



Advancing Wind Power in Illinois Conference 2011

**Kris Ruud**

MISO

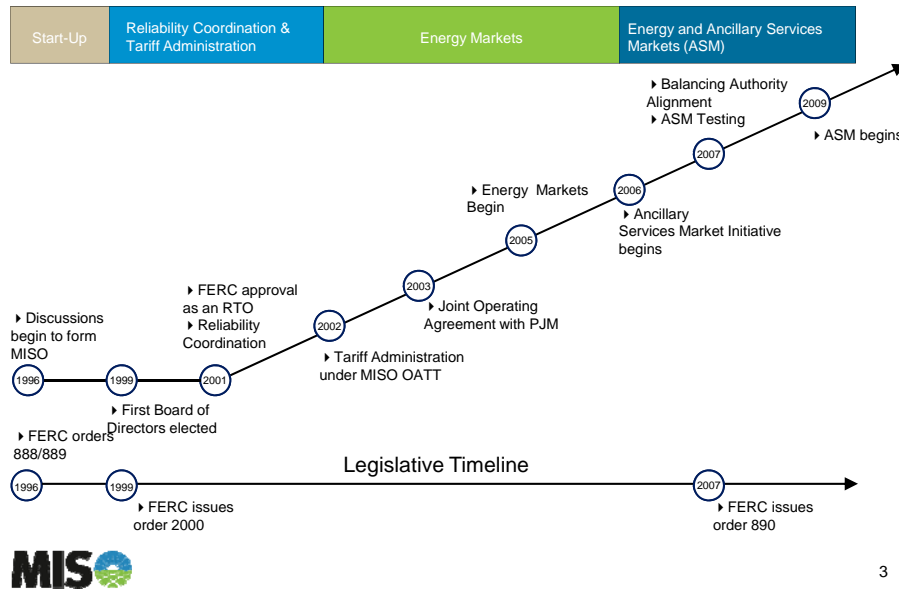
**Curtailment of Wind Farms Output**

**Breakout Session**

Friday, July 22, 2011, 1:30 PM

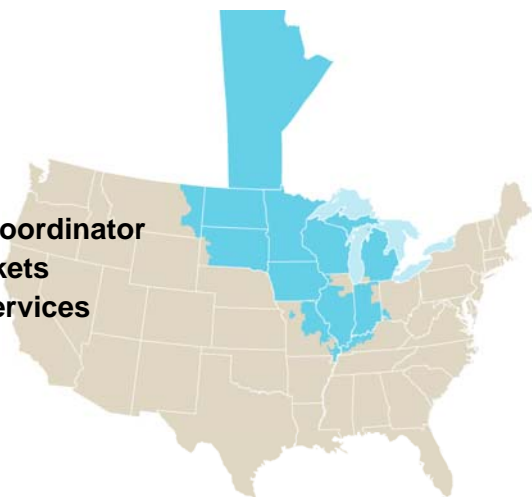


## Growth of MISO's value creation



## MISO Overview

- Independent
- Non-profit
- 2001 - Reliability Coordinator
- 2005 - Energy Markets
- 2009 – Ancillary Services
- Large Footprint



MISO Reliability Coordination Area, June 2011



## Scope of Operations

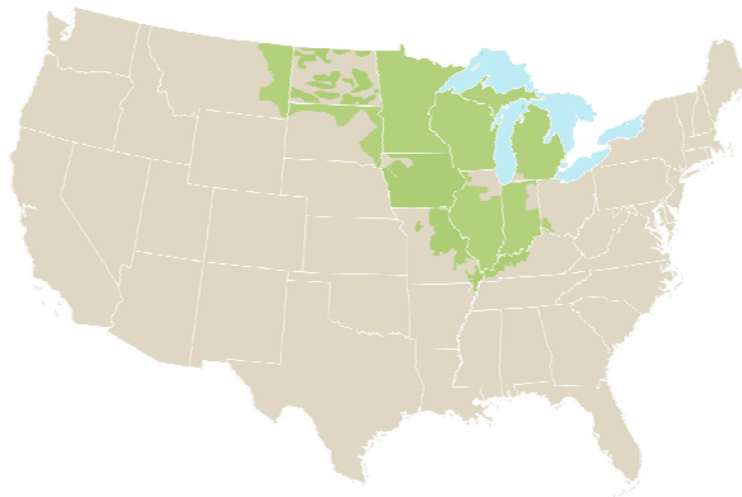
as of June 1, 2011

- **Generation Capacity**
  - 134,850 MW (market)
  - 146,497 MW (reliability)
- **Historic Peak Load**  
(set July 31, 2006)
  - 116,030 MW (market)
  - 136,520 MW (reliability)
- **53,203 miles of transmission**
- **12 states, 1 Canadian province**
- 5-minute dispatch
- 1,966 pricing nodes
- 5,774 generating units in the network model
- ~ \$27.5 billion per year settled in energy markets (2010)
- 368 market participants serving 40+ million people



5

## MISO Market Footprint

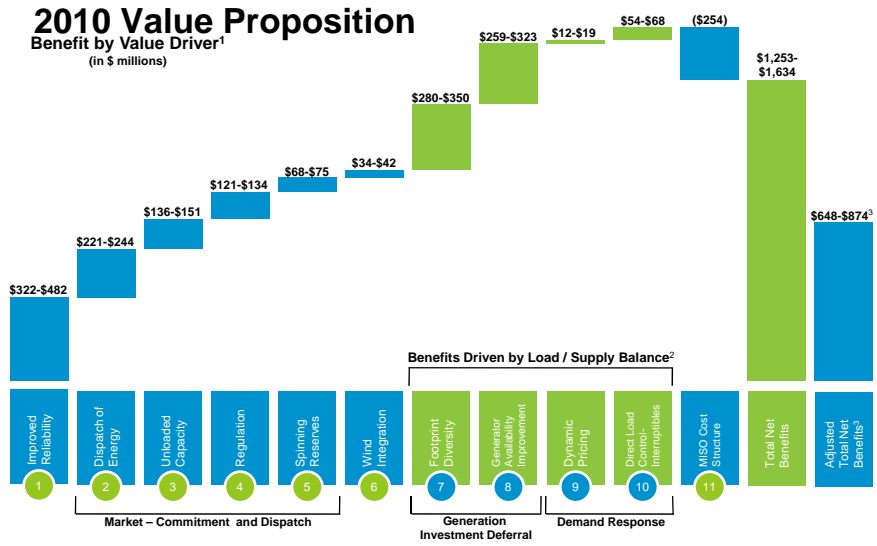


As of June 2011

6

# 2010 Value Proposition

Benefit by Value Driver<sup>1</sup>  
(in \$ millions)



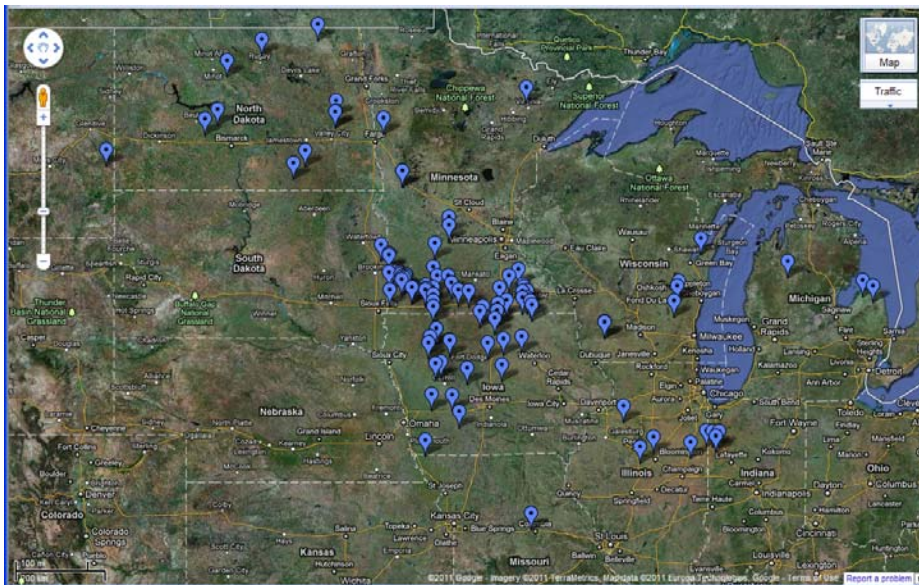
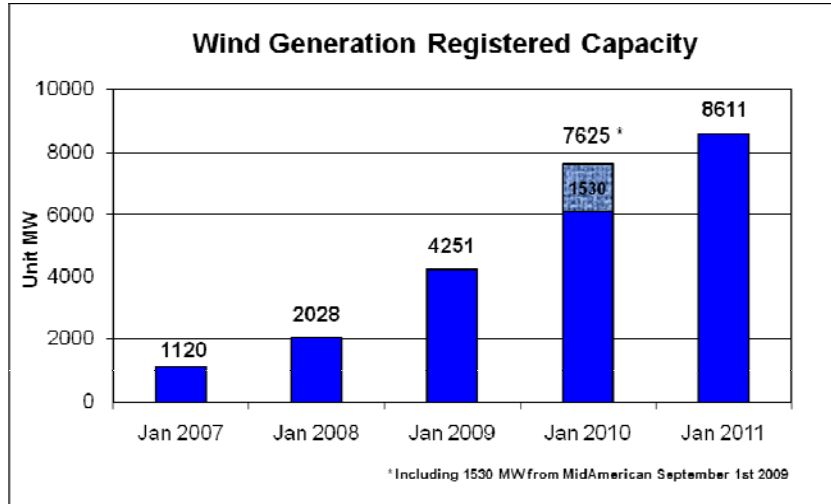
<sup>1</sup>Figures shown reflect annual benefits and costs expected for 2010  
<sup>2</sup>These benefits will be realized when the load / supply balance narrows  
<sup>3</sup>Adjusted total net benefits exclude benefits driven by load / supply balance

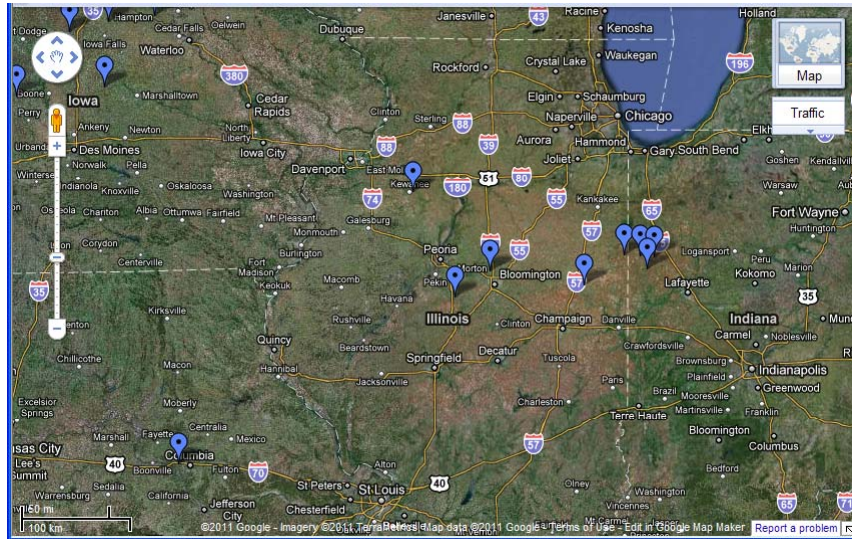


# Wind Development



# Wind Generation in Midwest ISO Market





## Transmission Congestion

- **High penetration of wind generation in areas that have historically had little generation**
- **Rapid development of wind has outpaced the associated transmission development**
  - Who pays to expand the transmission system?

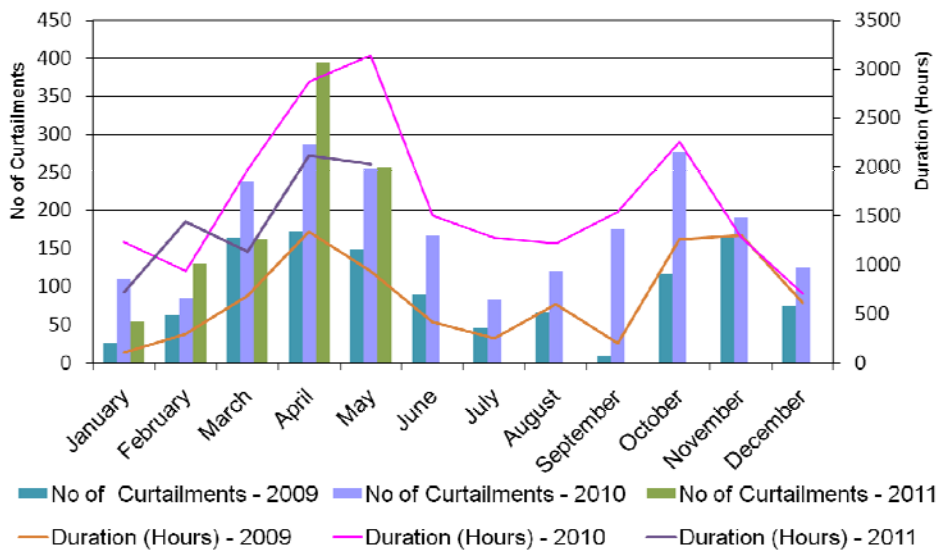


## How Does this Impact Operations?

- Original market design classified wind as an 'Intermittent Resource' and could not economically dispatch
- In areas with high wind penetration, it is difficult for the Security Constrained Economic Dispatch (SCED) to manage congestion with only dispatchable resources
- Reliability Coordinators must resort to manual curtailment of wind resources adversely impacting constraints

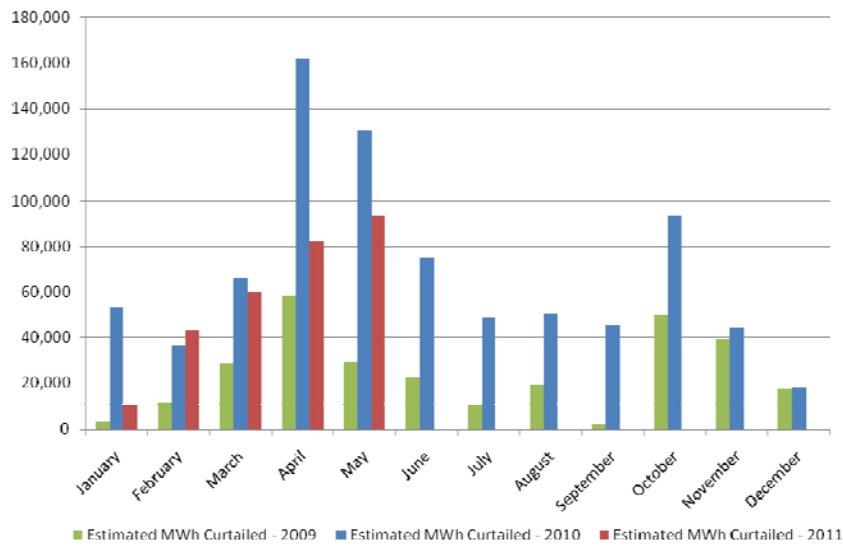


Curtailment Frequency & Duration in Hours





### Estimated Energy Curtailed



### 2010 vs. 2011

	2009 Total	2010 Total	2011 YTD
No of Wind Curtailments	1,141	2,117	996
Estimated MWh Curtailed	292,000	824,000	289,000
Duration (Hours)	8,005	19,951	7,447



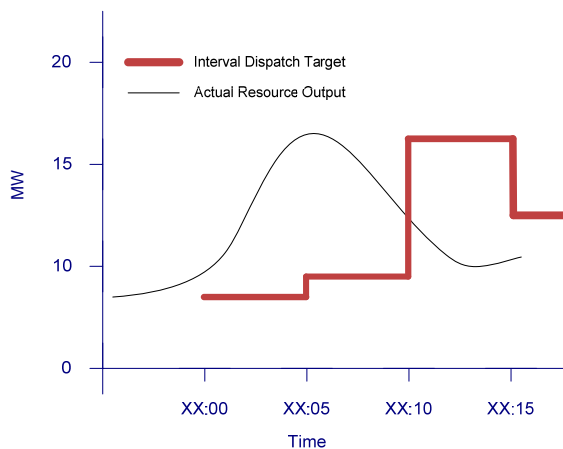
## Operational Concerns

- **While Manual Curtailment of Wind is effective as a constraint mitigation option, it has several drawbacks:**

- Highly manual process, and extremely time consuming for the Reliability Coordinator
- Tracking of Resources with Firm vs. Non-Firm Transmission service is time consuming
- The Manual Curtailments can not be accounted for in the Security Constrained Economic Dispatch (SCED), therefore there is loss of price transparency
- Manual Curtailments are generally less economically optimal as the automated SCED



## Intermittent Resource in MISO Market



UDS will issue a Dispatch Target Equal to observed output at the time of the State Estimator snapshot for that case.

Intermittent Resources  
- Cannot make RT economic offers

- Cannot set price

- Subject to RSG

- Not Eligible for Make Whole Payments

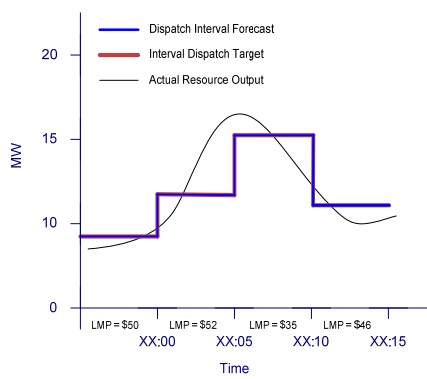


## What is Dispatchable Intermittent Resource?

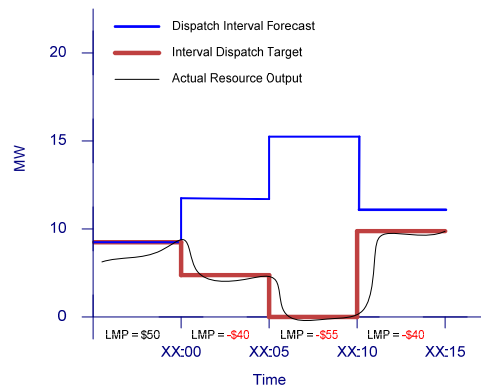
- DIRs are treated much the same as other Generation Resources with one exception:
  - Instead of using an hourly Economic Max offer, DIRs must submit a 'Forecast Limit' for each 5-minute interval. The UDS will use this Forecast limit as the Economic Max for the given interval.



## DIR Examples



Unconstrained



Nearby Congestion





**Wind Management at  
MISO**

IWWG Annual Conference

July 22, 2011

