



Midwest ISO
We manage power.

Modernizing the Grid Midwest Regional Summit

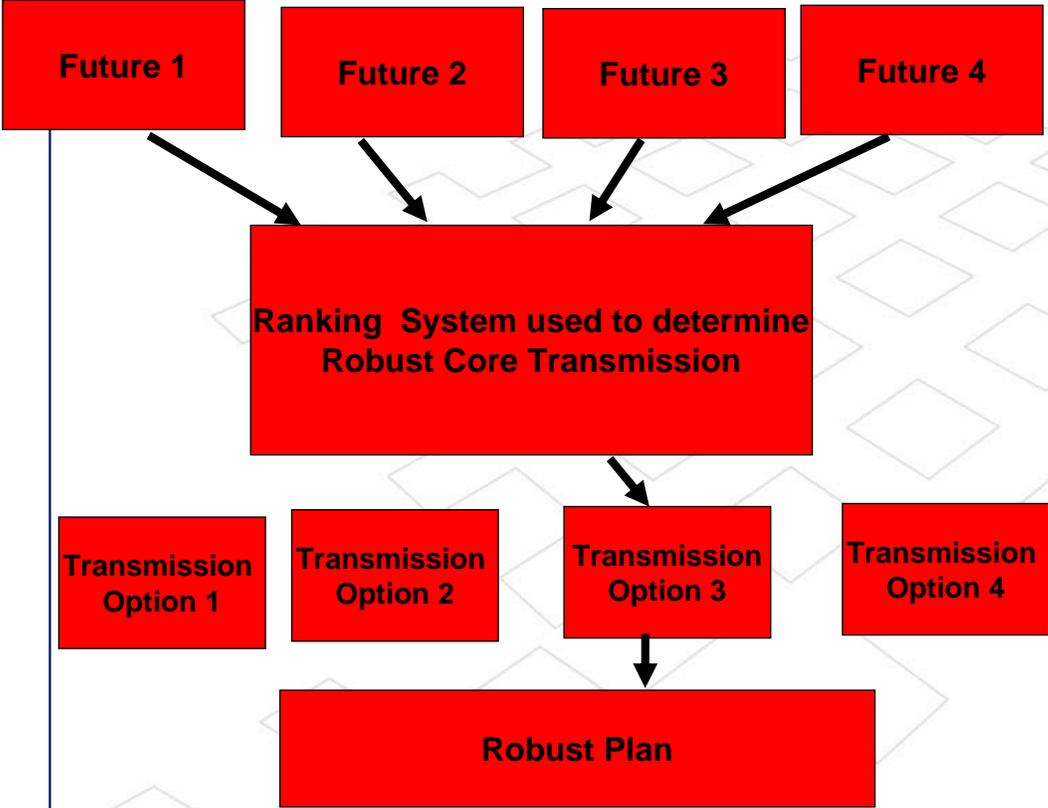
Robust, Not Optimum, Transmission System Design

Dale Osborn
Transmission Technical Manager
Midwest ISO
Nov 17, 2006
Columbus, Ohio

- **Presentation Overview**

- Why a Robust transmission design is needed- large uncertainties
- Example-Vision- for information only
 - 16,000 Mw of wind
 - 765 kV HSIL Transmission overlay from SD to NJ
 - Some preliminary economic indications

Robust Transmission Design Process



● **Exploratory Studies**

- For information only, not binding or to be constructed
- Address “ what if, then what” questions
- Used for guidance for policy, regulatory, legislative and conceptual generation and transmission investigation.
- Usually cover a future year and are usually focused on economics rather than reliability
 - Capacity-reliability
 - Energy-economics

● Drivers

- MISO has five times as much potential wind generation as present load
- Influence from government, wind advocacy, energy market
 - Market
 - Constraints to the east of MISO limit economical generation patterns in MISO-overlay mitigates most of these constraints
 - Power displaces from west to east
- 765 kV HSIL is lowest price per Mwh-mile-needed for an energy market

Example

● **MISO MTEP Draft Vision Study**

- 16,000 Mw of wind capacity distributed across MISO states was added to a base case with adequate non-renewable generation
 - 20% Renewable Energy in Minnesota
 - 10% Renewable Energy in other MISO states
- A 2016 study year was chosen
- Generation shortages to meet load in the base case is supplied from generation expansion studies
- Top down study type

Change in the Queue Over Time

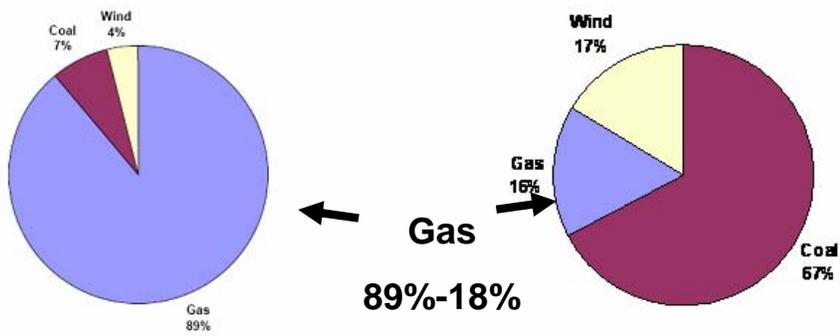
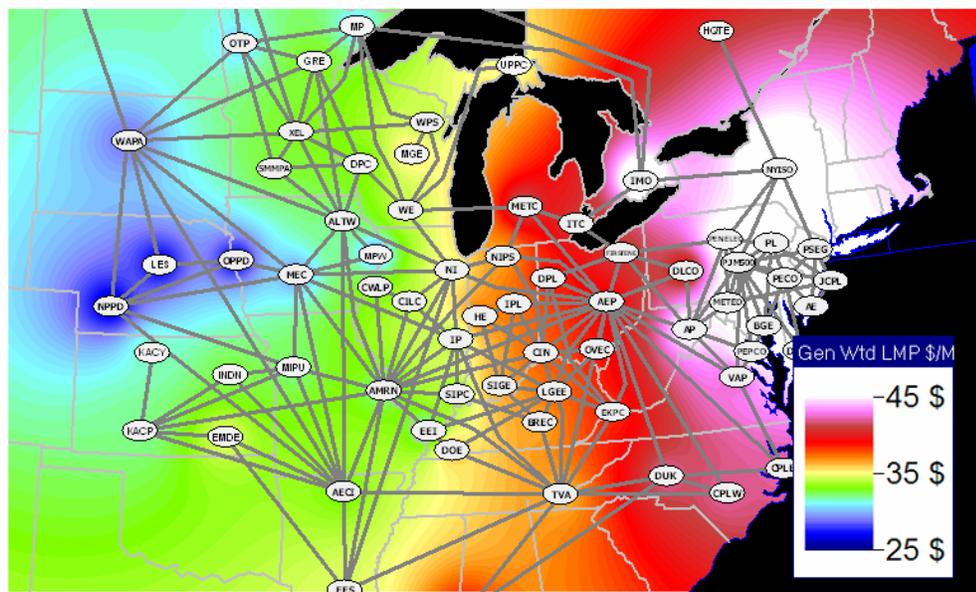


Figure 4.1-4. Fuel Mix by Capacity of the Queue

2003
72,000 Mw

2006
28,000 Mw

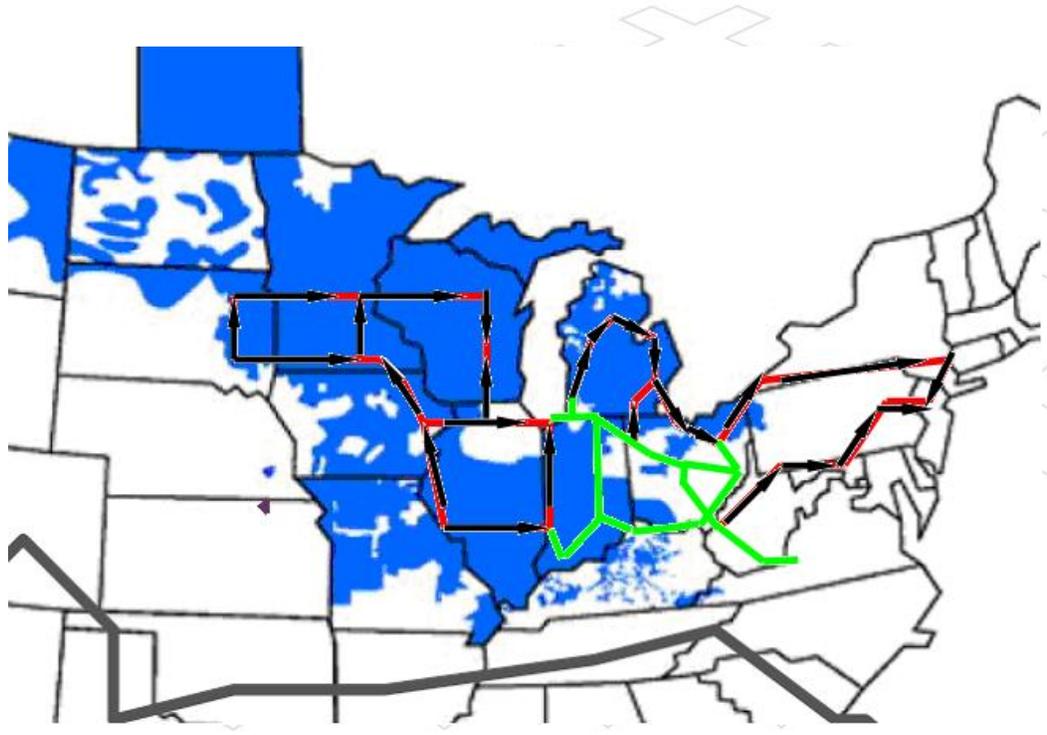
Generation Weighted LMP Contour Map



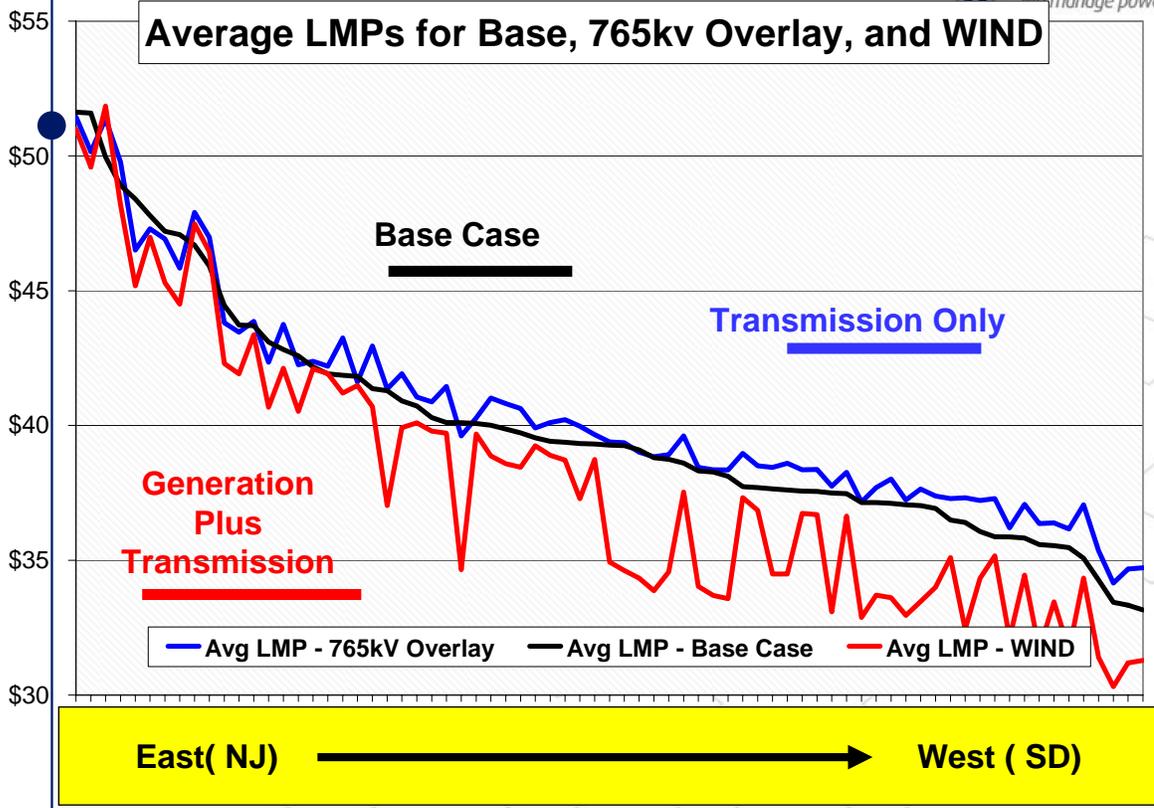
Market flow West to East



Predominant Flow Direction – 765kV Overlay



Average LMPs for Base, 765kv Overlay, and WIND



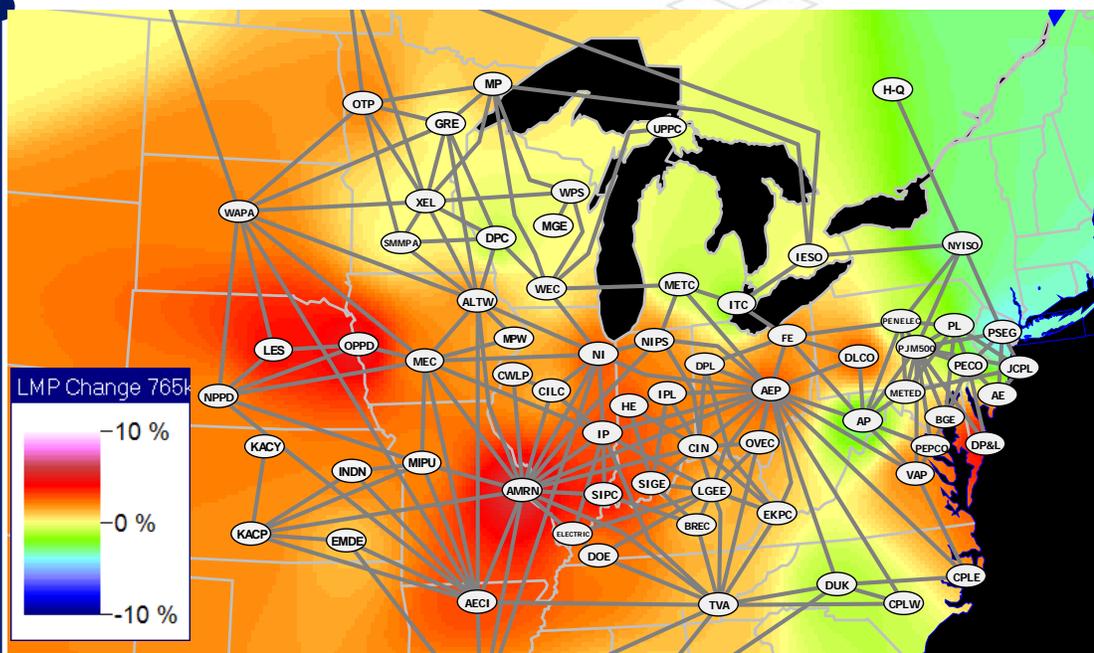
East(NJ)

West (SD)

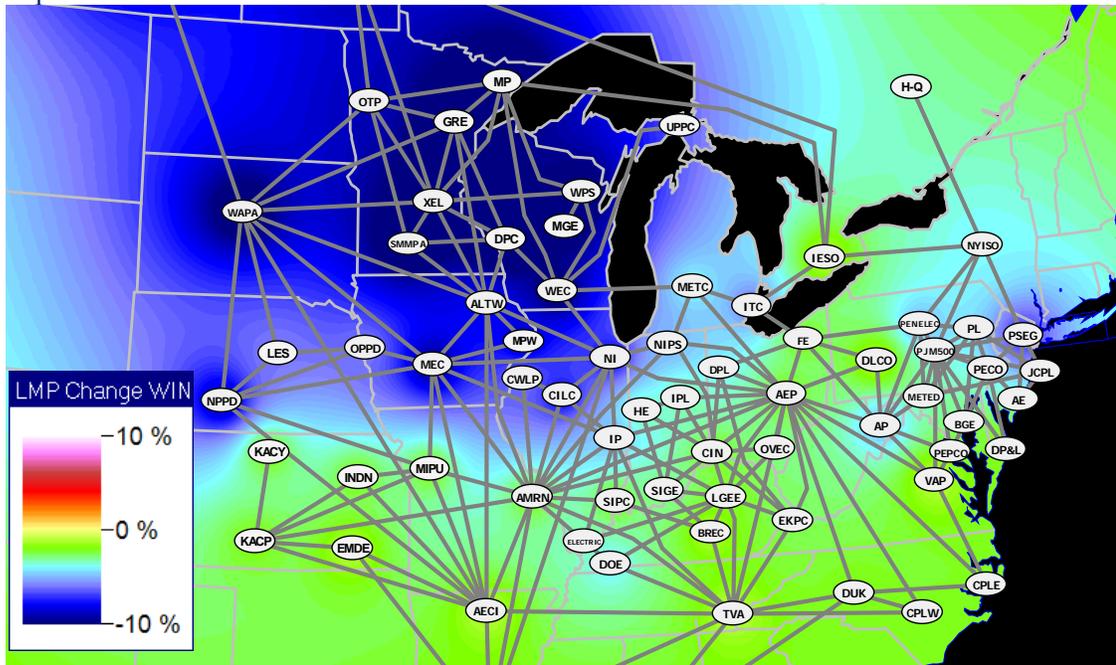
% CHANGE LMP – 765kV OVERLAY CASE vs. Base



Effect of Transmission Only



% CHANGE LMP – WIND CASE + Overlay vs. Base *We manage power.*

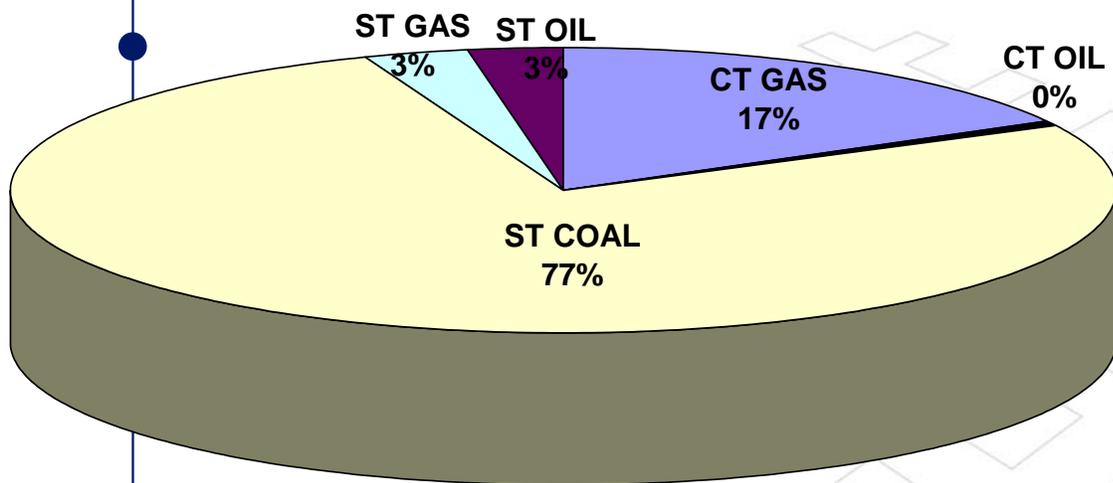


Wind lowers the Load LMP for all areas

● Economic Results

- \$6.9B/yr Net Generator Revenue reduction
- \$4.6B/yr transmission annual carrying charge-cost not recovered in the study
- 2.2B/yr Wind generation Revenue
 - 74% of annual carrying costs for a 2006 generator
 - 54% of annual carrying costs for a 2016 generator
- Net benefit from generation and transmission \$100M/yr.
- Other benefits may occur from a reduction in the deferment of capital expense due to a reduction in generator reserve margins

Generation Displaced by WIND - % Total MWhs



■ CT GAS ■ CT OIL ■ ST COAL ■ ST GAS ■ ST OIL

67 Twh/yr wind generation
43M tons/yr CO₂ displaced
171,000 tons/yr So_x displaced

● Initial Observations

- Need an Renewable Portfolio Standard economically until a market solution is in place-little transmission between states
- As presently constructed, the Energy Market does not provide revenue sufficiency for renewable energy resources. A method of providing renewable energy resources revenue from generator revenue reductions would need to be provided to make the combination of generation and transmission economically feasible.
- The transmission may have other value such as generation reserve reductions that may have significant value.
- Transmission could be recovered by a “user pays” method based on shift factors and recovered by the generator LMP.

● **Contact**

- Dale Osborn
- Transmission Technical Director
- Transmission Asset Management
- Midwest ISO
- Phone 317-249-5857
- Cell 317-697-4774
- Email: dosborn@midwestiso.org