

Challenges of Wind Scheduling and Capacity

**Regional Wind Conference
Swiftel Center, Brookings SD
September 12, 2005**

Overview

- **Xcel Energy**
- **Wind portfolio**
- **Studies supported**
- **Issues**
- **Initiatives**

Xcel Energy Wind Portfolio

	Currently Operating	Under Contract
PSC	247	60
NSP	527	191
SPS	<u>164</u>	<u>280</u>
	938	531

NSP Projects

- **In Operation**

- **Larger Projects**
 - **Four projects totaling 347 MW**
- **Medium Projects**
 - **Four projects totaling 63 MW**
- **Small Projects**
 - **69 projects totaling 116 MW**

- **Under Contract**

- **150 MW project with 50 MW in South Dakota**
- **One 12 MW project**
- **29 small wind contracts totaling 43 MW**

Energy Value

- **Simple Approach: Wind energy displaces marginal generation (avoids decremental cost)**

Energy Value (considering Ancillary Costs)



- **Unit Commitment Uncertainty**
 - Day-ahead purchases/sales & gas nominations
- **Load Following**
- **Voltage / Frequency Regulation**
- **Impacts are system specific**
- **Higher penetration = higher costs**

Scheduling

- **Limited Experience in Forecasting Wind**
- **Weather Station Data Availability**
- **Minute to Minute Fluctuations in Generation**
- **Requires Responsive Facilities be Available to Respond to the Wind**
- **MISO Day Two Challenges and Opportunities**

Why Is Wind Complicated to Value?

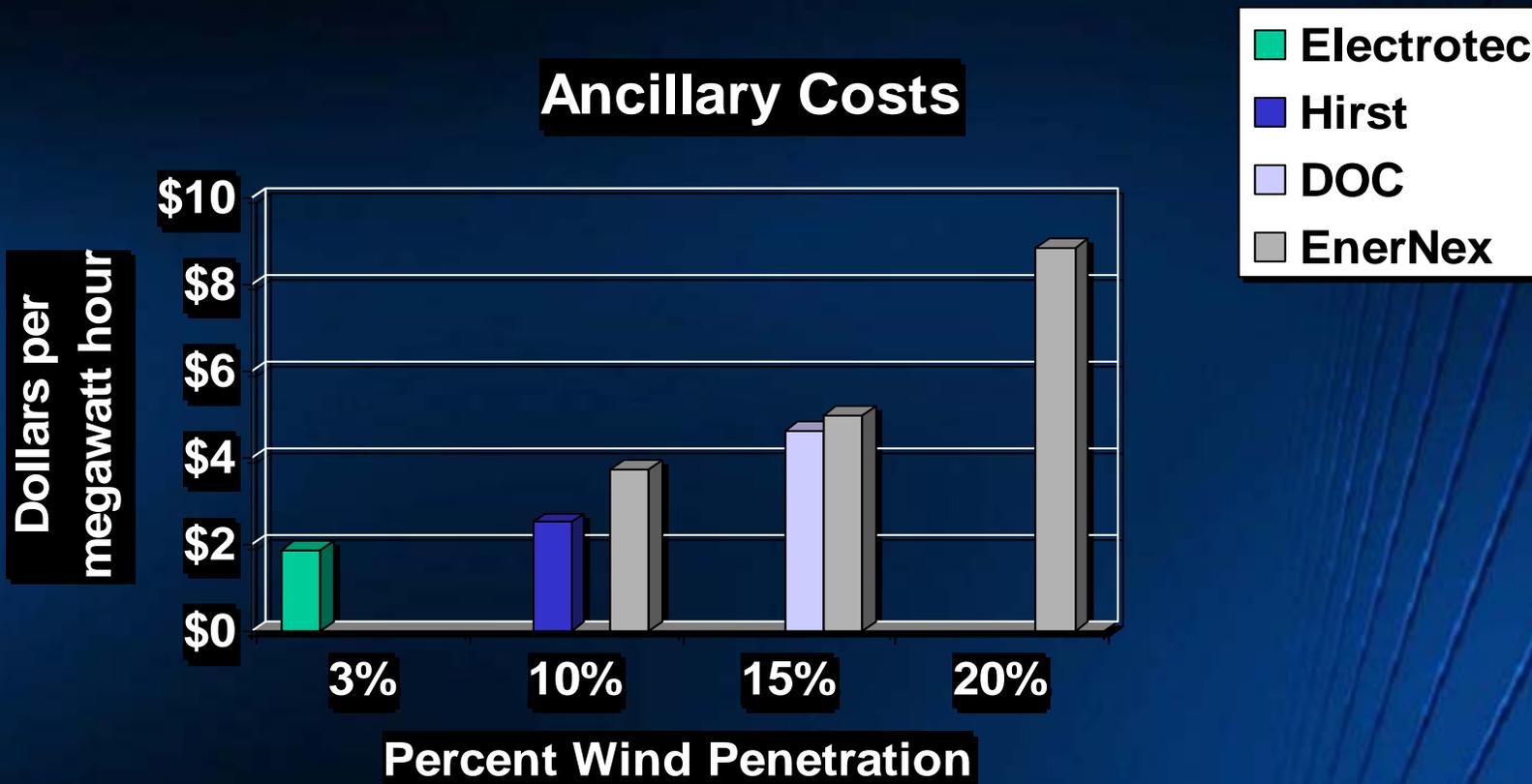
- **Wind does not blow all the time**
 - Non-dispatchable
 - Intermittent
 - Difficult to Predict
- **These characteristics impact:**
 - Capacity Value
 - Energy Value - including ancillary costs
- **Wind projects are not typically near load centers**
 - Transmission Costs / Impacts

Xcel Energy Supported Studies

- **Characterizing the Impacts of Significant Wind generation on Bulk Power Systems - NSP - Electrotek – 2003**
- **Integrating Lots of Wind with a Small Utility – SPS – Hirst, Hild - 2003**
- **Wind Integration Study (at 15% penetration) – NSP – EnerNex & WindLogics – 2004**
- **Currently developing a Minnesota statewide wind integration engineering study assessing the impacts on reliability and costs associated with increasing wind capacity to 20%.**
- **Currently developing a PSCo study to include ancillary service costs of 10%, 15%, and 20% wind - EnerNex**

Study Results

Ancillary Costs



Capacity

- **Intermittent Resource**
 - **Greatest Generation during**
 - Off-Peak Hours
 - Off-Peak Season
 - **Planning Capacity**
 - Based on Anticipated generation at System Peak
 - Calculated Differently on Different Systems
 - ~~Operating Reserve Capacity~~
 - ~~Spinning~~
 - ~~Non-Spinning Operating~~

Transmission Issues

- **Effective cost of wind energy curtailment**
- **Firm reservation for nameplate capability - or for capacity value w/ re-dispatch scheme**
- **Potential solutions:**
 - **Transmission tariff & market structure**
 - **Proactive planning to capture synergies of wind, transmission, peaking/intermediate generation, and economical storage**

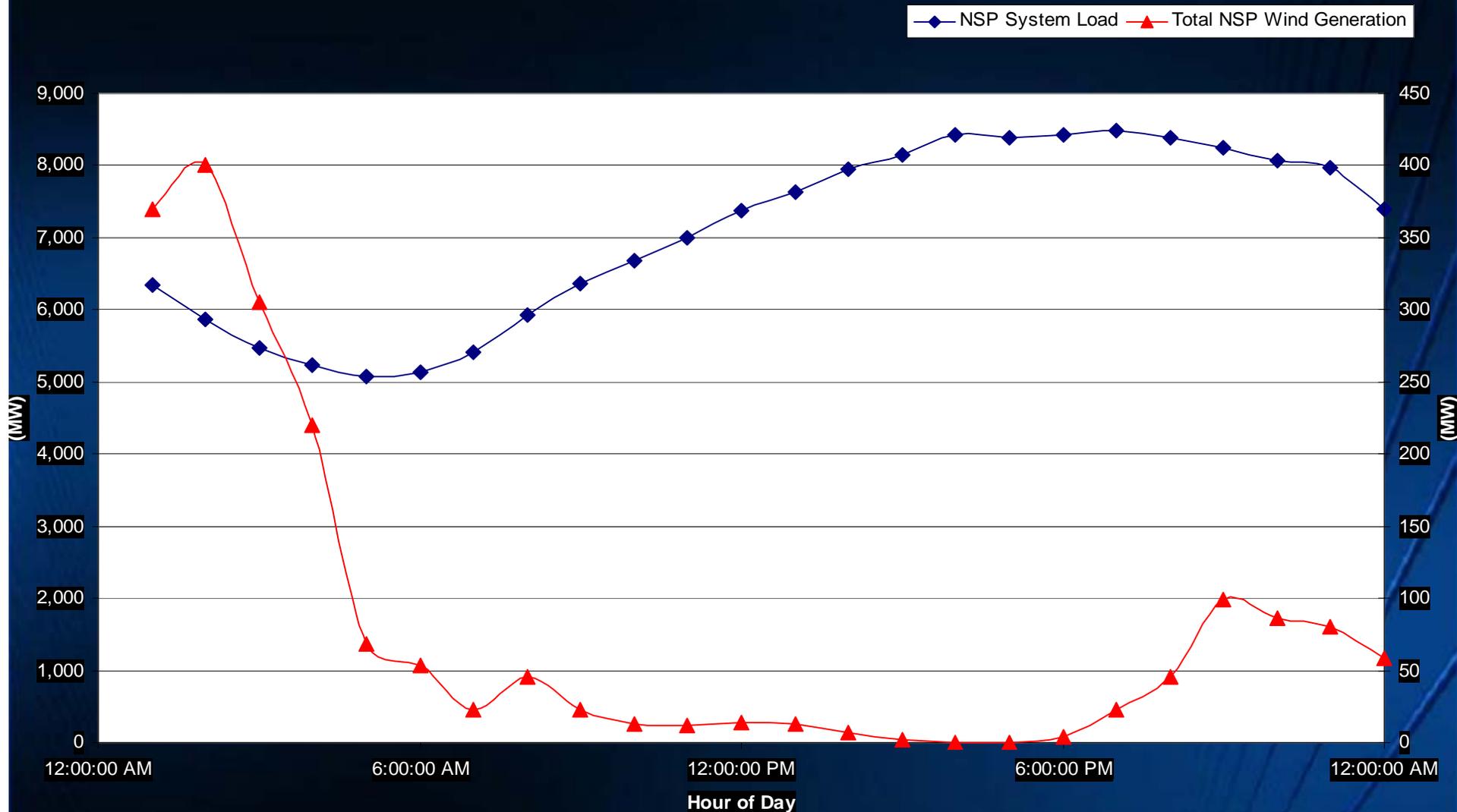
FERC – INTRECONNECTION for WIND ENERGY

- **Low Voltage Ride-Through Capability**
 - Adopted – only required if the SIS indicates that it is needed
- **Power Factor Design Criteria (Reactive Power)**
 - Measured at the POI
 - +/- .95 power factor range
 - Only if required by the SIS
 - Dynamic Reactive Power Capability
 - Required only based on SIS
- **Supervisory control and Data Acquisition Capability**
- **Wind Plant Interconnection Modeling**
- **Self Study of Interconnection Feasibility**
 - Can submit preliminary design

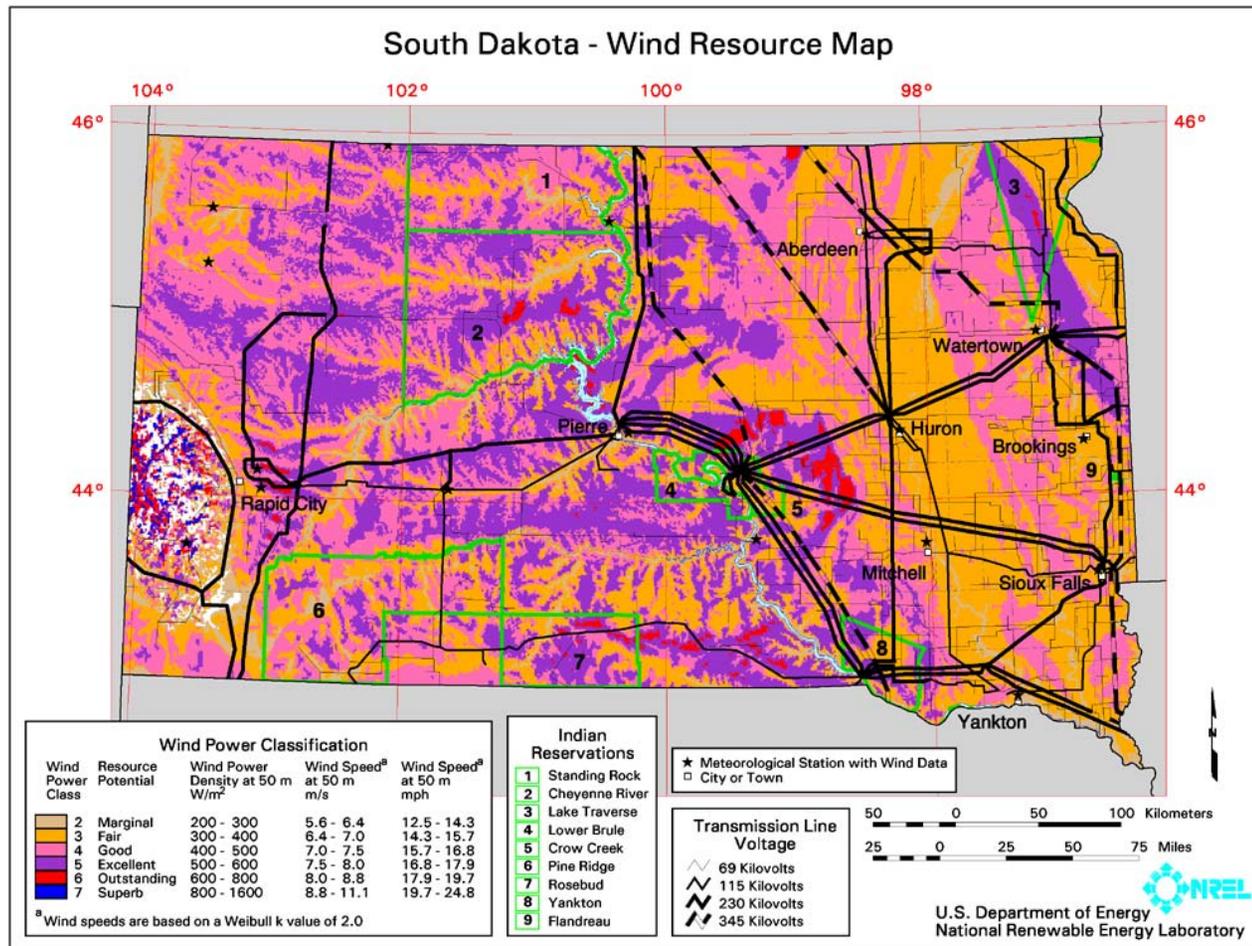
Current Xcel Energy Initiatives

- **Additional Studies 20% Penetration Studies for PSCo and NSP**
- **Co-locating Intermittent Resources with Peaking Resources**
- **Investigation of Energy Storage**
 - **Compressed Air**
 - **Hydrogen - Fuel Cell Technology**

Average Hourly Wind Data & System Load July 2005



South Dakota - Wind Resource Map



Questions?



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