pursuant to the requirements and rules of the prize. This license includes posting or linking to the public portions of the submission on the Prize Administrator websites, including the contest website, DOE websites, and partner websites, and the inclusion of the submission in any other media worldwide.

Each competitor acknowledges and agrees that the entire submission package and any other information provided by the competitor for the prize may be viewed by the U.S. Government, the Prize Administrator, any

other third party supporting the contest for the U.S. Government or the Prize Administrator, and the reviewers for purposes of the contests, including, but not limited to, evaluation purposes. The Prize Administrator and any third parties acting on its behalf will also have the right to publicize indefinitely a competitor's name and, as applicable, the names of the competitor's team members and organization on the prize website.

As appropriate and to further the goals of this prize competition, DOE may request a competitor's written consent to use intellectual property (IP) (e.g., inventions) developed by a competitor in this prize competition, if any. The prize rules for Stage 2 will provide further guidance on any rights the government will seek in such competitor IP to advance the goals of the competition, such as a license to use the IP for government purposes.

By entering, a competitor represents and warrants that:

1. Competitor's entire submission is an original work by the competitor and the 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; or 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 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; competitor may be asked by Prize Administrator to provide permission in writing.
 - c. Not been and are not currently under any union or guild agreement that results in any ongoing obligations resulting from the use, exhibition, or other exploitation of the submission.

5. COPYRIGHT

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

6. CONTEST SUBJECT TO APPLICABLE LAW

All contests are subject to all applicable federal laws and regulations. Participation constitutes each competitor'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 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.

8. PUBLICITY

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

9. LIABILITY

Upon registration, all competitors 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 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 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 AMO, 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.

10. RECORDS RETENTION AND FREEDOM OF INFORMATION ACT

All submission package components and any other materials submitted for the prize will likely be considered DOE records and subject to the Freedom of Information Act. The following applies only to components of the submission package not intended to be public according to the prize requirements and rules. 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 purposes. 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 submission package 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.

Confidential, proprietary, or privileged information in a nonpublic submission package component 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 or confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secret, 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 Secret, 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.

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.

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

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

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

13. PROGRAM POLICY FACTORS

Although the scores of the expert reviewers will be carefully considered, it is the role of the Prize Administrator to maximize the impact of contest funds. Some factors outside the control of competitors and beyond the independent expert reviewer scope 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 prize winners:

- The extent to which the submission is a solution to reduce climate impacts
- The inclusion of Minority Serving Institutions, Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, or entities located in a disadvantaged community that meet the eligibility requirements (see section [11.6](#))⁵
- Representation of diverse types and sizes of competitor organizations
- Geographic diversity and potential economic impact of projects
- Whether the use of additional DOE funds and provided resources are nonduplicative 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 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 activities described in the submission have been or will be performed in the United States
- 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 that, 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 technology.

14. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

DOE's administration of the CABLE Prize is subject to National Environmental Policy Act (NEPA) compliance (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/>.

Although NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all competitors in the Stage 1 contest 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. 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. 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 noncash prizes be returned to the government.

16. REQUEST TO WAIVE THE “DOMESTIC OWNERSHIP AND CONTROL” ELIGIBILITY REQUIREMENT

If an entity seeking to compete as the registered competitor does not have domestic ownership and control, the entity should include a waiver request that addresses the following waiver criteria and content requirements along with their submission. EERE may consider issuing a waiver of that eligibility requirement where the entity submits a compelling justification; the entity is incorporated in and maintains a primary place of business in the United States; and the entity otherwise meets the eligibility criteria. There are no rights to appeal EERE’s decision on the waiver request.

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:

1. Entity’s name and place of incorporation
2. The location of the entity’s primary place of business
3. A statement describing the extent the entity is owned or controlled 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
4. A compelling justification that addresses the waiver criteria stated above
5. A description of the project’s anticipated contributions to the U.S. economy
6. A description of how the entity has benefited U.S. research, development, and manufacturing, including contributions to employment in the United States and growth in new U.S. markets and jobs
7. A description of how the entity has promoted domestic manufacturing of products and/or services.

Requests should be submitted through the HeroX portal.

17. DEFINITIONS

Prize Administrator means both the Alliance for Sustainable Energy LLC operating in its capacity under the Management and Operating Contract for the National Renewable Energy Laboratory (NREL), and the U.S. Department of Energy’s Advanced Manufacturing Office (AMO). When the Prize Administrator is referenced in this document, it refers to staff from both the Alliance for Sustainable Energy and AMO. Ultimate decision-making authority regarding contest matters rests with the director of the Advanced Manufacturing Office.

APPENDIX A. ELECTRICAL CONDUCTIVITY TABLE

Table A. Electrical Conductivity of Common Conductors

Reference Conductivity Values (MS/m)	
Silver	63
Copper (Electrical)	59
Copper (Annealed Standard)	58
Gold	41
Aluminum	35
Calcium	30
Al 6061-T6	25
Magnesium	23
Tungsten	18
Zinc	17
Brass (Electrical)	15
Nickel	14
Lithium	11
Carbon Nanotubes	11
Iron	10



U.S. DEPARTMENT OF ENERGY