Xcel Energy’s Wind Energy Program

Wind Energy Prediction – Research & Development Workshop
May 11-12, 2010
About Xcel Energy

5th Largest Combination Electric and Gas Utility (based on customers)
Xcel Energy manages output from 3.4GW (2623 turbines) of wind energy across the three operating companies (NSP-MN, PSCo, SPS).
Obligations and Resources Today

- Net Load – Load less variable output generation.

PSCO - April 26, 2010 to May 2, 2010
Loads and Resources are forecast every working day for operational planning purposes. This is called *day-ahead commitment*.

Forecasts of loads, variable energy generation, and unit availability are inputs to the operational planning process. Typically 18 to 42 hours ahead, but as much as five days.
Uncertainty is driven by the wind portfolio.

Mean Absolute Error
Load = 86MW
Wind = 245MW
Net Load = 240MW
Loads and Resources Today and Tomorrow

2010 → 2013

Graphs showing load error, wind error, and net load error from 2010 to 2013.
Wind as a Percent of Load

In real-time, more wind means fewer dispatchable resources are online to manage the variability. Those resources that remain on-line are typically cheap and inflexible baseload facilities.
Who’s in Charge of Uncertainty?

- Balancing Authorities have final responsibility regarding managing uncertainty
- Market structure determines the forecast timeframe of most significance for market participants
- Uncertainty costs ultimately flow to customers in the form of increased fuel costs, O&M, starts, and market volatility.
- Xcel Energy Operating Company & Balancing Authority
  - NSP – MISO w/ day-ahead and real-time markets
  - SPS – SPS w/ SPP real-time market
  - PSCo – PSCo w/ WECC hour-ahead market gates
Wind Prediction System

- Goal: Create a new state-of-the-art wind forecasting system covering the entire Xcel Energy service territory
  - Minimize Dispatch Costs
  - Increase Reliability

- This is primarily a function of reducing uncertainty associated with short and long-term wind energy production
Opportunity Cost is a measure of real-time market exposure. Reducing forecast error reduces exposure to real-time price deviations.

\[
\Delta R = \sum_j \sum_i (RT_{ij} - DA_{ij}) \times (LMP^D_{ij} - LMP^{RT}_{ij})
\]
In PSCo, savings are due to more optimal dispatch of resources. This saves fuel through more efficient loading of units, leaner commitment, and avoided wind curtailments.

The *rate* of savings is a function of natural gas price...

\[ $5.50/\text{mmbtu} = $800k/\%\text{MAE} \]

Currently reducing error by 4% over 2009

\[ \sim$3.2M \text{ annualized} \]
Mean Absolute Error

30-Day Rolling nMAE (May 11, 2010)

Forecast Hours

PSCo
NSP
SPS