



Wind Forecasting and Curtailment Experience at NYISO

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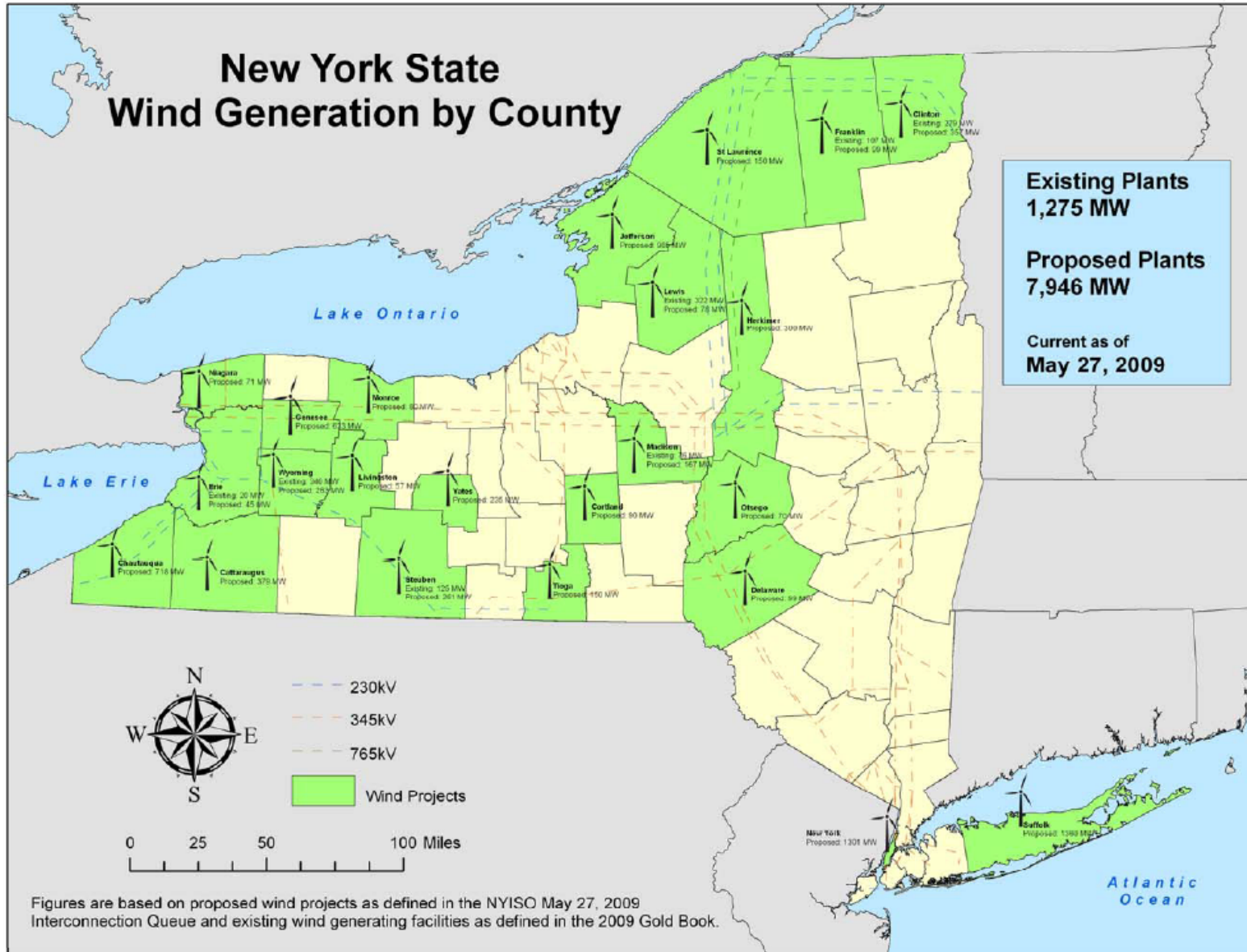
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Windpower in New York State

- ◆ In New York State, wind power development is primarily in Northern and Western regions, while load centers are in the Southeastern portion of the state.
 - *Currently **1,275 MW** of wind interconnected (~3.75% of peak load).*
 - *Nearly **8,000 MW** of wind in the interconnection queue.*
 - Including more than 2,000 MW of offshore wind development.

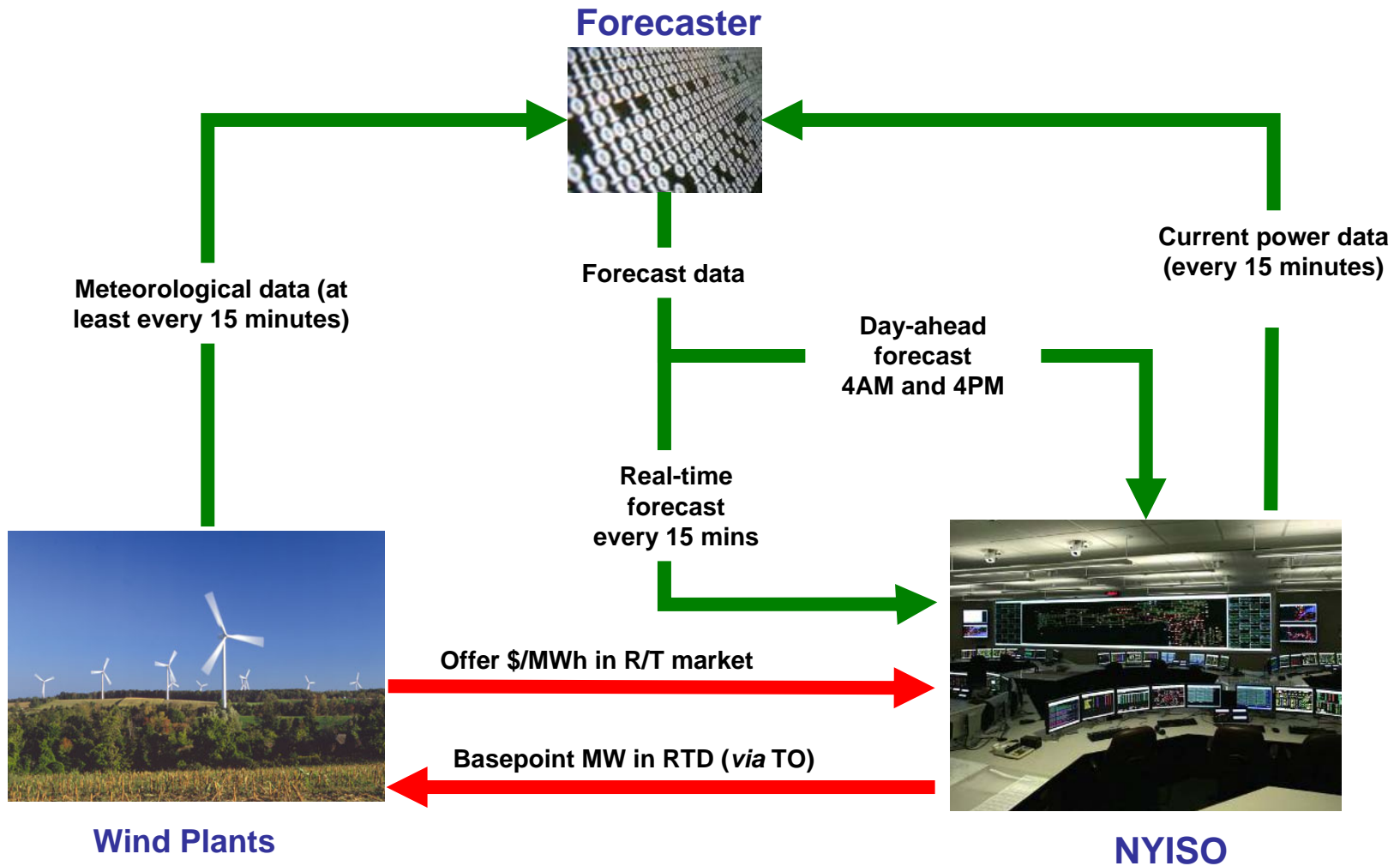




NYISO Wind Forecasting

- ◆ In 2008, the NYISO implemented a centralized program to forecast energy output for interconnected wind generating plants.
- ◆ Wind-energy output is being forecast for all but two wind generating plants.
- ◆ These forecasts are provided to the NYISO by a third-party wind forecasting company for both real-time and day-ahead energy market operations.

Wind Forecasting Overview



Wind Forecasting Integration

- ◆ Real-time forecasts are integrated into the NYISO's real-time Security Constrained Dispatch (SCD).
 - *Wind plant output levels are updated every 15-minutes on a 15-minute interval basis for an eight hour forecast period.*
 - *Mean Absolute Error (MAE) of 4.8% for one hour ahead forecast.*
- ◆ Day-ahead forecasts are integrated into the day-ahead unit commitment process for reliability purposes.
 - *Wind plant output levels are updated twice daily on an hourly interval basis for the next two operating days.*
 - *Mean Absolute Error (MAE) of 11.5% for day ahead operation.*

Windpower on Dispatch

- ◆ In May 2009, the NYISO implemented tariff changes for wind plants to receive and follow dispatch-down instructions via the **Security Constrained Dispatch (SCD)**.
- ◆ This enhanced wind management capability allows the NYISO to use the most economic resources to meet New York's energy demands while still meeting all reliability requirements.

On Dispatch: Benefits

- ◆ Integrating wind units into SCD provides the following benefits.
 - *Wind plants may indicate their economic willingness to generate (offering in Day-Ahead Market remains optional).*
 - *Identification and use of the most efficient resources to address reliability limitations while minimizing the energy limitation (MW) and duration.*
 - *Incorporates wind plant dispatch instructions into energy market clearing price.*
 - *Minimizes the need for less efficient, out-of-market actions to maintain reliable operations.*

On Dispatch: How It Works

- ◆ Wind resources will provide economic offers that indicate the price below which they no longer want to generate.
- ◆ Wind resources submit their economic offers by bidding into the real-time markets as flexible resources, and providing a bid curve with their offer.
- ◆ The bid curve allows them to specify up to eleven MW/price combinations at which they want to operate. For instance, a wind resource could structure its offer as such:
 - *If LBMP is less than -\$75, I don't want to generate*
 - *If LBMP is between -\$20 and -\$75, I want to limit my generation to 30mw*
 - *If LBMP is greater than -\$20, I don't want my generation limited at all*

On Dispatch: How It Works

- ◆ The system will use the wind resource's economic energy offer and its forecasted energy output to determine if the wind resource's output should be limited.
 - *Uses forecasted energy output as the upper bound of the dispatch range.*
 - *Uses zero as the lower bound of the dispatch range.*
 - *Uses the resource's economic offer to determine the point within the dispatch range that the resource is economic.*
- ◆ Normally the instructions sent to wind resources will reflect the ability of the system to take all the energy the wind resource can produce. However, if the wind resource's energy must be limited below its forecasted output level to avoid a reliability issue, instructions sent to the wind resource will reflect those limitations.

On Dispatch: How It Works

- ◆ The NYISO will continuously communicate when wind resources are subject to limitations and when they are not.
- ◆ Instructions are sent electronically from the NYISO via market basepoints to the transmission owners. Transmission owners communicate these instructions to the wind resources.
- ◆ Failure of the wind resource to respond to their market basepoints may result in a penalty based on our regulation clearing price.
- ◆ If the wind resource has been instructed to limit its output, it will be compensated at the lesser of its scheduled (limited) output or its actual output. Otherwise, it will be compensated for its actual output.

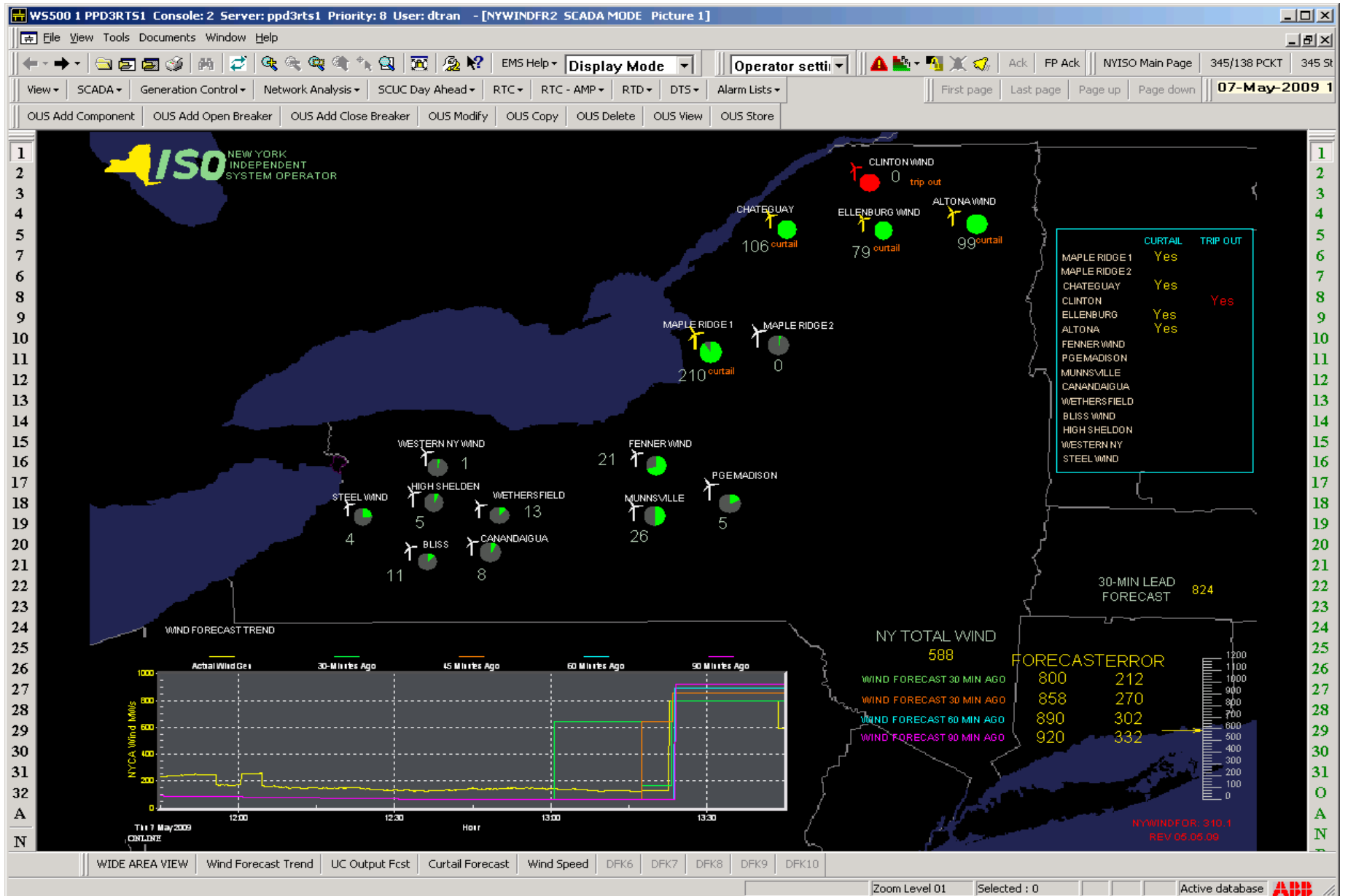
Monitoring

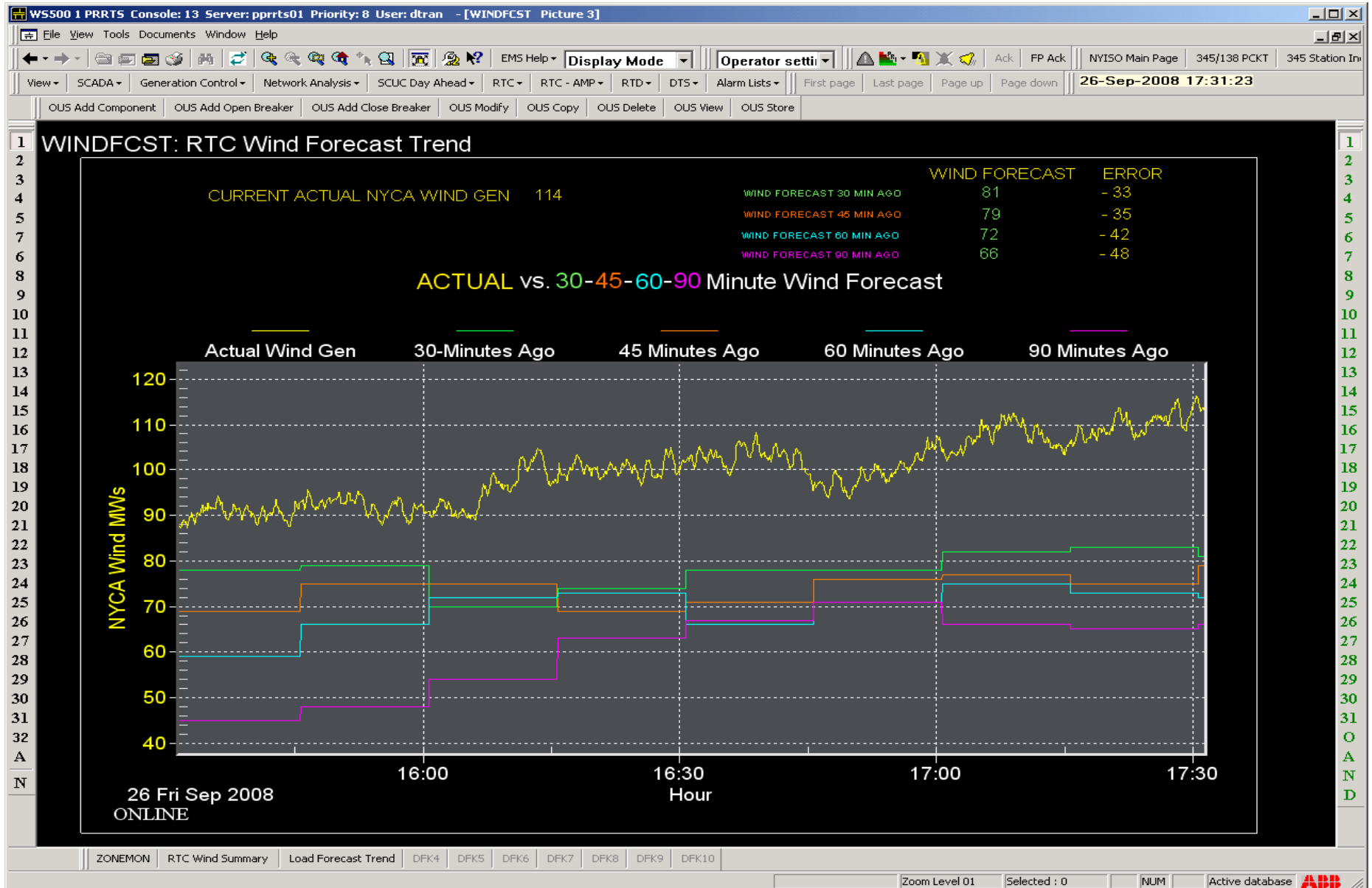
- ◆ The NYISO is investigating the ability to manage significant regional wind plant output ramp events.
 - *Sudden large increases in wind speeds and plant outputs.*
 - *High wind speeds approaching wind plant cut-out levels.*
 - *Sudden large drops in wind speeds and plant outputs.*
- ◆ New wind plant data requirements.
 - *Meteorological data (wind speed and direction) within 5 km from each wind turbine.*
 - *Meteorological data from plants to be transmitted directly to NYISO every 30 seconds.*
- ◆ SCD could be used to address some wind plant ramp events in order to maintain reliable operations.

Visualization

- ◆ **Develop dash board displays to allow System Operators to monitor all wind activities such as:**
 - *Wind output*
 - *Wind trip out*
 - *Wind curtailment*
 - *Wind speed*
 - *Wind direction*

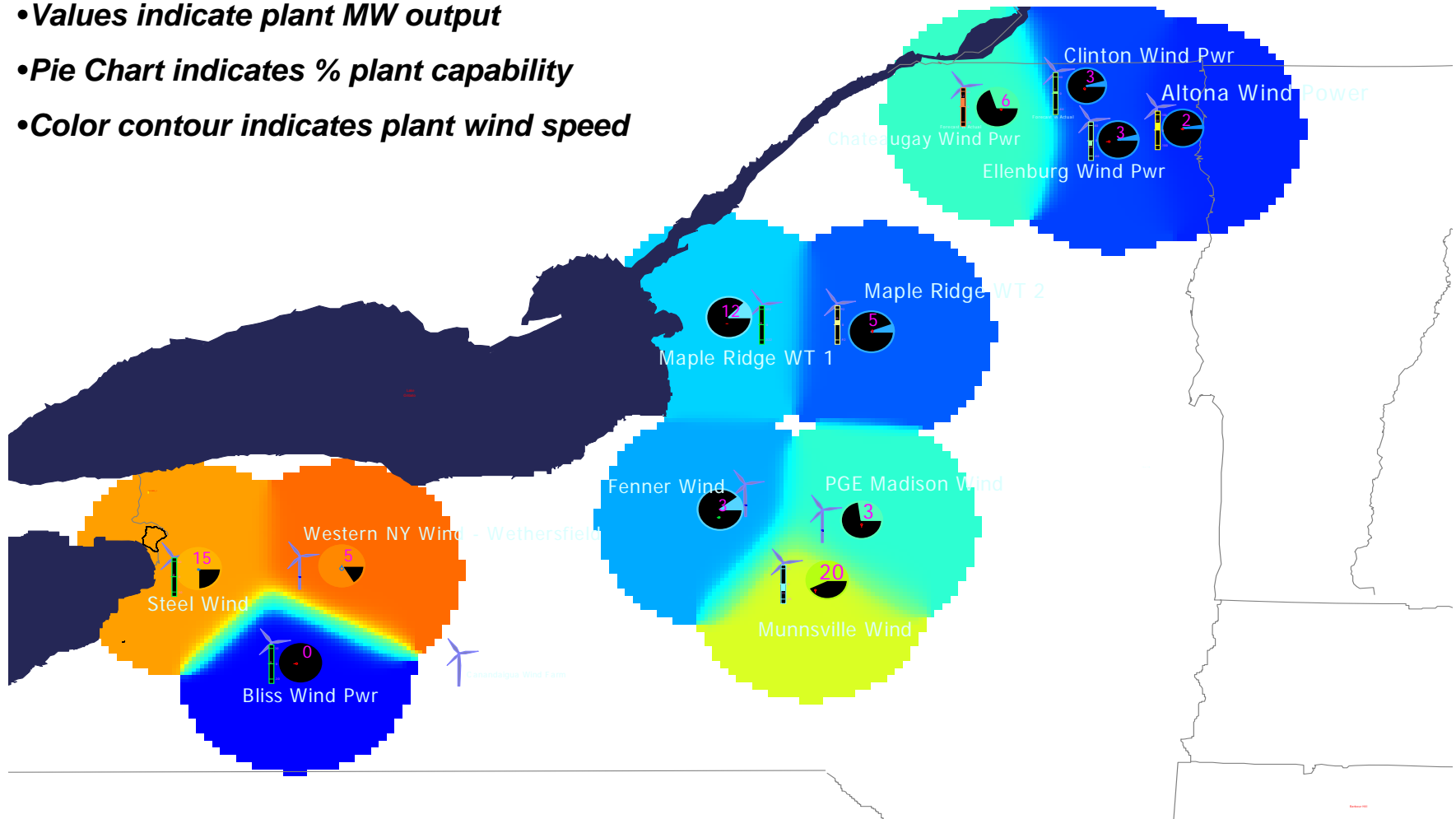






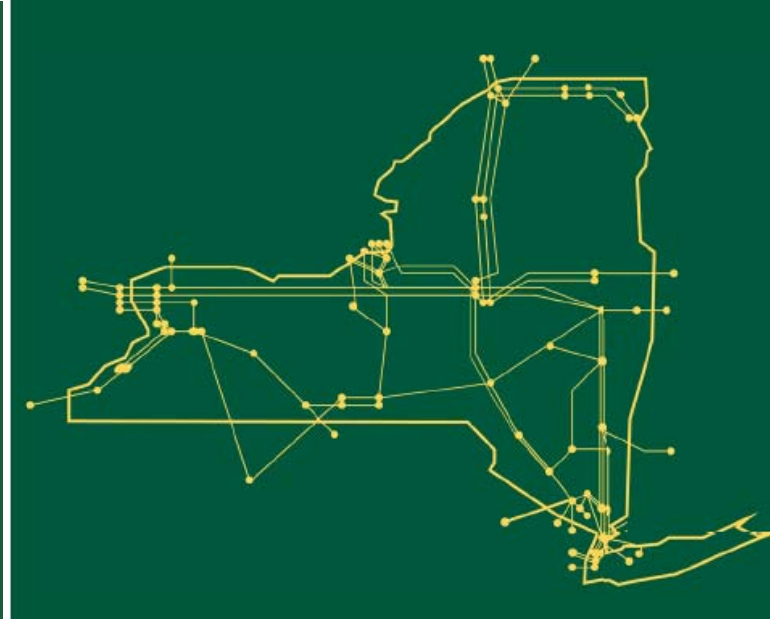
Future Visualization

- *Values indicate plant MW output*
- *Pie Chart indicates % plant capability*
- *Color contour indicates plant wind speed*



Questions?

The New York Independent System Operator (NYISO) is a not-for-profit corporation that began operations in 1999. The NYISO operates New York's bulk electricity grid, administers the state's wholesale electricity markets, and conducts reliability and resource planning for the state's bulk electricity system.



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