

GE Energy

The Value of Forecast Accuracy

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Imagination at work



New York State Wind Study



Sponsored by NYISO and NYSERDA

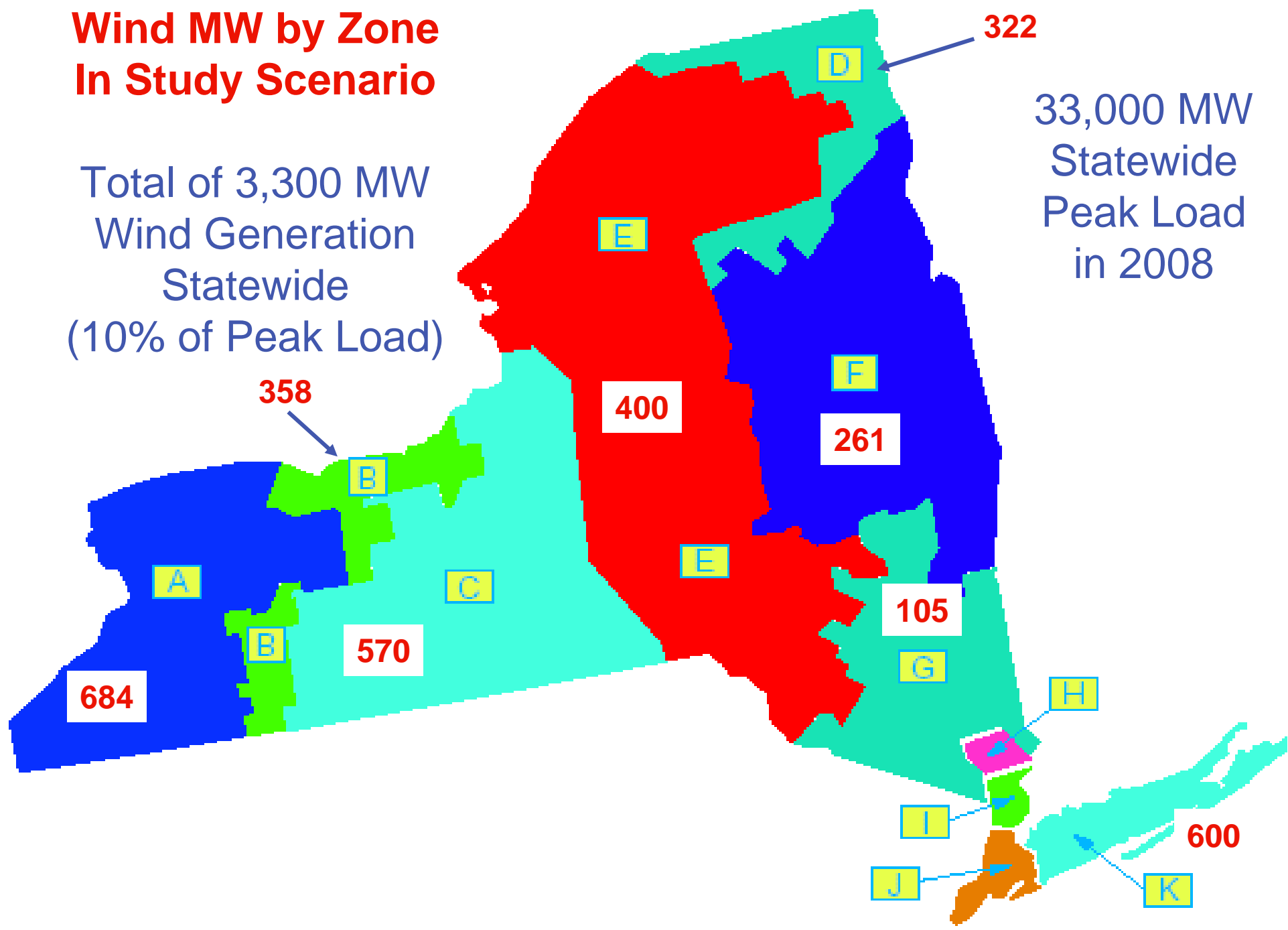
Objective

To produce empirical information that will assist the NYISO in evaluating the reliability implications of increased wind generation

Wind MW by Zone In Study Scenario

Total of 3,300 MW
Wind Generation
Statewide
(10% of Peak Load)

33,000 MW
Statewide
Peak Load
in 2008



Study Scenario; Wind and Load MW by Zone

(Total Wind Generation = 10% of Peak Load)

	Total Potential Wind Generation	2008 Noncoincident Peak Load	Wind MW in Study Scenario	Wind as % of Peak Load
Zone A	3,070	2,910	684.2	24%
Zone B	1,197	2,016	358.5	18%
Zone C	1,306	2,922	569.7	19%
Zone D	483	902	322.6	36%
Zone E	2,832	1,592	399.8	25%
Zone F	434	2,260	260.6	12%
Zone G	105	2,260	104.6	5%
Zone H	0	972	0.0	0%
Zone I	0	1,608	0.0	0%
Zone J	0	11,988	0.0	0%
Zone K	600	5,275	600.0	11%
sum	10,026	34,704	3300.0	10%

Analysis of Load and Wind Forecasting

Hourly load MW for 2001, 2002, 2003

- Forecast and actual

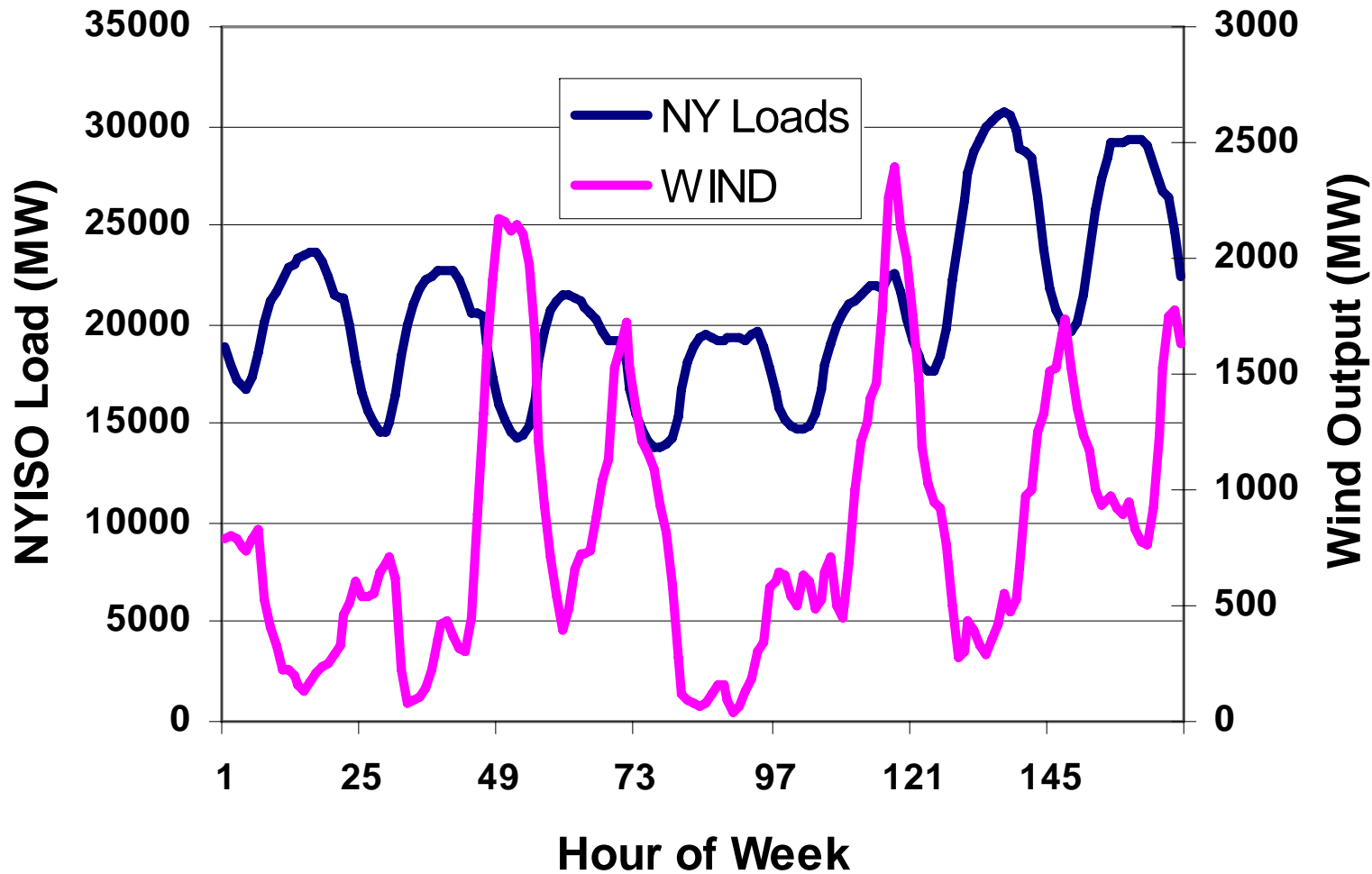
Hourly wind MW for 2001, 2002, 2003

- Forecast and actual

Production cost simulation for 3 years

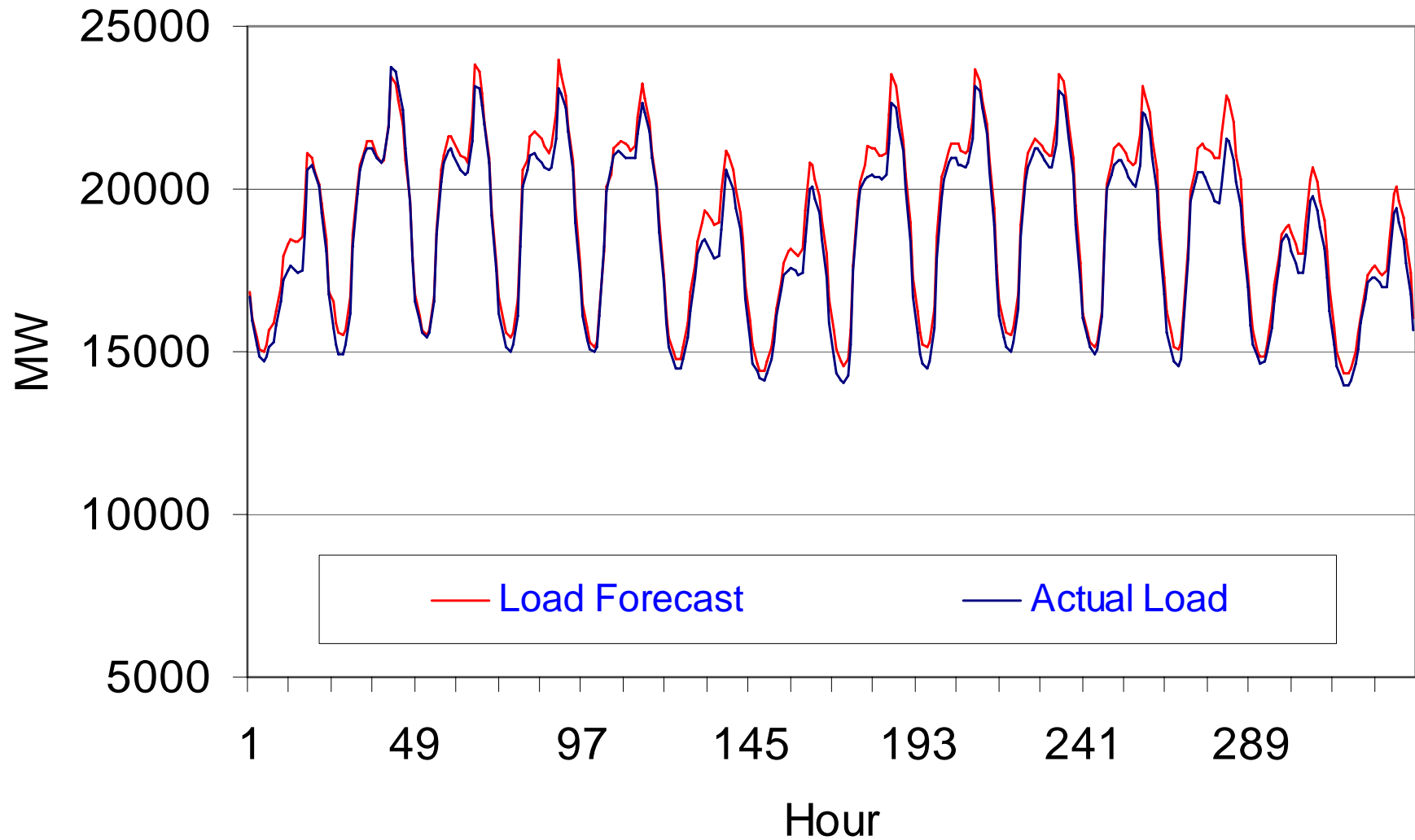
- GE's MAPS program
 - Modeled NYISO, ISONE, and PJM regions
- Hourly load and wind profiles from 2001, 2002, 2003
- System load scaled for year 2008

Load Data and Wind Data Are Time-Synchronized for All Analysis Performed



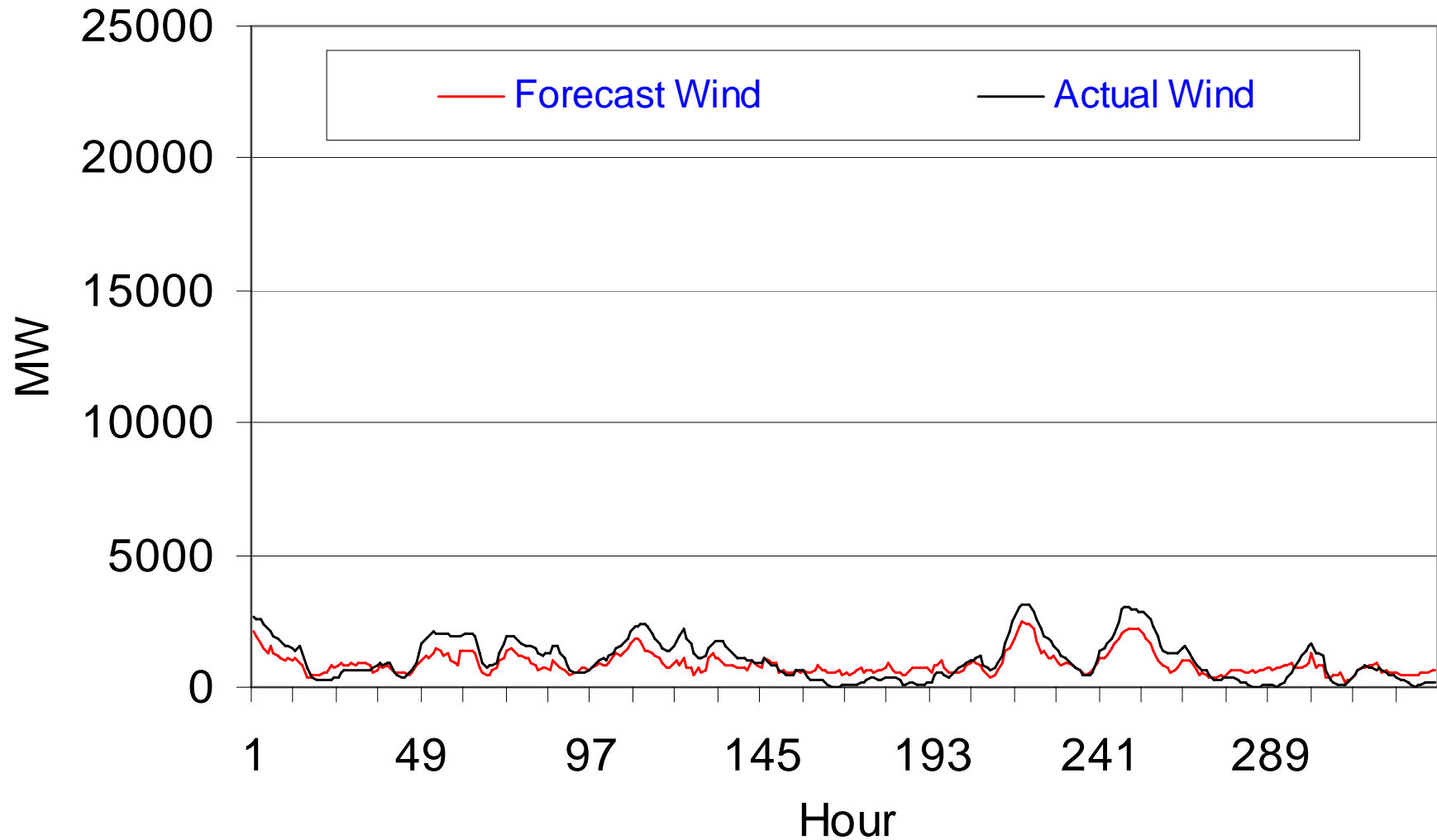
Source: One week in July 2002

NYISO Load: Day-Ahead Forecast vs Actual



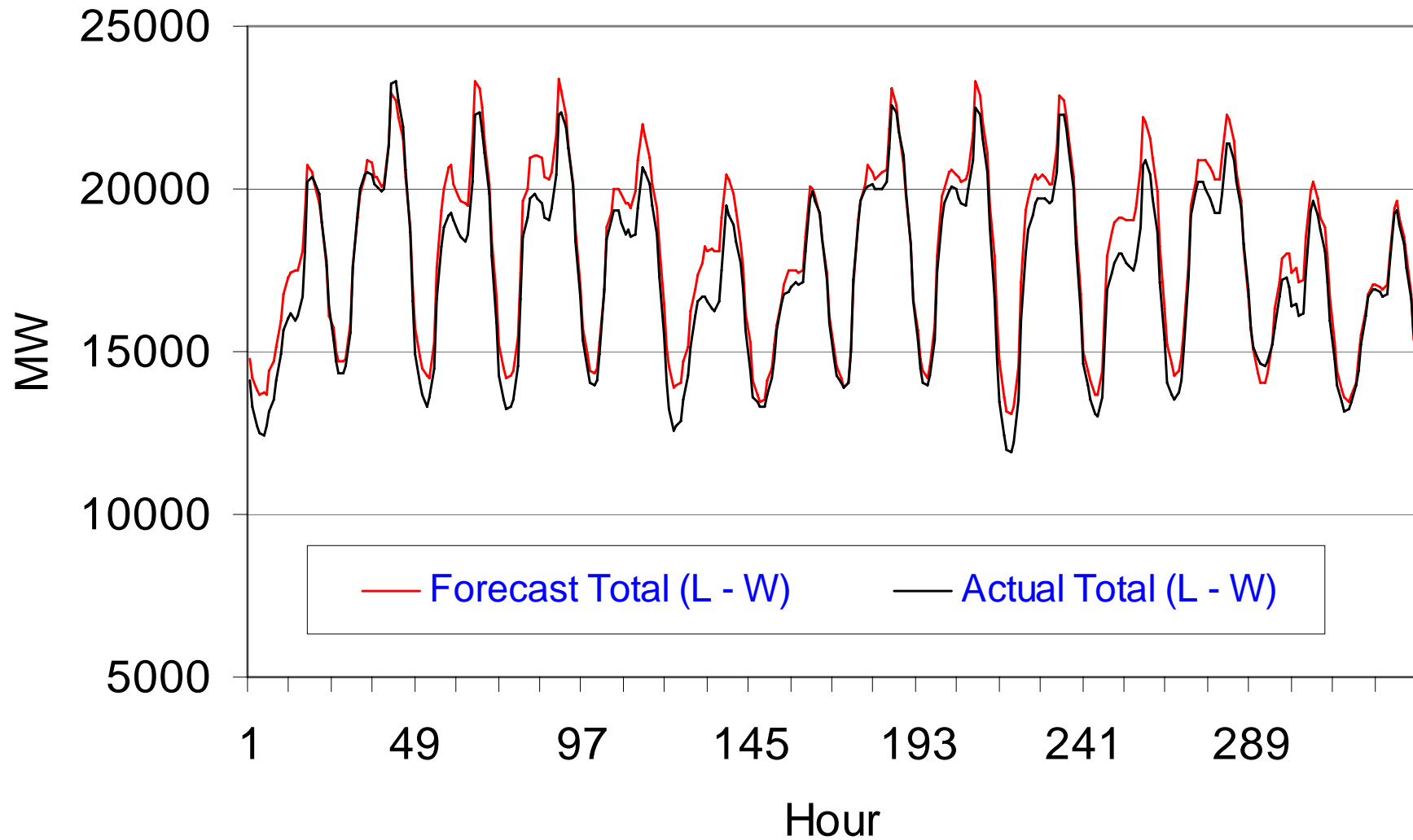
Source: Two weeks in January 2001

Wind Generation: Day-Ahead Forecast vs Actual



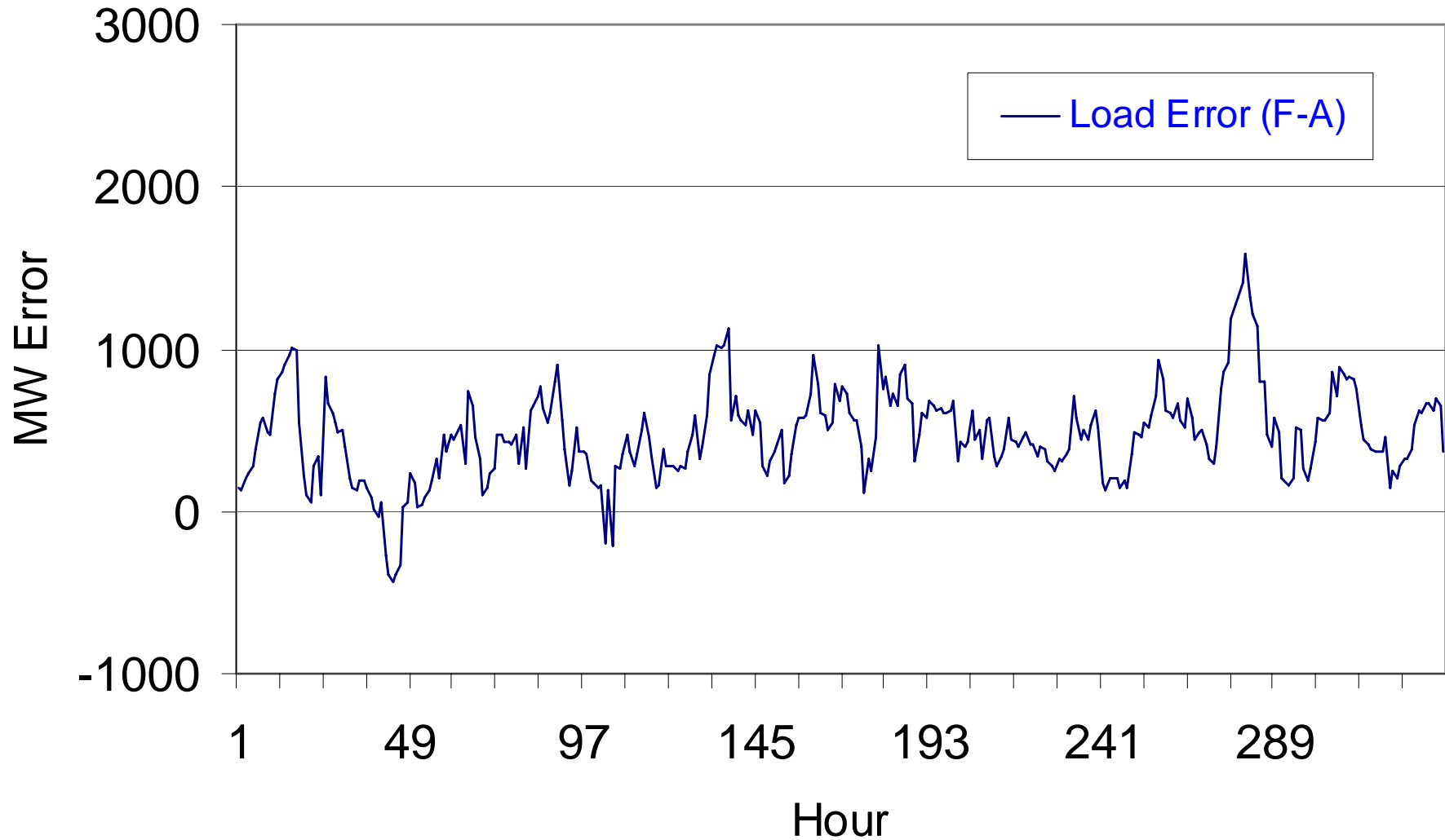
Source: Two weeks in January 2001

Total Load and Wind: Forecast vs Actual



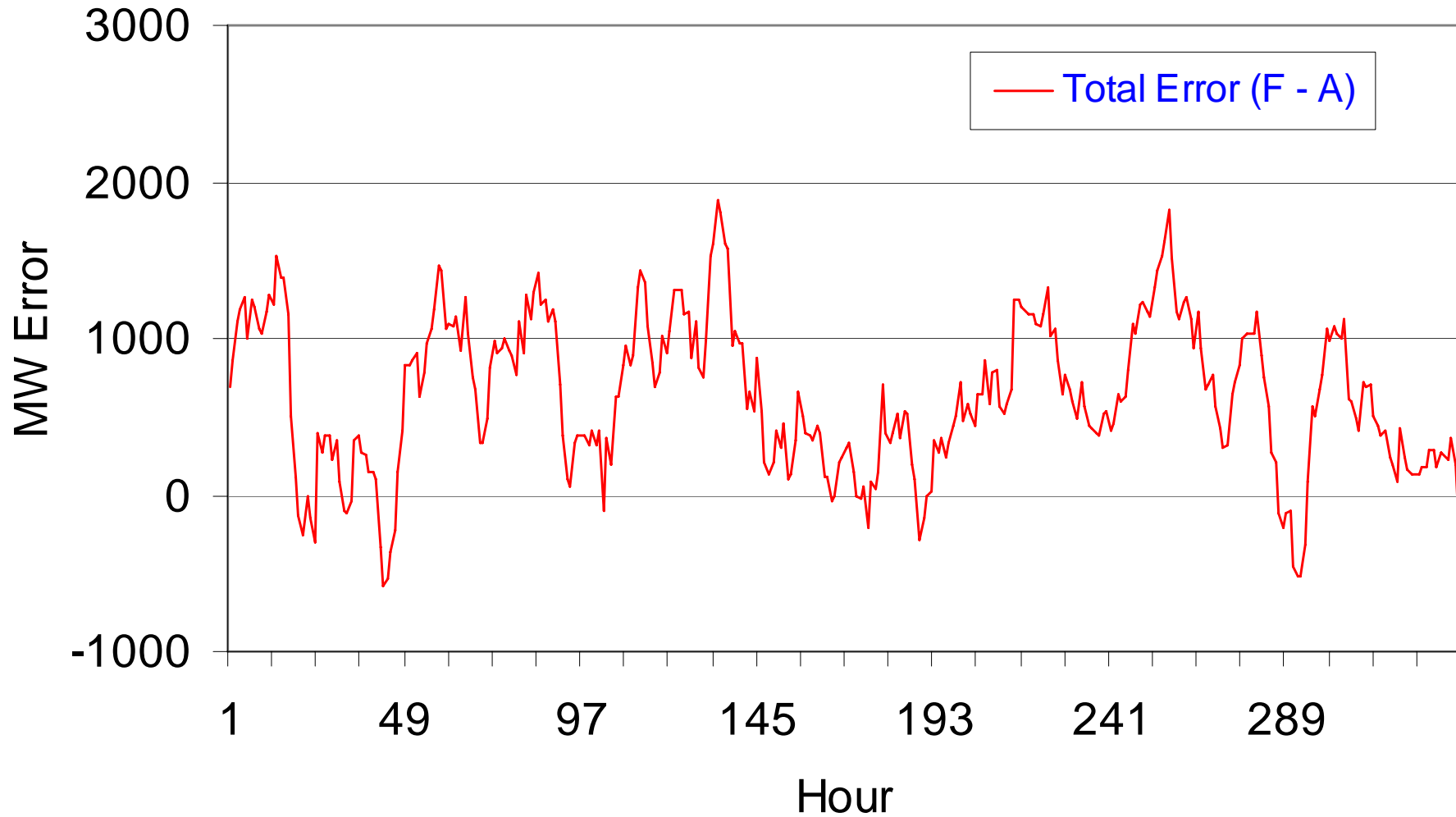
Source: Two weeks in January 2001

Load Forecast Error



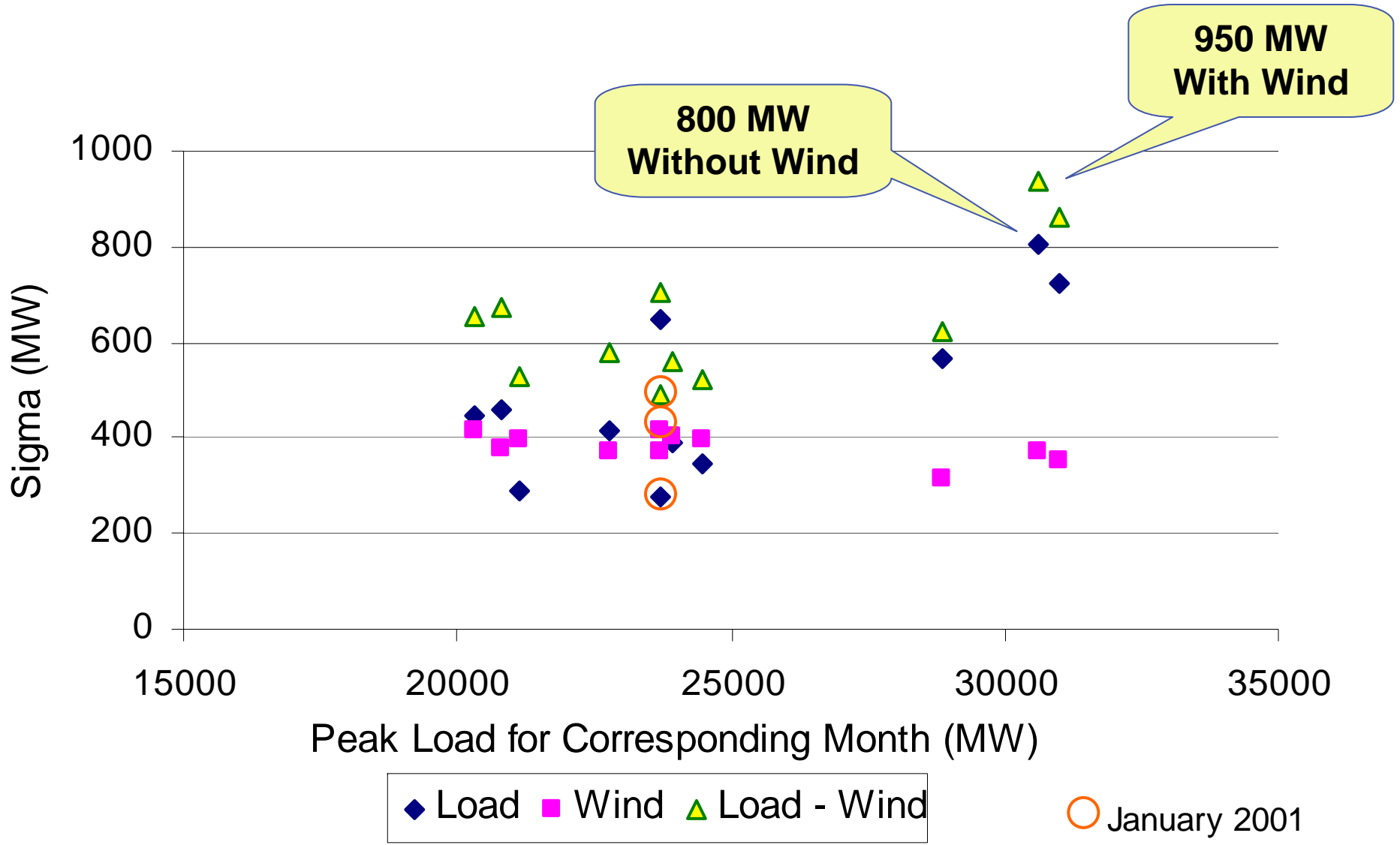
Source: Two weeks in January 2001

Total Forecast Error (Load and Wind)



Source: Two weeks in January 2001

Standard Deviations of Day-Ahead Forecast Errors



Hourly Production Simulation Analysis

Examine the impact of 3300 MW wind generation on overall operation of the NYISO grid

- Generation displacement
- Emission reductions
- Transmission congestion
- Economic impact
 - Fuel costs
 - Variable operation & maintenance costs
 - Start-up costs
 - Emission payments

Cases Analyzed

Base Case – Grid operation with no wind generation

- Basis of comparison for operation with wind

Cases with 3300 MW Wind generation (*nameplate rating*)

- Operation with no wind generation forecast
- Operation with state-of-art wind forecast
- Operation with perfect wind forecast

Operating Costs Without Wind Forecasts

- Wind generation not considered for day-ahead unit commitment
- Wind generation just “shows up” in the real time market

	No Wind Forecast \$ millions
Total variable cost reduction	\$ 335
Wind generator revenue	\$ 305
Non-wind generator revenue reduction	\$ 960
Load payment reduction	\$ 720

Operating Costs With State-of-Art Wind Forecasts

- Day-ahead unit commitment considers forecasted wind generation

	No Wind Forecast \$ millions	SOA Wind Forecast \$ millions
Total variable cost reduction	\$ 335	\$ 430
Wind generator revenue	\$ 305	\$ 315
Non-wind generator revenue reduction	\$ 960	\$ 795
Load payment reduction	\$ 720	\$ 515

Benefit of State-of-Art Forecast

System Variable Cost Reduction

Using SOA Wind Forecast: \$430 M

No Wind Forecast: \$335 M

Net Benefit : \$ 95 M

Wind Generation : 8900 GWh

Value of SOA Forecast: \$10.70 /MWh

Operating Costs With Perfect Wind Forecasts

- Day-ahead unit commitment considers forecasted wind generation

	No Wind Forecast \$ millions	SOA Wind Forecast \$ millions	Perfect Wind Forecast \$ millions
Total variable cost reduction	\$ 335	\$ 430	\$ 455
Wind generator revenue	\$ 305	\$ 315	\$ 325
Non-wind generator revenue reduction	\$ 960	\$ 795	\$ 755
Load payment reduction	\$ 720	\$ 515	\$ 485

Benefit of Perfect Wind Forecast

System Variable Cost Reduction

Using Perfect Wind Forecast: \$455 M

Using SOA Wind Forecast: \$430 M

Net Benefit : \$ 25 M

Wind Generation : 8900 GWh

Remaining Value of Improving Forecast: 2.80 /MWh

Total Potential Value of Forecast : \$13.50 /MWh

Conclusions



imagination at work

Conclusions

State-of-the-art wind generation forecasts can improve the value of wind energy by ~25%

- \$335M vs \$430M operating cost reduction with 3,300 MW wind generation in NY State

Improved wind forecasts could produce further benefits, but with diminishing returns



Complete report is available at

http://www.nyserda.org/publications/wind_integration_report.pdf

Appendices are available at

http://www.nyserda.org/publications/wind_integration_apps.pdf

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