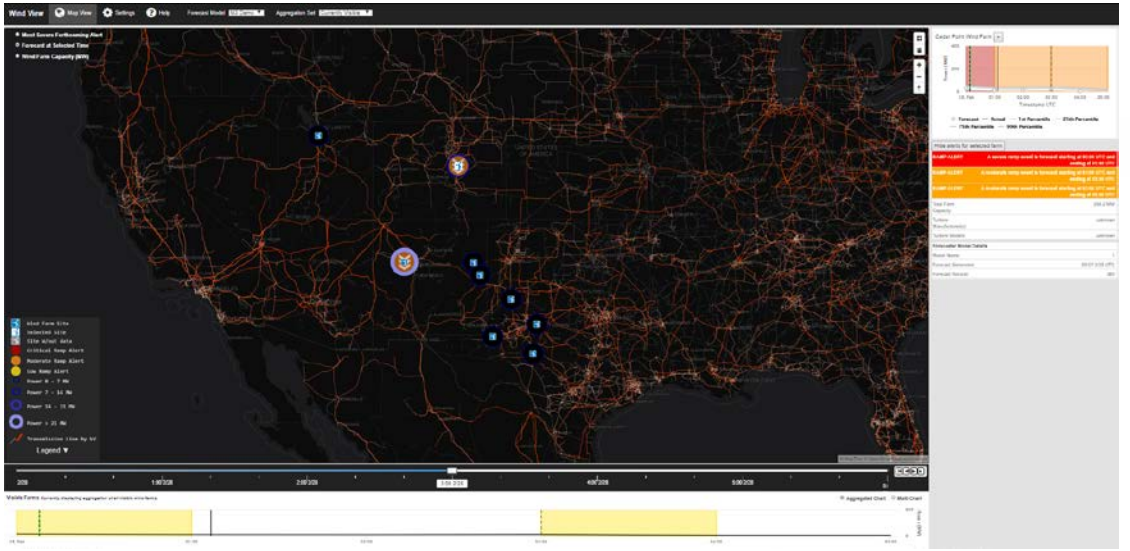
U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY



WindView
Project ID #M8

Bri-Mathias Hodge

National Renewable Energy Laboratory

FY17-FY18 Wind Office Project Organization

An Open Platform for Wind Energy Forecast Visualization

Technology Development

- Atmosphere to Electrons
- Offshore Wind
- Distributed Wind
- Testing Infrastructure
- Standards Support and International Engagement
- Advanced Components, Reliability, and Manufacturing

Market Acceleration & Deployment

- Stakeholder Engagement, Workforce Development, and Human Use Considerations
- Environmental Research
- Grid Integration
- Regulatory and Siting

Analysis and Modeling (cross-cutting)

Project Overview

M8: WindView

Project Summary

- Create an open-source, free, situational awareness and decision support platform called WindView which will provide grid operators with knowledge on the state and performance of their power system, with an emphasis on wind energy.
- Focus on utilizing advanced visualization to display pertinent information of wind farms and wind power.

Project Objective & Impact

- Significantly advances the Wind Energy Technologies Office objectives of effectively integrating higher penetration of wind energy through enhanced decision-support tools.
- WindView will enable power system operators and wind power forecasters to better understand and manage the uncertainty and variability of wind generation, to ensure a more reliable and resilient grid.

Project Attributes

Project Principal Investigator(s)
Bri-Mathias Hodge – NREL Zhi Zhou - ANL
DOE Lead
Charlton Clark, Jian Fu
Project Partners/Subs
University of Texas, Dallas
Project Duration
3 years

Project Budget

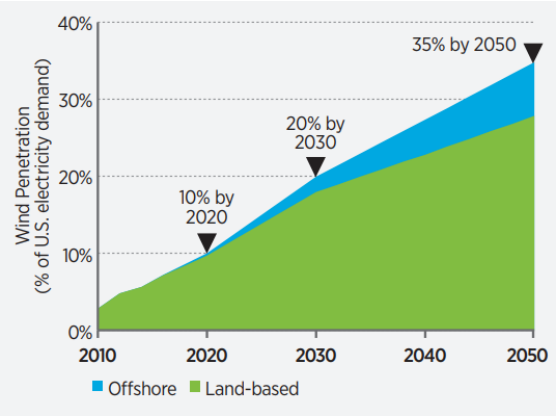
Total Project Budget (FY17 & FY18)	Total Actual Costs
$1,168,518	$1,036,439

Project Peer Review Budget is the sum of:

- All related Fiscal Year 2017 project beginning uncosteds
- All related Fiscal Year 2017 project budget authority
- All related Fiscal Year 2018 budget authority
- All related prior year unobligated carryover

- It does not include Fiscal Year 2018 Beginning Uncosted, as that would double-count some funds from Fiscal Year 2017

Technical Merit and Relevance

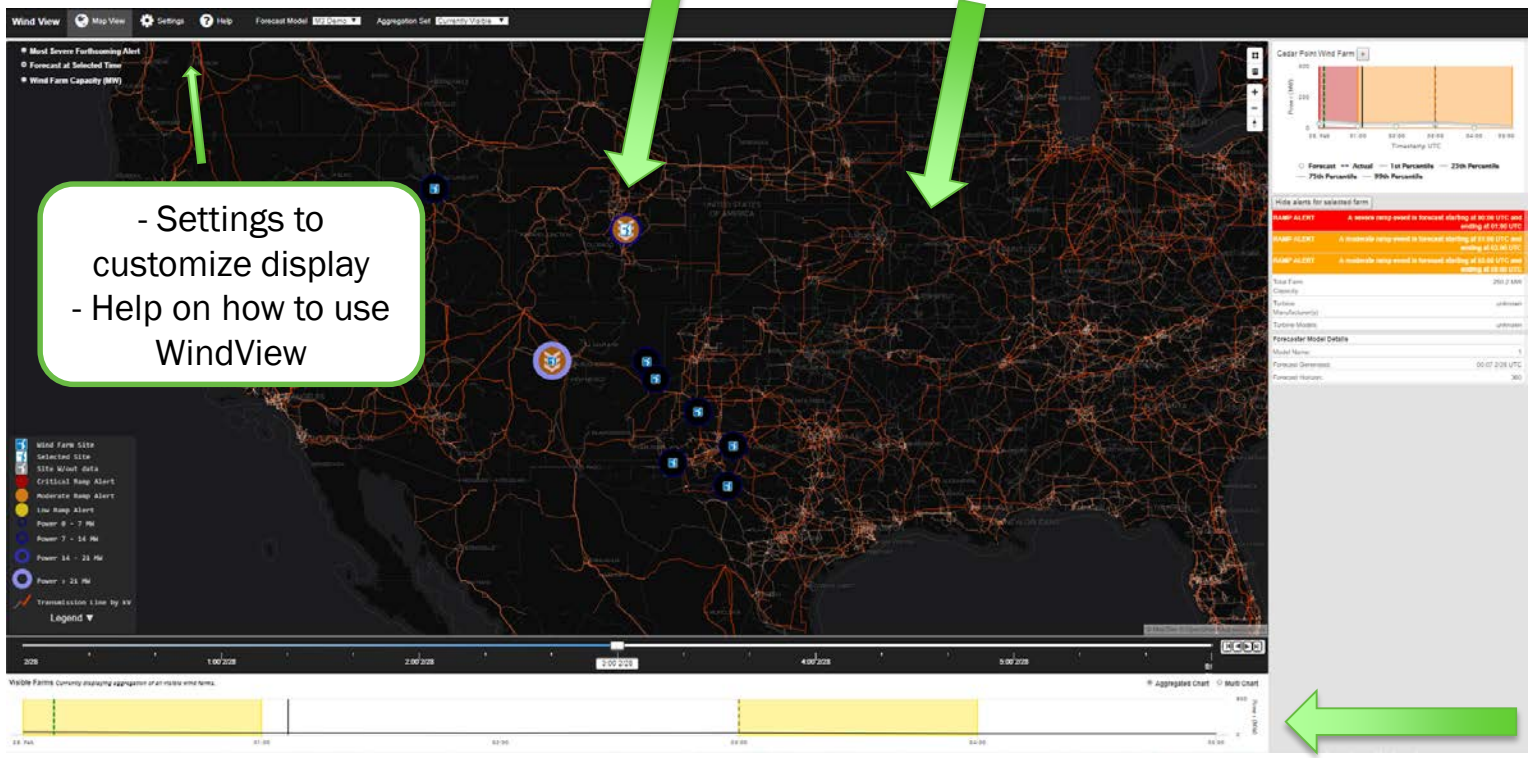


Wind Penetration from "A New Era for Wind Power in the United States – Department of Energy

Effectively integrate higher penetrations of wind energy with intuitive decision-support tools that enhance situational awareness.

Ramp alerts and power circles enhance situational awareness

Interactive map with open-source transmission layer and capable of displaying up to 200 wind farms



Probabilistic forecast to understand forecast uncertainty

Static information available for any wind farm selected from the map

Aggregated chart shows actual, forecast and ramping values for aggregation of choice, example balancing authority or transmission congestion zone

Approach and Methodology

NREL NATIONAL RENEWABLE ENERGY LABORATORY

Argonne NATIONAL LABORATORY

UT DALLAS

Playable Video (with sound)

Collaborated with:

CSIR our future through science

Xcel Energy

nationalgrid

Organized two technical review committees with:

Sharply Focused Understanding Renewable Resources

ercot

Western Area Power Administration

SPP Southwest Power Pool

Attended the Energy Systems Integration Group Wind Forecast Workshop

Approach and Methodology

Product Development

Developed prototype for demonstration: https://windview-beta.nrel.gov. Tested with Wind Site data.

Built a newly made probabilistic wind power forecaster, M3, into the WindView to allow users to fully interact with all of WindView's features.

Adapted ARGUS-PRIMA to work with WindView.

NWTC, NREL, Boulder

Accomplishments and Progress

Four publications completed, one in progress

- Feng, Cong, Sun, Mucun, Cui, Mingjian, Chartan, Erol Kevin, Hodge, Bri-Mathias, and Zhang, Jie. Characterizing forecastability of wind sites in the United States. United States: N. p., 2018. Web. doi:10.1016/j.renene.2018.08.085.

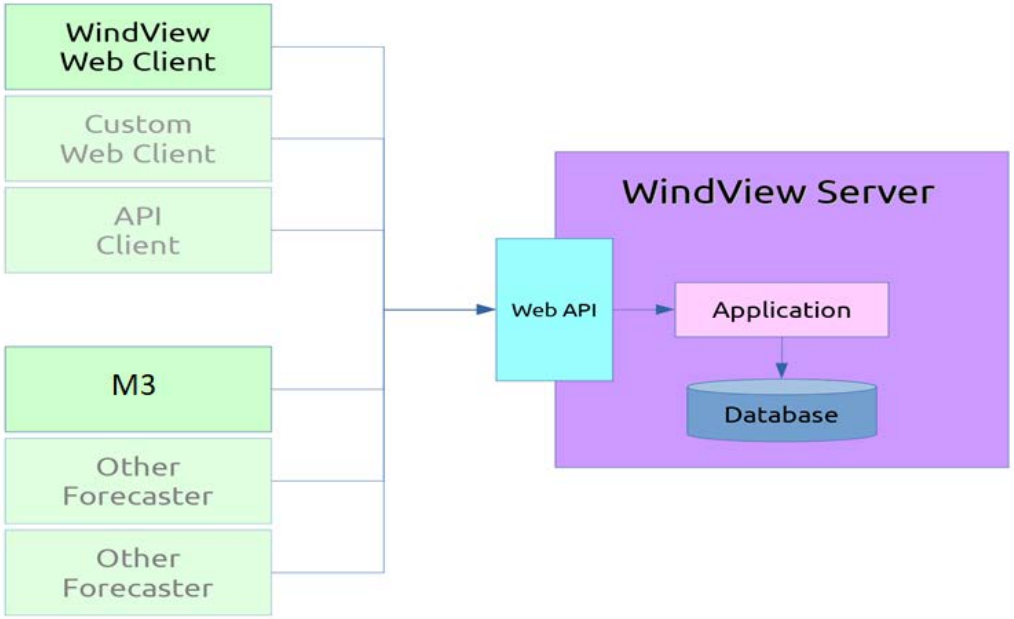
- Chartan, Erol Kevin, Hodge, Brian S, Sun, Mucun, Feng, Cong, and Zhang, Jie. Probabilistic Short-Term Wind Forecasting Based on Pinball Loss Optimization. United States: N. p., 2018. Web. doi:10.1109/PMAPS.2018.8440347.

- Hodge, Brian S, Chartan, Erol Kevin, Feng, Cong, and Zhang, Jie. Characterizing Time Series Data Diversity for Wind Forecasting: Preprint. United States: N. p., 2018. Web.

- Sun, Mucun, Feng, Cong, Chartan, Erol Kevin, Hodge, Bri-Mathias S., and Zhang, Jie. A two-step short-term probabilistic wind forecasting methodology based on predictive distribution optimization. United States: N. p., 2019. Web. doi:10.1016/j.apenergy.2019.01.182.

- Hodge Bri-Mathias, Chartan, Erol Kevin, Zhou, Zhi, Edwards, Paul, Abhyankar, Shri, Ayers, Andy. WindView – An Open Source Visualization Platform with a Focus on Wind Energy. Paper being written currently and due to be submitted to journal 'Wind Energy", by April 1st 2019.

Accomplishments and Progress



Architecture of WindView

- Open-source
- Free
- Available for download on GitHub
- Developed with mainstream code
- Compatible with any wind power forecaster

Accomplishments and Progress

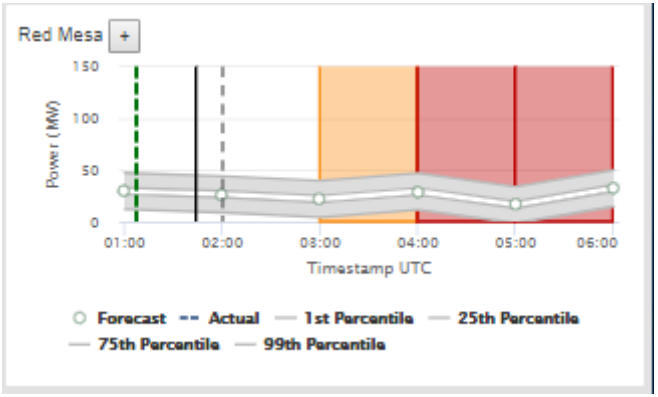
Created M3, a machine-learning-based short-term probabilistic forecaster to simulate real-time updated forecasts

Built M3 into the WindView user interface as a free ready-to-use wind power forecaster

National Oceanic and Atmospheric Administration's free, publicly available weather data is input into M3

M3

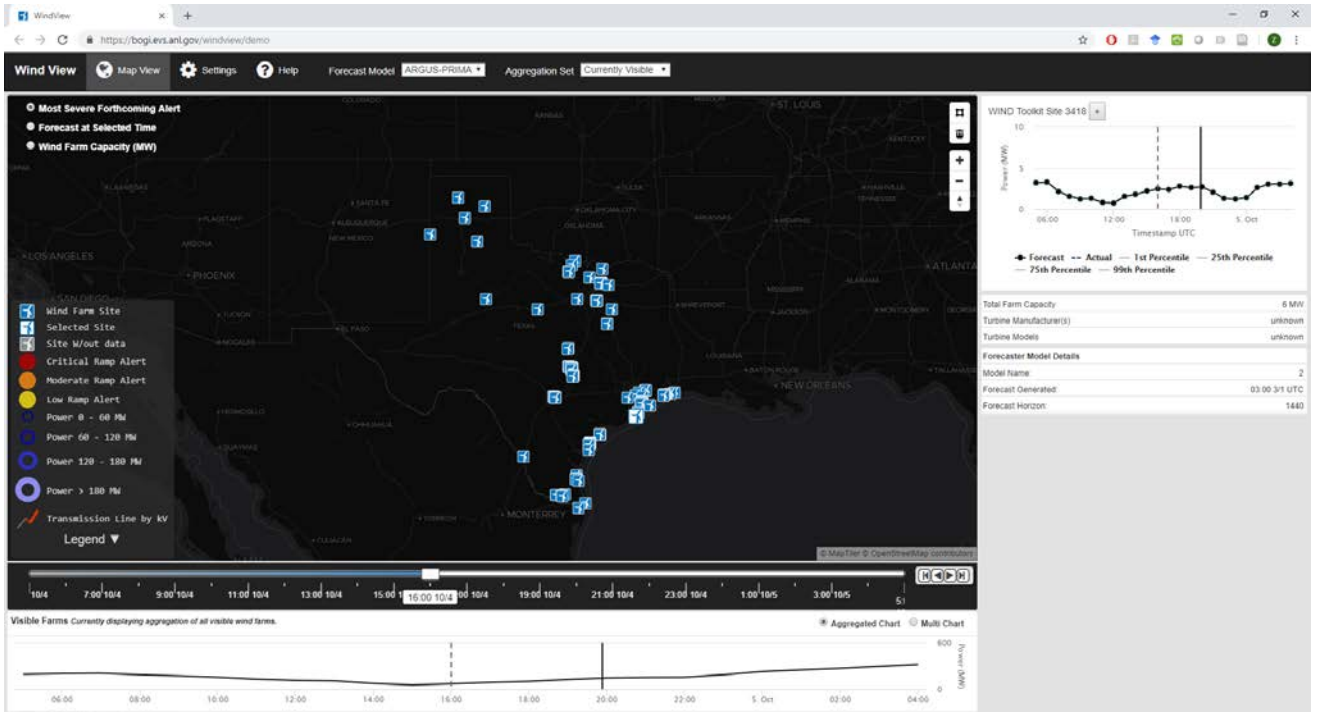
Trains models every week
Runs forecast every hour



Accomplishments and Progress

Argonne's existing probabilistic wind power forecasting tool, ARGUS-PRIMA, was made available to the public for free and open-source

ARGUS-PRIMA was enhanced and outputs made compatible with WindView and tested (picture below).



Communication, Coordination, and Commercialization

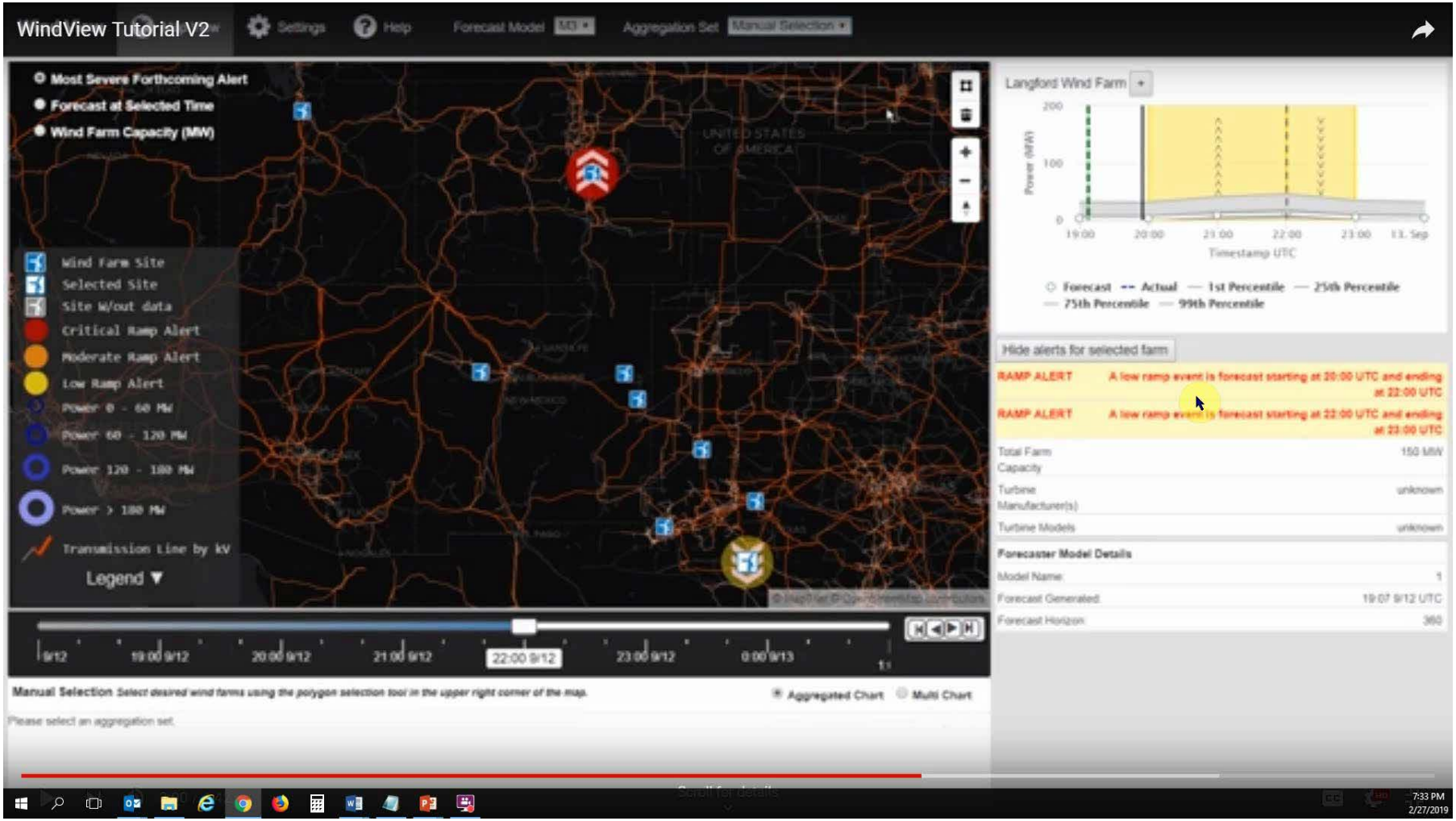
To come:

- Website
- Internal story
- Social media engagement activity
- Paper on WindView; submitting to Journal Wind Energy

Done:

- Discussions on adding WindView to the Great British Electricity National Control Center
- WindView available on GitHub
- Contacted technical review committee members and personal contacts
- Using NREL laboratory managers to outreach to industry

Communication, Coordination, and Commercialization



Created a tutorial video for new and potential users - playable video (with sound)