

Meteorology & Market Design For Grid Services Workshop **DENVER, CO**

June 4 - 6, 2019

4 Tuesday

7:00 – 8:00 a.m.

8:00 a.m. – 12:00 p.m.

The three-day event will bring together experts from North America, Europe, and around the world to explore the state-of-the-art in wind, solar and distributed generation forecasting and meteorology application to electric power systems planning, operations and market design. Wind and solar generation are now mainstream, and energy storage is developing rapidly; their influence on market design and system operation is profound. This is a unique, one-of-a-kind event where you can learn about the latest developments and share experiences with other others in this fast-developing field.



Registration & Breakfast

Location: Silverton 3

Tutorial: Electricity Markets and Forecast Utilization: How they work and how they interact

Co-chairs: **Erik Ela & Aidan Tuohy**, EPRI

Location: Silverton 1/2

In this tutorial, experts will cover two topics as the two focus areas of the workshop: the use of various forecasted information in electric power systems, and the design of wholesale electricity markets. The tutorial will include an introductory session with “Forecast Use 101” and “Electricity Markets 101” in the first half of the tutorial, and follow with cutting edge research on both topics including how the topics are intertwined and become more simultaneously important on the future evolving electric power grid. Topics may include:

- Utilization of forecast data in renewable integration studies
- Using forecasts in power system operations
- Energy markets and energy price formation
- Ancillary service market characteristics
- Capacity markets and financial transmission rights
- Forecasting for reliability needs: Dynamic reserve forecasting and frequency response forecasting
- Probabilistic forecasts and how they may be utilized
- Advanced electricity market clearing with electric storage
- New and evolving ancillary service markets

10:00 – 10:30 a.m.

Break

Location: Silverton Foyer

12:00 – 1:00 p.m.

Lunch

Location: Silverton 3

1:00 – 2:00 p.m.

Welcome and Overview Session

Location: Silverton 1/2

Introduction

Mark Ahlstrom, NextEra Energy Resources

Local Welcome & Keynote Remarks

Martin Keller, Director, NREL

Meeting Overview

Charlie Smith, ESIG

2:00 – 5:00 p.m.

Opening Plenary Session: Common Ground – Forecasting & Market Design for Clean Energy Futures

Chair: **Bethany Frew**, NREL

Location: Silverton 1/2

Linkage between Market Design and Forecasting – Why It Should be Even Tighter

Mark Ahlstrom, NextEra Energy Resources

How Much, How Far, How Certain – Market Proposals and Forecasting Implications

Rob Gramlich, Grid Strategies

Use of Probabilistic Forecasts – Are We Finally Ready to Use Them?

Ben Hobbs, Johns Hopkins University

Grid Services and Future System Values – The Big Picture

Mark O'Malley, NREL

Panel Discussion – What Are Your Major Drivers of Market Redesign Today?

Additional panelists:

Emma Nicholson, Concentric Energy Advisors

Sue Haupt, NCAR

Aaron Bloom, NextEra Analytics

3:15 – 3:45 p.m.

Break

Location: Silverton Foyer

6:30 – 8:00 p.m.

5 Wednesday

7:00 – 8:00 a.m.

8:00 – 10:00 a.m.

Networking Reception

Location: Cripple Creek

Registration & Breakfast

Location: Silverton 3

Forecasting Session 1: Solar Forecasting 2 Program

Chair: **Tassos Golnas**, DOE

Location: Silverton 1/2

Panel 1

Open Source Evaluation Framework for Solar Forecasting
Justin Sharp, Sharply Focused

Advancing the WRF-Solar Model to Improve Solar Irradiance Forecast in Cloudy Environments
Yangang Liu, Brookhaven National Lab

HAIMOS Ensemble Forecasts for Intra-day and Day-Ahead GHI, DNI and Ramps
Hugo Pedro, UCSD

Development of WRF-Solar v2—Improving Solar Forecasts
Larry Berg, PNNL

Probabilistic Cloud Optimized Day-Ahead Forecasting System based on WRF-Solar
Manajit Sengupta, NREL

Advanced Solar and Load Forecasting Incorporating HD Sky Imaging
Paul Kalb, Brookhaven National Lab

Panel 2

Solar Uncertainty Management and Mitigation for Exceptional Reliability in Grid Operations
Bri-Mathias Hodge, NREL + UC Boulder

Probabilistic Forecasts and Operational Tools to Improve Solar Integration
Aidan Tuohy, EPRI

Coordinated Ramping Product and Regulation Reserve Procurements in CAISO and MISO using Multi-Scale Probabilistic Solar Power Forecasts
Venkat Krishnan, NREL

Additional Panelist: **Justin Sharp**, Sharply Focused

8:00 – 10:00 a.m.

Markets Session 1: Hybrid Resources and Virtual Power Plants – Are They for Real?

Chair: **Erik Ela**, EPRI

Location: Cripple Creek 2

A VPP Case Study

Ulrich Focken, energy & meteo systems, Germany

Selection of a VPP as a Capacity Resource in the ISO-NE Auction

Ben Carron, Sunrun

Behind-the-Meter Resources, Aggregations and Market Participation

Jim Baak, Consultant

Alternative Market Designs for Various Hybrid Resources

Nikita Singhal, EPRI

How Will a Hybrid PV-Battery Plants Bid into a Market?

Gary Dorris, Ascend Analytics

10:00 – 10:30 a.m.

Break

Location: Silverton Foyer

10:30 a.m. – 12:00 p.m.

Forecasting Session 2: Forecasting for Distributed Energy Applications

Chair: **Bri-Mathias Hodge**, NREL + UC Boulder

Location: Silverton 1/2

Incorporating On-Premise Solar PV Generation into an Operational Load Forecast – Revisited

Frank Monforte, Itron

Forecasting for Congestion in the Distribution Grid

Ulrich Focken, energy & meteo systems, Germany

Load Forecasting with Customer Adoption of DER

Brady Stoll, NREL

Impact of BTM on Load Forecasting in the CAISO

Amir Javanbakht, CAISO

10:30 a.m. - 12:00 p.m.

Markets Session 2: Forecasting and Market Design for Grid Services

Chair: **Eric Gimon**, Energy Innovation

Location: Cripple Creek 2

ERCOT Market Directions – Forecasting Frequency Response and Inertia (or More?)

Nitika Mago, ERCOT

Solar Forecasting for Low Voltage Network Operations in Australia

Nick Engerer, Solcast and Australian National University

Forecast Error, the New Norm: Mitigating Risk in the SPP Market with Probabilistic Forecasting in Day-ahead Generation Studies

Gunnar Shaffer, SPP

System Services from Renewable Power Plants

Allison Weis, Ascend Analytics

12:00 - 1:00 p.m.

Lunch

Location: Silverton 3

1:00 - 2:45 p.m.

Forecasting Session 3: Solar and Wind R&D Forecasting Advances - Part 1

Chair: **Craig Collier**, DNV-GL

Location: Silverton 1/2

Improving Irradiance Forecast Accuracy (CEC project, Clean Energy Research)

Marc Perez, Clean Power Research

Error Correction in the Timing of BPA Wind Power Ramp Events

Andrea Staid, Sandia National Labs

Using Wind Plant Production Changes to Improve Neighboring Plant Forecasts

Anamaria Sabau, ConWX

Costs and Consequences of Wind Turbine Wake Effects Arising from Uncoordinated Wind Energy Development

Julie Lundquist, University of Colorado Boulder

Meso-Micro Model Coupling

Sue Haupt, NCAR

1:00 – 2:45 p.m.

Markets Session 3: Current and Future Market Revenue Streams

Chair: **Mark O'Malley**, NREL

Location: Cripple Creek 2

An Introduction to Grid Services

Paul Denholm, NREL

Value of Ancillary Services – Current Revenues and Future Scenarios

Robin Hytowitz, EPRI

Value of Capacity – Current Revenues and Future Scenarios

Onur Aydin, Brattle Group

Bringing It All Together - Impacts of VER on Wholesale Prices and Market Revenue Now and In the Future

Ryan Wiser, LBNL

2:45 – 3:15 p.m.

Break

Location: Silverton Foyer

3:15 – 5:00 p.m.

Forecasting Session 4: Solar and Wind R&D Forecasting Advances - Part 2

Chair: **Jeff Lerner**, Vaisala

Location: Silverton 1/2

Wind Plant Forecast Improvements in Complex Terrain and Extreme Weather Conditions

Mikkel Westenholz, ENFOR

Wind and Solar Forecasting Advances and The Potential Utilization for Improved Battery Storage Integration

Tyler McCandless, NCAR

Wind Power Production and Ramp Forecasting Research Update

Ryan Kilpatrick, NRCAN

More Accurate Solar and Wind Guidance from the NOAA HRRR Model in 2019-2020

Stan Benjamin, NOAA

3:15 – 5:00 p.m.

Markets Session 4: Innovation of Services and Markets – Learning from Distribution and Vertically Integrated Utility Experiences

Chair: **Elaine Hale**, NREL

Location: Cripple Creek 2

Incentivizing DERs Through Performance Based Rates

Beth Hartman, Rocky Mountain Institute

Distributed Storage and DER Participation in Markets

Jeff Dennis, AEE

DER Blockchain - How it Contributes to Services and Markets

Pete Bronski, Energy Web Foundation

Integration of Distribution System Markets and RTO Markets

Forrest Small, Concentric Energy Advisors

6 Thursday

7:00 – 8:00 a.m.

Breakfast

Location: Silverton 3

8:00 – 9:45 a.m.

Forecasting Session 5: IEA WIND Task 36 – Forecasting for Wind Energy

Chair: **Caroline Draxl**, NREL

Location: Silverton 1/2

Update on Global Coordination in Forecast Model Improvement and Energy Forecast Metrics in NWP Models (15 min incl. questions)

Will Shaw, PNNL

Recommended Practices Guidelines for Forecast Solution Selection (15 min incl. questions)

Jeff Lerner, Vaisala

John Zack, UL-AWS

Data Communication Standards for Wind and Solar Forecasting (15 min incl. questions)

Mikkel Westenholz, ENFOR

Panel Discussion on Standardization Needs for Wind and Solar Forecasting

Facilitator: **Caroline Draxl**, NREL

Panelists:

Will Shaw, PNNL

John Zack, UL-AWS

Jeff Lerner, Vaisala

Mikkel Westenholz, ENFOR

Aidan Tuohy, EPRI

8:00 – 9:45 a.m.

Markets Session 5: System Operation Under Extreme Weather Events

Chair: **Josh Novacheck**, NREL

Location: Cripple Creek 2

Weather Events in NREL's Wind and Solar Datasets
Justin Sharp, Sharply Focused LLC

Forecasting Power System Relevant Weather Events
Hannah Bloomfield, U of Reading, UK

Weather and Hydro Planning and Operations: Historical and Future Perspectives
Kevin Howard, Western Area Power Administration

MISO Market Operations during Weather Events
Stephen Rose, MISO

9:45 – 10:15 a.m.

Break

Location: Silverton Foyer

10:15 a.m. - 12:15 p.m.

Closing Plenary Session: Global Perspectives on Forecasting and Market Design for the Future Energy System

Chair: **Aidan Tuohy**, EPRI

Location: Silverton 1/2

Forecasting for an Integrated Energy System
Laurent Dubus, EDF, France

Forecasting and Market Design for Multi-area Energy Balancing: A European Perspective
Magnus Korpås, NTNU, Norway

Efficient Network Planning Under Uncertainty: The Role of Non-Wires Alternatives and Lessons from Australia
Anna Evans, MIT Energy Initiative

Market Design Considerations for a High Renewables Future
Aaron Townsend, ERCOT

12:15 – 12:30 p.m.

Closing Remarks

Location: Silverton 1/2

Charlie Smith, ESIG