American-Made Challenges Video

Link: https://www.youtube.com/watch?v=a2S00Z47VXw

This webinar will be recorded.

American-Made Challenges

SOLAR FORECASTING PRIZE

Informational Webinar

Agenda

1. Background on the American-Made Challenges Program
2. Solar Forecasting Prize Background
3. Prize Overview, Registration Process and Winner Selection
4. Solar Forecast Evaluation Period and Solar Forecast Arbiter Program
5. How to Use HeroX

Housekeeping

Two Options for Audio (select audio mode):

1. Listen through your computer:
   Click the ‘up arrow’ next to the “mute” button in the bottom left corner.
   Under “Select a Speaker,” click “Same as System.”
2. Listen by telephone:
   Click the ‘up arrow’ next to the “mute” button in the bottom left corner.
   Click “Switch to Phone Audio.”

Panelists – reminder to mute your audio device when not presenting.

To Ask a Question:

Select the ‘Q&A’ button at the bottom of your screen and type in your question.

Having Trouble with the Webinar?

Technical difficulties - contact Zoom Support at: 888-799-9666.
A video/audio recording of this webinar and the slide deck will be made available.

Background on the American-Made Challenges Program

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

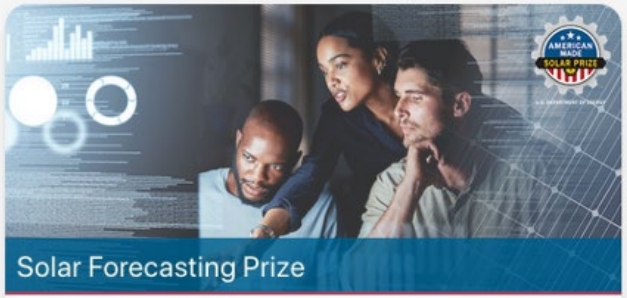
so ideas can become real products in months, not years

Solve Network

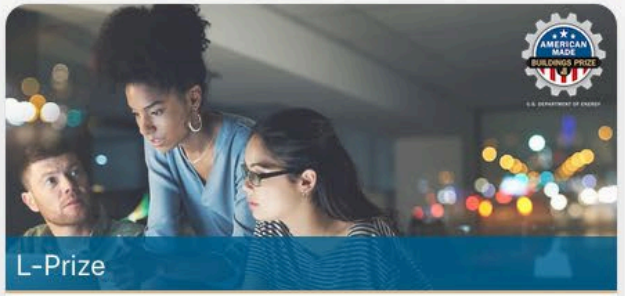
Our Prizes

https://americanmadechallenges.org

View prizes by status: all



up to $375,000 in prizes — enter now — enter by 12/15/2021



up to $12.2 million in prizes — enter now — enter by 11/19/2021

up to $250,000 in prizes — enter now — register by 10/29/2021

up to $2.5 million in prizes — enter now — enter by 02/25/2022

over $100,000 in prizes — coming soon

up to $3 million in prizes — coming soon

Grants vs. Prizes

Financial Award Process

- Write and submit concept papers
- Concept paper review
- Applicants write and submit full applications
- Full applications review
- Selections and negotiations
- **Begin performing**
- Prepare and submit reimbursement request
- Request reviewed and reimbursement issued

Prize Award Process

- Register for the Prize
- **Perform (submit forecasts and plan)**
- Reviewers score submissions
- Winners receive payment

Solar Forecasting Prize Background

What is the Solar Forecasting Prize?

The American-Made Solar Forecasting Prize incentivizes innovators to develop probabilistic tools that predict how much energy solar power plants will generate days in advance of the forecast, while rewarding bold commercialization plans and innovative ideas to accelerate the adoption of probabilistic forecasts.

This prize offers a total of up to $375,000 in cash prizes, with five anticipated winners and five anticipated runners-up.

Improvements to Solar Forecasting and Prize Goals

Solar accounts for about 3% of U.S. electricity, which 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.

Improvements in solar forecasting would:

- Support solar stakeholders such as electric utilities and other grid operators to serve their customers more reliably and cost-effectively.
- Support cost-efficient planning and dispatch of energy generation and storage.

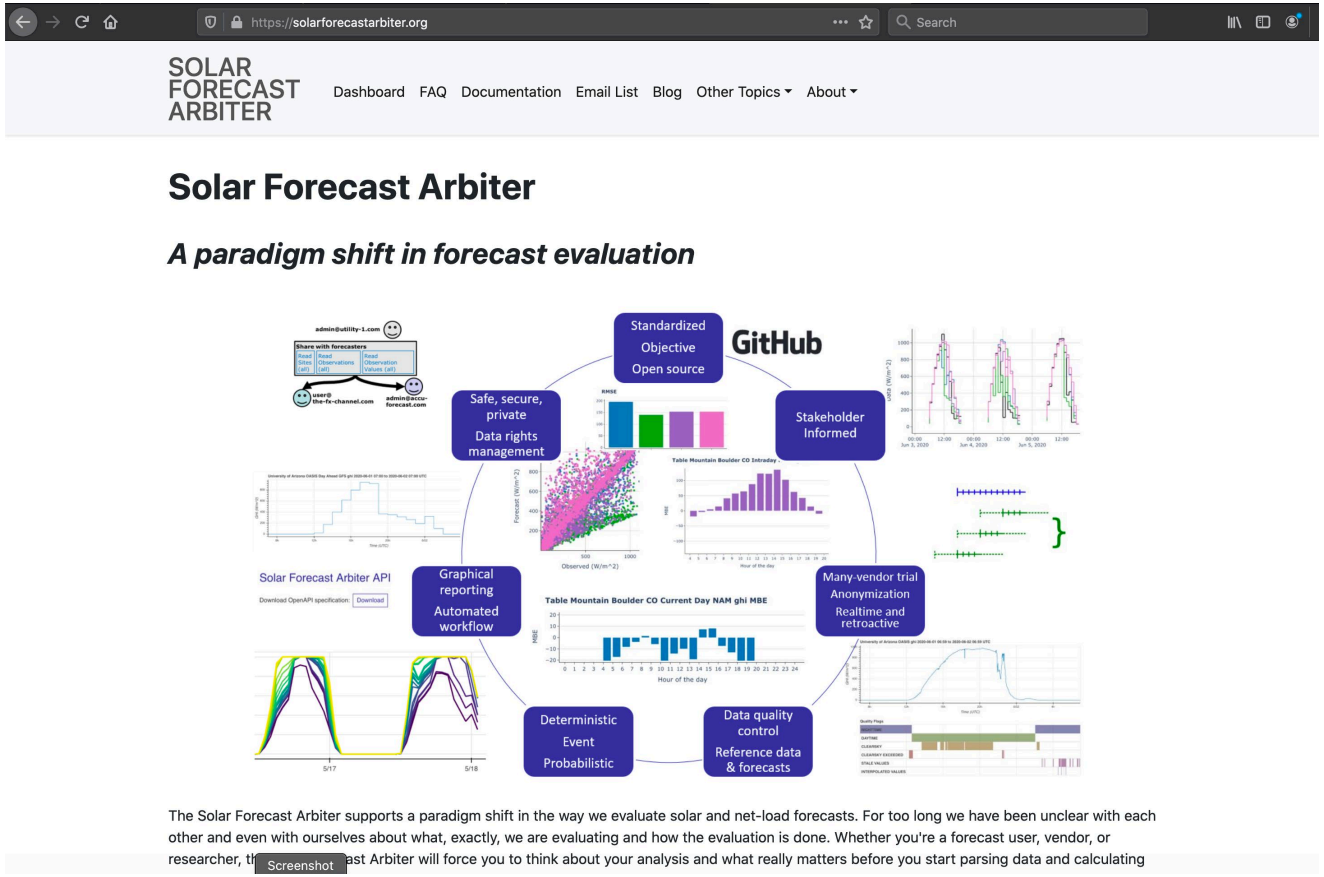
Solar Forecasting Prize goals:

- Identify the best-performing probabilistic forecasting models.
- Generate strong commercialization plans that could increase the availability of probabilistic solar forecasting algorithms on the market.
- Solicit innovative plans to accelerate adoption of probabilistic forecasting products by end users, such as independent system operators, integrated utilities, and other balancing authorities.
- Support the use of transparent metrics and specifications of probabilistic solar forecasts, through an open platform, such as the Solar Forecast Arbiter.

Solar Forecast Arbiter Background

Solar Forecast Arbiter (SFA) is an open-source, cloud-ready platform that facilitates evaluation of forecasts for solar irradiance, solar power, and net load.

University of Arizona led the development of the platform under the U.S. Department of Energy Solar Energy Technologies Office's Solar Forecasting II funding program.



Solar Forecasting Prize Overview and Registration Process

Prizes

This prize offers a total of $375,000 in cash prizes, with five anticipated winners and five anticipated runners-up.

	Number of Prizes Awarded	Prizes
Winners	5 anticipated winners	Each winner receives $50,000 in cash
Runners up	5 anticipated runners-up	Each runner-up receives $25,000 in cash

WHO?

CAN COMPETE

Any U.S.-based individual or team with a desire to transform ideas into impactful new solutions

Scientists

Students & Faculty

Businesses (of any size)

Anyone with a BIG! idea

Read the Rules

U.S. DEPARTMENT OF ENERGY

Official Rules

American-Made Solar Forecasting Prize

The American-Made Solar Forecasting Prize is designed to accelerate the commercialization and adoption of probabilistic tools that predict the amount of energy solar power plants generate days in advance.

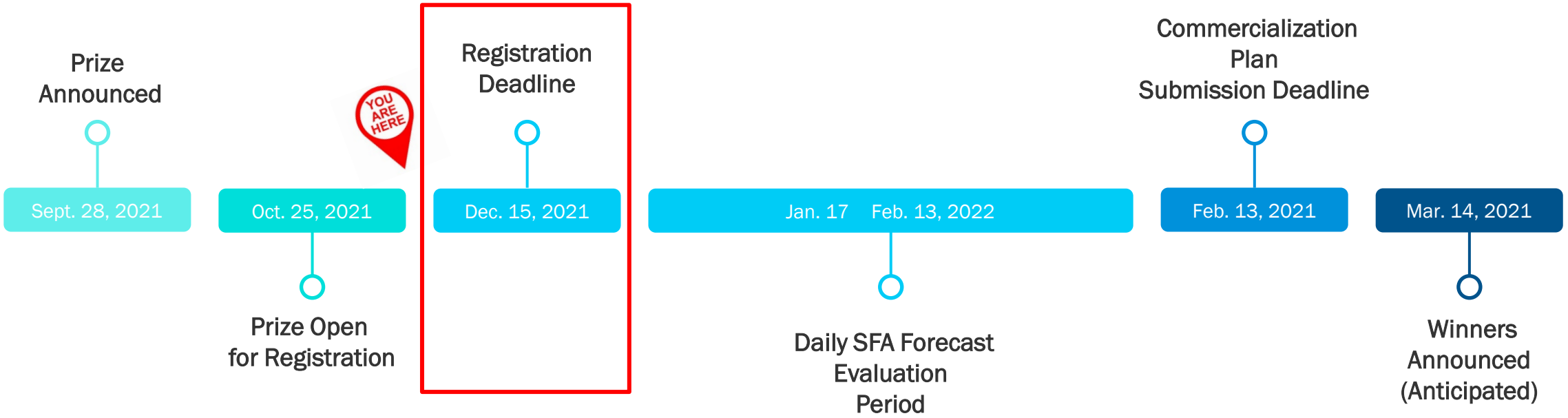
These rules are effective beginning October 25, 2021,
for the Solar Forecasting Prize

The U.S. Department of Energy (DOE)'s American-Made Solar Forecasting Prize will be governed by these official rules. The prize administrator and DOE reserve the right to modify the official rules if necessary, will publicly post any such modifications, and will notify prize competitors of any modifications.

Official rules of the Solar Forecasting Prize are available online

americanmadechallenges.org/solarforecasting/docs/rules/Solar_Forecasting_Prize_Official_Rules.pdf
or
Solar Forecasting HeroX Page > Resources Tab

Prize Process Overview and Timeline

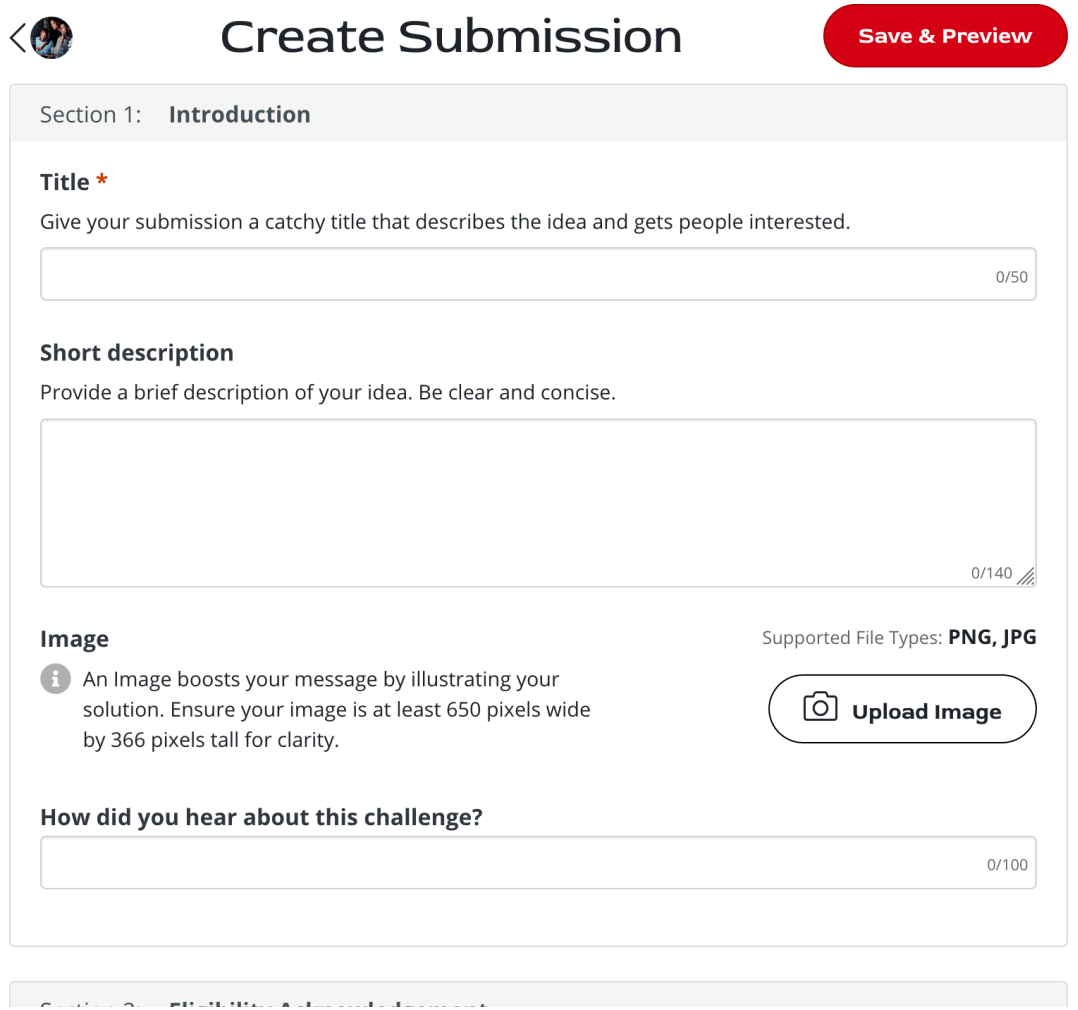


How to Sign Up: HeroX Registration Form

1. Go to HeroX.com/SolarForecasting
2. Click on “Solve This Challenge”
3. Sign-In or Create HeroX Account
4. Follow Prompts to Create Entry
5. You can adjust your registration until Dec. 15

Challenge Overview

(Registration Form)



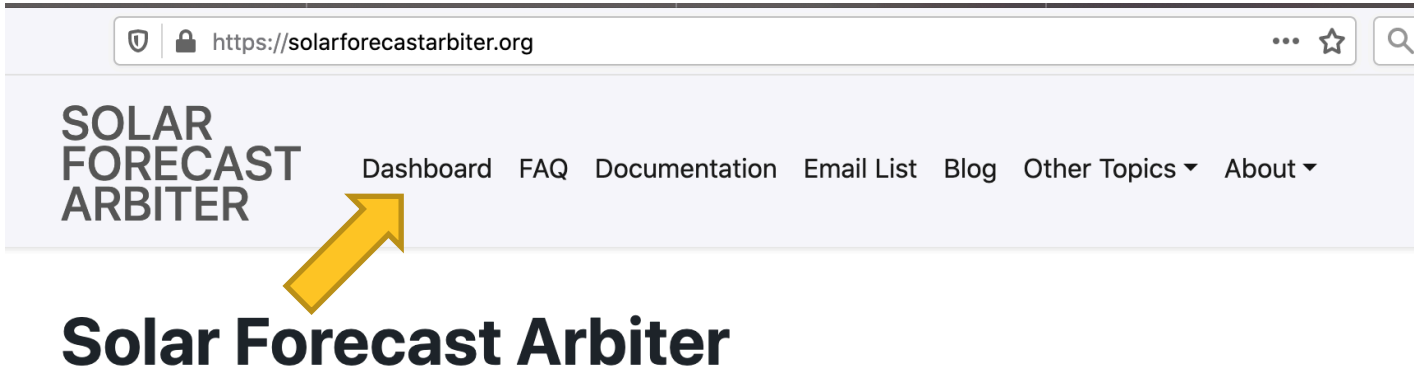
How To Sign Up – SFA Registration

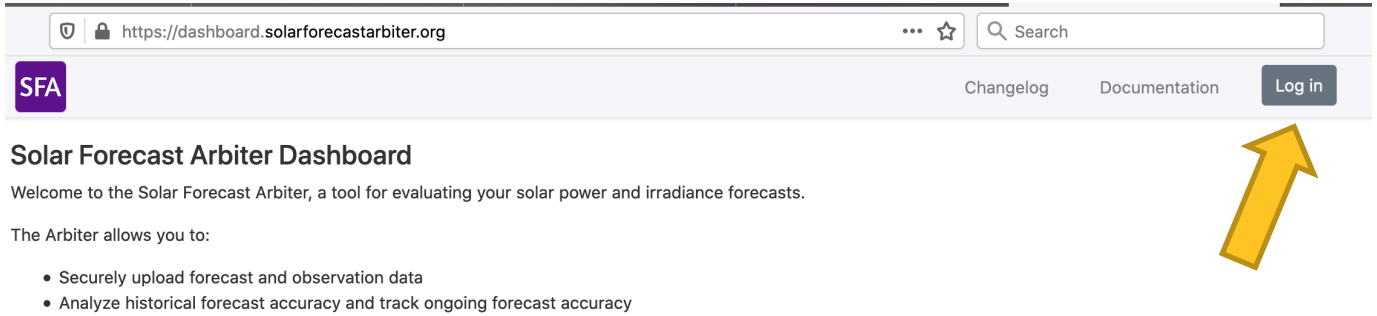
As a part of the registration process, you will be asked to create an account on the Solar Arbiter Forecast platform.

To create your account on the SFA platform:

1. Go to https://solarforecastarbiter.org/
2. Click on “Dashboard”
3. Click on “Log In”
4. Follow Prompts to Create an Account
5. Sign the SFA Data Use Agreement (if not already done) and upload it to your HeroX registration form

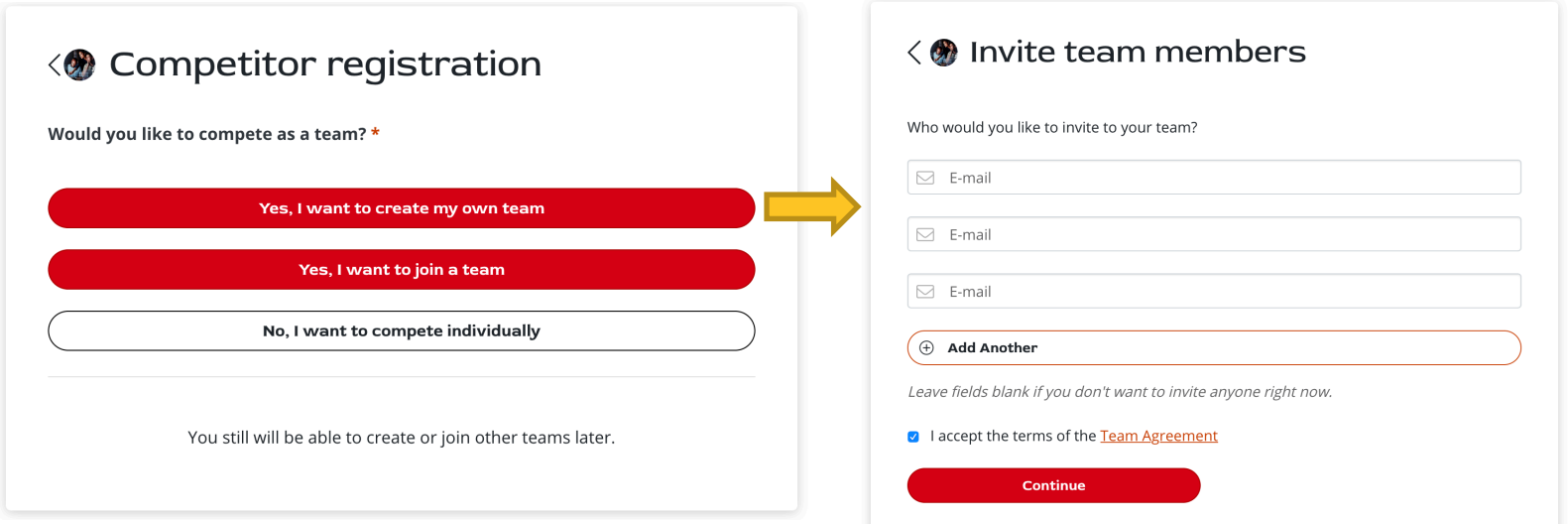
Important! In the HeroX registration form, you must enter in your e-mail EXACTLY how it appears on your SFA account registration.



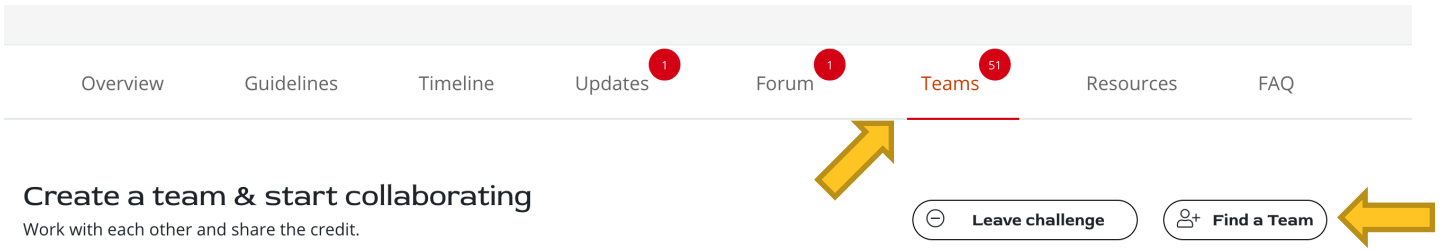


How to Sign-Up as a Team or Find New Team Members

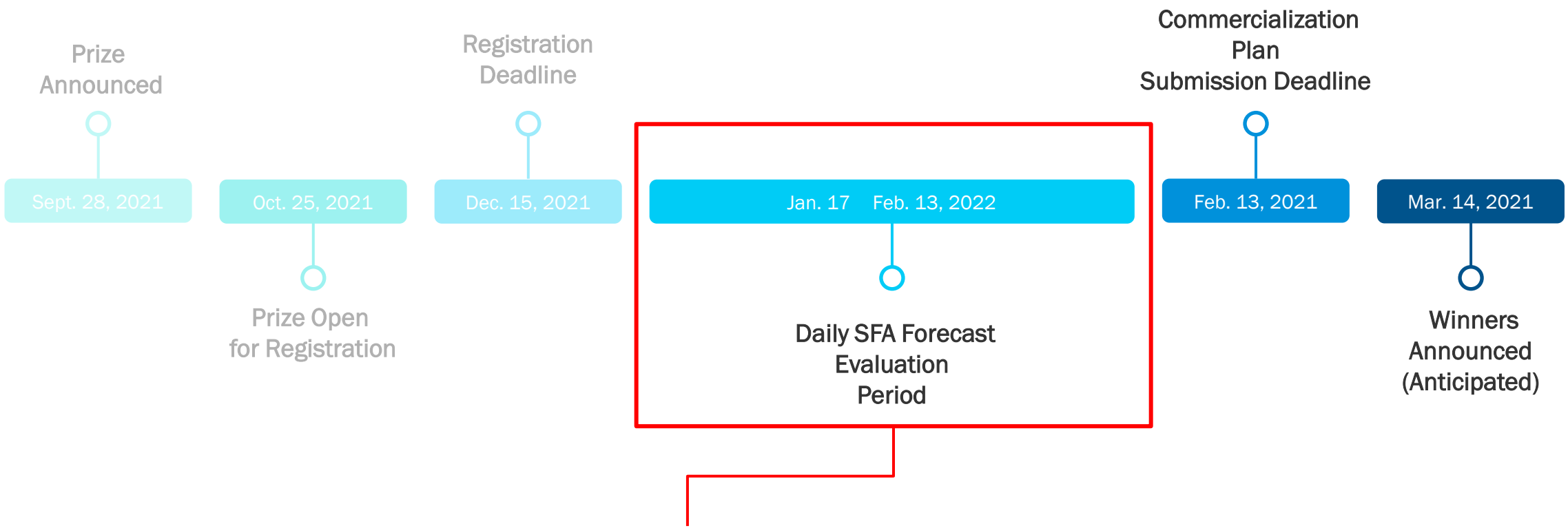
When you sign up on HeroX, you have the option of signing up as in individual or a team.



You can also use the HeroX Team Matching Tool to find new team members

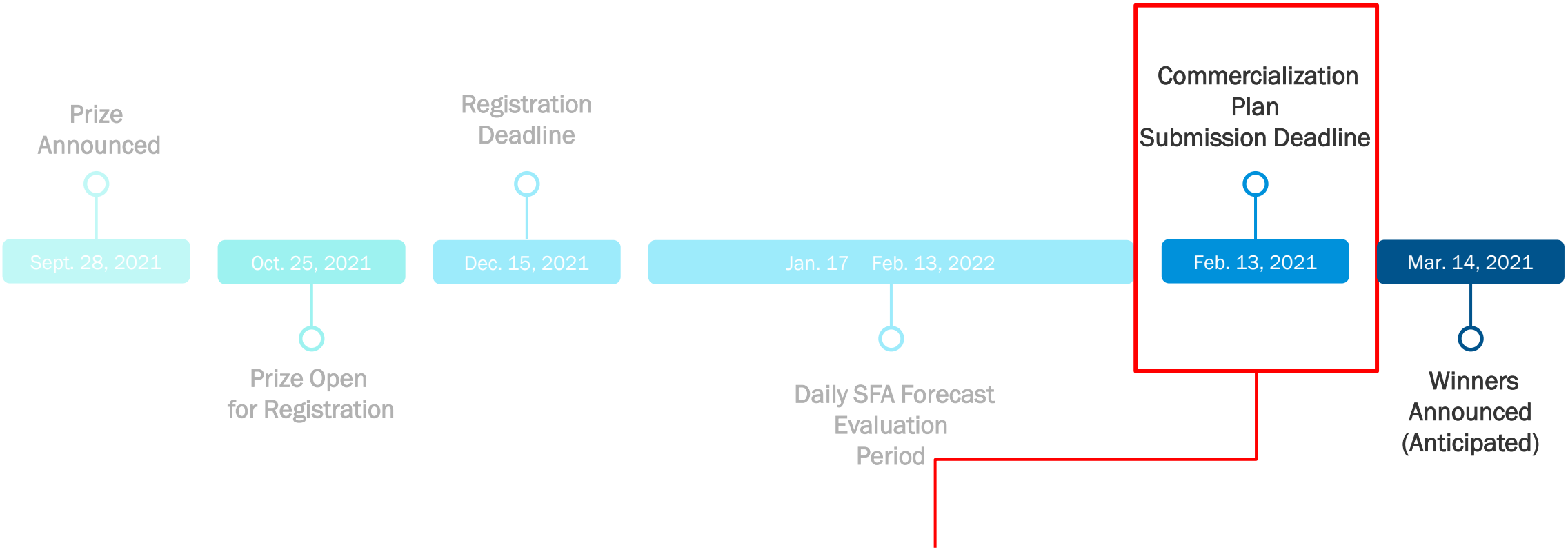


Prize Process Overview and Timeline



After registration, the next step of the prize will be to upload daily solar forecasts to the SFA platform.

Prize Process Overview and Timeline



After registering for the prize, you will have until Feb. 13, 2022 to upload your commercialization plan in HeroX

Commercialization Plan and Scoring

Final HeroX Submission

By Feb. 13 (last day of SFA evaluations), teams will need to upload the following Items :

Item	Content	Will Be Made Public?	Scored?
HeroX Submission Package	Cover page	No	No
	Commercialization plan (not to exceed 2,000 words)	No	Yes
	One summary PowerPoint slide	Yes	No
	Letters of commitment or support (optional)	No	No
	Intellectual property licensing agreements (if applicable)	No	No

Commercialization Plan

Competitors are required to submit a plan that addresses three questions:

1. Is the proposed solution innovative compared to the current state of the art?
2. Is the proposed plan specific and complete?
3. Is the proposed plan feasible and effective, and does the team have the experience to make the plan succeed?

Commercialization plans should be tailored as follows:

- **If you are NOT currently providing forecast services commercially**, your plans should focus on your product-to-market approach for your probabilistic forecasting algorithm or model.

- **If you do currently provide forecast services commercially**, your plans should focus on innovative approaches to accelerating the adoption of probabilistic forecasts by the broader industry.

Commercialization Plan Scoring Criteria

The commercialization plan judging criteria can be found in the official rules document. Each statement is scored on a 1-6 scale:

Commercialization Plan (PDF) Maximum 2,000 words and 5 supporting images or figures	
Question 1: Is the proposed solution innovative compared to the current state of the art?	
Suggested content to include in the plan: • Describe the state of the art for probabilistic forecasts, including existing commercially available solutions and their rate of adoption by the industry. • Depending on your perspective, briefly describe either the solution you plan to commercialize or the strategy you propose for the increased adoption of probabilistic forecasts.	Statements scored on 1–6 scale: • The competitor shows solid understanding of the current market conditions, limitations, and opportunities. • The competitor describes the innovation in their solution or proposed strategy. • The competitor's approach has a realistic potential to disrupt the existing market conditions.

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

How We Score Submissions and Select Winners

SFA Forecast Evaluation Scoring: The continuous ranked probability score (CRPS) 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:

$$Forecast\ Skill_{i,k} = CRPSS_{i,k} = 1 - \frac{CRPS_{i,k}}{CRPS_i^{PEF}}$$

Your final forecast score will be calculated as follows: your forecast skill values will be averaged across all locations and then rounded to two decimal points. This value will be then multiplied by 100 and then multiplied by a factor of three. The result of this multiplication will be your final forecast score.

Commercialization Plan Scoring: A panel of expert reviewers reads, scores, and comments on each submitted plan. Each statement listed in the review criteria under the three questions receives a score from 1 to 6. All reviewers' scores will then be averaged for a final reviewer score – the plan score – for the submitted plan.

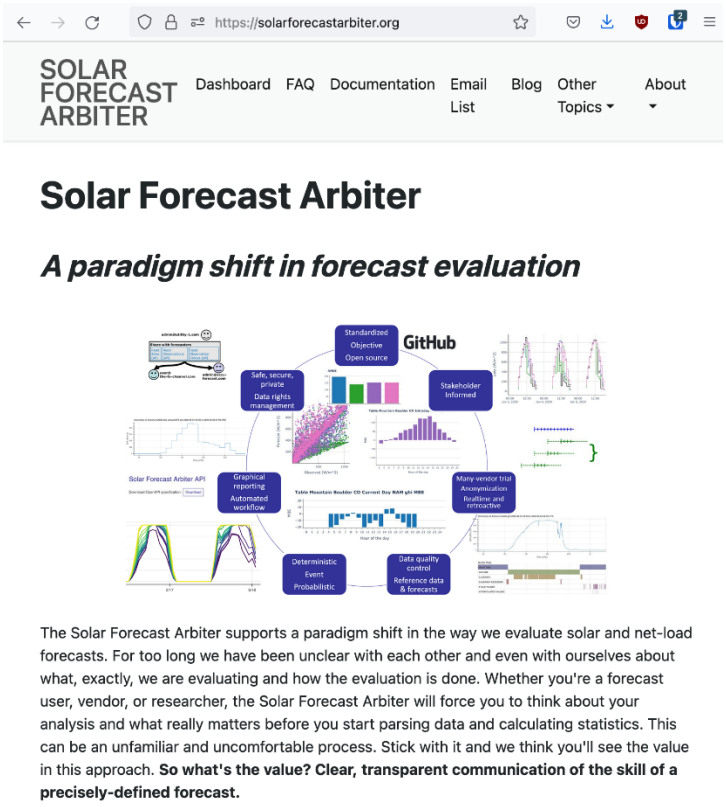
Total score: Your total score is the sum of your plan score and your final forecast score.

The prize judge (DOE) will consider overall SFA performance, commercialization plan scores and comments, and program policy factors when deciding the winners of the prize.

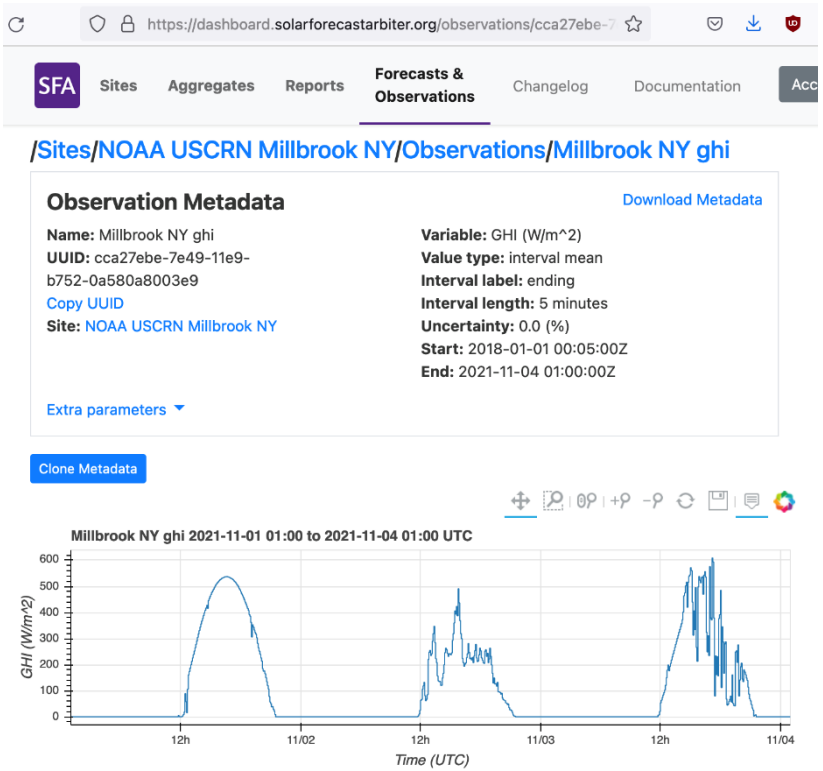
Solar Forecast Evaluation Period and Solar Forecast Arbiter Program

SFA Components

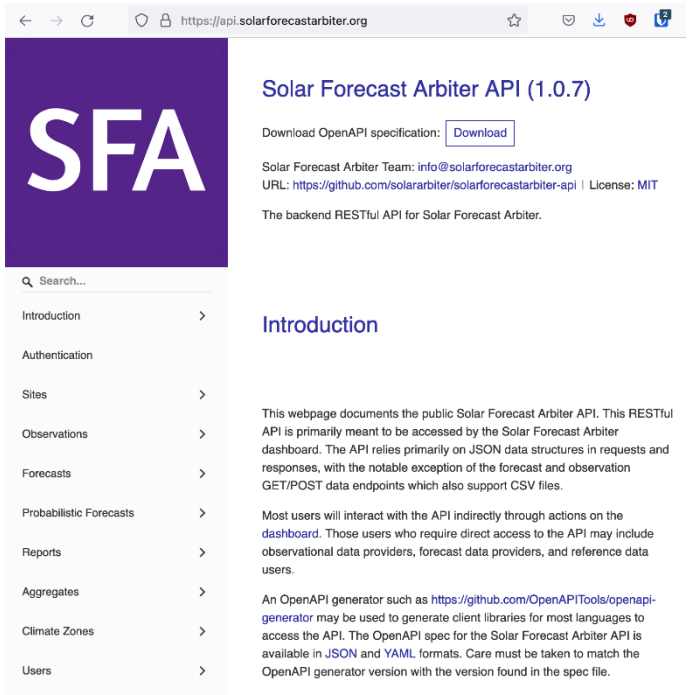
Informational Page
solarforecastarbiter.org



Dashboard
dashboard.solarforecastarbiter.org



API
api.solarforecastarbiter.org

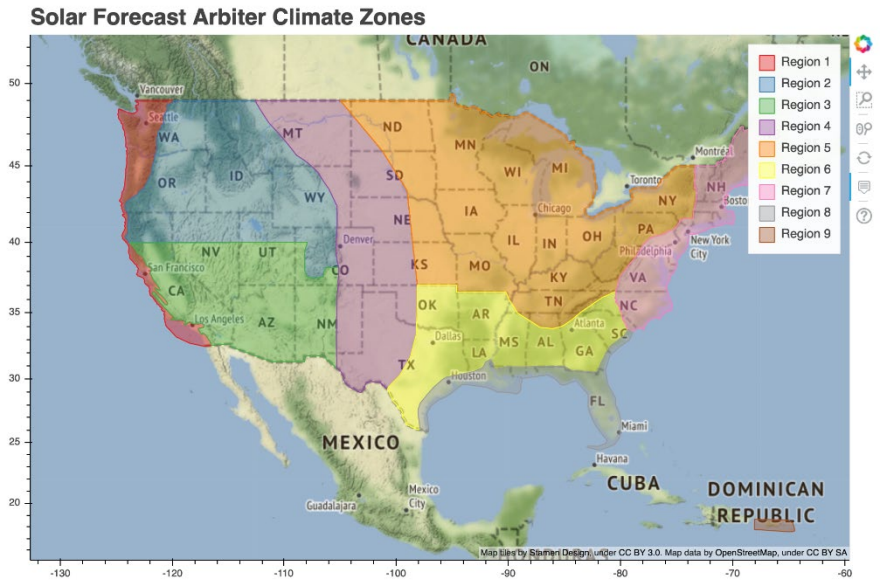


Code: github.com/SolarArbiter/

SFA Background

solarforecastarbiter.org

Climate Zone Definitions

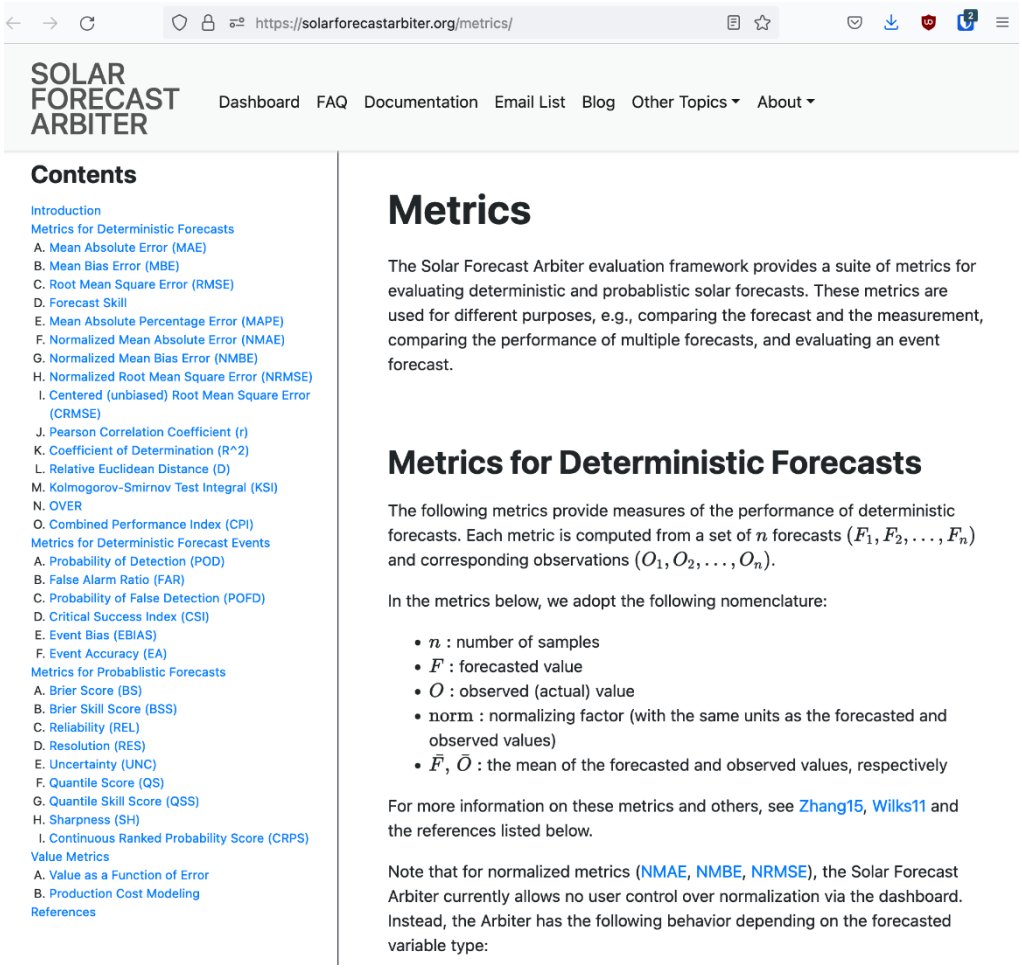


FAQ Page

Q. Can I use the Solar Forecast Arbiter to analyze wind power forecasts?

A. Yes! When creating a new Site, select Power Plant and simply ignore the solar-specific information such as surface tilt. Then proceed to use the Arbiter as normal. We are exploring what would need to be done to better support wind forecasts in this issue.

Metrics

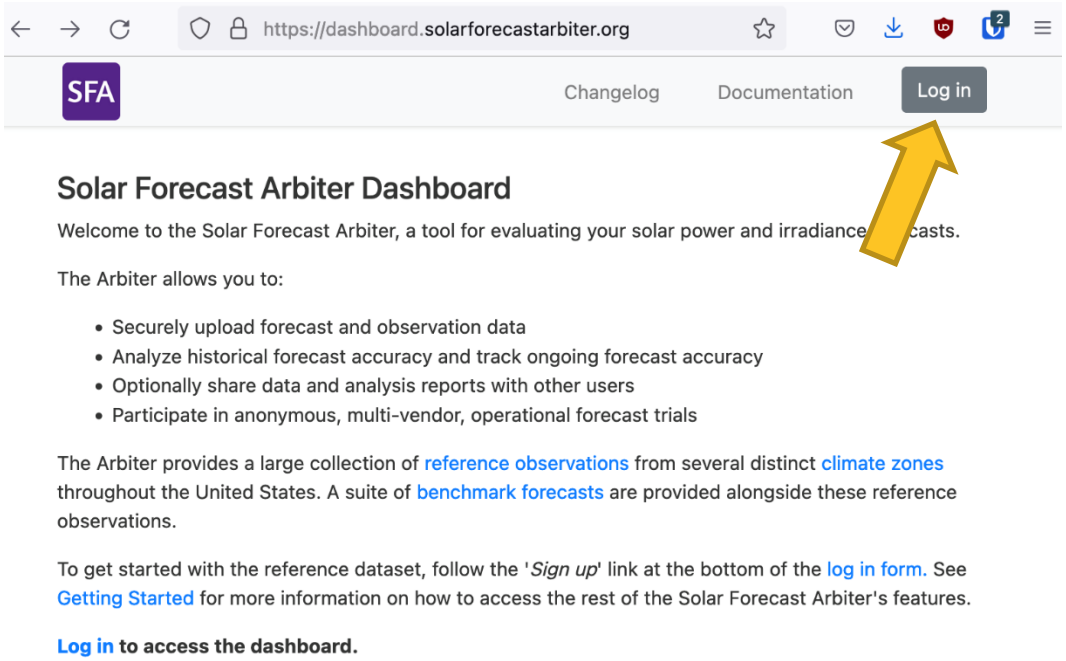


SFA Dashboard

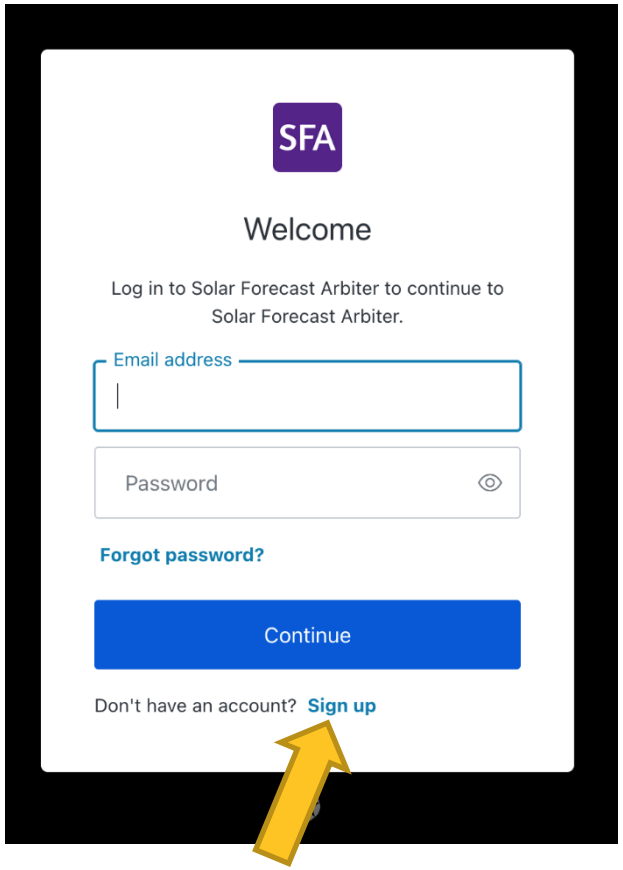
dashboard.solarforecastarbiter.org

Create free, no-obligation account to
browse reference data, forecasts, reports

1. Click “Log in”



2. Click “Sign up”



SFA Reference Data

SFA includes **226 reference data sites**

Observations

- All GHI
- Some DNI, DHI
- A few AC/DC power, POA
- Daily fetch for vast majority
- 2 – 4 years of data

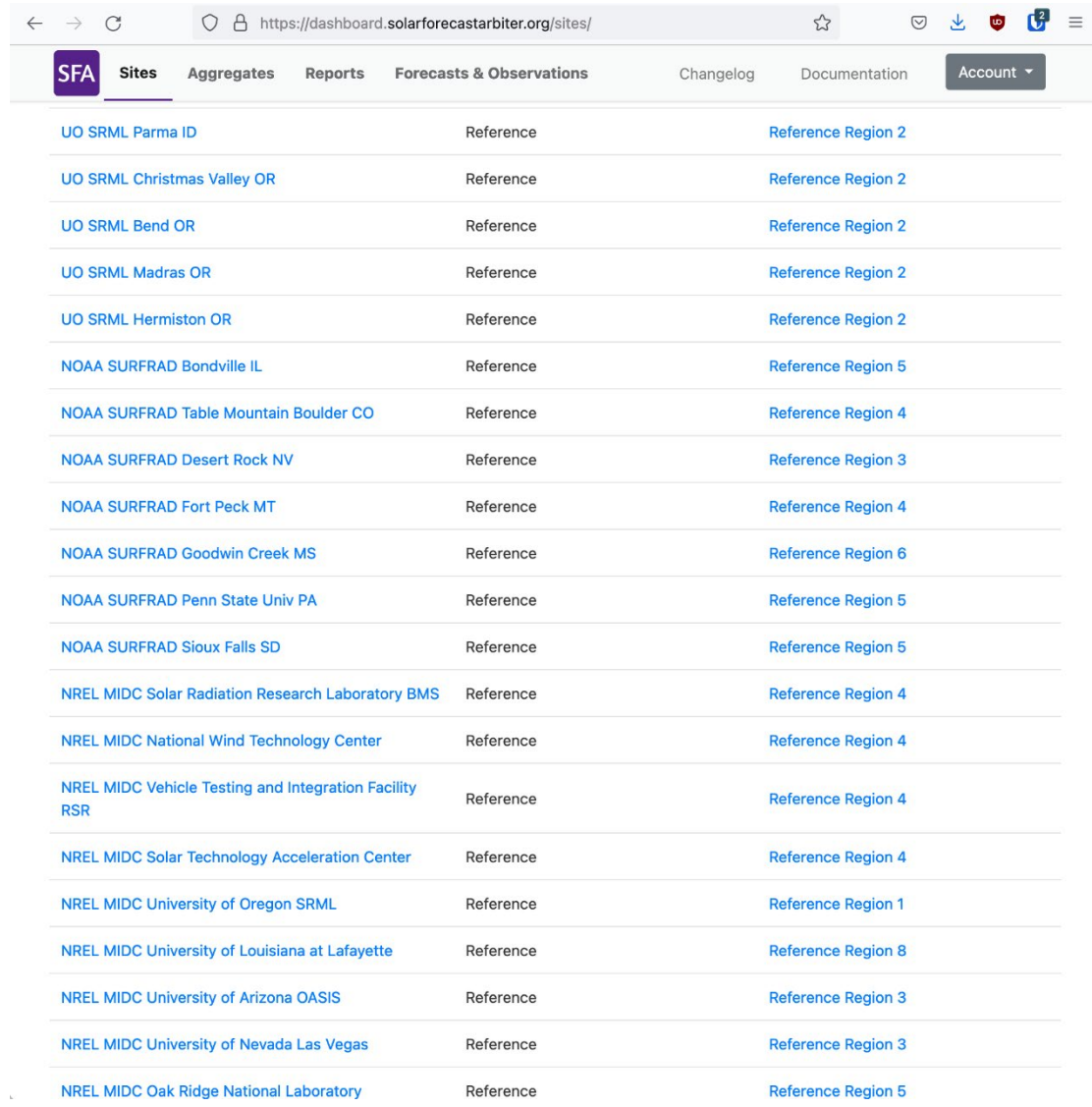
Forecasts

- Intraday – day ahead based on NOAA models
- Intraday based on persistence

Probabilistic Forecasts

- Day ahead based on NOAA GEFS
- Day ahead based on persistence ensemble

Nightly recomputed reports of reference fx performance

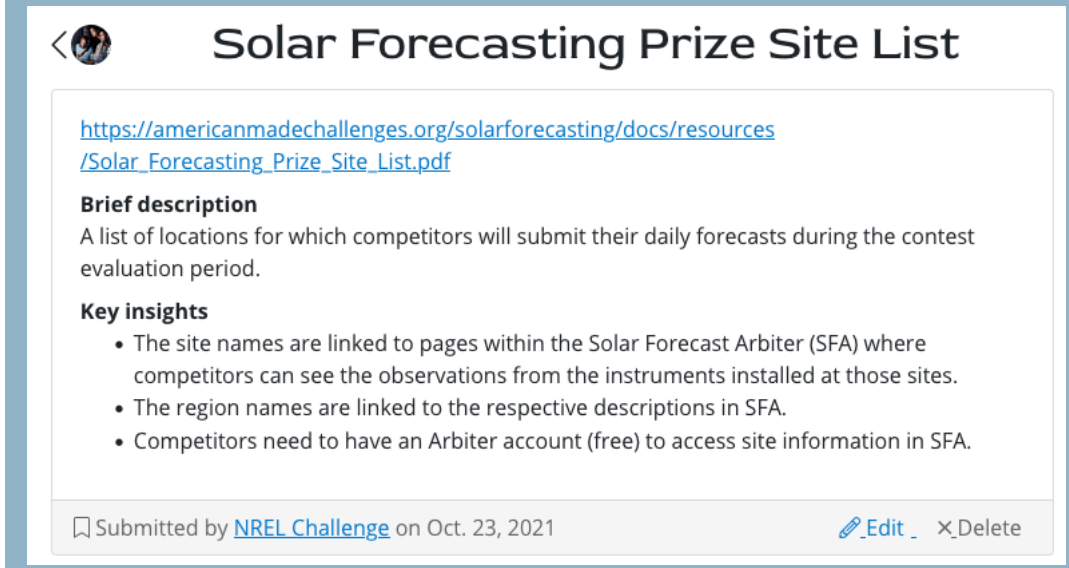


UO SRML Parma ID	Reference	Reference Region 2
UO SRML Christmas Valley OR	Reference	Reference Region 2
UO SRML Bend OR	Reference	Reference Region 2
UO SRML Madras OR	Reference	Reference Region 2
UO SRML Hermiston OR	Reference	Reference Region 2
NOAA SURFRAD Bondville IL	Reference	Reference Region 5
NOAA SURFRAD Table Mountain Boulder CO	Reference	Reference Region 4
NOAA SURFRAD Desert Rock NV	Reference	Reference Region 3
NOAA SURFRAD Fort Peck MT	Reference	Reference Region 4
NOAA SURFRAD Goodwin Creek MS	Reference	Reference Region 6
NOAA SURFRAD Penn State Univ PA	Reference	Reference Region 5
NOAA SURFRAD Sioux Falls SD	Reference	Reference Region 5
NREL MIDC Solar Radiation Research Laboratory BMS	Reference	Reference Region 4
NREL MIDC National Wind Technology Center	Reference	Reference Region 4
NREL MIDC Vehicle Testing and Integration Facility RSR	Reference	Reference Region 4
NREL MIDC Solar Technology Acceleration Center	Reference	Reference Region 4
NREL MIDC University of Oregon SRML	Reference	Reference Region 1
NREL MIDC University of Louisiana at Lafayette	Reference	Reference Region 8
NREL MIDC University of Arizona OASIS	Reference	Reference Region 3
NREL MIDC University of Nevada Las Vegas	Reference	Reference Region 3
NREL MIDC Oak Ridge National Laboratory	Reference	Reference Region 5

Site List for Solar Forecasting Prize

Site	Network
Kona, Hawaii	NREL MIDC
Seattle, Washington	NOAA SOLRAD
Hanford, California	NOAA SOLRAD
Salt Lake City, Utah	NOAA SOLRAD
Table Mountain Boulder, Colorado	NOAA SURFRAD
Goodwin Creek, Mississippi	NOAA SURFRAD
Bondville, Illinois	NOAA SURFRAD
Titusville, Florida	NOAA USCRN
Sterling, Virginia	NOAA SOLRAD
Millbrook, New York	NOAA USCRN

Detailed site list information can be found on HeroX under the Resource tab.

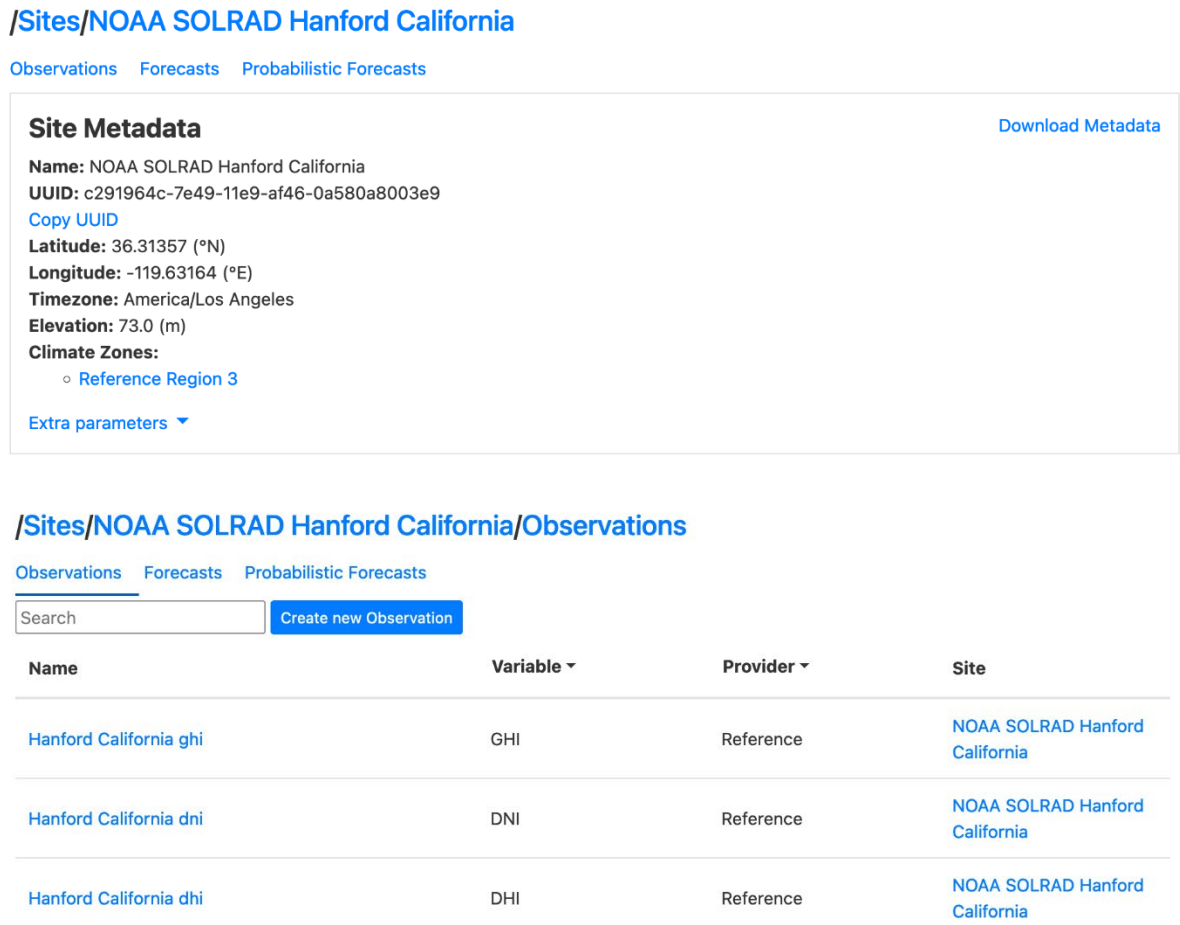


SFA Data Model

Concept 1: A **site** contains **observations** and **forecasts**.

Concept 2: **Observations** and **forecasts** are defined by their metadata.

Concept 3: Upload **time series** data to **observation** and **forecast** end points.



SFA Data Model

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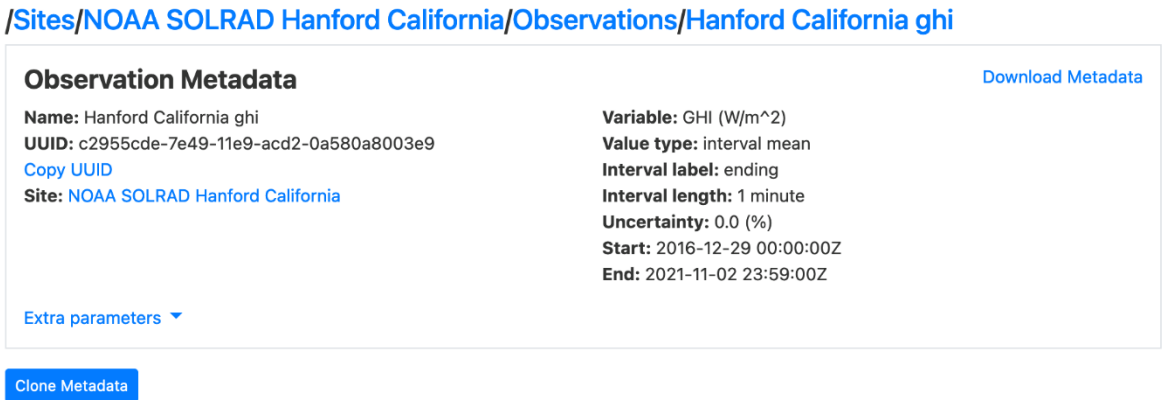
Concept 3: Upload/download **time series** data to/from **observation** and **forecast** objects.



SFA Data Model

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Concept 3: Upload/download **time series** data to/from **observation** and **forecast** objects.

SFA Forecasts

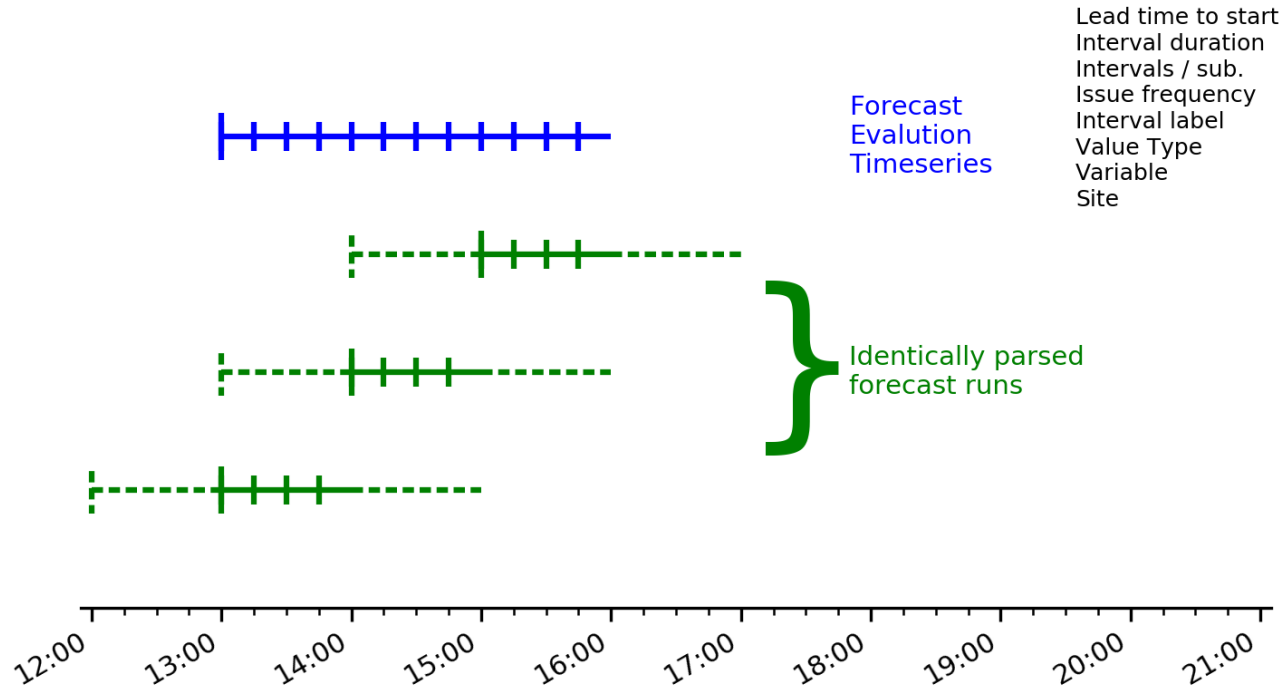
Problem

1. Forecasters produce much more data than people can easily understand (many issue times x long length x multiple temporal resolutions)
2. Most of that data is redundant
3. Eventually, a person must decide what really matters when assessing a forecast

SFA solution

- Decide what really matters before uploading data

Stop and think about the application/analysis before you start it



For Solar Forecasting Prize: the day ahead, midnight to midnight, forecast issued at 10 am local time

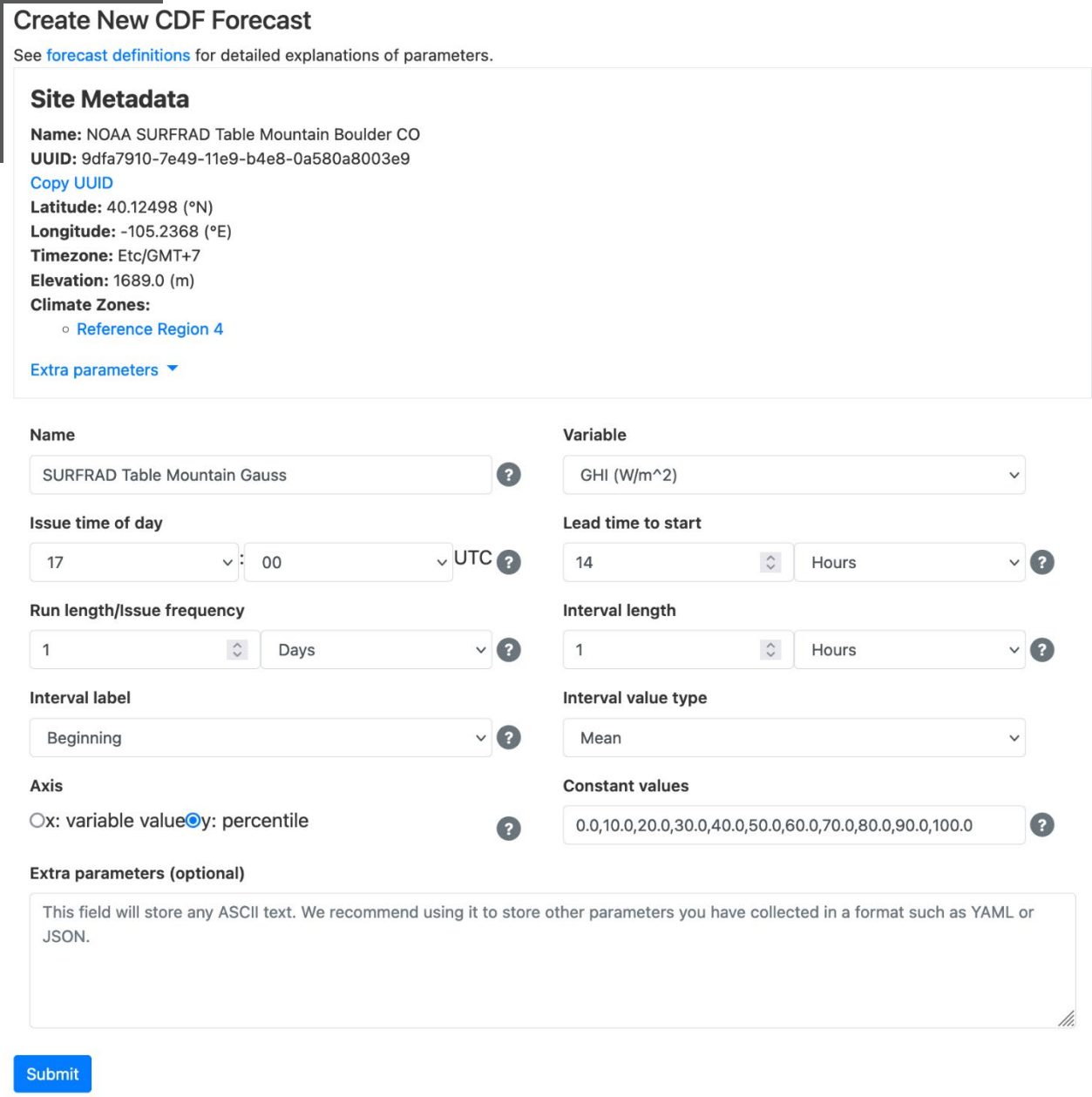
SFA Forecasts

For Solar Forecasting Prize…

Day ahead, midnight to midnight, hourly forecast issued at 10 a.m. local time

Example at SURFRAD Table Mountain (UTC-7):

- **Issue time of day**: 17 UTC
- **Lead time to start**: 14 hours
- **Run length/Issue frequency**: 1 day
- **Interval length**: 1 hour
- **Interval label**: Beginning



Probabilistic Forecasts

Distributions may be described by forecasts of:

- Fixed percentiles (e.g., 1, 5, 10…90, 95, 99)
- Fixed thresholds (e.g., 1 MW, 5 MW…25 MW, 30 MW)

Solar Forecasting Prize uses fixed percentiles.

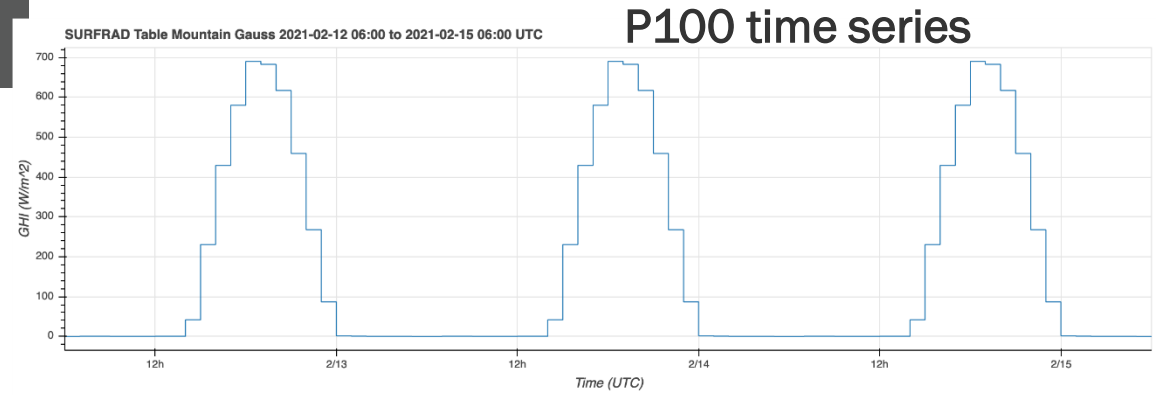
Each percentile is represented by a unique endpoint in the SFA API.

User posts a forecast to each percentile, so a forecast for each site requires 11 post operations…

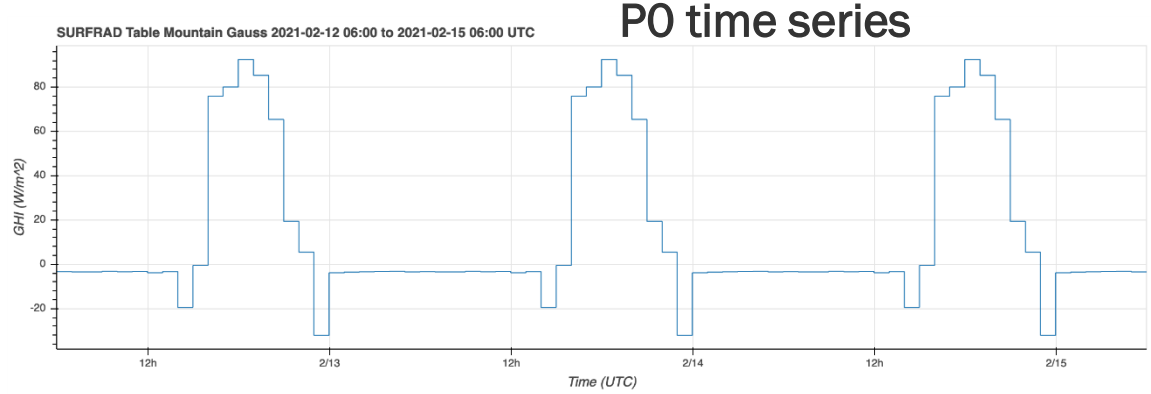
…but file format is trivial!

```
timestamp,value
2021-02-12T19:00:00Z,700
2021-02-12T20:00:00Z,690
```

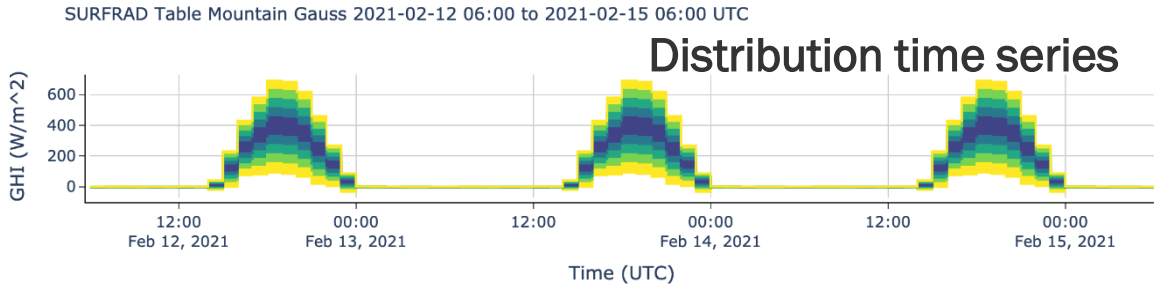
P100 time series



P0 time series



Distribution time series



SFA Reports

Reports structured for clear, reproducible analysis.

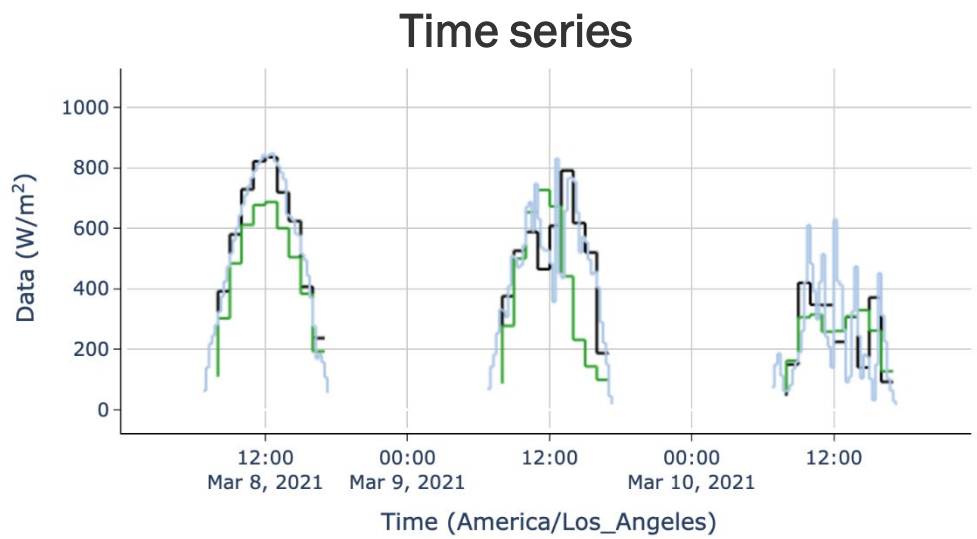
dashboard.solarforecastarbiter.org/reports/

▾ Table of data validation filters

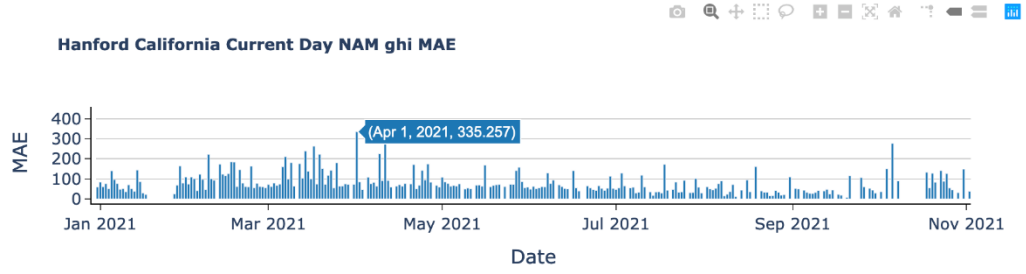
Quality flags	Discard before resample	Resample threshold (%)
NIGHTTIME, USER FLAGGED	True	10.0

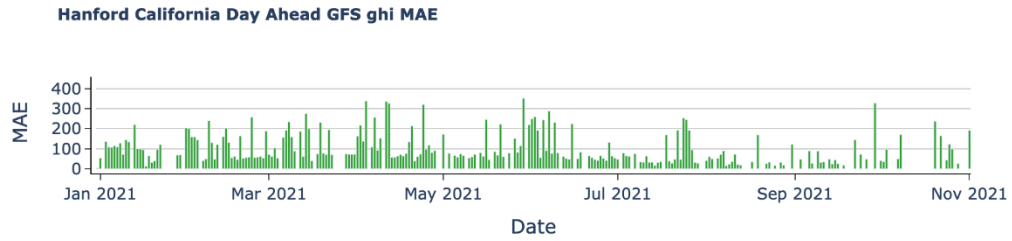
▾ Table of total metrics

Forecast	MBE	MAE	RMSE
Hanford California Day Ahead GFS ghi	-85.7	103	162
Hanford California Current Day NAM ghi	-62.9	79.4	114
Hanford California Intraday HRRR ghi	15.5	41	70.3
Hanford California Intraday RAP ghi	-101	113	171
Hanford California Hour Ahead Persistence ghi	5.18	60.7	99.7



Metrics by date, season, etc.





SFA Reports for Prize

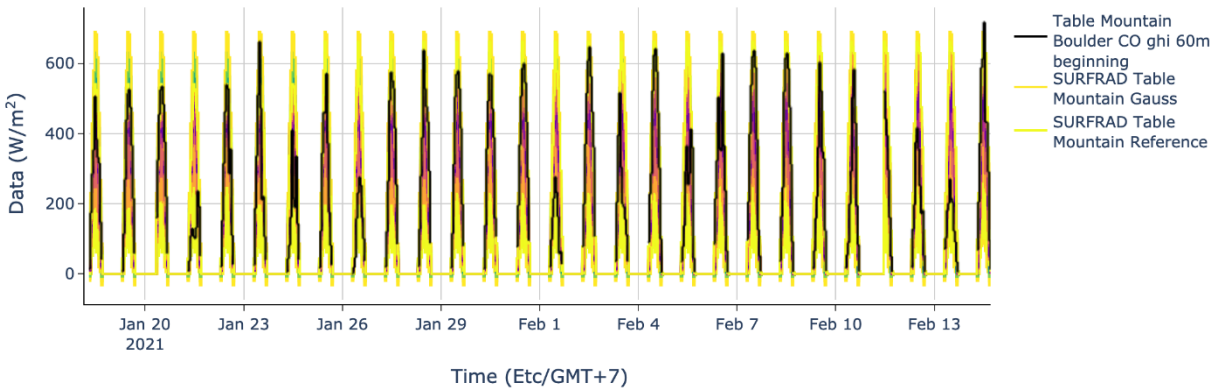
Solar Fx Prize SURFRAD Table Mountain

Recompute report | Clone report parameters

This report of forecast accuracy was automatically generated using the Solar Forecast Arbiter.

This report can be downloaded as a standalone HTML file, standalone HTML file without timeseries or PDF file. The download is a ZIP archive that includes checksums for the report file and a PGP signature that can be used to verify the authenticity of the report. The Solar Forecast Arbiter PGP key ID is 0x22bd497c0930f8b0.

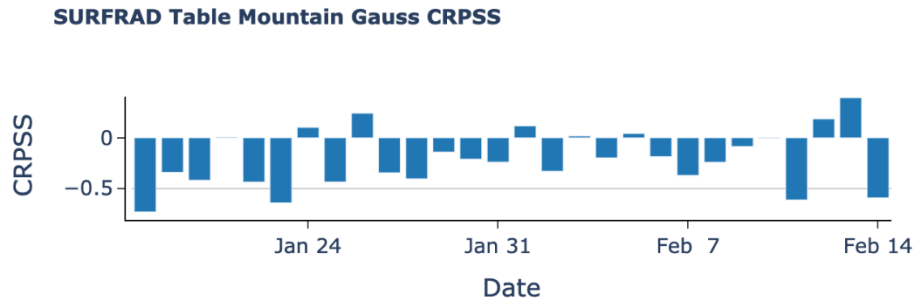
Time series of your forecast, reference forecast, observation



Metrics for your forecast and reference

▼ Table of total metrics

Forecast	CRPS	CRPSS
SURFRAD Table Mountain Gauss	61.9	-0.145
SURFRAD Table Mountain Reference	54.1	nan

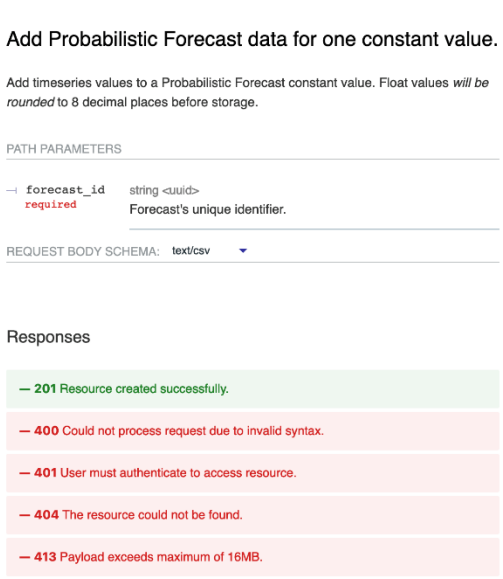


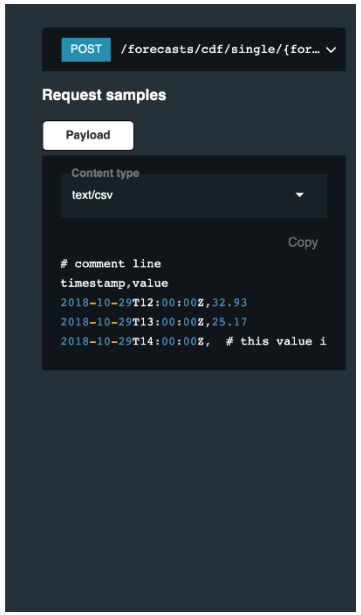
Leaderboard on HeroX compiled from CRPSS metrics computed in SFA reports

Data Upload/Download

Example data download and forecast upload script: solarforecastarbiter.org/documentation/dashboard/trials/#example-script

HTTP API documentation at api.solarforecastarbiter.org






```
215     # for each constant value, make a random timeseries and upload
216     # the timeseries for that constant value
217     for num, prob_constant_value in enumerate(prob_forecast.constant_values):
218         # set this distribution value to an interpolation between high
219         # and low values determined above.
220         # assumes len(prob_forecast.constant_values) > 1
221         distribution_member_value = (
222             forecast_value_low
223             + (
224                 num / (len(prob_forecast.constant_values) - 1)
225                 * (forecast_value_high - forecast_value_low)
226             )
227         )
228         forecast_series = pd.Series(distribution_member_value, index=index)
229         # upload the probalistic forecast constant value  to the API
230         # catch and log errors so we can try upploading the other forecasts
231         try:
232             session.post_probabilistic_forecast_constant_value_values(
233                 prob_constant_value.forecast_id, forecast_series)
234         except Exception:
235             logging.exception(
236                 'Failed to upload prob. forecast constant value for %s',
237                 prob_constant_value.name)
238             continue
```

trial_random_data_forecast_upload.py hosted with ❤ by GitHub view raw

Data Upload/Download

API gate closure

- Forecasts rejected if they contain valid times for which a gate has already closed
- Forecasts may contain valid times for additional days
- User may overwrite previously submitted forecasts up to the gate closure time.

Reference Forecast

Persistence ensemble (PeEn)

Time of day PeEn computes statistics from the past N days of observation data at the corresponding time of day.

1. Pull previous N days of data.
2. Resample data to desired interval length.
3. Bin data by desired times of day. Assuming no data gaps, there are N values in each bin.
4. For each bin, compute the desired percentiles.
5. Associate each bin with the forecast date time (e.g. first bin is midnight tomorrow, second bin is 1 am tomorrow, etc). This is the forecast.

SFA uses N = 30.

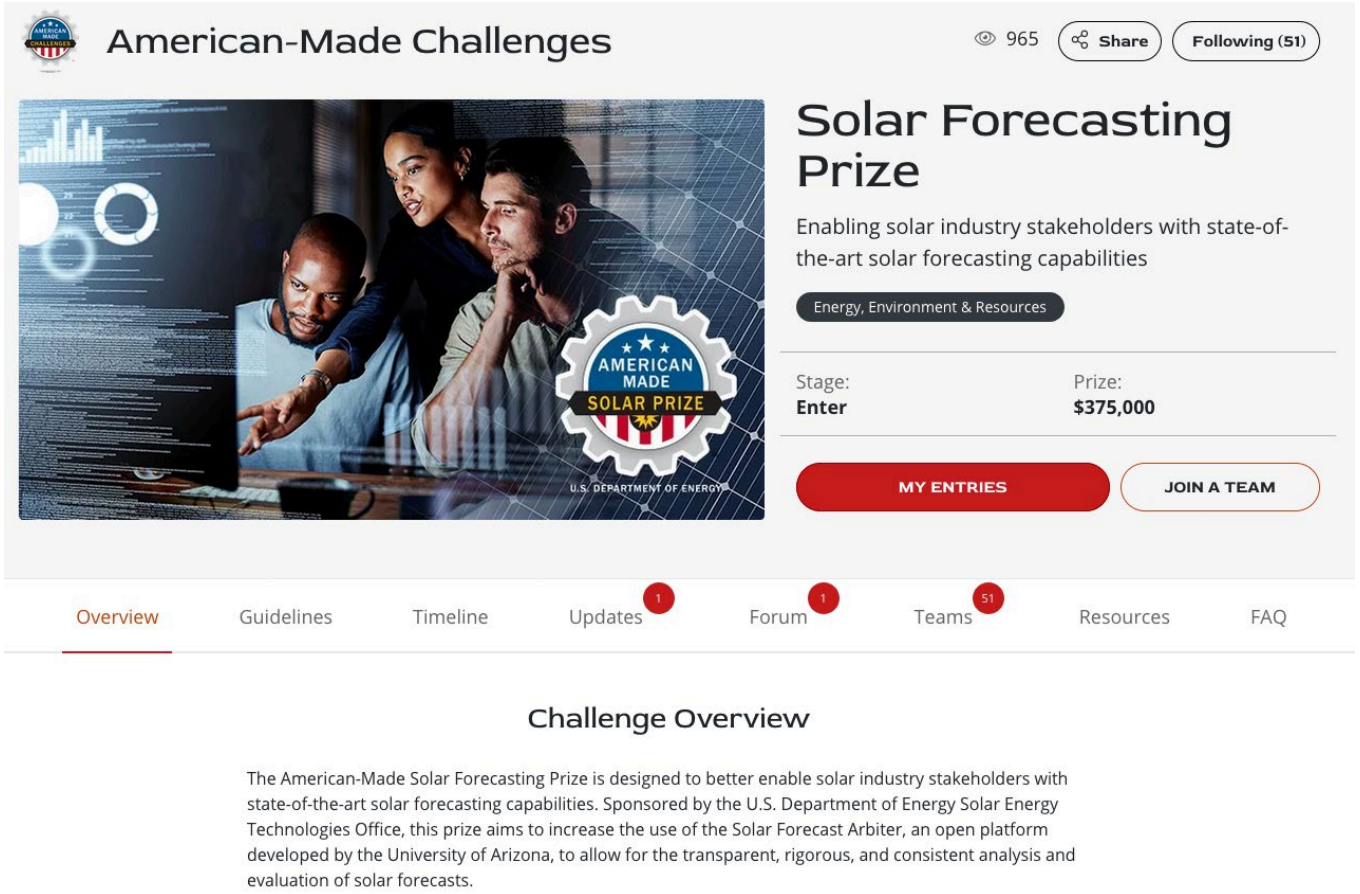
```
504
505 def persistence_probabilistic_timeofday(observation, data_start, data_end,
506                                          forecast_start, forecast_end,
507                                          interval_length, interval_label,
508                                          load_data, axis, constant_values):
509     r"""
510     Make a probabilistic persistence forecast using the *observation* from
511     *data_start* to *data_end*, matched by time of day (e.g. to forecast 9am,
512     only use observations from 9am on days between *data_start* and
513     *data_end*). This is a common variant of the Persistence Ensemble (PeEn)
514     method. [1]_ [2]_ [3]_
515
```

Reference forecast code on GitHub

solarforecastarbiter/reference_forecasts/persistence.py

Using HeroX

HeroX Live Demo



GET STARTED

Visit our website to learn more and register today!

https://www.herox.com/SolarForecasting

For Questions: Emily.Evans@nrel.gov