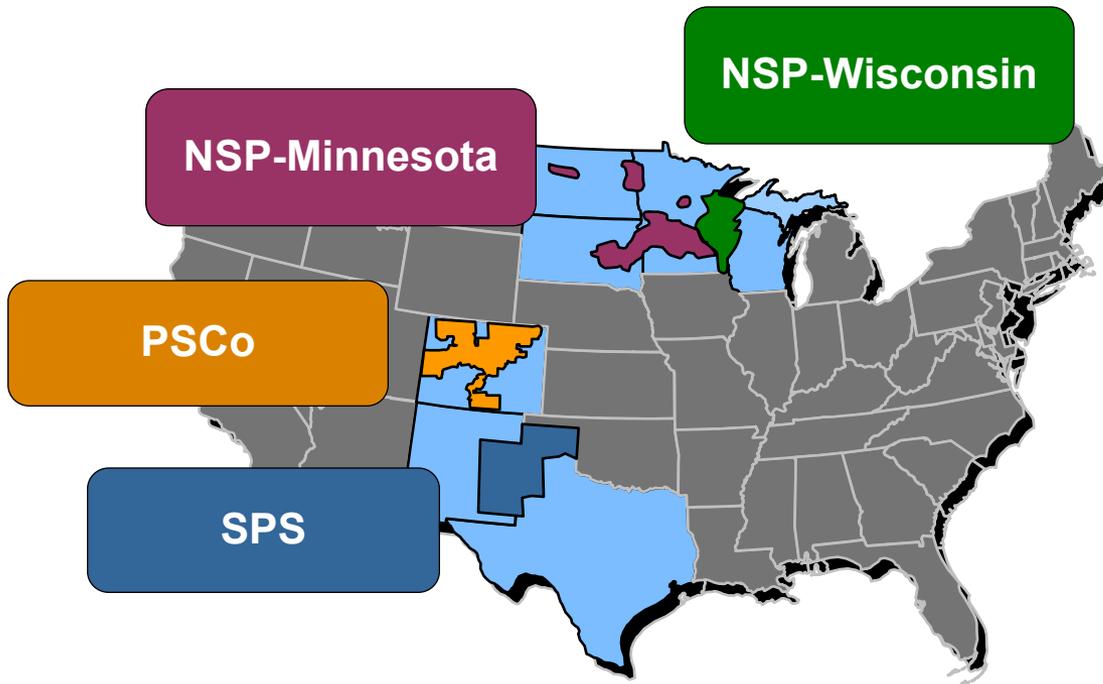


2015 Wind Energy Systems Engineering Workshop Boulder, CO January 2015

Who We Are...



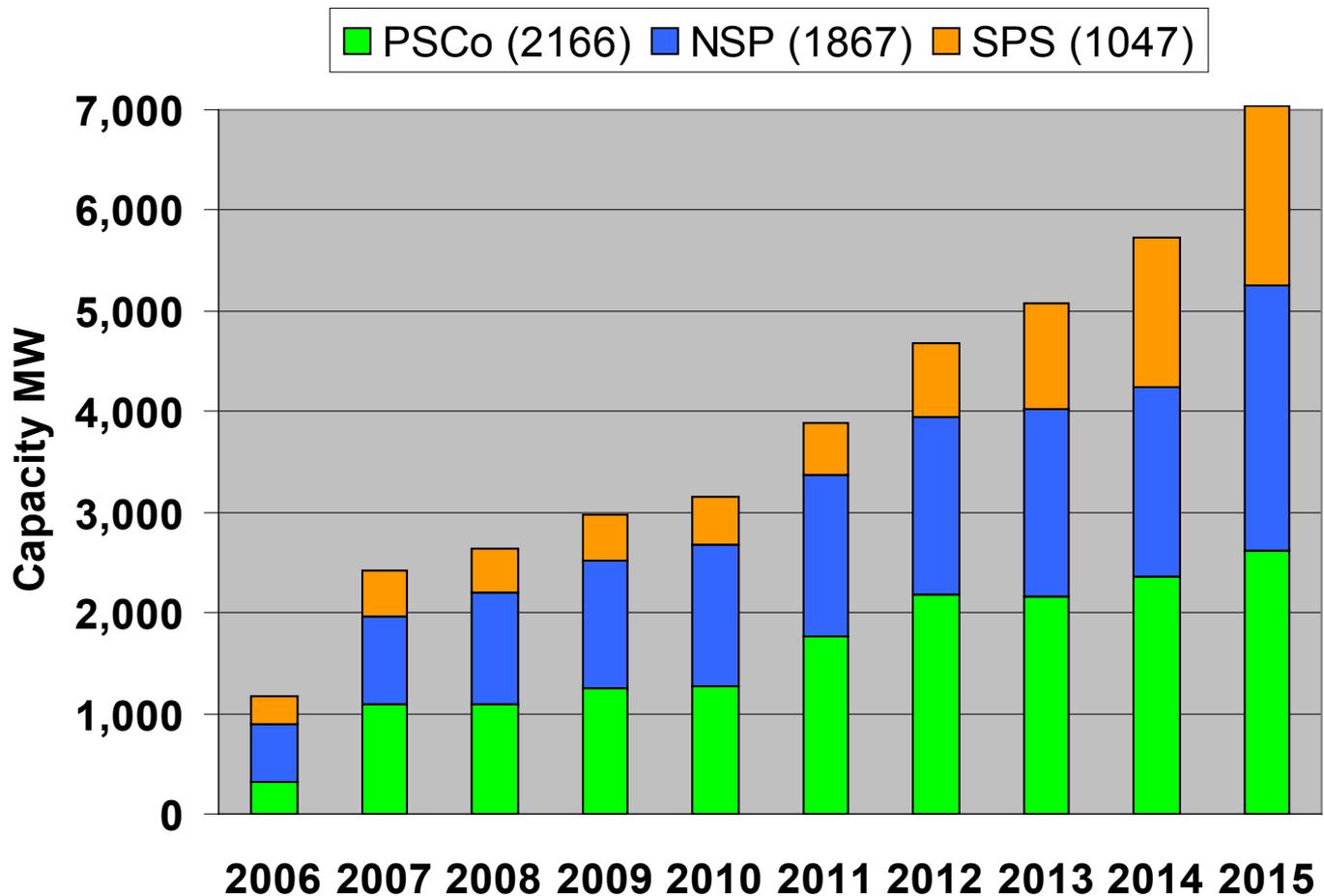
- 26,000+ MWs of generation
- Operating in 8 states
- No. 1 wind power provider
- 5,080 MW of wind capacity
- No. 7 solar power provider

Customers

3.4 million electric
1.9 million gas

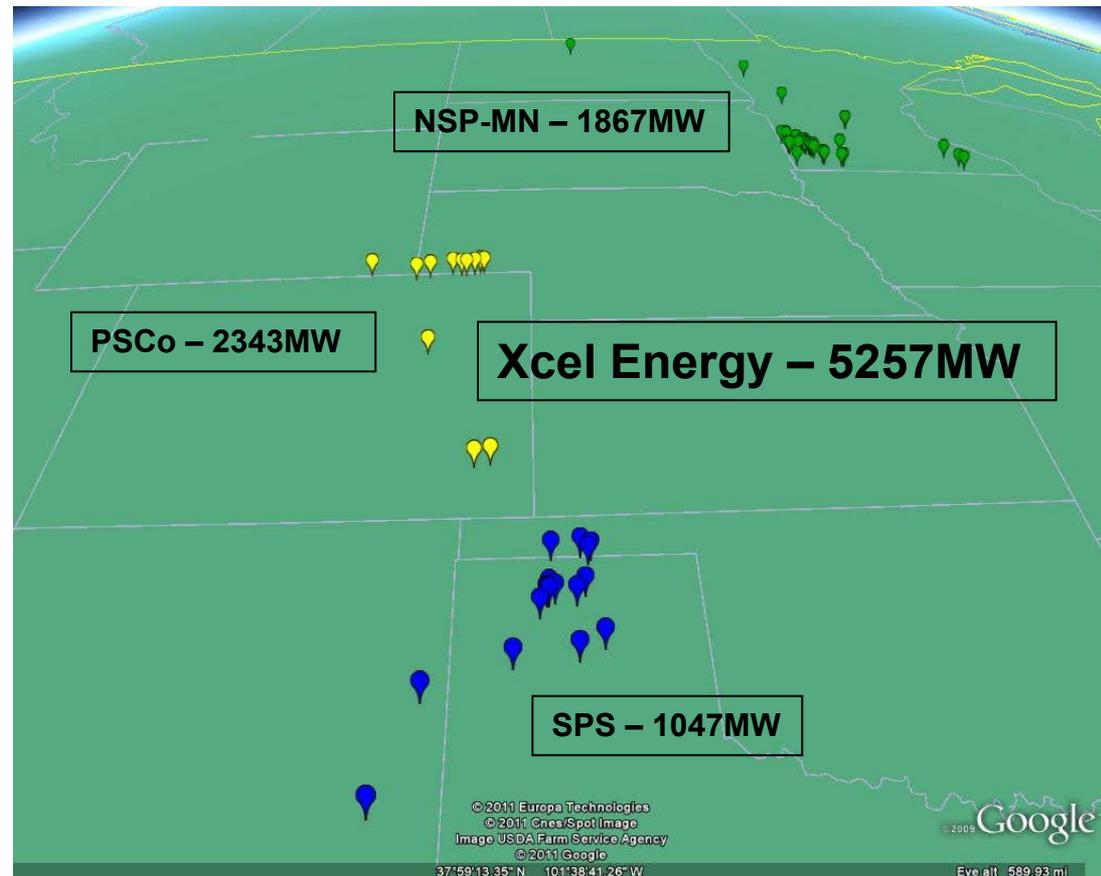
Xcel Energy is dedicated to being an environmental leader at reasonable cost

Xcel Energy Wind Generation Growth (current)



Xcel Energy Wind Farms

Currently, Xcel Energy will manages 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)



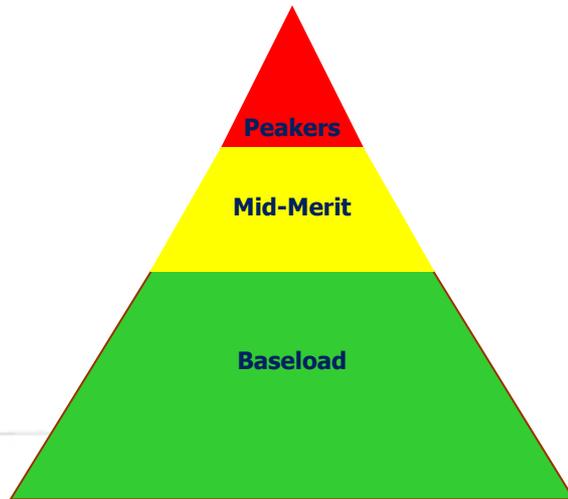
Forecast by end of 2012

Short-Term Uncertainty

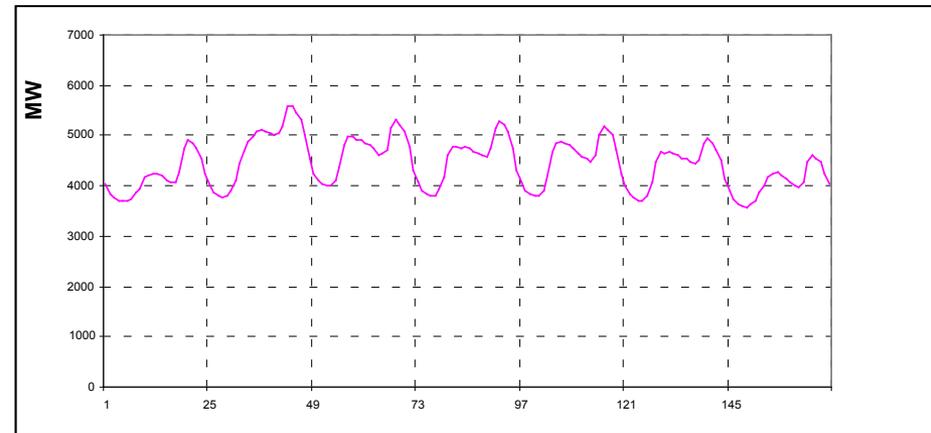
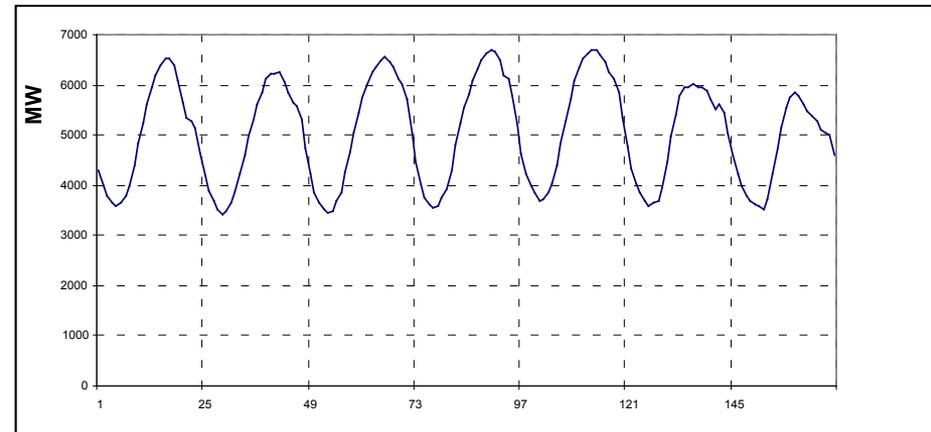


Loads and Resources

- **Obligations and resources are maintained in balance at all times**

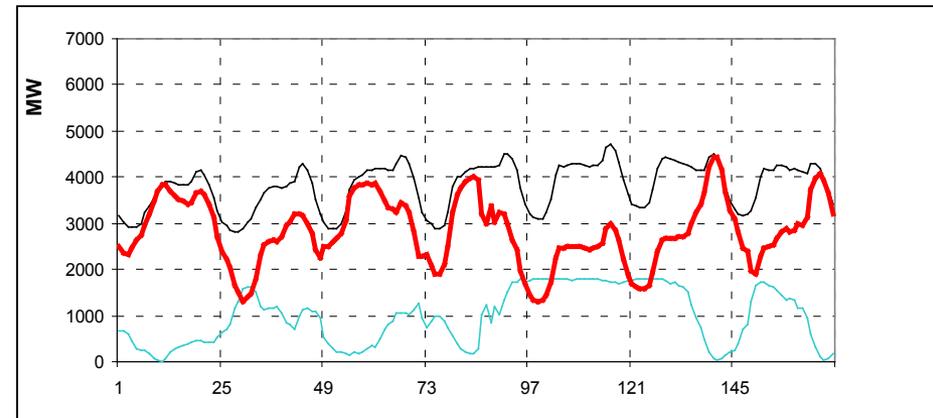
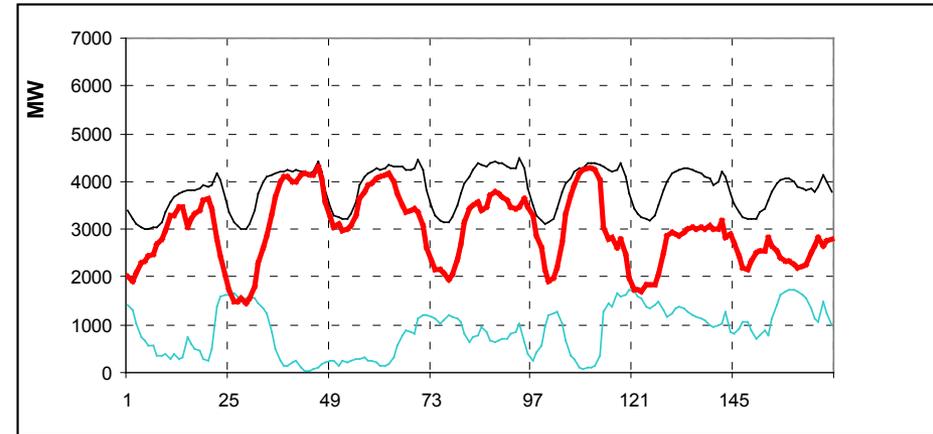
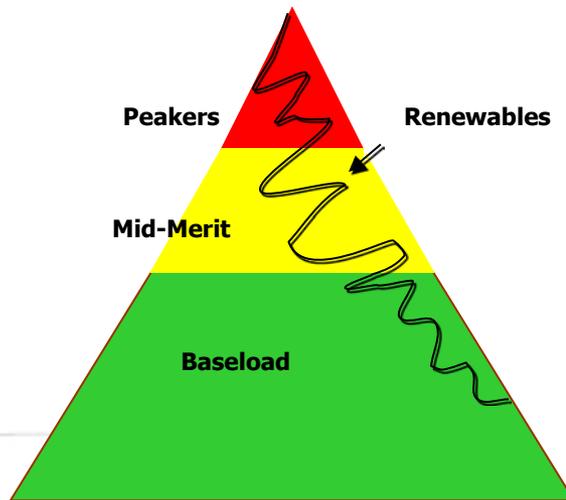


Traditional Energy
Paradigm



Loads and Resources (2015)

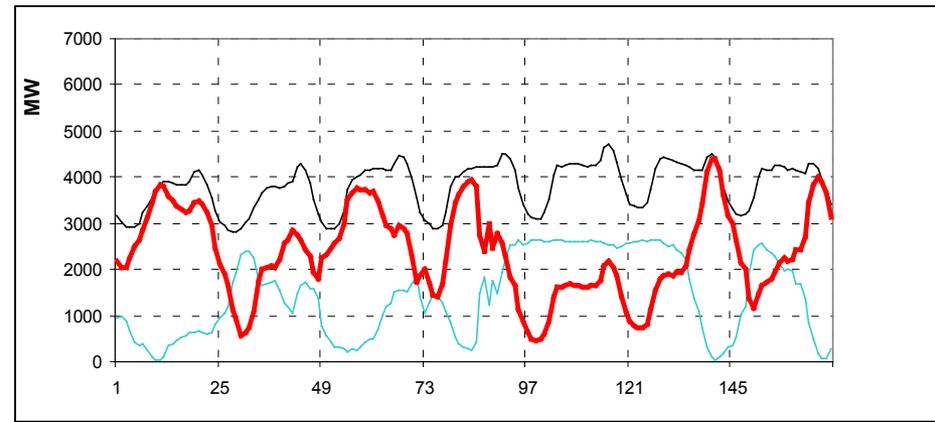
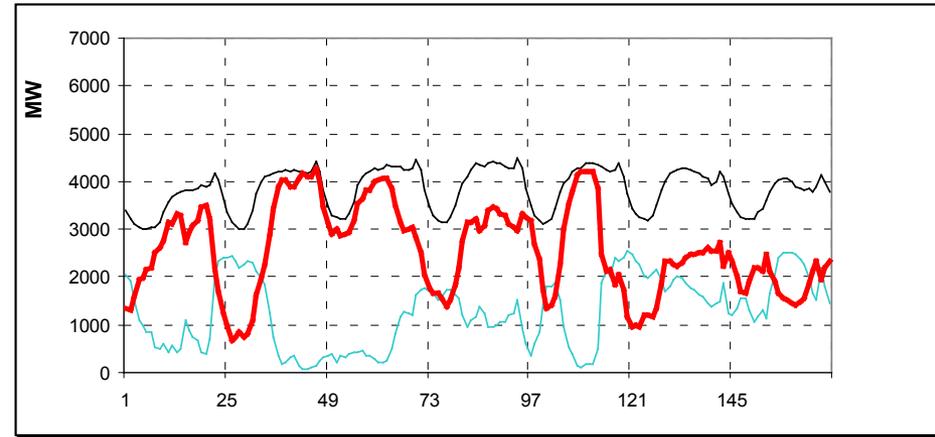
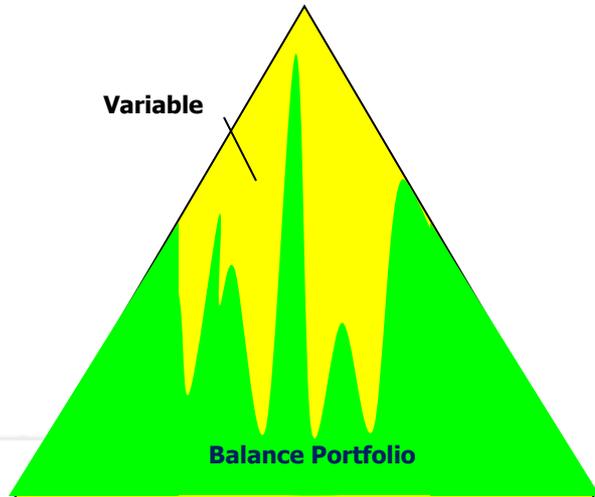
- Spread between daily high/low loads increase. Timing of ramps uncertain.



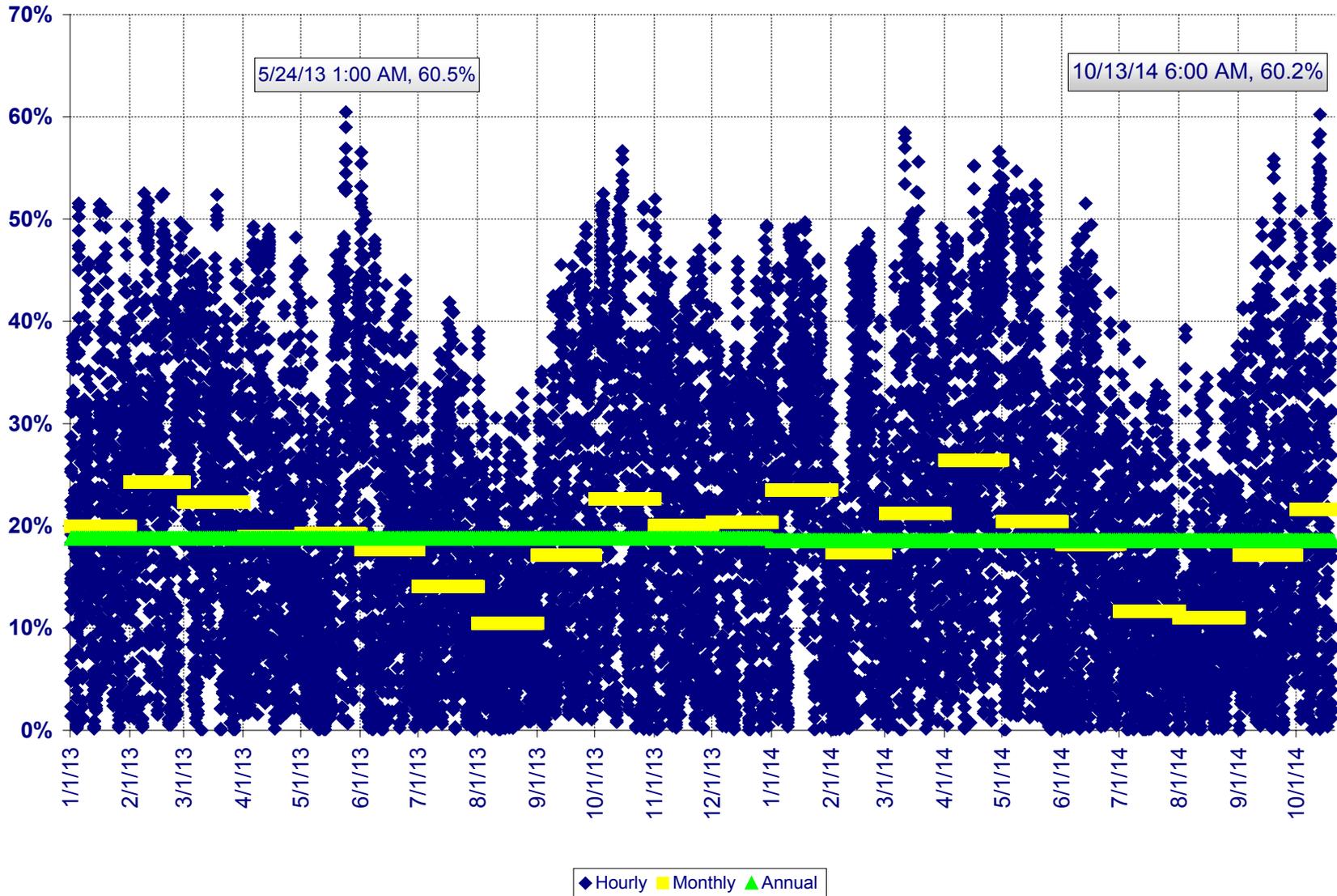
Traditional Utility
Paradigm

Loads and Resources (2020)

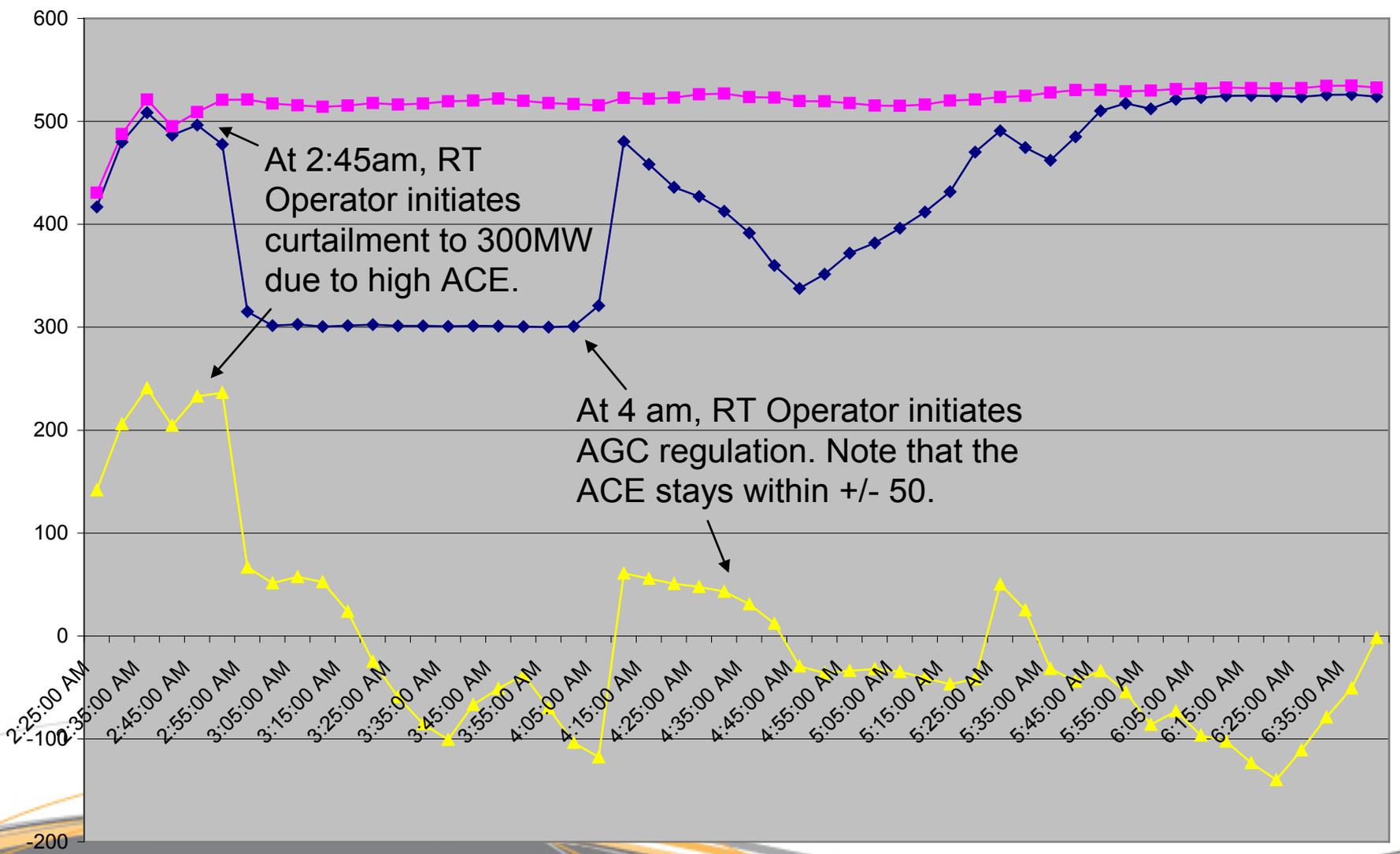
- **New paradigm: Flexible and Informed Grid**



PSCO Wind as a Percentage of Obligation Load (1/1/2010 thru 12/31/2011)



◆ Wind Farm Metered Generation
 ■ Park Potential
 ▲ ACE
 TURE™



Market Impacts



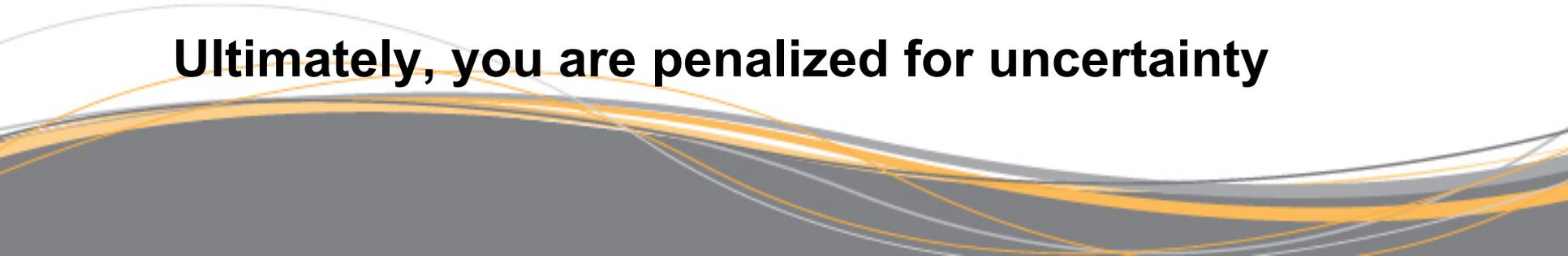
Day-Ahead Markets

- **Forecasts are awarded at a price**
 - **DA Award * DA Price**
- **In real-time, deviations are paid for**
 - **(DA Award – RT Gen) * RT Price**

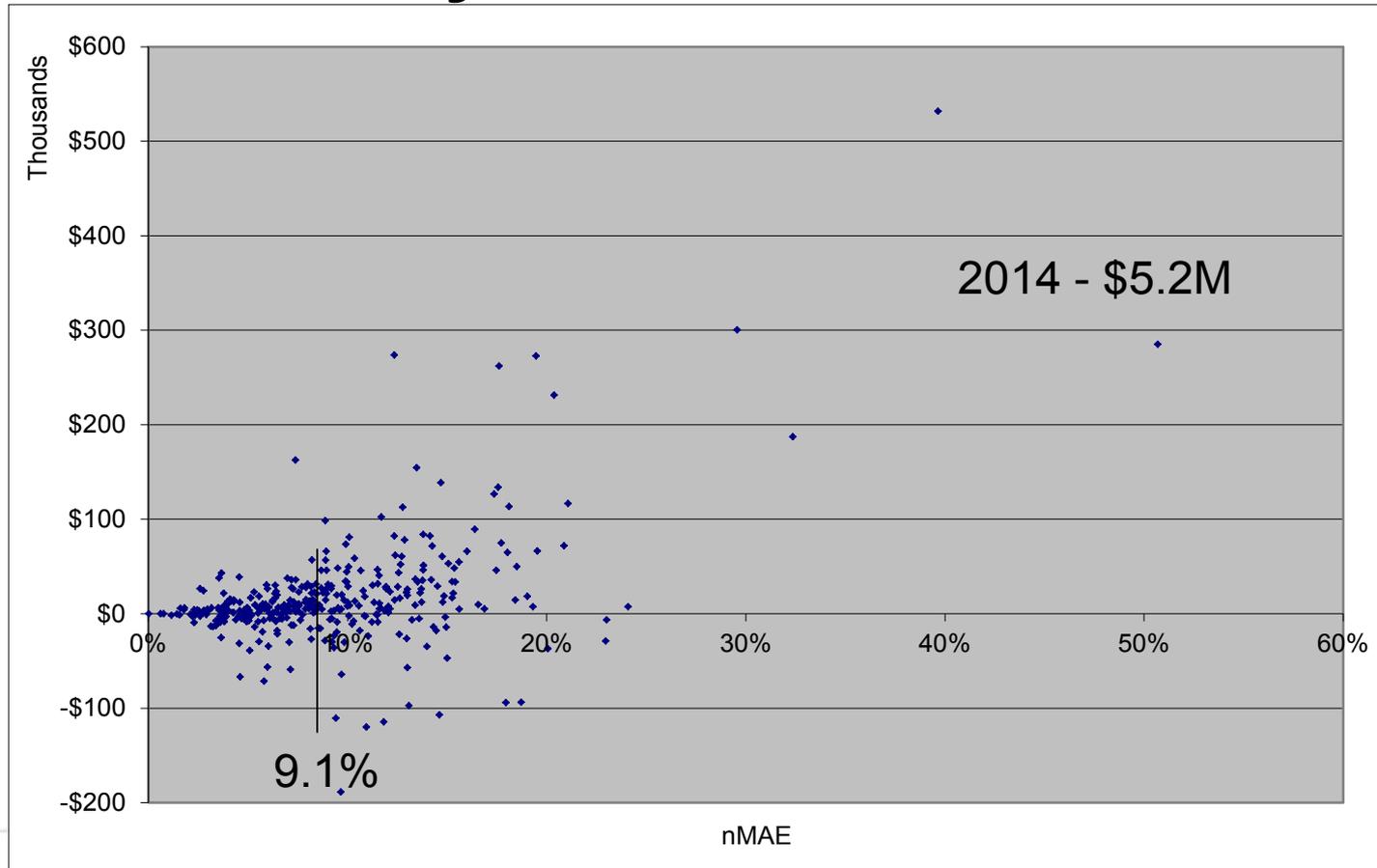
If there is oversupply, RT prices go down

If there is undersupply, RT prices go up

Ultimately, you are penalized for uncertainty



Day-Ahead Markets



Long-Term Uncertainty

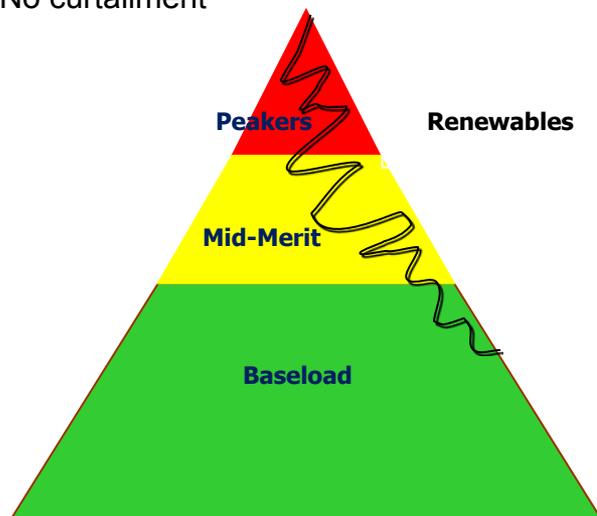


Resource Planning

- **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.**

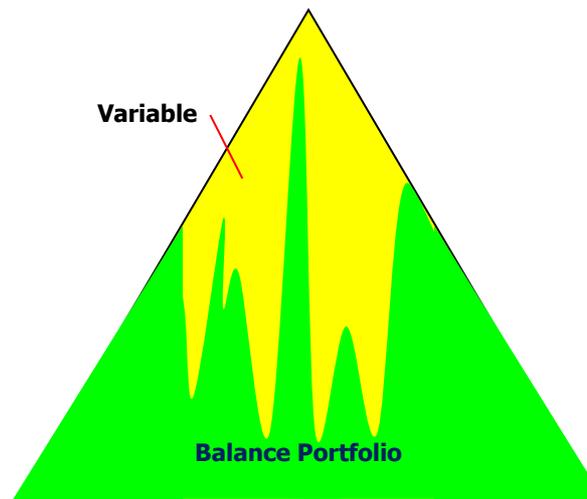
Loads and Resources – A New Paradigm

Commitment based on load forecasts
RE is must-take
No curtailment



Traditional Utility Paradigm (w/ some RE)

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



High Penetration Portfolio



Xcel Energy[®]

RESPONSIBLE BY NATURE™