

# ***Integrating Renewable and Variable Energy Resources in the New York Electricity Market***

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# The Roles of the NYISO



## Reliable operation of the bulk electricity grid

- *Managing the flow of power on 11,000 circuit-miles of transmission lines from more than 300 generating units*



## Administration of open and competitive wholesale electricity markets

- *Bringing together buyers and sellers of energy and related products and services*



## Planning for New York's energy future

- *Assessing needs over a 10-year horizon and evaluating projects proposed to meet those needs*



## Advancing the technological infrastructure of the electric system

- *Developing and deploying information technology and tools to make the grid smarter*

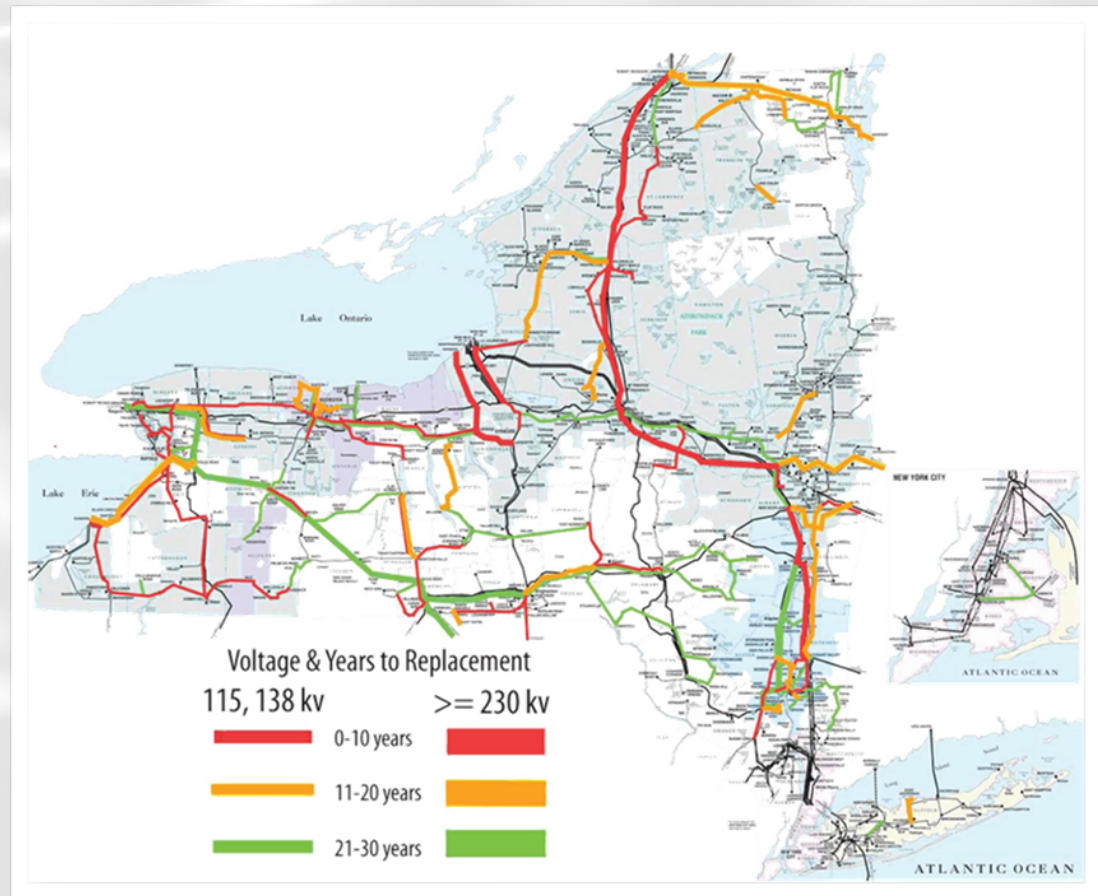
# NYISO Metrics

- ◆ New York State population -- 19.2 million
- ◆ 2009 load – 158,836 GWH
- ◆ 2010 Required Installed Capacity – 38,970 MW
- ◆ Record peak -- 33,939 MW (Aug. 2, 2006)
- ◆ Over 335 generating units
- ◆ 10,877 miles of high voltage transmission
- ◆ Over \$75 billion in market transactions since inception
- ◆ Nearly 400 Market Participants



# Transmission

- ◆ **Over 80% of New York's transmission was built before 1980**
- ◆ **More than 40% of NY's transmission will need replacement over the next 30 years**



SOURCE: *New York State Transmission Assessment and Reliability Study, April 2012*

# New York Energy Highway

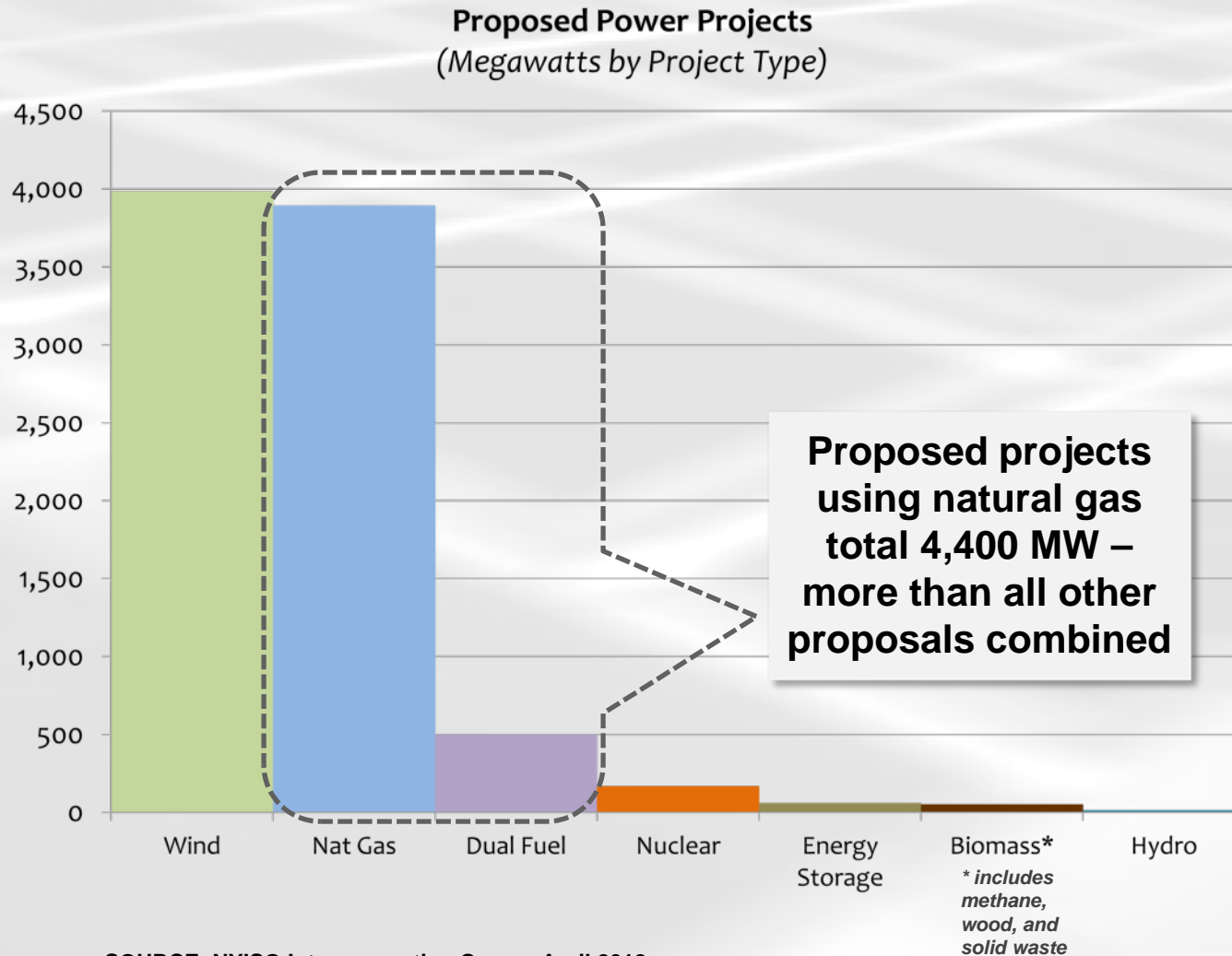
- ◆ In 2012 State of the State Address, Gov. Cuomo proposed “Energy Highway” initiative
- ◆ 85 responses to Energy Highway Task Force RFI with 130 proposals totaling over 25,000 MW
- ◆ Action plan released in October, 2012



## Objectives

- Reduce constraints on the flow of electricity within New York State
- Promote economic development, job creation and investment in New York State
- Expand diversity of downstate power generation
- Enhance reliability of the electric system
- Encourage development of renewable generation
- Increase efficiency of power generation

# Proposed Additions

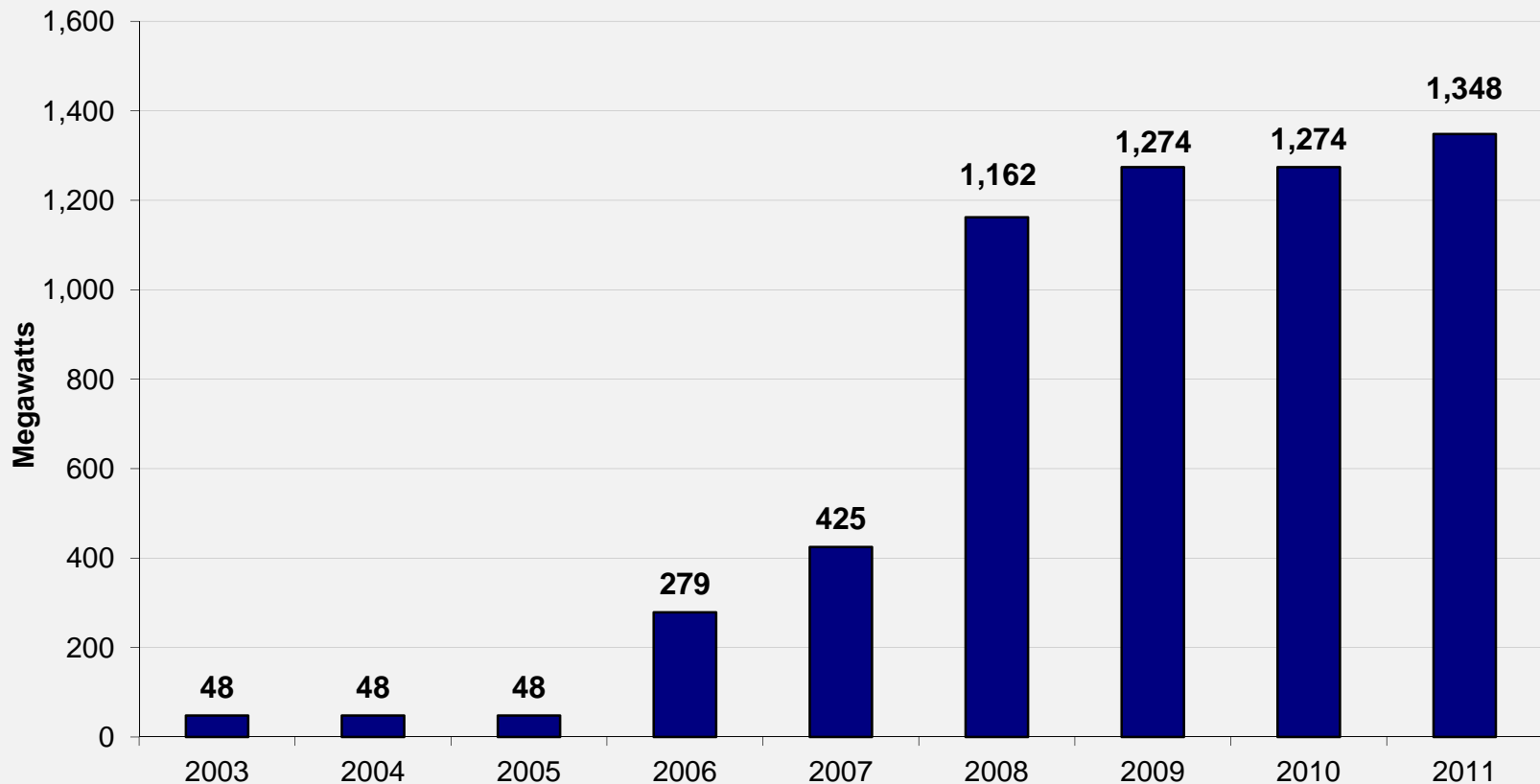


SOURCE: NYISO Interconnection Queue, April 2012



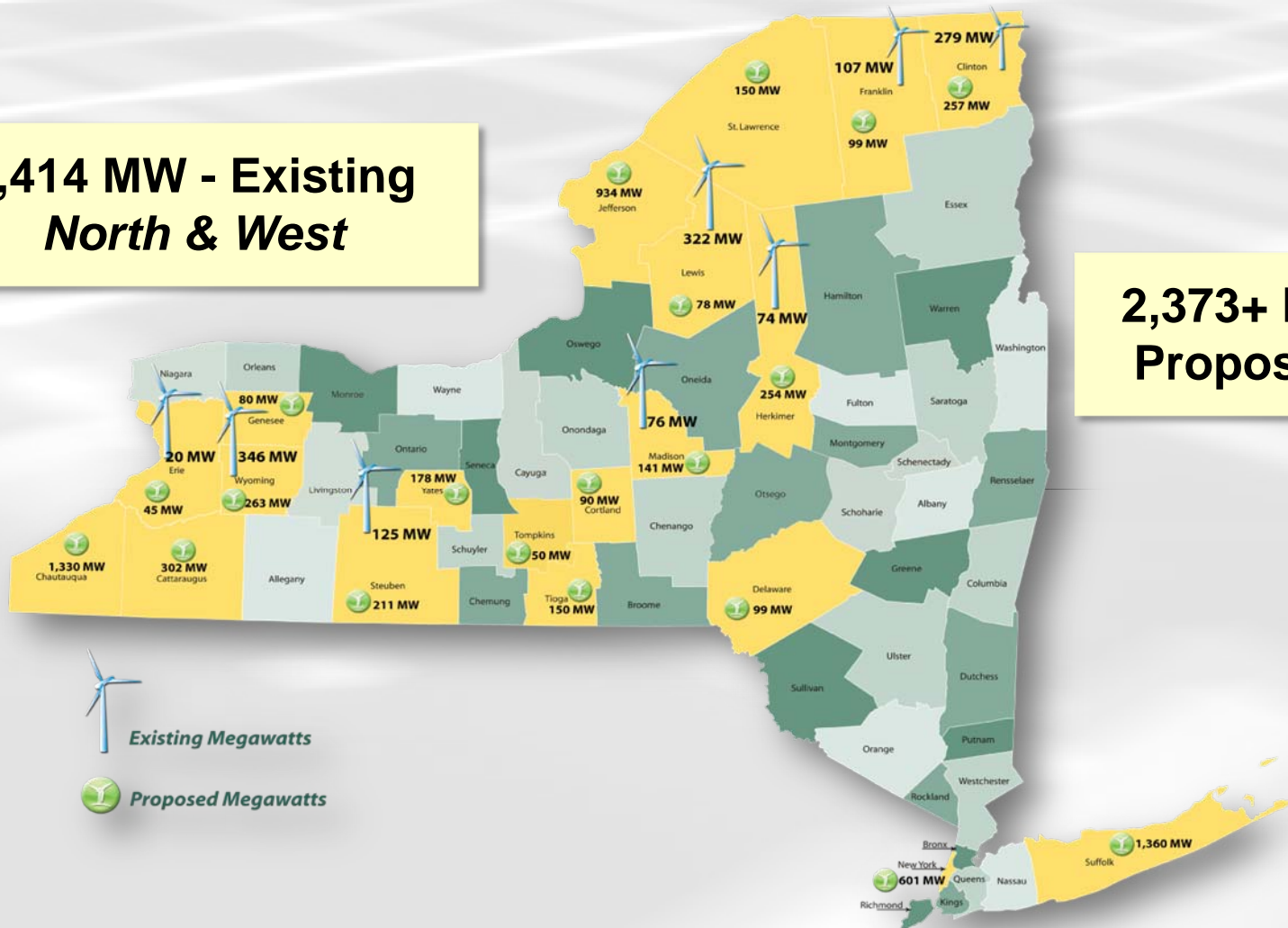
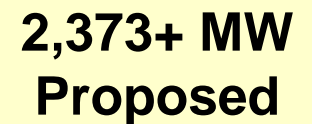
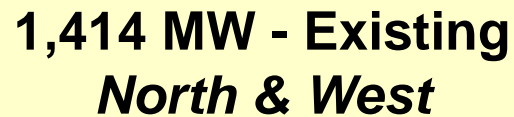
# Wind Growth in New York

## Installed Wind Capacity in New York State (Nameplate Rating)



SOURCE: 2011 Load & Capacity Data Report, New York Independent System Operator, April 2011

# Wind Resource Locations

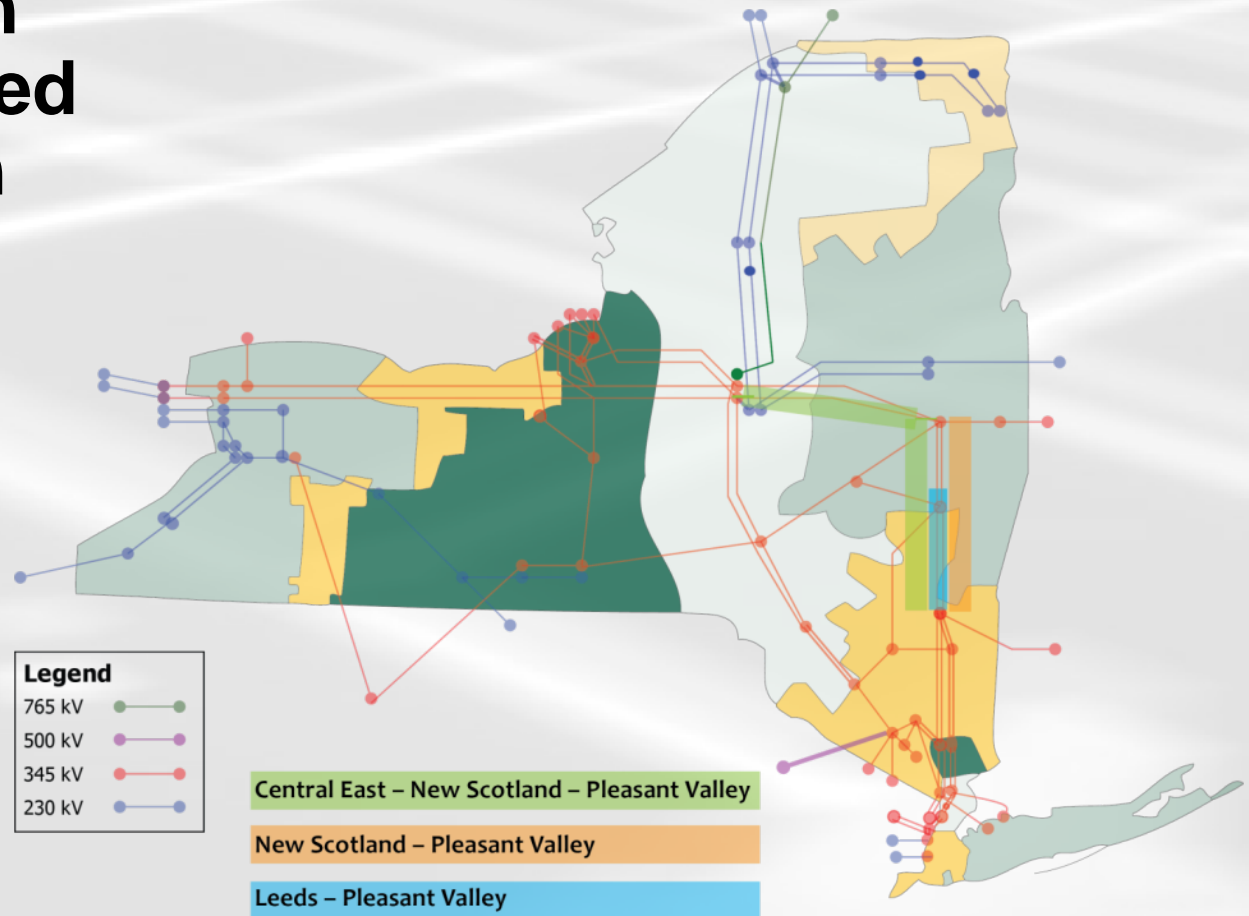




# Transmission Congestion

- ◆ **Congestion concentrated on paths in**

- **Mohawk Valley**
- **Capital Region**
- **Hudson Valley**



# Emerging Resources

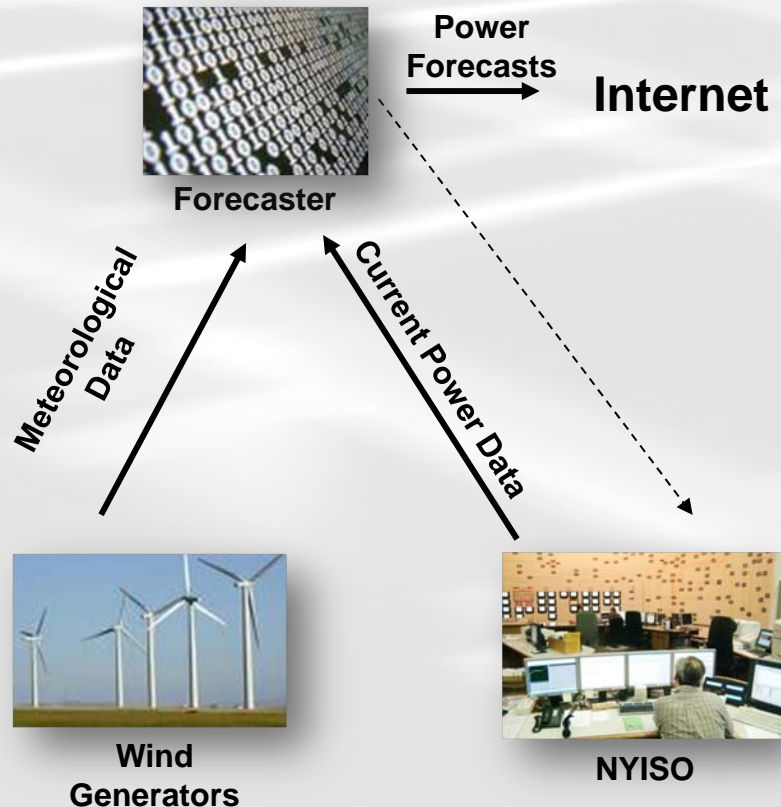
Renewable resource capacity additions scheduled for 2011-2013 include:



# Solar in the Markets

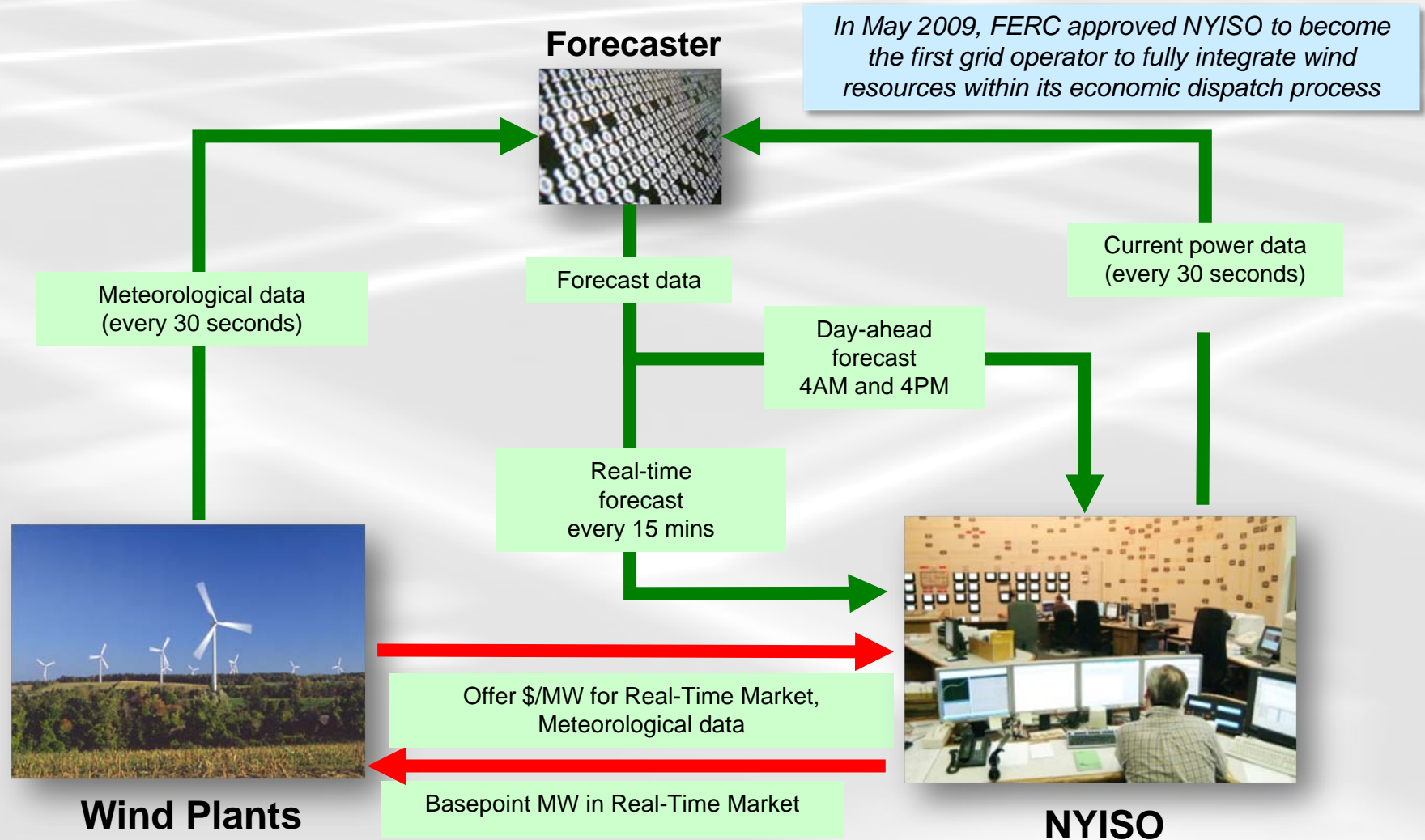
- ◆ In NYISO energy markets, solar resources are:
  - *Exempted from under-generation penalties and compensated fully for all energy production*
- ◆ Future considerations for solar resources in the energy market expected to parallel wind integration initiatives:
  - *Meteorological data collection requirements*
  - *Solar power production forecasts*
  - *Integrating solar power resources into economic dispatch*

# Wind Forecasting Overview



- Implemented in 2008
- AWS Truewind provides forecasts:
  - *Day Ahead and Real-Time*
  - *For each wind plant*
- Wind generators have access to their individual plant forecasts
- The NYISO uses the wind plant forecasts in its Day-Ahead and Real-Time economic commitment and dispatch software

# Pioneering Wind Dispatch



# Economic Dispatch Overview

Integrating wind resources into Security Constrained Dispatch provides the following benefits:

- Wind resources 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 resource limitation and duration.
- Incorporates wind plant dispatch instructions into energy clearing market price (Locational Marginal Price - LMP).
- Minimizes the need for less efficient, out-of-market actions to maintain reliable operations.



**ISO NEW YORK INDEPENDENT SYSTEM OPERATOR**

### CURRENT ACTUAL NYCA WIND GEN 618

Lag Error	Value
30-Minute Lag Error	39
45-Minute Lag Error	22
60-Minute Lag Error	-20
90-Minute Lag Error	-2

**WIND FORECAST TREND**

Map showing wind farms and their current output:

- CLINTON WIND: 24
- ALTONA WIND: 50
- CHATEAUQUAY: 25
- ELLENBURG WIND: 16
- NORTH
- MAPLE RIDGE 1: 136
- MAPLE RIDGE 2: 42
- FENNER WIND: 10
- PAGE MADISON: 4
- MUNNSVILLE: 11
- CANANDAIGUA: 61
- BLISS: 46
- WETHERSFIELD: 80
- HIGH SHEDDEN: 93
- STEEL WIND: 16
- WESTERN NY WIND: 4

**WIND FORECAST TREND**

Line graph showing NYCA Wind Miles vs Hour (Tue 28 Sep 2010). The graph displays Actual Wind Gen (yellow line) and forecasts from 30 minutes ago (green), 45 minutes ago (orange), 60 minutes ago (blue), and 90 minutes ago (purple).

**NY TOTAL WIND 618**

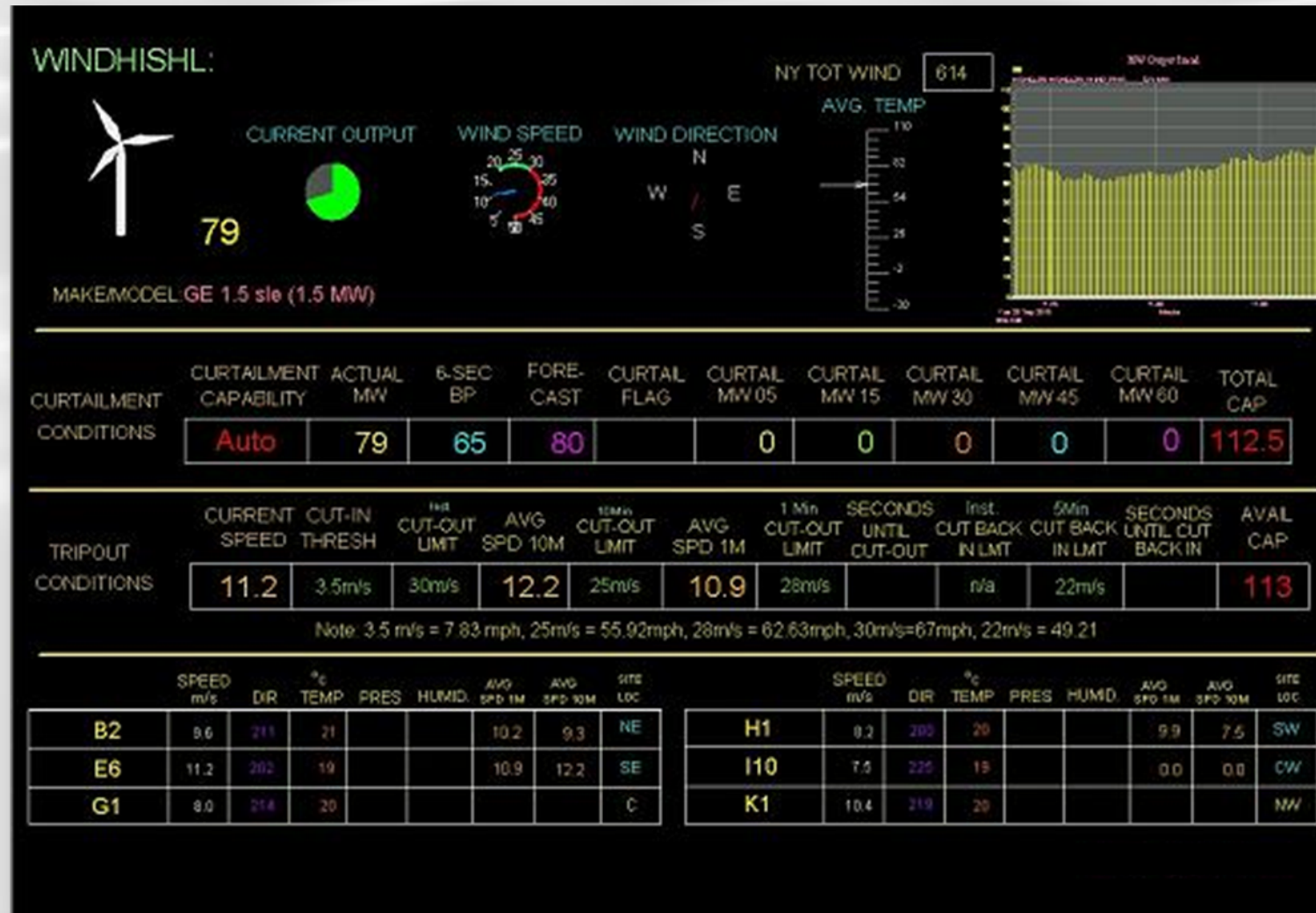
Forecast Lead Time	Forecast Value	Error
WIND FORECAST 30 MIN AGO	657	39
WIND FORECAST 45 MIN AGO	640	22
WIND FORECAST 60 MIN AGO	598	-20
WIND FORECAST 90 MIN AGO	616	-2

**FORECAST ERROR**

Scale: 0 to 1200.

15

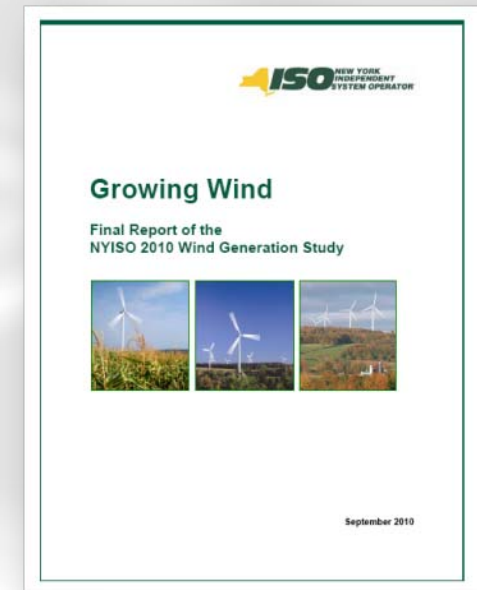
# Control Center Monitoring



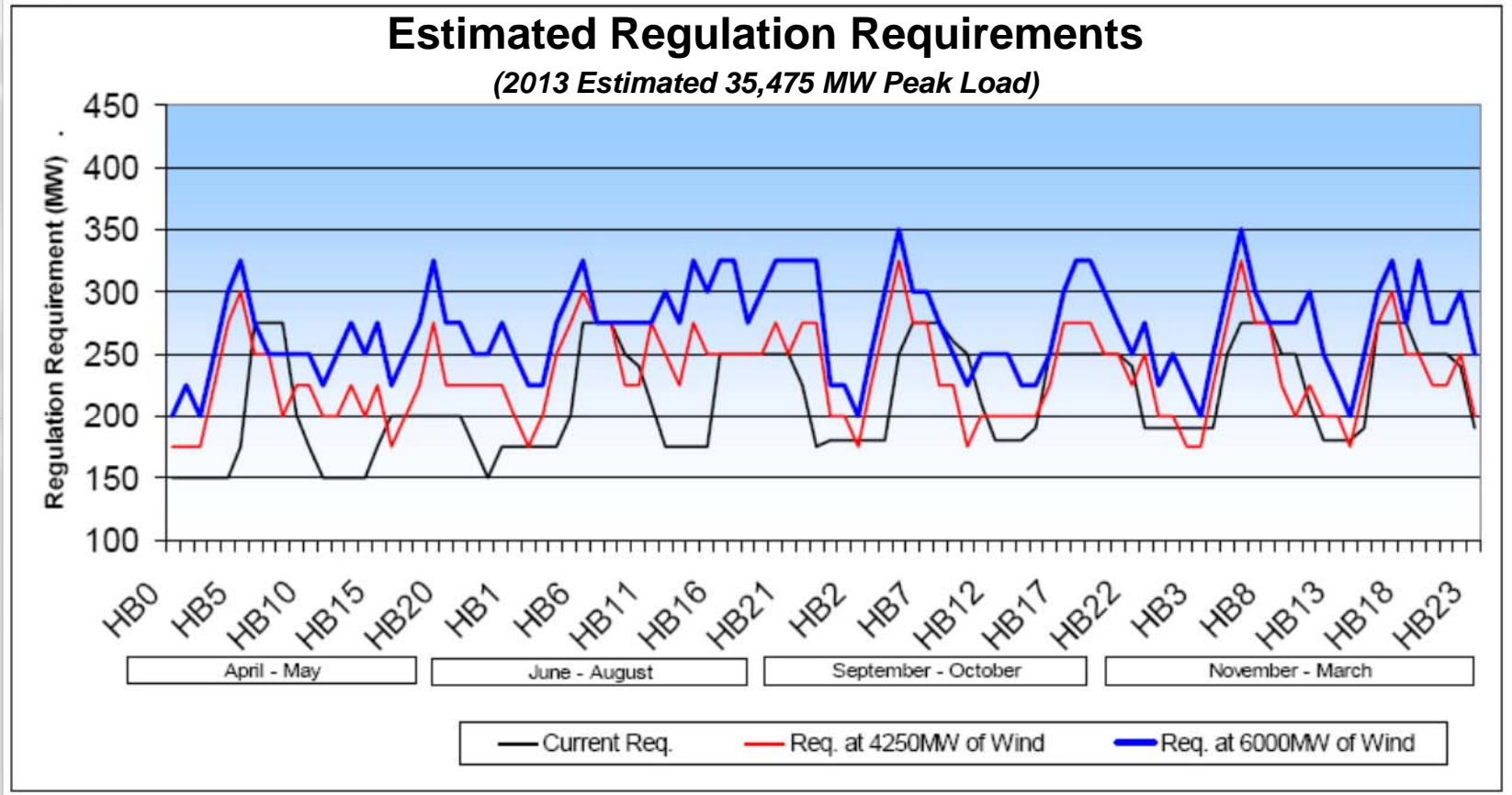
\*Information included in display is based on simulated data

# Planning for More Wind

- NYISO's 2010 Wind Generation Study looked at expanding wind power to 8000 MW by 2018
- It included analysis of the variability of load and wind (net system variability) at specified wind penetration levels and forecasted load levels
- The study found that:
  - No significant increase in regulation requirements is needed until the system reaches a 3500 MW wind penetration level (about 10% of peak load)
  - After 3500 MW, an increase in the regulation requirements of approximately 10% (25 MW) is needed for every 1000 MW increase in wind penetration up to 8000 MW (about 23% of peak load)



# Wind & Regulation



Source: *Growing Wind: Final Report of the NYISO 2010 Wind Generation Study*, October 2010



# Reporting: Wind Forecast Performance

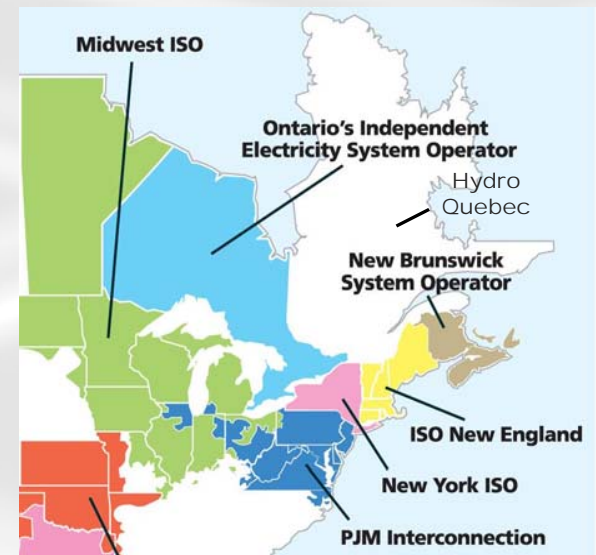
**Monthly statistics on the real-time and day-ahead wind forecast performance are available and presented to NYISO stakeholders in the NYISO's monthly CEO/COO Report**

- ***[http://www.nyiso.com/public/webdocs/committees/mc/meeting\\_materials/2011-07-27/agenda\\_03\\_Operations\\_Report\\_201106\\_v1.pdf](http://www.nyiso.com/public/webdocs/committees/mc/meeting_materials/2011-07-27/agenda_03_Operations_Report_201106_v1.pdf)***



# Regional Integration of Wind

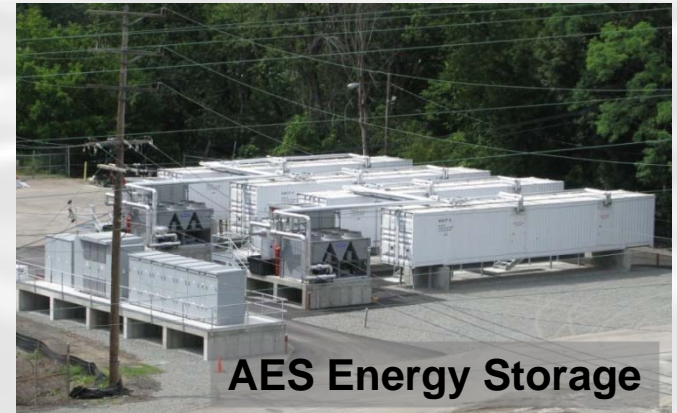
- **Broader Regional Market initiative**
  - Addresses “seams” between regional markets
  - Collaborative effort - NYISO, PJM Interconnection, Midwest ISO, ISO New England, Ontario’s Independent System Operator and Hydro Quebec
  - More frequent scheduling with HQ as well as PJM and ISO-NE can facilitate better regional integration of wind
  - HQ’s hydropower resources offer significant storage capability





# Energy Storage

- ♦ **NYISO -- *first grid operator in US to implement market rules enabling storage systems to participate in the markets as frequency regulation providers***
- ♦ **AES Energy Storage 20-MW system in Johnson City -- *first commercial grid-scale battery-based storage system to operate as a generator in US***
- ♦ **Beacon Power 20-MW flywheel project in Stephentown -- *first full-scale flywheel energy storage facility to provide frequency regulation service in US***



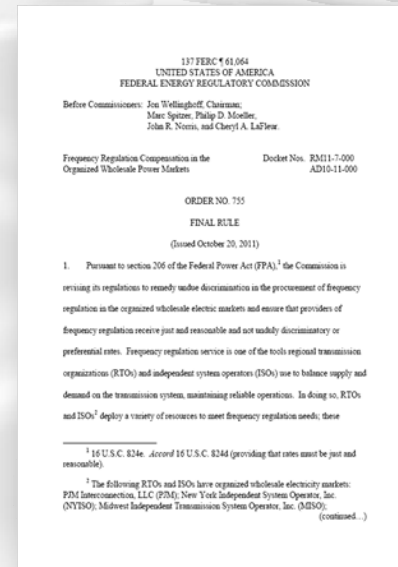
**AES Energy Storage**



**Beacon Power**

# FERC Order 755

- ◆ Requires markets to pay market based price for both the procurement of available regulation and moving those resources to secure the system
- ◆ Creates additional revenue stream for regulating resources -- particularly attractive for fast-responding storage devices





NEW YORK INDEPENDENT SYSTEM OPERATOR

**The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.**

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