Data-Driven Distributed (3D) Solar Visibility Prize

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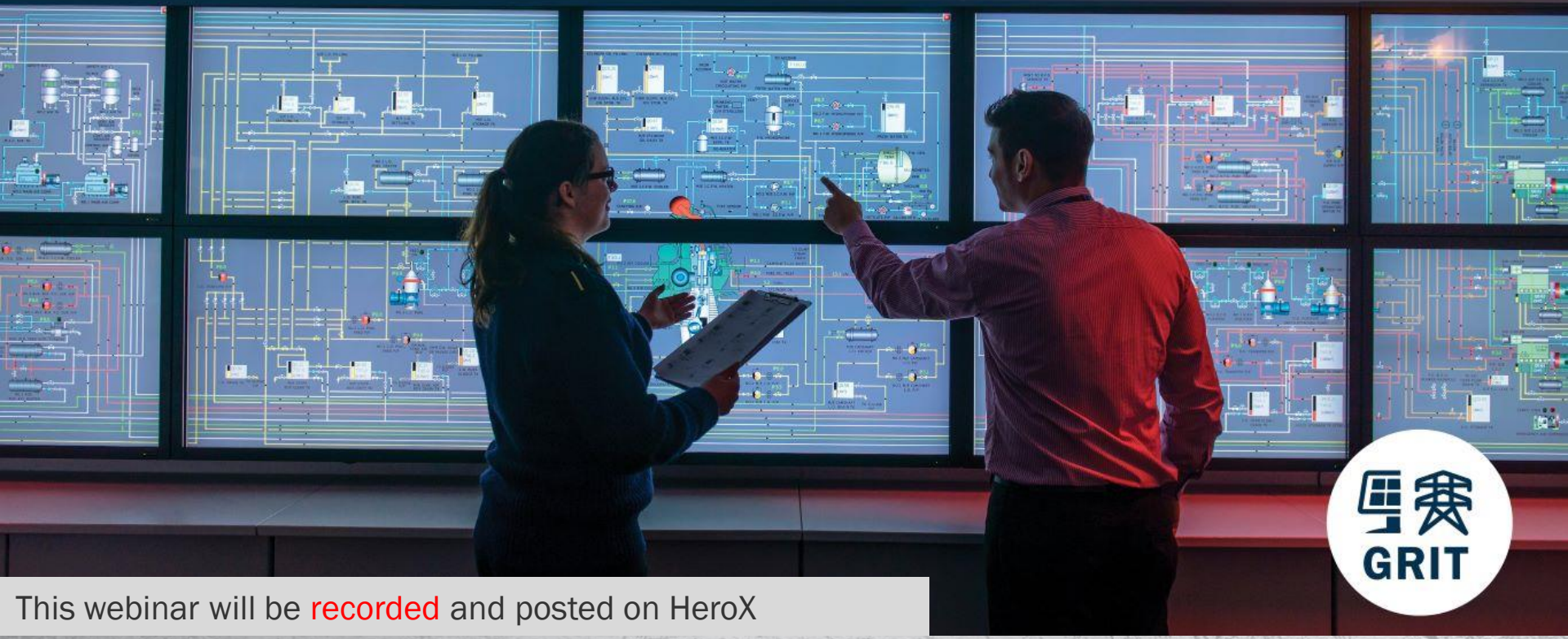

GRIT

This webinar will be recorded and posted on HeroX

Housekeeping

Two Options for Audio (select audio mode):

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   Under “Select a Speaker,” click “Same as System.”
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To Ask a Question:

- Select the ‘Q&A’ button at the bottom of your screen and type in your question.
- Questions may be answered live, but all questions will be answered in writing on HeroX.

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- Technical difficulties: Chat the webinar host for additional support.
- A video/audio recording of this webinar and the slide deck will be made available

Topics

1. Data-Driven Distributed (3D) Solar Visibility Prize Overview
2. Prize Process
3. HeroX Live Demo
4. Technical Details and Scoring
5. Q&A

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The American-Made program is your **fast track to the clean energy revolution**. Funded by the U.S. Department of Energy, we incentivize innovation through prizes, training, teaming, and mentoring, connecting the nation's entrepreneurs and innovators to America's national labs and the private sector.

The American Made Program is growing:

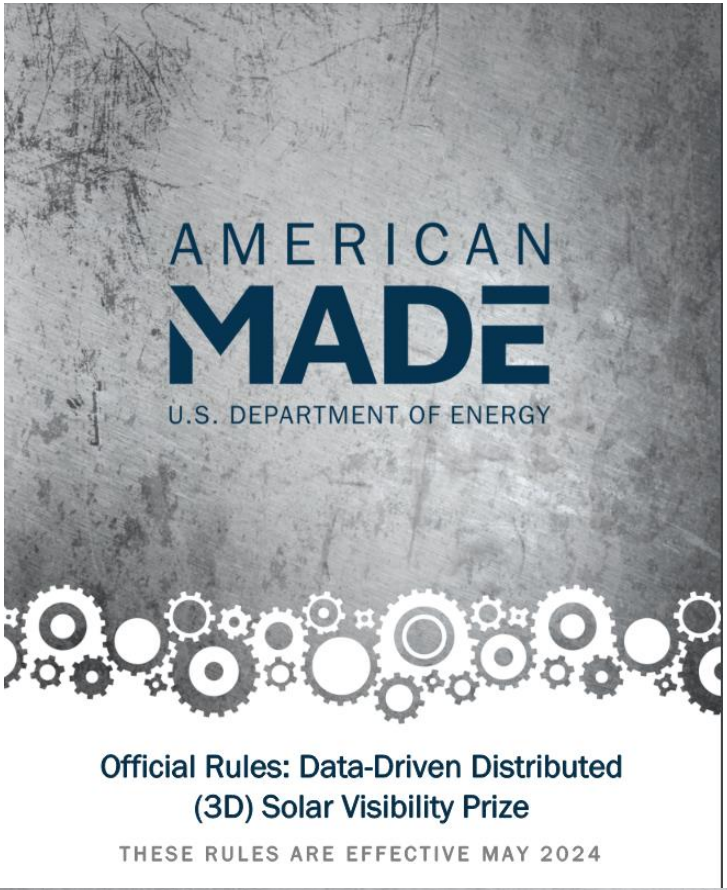
$100M
in cash prizes and support

40+
prizes

300+
Network members

AmericanMadeChallenges.org

Read the Rules



Official rules of the
3D Solar Visibility Prize
are available online

https://americanmadechallenges.org/challenges/3D-solar-visibility/docs/3D-Solar-Visibility-Prize-Official-Rules.pdf

Or

3D Solar Visibility Prize HeroX Page --> Resources Tab

GRIT Prize Series

- The 3D Solar Visibility Prize is part of the new Grid Resource Integration Technologies (GRIT) Prize Series. A joint effort from DOE's Office of Electricity (OE) and the Solar Energy Technologies Office (SETO), this prize series catalyzes research and development on grid modernization through large-scale integration of renewable technology, distributed resources, and stationary storage.

- SETO's 3D Solar Visibility Prize was launched in conjunction with OE's Science Synthesis Prize, a competition to expand the renewable energy research community, catalyze transdisciplinary scholarship and practice, and generate new and comprehensive knowledge on the current state of science in renewable integration.

- Follow the Science Synthesis Prize on HeroX for more information on upcoming GRIT Prize Series initiatives.

3D Solar Visibility Prize Overview

Prize Goals

- Increase stakeholder awareness of the state of the art in data-driven models and algorithms that provide accurate understanding of the electricity voltage, load, and power generation amounts (known as state estimation) including the contribution from distributed solar energy resources.

- Demonstrate the feasibility of fair, transparent, and uniform evaluations of computation models and algorithms using the publicly available, open-source data and software platform, Open Energy Data Initiative Solar Integration (OEDI SI). OEDI SI, a collaboration among multiple national labs with support from SETO, will serve as the benchmarking platform.

- Promote the adoption and use of these models and algorithms by researchers and industry practitioners to evaluate distribution network modeling and analysis algorithms using transparent and uniform metrics and specifications.

What is the 3D Solar Visibility Prize?

About the Prize:

- Designed to incentivize innovators to develop models and algorithms that can provide accurate and real-time information about distributed solar generation in electric power distribution networks.
- The prize will enhance the reliability and resilience of electric power distribution networks that have large amounts of solar generation.
- This prize is a one phase prize that offers a total of up to **$175,000 in cash prizes**.
- Competitors will submit their intent to compete submission package.
- If eligible, competitors will submit their DSSE solutions for two distribution system networks through the OEDI SI platform, every day for 14 consecutive days.

Who can compete?

- The 3D Solar Visibility Prize is open to:
  - Institutions
  - Companies
  - Nonprofit organizations
  - Individuals

- Competitors must be based in the United States to be eligible

- Full eligibility can be found in the official rules

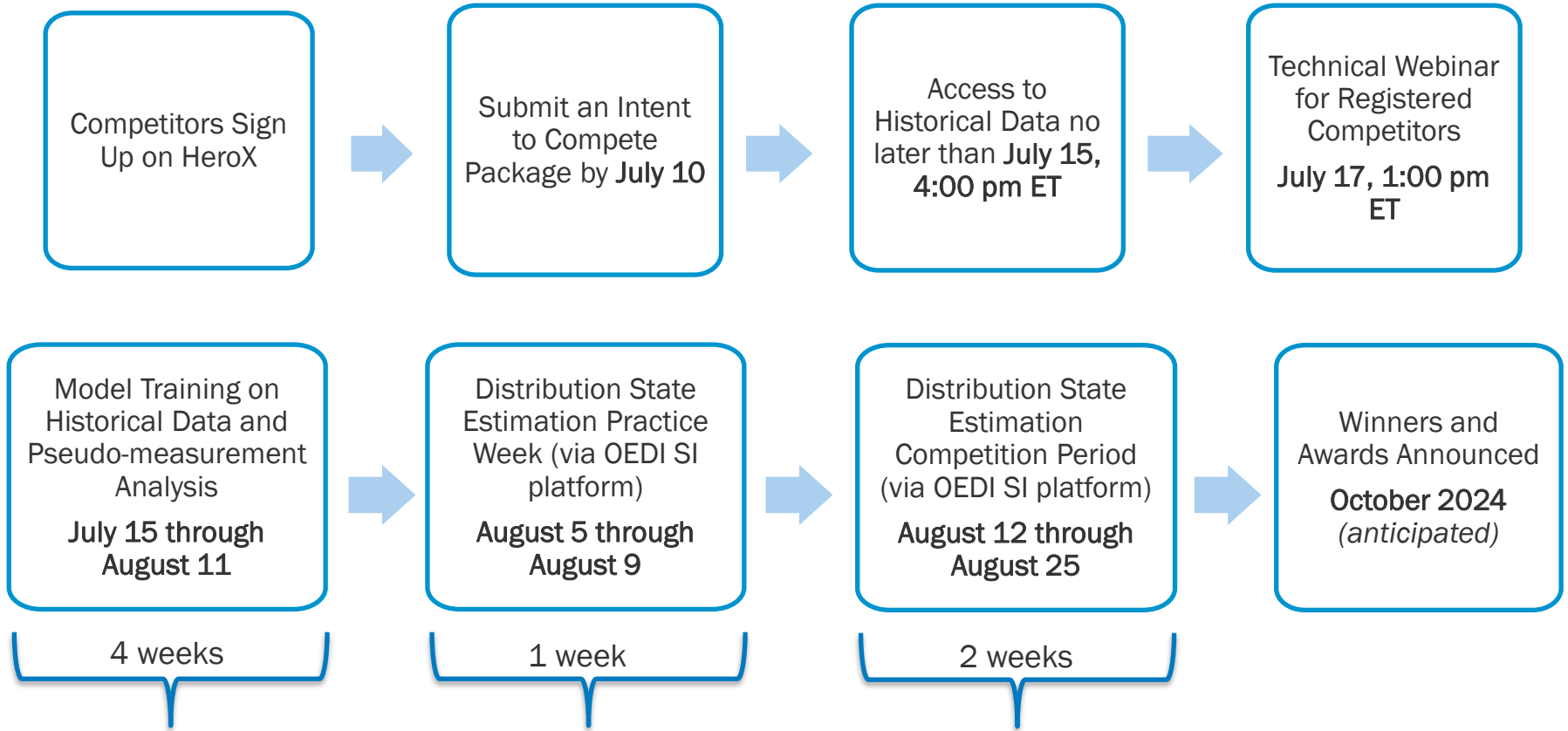
Prizes to Win

	Number of Prizes Awarded	Prizes
Winners	Up to two (2) anticipated cash prizes	$50,000 each
Runners-Up	Up to three (3) anticipated cash prizes	$25,000 each

Up to $175,000 in cash prizes

3D Solar Visibility Prize Process

Important Dates



Intent to Compete HeroX Package

All competitors must submit an intent to compete submission package by July 10 at 5 p.m. ET

Intent to compete form can be found on HeroX:

1. Go to: HeroX.com/3D-Solar-Visibility-Prize
2. Create a HeroX Account
3. Click on “Follow”
4. Click on “Solve This Challenge”

Item	Due	Content	Will Be Made Public	Scored
Intent to Compete HeroX Submission Package	July 10 by 5:00 pm ET	Cover page	Yes*	No
		One summary PowerPoint slide	Yes	No
		Intellectual property licensing agreements (if applicable)	No	No
OEDI SI DSSE Results Set Submissions	During the competition period, by 5:00 pm ET	See Section 9.5.2 of the Official Rules for details	No	Yes

*Only certain questions will be made public

Cover Page

- List basic information about your submission:
  - Team Name *(will be made public)*
  - Key Team Members (names, contact information, and links to their professional websites or LinkedIn profiles)
  - Competitor's city, and state *(will be made public)*
  - Competitor's nine-digit zip code
  - Statement of whether the competitor's organization currently provides distribution state estimation algorithm(s) commercially
  - The partners and affiliates who significantly helped competitors develop their model (if applicable).

To be completed via HeroX

Submission Summary Slide

- Make a public-facing, one-slide submission summary containing technically specific details about the competitor's DSSE algorithm (i.e., DSSE approaches and techniques used) that can be understood by most people
- There is no template
- Needs to be submitted as a PDF
- Slide will be made public after the competition ends.

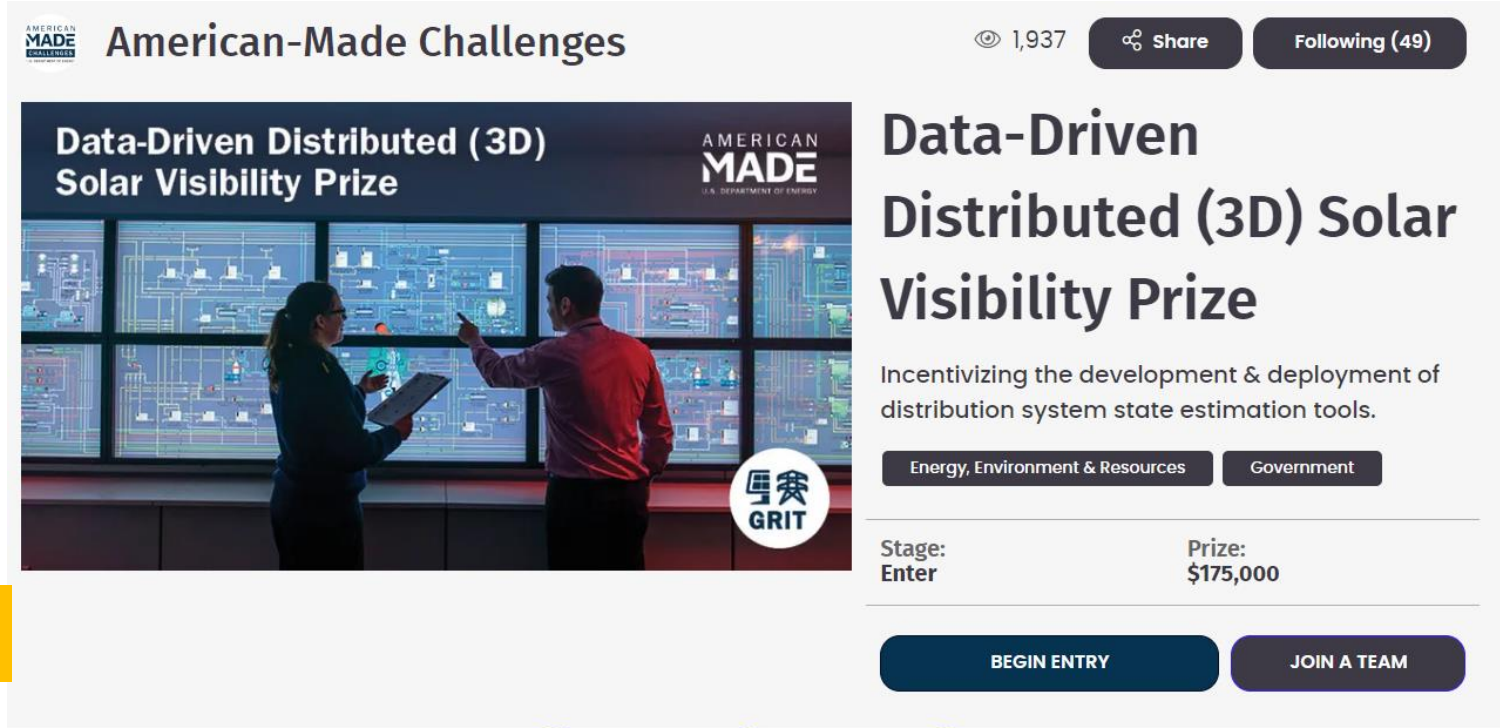
Intellectual Property Licensing Agreements

- Provide documentation showing that competitors have secured access to the intellectual property underlying their distribution state estimation algorithm(s) from the relevant institution where it was originally developed, where applicable.

- Needs to be submitted as a PDF

- Required, if applicable

HeroX Live Demo



Follow along

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Open Energy Data Initiative Solar Integration (OEDI-SI)

Submission Package Details

- Competitors must submit their distribution state estimator's results to the OEDI SI by **5 pm ET**
- The submission should include the following:
  - Results for each snapshot at 15-minute intervals of the 12-hour time-series
    - The estimated state variables (voltage magnitudes and phase angles)
    - Measurement residuals for all measurements [$res_i = y_i - y_i^e$, where y_i is a measurement, and y_i^e is the estimated measurement]
    - Any bad data detected.
    - Any distribution network topology change detected.

Submission Package Details (contd…)

- Failure to upload the daily result or results for one or more snapshot by the daily submission deadline will result in lower scores, because the daily and final scores will be averaged assuming all snapshots and daily results were provided by the competitors.
- The OEDI SI will reject DSSE results uploaded after the daily submission deadline. Competitors may, however, upload their results for future days even if they miss deadlines for some evaluation periods.

- If the OEDI SI is offline during the submission period, the corresponding evaluation period will not be included in the scores, and an additional day will be added to the competition.

- The OEDI SI will use the state variables values from a standard power flow algorithm, OpenDSS, for every 15-minute snapshot of the daily 12-hour time-series data using the original network data. The results from this algorithm will be used to benchmark the competitors' results.
- Competitors will receive daily a performance report that includes the reference results, and the metrics for each. The report will not include the results of other competitors.

Technical Details and Scoring

How We Score

The scoring of distribution state estimation results will proceed as follows:

- We will first calculate the metrics. See Appendix 2: Prize Metrics for more details.
  - M_1 is the mean absolute error for the state variables.
  - M_2 is a bonus for number of bad data correctly detected and identified (if any).
  - M_3 is the bonus for number of topology changes correctly detected and identified (if any).
- Then we will calculate a score for each day as the simple average of the $State\ Estimation\ Skill_{i,}$ calculated at 15-minute time intervals as the following:
  - $State\ Estimation\ Skill_i = M_1 + M_2 + M_3$
  - For each snapshot at 15-minute intervals of the 12-hour time-series for each day. The daily state estimation skill will be a simple average of the 15-minute state estimation skills for that day.
- Next, we will calculate the final average state estimation skill for the competition period (14 days) as:
  - $Final\ Average\ State\ Estimation\ Skill = {}^{1}/_{14} * \sum_{1}^{14} \quad Daily\ State\ Estimation\ Skill_i$
  - Final average state estimation skill will be the competitor's total score.

Prize Metrics

M_1 is the mean absolute error for the state variables; M_2 is the bonus for number of bad data detected and correctly identified (if any); and M_3 is the bonus for number of topology changes detected and correctly identified (if any).

There will not be bad data and topology changes *simultaneously* in the measurement set. In other words, there may be only bad data *OR* only topology change(s) in any of the measurement set. A particular measurement set will not flag any of these prior to the submission of results. The competitors are responsible for detecting and identifying them. They will be penalized for falsely reporting bad data or topology changes as explained below.

X_{MAE} is the mean absolute error [MAE] for the estimated state variables. It is calculated as the following:

$$X_{MAE} = \frac{1}{N}\sum_{i=1}^{N} |x_i - x_i^e|$$

Where x_i^e are the estimated state variables for x_i, defined by voltage magnitudes (*in per unit*) and phase angles (*in radians*) at distribution network nodes. $N = 2n - 1$, where *n* is the number of nodes (buses). M_1 is calculated as the following for *voltage magnitudes (in per units):*

- $M_1 = 1.00$ if $X_{MAE} \leq 0.005$
- $M_1 = -1.00$ if $0.02 \leq X_{MAE}$
- $M_1 = f(x)$ where f(x) is calculated as a linear function for $0.005 < X_{MAE} < 0.02$.

And, M_1 is calculated as the following for *voltage angles (in radians):*

- $M_1 = 1.00$ if $X_{MAE} \leq 0.017$
- $M_1 = -1.00$ if $0.09 \leq X_{MAE}$
- $M_1 = f(x)$ where f(x) is calculated as a linear function for $0.017 < X_{MAE} < 0.09$.

Prize Metrics

M_2 results in bonus points for the number of bad data correctly detected and identified (if any). It is calculated as the following.

- $M_2 = 0.2$ if 100% correctly detected and identified,
- $M_2 = 0.15$ if 75% correctly detected and identified.
- $M_2 = 0.1$ if 50% correctly detected and identified.
- $M_2 = 0.05$ if 25% correctly detected and identified.

This metric will be calculated by the prize administrator, because the actual number of bad data and their locations will not be known by the competitors. The competitors will also need to provide the measurement identity and location for the bad data measurement(s) they identified, and the prize administrator will ensure the measurement(s) identified as bad matches the actual bad data measurements.

The bad data detection and identification will need to be general and scalable. The competitors will have to define how they detect and identify bad data. Manual or arbitrary detection of measurements with gross errors (bad data) will not be acceptable.

Prize Metrics

M_3 results in bonus points for the number of topology changes correctly detected and identified (if any). It is calculated as the following.

- $M_3 = 0.2$ if 100% correctly detected and identified,
- $M_3 = 0.15$ if 75% correctly detected and identified.
- $M_3 = 0.1$ if 50% correctly detected and identified.
- $M_3 = 0.05$ if 25% correctly detected and identified.

This metric will be calculated by the prize administrator, because the actual number of topology changes and their locations will not be known by the competitors. Topology changes will include only on/off status changes at the switches provided in the network topology file. The competitors will also need to provide the switch number and location for the topology change(s) they identified, and the prize administrator will ensure the topology change(s) identified matches the actual topology change(s).

The topology change detection and identification algorithm will need to be general and scalable. The competitors will have to define how they detect topology changes. Manual or arbitrary detection of topology changes will not be acceptable.

Get Started Today!

Resources – Power Connectors

Competitors who are participating will be able to access support from ADL Ventures and Entrepreneur Futures Network (EFN), American-Made Power Connectors:

- Ask questions about the prize
- Receive feedback on submission materials
- Receive general support for the prize.

Find more information about Power Connectors on HeroX → Resources Tab.

ADL

- Contact Frank Yang at frank@adlventures.com

EFN

- Contact Tom Jensen at tjensen@entrepreneurfutures.org

Get Started Today!

- Follow the Challenge on HeroX: www.herox.com/3D-Solar-Visibility-Prize
- Read the Rules
- Post your questions to the Forum on HeroX
- Contact a Power Connector
- Email Data.Driven@nrel.gov with any questions
- **Submit your Intent to Compete by July 10, 2024, at 5 p.m. ET.**

Questions?

To Ask a Question:
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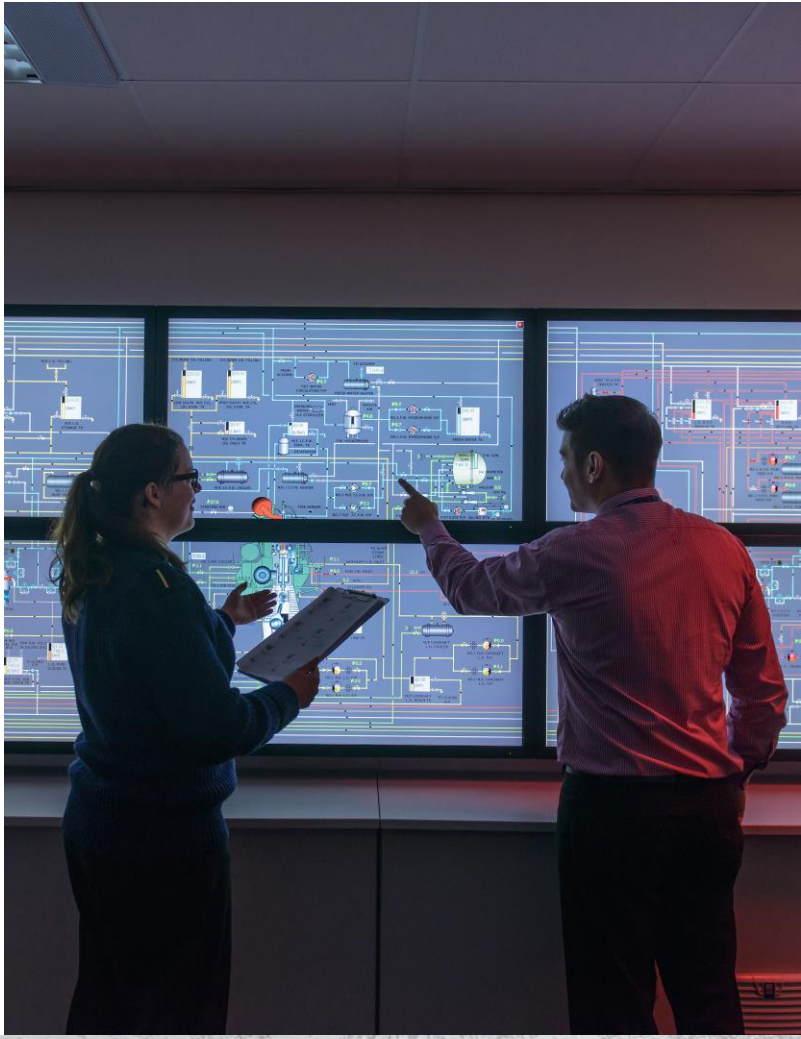

Thank you!

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