# AMERICAN MADE

## U.S. DEPARTMENT OF ENERGY

# Contents

# Modification Summary

| Date | Modifications |
|------|---------------|
| ==Revision 1== ==3/2/2022== | Page 9: Updated data availability date and clarified the NDA finalization process. Page 15: Clarified the evaluation criteria to indicate that only competitors whose forecasts have a positive forecast skill are eligible to win a prize. |
| ==Revision 2== ==3/24/2023== | Page 9: Modified dates of contest to allow for additional time for competitors to access the data following the release of the NDA. |
| ==Revision 3== ==4/17/2023== | Page 5: Updated anticipated number of data providers / locations to be no less than three. Page 9: Modified dates of contest to allow for additional time for competitors to access the data following the release of the NDA. |
| ==Revision 4== ==5/8/2023== | Page 9: Modified dates of contest to allow for additional time for competitors to access the date following the release of the NDA. Page 15: Modified dates of activities to align with dates of the contest. |

A M E R I C A N
MADE
U.S. DEPARTMENT OF ENERGY

# 1 Introduction

The American-Made Net Load Forecasting Prize is designed to incentivize innovators to develop probabilistic models that predict future amounts of net load—the difference between the "true load" (i.e., the total electricity demand of the loads) and the electricity generation in the distribution system from resources such as solar and other distributed generators—a day in advance of the forecast, while promoting the adoption of probabilistic forecasts and evaluation tools for such forecasts. This prize offers a total of up to $600,000 in cash prizes, with three anticipated winners and three anticipated runners-up.

Building a clean energy economy and addressing the climate crisis are top priorities of the Biden administration. This prize will advance the Biden administration's goals to achieve carbon-pollution-free electricity by 2035, "deliver an equitable, clean energy future, and put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050"[1] to the benefit of all Americans. The U.S. Department of Energy (DOE) is committed to pushing the frontiers of science and engineering; catalyzing clean energy jobs through research, development, demonstration, and deployment; and ensuring environmental justice and the inclusion of disadvantaged communities.

The activities incentivized by this prize will support the governmentwide approach to the climate crisis by promoting innovation and early deployment of clean energy technologies resulting in wider adoption, which are critical for climate change mitigation. Specifically, DOE's Solar Energy Technologies Office (SETO) in the Office of Energy Efficiency and Renewable Energy (EERE), in co-sponsorship with EPRI, is launching the Net Load Forecasting Prize to: (1) increase stakeholder awareness of the state of the art in net load forecasting; (2) demonstrate the feasibility of fair and high-quality evaluations of probabilistic net load forecasts using a publicly available, open-source platform; and (3) promote the use of probabilistic forecast models and an industry-common evaluation platform with transparent metrics and specifications for probabilistic net load forecasts. As co-sponsor of the prize, EPRI will provide historical net load data for competitors to train forecasting models, as well as providing operational support for the forecast evaluation platform used during the evaluation phase of the prize.

Institutions, companies, and nonprofit organizations based in the United States are eligible to compete. DOE expects to select three winners that will receive $200,000 (first place), $150,000 (second place), and $100,000 (third place) in cash, and three runners-up that will receive $50,000 each, based on the performance of their forecasting models.

Throughout the competition, competitors will have access to support from the American-Made Network, a diverse and powerful community of incubators, investors, philanthropists, fabrication facilities, and seasoned industry leaders who provide technical insight, business development expertise, product validation, and more.

Competitors will submit forecast model results for a number of diverse locations in the United States to the Solar Forecast Arbiter (SFA) platform. The number of locations will be no less than three and the locations will be published on the prize website. The SFA platform will be used to assess the models' forecasting performance.

Currently, the solar industry and its associated research community do not reflect the diversity of the United States. Women and minorities are underrepresented in the solar industry and in science, technology, engineering, and math (STEM) fields. STEM fields also lack diversity in geographical origin,

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[1] Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad" (Jan. 27, 2021).

with U.S. rural areas underrepresented relative to large population centers. Because STEM students and graduates support research and development (R&D) activities, which can often result in the formation of companies, the lack of diversity in that pipeline adversely affects opportunities and potential outcomes in scientific and economic output. To achieve the administration's energy justice goals, SETO is working to ensure that the work SETO funds will support more equitable participation in the solar energy community. SETO recognizes the inherent advantages of diverse teams and encourages competitors to consider diversity and inclusion when developing their teams. Additionally, the American-Made Network will support SETO in the recruitment of diverse applicants for the prize.

# 2 Background

As of summer 2022, solar accounted for about 5% of U.S. electricity produced on an annual basis. This means that to combat climate change, the nation's solar capacity would likely need to grow by hundreds of gigawatts in the next 15 years, with an annual rate of deployment three to four times higher than today's rate. The *Solar Futures Study*, released by SETO and the National Renewable Energy Laboratory (NREL) in September 2021, found that with aggressive cost reductions, supportive policies, and large-scale electrification, solar could account for as much as 40% of the nation's electricity supply by 2035 and 45% by 2050.

Integrating large amounts of variable energy resources, such as solar and wind, is a challenge for a power grid that was designed and built around central-generation thermal plants and unidirectional power flows. Predicting the net load allows grid operators to better plan for optimized procurement of reserves and utilization of other dispatchable energy sources. Given the uncertainty of future weather and the lack of visibility of behind-the-meter (BTM) solar generation (residential, commercial, and industrial solar installations), probabilistic forecasting can be a powerful tool when there are large amounts of solar energy on the grid, as it allows for cost-efficient planning and dispatch of energy generation and storage.

SETO has funded the development of advanced solar forecasting models, with an emphasis on predicting the formation, properties, and location of clouds over time horizons ranging from minutes to days. SETO has also supported the development of probabilistic forecast[2] as a technology better suited to the stochastic character of cloud cover.

Meanwhile, the increase in BTM solar has shined a light on the importance of net load forecasting for the reliable and cost-efficient operation of the national power system. SETO is funding research and development projects that use artificial intelligence and machine learning to improve the state-of-the-art forecasting of net load.

To help grid operators respond quickly to the changing environment, SETO has supported the development of the Solar Forecast Arbiter (SFA), an open-source, cloud-ready platform that facilitates the evaluation of forecasts for solar irradiance, solar power, and net load. The SFA can lower the cost and complexity of forecast evaluation for both end users and vendors. The platform (originally called "Solar Forecasting Arbiter") was developed by the University of Arizona with the help of DOE funding under SETO's Solar Forecasting 2 funding program. The SFA is now publicly available and under the stewardship of the Electric Power Research Institute (EPRI).

SETO has supported grid operators as they learn to use probabilistic forecasts and adaptive reserve calculations. To this end, past applicants of SETO funding opportunities have been encouraged to partner with balancing authorities and forecast vendors to boost the probability and pace of technology transfer. Prize competitors are encouraged to view presentations from the most recent SETO workshop on solar forecasting research and development, which covered current state-of-the-art and anticipated advances in data collection, sub-grid modeling, multiday forecasting, and integration of forecasts into real-world electricity generation. Competitors are also encouraged to view the website and results from SETO's recently completed American-Made Solar Forecasting Prize.

The Net Load Forecasting Prize will help address SETO's goals of achieving increased awareness of the state of the art in net load forecasting, demonstrating net load forecast evaluation by a public open-

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[2] https://www.energy.gov/eere/solar/improving-accuracy-solar-forecasting-funding-opportunity

source platform, promoting faster adoption of probabilistic forecasts by grid operators and establishing an industry-common platform and metrics for forecast evaluation.

# 3 Prize Overview

Every day for four weeks (28 consecutive days), competitors will submit probabilistic net load forecasts for each of the predetermined substations through the SFA platform. The submitted forecasts must have an hourly resolution. The SFA will compare the forecasts' performance against a benchmark forecast using a time-of-day persistence ensemble model (see Appendix 3 for more details).

The Net Load Forecasting Prize offers a total prize pool of $600,000 in cash.

Prize funding:

|  | Number of Prizes Awarded | Prizes |
|---|---|---|
| Winners | Up to three anticipated cash prizes | First: $200,000<br>Second: $150,000<br>Third: $100,000 |
| Runners-up | Up to three anticipated cash prizes | Fourth, fifth, and sixth each receive $50,000 |

SETO anticipates making a total of up to six awards (three winners and three runners-up) but may or may not award winners and runners-up, depending on the performance of the competitors and the discretion of the judge. However, the total prize purse will not exceed $600,000.

To learn more and sign up, go to https://www.herox.com/net-load-forecasting

# 4 Important Dates

- **Program Announced and Registration Opens:** February 7, 2023
- **Net-Load Forecasting Prize [Informational Webinar](#):** February 20, 2023, 3:00 p.m. ET

- **Intent to Compete HeroX Submission Package Deadline:** March 27, 3 p.m. ET
  - o **Note:** <mark>Competitors can only gain access to training data after they have submitted their Intent to Compete package and their countersigned NDA is accepted</mark>. Please note there is an expected delay of 5 business days between the submission of the signed NDA and the approval to access the training data.

- **Solar Forecast Arbiter Technical Webinar for Registered Competitors:** <mark>May 23, 1:00 p.m. ET</mark>

- **Solar Forecast Arbiter Test Week (via SFA platform):** <mark>June 5, 2023, thru June 9, 2023</mark>
  - o **Note:** The Test Week is meant to give an opportunity to competitors to test their forecast submission process with the SFA platform before the actual competition begins. Participation is entirely optional but highly encouraged.
- **Forecast Submission Period (via SFA platform):** <mark>June 18, 2023 until July 16, 2023</mark>
- **Winners and Awards Announced:** <mark>August 2023 (anticipated).</mark>

For the most up-to-date information on prize deadlines and events, please visit our website: https://www.herox.com/net-load-forecasting

# 5 Prize Administrator

The National Renewable Energy Laboratory (NREL) will support competitors by cultivating resources and building connections through the American-Made Network that enhance, accelerate, and amplify their efforts. The objective is to link competitors with potential new team members as well as the resources, financing, perspectives, and relevant industry expertise necessary for long-term success.

# 6 Eligibility Requirements

To compete in the Net Load Forecasting Prize, competitors must comply with the eligibility requirements below. By uploading an Intent to Compete submission package, a competitor certifies that they are in compliance with these eligibility requirements. Eligibility is subject to verification before prizes are awarded. As soon as the prize administrator becomes aware that a competitor is not eligible to win the prize, the competitor may be disqualified. The registered competitor is the individual or entity that registers in HeroX to compete.

In keeping with the goal of growing a community of innovators, competitors are encouraged to form diverse, multidisciplinary teams while developing their concepts. The HeroX platform provides a space where parties interested in collaboration can post information about themselves and learn about others who are also interested in competing.

- Private entities (for-profits and nonprofits), and nonfederal government entities (such as states, counties, tribes, municipalities, and academic institutions) are eligible to compete, subject to the following requirements:
    - Academic institutions must be based in the United States.
    - Private entities must be incorporated in and/or maintain a primary place of business in the United States with majority domestic ownership and control. This includes U.S.-based subsidiaries of entities incorporated in foreign countries.
    - If an entity seeking to compete does not have majority domestic ownership and control, EERE may consider issuing a waiver of that eligibility requirement where (1) the entity submits a compelling justification; (2) the entity is incorporated in and maintains a primary place of business in the United States; and (3) the entity otherwise meets the eligibility requirements. 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 Appendix 2 for more information on the waiver process.
- Individuals are not eligible to compete in this prize.
- Federally Funded Research and Development Centers (FFRDCs) are not allowed to compete. However, individual researchers affiliated with FFRDCs may compete if the expenses for the submission are covered by a third party.
- Federal employees are not eligible to win any prizes in this program.
- Researchers at federal facilities may provide a submission as a registered competitor in this prize and can receive honorable mention, but are not eligible to receive any cash prizes.
- Employees of an organization that co-sponsors this program with DOE are not eligible to participate in this competition.
- Individuals who worked at DOE (federal employees or support service contractors) within six months prior to the submission deadline are not eligible to participate in this program. Additionally, members of their immediate families (i.e., spouses, children, siblings, or parents) and anyone who lives in their household, regardless of relation, are not eligible to participate.
- NREL employees directly involved in the administration of this prize are not eligible to participate in this program.

- 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 by the Department of Homeland Security (DHS) Binding Operational Directives (BOD) as an entity publicly banned from doing business with the United States government are not eligible to compete. See https://cyber.dhs.gov/directives/.
- Entities and individuals identified as a restricted party on one or more screening lists of Departments of Commerce, State, and the Treasury are not eligible to compete. See the Consolidated Screening List: https://www.trade.gov/consolidated-screening-list.
- This prize is expected to positively impact U.S. economic competitiveness. Participation in a foreign government talent recruitment program[3] 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[4] are not eligible to compete.
- As part of competitors' submission to this prize program, competitors 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 in providing this submission to the Federal Government, I certify under penalty of perjury that the named competitor meets the eligibility requirements for this prize 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.

# 6.1 Number of Submission Packages Allowed

Multiple submissions are not allowed. Each organization is allowed to have one submission each.

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[3] 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 participants 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.
[4] Currently, the list of countries of risk includes Russia, Iran, North Korea, and China.

# 7 Program Goal Requirements

Only submissions relevant to the goals of this program are eligible to compete. DOE will review all submissions to ensure that the following statements are **true**:

- The submitted forecasts are probabilistic forecasts of net load and are submitted in a manner compliant with the submission requirements of the SFA platform.
- The proposed solution 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 Appendix 1.

**COMPETITORS WHO DO NOT COMPLY WITH THESE REQUIREMENTS MAY BE DISQUALIFIED**

# 9 Rules

## 9.1 Introduction

The Net Load Forecasting Prize is a single-contest program with $600,000 in cash prizes. This competition focuses on three key areas:

- Identifying the best-performing probabilistic forecasting models.
- Demonstrating fair and transparent evaluation of probabilistic net load forecasts using a publicly available open-source platform.
- Promoting the adoption of probabilistic forecasting products by end users, such as independent system operators, integrated utilities, and other balancing authorities.

| Cash Prizes |
| --- |
| <ul><li>Up to three anticipated winners</li><li>Up to three anticipated runners-up</li><li>First-, second-, and third-place winners receive $200,000, $150,000, and $100,000 each, respectively</li><li>Each runner-up receives $50,000.</li></ul> |

The following rules are for potential and actual competitors in the Net Load Forecasting Prize.

## 9.2 Prizes to Win

The prize offers cash prizes of $200,000, $150,000, and $100,000 for three anticipated winners (first, second, and third, respectively) and $50,000 for three anticipated runners-up (fourth, fifth, and sixth).

## 9.3 How to Enter

Competitors must submit an Intent to Compete submission package on HeroX by the submission deadline. After the competitor submits an Intent to Compete submission package and is verified as eligible, competitors will be asked create a profile on the Solar Forecast Arbiter platform and sign a non-disclosure agreement (NDA) before receiving access to the forecast model training data.

 See Section 4 ("Important Dates") for information regarding submission deadlines and Section 9.4 for more information on the overall prize process.

## 9.4 Prize Process

The prize requires the following steps:

1. **Sign Up To Compete** – To sign up and prepare for the prize, competitors are asked to complete the following steps by March 27, 2023, at 3 p.m. ET:

    1A: **Create a HeroX account** and follow the prize on HeroX for updates and notifications.

    1B (optional): If desired, determine appropriate partners for competitors' team.

    1C: **Submit an Intent to Compete submission package** via the HeroX platform before the registration deadline. The submission can be accessed after creating an account on HeroX by clicking "Solve this Challenge" and then "Begin Entry" on the HeroX prize website.

    1D: **Receive Solar Forecast Arbiter Platform log in credentials and sign a the NDA**. After creating an account in HeroX and submitting an Intent to Compete submission form the prize

administrator will confirm eligibility and will register the competitor on the Solar Forecast Arbiter (SFA) platform. SFA Platform log-in details will then be sent to the competitor along with instructions on how to sign the NDA to access the forecast model training data.

2. **Solar Forecast Arbiter Test Week** – There will be a week provided (anticipated to last from June 5 to June 9, 2023) for competitors to test uploading forecasts to the SFA platform. Competitors may use this week to ensure understanding of any SFA-related tasks for the prize. The test week will be led by EPRI, who will serve as the SFA platform operator.

3. **Forecast Submission** – For each of the 28 days of the forecast evaluation period (anticipated to last from June 18 to July 16, 2023), competitors must upload to the SFA platform a day-ahead probabilistic net load forecast for each of the locations specified (locations to be posted on HeroX), per Section 9.5.2 of this rules document. Reports will be generated nightly to allow competitors to understand their performance as the competition progresses.

4. **Ranking** – All competitors whose forecasts perform better than the time-of-day persistence ensemble benchmark (see Appendix 3) in each location will be displayed with their assigned anonymized pseudonyms on the HeroX website, ranked by forecast skill. Details about the forecast skill calculation are in Section 10. At the end of the competition, the prize administrator will make public the team names and/or team organization names of the winning and runner-up teams.

5. **Evaluation** – Competitors will be evaluated on the accuracy of their forecasts compared to a benchmark. Only competitors whose forecasts have a positive forecast skill are eligible to win a prize. Section 10 describes the calculation of the forecast skill. A positive skill signifies that the forecast is more accurate than the reference, or benchmark, forecast (in this case, the persistence ensemble forecast, described in Appendix 3).

   - On the first business day after the end of the forecast competition, the SFA platform operator will generate a final report for each competitor with the calculated metrics for the submitted forecasts. Competitors will receive a copy of their report.

6. **Announcement** – Approximately one month after the competition closes, the prize administrator notifies winners and runners-up and requests the necessary information to distribute cash prizes. The prize administrator will then publicly announce winners and runners-up. Winners and runners-up may be invited to present at a stakeholder workshop (to be organized by DOE and EPRI) following the winner announcement.

# 9.5 What To Submit

Competitors will need to complete a HeroX Intent to Compete HeroX submission package as well as uploading daily forecasts during the forecast period via the Solar Forecast Arbiter:

| Item | Content | Will Be Made Public | Scored |
|---|---|---|---|
| Intent to Compete HeroX Submission Package | Cover page | No | No |
| | One summary PowerPoint slide | Yes | No |
| | Intellectual property licensing agreements (if applicable) | No | No |
| Solar Forecast Arbiter Submissions | See Section 9.5.2 for details | No | Yes |

> **Note**: Portions of the submission package are made available to the public. These have been denoted as such, and DOE does not intend to release the remaining parts of the submission to the public. See Appendix 1 for additional details.

**All documents must be uploaded as a PDF.**

# 9.5.1 HeroX Intent to Compete Submission Package

Competitors are required to submit the following items:

| Cover Page – List basic information about your submission (public) |
|---|
| • Team name<br>• Key team members (names, contact information, and links to their professional websites or LinkedIn profiles)<br>• Competitor's city, state, and nine-digit zip code<br>• Whether the competitor's organization currently provides forecasting services commercially<br>• The partners and affiliates who significantly helped competitors develop their model (if applicable). |

| Submission Summary Slide – A PowerPoint slide as a PDF (public) |
|---|
| Make a public-facing, one-slide submission summary containing technically specific details about the competitor's model (i.e., modeling techniques used) that can be understood by most people. There is no template, so competitors should feel free to present the information as they see fit. Please make any text readable in a standard printout and conference room projection. |

| **Intellectual Property Licensing Agreements** (required if applicable, as a PDF) |
|---|
| Provide documentation showing that competitors have secured access to the intellectual property (IP) underlying their forecasting algorithm from the relevant institution where it was originally developed, where applicable. |

## 9.5.2 Solar Forecast Arbiter Submission Package Details

Competitors must submit day-ahead probabilistic forecasts to the SFA that meet the following requirements:

- Issue time of day: 10 a.m. local at each site[5]
- Lead time to start: 14 hours
- Run length: 24 hours
- Interval length: 1 hour
- Interval label: Ending
- Interval value type: Average
- Variable: Net load (% of peak)
- Percentiles: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100.

The forecasted net load percentiles for each of the 24 hourly intervals beginning with hour 01 on day+1 through hour 24 on day+1 must be sent to SFA in the required format before 10 a.m. in the applicable forecast location. Forecasts will be time-stamped with the end time of each interval (i.e., hour 01 = 00:01 until 01:00; hour 02 = 01:01 until 02:00; … ; and hour 24 = 23:01 until 00:00).

See the SFA documentation for definitions of the terms used above.

Failure to upload forecasts by the daily submission deadline will result in all percentiles being set to zero for the corresponding evaluation period.

In the event that the SFA is offline for the hour before a submission deadline, the corresponding evaluation period will not be included in the scores.

The SFA will reject forecasts uploaded after the daily submission deadline. Competitors may, however, upload forecasts for future days and then overwrite these values until the daily deadline. For example, until day 4 at 10:00 local time at a given site, competitors may submit forecasts for day 5 at 00:00 through 23:00 *and later*.

The SFA will compute the Continuous Ranked Probability Skill Score (CRPSS, or Forecast Skill), as shown below (section 10), of competitors' submitted forecasts with respect to the persistence ensemble benchmark forecast. CRPSSs will be calculated at the end of each day.

Competitors will receive daily a performance report that includes their forecast, the reference forecast, and the metrics for each. The report will not include the forecast time series of other competitors.

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[5] A final site list will be posted on HeroX.

The SFA will exclude nighttime from the analysis. Nighttime hours are the hours in which the solar zenith angle is greater than 87 degrees for each minute of the hour. Hours that have any minutes of daylight (solar zenith angle is less than 87 degrees) will be included in the analysis.

The SFA provides an example script to help users become acquainted with using the application programming interface (API) for operational evaluations.

# 10 How We Score

The scoring of forecasts will proceed as follows:

- The Continuous Ranked Probability Score (CRPS; see Appendix 4) will be calculated for each set of the 28 submitted forecasts—e.g., $CRPS_{i,k}$ for the $i$-th location and the $k$-th competitor. The Forecast Skill will be calculated against the CRPS of the baseline persistence ensemble forecast, which will be designated as $CRPS^{PEF}_i$ for the $i$-th location:

- $Forecast\ Skill_{i,k} = CRPSS_{i,k} = 1 - \dfrac{CRPS_{i,k}}{CRPS_i^{PEF}}$
  - Competitors' final forecast scores will be calculated as follows: competitors' Forecast Skill values will be averaged across all locations and then rounded to two decimal points. This value will be multiplied by 100. The result of this multiplication will be the competitor's total score.

- Interviews: The prize administrator, at its sole discretion, may decide to hold a short interview with the winners. Interviews would be held after the announcement of winners and would serve as further discussion about the winners' forecasting algorithms. Attending interviews is not required.

- The judge's final determination of winners will take into account total scores and the program policy factors listed in Appendix 1. DOE is the judge and final decision maker and may elect to award all, none, or some of the submissions accepted.

# Appendix 1: Additional Terms and Conditions

## A1.1 Universal Prize Requirements

Each competitor's submission for the Net Load Forecasting Prize is subject to the following terms and conditions:

- If any team member is actively receiving funding from SETO at the submission deadline, SETO will review any potential prize awards, as well as other DOE funding, and make a decision as to whether awarding a prize to individuals or entities already receiving funding is in line with the program policy factors stated later in these rules (Section A1.13).

- Competitors must post the final content of their submission or upload the submission form online at https://www.herox.com/net-load-forecastingbefore the prize closes. Late submissions or any other form of submission do not qualify.

- The summary slide will be made public.

- The cover page, narrative, and letters of commitment/support are not intended to be made public; however, see Section A1.10 regarding the Freedom of Information Act (FOIA).

- Competitors must include all the required submission elements. The prize administrator may disqualify a competitor's submission after an initial screening if the competitor fails to provide all required submission elements. Competitors may be given an opportunity to rectify submission errors due to technical challenges.

- Competitors' submissions must be in English and in a PDF readable and searchable format. Scanned handwritten submissions will be disqualified.

- Competitors will be disqualified if any engagement during the Net Load Forecasting Prize— including but not limited to the submission, the online forum, emails to the prize administrator, or other forms of communication—contains any matter that, in the discretion of DOE, is indecent, lacking in professionalism, or demonstrates a lack of respect for people or life on this planet.

- If competitors click "Accept" on the HeroX platform and proceed to register for the competition described in this document, these rules will form a valid and binding agreement between competitors and DOE and is in addition to the existing HeroX Terms of Use for all purposes relating to this competition. Competitors should print and keep a copy of these rules. These provisions apply only to the competition described here and no other competitions on the HeroX platform or anywhere else.

- The prize administrator, when feasible, may give competitors an opportunity to fix nonsubstantive mistakes or errors in their submission packages.

## A1.2 Verification for Payments

The prize administrator will verify the identity and the role of a participant entity 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 (or parent/guardian if under 18 years of age) 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 and a completed W-9 form (https://www.irs.gov/pub/irs-pdf/fw9.pdf). At 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.

## A1.3 Teams and Single-Entity Awards

The prize administrator will award a single dollar amount to the business entity designated by the primary submitter, whether consisting of a single entity or multiple entities. The winning business entity is solely responsible for allocating any prize funds among its member competitors as they deem appropriate.

## A1.4 Submission Rights

By making a submission and consenting to the rules of the competition, a competitor is granting to DOE, the prize administrator, and any other third parties supporting DOE in the competition, a license to display publicly and use the parts of the submission that are designated as "public" for government purposes. This license includes posting or linking to the public portions of the submission on the prize administrator's or HeroX's applications, the competition website, DOE websites, and partner websites, and the inclusion of the submission in any other media, worldwide. The submission may be viewed by DOE, the prize administrator, and reviewers for purposes of this competition, including, but not limited to, screening and evaluation purposes. The prize administrator and any third parties acting on their behalf will also have the right to publicize the competitors' names and, as applicable, the names of competitors' team members and organizations, which participated in the submission on the competition website indefinitely.

By entering, the competitor represents and warrants that:

- The competitor is the sole, original author and copyright owner of the submission or that the applicant has acquired sufficient rights to use and to authorize others, including DOE, to use the submission as specified throughout the rules; that the submission does not infringe upon any copyright, trade secret, trademark, nondisclosure agreement, patent, or any other third-party rights; and that the submission is free of malware.

## A1.5 Copyright

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

## A1.6 Prize Subject to Applicable Law

This competition is subject to all applicable federal laws and regulations. Participation constitutes each participant's full and unconditional agreement to these official rules and administrative decisions, which are final and binding in all matters related to the competition. This notice is not an obligation of funds; the final awards are contingent upon the availability of appropriations.

# A1.7 Resolution of Disputes

DOE is solely responsible for administrative decisions, which are final and binding in all matters related to the competition.

In the event of a dispute, the authorized account holder of the email address used to register will be deemed to be the competitor. The "authorized account holder" is the natural person or legal entity assigned an email address by an internet access provider, online service provider, or other organization responsible for assigning email addresses for the domain associated with the submitted address. Competitors and potential winners may be required to show proof of being the authorized account holder.

The prize administrator will not arbitrate, intervene, advise on, or resolve any matters between team members or any disputes between competitors.

# A1.8 Publicity

The winners of these prizes (collectively, "Winners") will be featured on DOE's and NREL's websites.

Except where prohibited, participation in the competition 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.

# A1.9 Liability

Upon registration, all participants agree to assume and, thereby, have assumed any and all risks of injury or loss in connection with or in any way arising from participation in this competition or development of any submission. Upon registration, except in the case of willful misconduct, all participants agree to and, thereby, do waive and release any and all claims or causes of action against the federal government and its officers, employees, and agents for any and all injury and damage of any nature whatsoever (whether existing or thereafter arising; whether direct, indirect, or consequential; and whether foreseeable or not) arising from their participation in the competition, whether the claim or cause of action arises under contract or tort.

In accordance with the delegation of authority to run this competition delegated to the director of SETO, the director has determined that no liability insurance will be required of competitors to compete in this competition, per 15 USC 3719(i)(2).

# A1.10 Records Retention and Freedom of Information Act (FOIA)

All materials submitted to DOE as part of a submission become DOE records. Any confidential commercial information contained in a submission should be designated at the time of submission.

Competitors are encouraged to employ protective markings in the following manner:

- The cover sheet of the submission must be marked as follows and identify the specific pages containing trade secrets or commercial or financial information that is privileged or confidential:

  Notice of Restriction on Disclosure and Use of Data:

  Pages [list applicable pages] of this document may contain trade secrets or commercial or financial information that is privileged or confidential and is exempt from public disclosure. Such

information shall be used or disclosed only for evaluation purposes. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

- The header and footer of every page that contains trade secrets or privileged commercial or financial information must be marked as follows: "May contain trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure."

- In addition, each line or paragraph containing trade secrets or commercial or financial information that is privileged or confidential must be enclosed in brackets.

Competitors will be notified of any FOIA 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.

## A1.11 Privacy

If competitors choose to provide HeroX with personal information by registering or completing the submission package through the competition website, competitors 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 competitors in matters regarding the competitor's submission and/or the competition unless competitors choose to receive updates or notifications about other competitions or programs from DOE on an opt-in basis. DOE and NREL are not collecting any information for commercial marketing.

## A1.12 General Conditions

DOE reserves the right to cancel, suspend, and/or modify the competition, 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 competition, as determined by DOE in its sole discretion, DOE may cancel or modify the competition.

Although DOE indicates that it will select up to several winners for the competition, DOE reserves the right to only select competitors that are likely to achieve the goals of the prize. If, in DOE's determination, no competitors are likely to achieve the goals of the prize, DOE will select no competitors to be winners and will award no prize money.

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

## A1.13 Program Policy Factors

While the scores of the expert reviewers will be carefully considered, it is the role of the prize administrator to maximize the impact of competition funds. Some factors outside the control of competitors and beyond the independent expert reviewer scope of review may need to be considered to accomplish this goal. The following is a list of such factors. In addition to the reviewers' scores, the following program policy factors may be considered in determining winners:

- Geographic diversity and potential economic impact of projects in a variety of markets
- Whether the use of additional DOE funds and provided resources continue to be nonduplicative and compatible with the stated goals of this program and DOE's mission generally
- The degree to which the submission exhibits technological or programmatic diversity when compared to the existing DOE project portfolio and other competitors

- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers
- The degree to which the submission is likely to lead to increased employment and manufacturing in the United States or provide other economic benefit to U.S. taxpayers
- The degree to which the submission will accelerate transformational technological, financial, or workforce advances in areas that industry by itself is not likely to undertake because of technical or financial uncertainty
- The degree to which the submission supports complementary DOE efforts or projects, which, when taken together, will best achieve the research goals and objectives
- The degree to which the submission expands DOE's funding to new competitors and recipients that have not been supported by DOE in the past
- The degree to which the submission exhibits team member diversity and the inclusion of underrepresented groups, with participants including but not limited to graduates and students of historically Black colleges and universities (HBCUs) and other minority-serving institutions (MSIs) or members operating within Qualified Opportunity Zones or other disadvantaged communities[6]
- 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.

# A1.14 Return of Funds

As a condition of receiving a prize, competitors agree that if the prize was awarded 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.

# A1.15 Definitions

**Prize administrator** means both the Alliance for Sustainable Energy, operating in its capacity under the Management and Operating Contract for NREL, and SETO. When the prize administrator is referenced in this document, it refers to staff from both the Alliance for Sustainable Energy and SETO. Ultimate decision-making authority regarding competition matters rests with the director of SETO.

**Solar Forecast Arbiter (SFA) operator** means the technical team from EPRI, who run and maintain the SFA.

**Judge** is the DOE official who makes the final decision for the winners and runners-up, taking into consideration total scores and the program policy factors listed in Appendix 1.

**Competitor** is an individual, organization, or team that registers to compete in the prize and submits the required items to be considered eligible for a cash prize.

**Forecast Skill** is the metric used to evaluate the performance of each competitor's submitted forecasts.

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[6] DOE defines "disadvantaged communities" as areas that most suffer from a combination of economic, health, and environmental burdens, such as poverty, high unemployment, air and water pollution, and presence of hazardous wastes, as well as high incidence of asthma and heart disease. Examples 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.

**Continuous Ranked Probability Score (CRPS)** is a metric that is a designed to measure both the reliability and accuracy of a probabilistic forecast (see Appendix 4).

# Appendix 2: Request To Waive the "Domestic Ownership and Control" Eligibility Requirement

## A2.1 Waiver

If an entity seeking to compete does not have majority domestic ownership and control, the Office of Energy Efficiency and Renewable Energy (EERE) may consider issuing a waiver of that eligibility requirement where (1) the entity submits a compelling justification; (2) the entity is incorporated in and maintains a primary place of business in the United States; and (3) the entity otherwise meets the eligibility requirements. EERE will not waive the eligibility requirement that all competing entities must be incorporated in and maintain a primary place of business in the United States. Entities seeking a waiver should include a justification along with their submission. EERE may require additional information before making a determination on the waiver request. There are no rights to appeal DOE's decision on the waiver request.

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

## A2.2 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 U.S. industry and U.S. economic development.

## A2.3 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 to which 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 benefitted U.S. research, development, and manufacturing, including contributions to employment in the United States and growth in new U.S. markets and jobs.

# Appendix 3: Time-of-Day Persistence Ensemble Benchmark Forecast

Persistence is among the simplest forecasting methods. The method takes observed data from a set time period prior to the forecast, and forecasts that the future data values will be the same as the previous observed data value. In this prize, the time-of-day persistence ensemble benchmark forecast calculates the forecast by aggregating the observed net load in units of percentage of peak load (%) on an hourly basis from the last 30 days and calculating the probability of net load values for every hour of the next day.

A more detailed description of the implementation of the time-of-day persistence ensemble can be found at [https://solarforecastarbiter-core.readthedocs.io/en/latest/generated/solarforecastarbiter.reference_forecasts.persistence.persistence_probabilistic_timeofday.html](https://solarforecastarbiter-core.readthedocs.io/en/latest/generated/solarforecastarbiter.reference_forecasts.persistence.persistence_probabilistic_timeofday.html).

For an overview of benchmark forecasts, including probabilistic forecasts, please refer to the work by Doubleday, Van Scyoc Hernandez, and Hodge, linked in [https://www.osti.gov/biblio/1762478-benchmark-probabilistic-solar-forecasts-characteristics-recommendations](https://www.osti.gov/biblio/1762478-benchmark-probabilistic-solar-forecasts-characteristics-recommendations).

# Appendix 4: Continuous Ranked Probability Score (CRPS)

The CRPS is a score that is a designed to measure both the reliability and accuracy of a probabilistic forecast.[7] For a time series of forecasts comprising a cumulative distribution function (CDF)—a function that gives the probability that a random variable is less than or equal to the independent variable of the function—at each time point, the CRPS is:

$$CRPS = \frac{1}{n} \sum_{i=1}^{n} \int (F_i(x) - O_i(x))^2 dx$$

where *n* is the number of forecast time stamps, *x* is the forecast quantity (Net load (% of peak)) in the case of this competition), *F_i(x)* is the CDF of the forecast quantity *x* at time stamp *i*, *O_i(x)* is the CDF associated with the observed value $x_i$, and *dx* is the change in *x*:

$$O_i = \begin{cases} 0, & x < x_i \\ 1, & x \geq x_i \end{cases}$$

The CRPS reduces to the mean absolute error (MAE) if the forecast is deterministic.

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**This is the end of the rules document; thank you for reading.**

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[7] J. E. Matheson and R. L. Winkler. 1976. "Scoring Rules for Continuous Probability Distributions." *Management Science* 22 (10): 1087–1096. DOI: 10.1287/mnsc.22.10.1087.

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