Wind Plants on Automatic Generation Control
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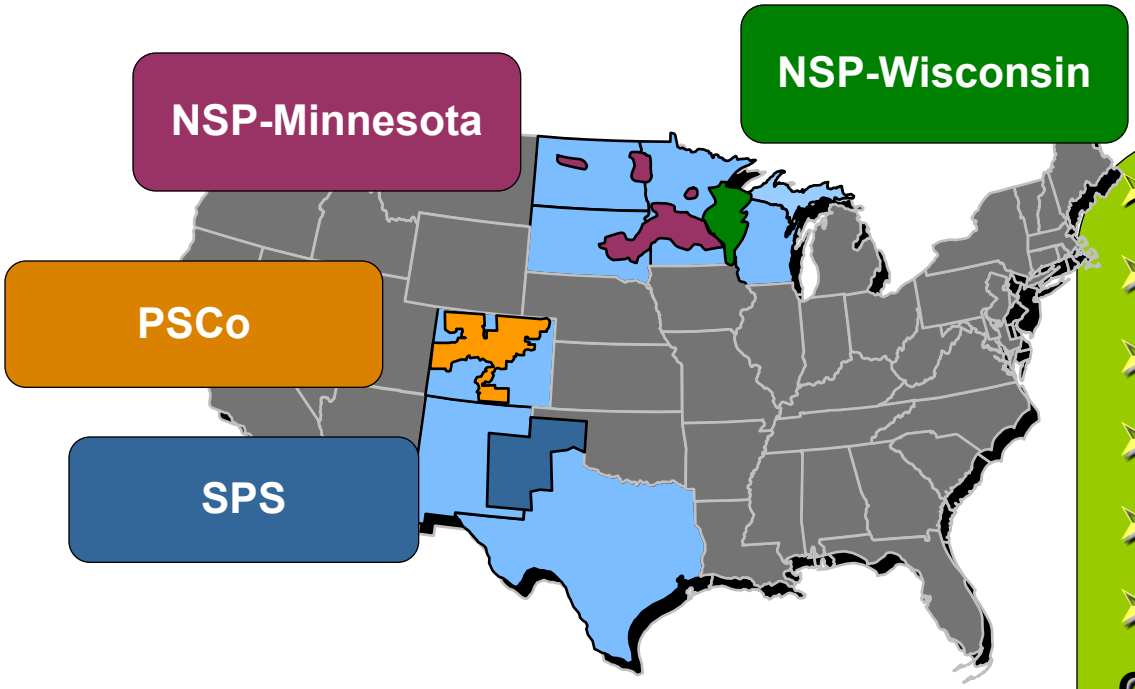
Who We Are…



- 25,000+ MWs of generation
- Operating in 8 states
- No. 1 wind power provider
- No. 5 solar power provider
- 4.9 GW of wind
- 2.3 GW of wind on Control

Customers

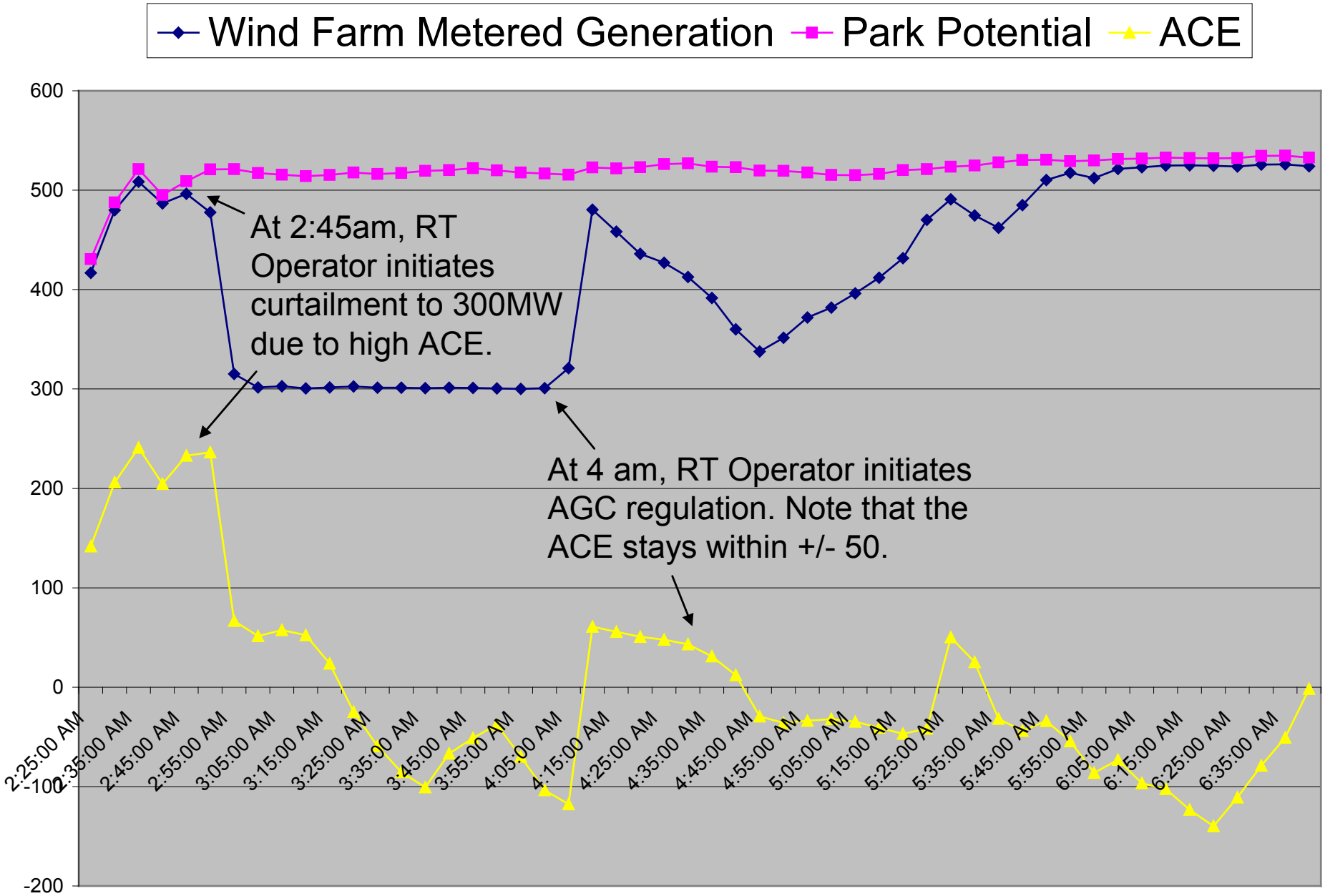
3.4 million electric
1.9 million gas

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

Set-Point Control vs. AGC

- Set-Point Control – Manual or automated dispatch signal for wind plant generation output.
- Automatic Generation Control (AGC) – Automated dispatch signal from Energy Management System.
  - 4 second dispatch
  - Incorporates frequency and ACE

- NSP – Use set point control
  - 5-minute dispatch instructions from MISO
  - Reliability instructions
  - MISO does not allow wind generation to participate in ancillary markets
- SPS – Use set point control
  - Use set-point control to respond to 5-min market prices
- PSCo – Use set point control or AGC depending on the circumstances


Wind Farm Metered Generation
Park Potential
ACE
600
500
400
300
200
100
0
-100
-200
2:25:00 AM
2:35:00 AM
2:45:00 AM
2:55:00 AM
3:05:00 AM
3:15:00 AM
3:25:00 AM
3:35:00 AM
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5:45:00 AM
5:55:00 AM
6:05:00 AM
6:15:00 AM
6:25:00 AM
6:35:00 AM
At 2:45am, RT Operator initiates curtailment to 300MW due to high ACE.
At 4 am, RT Operator initiates AGC regulation. Note that the ACE stays within +/- 50.

Conclusions: Wind on AGC

- Very responsive
  - Fast ramp rates
  - Excellent ACE compliance
- Very expensive
  - Regulating with wind requires wind generation curtailments (combined battery storage would address this)
  - AGC dispatch is most efficient curtailment
  - PSCo used wind on AGC for ~3.5% of 2012