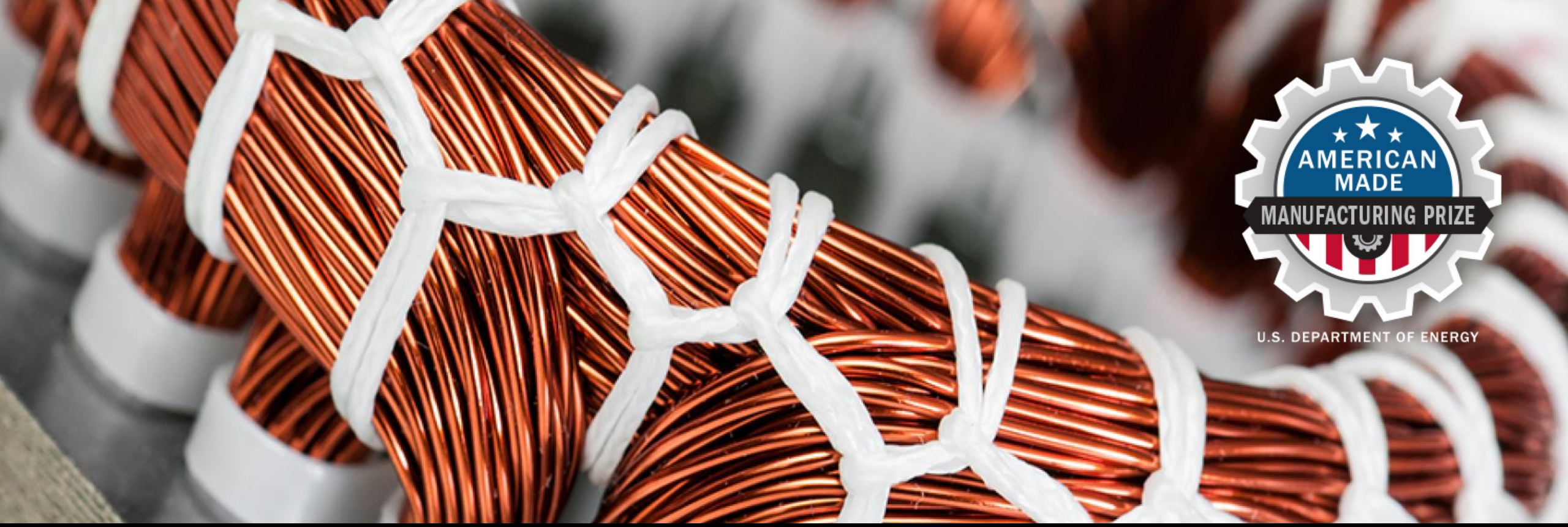


CABLE Conductor Manufacturing Prize

Informational Webinar

March 30, 2021

Tina Kaarsberg, DOE CABLE Team Lead,
--Advanced Manufacturing Office (AMO)
Tommi Makila, DOE AMO

Mai (Kimmai) Tran, DOE AMO
Christopher Oshman, DOE AMO
Emily Evans, National Renewable Energy Laboratory (NREL)
Danny Zimny-Schmitt, NREL

Agenda

1. American-Made Challenges and Network Overview
2. CABLE Initiative Overview
3. CABLE Prize Overview
4. CABLE Prize Technical Considerations
5. CABLE Prize, Stage 1 Overview
6. Use HeroX Early and Often
7. Q&A Session

CABLE Prize Presenters

Tina Kaarsberg, PhD
CABLE Team Lead, Technology Manager at U.S. DOE

Christopher Oshman, PhD, P.E.
DOE Science, Technology and Policy Fellow

Mai (Kimmai) Tran, PhD
DOE Science, Technology and Policy Fellow

Tommi Makila
Principal Energy Analyst at Energetics, Inc.

Daniel Zimny-Schmitt
NREL Prize Administrator

Emily Evans
NREL Prize Administrator

Housekeeping

This webinar is being recorded and will be made available later

Questions:

There will be a Q&A session at the end of the presentation

- **To submit a question, type it into the "Chat"**

Technical Issues:

If you experience technical issues, *please check your audio settings under the "Audio" tab*

- If you continue experiencing issues, contact **Webex support: +1 (866) 229-3239**

American-Made Challenges & Network Overview

American-Made Challenges

PURPOSE

Energize American ingenuity

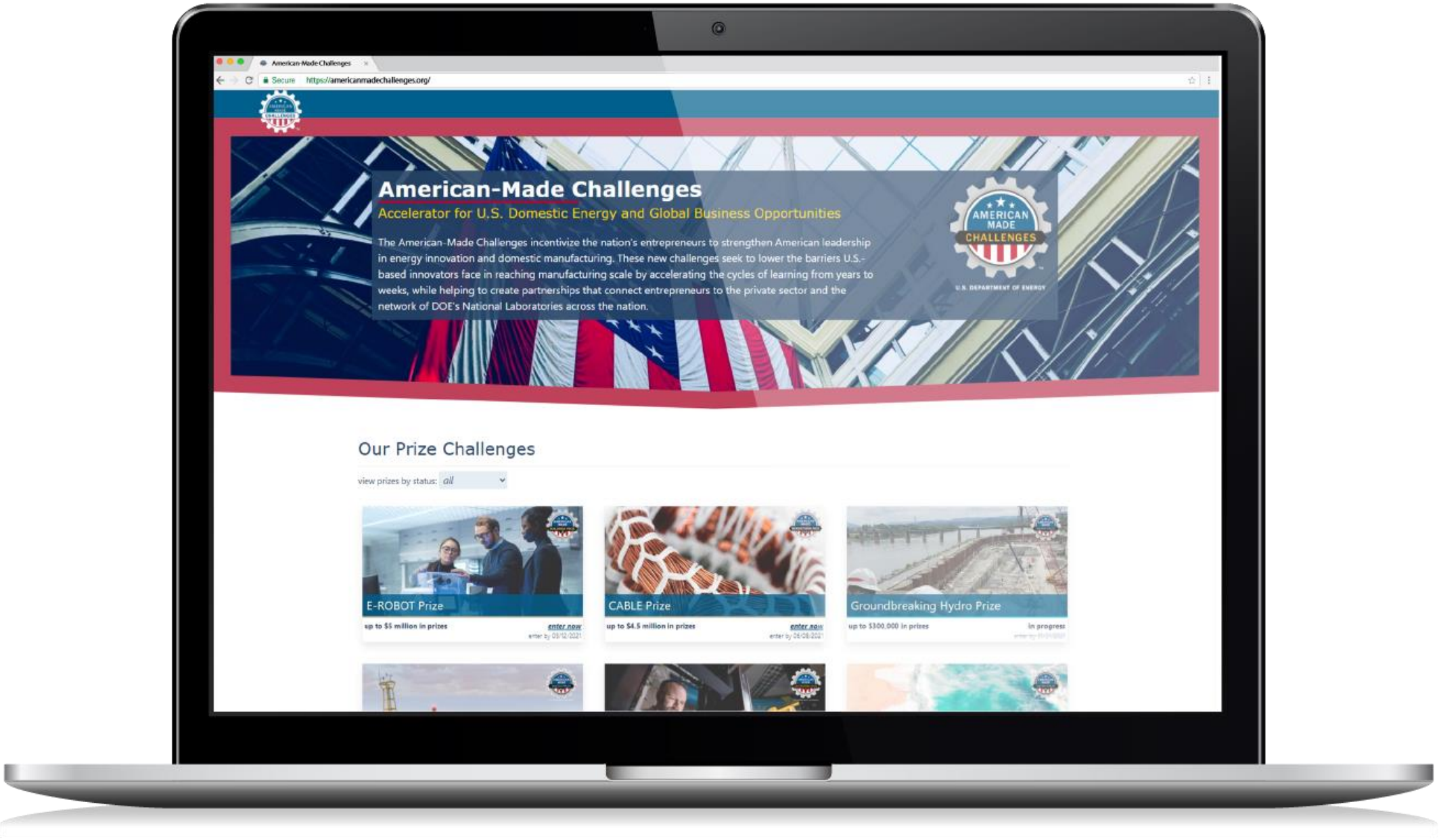
in American innovation and manufacturing

Empower innovators

with knowledge, resources, and access to rapidly transform ideas into prototypes

Provides Network-powered pathway to disruptive innovation

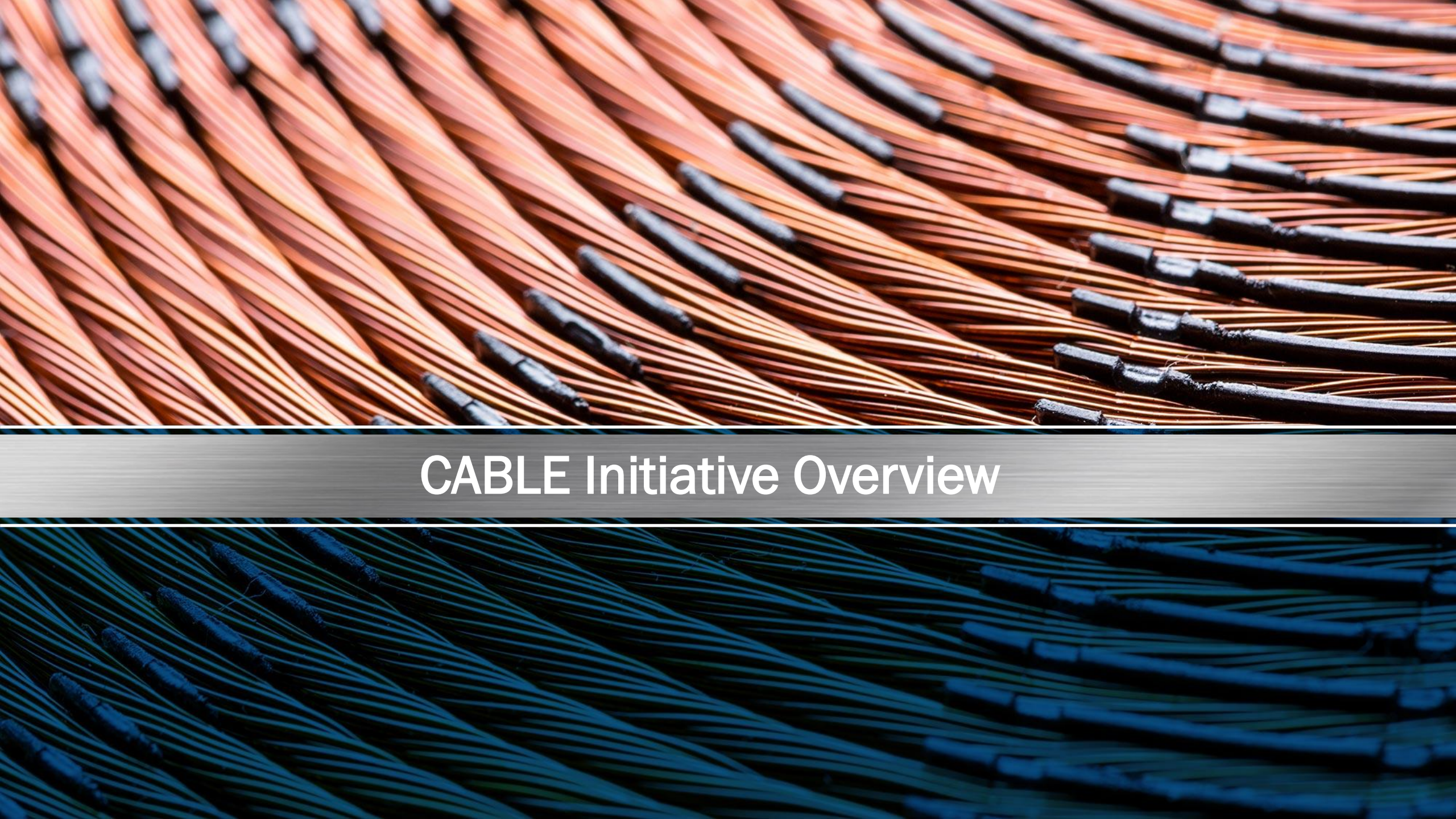
so ideas can become real products in months, not years


American-Made Challenges
Secure https://americanmadechallenges.org/
American-Made Challenges
Accelerator for U.S. Domestic Energy and Global Business Opportunities
The American-Made Challenges incentivize the nation's entrepreneurs to strengthen American leadership in energy innovation and domestic manufacturing. These new challenges seek to lower the barriers U.S.-based innovators face in reaching manufacturing scale by accelerating the cycles of learning from years to weeks, while helping to create partnerships that connect entrepreneurs to the private sector and the network of DOE's National Laboratories across the nation.
AMERICAN MADE CHALLENGES
U.S. DEPARTMENT OF ENERGY
Our Prize Challenges
view prizes by status: all
E-ROBOT Prize
up to $5 million in prizes
enter now
CABLE Prize
up to $4.5 million in prizes
enter now
Groundbreaking Hydro Prize
up to $300,000 in prizes
in progress

American-Made NETWORK

Designed to strengthen and scale critical connections to accelerate and sustain innovation.

Connect with a Network of World-Class Experts | americanmadechallenges.org/network



CABLE Initiative Overview

A Big Idea: The CABLE Initiative

CABLE:

C onductivity-enhanced materials for

A ffordable,

B reakthrough

L eapfrog

E lectric and thermal applications.

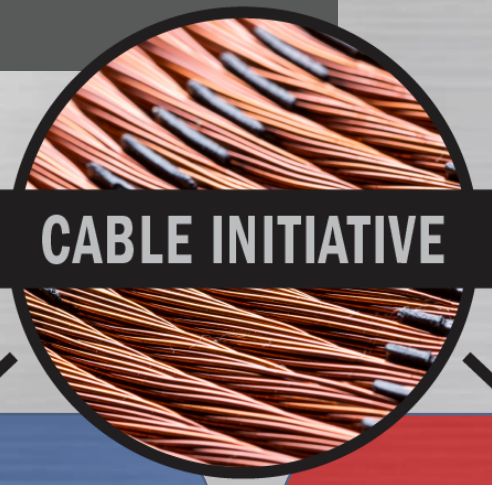
CABLE supercharges breakthroughs in conductive materials—fundamental to nearly all energy use applications—by harnessing the unmatched innovative spirit of the American workforce to:

- **Apply new Nobel Prize-winning science and world-renowned DOE Laboratory tools** to research on breakthrough conductivity enhanced materials
- **Develop high-performance yet affordable electric and thermal applications** that improve U.S. energy and material efficiency and turn the threat of climate change into an opportunity to revitalize the U.S. energy and manufacturing sectors and create millions of high-quality union jobs.

CABLE leverages the American-Made Challenge Network and DOE's Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs to enable U.S. manufacturers to leapfrog international competition by upgrading the fundamental materials and applications that support grid reliability and other electric and thermal energy systems.

CABLE Big Idea, SBIR and Prize

EERE BIG IDEA 2020



CABLE INITIATIVE

CABLE SMALL BUSINESS INNOVATION RESEARCH (SBIR)

CABLE CONDUCTOR MANUFACTURING PRIZE

AMERICAN MADE MANUFACTURING PRIZE

CABLE APPLICATIONS:

CABLE MATERIALS

CABLE BIG IDEA WORKSHOP

APRIL 7-9

DOE Offices Participating (CABLE Big Idea Workshop)

Office of Energy Efficiency & Renewable Energy

Advanced Manufacturing Office (lead)

Building Technologies Office
Geothermal Technologies Office
Solar Technologies Office
Vehicle Technologies Office
Water Power Technologies Office
Wind Energy Technologies Office
+Hydrogen & Fuel Cells Technology Office

Office of Electricity

ARPA-e

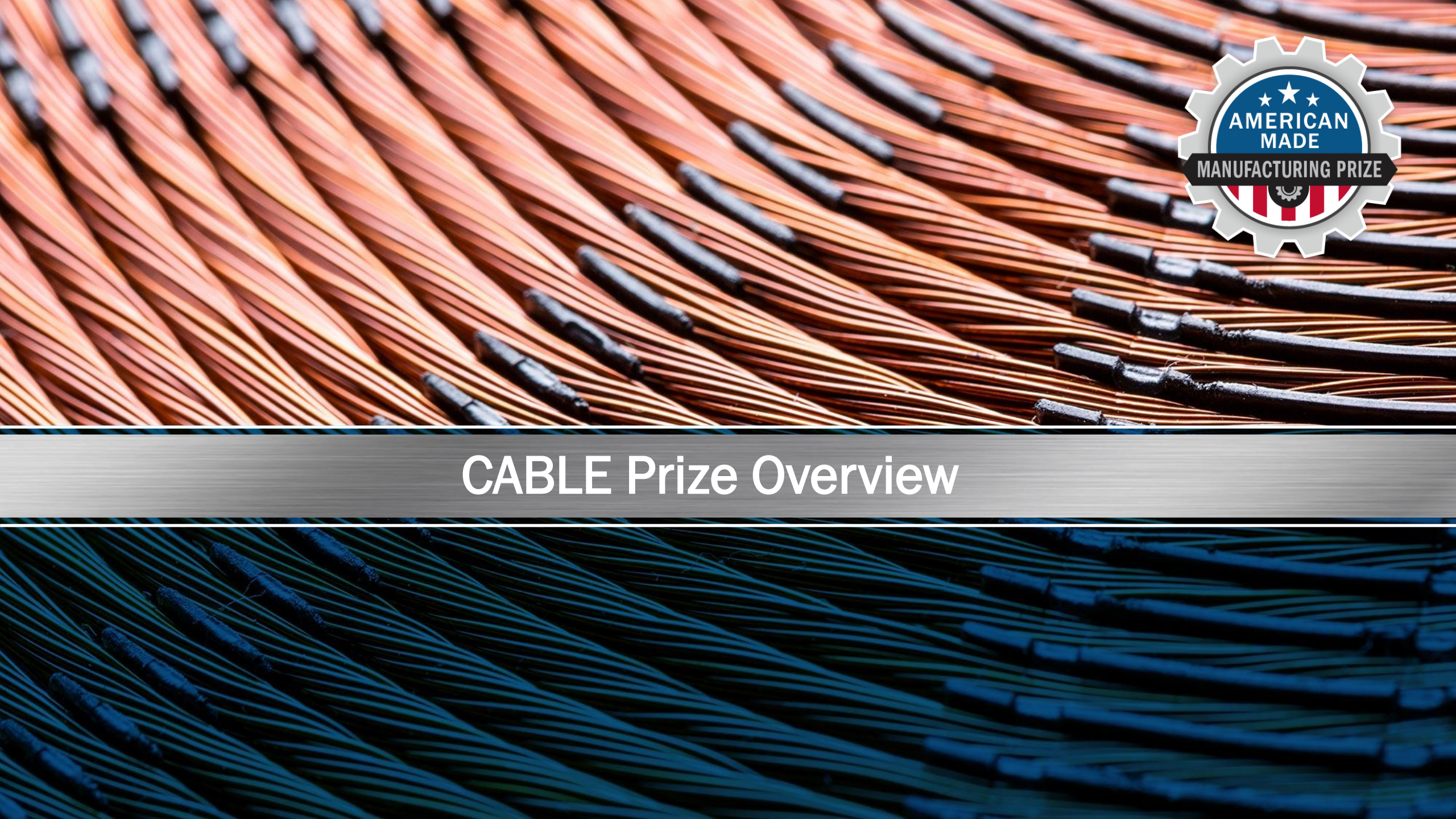
Office of Science,

-Basic Energy Sciences

CABLE Big Idea Workshop

CABLE Big Idea 3-day Virtual Workshop
April 7 - 9, 2021
11:30 a.m. – 5 p.m. (EDT)

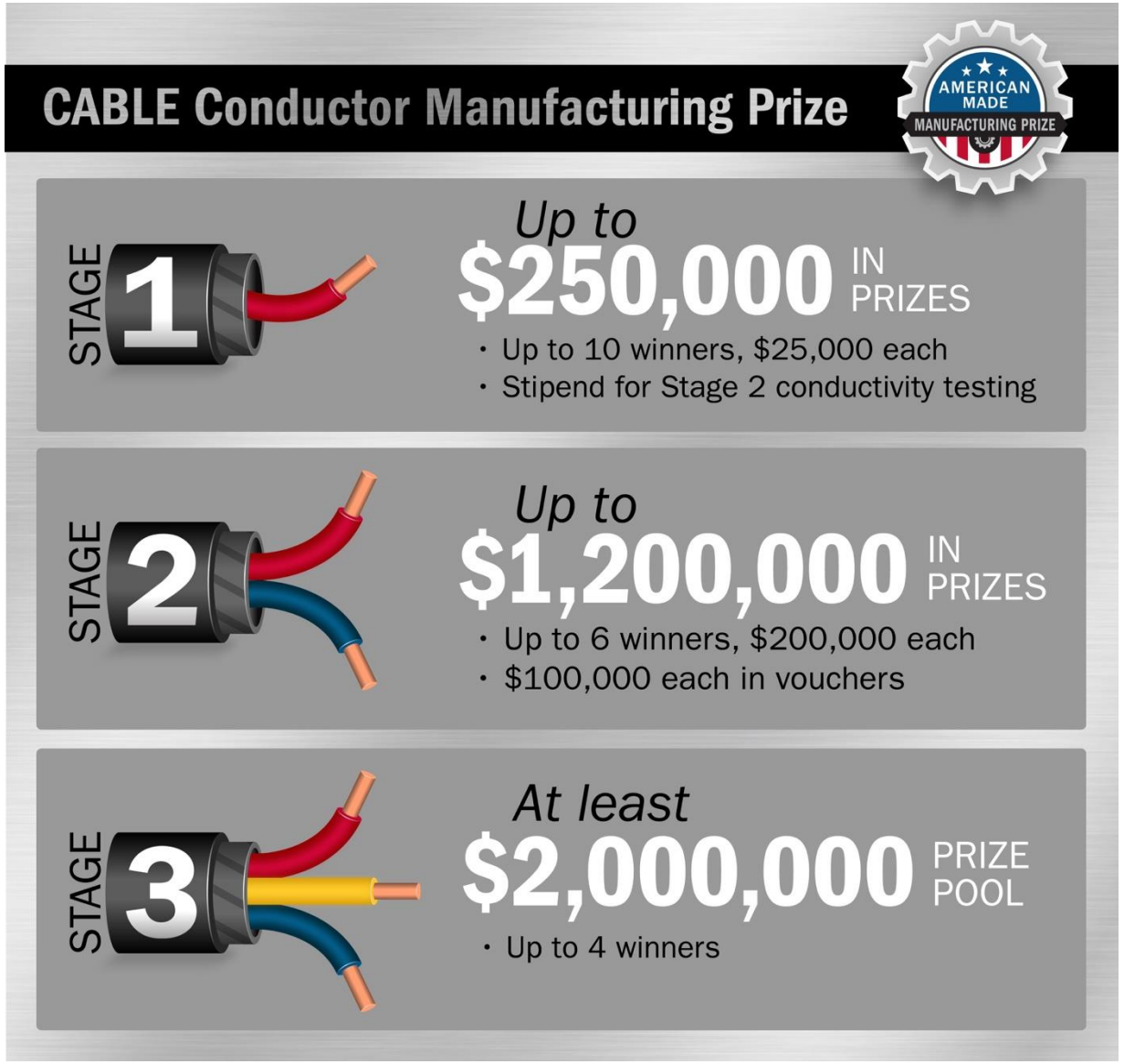
- A virtual CABLE Big Idea **Workshop** will bring together materials inventors and application innovators, and encourage partnering among material scientists, product developers, manufacturers, and other CABLE-relevant researchers.
- All competitors in the CABLE Conductor Manufacturing Prize Contest and all LOI submitters to the EERE SBIR/STTR Phase I FOA Topic 20(a-h), along with any recently announced award selectees in other relevant FOAs invited to the April workshop.
- The workshop will identify research needs to make CABLE breakthrough materials and applications more affordable and enable U.S. product manufacturers to use these conductivity-enhanced materials to leapfrog their international competitors. Register here: https://cable-bigidea.anl.gov/workshop/.



CABLE Prize Overview

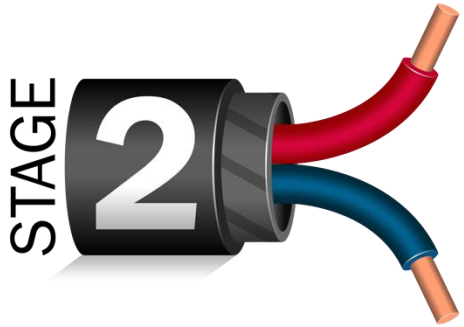
A Tiered Prize Structured for Success

Three years, three stages, up to **$4.5 million** in prizes and vouchers



Prize Structure

Stage 1 seeks concepts to develop and manufacture conductors with bulk electric conductivity enhanced significantly over today's best commercial copper and aluminum. Judging based on written proposal only.



Stage 2 will test lab-scale samples for electrical conductivity and will require proposals describing other high performance properties and manufacturability including how to leverage the American-Made Network to scale up from lab-scale. Judging based on written proposal and testing.

Stage 3 will evaluate manufacturing-scale samples for conductivity and other properties, and examine the documented manufacturing process, scale-up plans, and cost. Judging based on written proposal and comprehensive testing results.

Important Dates

Date	Event
March 17, 2021	CABLE Conductor Manufacturing Prize announcement Stage 1 contest begins and registration opens
March 30, 2021	Stage 1 contest webinar
April 7–9, 2021	CABLE Big Idea Workshop
June 8, 2021, 5:00 p.m. ET	Stage 1 contest submission deadline
August 2021*	Stage 1 awards announcement
October 2021*	Stage 2 contest begins
July 2022*	Stage 2 contest submission deadline
August 2022*	Stage 2 awards announcement
October 2022*	Stage 3 contest begins
August 2023*	Stage 3 contest submission deadline
October 2023*	Stage 3 awards announcement

** Indicates date subject to change.*

CABLE Prize Technical Considerations

Electrical Conductivity Goals

International Annealed Copper Standard (IACS) set in 1913 as 100% IACS = 58.1 X10^6 Siemens /meter at 20°C.

Element	%IACS	Notes
Silver (Ag)	108.62	Used for premium applications
Copper (Cu)*, annealed	100	Most used because it is less expensive than silver with other good properties. Commercial electrolytic Cu ~01 % IACS. Pure Cu has poor mechanical properties.
Copper (Cu), pure	102.75	
Gold (Au)	70.86	Most costly--- used for premium applications when corrosion resistance is important
Aluminum (Al)	65.99	Second most used, mainly in an alloy. For power lines AA1350 with conductivity 61-62.4% depending on purity is used as it is cheapest, lightweight and flexible.

Electrical Conductivity Enhancement Goals

- Ag-enhanced: >113% IACS
- Cu-enhanced: >109% IACS
- Al-enhanced: >67% IACS
- Nonmetal-enhanced: >50% IACS

These goals must be met at the microscale.

For this contest, microscale means one gram minimum sample size.

CABLE Prize Official Rules document, Table 2. Defining Significant Enhancements

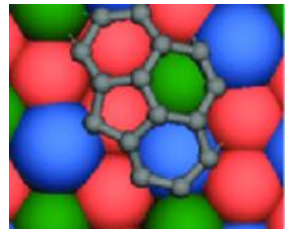
Conductor Material Class

All conductor materials are judged against each other for improvement over the state of the art. In Stage 1, competitors should classify their materials invention according to one of the following three technical classes of conductivity-enhanced materials:

- **Metal* enhanced with nanocarbon**. Metal-nanocarbon conductors are metals that also contain carbon nanotubes, single- or few-layer graphene, doped or undoped, or other carbon allotropes.
- **Metal* enhanced without nanocarbon**. These conductors—metal alloys or metal matrix composites—also contain other metals or non-nanocarbon compounds
- **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.

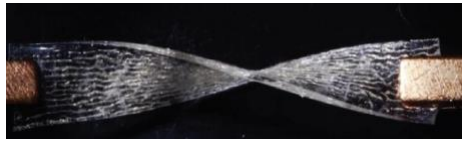
*Metals are primarily the "parent" conductor metals listed in the right-hand table

Metal + nanocarbon



Cu_2NiZn-cold worked

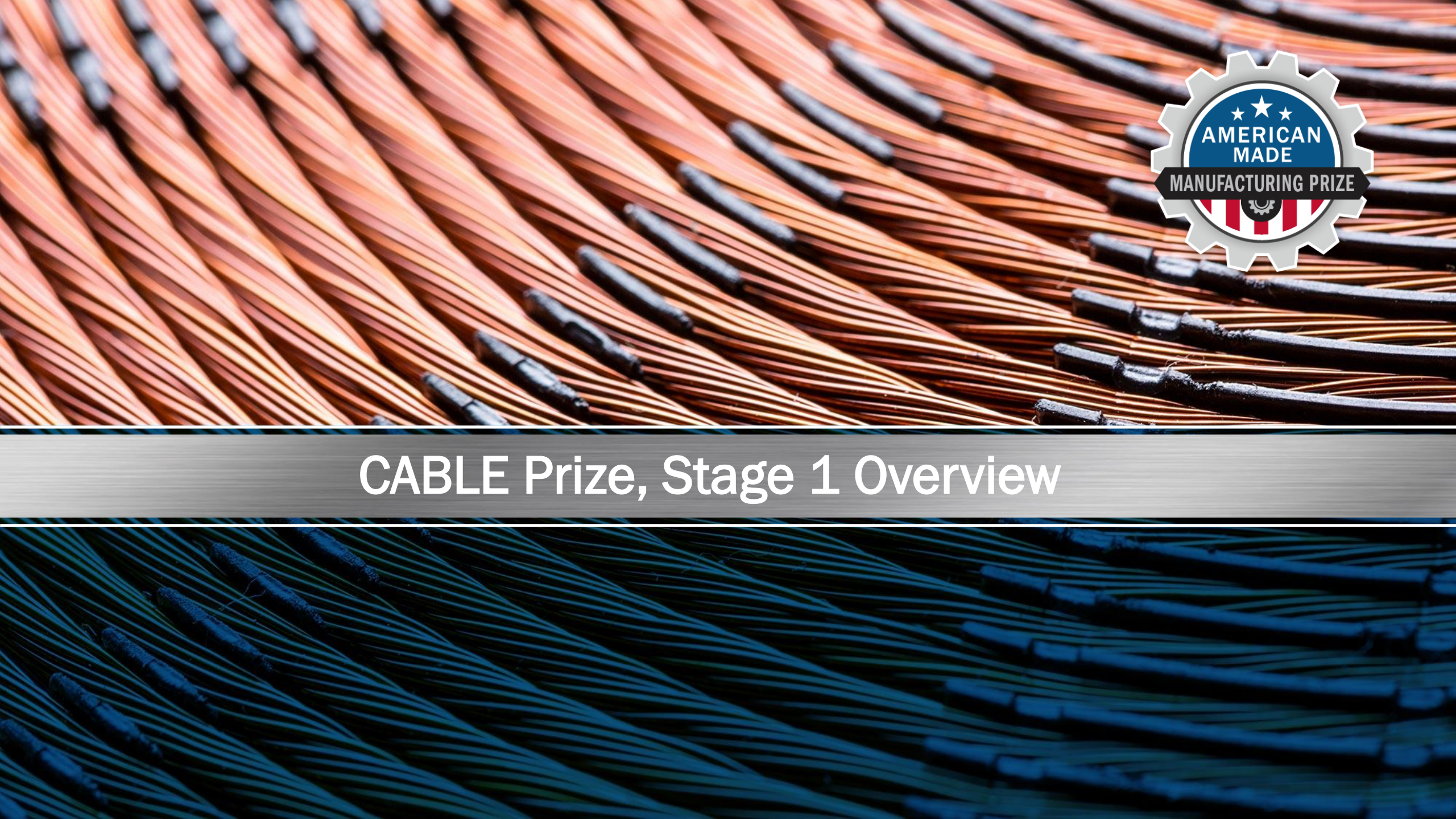
Nanocarbon (doped)



Ag-coated fiber elastomeric composite

Nonconductivity Properties

- In Stages 1 and 2, the required properties of the conductor are affordability, electrical conductivity, and potential for breakthrough applications.
- By 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.
- In the final stage, 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
  - ✓ Thermal properties
  - ✓ Electrical properties
  - ✓ Other



CABLE Prize, Stage 1 Overview

Stage 1 Timeline

Competitors will submit their breakthrough concepts to develop and manufacture a new, affordable, conductivity-enhanced material usable for electrical applications. Stage 1 competitors are invited to a virtual CABLE Big Idea Workshop on April 7–9 to enable networking with the CABLE research ecosystem before Stage 1 applications are due.

Stage 1 Overview

- Competitors will submit their breakthrough concepts to develop and manufacture a new, affordable, conductivity-enhanced material useable for electrical applications.
- This stage of the prize will inform DOE about the minimum conductivity enhancement and other property standards, 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.

Stage 1 Contest Prizes

- **Up to 10 winners**
- **Up to $250,000 distributed among winners in cash prizes ($25,000 per winner)**
- **Stage 2 testing stipend (for each Stage 1 winner)**

How We Score

1. All items in the submission package, except for the cover page, will be considered when scoring each submission.
2. After reviewing all elements of the submission package, expert reviewers will assign a score between 1 and 6 for each of the scoring criteria.

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

3. Expert reviewers will score submissions based on the judging criteria (judges will sign a non-disclosure agreement).
4. The final score from an individual expert reviewer for a submission package equals the total sum of the scores for all the criteria.
5. All expert reviewers' scores will then be averaged for a final score for the submission package.

Stage 1 Criteria and Points

The CABLE Conductor Manufacturing Prize aims to recognize new materials and manufacturing methods to achieve the significant electrical conductivity goals:

- Affordability (up to 6 points)
- Breakthrough material (up to 12 points)
- Technical readiness (up to 18 points)
- Application (up to 6 points)

MAXIMUM number of Points in Stage 1 = 42 points

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.

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 items:

1. Cover Page
2. Link to a 90-second video (publicly accessible online)
3. Summary PowerPoint slide (will be made public)
4. 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.***
5. Letters of commitment or support (optional).

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

Cover Page

Required: ☑ Public: ☑ Scored: ☒

Cover Page – List basic information about your submission.

1. Submission title
2. Competitor or team name
3. Team leader (point of contact)
4. Short description (e.g. your slogan)
5. Material class of your conductor according to the three categories in “Conductor Material Class” (Slide 20)
6. Link to your 90-second video online
7. Key project members (names, contacts, and, if possible, links to online profile/resume)
8. <100-word abstract.

A cover page template can be found at: https://www.herox.com/cable/resources.

90-Second Video

Required: ☑ Public: ☑ Scored: ☑

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

Suggested content:

1. Your proposed idea
2. How your idea works
3. Why your idea is innovative
4. Who you are and why you have a competitive edge.

Summary PowerPoint Slide

Required: ☑ Public: ☑ Scored: ☑

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
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 Criteria 1 & 2 (18 points)

Required: ☑ Public: ☒ Scored: ☑

1: Affordability

Suggested content:

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.

Judging criteria (1–6 scale per statement):

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

Suggested content:

- 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 material represents a breakthrough, describe the new scientific understanding.
- 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.

Judging criteria (1–6 scale per statement):

- The proposed material shows enhanced conductivity at or above goals listed on Slide 19, 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 manufacturing technologies or approaches.

Technical Narrative Criteria 3 & 4 (24 points)

Required: ☑ Public: ☒ Scored: ☑

3: Technical Readiness

Suggested content:

- 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.

Judging criteria (1–6 scale per statement):

- 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.

4: Technology Application

Suggested content:

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.

Judging criteria (1–6 scale per statement):

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

Required: ☒ Public: ☒ Scored: ☑

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 who 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

Competitors are highly encouraged to include individuals from groups historically underrepresented in STEM on their teams.

As part of the submission package (**Technical Narrative**), 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.

Who Is Eligible?

To compete in this prize, competitors must comply with the eligibility requirements in the Official Prize Rules. A summary of those rules is provided below. The registered competitor is the individual or entity that registers to compete in HeroX.

- 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 eligibility requirement where the entity submits a compelling justification.
- Academic and nonfederal government entities must be based in the United States.
- This prize competition is expected to positively impact U.S. economic competitiveness. Participation in a foreign government talent recruitment program could conflict with this objective 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 risk are not eligible to compete.
- 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.

Additional Factors

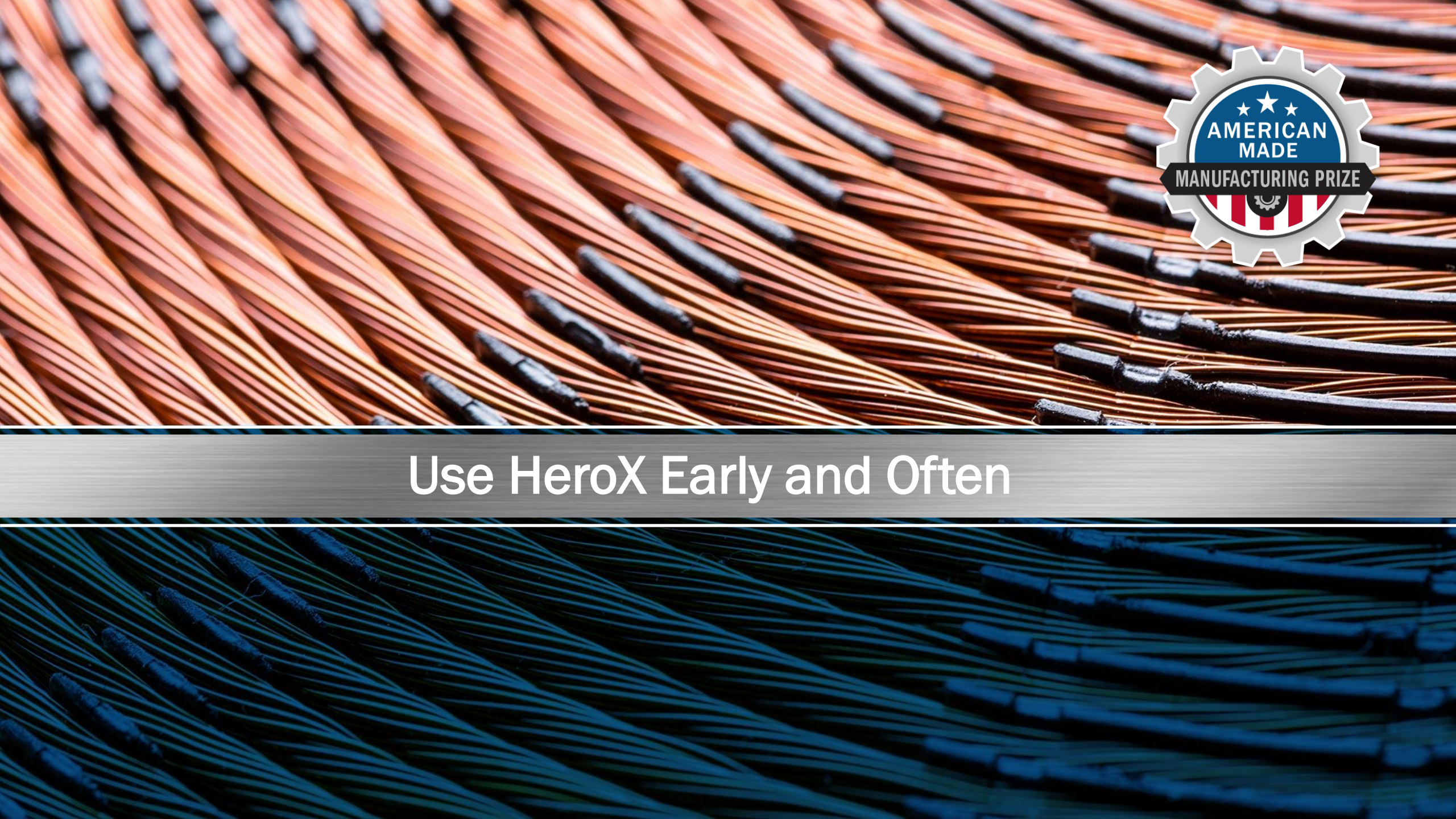
Only submissions relevant to the goals of this program are eligible to compete. The Prize Administrator must conclude that all the following statements are **true** when applied to your submission:

- The proposed conductor material must have an electrical conductivity goal of at least 50% IACS.
- 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.

Read the Rules

Official CABLE Conductor Manufacturing Prize Rules are available online:

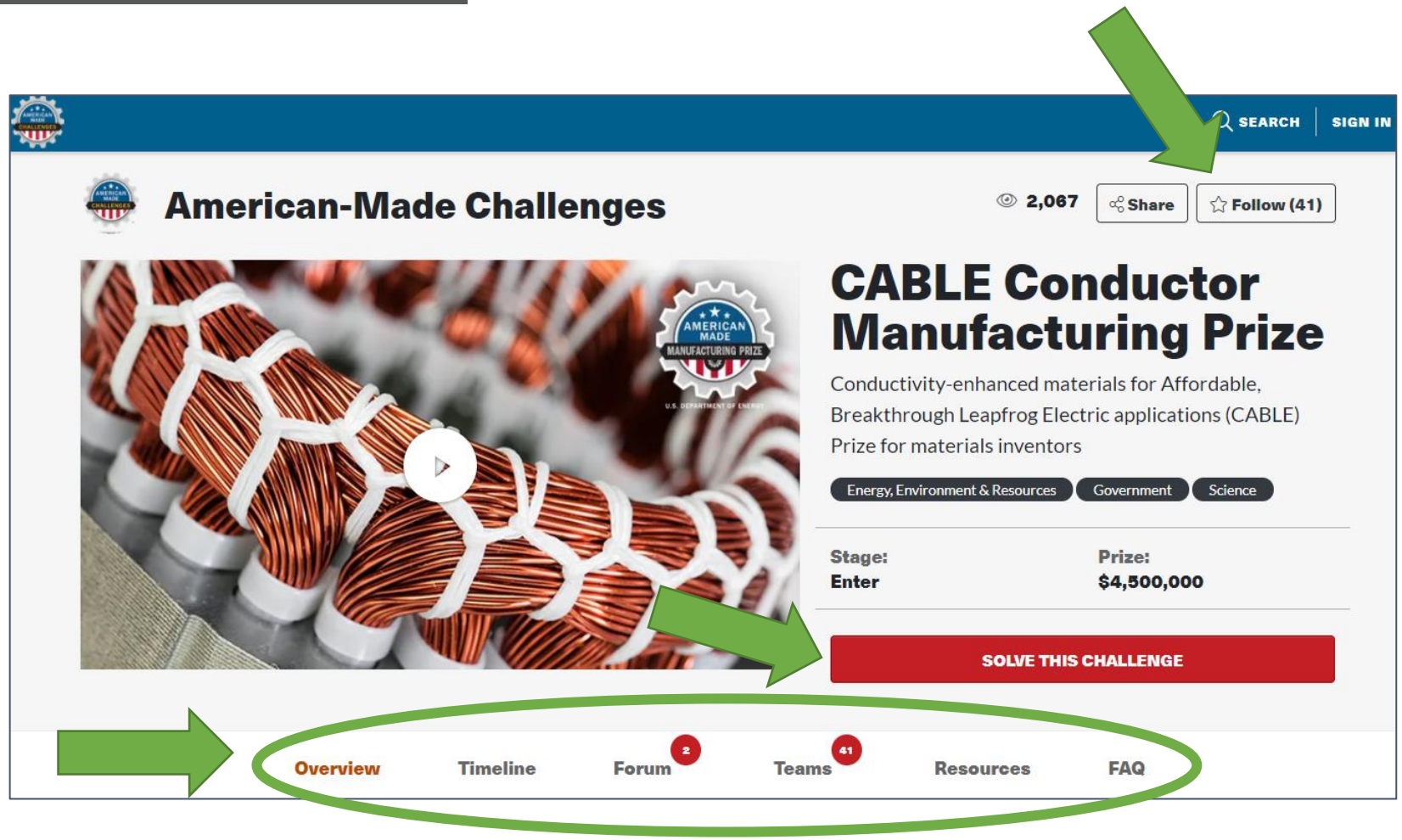
https://www.herox.com/cable/resource/665



Use HeroX Early and Often

Join the Prize on HeroX

1. **Register** for an account on HeroX at https://www.herox.com/cable.
2. **Follow** the Challenge on HeroX
3. **Review** prize information using tabs on HeroX
4. **Submit** your application before June 8, 2021 at 5PM ET

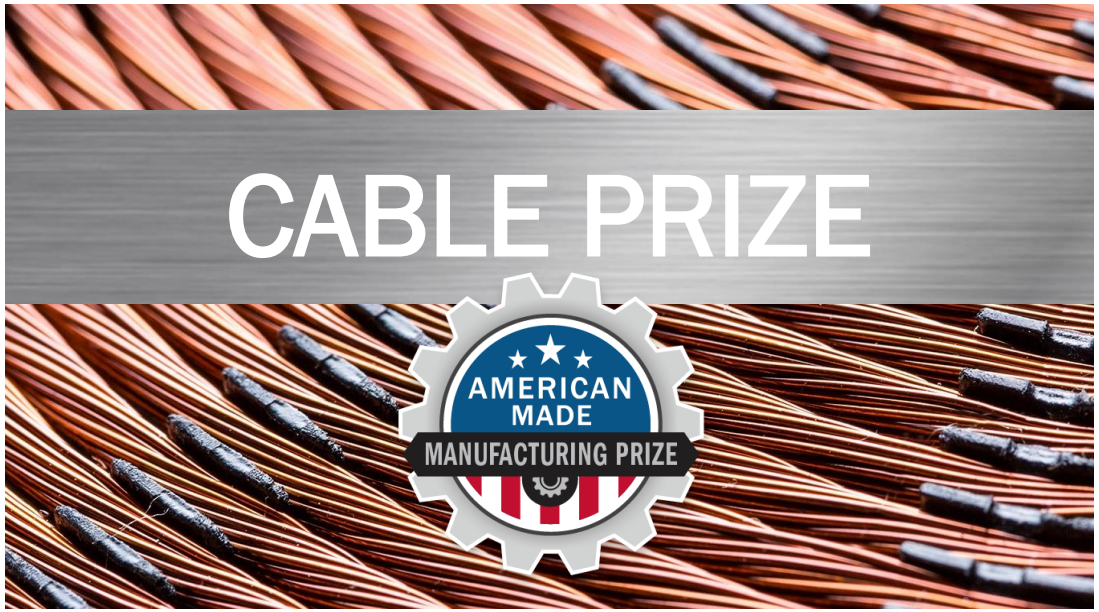


Stage 1 Important Deadlines

- **CABLE Prize Stage 1**
  - Open for submissions: March 17, 2021
  - Submission deadline: June 8, 2021, 5 p.m. ET
  - Winners announced: August 2021 (anticipated)

- **CABLE Big Idea Workshop:**
  - April 7–9, 2021
  - Register for the workshop:

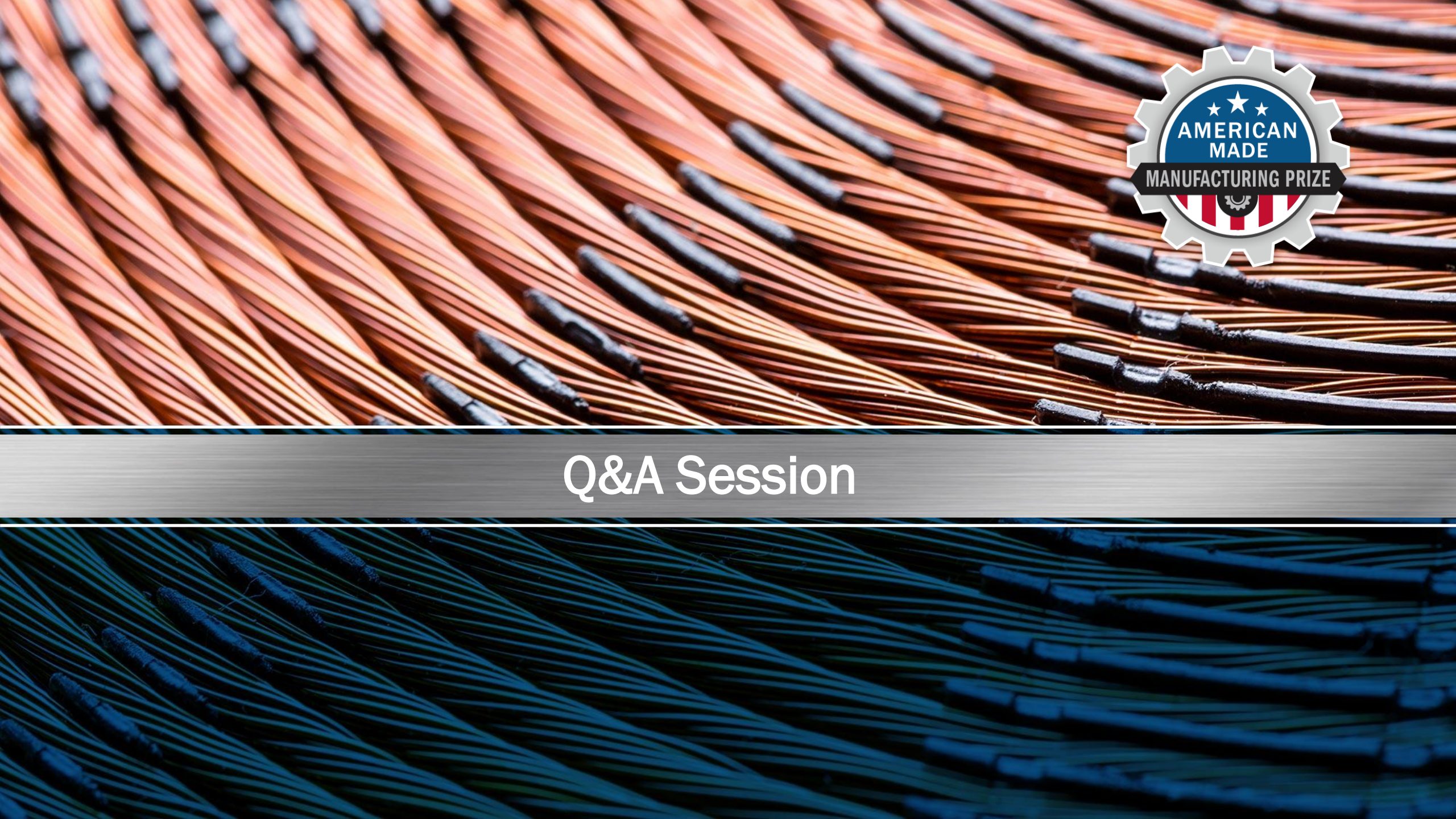
    https://cable-bigidea.anl.gov/workshop/



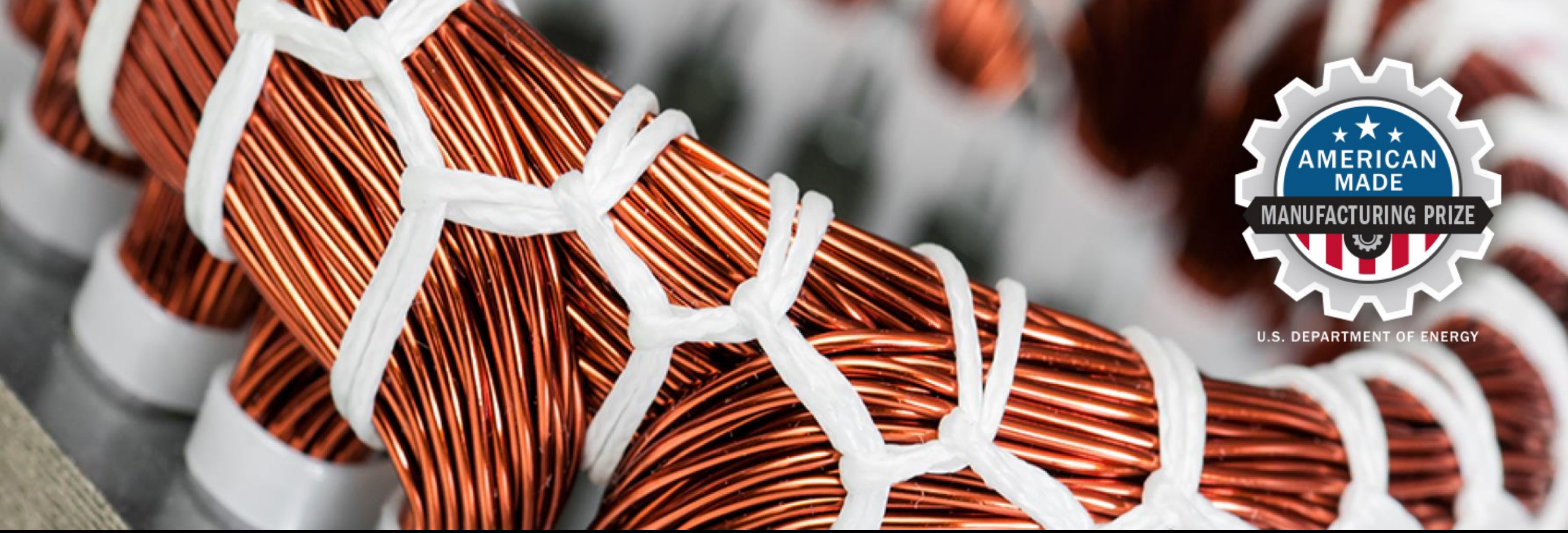
Help Electrify Innovation

Join the CABLE Prize challenge today

1. Register and follow the Prize on HeroX:
   https://www.herox.com/cable
2. Sign up for the workshop:
   https://cable-bigidea.anl.gov/workshop
3. Read the rules:
   https://www.herox.com/cable/resource/665
4. Submit your entry on HeroX:
   https://www.herox.com/cable



Q&A Session


AMERICAN
MADE
MANUFACTURING PRIZE
U.S. DEPARTMENT OF ENERGY

Thank you

Supplementary – CABLE workshop

You're Invited! Join the CABLE Conductor Manufacturing Kick-off Webinar and Learn How to Compete

Have you considered competing in the CABLE Conductor Manufacturing Prize? Do you have questions about what technologies can be submitted? Are you curious if you qualify to compete?

All these questions and more will be answered next week on March 30, 2021, at 1 p.m. ET during the CABLE Prize Informational Webinar.

If you have an idea to develop and manufacture breakthrough conductivity-enhanced materials, join us on the webinar and learn how you can compete to win part of the $4.5 million prize pool. The CABLE Prize administration team will give insight into the application process, answer questions about the prize, and share how participating can catapult your innovation.

Interested in competing? Register now for the CABLE Prize Informational Webinar and tune in on March 30!

Supplementary – CABLE workshop Summary

April 7-9, 2021

DRAFT AGENDA

DAY 1: April 7	
Time	**Activity**
11:30 AM – 12:00 PM	**Welcome from Organizers and CABLE Overview** **Welcome from Biden/Harris Administration**
12:00 PM – 2:15 PM	**Applications Panel Session** – Electric Distribution and Supply, Transportation
2:15 PM – 2:45 PM	**Break**
2:45 PM – 4:45 PM	**Applications Panel Session** – Efficiency, Renewables
4:45 PM – 5:00 PM	**Preview of Day 2**
DAY 2: April 8	
Time	**Activity**
11:30 AM – 11:40 AM	**Welcome from CABLE Big Idea Team Lead, Overview of CABLE Prize**
11:40 PM – 2:30 PM	**Materials Fabrication Panels** – Metal/Nanocarbon, Metal and Composite, Polymer and Conductors
2:30 PM – 2:45 PM	**Break**
2:45 PM – 4:50 PM	**Materials Modeling and Computation Panels** – Atomistic-scale, Multi-scale Simulation, Cross-cutting Topics in Materials Simulation
4:50 PM – 5:00 PM	**Preview of Day 3**
DAY 3: April 9	
Time	**Activity**
11:30 AM – 11:40 AM	**Welcome from CABLE Big Idea Team Lead and Highlights from Day 2**
11:40 AM – 2:00 PM	**Supply Chain, Available Technical Resources, and Patenting Panels**
2:00 PM – 2:30 PM	**Break**
2:30 PM – 3:30 PM	**Priority Research Directions Summary (from Facilitated Sessions) and Comments**
3:00 PM – 4:00 PM	**Conclusions and Next Steps**

Supplementary – CABLE workshop Detailed

DAY 1: April 7
Activity
1.1 Opening Plenary
1.1.1 Welcome from Organizers (Tina Kaarsberg)
1.1.2 Welcome from Biden/Harris Administration (Kelly Speakes-Backman*, Acting EE-1)
1.1.3 Overview of CABLE (Tina Kaarsberg)
1.2 Applications Panel Session (Part 1)
1.2.1 Electric Distribution and Supply (EDS) Applications Panel – Moderator: Andre Pereira, Office of Electricity Benjamin Shrager, Office of Electricity Joe Hagerman, ORNL Iver Anderson, Ames Laboratory
1.2.2 Transportation Applications Panel – Moderator: Isik Kizilyalli, ARPA-E Timothy Haugan, U.S. Air Force Lab Maricela Lizcano, NASA Lynn Petersen, Office of Naval Research Burak Ozpineci, ORNL Don Hillebrand, ANL
1.2.3 Facilitated Discussion on EDS and Transportation Applications (Emmanuel Taylor)
Break
1.3 Applications Panel Session (Part 2)
1.3.1 Efficiency Applications Panel – Moderator: Fredericka Brown, BTO Kashif Nawaz, ORNL Jason Woods, NREL Matteo Pasquali, Rice University
1.3.2 Renewables Applications Panel – Moderator: Jian Fu, WETO Bill Vandermeer, Geothermal Technologies Office Eduard Muljadi, NREL Nate McKinsey, Wind Energy Technologies Office TBD (solar)
1.3.3 Facilitated Discussion on Efficiency and Renewables Applications (Emmanuel Taylor)
1.4 Preview of Day 2

Supplementary – CABLE workshop detailed

DAY 2: April 8
Activity
2.1 Welcome from CABLE Big Idea Team Lead, Overview of CABLE Prize
2.2 Materials Fabrication Panels
2.2.1 Metal/Nanocarbon Conductor Panel – Moderator: Brian Valentine, AMO Saniya LeBlanc, GWU Mehran Tehrani, UT Austin Keerti Kappagantula, PNNL Balu Balachandran, ANL
2.2.2 Metal Enhanced without Nanocarbon Panel – Moderator: Chris Hovanec, AMO Nhon Vo, NanoAL, LLC Alex Plotkowski, ORNL/MDF Jon McCrea, Integran John Hryn, ANL
2.2.3 Polymer and Other Non-metallic Enhanced Conductor Concepts Panel – Moderator: Tony Bouza, AMO Dan Gianola, University of California, Santa Barbara Chuck Booten, NREL Michael Ohadi, University of Maryland
2.2.4 Facilitated Discussion on Materials Fabrication (Emmanuel Taylor)
BREAK
2.3 Materials Modeling and Computation Panel – Moderators: George Maracas, BES and Santanu Chaudhuri, ANL
2.3.1 Atomistic-scale Simulation Subramanian Sankaranarayanan, ANL David Drabold, Ohio University Panchapakesan Ganesh, ORNL
2.3.2 Multi-scale Simulation Approaches Pallab Barai, ANL Duane D. Johnson, Iowa State University/Ames Lab TBD
2.3.3 Cross-cutting Topics in Materials Simulation Maria Chan, ANL Angel Yanguas-Gil, ANL Bobby Sumpter, ORNL
2.3.4 Facilitated Discussion on Materials Modeling and Computation (Emmanuel Taylor)
Preview of Day 3

Supplementary – CABLE workshop detailed

DAY 3: April 9	
Time	**Activity**
11:30 AM – 11:40 AM	**3.1 Welcome from CABLE Big Idea Team Lead and Highlights from Day 2**
11:40 AM – 2:00 PM	**3.2 Supply Chain, Available Technical Resources, and Patenting – Moderator: Hal Stillman, Independent Consultant**
11:40 AM – 12:30 PM	3.2.1 Supply Chain • Richard Collins, IDTechEx • Joseph Saleh, Fisk Alloy Wire • Terrance Barkan, The Graphene Council • TBD
12:30 PM – 1:30 PM	3.2.2 Available Technical Resources • PNNL: ShAPE, conductivity measurement (Keerti Kappagantula) • NETL: Covetic Furnace (Paul Jablonski) • ANL: Advanced Photon Source (Ben Gould) • ANL: Chemical Vapor Processing (Jeff Elam) • ORNL/MDF, metallic (Mike Kirka*) • ORNL/MDF, non-metallic (TBD)
1:30 PM – 2:00 PM	3.2.3 Patenting • Hal Stillman, Independent Consultant, “Global Patenting Overview” • Glen Drysdale, DOE, “Patenting Requirements for U.S. Government Funded R&D”
2:00 PM – 2:30 PM	**Break**
2:30 PM – 3:30 PM	**3.3 Priority Research Directions Summary (from Facilitated Sessions) and Comments**
3:30 PM – 4:00 PM	**3.4 Conclusions and Next Steps**

Supplementary - FAQ

Q: What is the connection between nano technology and the CABLE Prize

The three classes of materials that are the subject of the CABLE Prize all involve nanoscience and nanotechnology at different nano-length scales. Class 1—metal enhanced with nanocarbon involves the addition of carbon allotropes such as 1-dimensional carbon nanotubes (CNTs) (spacing of 0.2-0.4 nm) and two dimensional Graphene (interplanar spacing of 0.3nm) to conducting metals such as silver, copper and aluminum to enhance the conductivity above that of the base metal Class 2—metal enhanced without nanocarbon, involves the precise control of metal and other interfaces especially in metal matrix composites at the scale of >100 nms for metal grain sizes. Class 3—Non-metals. For those based on enhancing conductivity with nanoparticles of metal—the relevant nano length scales are the metal atomic mono-layer (~10s nm) for the deposition of metal nanoparticle films on the polymer.

Q: What is the CABLE R&D Workshop and how does it relate to the CABLE Prize?

The April 7-9 2021 CABLE Workshop has a dual purpose. First, it is intended to encourage partnering among material scientists, product developers, manufacturers, and other CABLE-relevant researchers to to network and strengthen the emerging field of conductivity-enhanced research, development and deployment (RD&D) as well as key workforce and education efforts. In particular, the workshop will bring together the disparate existing elements of the CABLE Big Idea Research Ecosystem. This 'ecosystem' includes Prize Competitors, SBIR applicants, and currently funded (or recently completed) CABLE-related national laboratory, company and university research teams) Also invited to the CABLE workshop are representatives of RD&D efforts from key CABLE application areas (including CABLE SBIR 20 b-h) such as electricity distribution systems (e.g. transmission cables TRAC awardees), transportation (e.g. ARPA-e's DE-FOA-0001953 Topic Q: Connecting Aviation by Lighter Electric Systems competitors), energy efficiency (e.g. AMO FY19 MTFOA on nanocrystalline metals); and renewable energy.

Second—like all AMO-sponsored RD&D workshops—this workshop will provide input to guide AMO's future portfolio of RD&D investments.

The interrelationship of the CABLE Prize, the CABLE workshop and other CABLE Big Idea activities are outlined and updated at the overall CABLE Big Idea website (cable-bigidea.anl.gov).

Supplementary - FAQ

Q: What is CABLE SBIR and how does it relate to the CABLE Prize?
The CABLE FY20 DOE Small Business Innovation Research/Small Business Technology Transfer Research (SBIR/STTR) Topic released last Fall-- Topic 20 entitled “Conductivity-enhanced Materials for Affordable, Breakthrough, Leapfrog Electric and thermal applications (CABLE) Materials and Applications—supported R&D for both CABLE materials and CABLE applications. The first CABLE subtopic (20a) was focused on transferring a technology for a type of CABLE material from Argonne National Laboratory to the marketplace. Any awardees for 20a might also compete for the CABLE Prize. The rest of the CABLE subtopics (20-b-h) –though they may involve materials fabrication—are for applications of CABLE materials in various products ranging from transmission line cables to electric vehicles. Any proposers for the CABLE SBIR application subtopics (20b-h) that intend to fabricate their own materials may also compete for the CABLE Prize. In addition, any such proposers that do NOT intend to fabricate their own material for the disruptive innovations they are planning for U.S. manufacturers of cables (for grid and EVs), motors, generators, and renewable power technologies are strongly encouraged to partner with CABLE Conductor Manufacturing Prize competitors. The timing of the Prize is set so that CABLE Prize winners receive their government funding at about the same time that CABLE SBIR awardees grants begin.
The interrelationships of the CABLE Prize, the DOE Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) FY 2021 Phase I Release 2 CABLE Topic, and the CABLE workshop are outlined and updated at the overall CABLE Big Idea website (cable-bigidea.anl.gov).

Q: What is the third-party conductivity testing that is required in Stage 2?
Stage 2 competitors will be required to submit a microscale sample (1 gram minimum, other size requirements to be provided in Stage 2 rules) of their material for electrical conductivity testing. Two or more geographically diverse approved testing locations will be identified in the Stage 2 Rules.
Winners of Stage 1 will receive a testing stipend for Stage 2. New competitors may enter the prize in Stage 2 but will need to self-fund required testing at an approved testing facility.
More information about Stage 2 testing will be included in the Stage 2 official rules document to be released prior to the Stage 2.

Q: How are "conductivity-enhanced materials" different from super conductors?
Unlike superconductors, "conductivity-enhanced materials" have reliable enhanced conductivity at room temperature and promise even more enhancement at elevated industrial process temperatures. 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.