

Integrating Renewables into the Electricity Grid

Tariff and Market Issues

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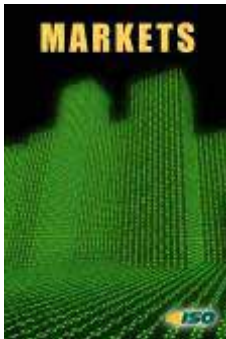
**Joint Session of the Staff Subcommittees
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The Roles of the NYISO



Reliable operation of the bulk electricity grid

- *Managing the flow of power over 11,000 circuit-miles of high voltage transmission lines from more than 500 generating units*



Design and implementation of open and competitive wholesale electricity markets

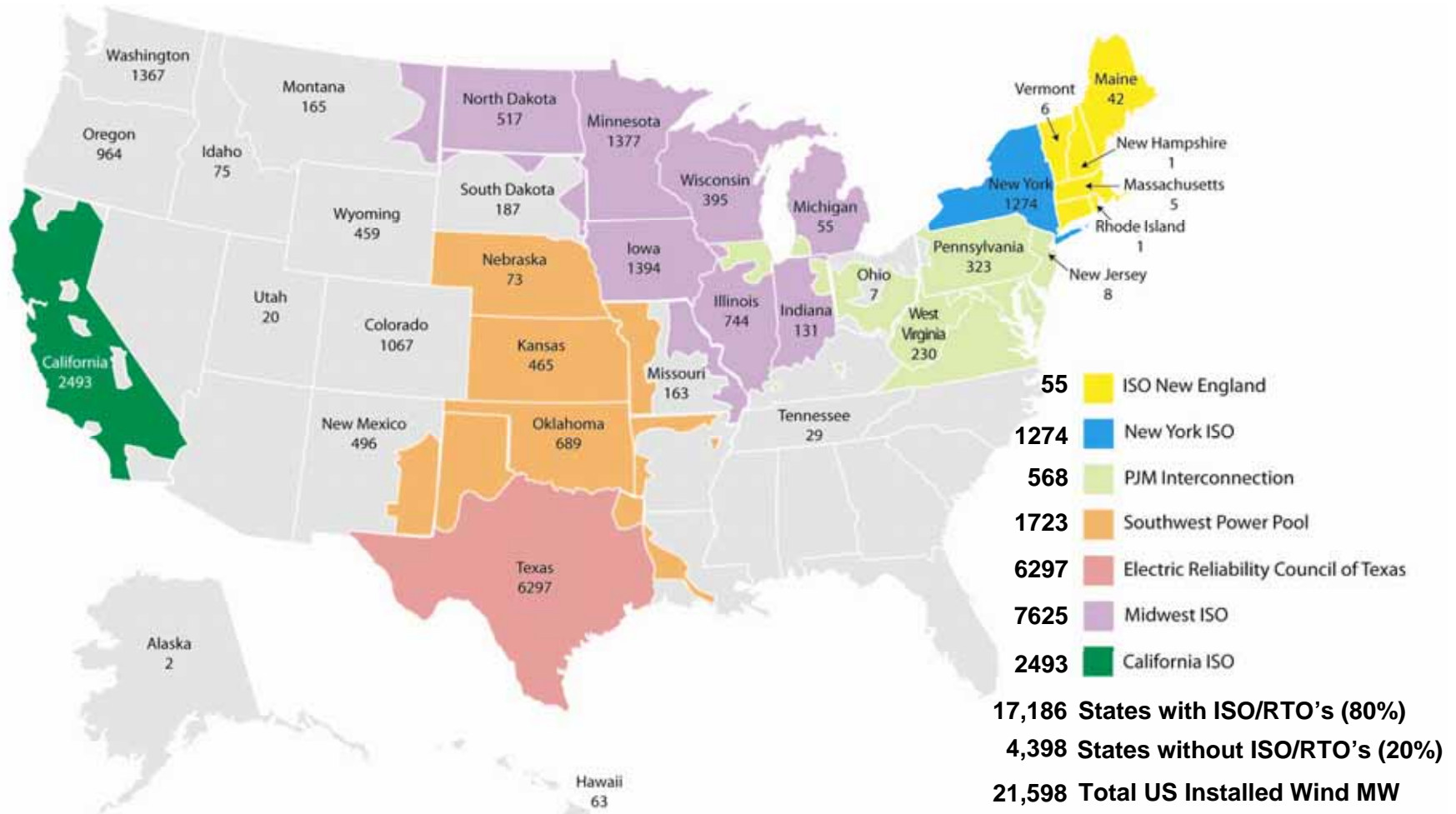
- *Market transactions totaling more than \$70 billion since inception in 1999*



Planning for New York's energy future

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

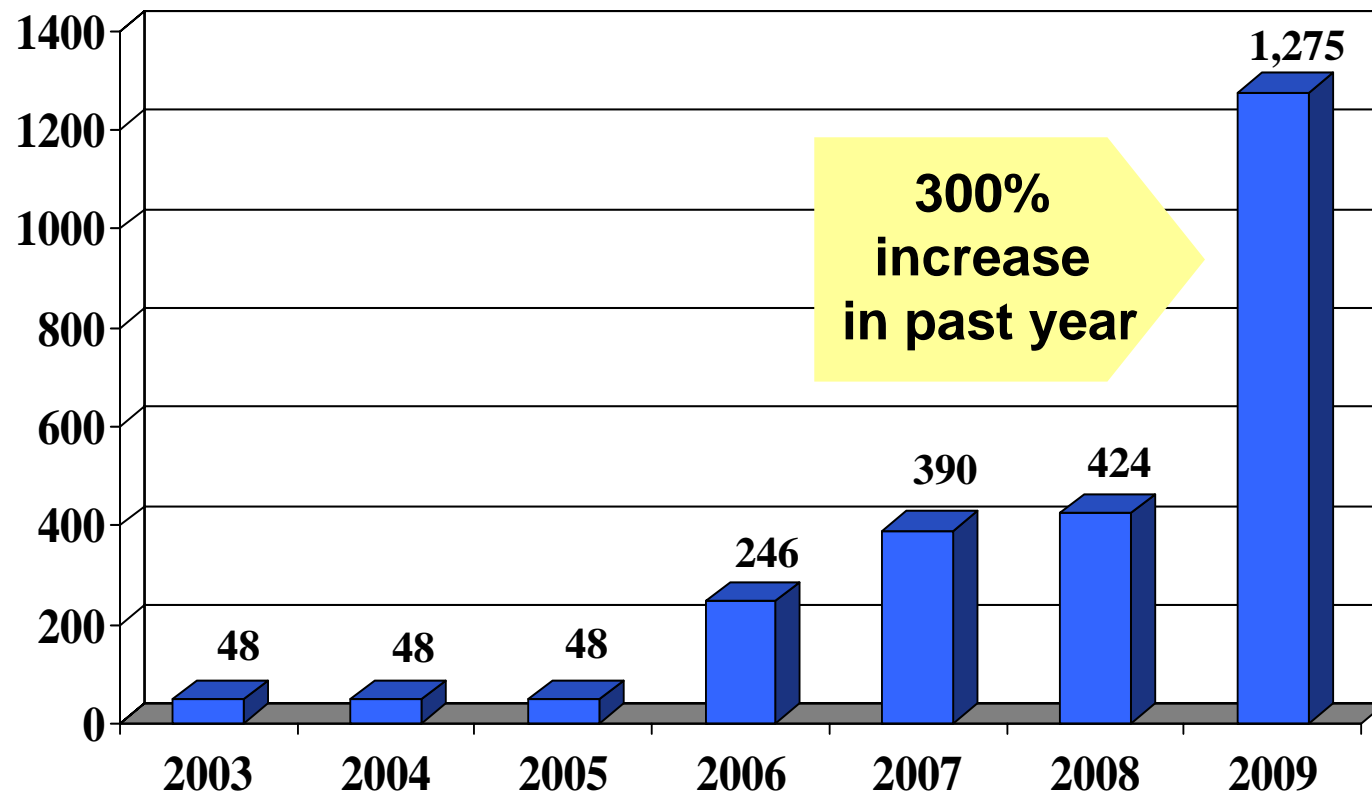
Wind Growth in ISO/RTOs



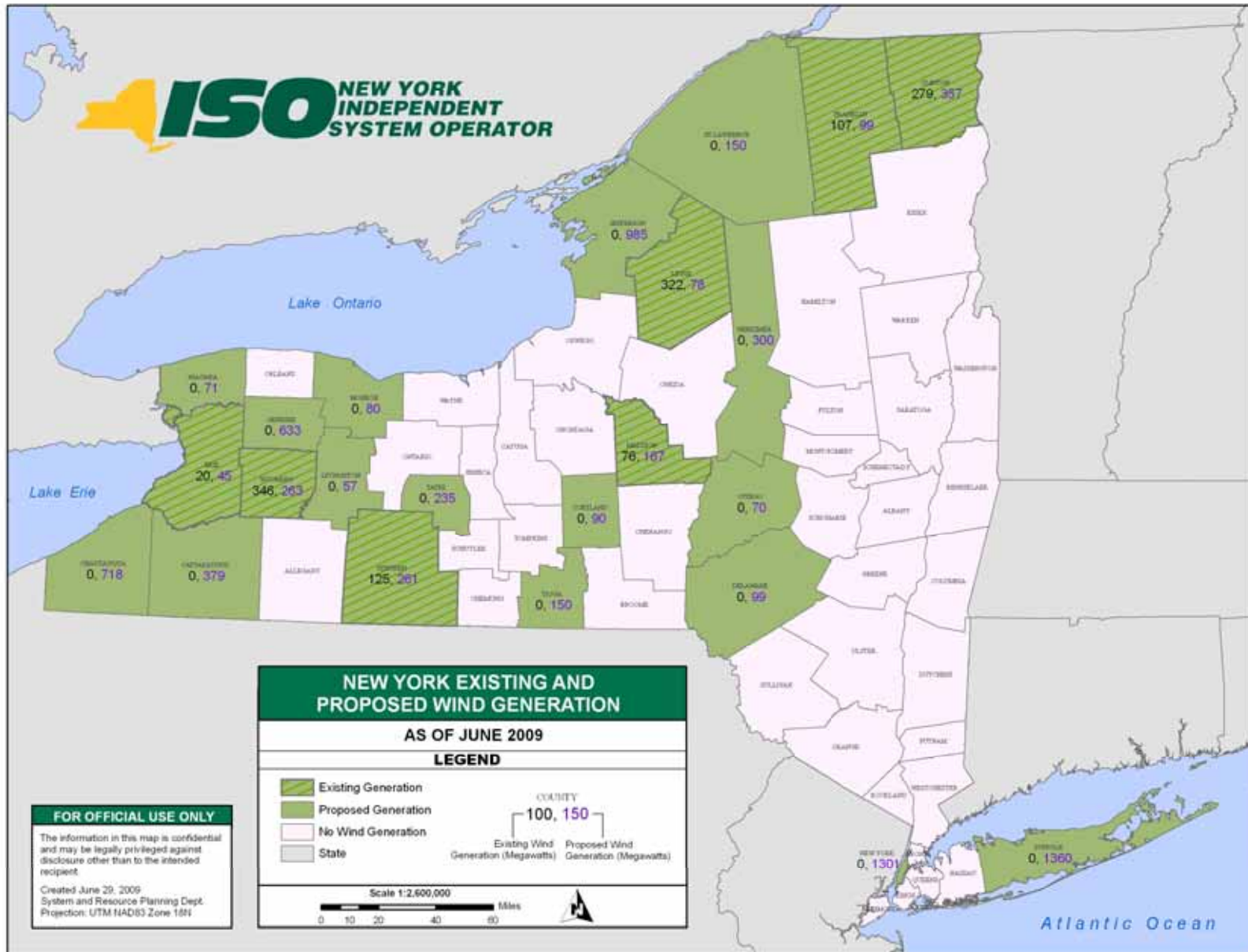
Data sources: American Wind Energy Association and NYISO

Wind Growth in New York

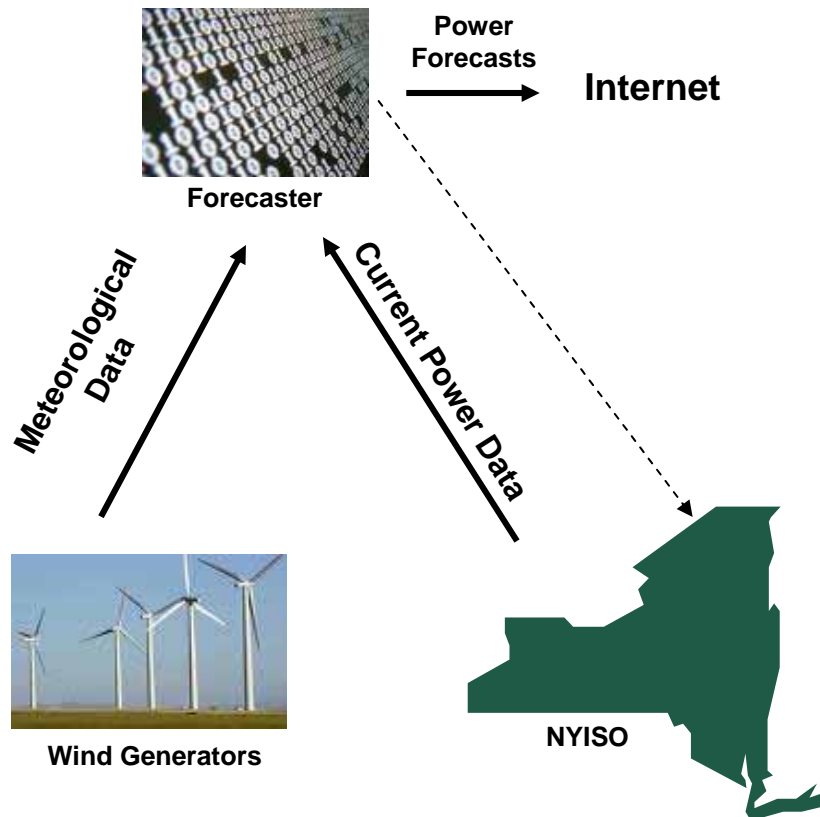
Wind Power Capacity in New York State
Nameplate capacity (MW)



An additional 8,000 MW of wind project proposals have been submitted by developers to be studied for grid interconnection



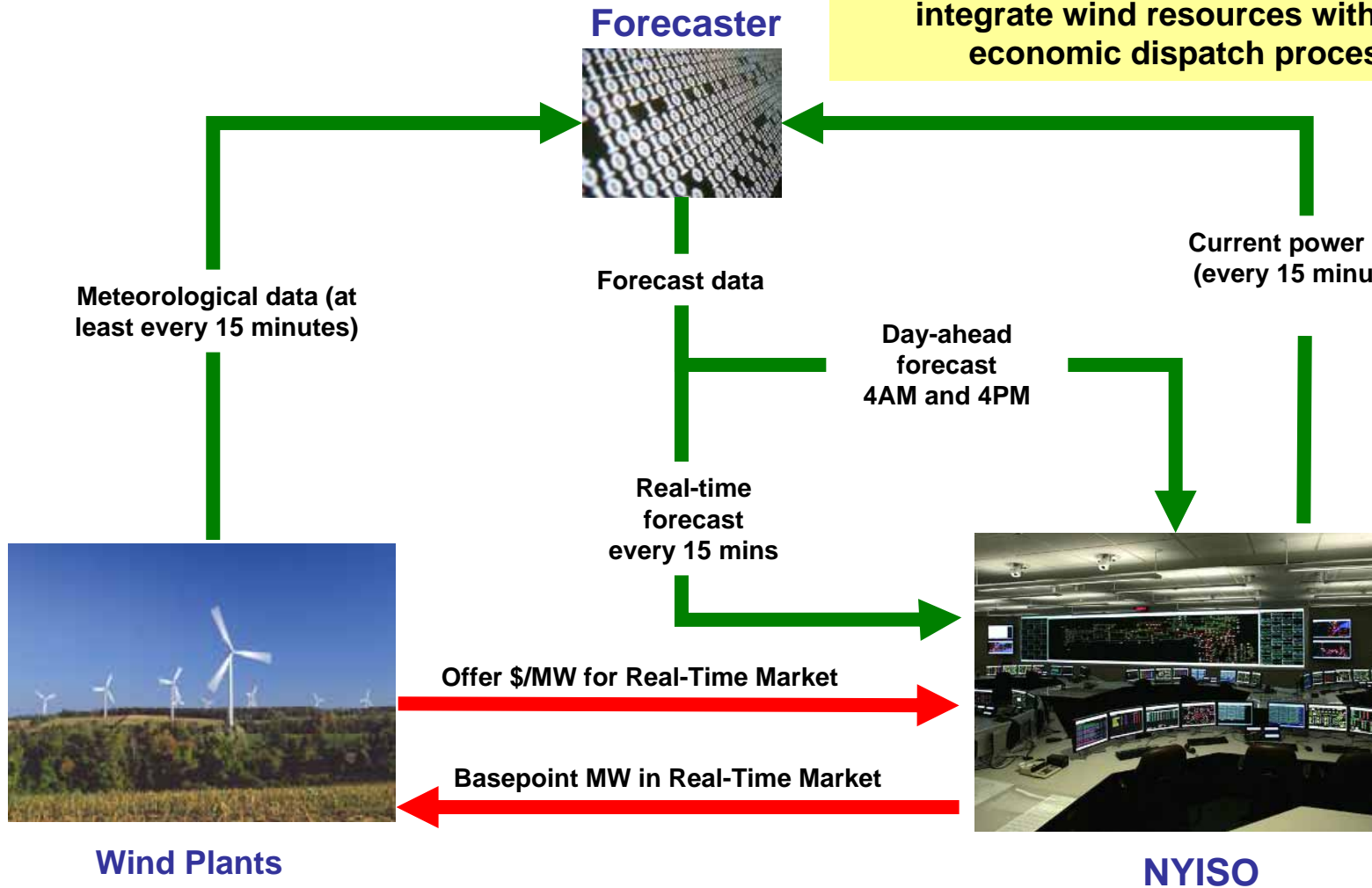
NYISO Wind Forecasting



- ◆ The NYISO implemented a centralized wind forecasting system in 2008
- ◆ Forecasts (Day Ahead and Real-time) are provided to NYISO for all wind plants by AWS Truewind
- ◆ Wind generators have access to their individual plant forecasts
- ◆ The NYISO uses the wind plant forecasts in its energy market economic dispatch software

Pioneering Wind Dispatch

In May 2009, FERC approved NYISO to become the first grid operator to fully integrate wind resources within its economic dispatch process



Economic Dispatch of Wind

- ◆ Integrating wind units into the Security Constrained Economic Dispatch provides the following benefits:
 - ***Wind resources indicate their economic willingness to generate in the Real-Time Energy Market (offering in Day Ahead Energy Market remains optional)***
 - ***Identifies and uses the most efficient resources to address reliability [transmission] limitations while minimizing the wind energy limitation and duration***
 - ***Incorporates wind plant dispatch instructions into energy market clearing price (LMP)***
 - ***Minimizes the need for less efficient, out-of-market actions to maintain reliable operations***

Planning for More Wind

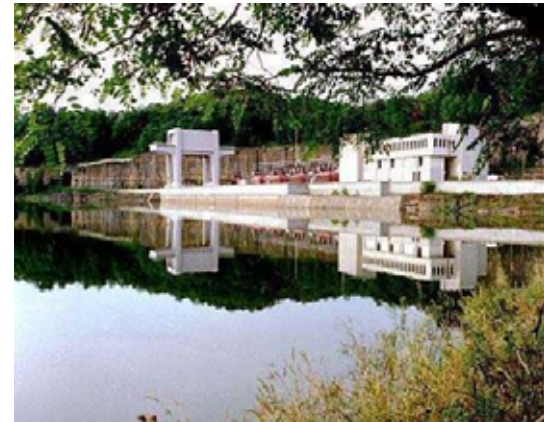
- In 2009, the NYISO studied the impact up to 8000MW of wind resource integration on system regulation requirements
 - *Analyzed the variability of load and wind (net system variability) at specified wind penetration levels and forecasted load levels*
 - *No significant increase in regulation requirements up to a 3500MW wind penetration level (about 10% of peak load)*
 - *Increases in the regulation requirement of approximately 10% (25MW) for every 1000MW increase in wind penetration level above 3500MW up to 8000MW (about 23% of peak load).*

Future Wind Related Actions

- ◆ NYISO is improving its ability to monitor and 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 in 2010
 - ***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***
- ◆ Security Constrained Dispatch can be used to address significant wind plant ramp events in order to maintain reliable operations

Energy Storage Technologies

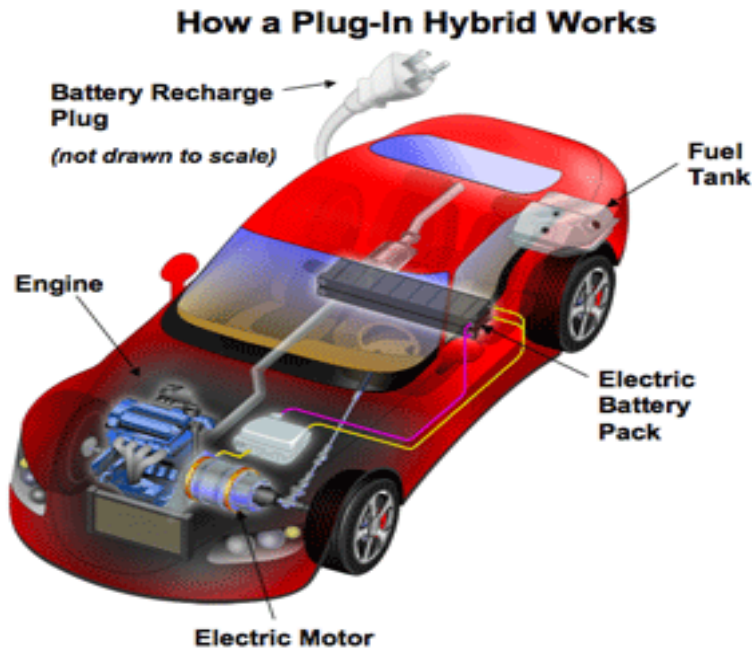
- ◆ Energy storage technologies in New York include:
 - ***Large-scale hydro pumped storage***
 - ***New technologies such as flywheel and advanced battery systems***
- ◆ Energy storage providers in NYISO markets can select treatment as either:
 - ***Traditional Pump Storage Generator***
 - ***Limited Energy Storage Resource (LESR)***



Limited Energy Storage Resource (LESR)

- ◆ Suppliers that:
 - *Provide only Regulation Service*
 - *Convert energy but do not offer it; energy output is only incidental to the provision of Regulation Service*
- ◆ Scheduling of Regulation Service is comparable to other suppliers of Regulation Service
- ◆ Real Time Economic Dispatch functionality
 - *Recognizes the Limited Energy Storage Resource (LESR) capabilities and limitations, and*
 - *Manages energy levels by scheduling charge/discharge operations to maintain full regulating capability*

Plug-in Hybrid Vehicles



Source: Odyne Corporation

A plug-in hybrid electric vehicle (PHEV) is defined as a hybrid electric vehicle which contains at least:

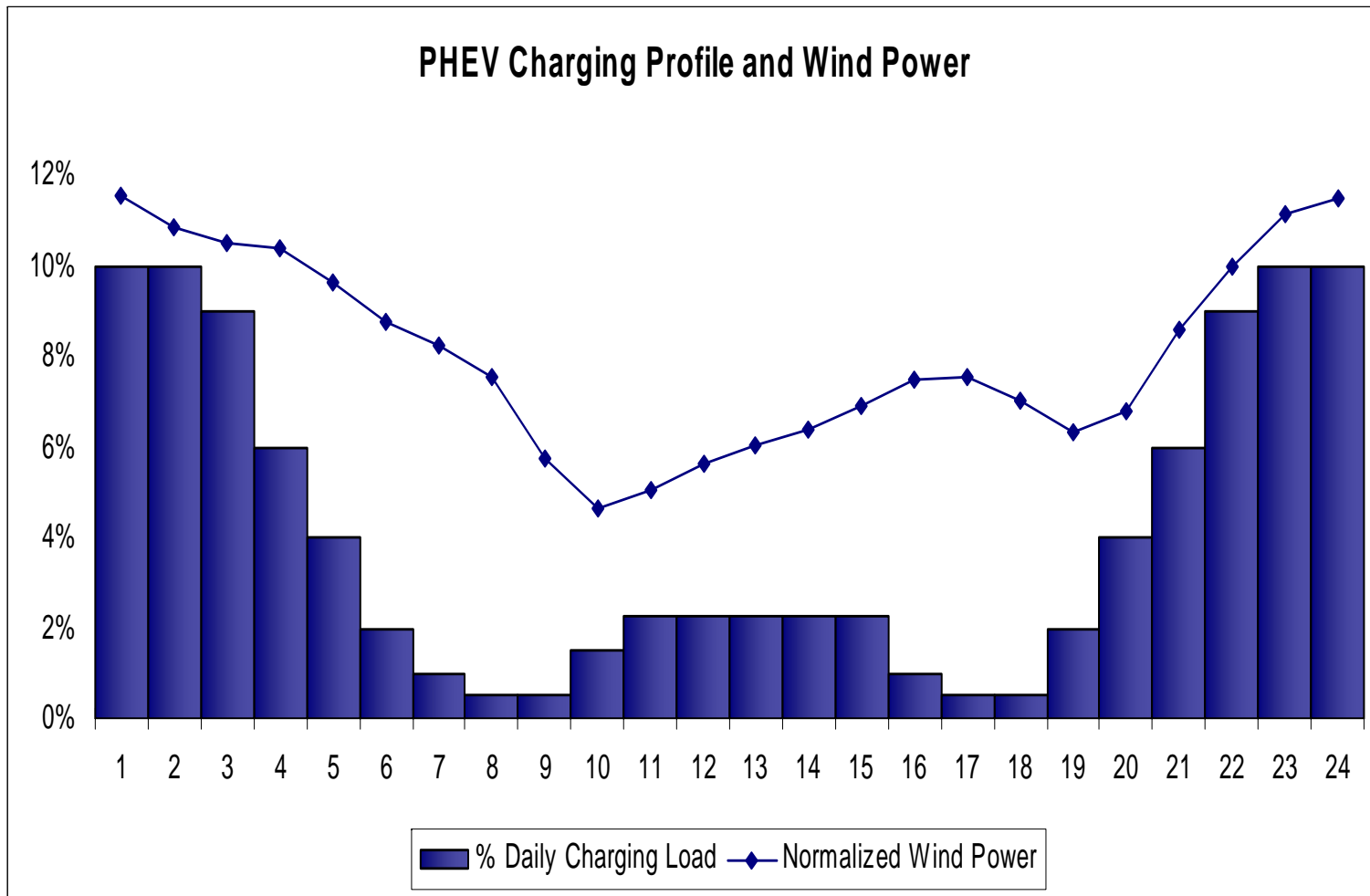
- *A battery storage system of four kilowatt-hours or more, used to power the motion of the vehicle*
- *A means of recharging that battery system from an external source of electricity; and*
- *An ability to drive at least ten miles in all-electric mode, and consume no gasoline*

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Position Statement on Plug-in Hybrid Vehicles
June 2007

If deployed with technology and incentives to encourage favorable charging patterns, PHEVs can offer valuable new ways to store electricity produced in off-peak periods

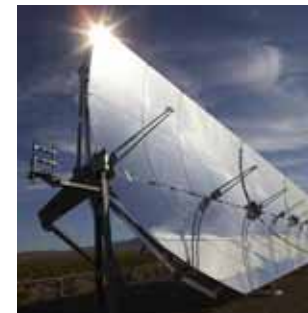
PHEVs & Wind Integration



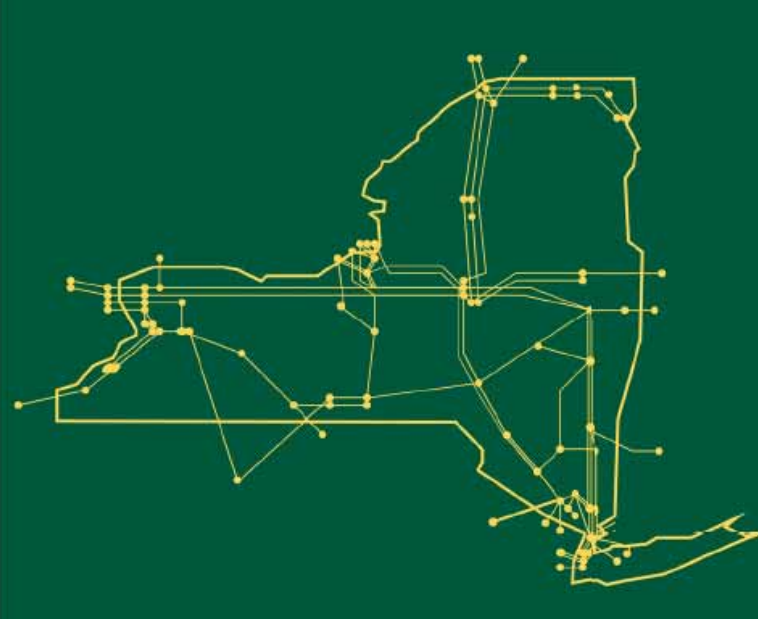
SOURCE: Charging profile: EPRI/NRDC Windpower profile: NYISO 2007 average normalized wind load

“Smart Grid” Future State

- ◆ Improves market efficiency and enhances reliable operations
- ◆ Seamlessly integrates all type of intermittent renewable resources
 - ***Wind, solar, hydropower***
- ◆ Enhances control of power grid
- ◆ Provides for Dynamic price signals with Intelligent load responding to ISO Real-Time energy market prices
 - ***Plug-in hybrid vehicles***
 - ***Advanced consumer components***



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.



www.nyiso.com