Progress and Needs for Renewable Energy Forecasting IEA Wind Task 51 Workshop

Eamonn Lannoye

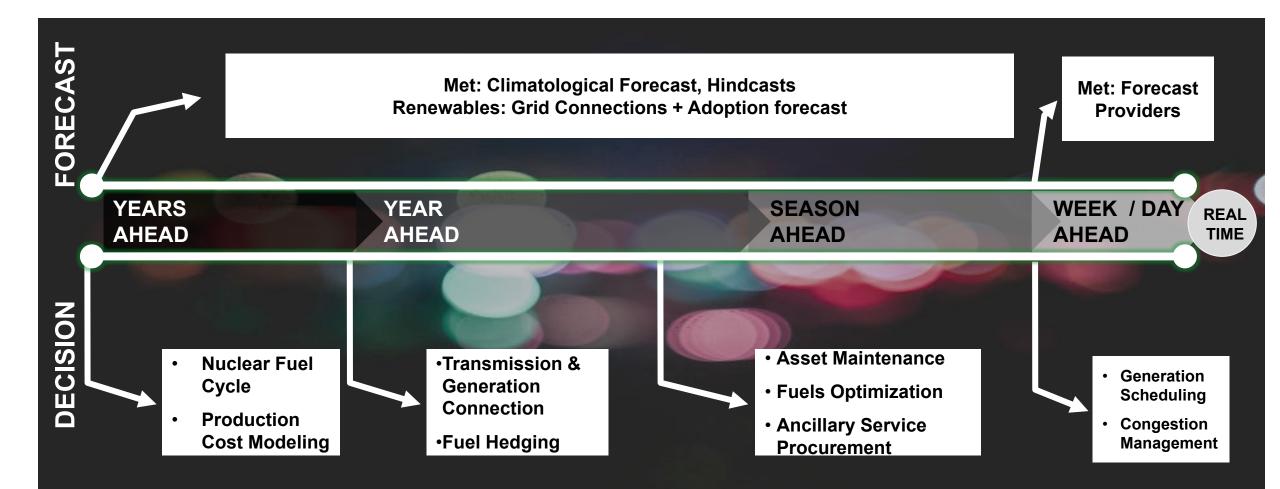
Sept 12th, 2022



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Bulk System Forecast Uses



Similar time frames for distribution



Emerging Challenges for Forecasts



Plant Operations

Hybridization with storage, solar Active wake steering, plant optimization



Extreme Conditions

Operational decision making in stressful grid conditions Impact of wildfire, storm, flood



End Use Applications

Integration of forecasts into ops planning / balancing Valuation of forecasts

Deeper integration into system operations



NWP Highlights

North American Models

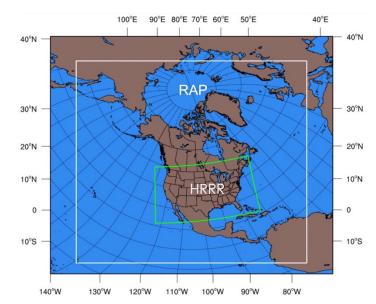
- Extended horizons for rapid refresh (HRRR, RAP) models
- Assimilation of satellite data
- Cloud physics improves subgrid mesh

European Models

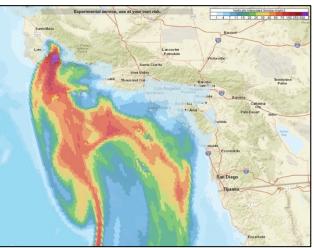
- Improved cloud, precipitation modeling
- Assimilation of satellite data
- Increased vertical resolution

Wildfire and Smoke

• NOAA HRRR-Smoke and RAP-Smoke models



Domains of the RAP (13-km resolution) and HRRR (3-km resolution) models. Source: rapidrefresh.noaa.gov

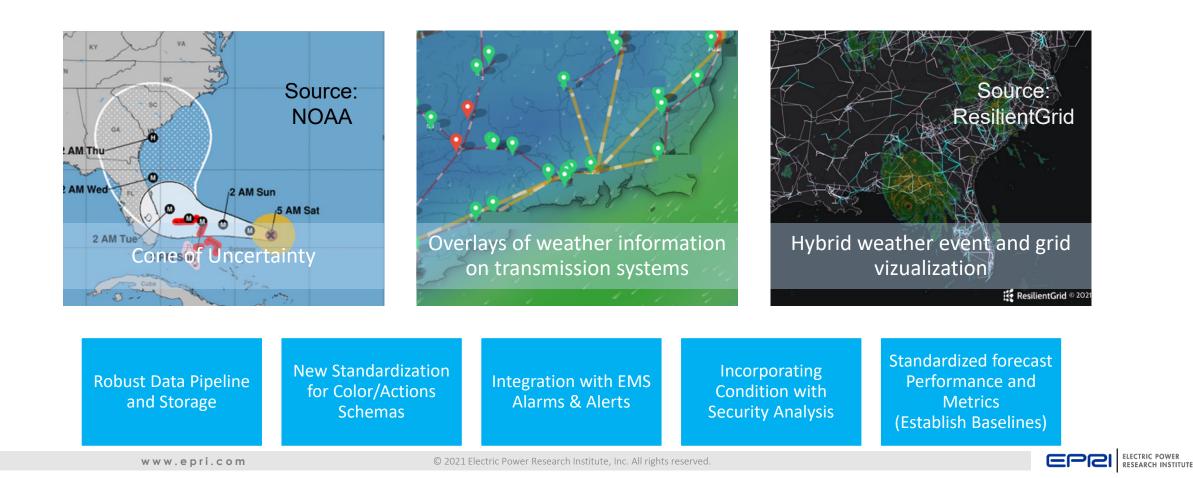


Sample HRRR-Smoke forecast of vertically integrated smoke from a fire near Santa Barbara, CA on October 12, 2021. Source: rapidrefresh.noaa.gov/hrrr/HRRRsmoke/

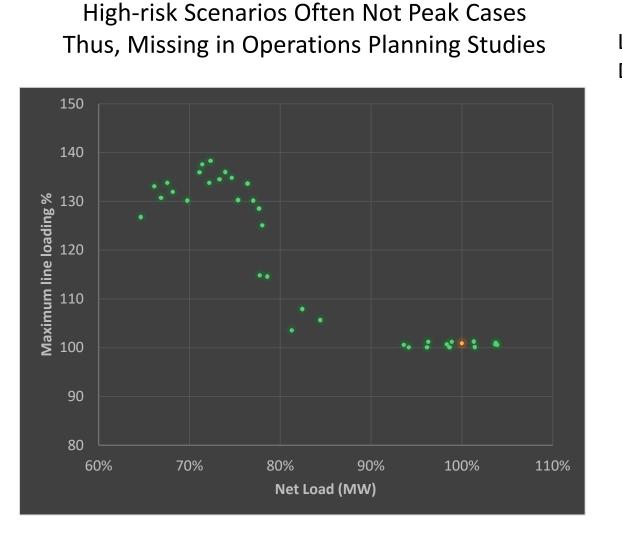


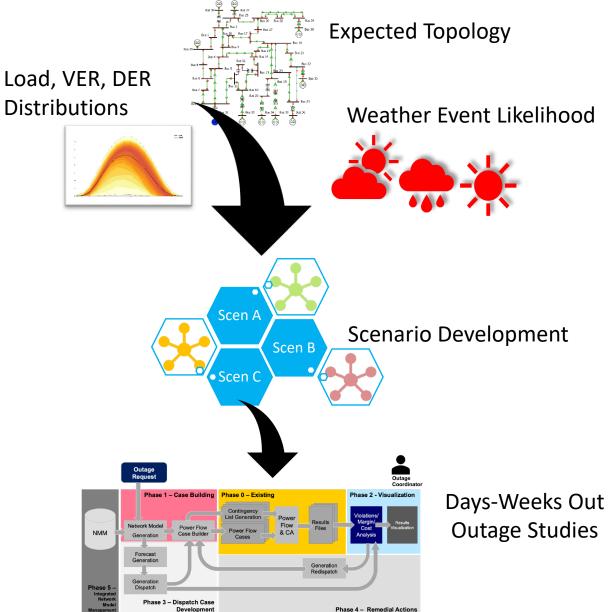
Forecast in Operator Decisions Highlights

»Support operator decision making without information overload Primarily involves incorporating weather forecasts

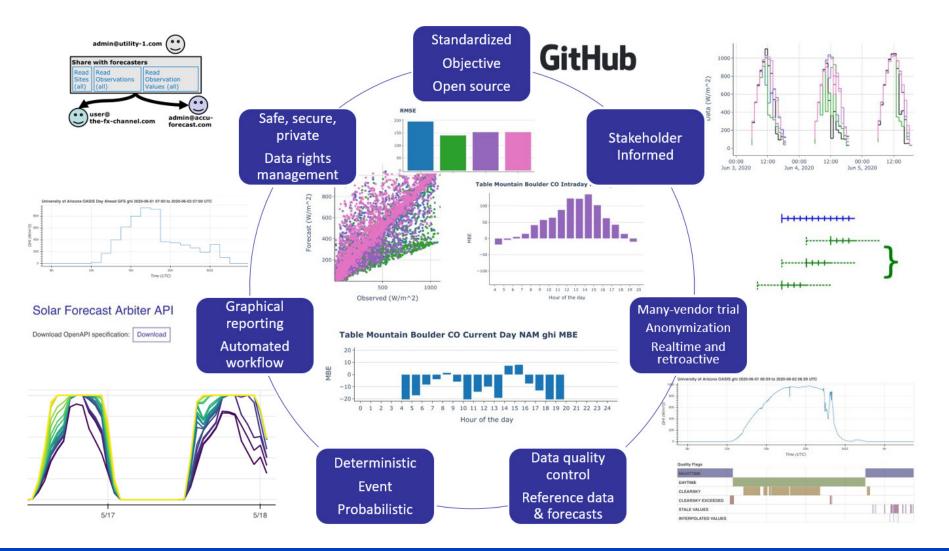


Days Out Forecasts Help Develop Scenarios to Improve Reliability





Solar Forecast Arbiter: https://solarforecastarbiter.org/

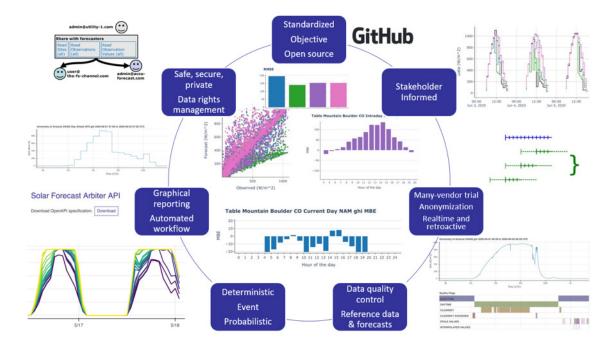


impartial, repeatable & auditable forecast evaluation tool



Solar Forecast Arbiter

- » online platform that provides transparent evaluation of forecast performance
 - user friendly, with graphical and API interfaces
 - supports anonymized forecast trials
 - open-source code
- » currently focused on solar, but is generalizing to cover solar, wind and load forecasts
- » will transition to EPRI management starting mid-2022*
 - will be part of a Forecasting Users Group (UG) for utilities/ISOs/RTOs, but still available to the public
 - UG will include annual meetings, updates on performance, support in benchmarks and use



https://solarforecastarbiter.org/

*EPRI was one of the co-developers, along with University of Arizona (lead), Sandia and Sharply Focused, with funding provided by DOE

Contact David Larson <dlarson@epri.com> or Aidan Tuohy <atuohy@epri.com> for more info



Why use the Forecast Arbiter?

» standardized process to evaluate forecasts

» anonymized, multi-vendor forecast trials

» track forecast accuracy over time

- » automated reports with wide range of error metrics
- » support for both deterministic and probabilistic forecasts
- » benchmark forecasts and reference data for 200+ sites already included
- » ... and many more features!

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More metadata for the objects in this report may be downloaded in JSON format.

he plots below show the filtered, resampled, and aligned time series of observation and forecast data as well as the distribution of forecast vs. observation data. This sampled and realigned timeseries data may also be downloaded below.

Download timeser

Controls to pan, zoom, and save the plot are shown on the right. Clicking on an item in the legend will hide/show it.

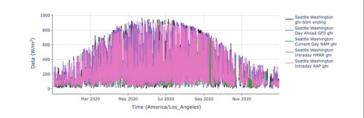


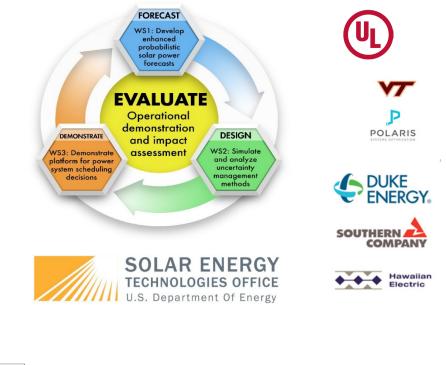
Figure: Screenshot of sample report.

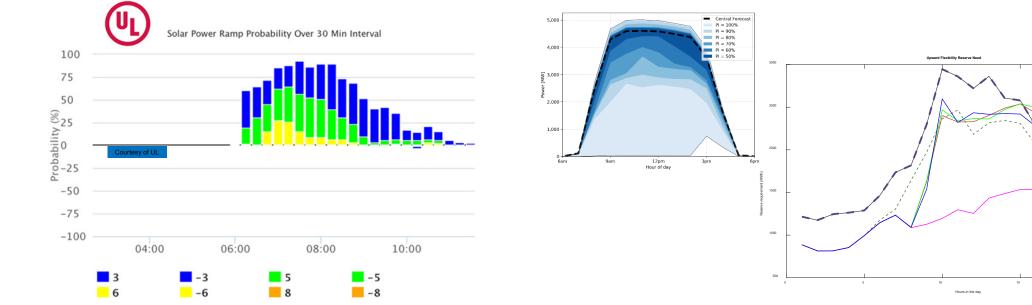


Probabilistic Forecasts

www.epri.com

- » Useful for providing additional awareness and insight on uncertainty
- » Working on methods to incorporate these directly into decision processes
- » Balancing authority is main focus now, but similar concepts could be applied to others

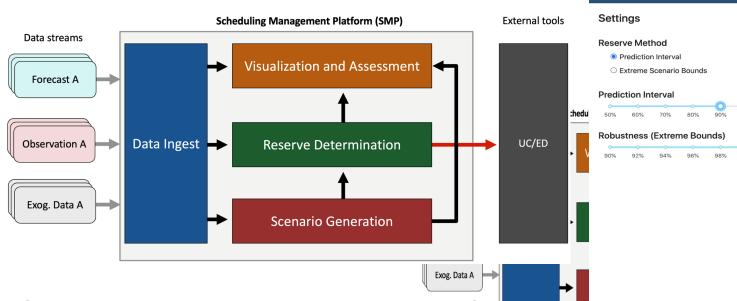






Software Tool to Support Integration with Operations

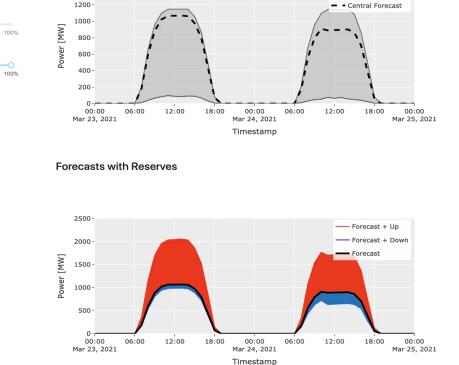
Scheduling Management Platform



Currently working with participating utilities to refine the platform

- Reserve requirements for different risk preferences and methods
- Scenario generation for UC
- Link to unit commitment/economic dispatch
- Visualize and assess forecasts and reserves

SMP to be released as open-source at end of DOE project



Prediction Interval: PI = 90%

1400



Operations View Historical Per

Prediction Interval

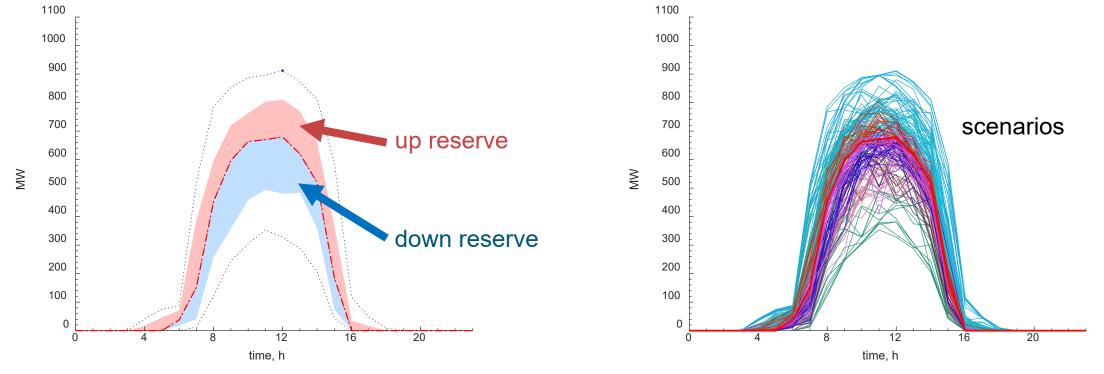
Use of Probabilistic Forecasts in Operations

Use #1: Directly use to set reserves

 » Set operating reserves based on probabilistic forecasts – different methods can be used

Use #2: Scenario Generation for UC or reserves

 » Transform probabilistic info into scenarios, which can be used in a UC model to allow for stochastic UC



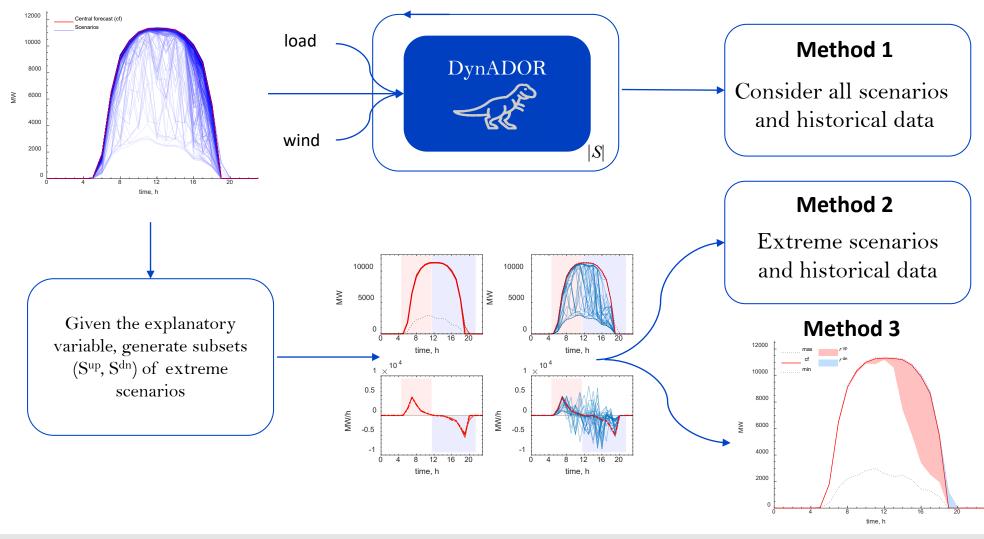
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Probabilistic Scenarios to Reserve Requirements

» From scenarios to reserve requirements

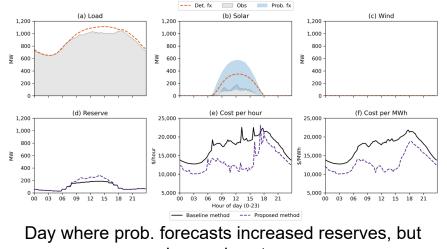


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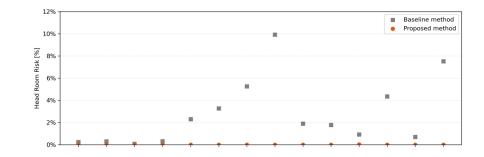
Utility Case study results (Hawaiian Electric)

» Using probabilistic forecasts to set reserves:

- increased reserves during middle of the day (when solar generation peaks)
- did not conclusively increase or decrease costs, but led to more consistent operating costs week-to-week
- improved operating conditions, including lower head room risk (< 1%) and more consistent frequency compliance



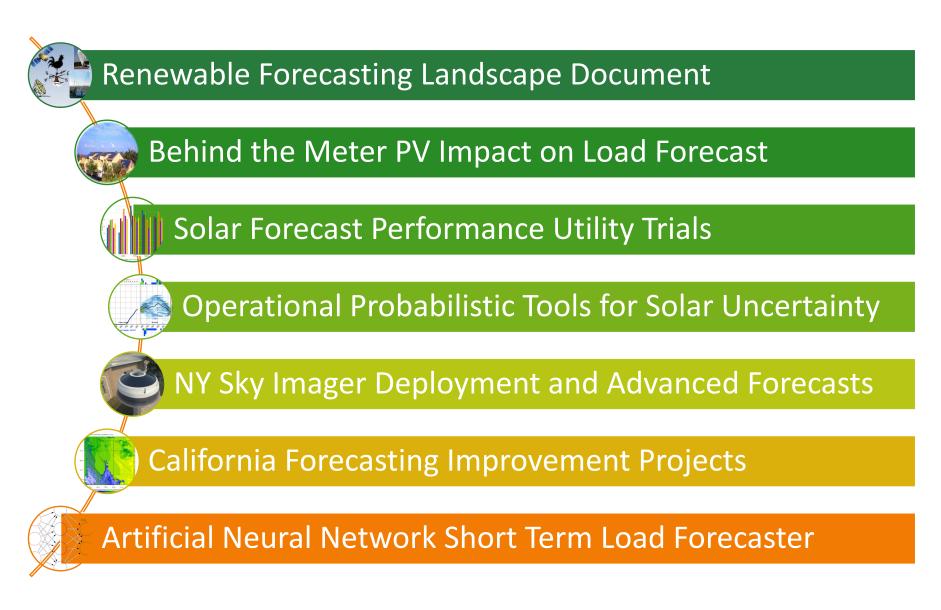
lowered costs.



Prob. forecasts (orange) led to lower risk (< 1%) for all weeks simulated.



EPRI Short Term Forecast Integration Efforts





Together...Shaping the Future of Electricity



For more info on the Forecast Arbiter

»ESIG blog post: <u>https://www.esig.energy/the-solar-forecast-arbiter/</u>

»webcast (~14-min): https://youtu.be/oqidNhlAkAo

»main website: <u>https://solarforecastarbiter.org/</u>

