2002 State of the Market Report
Midwest ISO

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POTOMAC ECONOMICS

Introduction

- This report evaluates the state of the market in the Midwest during 2002.
- The Midwest ISO currently provides transmission service, but does not facilitate centralized spot markets for energy or ancillary services.
- Hence, the focus of this report will be significantly different than the State of the Market reports from other RTOs or ISOs with operating markets.
- This report will assess market conditions and characteristics during 2002 in anticipation of the Midwest ISO markets to be implemented by March 2004, including:
  - ✓ Characteristics of the Midwest Markets;
  - ✓ Wholesale Market Prices in 2002;
  - ✓ Assessment of Transmission Utilization;
  - ✓ Pivotal Supplier Analysis;
  - ✓ Market Development Summary and Recommendations; and
  - ✓ RTO Configuration and Coordination.

Summary of Conclusions

Market Characteristics

- The fuel mix in the Midwest is dominated by coal-fired resources, accounting for 60 percent of the capability.
- Most of the recent investment has been in natural gas resources, which currently account for 16 percent of the capability in the region.
- The report calculates the capacity margin in the Midwest ISO area at 19.8 percent, which is substantially higher than FERC's minimum requirements
  - ✓ In four sub-regions within the Midwest ISO (not including WUMS), the capacity margin ranges from 19 percent to 27 percent, which is substantial.
  - ✓ The capacity margin in WUMS is much lower, at 15 percent.
- The market concentration in most of the sub-regions is moderate to high with HHIs ranging from 1000 to 2700. The HHI in the WUMS sub-region is 2700.

Summary of Conclusions

Wholesale Market Prices in 2002

- Bilateral market prices were primarily determined by load levels, with the highest prices occurring during peak periods.
- Daily prices increased by more than 20 percent from February to December, influenced largely by increases in natural gas and fuel oil prices.
- These price increases were moderated by decreases in coal prices through 2002, which play an important role in setting prices during lower load periods.
- The report also assesses how accurately prices reflected transmission congestion during 2002.
  - ✓ Based on this analysis, we conclude that the current bilateral prices do not fully or accurately reflect the transmission congestion.
  - ✓ This conclusion supports the Midwest ISO's move to LMP spot markets in Day 2, which should provide more accurate and transparent price signals.

Summary of Conclusions

Transmission Utilization: Disposition of Service Requests and AFC Values

- The report finds that both the requests and approvals of transmission service have risen sharply from February to December 2002.
  - Approved non-firm requests increased by 173 percent.
  - Approved firm requests increased by 129 percent.
- The increase in approved reservation requests was primarily caused by:
  - The increasing discounts offered by the Midwest ISO for non-firm transmission service through the year; and
  - Improved modeling of available flowgate capability ("AFC").
- Improvements in AFC calculation are planned for 2003 that should improve the accuracy of the AFC calculations and the availability of capability.
  - The report recommends that the MISO investigate methods to better coordinate hourly non-firm AFC with actual power flows on the flowgates.

Summary of Conclusions

Transmission Utilization: Congestion Management and TLRs

- The report evaluates the TLRs invoked in 2002 to reduce flows on the Midwest ISO flowgates.
- This analysis supports the conclusion that the Midwest ISO has invoked TLRs in a consistent and justifiable manner.
  - TLRs occurred in only 1.5 percent of the hours during the time period studied in the report when the flow on the relevant flowgate was less than 95% of the limit.
  - Additionally, in less than 0.2 percent of the intervals was the power flow greater than the flowgate limit without a TLR being invoked.
- The report also evaluates the effectiveness of the TLR process.
  - This evaluation shows that the TLR procedures are substantially inferior to the economic dispatch process that will occur under the Day 2 LMP markets.
  - The report shows that, on average, almost three times as many transactions are curtailed as would be required to be economically redispatched to provide the necessary relief on the flowgate.
  - This conclusion strongly supports the move to LMP spot markets in the Midwest.

Summary of Conclusions

Pivotal Supplier Analysis

- The report summarizes the pivotal supplier analysis performed in 2002, showing those flowgates that have one or more pivotal suppliers.
- A pivotal supplier is a supplier whose resources must be used to prevent a flowgate from becoming over-loaded.
- This analysis:
  - ✓ Identifies significant potential local market power issues; and
  - ✓ Is a precursor to the analysis that will need to be conducted to define Narrow Constrained areas for purposes of the market power mitigation measures.

Summary of Conclusions

RTO Configuration and Coordination

- The report updates the configuration analysis, which examines the potential seams issues between the MISO, PJM and SPP.
- This analysis reflects the changes that have been made since the analysis was first conducted in the Summer 2002.
- It continues to show a high degree of electrical interaction between the Midwest ISO region and adjacent areas.
- This interaction raises significant efficiency concerns related to the locational prices and market dispatch, and potential gaming concerns.
- Based on our review of the current materials, the MISO, PJM and SPP have worked to develop a TLR process that will allow TLRs to continue to be used to manage interactions between market and non-market areas.
- However, the provisions to coordinate network flows and congestion management between adjacent market areas have not been well-developed.
- Hence, the report provides recommendations for the MISO, PJM and SPP to consider in preparing to implement adjacent LMP markets under the current configuration.

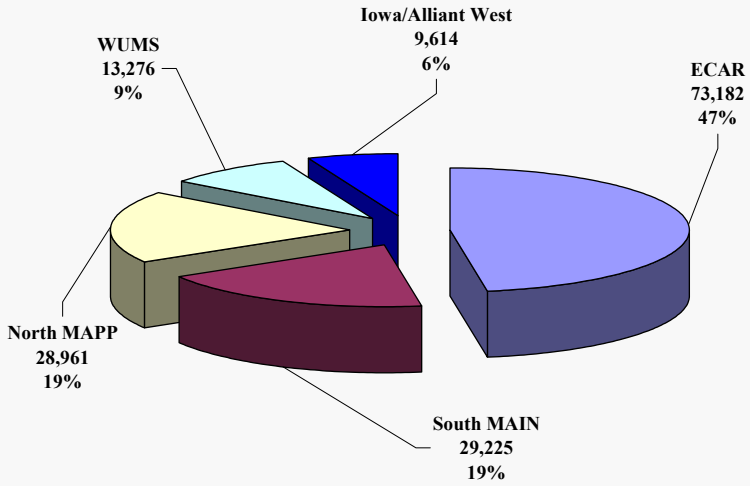
Characteristics of Midwest Markets

Midwest Markets -- Supply

MISO Generating Capacity

- The MISO footprint, including entities that are anticipated to join MISO before the end of 2003, includes over 155,000 MW of generating capacity;
- The following figure shows the distribution of this capacity among the major transmission systems comprising MISO;
  - ✓ The Table is presented according to one of five sub-regions of MISO
    - – ECAR, Iowa, N. MAPP, South MAIN, and WUMS;
  - ✓ These sub-regions correspond to major study areas of the MAIN Summer Transmission Assessment;
  - ✓ Iowa includes the transmission areas served by Mid-American Energy and Alliant West;

Geographic Distribution of MISO Capacity



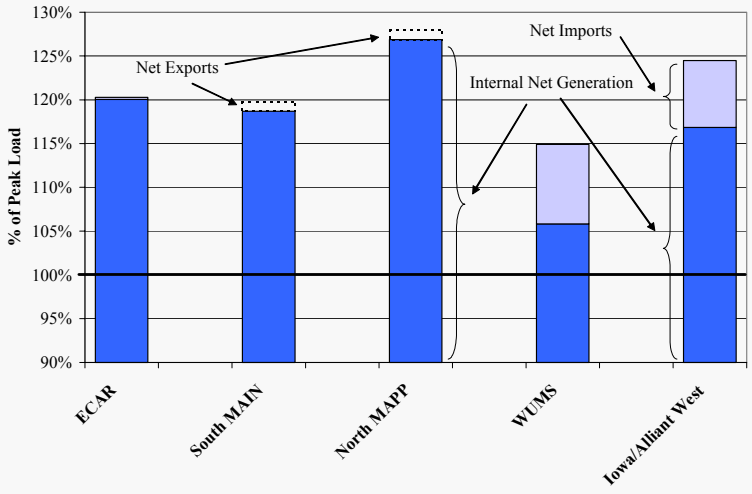
Transmission Interconnections and Resource Balance

- The table below and the following figure show capacity margins in each of the sub-regions, calculated by dividing the total resources by the peak load.
- With the exception of WUMS, the MISO sub-regions have access to substantial generation capacity resources.
- WUMS has the relatively weak interconnections and the lowest capacity margin, relying on firm imports to meet its reliability requirements.

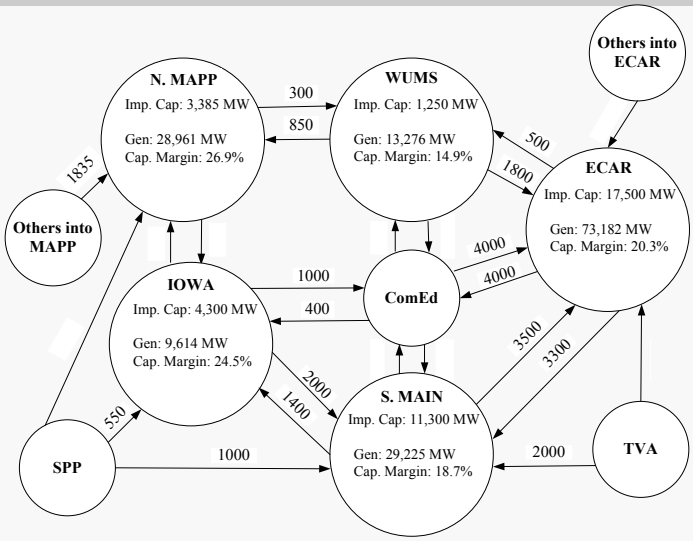
Transmission Area	Generating Capacity	Net Firm Imports	Total Firm Resources	Capacity Margin
ECAR	73,182	144	73,326	20.3%
South MAIN	29,225	-265	28,960	18.7%
North MAPP	28,961	-260	28,701	26.9%
WUMS	13,276	1,138	14,414	14.9%
Iowa/Alliant West	9,614	630	10,244	24.5%
Total MISO	154,259		155,646	19.8%

Notes : Source for Net firm Imports is base transfers in the MAIN 2002 Summer Assessment. Because the 2002 peak loads were not available, we calculated the capacity margin using 2001 peak loads increased by two percent.

Capacity Margins in the MISO Sub-regions



MISO Transmission Interconnections and Resource Balance



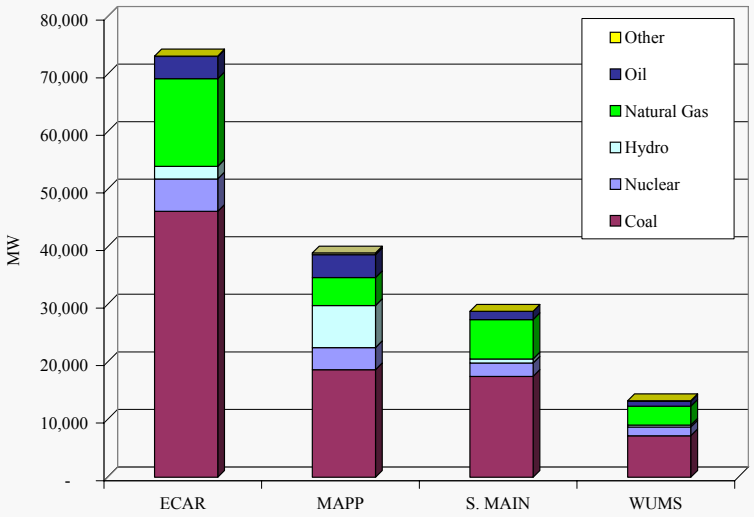
Note: Values between areas represent non-simultaneous incremental transfer capability.

Midwest ISO Capacity – Fuel Profile

The following figures show the quantities and shares of generating resources by fuel-type.

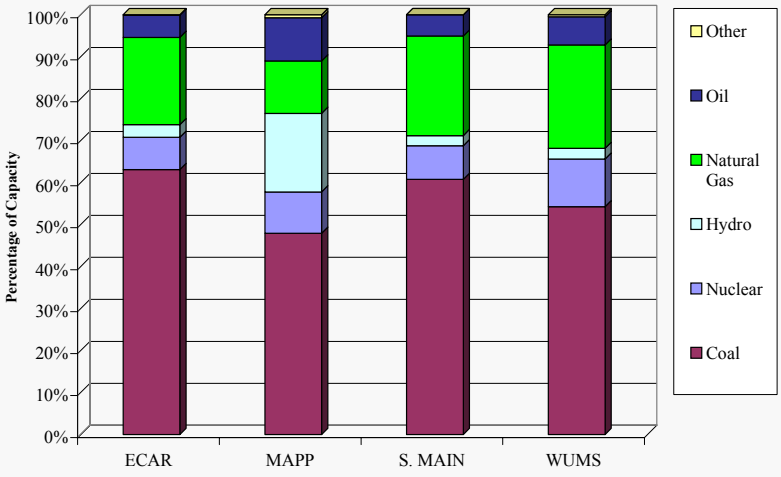
- MISO and each of its sub regions relies heavily on coal-fired generation.
- Over 60% of the generation in MISO is coal-fired.
- Nuclear, Oil, and Hydro resources are all less than 10% of the resources.
- Natural gas-fired generating resources are 16% of the supply in the Midwest, although they account for the majority of the new capacity.

MISO Capacity by Fuel Type in the Midwest ISO Sub-Regions



Note: MAPP includes Iowa Area indicated in the previous figures.

MISO Capacity by Fuel Type in the Midwest ISO Sub-Regions



Market Concentration in MISO Sub-regions

- The following table shows the Herfindahl-Hirschman Index (HHI) for each sub-region within MISO, a measure of market concentration;
  - ✓ For this table, Iowa transmission area collapsed into larger NERC region – Mid American Energy to MAPP and Alliant West to South Main
  - ✓ HHI measures are calculated by summing the squares of each supplier's market share.
  - ✓ The antitrust agencies generally characterize markets with HHIs of greater than 1800 as highly concentrated.
  - ✓ The HHIs in the Midwest are higher than in some regions because the vertically integrated utilities have divested less capacity than in other regions.
- In addition to having the lowest capacity margin, WUMS is the most highly concentrated of the MISO regions.
- The HHI provides only a general indication of market characteristics and is not a definitive measure of market power, which must consider demand and network constraint factors.

MISO Sub- Region	HHI
ECAR	1,087
MAPP	1,128
S. MAIN	1,669
WUMS	2,752
MISO-Wide	408

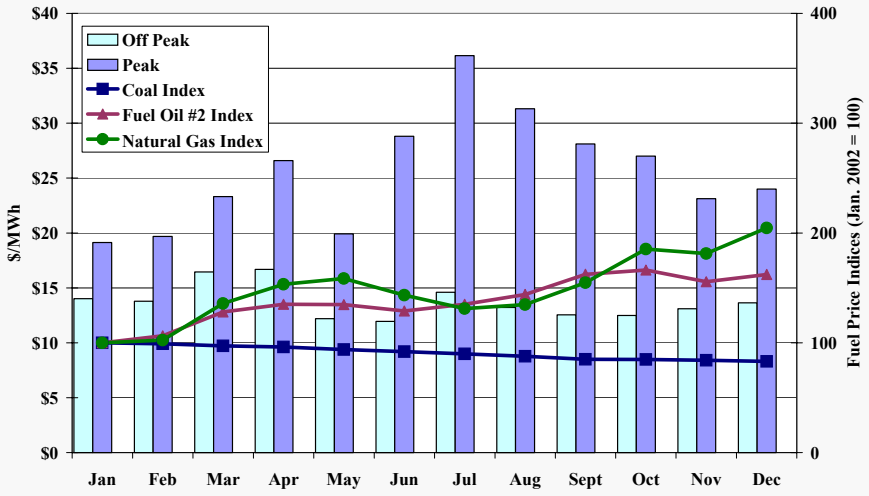
Wholesale Market Prices in 2002

Market Prices in 2002

- The following figures show price trends in the bilateral electricity markets during 2002.
- The prices shown are prices associated with daily forward contracts initiated day ahead.
- The first figure shows monthly average prices at the Cinergy hub during peak and off-peak periods, and includes natural gas, fuel oil, and coal price indices to indicate general trends in underlying input prices.
- This figure shows:
  - ✓ Prices are substantially higher during peak hours due to the lack of economic storage.
  - ✓ The increase in gas and oil prices through the year contribute to the modest increase in electricity prices through the fall and into the winter.
  - ✓ However, the decrease in coal prices moderates these effects since coal is frequently on the margin in lower load periods.
  - ✓ The high loads that occur in the summer months predictably lead to the highest prices in these months.
  - ✓ Relatively high quantities of generating resources on maintenance outages in the shoulder months (e.g., April) can cause prices to rise in these months.

Monthly Average Electricity and Fuel Prices

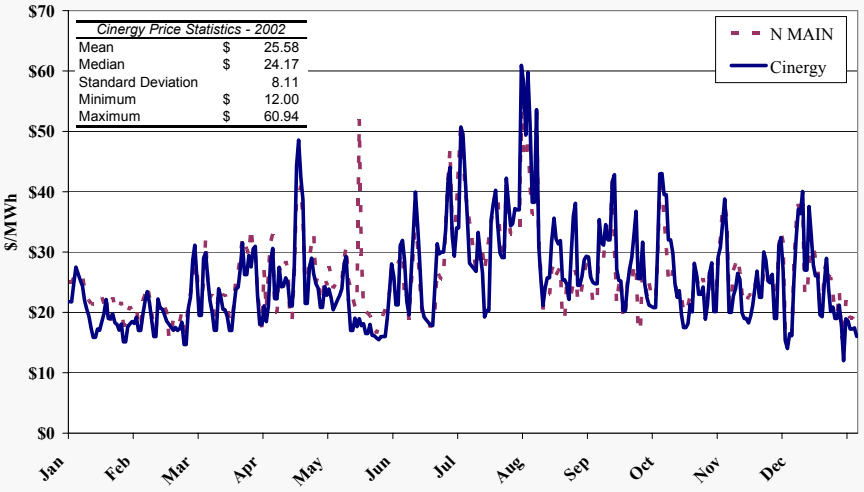
Cinergy Day-Ahead Electricity Prices -- 2002



Daily Prices in 2002

- The following figure shows the daily average pries during peak hours at the Cinergy hub and the North MAIN point, corresponding to the WUMS area.
- The Cinergy hub is shown because it is the most liquid trading point in the Midwest.
- This figure includes the North MAIN pricing point because the constraints into the WUMS area are among the most frequently binding in the Midwest.
  - ✓ When these constraints are not binding, the prices outside and within WUMS should be highly correlated.
  - ✓ When these constraints are binding, the prices within WUMS should be higher than outside of WUMS.
- The figure shows that on only one day was the price in North MAIN significantly higher than at the Cinergy hub.
- However, prices are generally very similar, with the North MAIN price often lower than the Cinergy price.

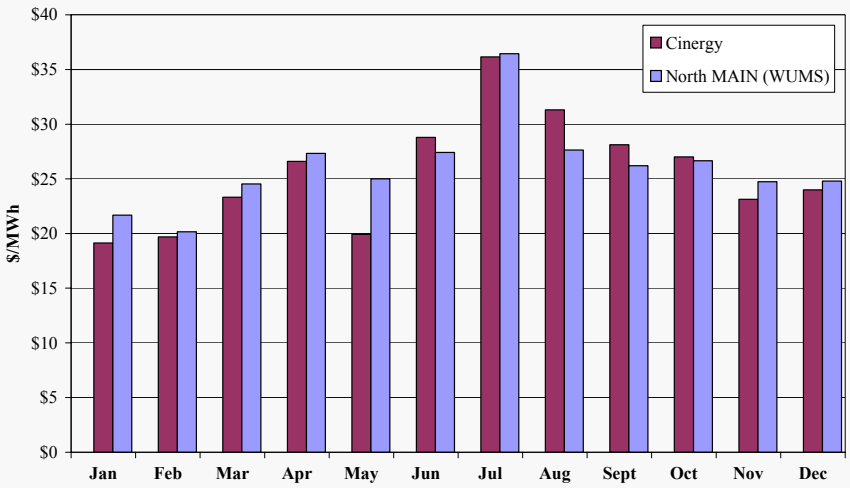
Daily Day-Ahead Electricity Peak Hour Prices
Cinergy and North MAIN -- 2002



Market Prices in 2002

- The prior figure shows that prices are generally very similar, with the North MAIN price often lower than the Cinergy price.
- This relationship can be better observed in the following figure showing the monthly average prices at the two points during peak hours.
- This figure shows that the monthly average price in North MAIN was slightly higher in most months, with the exception of the months from June to October.
- The relationship of these bilateral energy prices and transmission constraints is analyzed in more detail below.

Day-Ahead Energy Price During Peak Hours
Cinergy and North MAIN - 2002



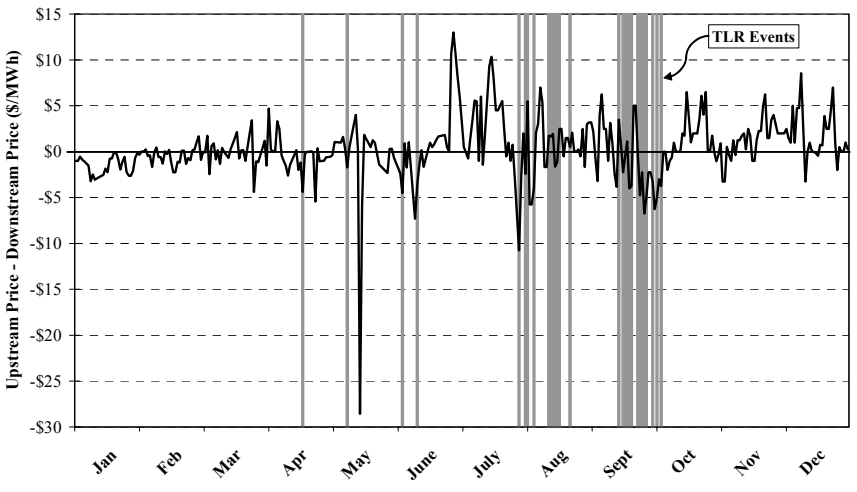
Relationship of Prices and Transmission Constraints

- The Midwest is implementing LMP spot markets that will efficiently dispatch supply to manage network constraints, setting efficient prices at each location on the network.
- Prices will equal the marginal system cost of serving an additional increment of demand at each location, given the supply offers and demand bids.
- When constraints are binding, preventing additional power from flowing into a constrained area, the prices in the constrained area ("downstream price") should rise relative to prices outside of the constrained area ("upstream price").
- The following analysis investigates whether these pricing relationships exist under the current bilateral markets in the Midwest.
- This analysis computes the differences between the upstream and downstream prices associated with a particular constraint.

Relationship of Prices and Transmission Constraints

- One of the most frequently binding constraints is associated with the Eau Claire-Arpin flowgate that interconnects Minnesota and Wisconsin.
- The following figure shows the daily price difference between the upstream (N. MAPP) and downstream (WUMS) market locations, indicating with shading when TLR events occurred.
- Consistent with the discussion above, the upstream – downstream price difference should be negative when the flowgate constraint is binding.
- The figure shows that some of the negative price differences coincide with the TLR events called on the flowgate.
- Although the figure may be useful in observing the relationship of the upstream-downstream price relationships during TLRs, econometric methods provide a more reliable means to draw conclusions.

Relationship of Upstream-Downstream Prices During TLR Events -- Eau Claire-Arpin Flowgate in 2002



Market Prices in 2002

- This report includes two econometric tests designed to determine the relationship between the current bilateral prices and transmission constraints.
- The first analysis tests whether the mean upstream-downstream price is statistically different in days with TLR events versus all other days.
  - ✓ The analysis is conducted on a flowgate by flowgate basis.
  - ✓ This analyzes the peak prices for the day following the TLR event, which result from transactions initiated on day with the TLR event.
  - ✓ We performed the same analysis on the prices for the day with the TLR and the results were comparable.
- The results are presented in the following table, showing:
  - ✓ The number of days in each category (i.e., with TLRs vs. without TLRs);
  - ✓ The mean upstream-downstream price difference for each category, and the difference in these means;
  - ✓ The "p-value", which indicates the probability that the difference in means is statistically equal to zero.
  - ✓ Economists generally employ a 95% confidence interval to determine whether a result is statistically significant, corresponding to a p-value less than 0.05.

Effects of TLRs on Energy Prices

	Without TLR		With TLR		Difference	
Flowgate Name	**N**	**Mean**	**N**	**Mean**	**of Means**	**P-Value**
Eau Claire-Arpin 345 Kv	**299**	**$0.41**	**29**	**-$0.85**	**$1.27**	**0.052***
Paddock Xfmr 1 + Paddock-Rockdale	311	-$0.66	19	-$0.45	-$0.21	0.769
Albers-Paris138 For Wemp-Padock 345	317	-$0.65	13	-$0.67	$0.03	0.978
Kewaunee Xfmr+Kewaunee-N Appleton	295	-$0.72	35	$0.00	-$0.72	0.169
Lor5-Trk Riv5 161kv/Wempl-Paddock 345	**307**	**$0.81**	**23**	**-$1.56**	**$2.37**	**0.002***
Poweshiek-Reasnor 161 For Montezuma-Bondurant	300	-$0.72	7	-$1.06	$0.34	0.79
MHEX_N	319	$0.27	9	$1.45	-$1.19	0.291
MHEX_S	322	-$0.28	6	-$1.28	$0.99	0.599
MWSI	308	$0.38	20	-$0.89	$1.27	0.073

* Statistically significant at 95% level or better.

This table shows that the difference in the means in TLR hours vs. non-TLR hours is not statistically different from zero for most of the flowgates.

- Hence, no apparent relationship exists between the market prices and transmission congestion (as one would expect in a well-functioning market).
- The exceptions to these results are two flowgates shown in **bold** in the table, both of which exhibit the pricing relationships one would expect:
  - ✓ A negative mean exists on TLR days (prices higher in the downstream area), although the magnitude of these values is relatively small ($0.85 to $1.56 per MWh).
  - ✓ Positive difference in the means (prices in downstream markets exceed prices in upstream markets by more on the TLR days than non-TLR days).

Market Prices in 2002

- The second analysis examines whether the difference in the means increases or decreases significantly when a TLR is invoked.
  - ✓ This is done by determining whether the mean of the upstream-downstream price difference for the day following the TLR event (associated with transactions initiated on the day with the TLR event) is significantly different than the mean of the difference for the previous day.
  - ✓ The hypothesis in the case is that the upstream-downstream price difference should become more negative when the TLR occurs.
- The table below shows the regression results for this case by flowgate. This table shows:
  - ✓ The counts of days with and without TLRs in the analysis
  - ✓ The change in the upstream-downstream price difference from the current day to the following day; and
  - ✓ The p-value for the test, which will be less than 0.05 when the result is statistically significant at the 95 percent confidence level.
- Like the results of the first analysis, these results generally do not show a statistically significant relationship between the upstream-downstream price differences on the two days.

Effects of TLRs on Energy Prices

Flowgate	Est. Change ($/MWh)	P-value
Eau Claire-Arpin 345 Kv	-1.25	0.061
Paddock Xfmr 1 + Paddock-Rockdale	-0.08	0.918
Albers-Paris138 For Wemp-Padock 345	0.06	0.946
Kewaunee Xfmr+Kewaunee-N Appleton	-0.38	0.522
Lor5-Trk Riv5 161kv/Wempl-Paddock 345kv	0.47	0.584
Poweshiek-Reasnor 161 For Montezuma-Bondurant 345	-0.75	0.457
MHEX_N	-0.91	0.434
MHEX_S	0.84	0.676
MWSI	-0.15	0.835

Market Prices in 2002

- Taken together, these results indicate that the daily bilateral prices in the Midwest do not generally reveal the presence of transmission congestion.
  - ✓ Hence, the bilateral market prices do not provide transparent and accurate price signals for participants in the Midwest market.
- These conclusions must be tempered by the fact that the prices are daily prices, rather than intraday hourly prices which may provide more accurate price signals.
- In addition, the prices are developed through a survey process that may not be accurate.
  - ✓ For example, we perform many of our market monitoring tasks using both Megawatt Daily price data and similar price data from IO Energy.
  - ✓ Although these sources produce prices for the same locations using very similar methods, their prices differed on a monthly average basis during 2002 by as much as 11%.
- Nonetheless, this analysis indicates that the LMP markets to be implemented by the Midwest ISO should substantially improve the accuracy of prices at various locations throughout the region.

Assessment of Transmission Utilization in 2002

Introduction to Transmission Utilization Section

- This section of the report summarizes and evaluates the operation of the transmission system from the perspective the wholesale market.
- This section addresses the:
  - ✓ Disposition of transmission reservation requests;
  - ✓ Frequency of and justification for TLRs invoked to reduce the flow on the Midwest ISO's flowgates;
  - ✓ Efficiency of the TLR process for managing congestion relative to the economic dispatch process that underlies the Midwest ISO's Day 2 markets; and
  - ✓ Estimated available flowgate capability.

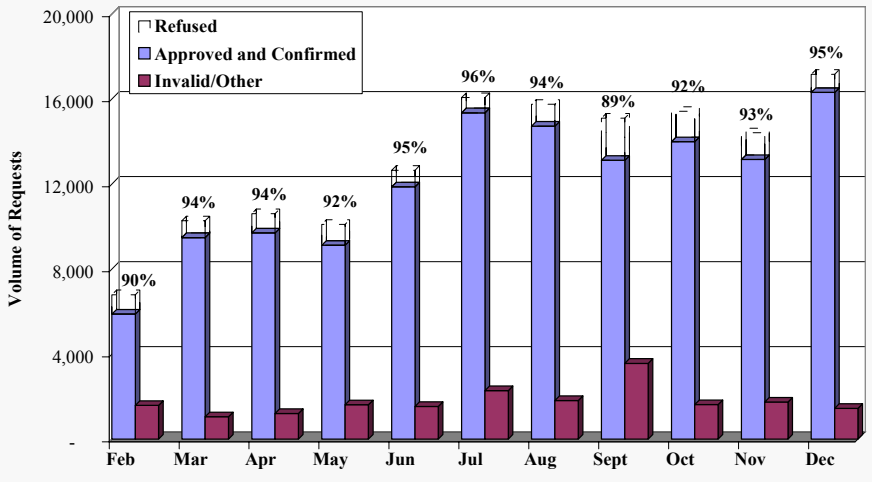
Summary of the Disposition of Transmission Reservation Requests

- The first figure shows the disposition of requests for transmission reservations from February to December 2002.
- The vast majority of transmission requests ultimately fall in one of two categories:
  - ✓ Approved and confirmed; or
  - ✓ Refused – generally due to a lack of available transmission capability.
- Other categories include: invalid, denied, annulled, and withdrawn.
  - ✓ These requests ultimately do not result in a transmission reservation due to the participant's action or the validity of the request.
  - ✓ These categories are grouped and shown as "other" on the following figure.
- Some requests must be studied before a request can be approved or refused. Because this is an interim designation, the figure does not include this category.

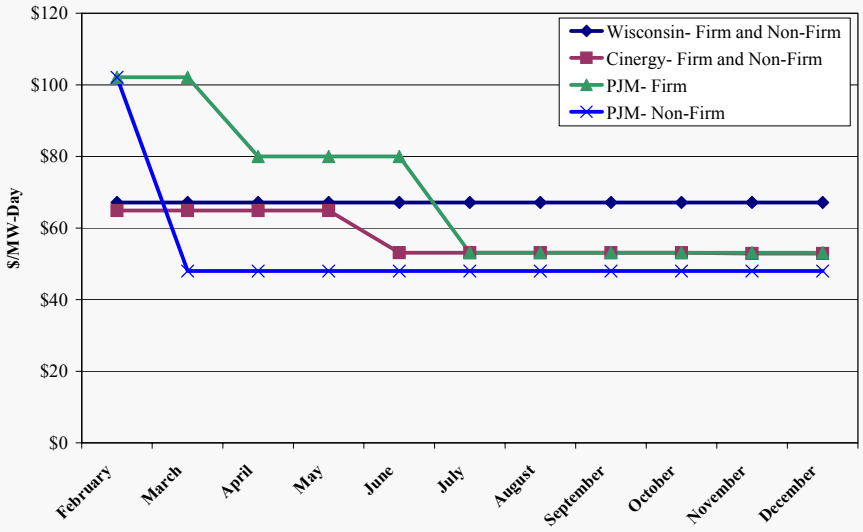
Summary of the Disposition of Transmission Reservation Requests

- The figure shows that:
  - ✓ The volume of approved requests increased substantially – more than doubling from February to December;
  - ✓ The Midwest ISO approved a high proportion of the requests made, ranging from 89 percent to 96 percent on a monthly basis during 2002; and
  - ✓ The "other" category remained at modest levels throughout the year, with a increased quantity shown in September 2002. This increase was caused by a data entry error rather than an increase in real requests in this category.
- The increase in approved reservation requests was caused primarily by two factors:
  - ✓ The increasing discounts offered by the Midwest ISO for non-firm transmission service through the year; and
  - ✓ Improved modeling of available flowgate capability ("AFC").
- After the following figure showing the summary of requests the next figure shows the trends in transmission rates that have contributed to the increase in reservations.

Disposition of Reservation Requests in 2002



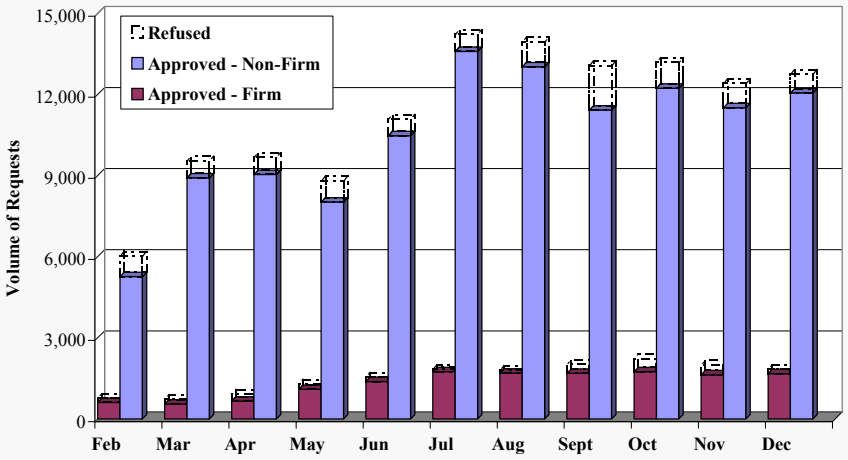
Summary of Transmission Rates During 2002
Daily Firm and Non-Firm Peak Service



Firm and Non-Firm Transmission
Reservation Requests

- These patterns can be better understood by examining the approved transactions by type of service.
- The following figure shows the quantities of non-firm and firm transmission requests by month in 2002.
- This figure shows that the quantities of firm and non-firm transmission requests rose significantly over the year.
  - ✓ Non-firm requests increased by 141 percent from February to December.
  - ✓ Firm requests increased by 112 percent.
  - ✓ The percentages do not include the “other” category shown on the prior figure.
- Approved requests increased more sharply than the total requests because the portion of the requests approved increased for both firm and non-firm service.
  - ✓ Approved non-firm requests increased by 173 percent.
  - ✓ Approved firm requests increased by 129 percent.

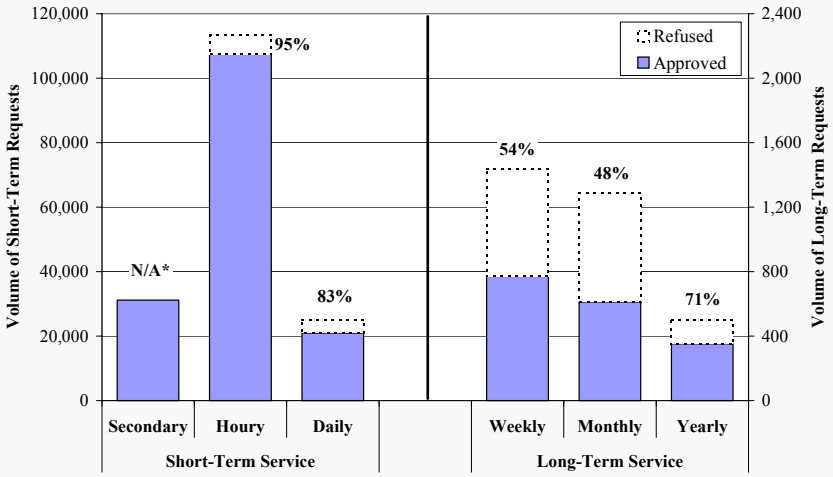
Firm and Non-Firm Reservation Requests



Short and Long-Term Transmission Reservation Requests

- In addition to the firm and non-firm distinction, it is useful to examine the requests by term of service.
- The following figure shows the quantities approved and refused by duration of service, grouping the requests by:
  - ✓ Short-term service (secondary non-firm, hourly, daily); and
  - ✓ Long-term (weekly, monthly, yearly).
- The short-term and non-firm requests should generally exhibit a higher approval rate because (i) there is less uncertainty regarding availability of transmission capability in the short-term, and (ii) the service is less of a obligation on the system.
  - ✓ For example, the Midwest ISO must have the ability to deliver power under all conditions over a year to approve yearly firm service.
  - ✓ Alternatively, hourly non-firm service must only be deliverable in the next hour and, if necessary, it can be curtailed.
- The results shown in the following figure are consistent with these expectations.

Short and Long-Term Reservation Requests



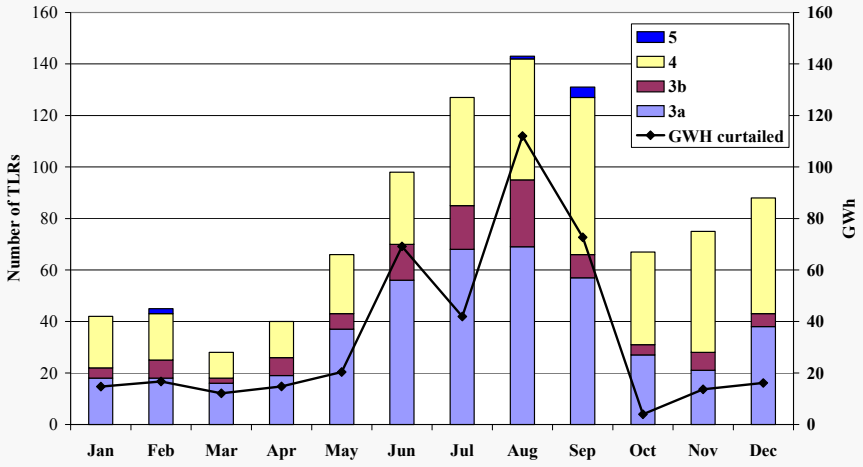
* Secondary non-firm service are schedules between secondary receipt or delivery points that are made under a firm reservation. These schedules are non-firm in priority and refusals of these schedules are not contained in the OASIS data (since they are not a request for new service). Therefore, no approval share is computed.

TLR Events and Curtailments in 2002

- The next figure shows the number of TLRs by level that occurred in each month and the quantity of transactions curtailed by the TLRs.
- The TLR levels shown include:
  - ✓ Level 3 – non-firm curtailments.
  - ✓ Level 4 – commitment or redispatch of specific resources, or other operating procedures to manage specific constraints.
  - ✓ Level 5 – curtailment of firm transactions.
- The TLRs called on Midwest ISO flowgates (level 3 and above) account for 64 percent of all TLRs called in the eastern interconnect.
  - ✓ Much of the eastern interconnect is operated under LMP or other central markets that redispatch generation rather than utilizing TLRs to manage congestion.
  - ✓ To maximize the utilization of the system, the Midwest ISO will approve non-firm reservations that are later curtailed in favor of a firm reservation and schedule.
- The figure shows that the curtailment quantities have increased as the number of TLR events has increased, with the highest frequency of TLRs and curtailments occurring during the summer months.

TLR Events and Transactions Curtailed in 2002

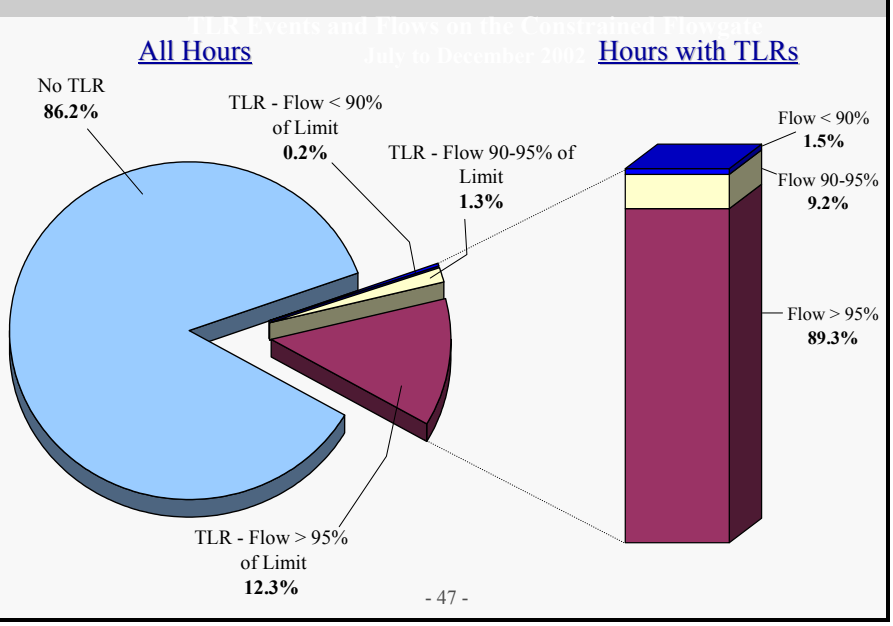
TLR Events and Transactions Curtailed
2002



TLR Events and Curtailments in 2002

- The analysis in this section evaluates Midwest ISO's TLR calls in 2002 and assesses the efficiency of the TLR process.
- To evaluate the TLR calls by the Midwest ISO in 2002, we examined the flows on each of the flowgates in the Midwest in hours when TLRs were called.
- Data on the electrical flows over the Midwest ISO flowgates were only available for the period from July to December in 2002 so the following analyses address only this period.
- The following figure shows that 86 percent of the intervals in this period had no TLRs while 14 percent had one or more TLRs.
  - ✓ TLRs should only be called when the flows on a flowgate approach the limit to which the Midwest ISO operators manage the system.
  - ✓ The pie chart shows that in only 1.5 percent of the hours was a TLR called when the flows on the relevant flowgate were less than 95 percent of its limit.
  - ✓ Likewise, the stacked bar in the figure shows that the flows were over 95 percent of the flowgate's limit in almost 90 percent of the hours that TLRs were invoked by the Midwest ISO.

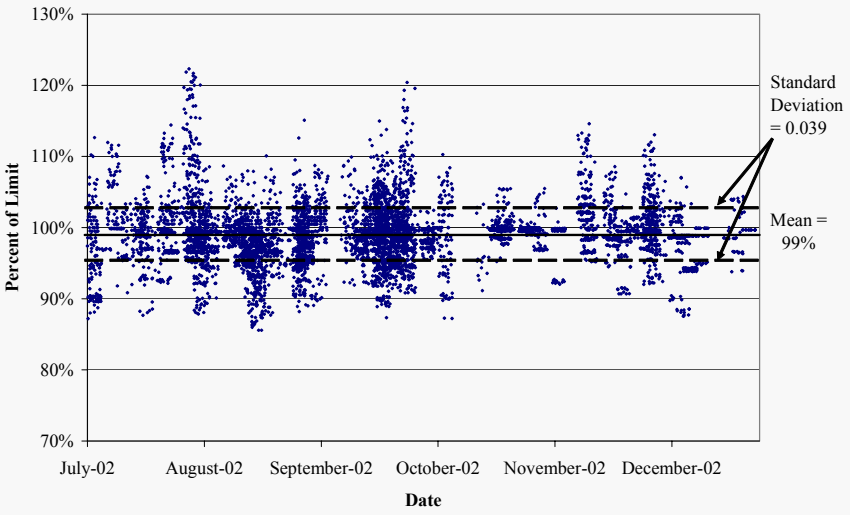
TLR Events and Flows on the Constrained Flowgate July to December 2002



TLR Events and Curtailments in 2002

- These patterns are shown in more detail in the following scatter plot that depicts the interval flow as a percent of the flowgate limit during all TLR events.
- The figure shows that the mean flow is 99 percent of the flowgate limit during TLR events and that most of the observations are within 5 percent of the mean.
- Although the frequency of TLRs in the Midwest ISO region is relatively high, this analysis concludes that TLRs are generally invoked only when justified based on the actual power flows over the flowgate.
- With regard to the relatively small quantity of TLRs that occurs when the power flow over the relevant flowgate is less than 90 percent of the limit:
  - ✓ Some of these flows relate to TLR level 4 events where a generating unit may be brought on to relieve a constraint, which can reduce the flow to less than 90 percent. The TLR will remain in effect until the generator is no longer needed.
  - ✓ In addition, the actual relief acquired from the TLR can be quite variable.
    - – The relief assumed when curtailments are made is based on control area to control area shift factors.
    - – However, the actual relief provided by the curtailment can be considerably higher or lower than the assumed relief.
    - – The actual relief is determined by the specific location of the generator and load (or replacement generator).

TLR Events and Flows on the Constrained Flowgate July to December 2002



TLR Events and Curtailments in 2002

- Complementing the prior analysis of TLR calls by the Midwest ISO, we also sought to identify any cases where the MISO was slow in invoking a TLR, allowing the flow to rise above the flowgate limit.
- To do this we identified every interval on every flowgate where the flow was greater than 100 percent of the limit and no TLR was invoked.
- This analysis showed that it was extremely rare for flow to be greater than 100 percent without the Midwest ISO invoking the TLR procedures:
  - ✓ The average frequency over all the flowgates was less than 0.02 percent of the intervals (approximately 1 hour) from July to December 2002.
  - ✓ The highest frequency on any flowgate was 0.62 percent.
- Taken together with the prior analysis, this analysis supports the conclusion that the Midwest ISO's operators invoked TLRs in a consistent and justified manner.

Analysis of TLR Efficiency

- Although the Midwest ISO has implemented TLRs justifiably, the TLR procedures are not an efficient means to manage congestion.
- The analysis in this section examines the effectiveness of the TLR procedures by comparing its results to an economic dispatch of generation to manage the same congestion.
- The following analysis examines all TLR events by flowgate to determine the quantity of redispatch that would have been necessary to achieve the same relief that the TLRs provided. We examine two scenarios:
  - ✓ Minimum redispatch: most effective generating units at relieving flow on the flowgate are used (based on the generation shift factors), regardless of their cost.
  - ✓ Economic redispatch: cost data is used to choose the most economic alternative for relieving the flow on the flowgate.
  - ✓ The latter scenario requires a higher quantity of redispatch because a generator with a smaller impact on the flowgate may be redispatched if it is less costly.

Analysis of TLR Efficiency

- The statistic calculated for this evaluation is a "redispatch ratio", which is calculated by dividing the redispatch quantity by the TLR curtailment.
  - ✓ Hence, a redispatch ratio of 50 percent indicates that the same flowgate relief could have been provided by redispatching a quantity of generation equal to one half of the quantity of transactions curtailed by TLR.
- The results of this analysis are presented in the following table, showing:
  - ✓ The average redispatch ratio (weighted by TLR curtailment quantities) in the minimum redispatch scenario was 30 percent.
  - ✓ The average redispatch ratio in the economic redispatch scenario was 38 percent.
  - ✓ The redispatch ratio in the minimum redispatch scenario ranged from 22 percent to 90 percent, with the flowgates with the most TLRs at 22 and 27 percent.
  - ✓ The redispatch ratio in the economic redispatch scenario ranged from 24 percent to 92 percent, with the flowgates with the most TLRs at 31 and 39 percent.
- These results indicate that the Day 2 LMP markets that will be implemented by the Midwest ISO promises to substantially improve the efficiency with which congestion is managed in the Midwest.

Redispatch Ratio by Flowgate for TLR Events July to December 2002

Flow Gate	TLR Events	Relief Provided (MW)	Curtailed Amount (MW)	Minimum Redispatch Redispatch Amount (MW)	Minimum Redispatch Redispatch Ratio	Economic Redispatch Redispatch Amount (MW)	Economic Redispatch Redispatch Ratio
Northside-Clifty Creek 138 (Flo) Trimble	6	10	161	128	80%	146	92%
Eau Claire-Arpin 345 Kv	25	51	368	107	27%	120	31%
Paddock Xfmr 1 + Paddock-Rockdale	16	27	189	59	31%	63	33%
Russel-Rockdale 138/Paddock-Rockdale 345	5	23	221	56	27%	58	28%
Albers-Paris138 For Wemp-Padock 345	10	16	184	158	74%	163	76%
Poweshiek-Reasnor 161 For Montezuma-Bond	8	9	133	41	32%	71	56%
Lor5-Trk Riv5 161kv/Wempl-Paddock 345kv	21	21	217	48	22%	92	39%
Salem 345/138 Quad Cities-Sub 39	7	20	344	77	22%	87	24%
MWSI	17	102	477	157	30%	195	39%
N.Platte-Stvl /Gentl-Redwil	3	38	387	354	90%	354	90%
Quad City West 345kv	2	26	316	114	35%	155	48%
Sub 92-Hills Flo Sub93-Subt	1	53	630	156	25%	164	27%
Arnold - Tiffin 345kv line	2	52	447	183	38%	225	47%
Weighted Average Redispatch Ratio					**30%**		**38%**

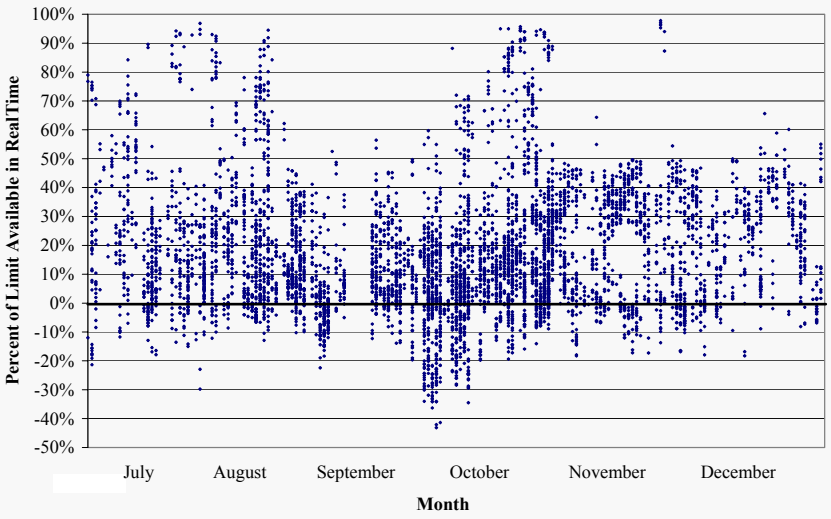
AFC Issues and Analysis

- MISO calculates available flowgate capability (AFC) for firm and non-firm transmission service of various durations (hourly, daily, weekly, monthly, yearly).
- The AFC calculations involve a complicated process including:
  - ✓ Multiple models addressing different time horizons; and
  - ✓ Forecasted generation, load, transmission schedules, and loop flows from other systems.
- MISO has spent considerable resources improving the AFC calculations by improving the quality and completeness of the data and models, including:
  - ✓ Generation outages and expected production;
  - ✓ Forecasted magnitude and location of load;
  - ✓ Transmission facility ratings and outages; and
  - ✓ Topology of the network and definition of flowgates.
- Much of this data are provided by members.

AFC Issues and Analysis

- To assess the accuracy of the AFC values, we have conducted an analysis of the AFC relative to the un-utilized physical capability of the flowgates.
  - ✓ The analysis focuses on hours when MISO posted zero AFC for non-firm hourly PTP service on a flowgate. Only 32 of MISO's 400 flowgates had zero AFC posted in any hour during 2002.
  - ✓ Hours with zero AFC are studied because they affect power trading in the Midwest by (i) causing short-term reservation and scheduling requests to be refused, and (ii) signaling to participants that capability is unavailable.
- The AFC values will not match the unused physical flowgate capability because:
  - ✓ Transmission reservation margins (TRM) are subtracted from the AFC values;
  - ✓ The AFC values forecast loads, generation, and other factors that can vary significantly from actual realized values.
  - ✓ Longer-term AFCs are additionally affected by assumptions that most reservations will be fully scheduled between their primary points and that counter-flow reservations will not be scheduled (for firm AFC and 50% scheduled for non-firm AFC calculations).
- The following figure shows the percent of the flowgate capability available based on the real-time flows (accounting for TRM) in hours when a flowgate has a zero hourly non-firm AFC.

Percent of Flowgate Limit Physically Available in Real Time During Hours with Zero AFC



AFC Issues and Analysis

- This figure shows a wide variance in the physical capability available, net of TRM, when the AFC is zero.
  - ✓ Some of these AFC values are calculated by others (e.g., such as Xcel and the Southwest Power Pool) although the Midwest ISO will be assuming responsibility for some of these additional flowgates over time.
  - ✓ The effect of the zero AFC values in hours when physical capability is available is mitigated by the fact that the Midwest ISO will often approve hourly non-firm service in these hours.
- Nonetheless, it is important to continue to improve the AFC values and make them as accurate an indicator of available capability as possible.
- To this end, the Midwest ISO has completed a number of improvements to the AFC process since it began operation, including:
  - ✓ Enhancing the data processing and data validation tools used by MISO staff; and
  - ✓ Providing models, data, AFC reports and other information to reliability coordinators and Members to assist in validating AFC values and improving flowgate definitions.

AFC Improvements and Recommendations

- A number of additional projects are underway to improve the AFC values, including:
  - ✓ Enhancing the resolution of modeling tools including:
    - – Utilize a state-estimator to improve data on the status of the system and load levels.
    - – Creating the ability to vary key assumptions by flowgate and time period.
    - – Providing more detail in modeled topology using zones (underway).
  - ✓ Tracking of forecasted data versus actual results, and use of "score cards" by Members to identify needed improvements in the accuracy of the data.
  - ✓ The Midwest ISO will be coordinating the review of the score cards with the IMM.
- Based on this review, we recommend that the Midwest ISO:
  - ✓ Make maximum use of the state estimator results to correct inaccurate generator data from the Members and calibrate to real-time flows.
  - ✓ Evaluate whether penalties are warranted for persistent incomplete or unreliable data.

Pivotal Supplier Analysis

Pivotal Supplier Analysis -- Background

- The HHI statistics provide only a general indicator of market concentration.
  - ✓ HHIs are not a reliable indicator of potential market power concern in the Midwest ISO market area;
  - ✓ They do not recognize the critical role of transmission constraints in determining the extent of the geographic market or of demand levels;
- Most market power concerns (and the primary focus of the mitigation measures) are on the locational market power associated with network constraints that limit competition in a narrow area.
- For the reliability redispatch service that was proposed by the MISO during 2002, we conducted a preliminary analysis of potential locational market power in the Midwest market area.
- The objective of the analysis is to identify any suppliers that are "pivotal" for managing congestion on particular flowgates;
  - ✓ A pivotal supplier is a supplier whose resources must be used to prevent a flowgate from becoming overloaded.
  - ✓ We will be extending and updating this analysis prior to the implementation of the MISO markets as required by FERC.

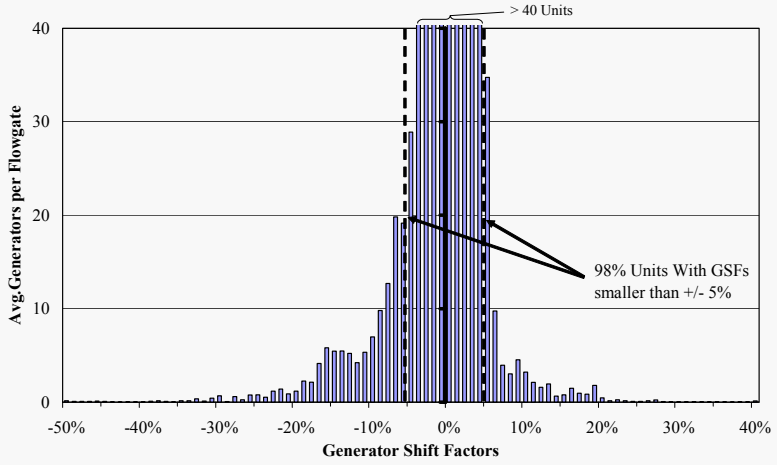
Pivotal Supplier Analysis

- The analysis was conducted on 41 flowgates likely to be the source of congestion, including those that:
  - ✓ had the highest frequency of Transmission Line Relief (TLR) events of Level 3 and above – the level at which transaction curtailments are initiated; and
  - ✓ are internal to the MISO and showed an AFC value less than 25 percent of the flowgates' rating for July 2002.
- Generation Shift Factors (GSFs) were estimated and used in the analysis. GSFs indicate the portion of each generator's output that will flow on each flowgate.
  - ✓ A positive GSF indicates that incremental production from the unit will increase the flow in the direction of the constraint.
  - ✓ A negative GSF indicates that incremental production from the unit will create flows in the opposite direction from the constraint (i.e., "counter-flow") that will relieve congestion on the flowgate by increasing production.
  - ✓ Likewise, a generator with a negative GSF may create congestion on the facility by reducing its output from expected levels.

Pivotal Supplier Analysis

- As one moves away from a given transmission facility, geographically and electrically, the GSFs decline rapidly.
- To illustrate the distribution of GSF factors, the following figure shows a histogram of GSF factors for all flowgates examined in the report.
  - ✓ This figure indicates that more than 98 percent of the units have GSF factors less than 0.05 and greater than -0.05.
  - ✓ This analysis indicates that, for most flowgates, the vast majority of units within the Midwest ISO region are electrically distant and, thus, have very little influence on the flow over the flowgate.
- For many flowgates, there are a limited number of generating units, sometimes owned by a single supplier, that can significantly increase or decrease the flowgate's loading by altering its output levels.
- Such suppliers are pivotal because the flowgate constraint cannot be satisfied or managed without the supplier's resources. Likewise, a pivotal supplier can often cause a constraint to bind that would not bind under normal operations.

Distribution of Generation Shift Factors
All Flowgates



Source: Midwest ISO July 2002 AFC Load Flow Case, Potomac Economics Analysis.

Pivotal Supplier Analysis -- Assumptions

- For purposes of the analysis, all online units with negative GSF values less than -0.03 were assumed to be available to change output levels.
- Because the analysis does not guarantee that supply will equal demand in total, units owned by rival suppliers with positive GSFs of less than 0.1 were restricted from reducing output to respond to the pivotal supplier.
- The analysis includes two scenarios relating to flowgate capability:
  - ✓ The first uses the firm AFC values to represent the residual physical capability of the flowgate.
  - ✓ The second uses non-firm AFC values.
  - ✓ In both cases, negative AFC values are set to zero.
  - ✓ These cases likely bound the amount of flowgate capability that would be unused after a typical dispatch under the Day 2 LMP markets.
- The results of the analysis are shown in the following table.

Pivotal Supplier Analysis Results by Flowgate

Flowgate	Firm AFC Case			Non-Firm AFC Case		
	Pivotal Suppliers	Min Portfolio Percent	Max Portfolio Percent	Pivotal Suppliers	Min Portfolio Percent	Max Portfolio Percent
COLUMBIA_PORTAGE138CKT1_FOR_COLUMBIA_PORTAGCKT2	5	0.0%	4.1%	0		
WHITINGAVE_HOOVER_FOR_NAPPLETON_ROCKYRUN	2	0.2%	4.2%	0		
CEDAR_NATIONAL_FOR_CEDAR_TILDEN	2	0.3%	1.1%	2	0.3%	1.1%
POWESHIEK_REASNOR_161_FOR_MONTEZUMA_BONDURANT34	2	0.6%	1.1%	0		
ADAM_HAZLTON	2	1.3%	27.6%	2	1.3%	27.6%
LAKEHEAD_HIAWATHA138_UP	1	1.4%	1.4%	1	1.4%	1.4%
WHITEWATER_MUKWONAGO_FOR_COLUMBIA_SFONDDULAC	1	1.5%	1.5%	1	14.1%	14.1%
SALEM_345_138_QUAD_CITIES_SUB_39_	1	1.6%	1.6%	0		
ROCKYRUN_WHITINGAVE_FOR_ROCKYRUN_NAPPLETON345	1	1.6%	1.6%	0		
8TH_STREET_LORE161KV	3	1.7%	21.6%	1	8.2%	8.2%
CASSVL_NED_161_FOR_WEMP_PADDOCK_345	1	3.0%	3.0%	1	22.4%	22.4%
MANIPMDOLSWS	1	3.0%	3.0%	1	6.6%	6.6%
LOR5_TRK_RIV5_161KV_WEMPL_PADDOCK_345KV	2	3.7%	11.3%	1	36.4%	36.4%
OTDF_ALBERS_PARIS138_FOR_WEMP_PAD345	1	4.1%	4.1%	1	13.4%	13.4%
PADDOCK_XFMR_1_PADDOCK_ROCKDALE	2	4.5%	11.1%	2	22.6%	37.5%
FTSXFRFTSXFR	3	5.0%	10.0%	1	59.1%	59.1%
NAPPLETON345XFMR2_FOR_NAPPLETON345XFMR1	2	5.3%	17.5%	2	5.3%	17.5%
NAPPLETON345XFMR2_FOR_NAPPLETON345XFMR3	2	5.3%	17.5%	2	5.3%	17.5%
NAPPLETON345XFMR1_FOR_NAPPLETON345XFMR2	2	5.4%	17.4%	2	5.4%	17.4%
NAPPLETON345XFMR3_FOR_NAPPLETON345XFMR2	2	5.4%	17.3%	2	5.4%	17.3%
KEWAUNEE_XFMR_KEWAUNEE_N_APPLETON	2	6.3%	8.6%	2	8.8%	10.8%
RUSSEL_ROCKDALE_138_PADDOCK_ROCKDALE_345	1	10.4%	10.4%	0		
NAPPLETON_LOSTDAUPHIN_FOR_EASTKROUK_KEWAUNEE	1	12.6%	12.6%	1	16.1%	16.1%

Source: Midwest ISO July 2002 AFC Load Flow Case, Potomac Economics Analysis.

Pivotal Supplier Analysis

- The table shows how many pivotal suppliers are identified for each flowgate, including only those flowgates with one or more pivotal suppliers identified in the firm or non-firm scenarios,.
  - ✓ In the firm AFC scenario, the table shows 42 pivotal suppliers on 23 flowgates of the 41 total flowgates evaluated.
  - ✓ In the non-firm scenario, 25 pivotal suppliers were identified on 17 flowgates.
- The table also shows the maximum and minimum portfolio percentages associated with the pivotal suppliers.
  - ✓ This is computed by dividing the quantity of resources (MW) that must be manipulated to cause the flowgate to be binding by the supplier's total capacity.
  - ✓ This calculation is by supplier, so the maximum and minimum percentages will only be different when more than one supplier is identified as pivotal.
  - ✓ This portfolio percentage estimate is important because it helps determine whether the pivotal supplier would have an incentive to manipulate the necessary quantity of capacity to cause the constraints to be binding.

Pivotal Supplier Analysis

- If one were to exclude those pivotal suppliers that must manipulate more than 20 percent of their portfolio, the non-firm scenario would still include 20 pivotal suppliers on 13 flowgates.
- The results of the pivotal supplier analysis are conservative in identifying locational market power.
  - ✓ First, a supplier is only pivotal if the constraint cannot be resolved with others' generation with GSFs greater than 3%.
  - ✓ However, large disparities in GSF factors can allow a supplier to raise its prices substantially even when they are not technically pivotal.
- Hence, network constraints in some locations can create substantial market power concerns.
- These concerns are addressed by the proposed market power mitigation measures that have been conditionally approved by the FERC.
- A similar analysis will be conducted prior to the implementation of the Day 2 markets to define narrow constrained areas ("NCAs") for purposes of the mitigation.

Market Developments

Key Market Developments

- February 2002: the Midwest ISO introduced a regional open-access tariff that eliminates rate pancaking within the MISO.
- Steps were taken during 2002 to complete the MISO/SPP merger, but the merger was suspended indefinitely in March 2003.
- In December 2002, the Midwest ISO filed with FERC a request for declaratory order on overall market design for "Day 2".
  - ✓ FERC issued declaratory order in February 2002 largely approving the Midwest ISO direction on market design.
- A market power mitigation plan was filed at FERC in December 2002.
  - ✓ FERC conditionally approved the mitigation plan in March 2003 and gave final approval to the previously filed market monitoring plan.
- The former Alliance RTO companies announced intentions to join RTOs:
  - ✓ American Electric Power, Dayton Power and Light, and Commonwealth Edison selected PJM.
  - ✓ Ameren, Illinois Power, First Energy, and Northern Indiana Public Service selected the Midwest ISO.

Status of the Day 2 Market Rules

- The Day 2 market rules are being completed during 2003 and the opening of the Day 2 markets is scheduled for March 31, 2004.
- The Midwest ISO will facilitate a spot energy market designed to manage the congestion on the system and to set accurate market prices at each location.
  - ✓ Prices will reflect the marginal system cost of meeting an increment of load at each network location, including congestion and marginal losses;
  - ✓ This pricing is referred to as locational marginal pricing or LMP.
- The energy markets will include a multisettlement system, consisting of a voluntary day-ahead market and a real-time market.
  - ✓ In the day-ahead market, participants without physical load to serve may submit "virtual" bids to buy power in the day-ahead market to sell back in the real-time market. Likewise, participants may make virtual sales in the day-ahead market.
- Firm Transmission Rights (FTRs) will be allocated to firm customers.
  - ✓ FTRs entitle the holder to the congestion revenue collected between defined locations, allowing customers to hedge congestion costs.
- The Midwest ISO markets will accommodate bilateral forward contracts.
- Ancillary services will be scheduled by each control area – markets in ancillary services will be developed subsequently.

Market Design Issues and Developments

- The preliminary market rules provide a solid foundation for efficient Day 2 electricity markets, but work continues in a number of key areas:
  - ✓ Resource adequacy provisions/market and a safety-net bid cap as proposed in FERC's standard market design (SMD) notice of proposed rulemaking.
  - ✓ Real-time pricing provisions to set energy prices efficiently when the market is in shortage conditions (when resources are insufficient to simultaneously meet both energy and ancillary services requirements);
  - ✓ Real-time pricing provisions to set energy prices efficiently when gas turbines, external contracts, or other resources with limited flexibility are the marginal source of supply.
- Shortages occur in very limited number of hours each year, but prices in these hours are critical in sending economic signals to:
  - ✓ Resources in other regions that could enter in response to the shortage;
  - ✓ Peaking generation or demand response resources whose primary value is to be available during these conditions; and
  - ✓ In the long term, to existing and new generation or demand-response resources needed to serve the region.

The Relationship of Reserves and Energy

- To ensure efficient prices during shortages, the market rules should better reflect the economic relationship between reserves and energy.
  - ✓ Resources must be allocated between reserves and energy.
  - ✓ Reserves are *requirements* – The market model will dispatch available resources up to the safety-net bid cap before voluntarily releasing the reserves.
  - ✓ Hence, reserves are implicitly valued at safety-net bid cap under the Day 2 markets (and in the currently operating LMP markets and FERC's SMD).
- In shortage conditions, the energy demand can only be satisfied by dispatching the reserves – 2 ways to think about this:
  - ✓ The market is no longer clearing.
  - ✓ The reserves are the marginal source of supply for the energy market – as the load rises, the ISO will dispatch more reserves.
- We have proposed pricing provisions to ensure shortages are accurately reflected in energy prices.

Shortage Pricing Recommendations

- Our shortage pricing proposal includes the following components:
  - ✓ When energy is produced from reserve resources in shortage conditions, the reserve resource should set the energy price at the safety-net bid cap in the reserve-deficient area.
  - ✓ Suppliers providing reserves when the system is in shortage would be paid a lost opportunity cost payment equal to the difference between the energy price and their energy offer.
  - ✓ Shortage conditions should be defined so as not to include transitory responses to system contingencies.
- This proposal was provided to the operating reserves task force in October 2002.
- The Midwest ISO staff is currently developing provisions to address shortage pricing in its stakeholder working groups.
- When reserve markets are introduced, a reserve demand curve would provide a superior means to ensure that the energy and reserve prices are set efficiently under shortage conditions.

Assessment of Market Configuration and Coordination

Background

- MISO will be implementing markets over an extremely broad area including substantial portions of MAPP, MAIN, and ECAR;
- Given the RTO elections of the transmission owners in the Midwest, there will be significant electrical interactions between the MISO and adjacent markets;
- These interactions raise the potential for significant seams issues;
- To address these issues, the MISO agreed with PJM and SPP to collaboratively develop a Joint and Common Market ("JCM"). This initiative in intended to:
  - ✓ Address potential economic and reliability issues related to the seams between the MISO and adjacent markets; and
  - ✓ Make it easier to transact between the markets throughout the Midwest.

Joint and Common Market

- These issues are particularly important in the Midwest given the configuration of the MISO/PJM systems.
- Hence, this section will critically evaluate the status and plans for the JCM;
- This evaluation addresses only the coordination provisions directly affecting the efficiency of the Midwest markets. It does not address the one-stop shopping or customer interfaces being developed as part of the JCM;
- This evaluation will include:
  - ✓ An analysis of the electrical interdependence of the two systems;
  - ✓ A discussion of the economic efficiency and potential gaming issues that should be addressed by the JCM proposals;
  - ✓ An assessment of the current state of the proposals; and
  - ✓ Our recommendations for improvements to the JCM framework.

RTO Configuration Analysis

- Potomac Economics conducted an analysis of the configuration of electrical facilities last fall when the Alliance companies proposed their RTO elections;
  - ✓ At that time, AEP, Commonwealth Edison, Dayton Power & Light, and Illinois Power announced their intention to join PJM;
  - ✓ FirstEnergy, Ameren, and NIPSco elected to join the MISO;
  - ✓ Illinois Power has since decided to join MISO;
- These elections created a potentially irregular seam between MISO and PJM;
- The following analysis was first performed to inform the FERC decision to approve these elections.
  - ✓ This analysis was contained in a letter to James Torgerson dated July 10, 2002.
  - ✓ FERC approved the elections with specific requirements on the development of the JCM to address reliability and efficiency concerns.
  - ✓ The analysis shown in this report has been updated to reflect changes in the MISO's configuration, including the dissolution of the MISO-SPP merger.

RTO Configuration Analysis

- It is an inherent property of electric networks that power injected at one point and withdrawn at another will flow over all interconnected lines and facilities.
  - ✓ The flows that occur on others' facilities is generally referred to as "loop flow".
  - ✓ Loop flow is less on longer distance (more circuitous) paths and lower voltage facilities, and higher on more direct paths and higher voltage facilities.
- Ideally, RTOs should be configured such that the generation in each RTO area has only minimal impacts on adjacent RTO areas:
  - This is achieved when loop flows do not contribute to congestion in other areas.
  - I will refer to this as the systems having a low degree of electrical interaction.
- RTOs with high degrees of electrical interaction may inefficiently dispatch generation by ignoring relevant constraints on each others' systems.
- The configuration analysis described below addresses this issue.

RTO Configuration Analysis

- The analysis was focused on selected flowgates located throughout the MISO and PJM areas in the Midwest that have historically been the source of congestion.
  - ✓ The study was not intended to be a comprehensive assessment of all the flowgates.
  - ✓ Approximately 70 flowgates throughout the region were studied.
- Generation shift factors ("GSF") were estimated for each generator that indicate the portion of flow that occurs on each flowgate when the resource is dispatched.
- Using the GSFs, we identified the share of generation resources that would be located within the MISO and PJM that have significant impacts on each of the flowgates studied.
- The following table summarizes the analysis for those flowgates that indicated relatively high degrees of electrical interaction.

Flowgate Impacts for Generation in PJM and MISO

Flowgate Name	RTO Area	Control Area	MISO %	PJM %	SPP %
Bay_Sh_345_Mon12_345_1	MISO	FE, DECO	96%	4%	0%
Bland_Franks_345_KV	MISO	AMRN,AECI	25%	0%	75%
Breed_Casey_345_KV	MISO	AEP,AMRN	49%	11%	40%
Mntzuma	MISO	MEC	59%	3%	39%
Paddock_Xfmr_1_Paddock_Rockdale	MISO	ALTE	59%	41%	0%
Rush_Island_St_Francois_345_KV	MISO	AMRN	77%	0%	23%
Rush_St_Francois_Blands_Franks	MISO	AMRN	78%	0%	22%
Coffn_Roxfd_Ip_For_Newtn_Mt_Vrnon	MISO	IP,AMRN	36%	4%	61%
Sidney_Xfmr_Bunsonville_XFMR	MISO	IP	76%	24%	0%
Quad_Cities_Rock_Creek_345	MISO-PJM	ALTW, CE	55%	19%	25%
Bentnhrbr-Palisades345/Twinbranch-Argenta	MISO-PJM	MECS AEP	91%	9%	0%
State Line To Wolf Lake 138	MISO-PJM	CE,NIPS	76%	24%	0%
Sugrck_345_Foster_345_1	MISO-PJM	DPL,CIN	86%	14%	0%
S Canto_Star_	MISO-PJM	AEP,FE	84%	16%	0%
Bunsonville_Eugene_Breed_Casey	MISO-PJM	IP,AEP	95%	5%	0%
Cook_345_Benton_345_1	PJM	AEP	90%	10%	0%
Dumont_765_Dumteq_999_1	PJM	AEP	79%	21%	0%
Kyger_Sporn345_For_Amos_765_345XFMR	PJM	AEP,OVEC	39%	61%	0%
Olive_345_138XFMR	PJM	AEP	84%	16%	0%
Plano-Electric Junction 345 Kv	PJM	CE	48%	52%	0%

Results of the Configuration Analysis

- This table shows that there are a number of flowgates within the expanded MISO and PJM areas that are substantially impacted by generation in other RTOs. For example:
  - ✓ 90% of the generation affecting the Cook 345 – Benton 345 flowgate on the AEP system would be dispatched by MISO.
  - ✓ 41 % of generation affecting the Paddock Transformer flowgate on the Alliant East system in MISO would be dispatched by PJM.
  - ✓ 75% of the of generation affecting the Bland – Franks 345 flowgate on the Ameren system in MISO would be dispatched by SPP.
- Overall, the analysis shows:
  - ✓ PJM would dispatch between 3 % and 41 % of the generating resources affecting the flow on 8 MISO flowgates;
  - ✓ SPP would dispatch between 22% and 75 % of the generating resources affecting the flow on 6 MISO flowgates; and
  - ✓ MISO would dispatch 39 % to 90 % of the generating resources affecting the flow on 5 PJM flowgates.
  - ✓ The 6 flowgates indicated as "MISO-PJM" are those that would represent the seams between the MISO and PJM. They generally are affected by generation in both RTOs, with the MISO generation having the largest effects.

Conclusions of the Configuration Analysis

- This analysis indicated that the configuration of the RTOs raises significant potential efficiency concerns.
  - ✓ These concerns arise because the dispatch decisions and market prices in one RTO area will not be efficient when the significant congestion is caused (or could be alleviate) by the operation of the adjacent RTO's system.
  - ✓ The JCM should develop procedures to coordinate between the RTOs and address this concern.
- The electrical configuration between the PJM and the MISO also raises substantial gaming concerns.
  - ✓ In a poorly configured RTO, a generation owner in one RTO can dispatch its units to cause congestion in a neighboring RTO.
  - ✓ Having dispatched its units to create this congestion, the supplier could then schedule transactions across the neighboring system that would apparently help relieve the congestion, and be compensated.
  - ✓ These concerns arise because the prices in the first RTO will not reflect the congestion occurring on the second RTO's system.

Market Interfaces

- The JCM work to resolve seams issues involves the development of a (i) market to non-market interface, and a (ii) market to market interface between the RTOs.
- The market to non-market interface involves developing rules and procedures that allow the use of line loading relief procedures.
  - ✓ These procedures cause the market area resources to be redispatched to reduce their impact on transmission facilities in adjacent areas;
  - ✓ The market to non-market interface will address the initial time frames when one area may have an LMP market operating and the adjacent area does not.
  - ✓ The procedures are being developed with NERC participation and could be used between MISO and other areas after MISO and PJM have operating markets;
- Market to market interface addresses a longer-run state when PJM and MISO are both operating LMP markets in the Midwest;
- Due to the timing of implementation of the markets in the Midwest, the market to non-market interface is likely the first interface to be needed, and has therefore been the focus of most of the JCM work by the RTOs.

Market to Non-Market Interface

- The proposal involves identifying flowgates that are likely to be affected by adjacent markets – e.g., PJM flowgates that are loaded by the MISO dispatch;
  - ✓ These flowgates will then be monitored by the RTO in modeling dispatch;
- Procedures are being developed to quantify the flow on the flowgate that is associated with native and network load ("NNL") versus the amount that results from the market's economic dispatch;
  - ✓ The economic dispatch quantities will be provided to the NERC IDC.
  - ✓ When the non-market area flowgate becomes constrained, the operator may call a TLR.
  - ✓ In response to the TLR, the market operator would redispatch to reduce the flow on the flowgate associated with the economic dispatch.
- This proposal should provide a workable system to allow the use of TLRs to manage loop flows created by the RTO market in adjacent non-market areas.

Recommendations: Market to Market Interface

- Develop expanded market models in each RTO area that would include an accurate representation of a portion of the adjacent RTO's system.
- Develop a communication interface that would provide from the adjacent RTO:
  - ✓ Active constraints and shadow prices; and/or
  - ✓ Locational prices at key network locations that would embody the constraints and relative value of energy in the two areas.
- This information would serve as an input to the next real-time dispatch by the MISO and would result in:
  - ✓ The redispatch of MISO generation to manage the active constraint on the adjacent system and cause the locational prices between the areas to converge.
  - ✓ Locational prices that fully reflect all active constraints, within the MISO and the adjacent market area.
  - ✓ Physical interchange determined through the coordinated dispatch process rather than by participant schedules – participant schedules would be financial.
- This approach would address the efficiency and gaming concerns by virtually eliminating the seam.

Recommendations: Market to Market Interface

- Because locational prices will be efficient, the RTOs should explore creating FTRs between markets.
  - ✓ The coordinated dispatch will result in congestion revenue being collected when the interfaces between the RTO areas are congested, which would fund the FTRs.
  - ✓ The FTRs would allow the participants to transact financially throughout the Midwest just as they can within the Midwest ISO.
- Coordination will also be required in the settlement process, including:
  - ✓ Settlement of the net interchange;
  - ✓ Allocation of the surplus congestion revenues or shortfalls at the interfaces between areas; and
  - ✓ Allocation of the seam FTRs (or the revenue from the auction of the FTRs).