2015 Wind Energy Systems Engineering Workshop
Boulder, CO
January 2015
Who We Are…

Xcel Energy is dedicated to being an environmental leader at reasonable cost.

- 26,000+ MWs of generation
- Operating in 8 states
- No. 1 wind power provider
- 5,080 MW of wind capacity
- No. 7 solar power provider

Customers
- 3.4 million electric
- 1.9 million gas
Xcel Energy Wind Generation Growth (current)

- PSCo (2166)
- NSP (1867)
- SPS (1047)

Capacity MW

Currently, Xcel Energy will manage the output from 5.1GW of wind energy across the three operating companies (NSP-MN, PSCo, SPS) and seven states (CO, TX, NM, WY, MN, SD, ND).
Short-Term Uncertainty
Obligations and resources are maintained in balance at all times
Spread between daily high/low loads increase. Timing of ramps uncertain.
Loads and Resources (2020)

- New paradigm: Flexible and Informed Grid

![Diagram showing variable and balance portfolio]
PSCO Wind as a Percentage of Obligation Load (1/1/2010 thru 12/31/2011)

5/24/13 1:00 AM, 60.5%
10/13/14 6:00 AM, 60.2%
At 2:45 am, RT Operator initiates curtailment to 300 MW due to high ACE.

At 4 am, RT Operator initiates AGC regulation. Note that the ACE stays within +/- 50.
Market Impacts
Day-Ahead Markets

- Forecasts are awarded at a price
  - DA Award * DA Price

- In real-time, deviations are paid for
  - (DA Award – RT Gen) * RT Price

If there is oversupply, RT prices go down
If there is undersupply, RT prices go up

Ultimately, you are penalized for uncertainty
Day-Ahead Markets

2014 - $5.2M

nMAE

9.1%
Long-Term Uncertainty
Resource Planning

- Utilities estimate the dispatch costs of integrating variable resources like wind – these costs have a large uncertainty component.
- The costs are added to these resources in the resource planning process to create “resource parity”.
- When contracting, the utility pays for performance ($/MWh) while protecting the IPP from market-based curtailments.
- The IPP takes on long-term uncertainty (year to year) as well as availability.
Loads and Resources – A New Paradigm

Traditional Utility Paradigm (w/ some RE)
Commitment based on load forecasts
RE is must-take
No curtailment

High Penetration Portfolio
Commitment based on load net wind forecasts
RE is dispatchable
Curtailment is an important tool for balancing the grid

Mid-Merit
Baseline
Peakers
Renewables
Balance Portfolio
Variable