MISO 2013 Annual Market Assessment Report

Information Delivery and Market Analysis

June 2014

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Table 1: Abbreviations

Abbreviations	Description
ARR	Auction Revenue Rights
BAAL	Balancing Authority Area Control Error Limit
BTMG	Behind The Meter Generation
CONE	Cost Of New Entry
CPS1	Control Performance Standard 1
DA	Day-Ahead
DIR	Dispatchable Intermittent Resources
DR	Demand Response
DRR	Demand Response Resource
LMR	Load Modifying Resource
MP	Market Participant
MPMA	Multiple Period Monthly Auction
NBT	Net Benefit Test
PRC	Planning Resource Credit
PRMR	Planning Reserve Margin Requirement
PVMWP	Price Volatility Make Whole Payment
PRA	Planning Reserve Auction
PRC	Planning Resource Credit
RSG	Revenue Sufficiency Guarantee
RSI	Residual Supply Index
RT	Real-Time
ZRC	Zonal Resource Credit

I. Disclaimer:

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II. Executive Summary

This review of MISO's market operations during the period of 2013 is the first MISO-authored annual market assessment. It provides year-over-year comparisons that highlight longer-term changes and trends.

- MISO operates energy, ancillary services, capacity and financial transmission rights (FTR) markets that facilitate market participant's electricity needs being met. During the majority of 2013, MISO's markets were operated within its "classic" footprint, which spans from Montana to Michigan and south to Kentucky and the Missouri-Arkansas border. MISO's market operations expanded to its new South Region in December, which extends the MISO footprint from Texas to Mississippi and south to the Gulf of Mexico.

- MISO's reliability, markets and operational functions performed well in 2013. The results of MISO's market competitiveness evaluation, which considers market share and supply concentration, indicates that MISO's markets functioned competitively during the year as well.

- Overall, MISO's energy and ancillary services markets worked efficiently in 2013.

    - The wholesale cost, which is made up of energy, ancillary services and uplift payments, and gives an indication of the overall cost to serve load in the MISO market averaged $32.90 per MWh. This was an 11.5% increase over the $29.52 per MWh cost in 2012, which was driven primarily by higher natural gas prices in 2013.

    - The average absolute hourly price difference between the Day-Ahead and Real-Time markets in 2013 remained consistent with 2012, which was significantly lower than the preceding years. This is indicative of continued good Day-Ahead market performance and efficiency.

    - Total uplift[1] payment was $164 Million and 18% higher than 2012, mainly impacted by a 44% increase in Revenue Sufficiency Guarantee (RSG) payment.

    - Real-Time RSG was $82 million for 2013 and substantially higher than 2012, mainly reflective of higher fuel prices and more Real-Time capacity commitments in 2013. Day-Ahead RSG payments rose by 16%, primarily due to the higher fuel prices and more Voltage and Local Reliability (VLR) commitments.

[1] Uplift includes Day-ahead and Real-Time Revenue Sufficiency Guarantee Make Whole Payment and Price Volatility Make Whole Payment.

- The marginal clearing prices for ancillary reserve products in 2013 were higher than 2012. Increased fuel costs and implementation of performance based regulation mileage contributed to the increased marginal clearing prices.

- Throughout the recent four years, many market development enhancements have been implemented and have brought incremental value to the market, either reducing overall production cost, improving operation reliability, producing more efficient market outcomes, or providing fair compensation for the services provided.
  - The implementation of Dispatchable Intermittent Resources (DIR) has enabled wind to set price 53.7% of the time this year. This has also resulted in a decrease in MWh of wind curtailments, as well as the duration of curtailments.

  - The December 2012 regulation mileage implementation introduced a regulation performance measurement to discount regulation payment for poor performance. The new regulation compensation method has incentivized existing fast-ramping resources to participate in the regulation market, with the benefit of improved control performance measures.

  - In 2013 MISO administered the first capacity auction under its enhanced resource adequacy construct. The annual Planning Resource Auction (PRA) replaced the monthly Voluntary Capacity Auction. In addition, MISO introduced a zonal requirement for capacity, which more accurately values capacity at various locations and reflects transmission system limitations that might exist between zones. The auction, which covered the 2013-2014 planning year, cleared at $1.05 per MW-day. This clearing price is reflective of the capacity surplus that currently exists in the region.

  - On October 1st 2013, MISO launched a multi-period monthly FTR auction ("MPMA") that allows market participants to buy and sell FTRs for the next month and future months/seasons, up to the balance of the FTR year. As an expansion and enhancement of current FTR products, MPMA is expected to further promote efficiency and participation in the MISO FTR Market as well as provide market participants additional hedging opportunities.

- On December 19th 2013, MISO successfully integrated the MISO South Region, including parts of Arkansas, Louisiana, Mississippi, and Texas. The South Region integration provides MISO's Midwest region easier access to natural gas and nuclear generation in the south region, balancing the generation fuel mix and better positioning for MISO's future operational challenges. MISO's increased scale will drive benefits through improved reliability and reduced regulation and spinning reserve requirements by consolidating balancing authorities and expanding options for generation commitment and dispatch from a more diverse set of fuel types.

III. Key Facts

- MISO successfully completed each strategic element of its 2013 annual incentive goals. The strategic elements are categorized as follows: South Region Integration, Seams Enhancement, Extended Locational Marginal Pricing, Resource Adequacy Assurance, Multi-Period Monthly FTR Auction, Transmission Constraint Demand Curve and Synchrophaser.

- MISO successfully managed 2013 instantaneous peak demand of 95,777 MW on July 18th, which was just 2,799 MW or 2.8% lower than the all-time peak load reached during summer 2012. MISO did not call a Maximum Generation Alert on that day due to high wind generation, while a Maximum Generation Alert was declared on July 17th when MISO forecasted less than a 1% capacity surplus across the peak hour on July 17th.

- The MISO system-wide averages of hourly Real-Time and Day-Ahead prices for 2013 were $31.60/MWh and $31.94/MWh, respectively, significantly higher than 2012, mainly due to higher natural gas prices in 2013. The system-wide averages of Day-Ahead Regulation, Spinning and Supplemental Reserve MCPs for 2013 were $9.10/MWh, $3.25/MWh, and $1.75/MWh, in the Real-Time market; the corresponding MCPs were $10.56/MWh, $3.32/MWh, and $2.02/MWh, respectively.

- The overall MISO region continued to rely on coal-fired generating resources the majority of the time this year. Coal units accounted for 70% of the total energy produced. The share of total generation attributed to natural gas-fired generation declined 2% over 2012 due to increasing gas price in 2013. The percent of generation due to wind resources has been steadily increasing and rose 2% over 2012 and 4% over 2011.

- Wind generation has been gradually increasing over the last several years. As of December 2013, MISO had 13.0 GW of total installed wind capacity and 10.5 GW of wind capacity was registered as DIRs.

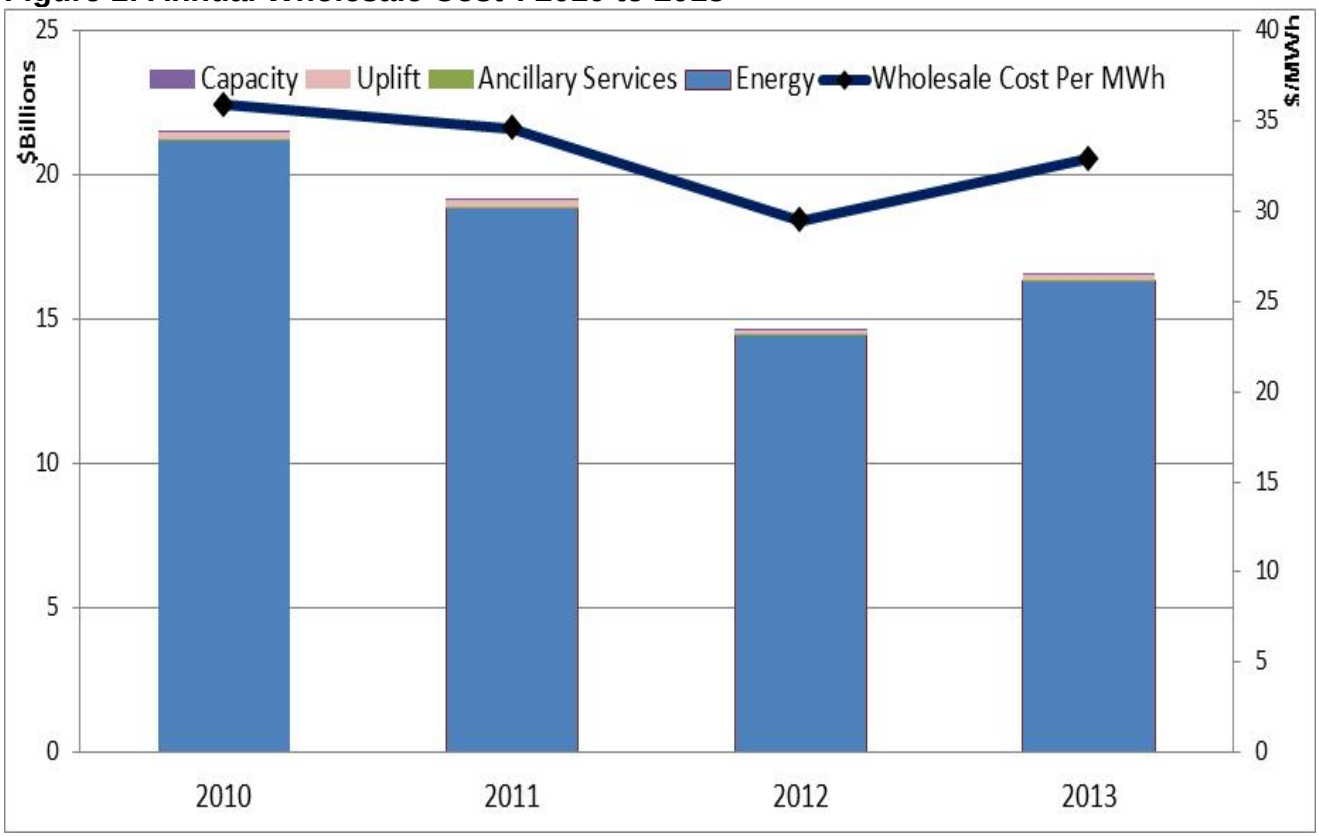
- 2013 FTR funding decreased slightly to 95.0% from 95.3% in 2012, partly driven by unforeseen transmission outages and topology differences between the FTR and Day-Ahead market models. May 2013 contributed the largest FTR shortfall during 2013 and was also the last month of the prior Planning Year. MISO FTR funding has increased after May 2013 due to the improved modeling assumptions for the 2013-2014 Planning Year.

- Gross virtual profitability index increased 94.9% from 2012 to $1.00/MWh in 2013. The increase was driven by virtual demand transactions, which were profitable for the first time since 2005.

IV. MISO Annual Market Wholesale Cost

Annual wholesale cost is an overall indication of cost to serve load in the MISO market. This section is intended to show how the wholesale cost changes over the years and what a load serving entity within the MISO footprint pays on average for 1 MWh of load[2] for each year.

Figure 1: Annual Wholesale Cost[3]: 2010 to 2013



- Energy, ancillary services and uplift payments accounted for around 98.5%, 0.4% and 1% of total wholesale cost across years, respectively.
- Total wholesale costs in 2013 increased 13.2% when compared with 2012, mainly impacted by increased energy payment.
- The annual wholesale cost per MWh load served in 2013 increased 11.5% to $32.9/MWh from $29.5/MWh recorded in 2012, while still significantly lower than the levels in 2010 and 2011.

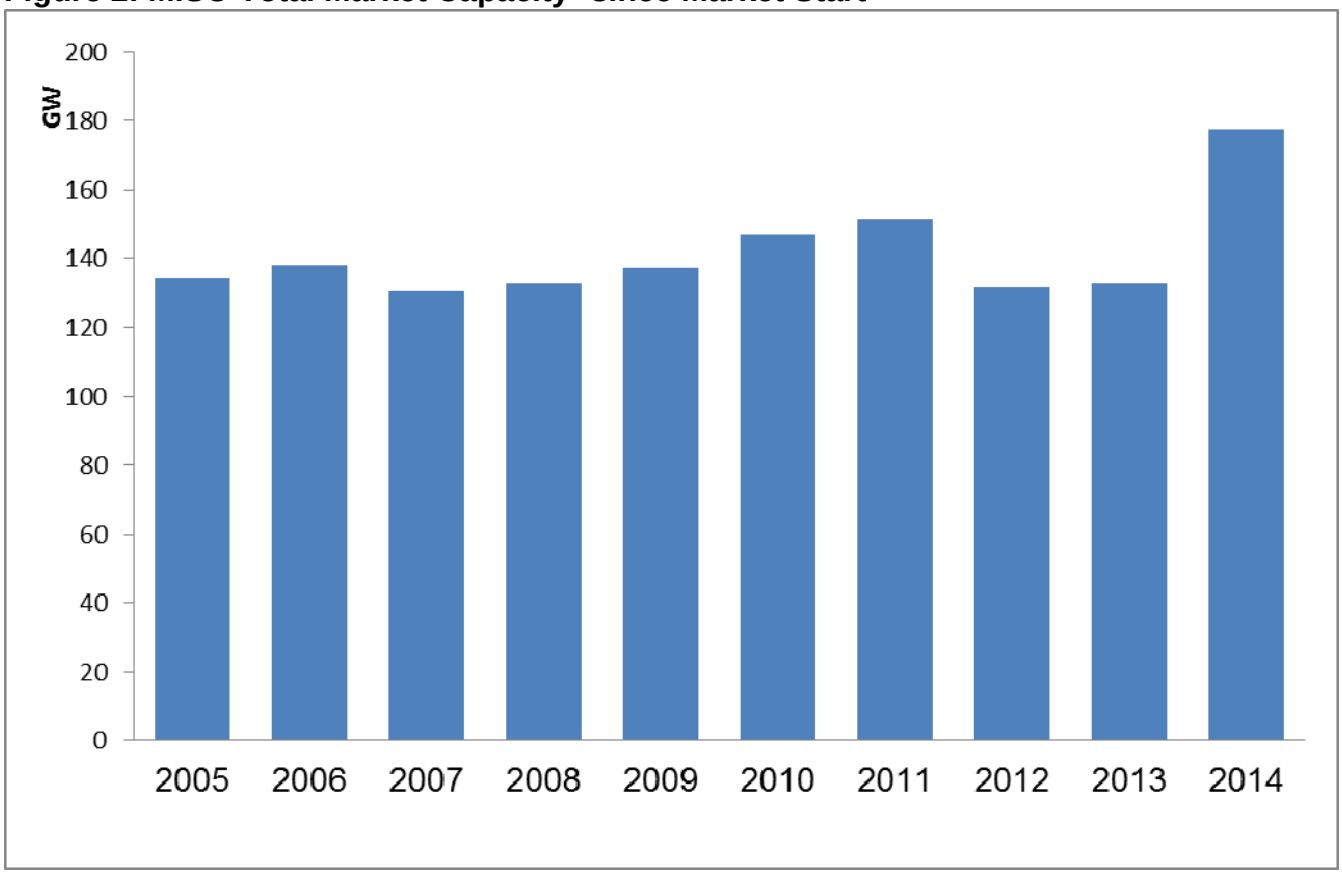
[2] including internal meter load and Real-Time export

[3] The annual wholesale cost of energy is a sum of hourly Energy payment, which is estimated by aggregated energy transactions for each load and generation asset when they withdraw energy from the grid. The annual wholesale cost of capacity payment is estimated by auction clearing price*cleared Planning Reserve Credit (PRC) or Planning Reserve Margin Requirement (PRMR).

V. Overall Resource Assessment

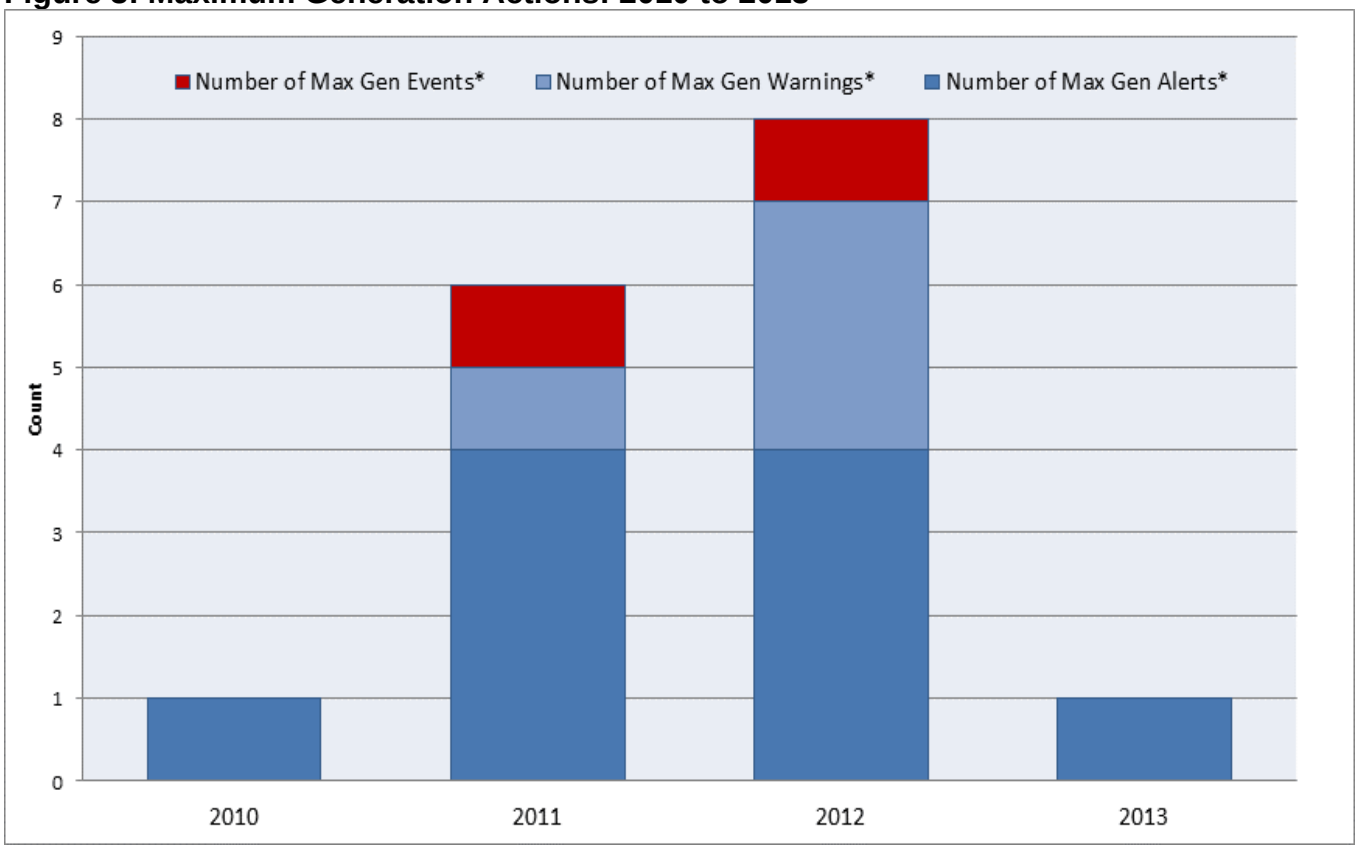
The figure 2 below shows that the total market capacity changes over the years, due to membership changes, generation additions and retirement. In the short term, MISO has adequate resources to meet its demand, while the capacity surplus will diminish in the near future as MISO projects 18% of its coal fleet will retire in the next several years, due to economic factors, including environmental costs.

Figure 2: MISO Total Market Capacity* since Market Start



**MISO market started from April 2005 and total market capacity extracted from Asset Registration database on January 1st of each year after 2005*

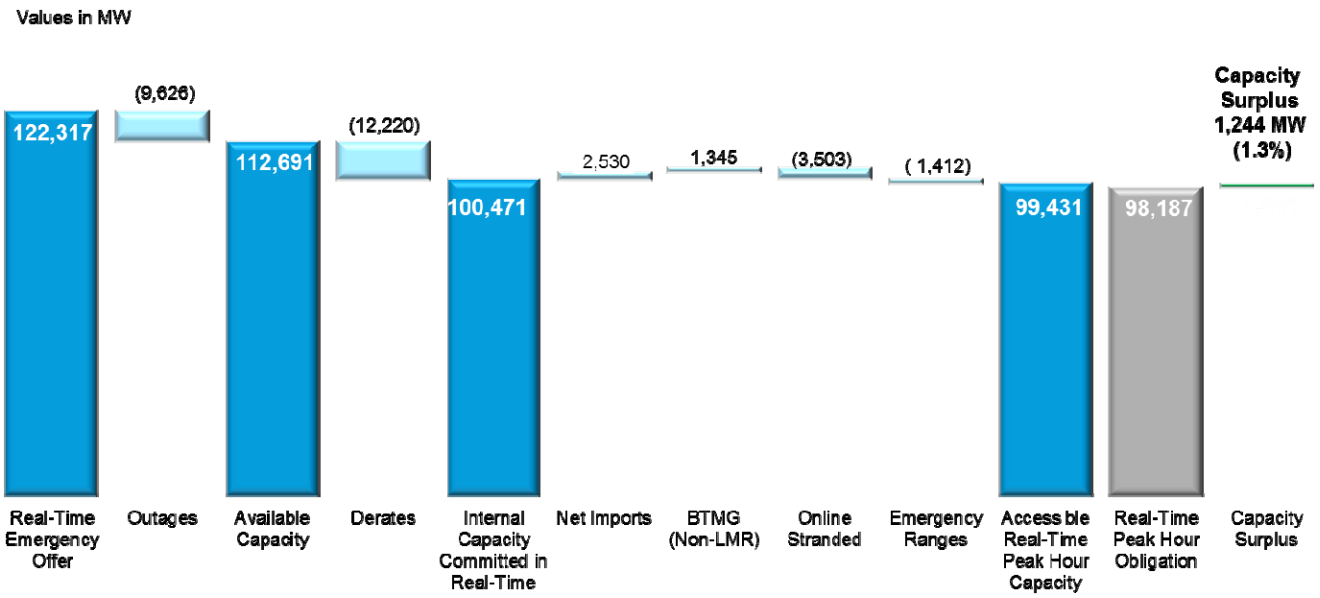
Figure 3: Maximum Generation Actions: 2010 to 2013



** Alerts – forecasting potential emergency situations in a future time-frame*
** Warnings – experiencing initial stages of an emergency situation and taking action*
** Events – experiencing an emergency situation and taking action*

- On July 21st, 2011, MISO made declarations associated with a Maximum Generation Emergency up through Event Step 1a due to a combination of load trending above forecast and forced generation outages.
- on July 17th 2012, MISO declared a Maximum Generation Emergency Event Step 1a, which provided MISO access to resources that are available only in an emergency situation
- Summer 2013 was characterized by below average to average temperatures with one moderate heat wave noted during the week of July 15th. On July 17th, MISO declared a Maximum Generation Alert when the projected peak hour capacity surplus was expected to be less than 1% of requirements.

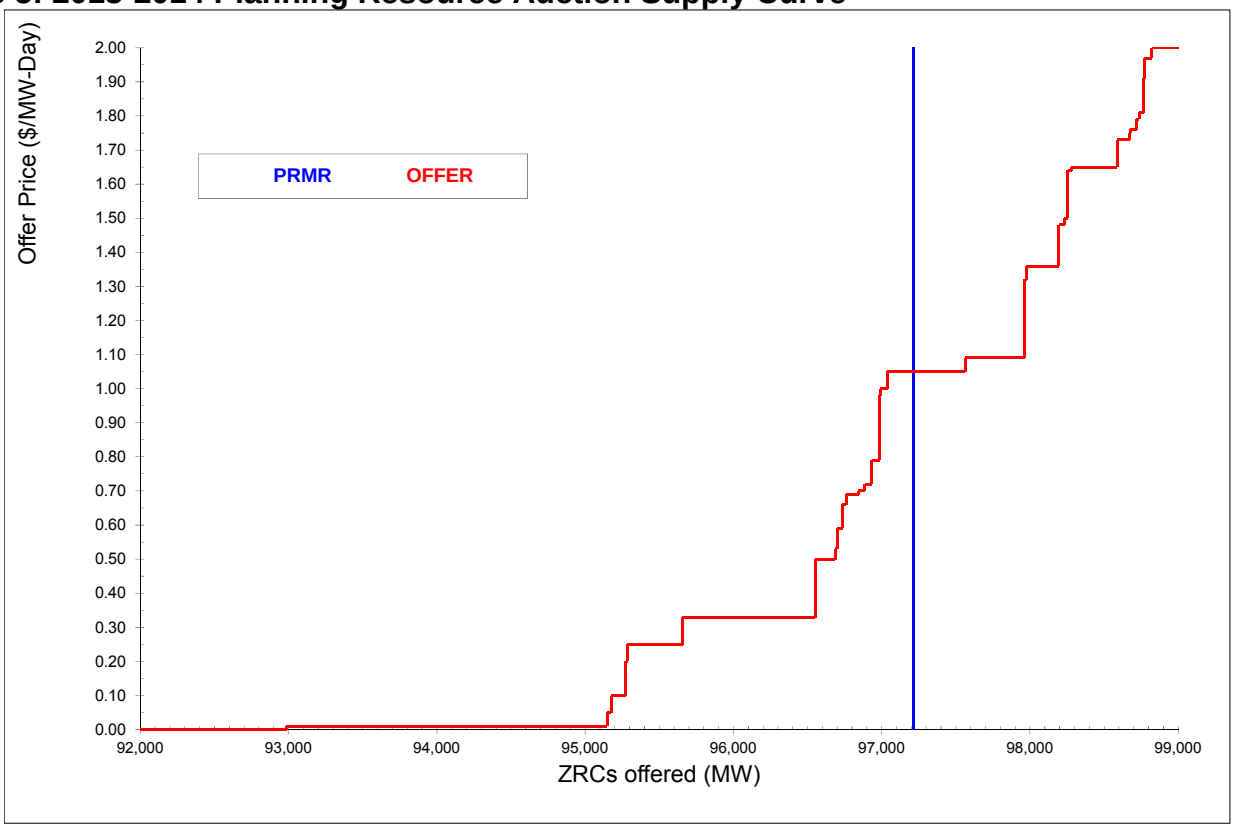
Figure 4: Demand and Capacity Analysis for 2013 Peak Demand Hour: July 18, 2013, Hour Ending 16(Eastern Standard Time)



- Figure 4 above shows the operational analysis of demand and capacity during the 2013 peak demand hour.
- MISO had over 99.4 GW of available capacity to manage during this year's instantaneous peak demand obligation of 98.2 GW. Based on available capacity, the capacity margin was only 1.3%. This does not include roughly 8 GW of registered LMR assets and 2.7GW of one hour long lead-time resources.
- Capacity margin in the Real-Time market is mainly influenced by generation outages, volatile wind generation and net actual tie-line flow between MISO and neighboring balance authorities.
- Per MISO procedure, Load Modifying Resources (LMR) would not be used unless an Energy Emergency EEA2 situation was declared. MISO would utilize over 5GW of available[4] LMR resources during the 2013 summer peak hour, if MISO experiences Energy Emergency Event Step 2.
- MISO implemented LMR automation tool in July 2013 and has continued to work with stakeholders to improve the situational awareness of Voluntary LMR Deployment.

[4] 5GW of available LMR capacity is estimated from LMR automation tool which was implemented in July 2013.

Figure 5: 2013-2014 Planning Resource Auction Supply Curve



- In March 2013, MISO administered the first annual capacity auction. The system wide clearing price for the 2013-2014 planning year was $1.05 per MW-day, which indicated sufficient resource adequacy in the short term time frame.
- Planning Resource Auction cleared sufficient resources to meet the system-wide and zonal resource requirements. Total Planning Resources offered were about 8.2 GW in excess of the system requirement, i.e., Planning Reserve Margin Requirements (PRMR).

VI. Market Demand

Load serving entities represent MW demand within the MISO footprint that receive electricity from the electric grid for a given time period. Demand can be influenced by weather conditions, as well as economic and demographic factors.
Market demands in MISO area from 2010 to 2013 are not adjusted for membership changes.

Table 2: Forecasted* Coincident Yearly Peak Demand vs. Actual Coincident Yearly Peak Demand

	2010	2011	2012	2013
Forecasted* Peak Demand(MW)	107,629	98,053	94,395	96,193
Hourly Integrated Peak Load(MW)	108,346	103,551	98,026	95,400
Forecast Error	-0.7%	-5.3%	-3.7%	0.8%

**50/50 forecast from MISO Pre-Summer Assessment Analysis*

- Table 2 summarizes the forecasted peak hour demand versus actual hourly integrated peak load.
- The forecasted demand, as reported by Network Customers, is weather normalized, or 50/50 forecasts. A 50/50 forecast is the median value in a normal probability distribution, meaning there is a 50 percent chance the actual load will be higher and a 50 percent chance the actual load will be lower than the forecast.
- MISO's hourly integrated peak load for 2013 of 95,400 MW was set on July 18th in HE16. Gross coincident demand was forecasted to peak at 96,193 MW, reflecting a difference of 0.8%. Actual integrated demands are not weather adjusted.

Figure 6: Annual System-Wide Demand: 2010 to 2013

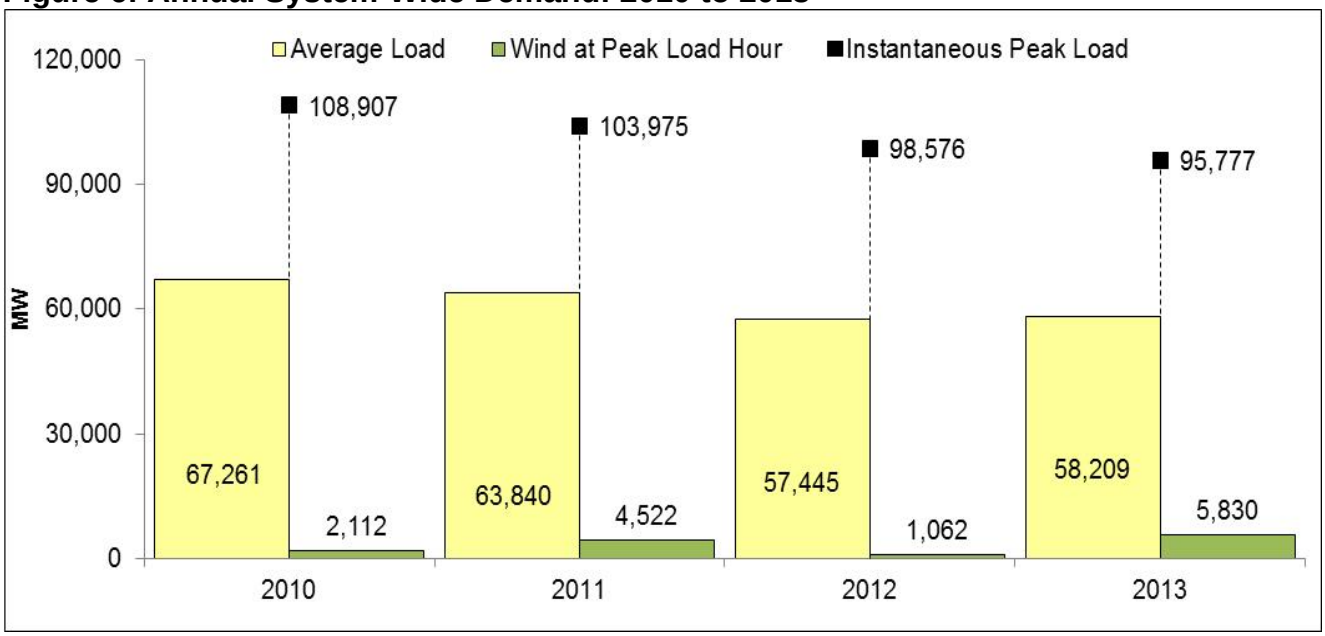
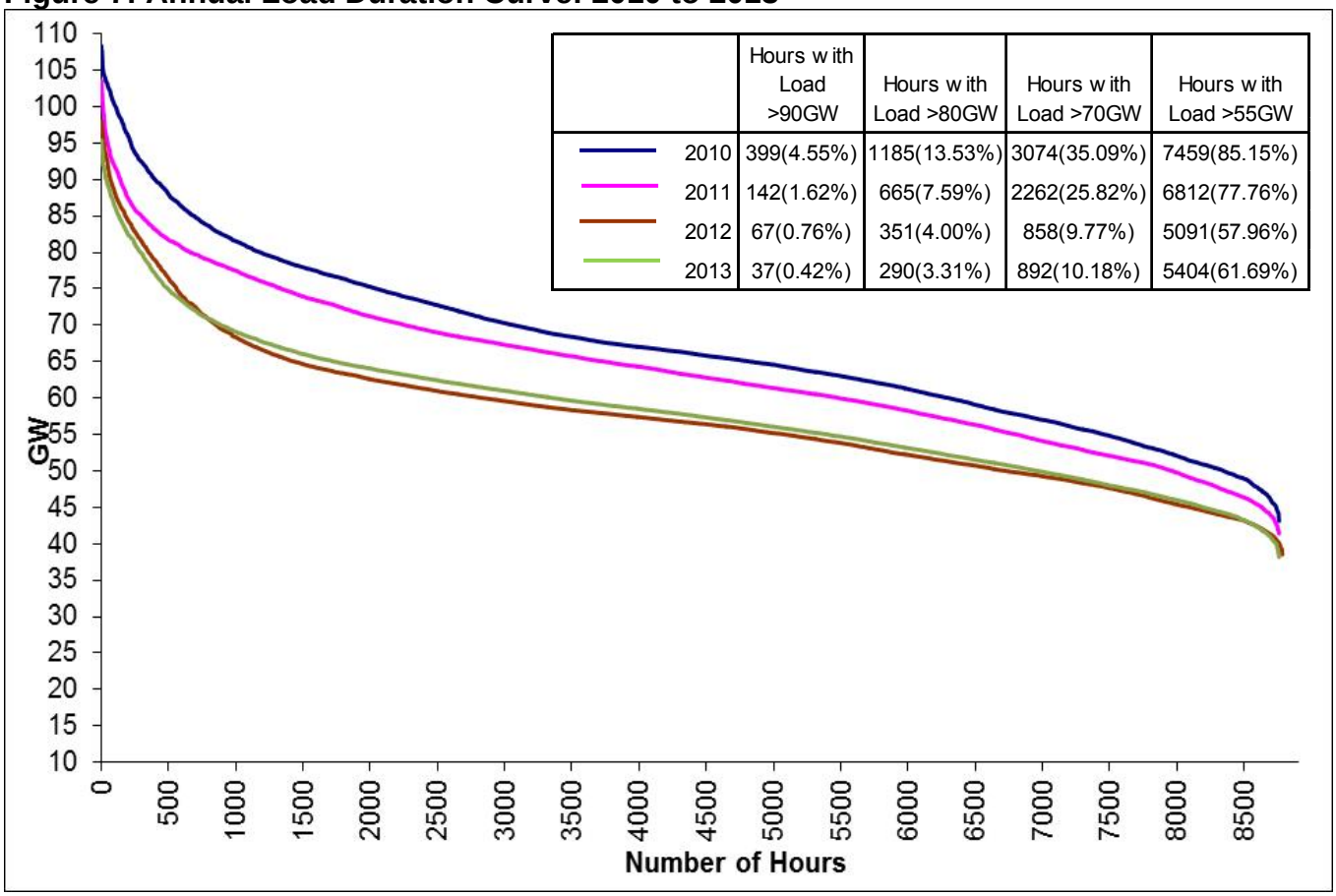


Figure 7: Annual Load Duration Curve: 2010 to 2013



	Hours with Load >90GW	Hours with Load >80GW	Hours with Load >70GW	Hours with Load >55GW
2010	399(4.55%)	1185(13.53%)	3074(35.09%)	7459(85.15%)
2011	142(1.62%)	665(7.59%)	2262(25.82%)	6812(77.76%)
2012	67(0.76%)	351(4.00%)	858(9.77%)	5091(57.96%)
2013	37(0.42%)	290(3.31%)	892(10.18%)	5404(61.69%)

- Figure 6 shows MISO system-wide average, instantaneous peak load, and wind generation at the peak load hour, while table Figure 7 indicates the number of hours during the year when Real-Time Load was greater than a given level within the MISO footprint.
- In the short-term, load is mainly impacted by the weather conditions: 2012-2013 Winter was marked by variable temperatures, gusty winds, severe storms, and high snowfall totals throughout many parts of the footprint, while summer 2013 was characterized by below average to average temperatures with one moderate heat wave in the middle of July. In addition,
  - MISO membership changes during the periods analyzed contributed to load differences between years.
  - Improved economic conditions and temperatures fluctuations also impacted weather sensitive load over the past four years.
  - All-time instantaneous peak demand of 98,576 MW with membership adjustment was set on July 23rd, 2012.

VII. Market Supply

Supply is the amount of electricity available to the grid within the MISO footprint for a given time period that is consumed by load or losses.

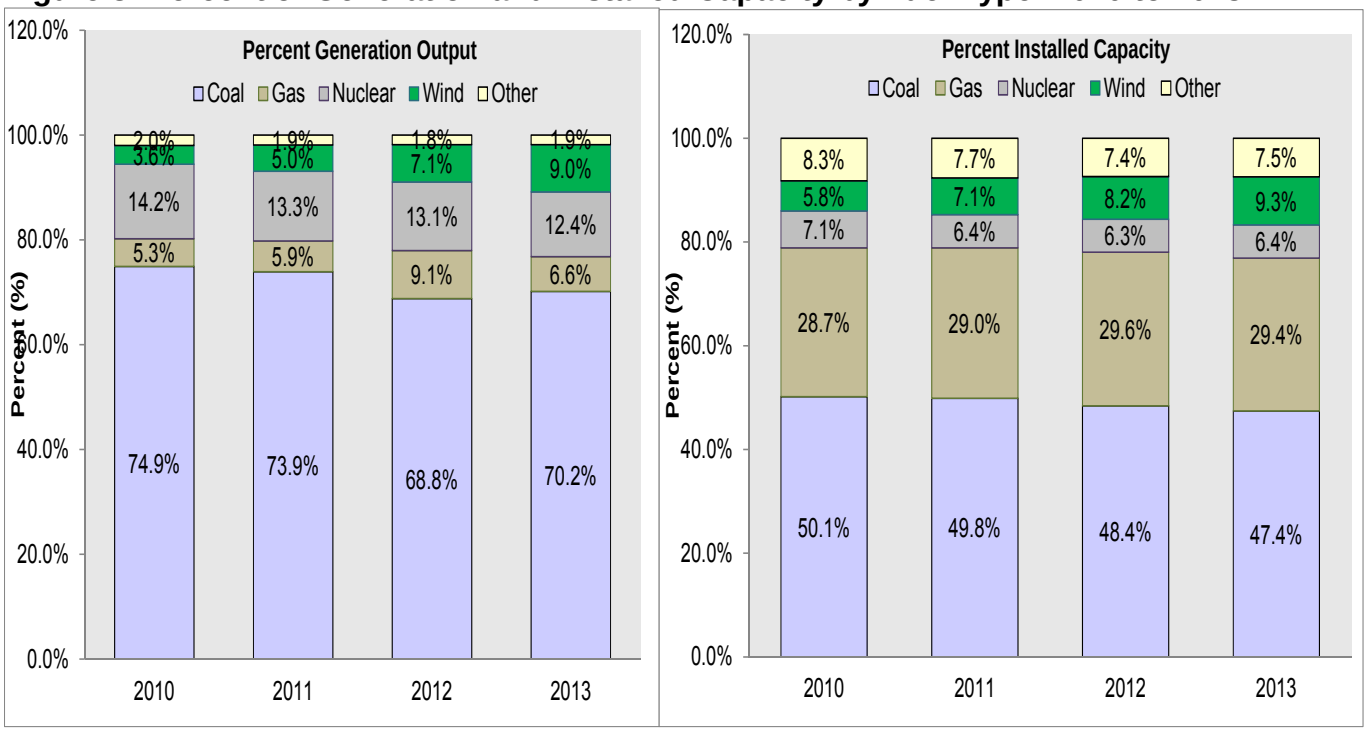
Competitive wholesale power markets have provided incentives for generation owners to take actions to achieve higher power plant availability and lower forced outage rates, particularly during peak demand periods.

Fuel Diversity is the mix of fuel types installed and available (capacity) or used (generation) to produce electricity. The breakdown can vary due to the availability of resources in the area, and political, economic and environmental factors associated with producing electricity from various fuel types.

Wind energy, unlike other fuel types, can be intermittent and highly variable. Because instantaneous electrical generation and consumption must remain in balance to maintain grid stability, the properties of wind may present challenges to incorporating large amounts of wind power into a grid system.

On June 1st, 2011, MISO successfully launched Dispatchable Intermittent Resources (DIRs) which treat renewable energy resources like any other generation resource and allow participation in the Real-Time energy market to be dispatched.

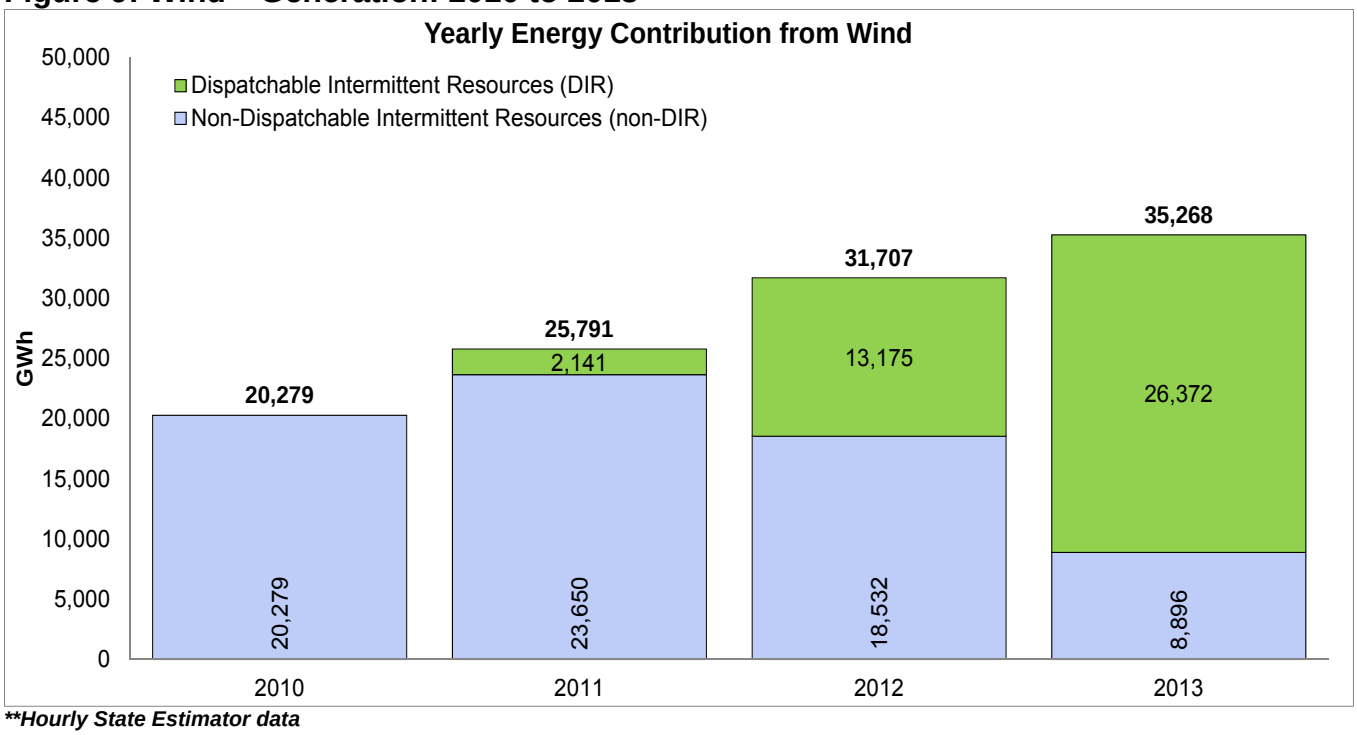
Figure 8: Percent of Generation and Installed Capacity by Fuel Type: 2010 to 2013



Note: *Other is comprised of Hydro, Oil, Other, Pet Coke, and Waste. Gas includes units with gas and gas/oil fuel type. Annual Installed capacity extracted from Asset Registration database on January 1st of each year*
Generation Output based on 5-min UDS dispatch target data

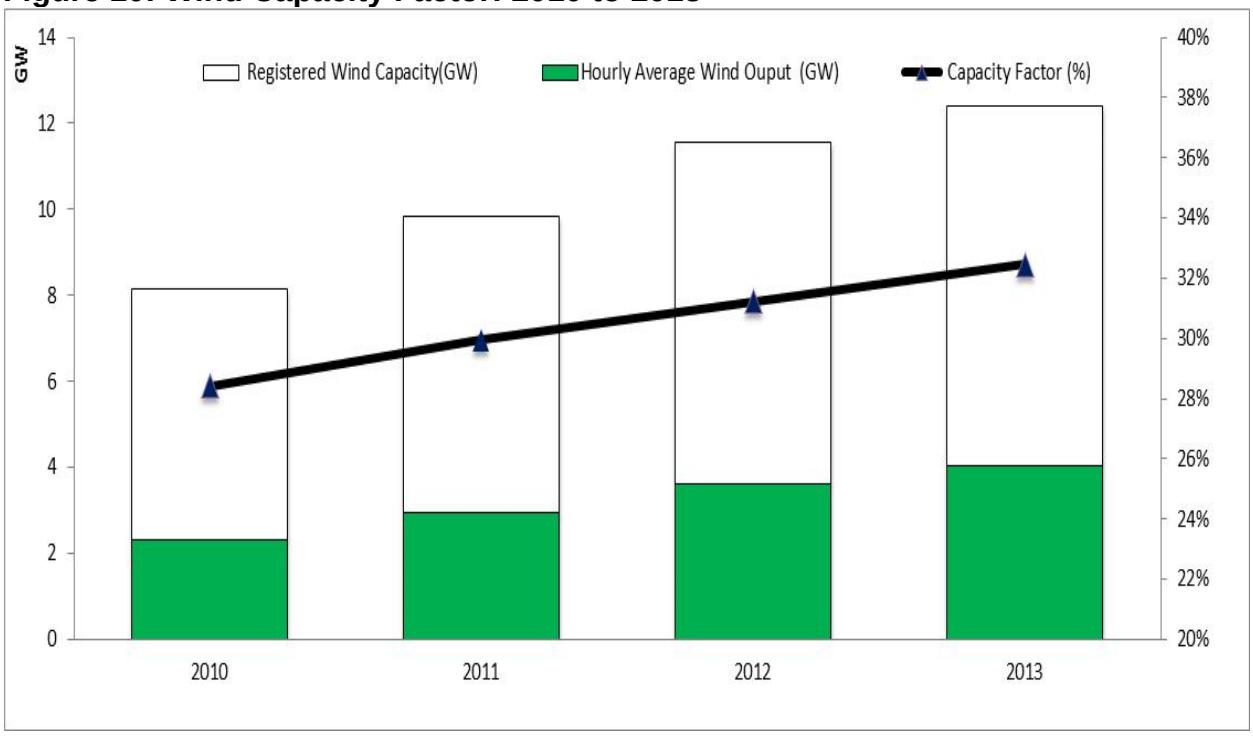
- Figure 8 shows the percent of total installed capacity and generation output contributed by the four major fuel types for the previous four years.
- While MISO expects the generation fleet in its region to be impacted by unit age, fuel prices and environmental regulation in the coming years, and our fuel mix to adjust as a result of the footprint expansion, the supply picture in 2013 did not change significantly from prior years. Coal units continued to make up nearly half of MISO's installed capacity, with another 30% coming from gas resources. Wind capacity did increase from 8% to 9%.
- The MISO region continues to rely on coal-fired generating resources the majority of the time. Because coal units are generally base loaded, they generate a larger share of the total energy produced.
- Coal's share of total energy generation declined in 2012 due to historically low gas prices and increased wind generation.
- Wind production is the fastest growing segment of energy production in the MISO footprint.

Figure 9: Wind Generation: 2010 to 2013**



Hourly State Estimator data

Figure 10: Wind Capacity Factor: 2010 to 2013



- Figure 9 shows total wind generation in the MISO footprint, grouped by Dispatchable Intermittent Resources (DIR) and non-DIR for the previous four years. DIRs maximize wind utilization; minimize the need for manual curtailments in Real-Time, and assist with congestion management. At the end of 2013, 10,535 MW of wind capacity was registered as DIR. As DIR capacity increases, MISO expects additional improvements in congestion management and market pricing.
- Figure 10 shows that registered wind capacity and average yearly wind generation have consistently grown in the MISO market for the last four years. MISO anticipates the continuation of this trend in the coming years due to the State Renewable Portfolio Standards and potential Federal mandates.
- The all-time record instantaneous wind peak of 10,012 MW was set on November 23rd, 2012, surpassing the previous wind peak of 9,474 MW set on October 25th, 2012.

VIII. Energy Price Analysis

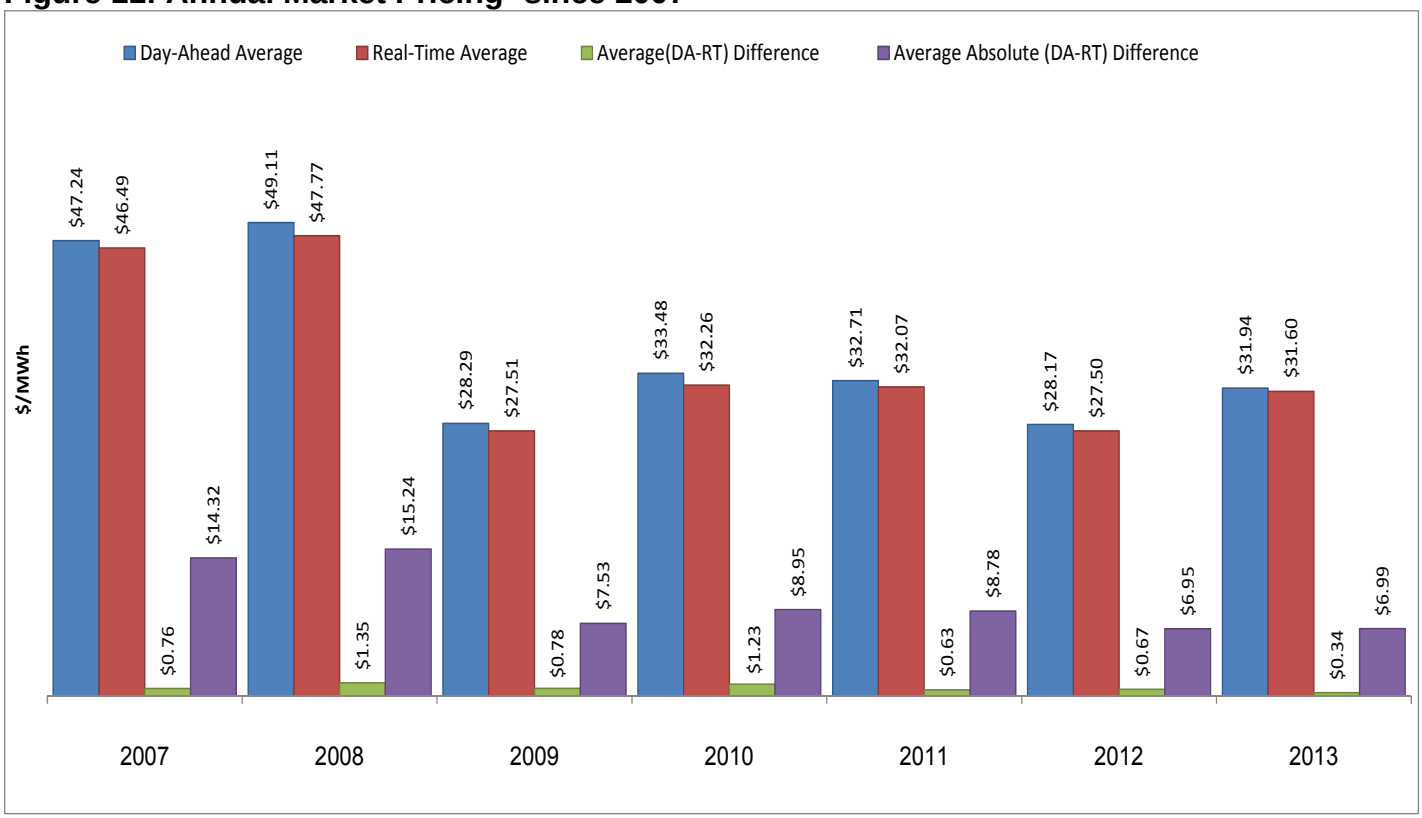
In any energy market, the goal in determining price is to capture all factors that contribute to the cost for energy and then price that energy accordingly. Electricity markets require energy prices for balancing spot and short-term forward transactions. These prices are charged to loads and credited to suppliers.

LMP is based on the marginal cost of serving a small increment (or decrement) of load at a particular location. For a resource to contribute to setting prices, it must already be committed and able to respond to this small change in demand.

Production costs incurred by those units committed in Day-Ahead and Real-Time market that are not covered by the energy and ancillary service payment are uplifted to the market through various settlement mechanisms such as Revenue Sufficiency Guarantee (RSG) payment.

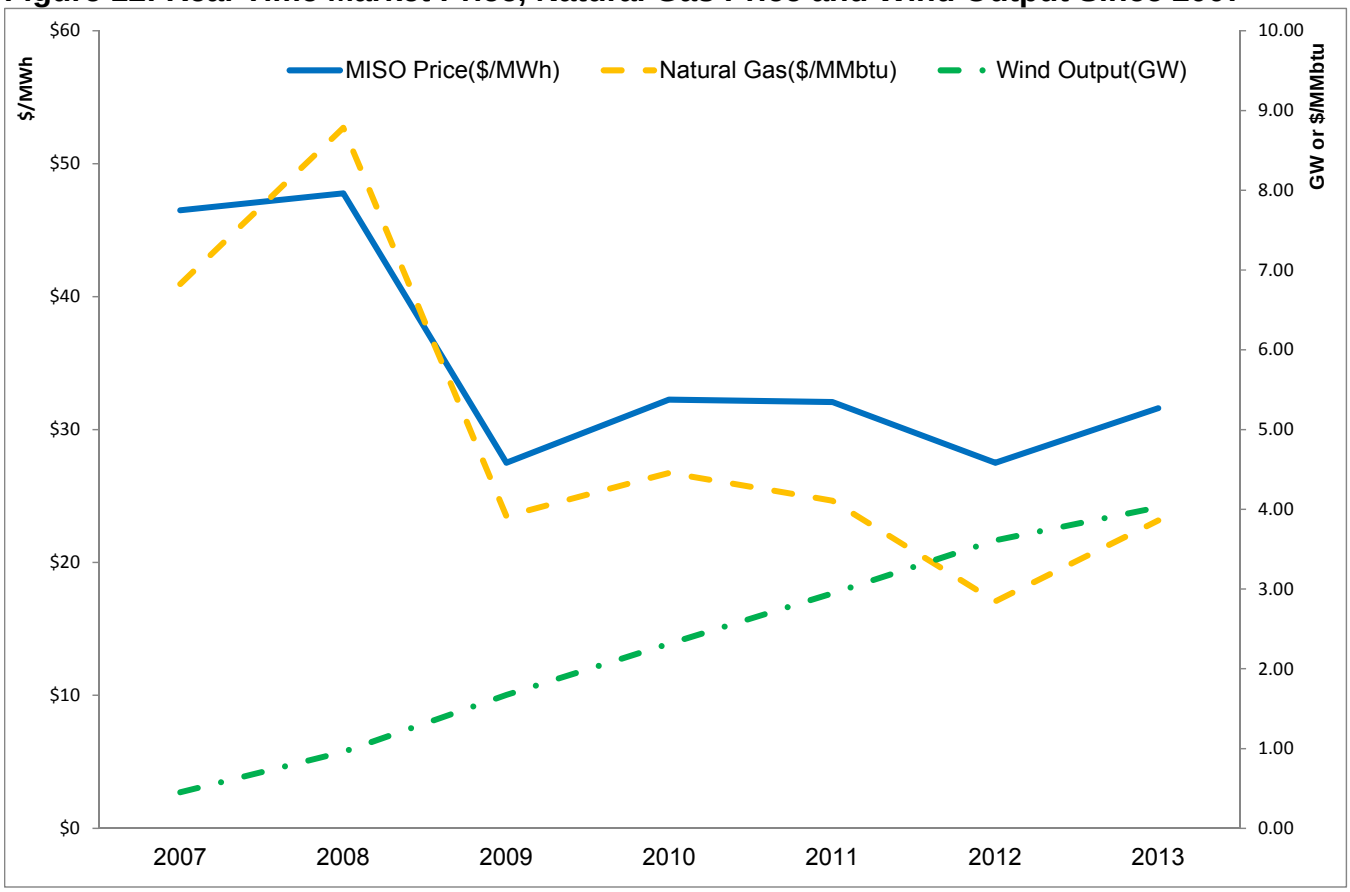
Good convergence between the Day-Ahead and Real-Time prices is a sign of a well-functioning energy market. Since the Day-Ahead market facilitates most of the energy settlements and generator commitments, good price convergence with the Real-Time market helps ensure efficient Day-Ahead commitments that reflect Real-Time operating needs. Better convergence is indicated by a smaller dollar spread or a smaller percentage difference.

Figure 11: Annual Market Pricing[5] since 2007



[5] Average price at the trading hubs

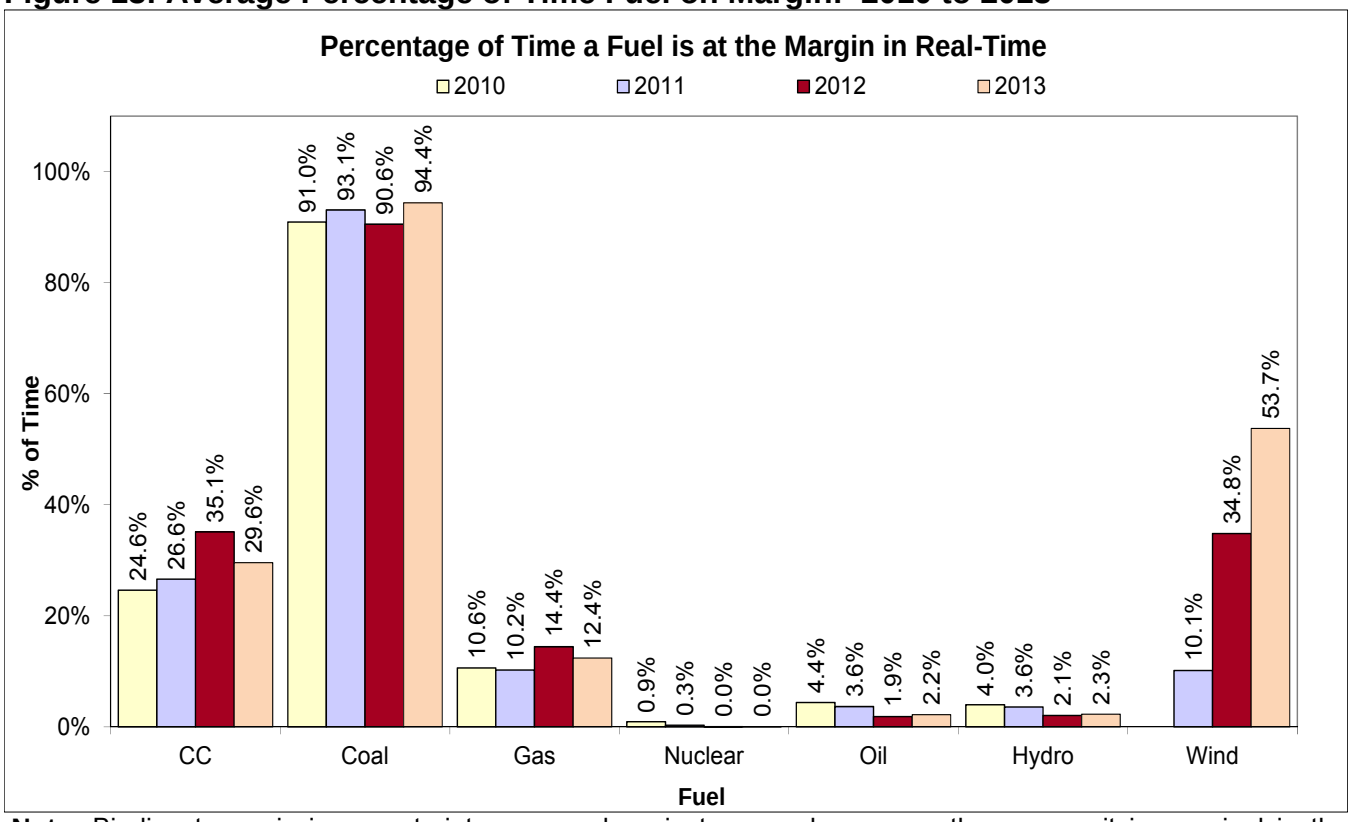
Figure 12: Real-Time Market Price, Natural Gas Price and Wind Output Since 2007



- Figure 11 shows yearly average of hourly energy price information since 2007. And figure 12 indicates that energy price trends in the MISO footprint are driven by declining natural gas prices and increased penetration of renewables.
    - The energy price is estimated[6] to decrease $3.8/MWh if natural gas price drops $1/MMBtu.
- The MISO system wide averages of hourly Real-Time and Day-Ahead prices for 2013 were higher than 2012, mainly due to increase of natural gas price in 2013.
- MISO Ancillary Services market (ASM) started in 2009, overall, the yearly average energy prices after 2009 have been stable and much lower than those values prior to ASM.
- When the average absolute hourly price difference between the Day-Ahead and Real-Time markets becomes small (i.e., close to zero), it indicates efficient dispatch in the Day-Ahead market and improved price convergence.
- The MISO market generally exhibits a Day-Ahead price premium, such that average Day-Ahead prices are higher than average Real-Time prices.
- Price differences between Day-Ahead and Real-Time markets exist due in part to market uncertainties inherent in a competitive bidding process, expectations of participants, transmission constraint management practices.

[6] Simple linear regression of energy price on natural gas price

Figure 13: Average Percentage of Time Fuel on Margin: 2010 to 2013



Note: Binding transmission constraints can produce instances where more than one unit is marginal in the system. Consequently, more than one fuel may be on the margin; and, since each marginal unit is included in the analysis, the percentage may sum to more than 100%. In addition, on June 1st, 2011, MISO successfully launched Dispatchable Intermittent Resources (DIRs), allowing wind to participate in the Real-Time energy market. *^^Gas excludes Combined Cycle units*

- Figure 13 provides the percentage of time that a fuel is on the margin and contributes to setting price over the last four years.
- Coal was the major fuel at the margin, setting Real-Time LMPs 94.4% of the time during 2013.
- Gas and combined-cycle units were responsible for setting Real-Time prices around 12.4% and 29.6% of the time during 2013--- around 2.0% and 5.5% decreases from 2012.
- The implementation of Dispatchable Intermittent Resources (DIR) in 2011 enabled wind to set price and was at the margin, 53.7% of the time this year, an 18.9% increase from last year.

IX. Ancillary Services Market Analysis

The Ancillary Services market started in January 2009. MISO establishes Reserve Zones to ensure Regulating Reserves and Contingency Reserves are dispersed in a manner that prevents adverse operating conditions affecting the reliability of the Transmission System.

On November 1st, 2011, MISO implemented the Enhanced Reserve Procurement Procedures to ensure deliverability of Ancillary Services Market products. The Day Ahead and Real Time markets solve co-optimized reserve zone requirements to meet system deliverability requirements on a zonal basis. Reserve procurement adds the potential for price differences across zones due to transmission constraints.

On December 17th, 2012, MISO began Frequency Regulation Compensation (FERC Order 755) in order to compensate frequency regulation resources on the actual regulation service provided. In the Real-Time market, Regulation market clearing prices are divided into a regulating capacity MCP and a Regulating Mileage MCP. Resources will be paid or charged regulation payments based on regulation mileage performance and derived from Regulation Mileage MCP.

Figure 14: ASM Pricing: 2009 to 2013

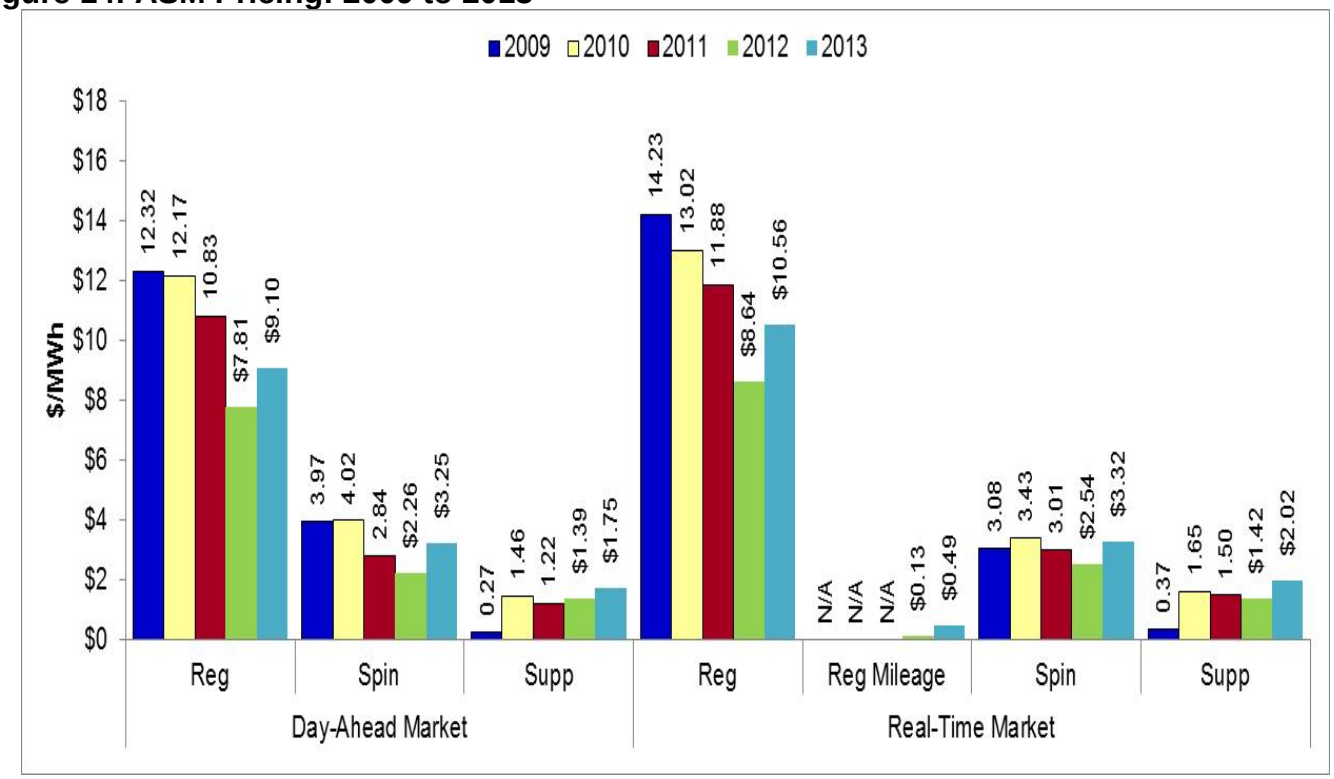


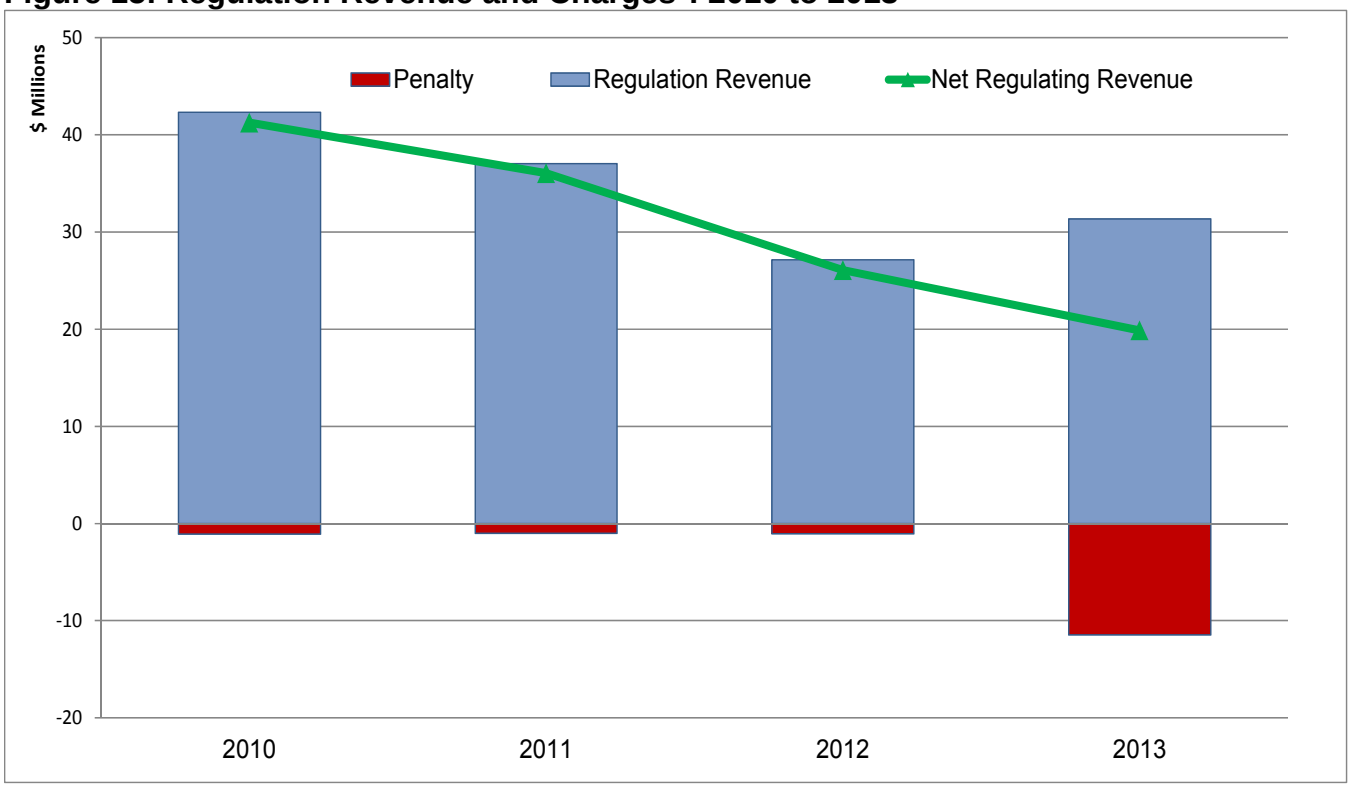
Table 3: Reserve Scarcity Intervals: 2009 to 2013

Scarcity Intervals	2009	2010	2011	2012	2013
Regulation Reserve Deficit	773 (0.75%)	165 (0.16%)	243 (0.23%)	154 (0.15%)	32 (0.03%)
Spinning Reserve Deficit	1475 (1.43%)	1152 (1.10%)	765 (0.73%)	472 (0.45%)	515 (0.49%)
Supplemental Reserve Deficit	4 (0.00%)	7 (0.01%)	3 (0.00%)	27 (0.03%)	24 (0.02%)

- Figure 14 shows average hourly reserve product prices, while Table 3 displays a comparative analysis of the number of 5-minute intervals in which system-wide deficits occurred by ancillary service product for the previous five years.
- Ancillary Services Market (ASM) product prices exhibit a generally decreasing trend over the last five years. The low Day-Ahead and Real-Time marginal clearing prices in 2012 and 2013 were influenced by low gas prices, less Regulation and Spinning Reserve scarcity intervals.
- A total of 24 Operating Reserve scarcity intervals was noted in 2013, mainly due to ramp constraint shortage and forced generation outage during the morning or evening load ramping period.
- Effective May 1st 2013, MISO implemented a new multi-segment operating reserve demand curve (ORDC). The newly implemented demand curve replaces a single point marginal value limit. This should better represent the marginal increase in the value of reserves as their availability marginally decreases during scarcity events. The new ORDC is expected to mitigate transient price spikes and improve price efficiency in the Real-Time market.

The December 2012 regulation mileage implementation introduced a regulation performance measurement to discount regulation payment for poor performance. Since that time, performance of regulating resources has remained steady and additional fast ramping resources are clearing in the regulation market.

Figure 15: Regulation Revenue and Charges*: 2010 to 2013



**A negative dollar sign indicates a charge to regulation resources and a positive dollar sign indicates a credit to regulation resources.*

- MISO's implementation of regulation mileage has been successful since December 17th, 2012 and operation performance has slightly improved as evidenced by improved control performance measures.
- The regulation market net regulation payment in 2013 was much less than the payment in 2012, even though the average Day-Ahead regulation clear prices in 2013 were $1.29/MWh higher than 2012.

X. Market Impacts

The Market Settlements process financially settles competitive transactional activities by and between MPs within MISO's managed Transmission System (i.e., market operations footprint). MP charges and credits resulting from the Day-Ahead, Financial Transmission Rights (FTRs), and Real-Time Energy and Operating Reserve Markets are calculated based on the Tariff.

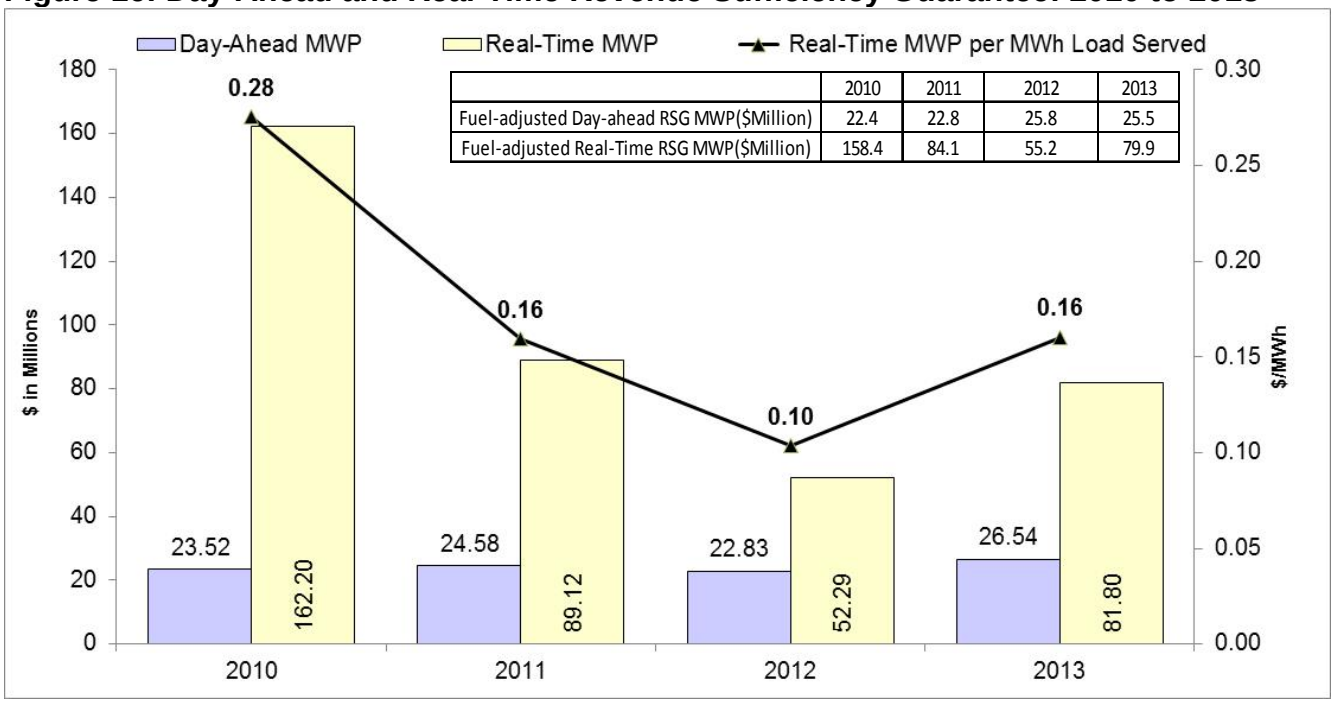
Day-Ahead Revenue Sufficiency Guarantee Make-Whole Payment represents the daily amount of Production Costs not covered by the Asset's location marginal price and market clearing price. Generation Resources that are committed by MISO and scheduled in the Day-Ahead Market are guaranteed recovery of their production offer costs.

Real-Time RSG Make-Whole credits are the direct result of having insufficient Resources cleared in the Day-Ahead Market to meet the requirements of the Real-Time Market. The RAC process commits additional Resources over those from Day-Ahead to meet Load and system conditions in Real-Time. Resources committed in the RAC process are guaranteed recovery of their production costs.

FTRs are financial instruments whose values are determined by the transmission congestion charges that arise in the Day-Ahead Energy and Operating Reserve Market. The difference between an MP's target revenue allocation and the actual credit paid is referred to as shortfall. When FTRs of MPs are not fully funded by the hourly available congestion dollars, MPs are eligible to receive additional revenue allocations to cover their shortfall in the monthly and/or the yearly revenue allocations.

Virtual supply (or increment) and virtual demand (or decrement) are market instruments that do not have to be backed by physical generation or consumption. They are used by Market Participants to hedge risks posed by stochastic uncertainties of Real-Time Operations and to arbitrage energy price differences between the Day-Ahead and the Real-Time markets. Virtual transactions provide liquidity to the market and can aid convergence between Day-Ahead and Real-Time energy prices. Profit or loss on each MWh of virtual transaction traded at a CPNode is driven by the spread between the Day-Ahead and Real-Time LMP at the node and the position of the transaction.

Figure 16: Day-Ahead and Real-Time Revenue Sufficiency Guarantee: 2010 to 2013

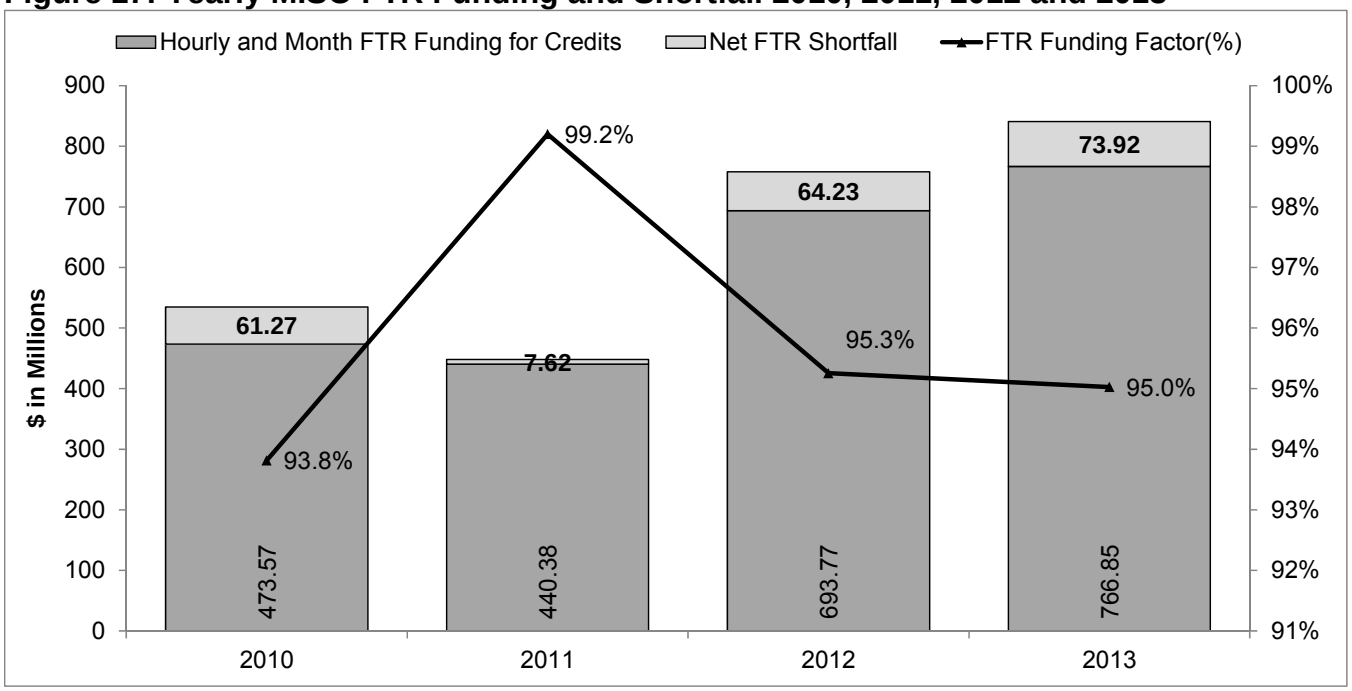


	2010	2011	2012	2013
Fuel-adjusted Day-ahead RSG MWP($Million)	22.4	22.8	25.8	25.5
Fuel-adjusted Real-Time RSG MWP($Million)	158.4	84.1	55.2	79.9

Extraction from settlements Feb 2014 and can change with resettlement and average four-year fuel prices are used for fuel adjustment

- Figure 16 shows Day-Ahead and Real-Time Revenue Sufficiency Guarantee (RSG) uplifted to the market.
- The nominal Day-Ahead RSG during 2013 was higher than the previous three years. The fuel-adjusted Day-Ahead RSG in 2013 declined 1.2% from 2012.
- The nominal Real-Time RSG Make-Whole Payments were $82 million for 2013 and were substantially higher than 2012, mainly impacted by higher fuel prices and more Real-Time capacity commitments in 2013. The capacity-related nominal Real-Time RSG in 2013 was $64 Million and more than doubled from 2012.

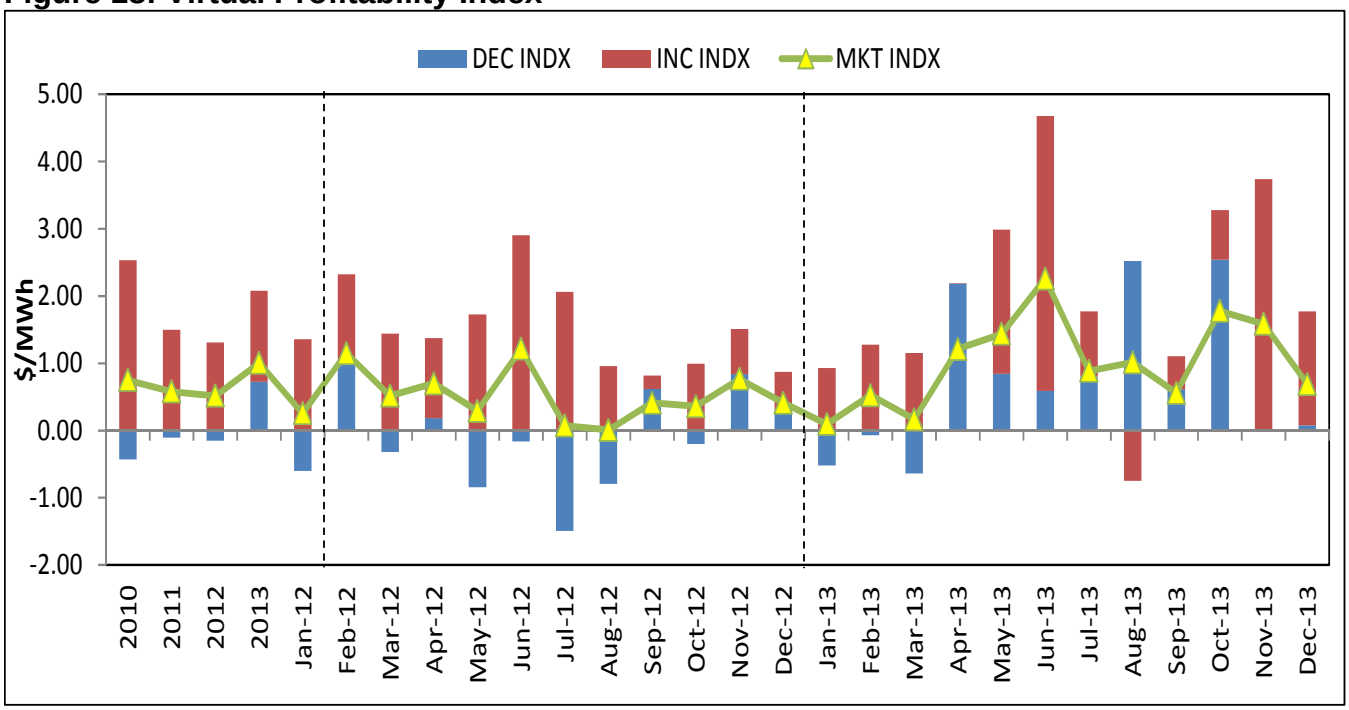
Figure 17: Yearly MISO FTR Funding and Shortfall 2010, 2011, 2012 and 2013



Based on data extracted Feb 2014 and values may change due to resettlement.

- Figure 17 shows FTR funding levels during previous four years.
- Yearly FTR funding levels for 2013 after hourly and monthly allocation were lower than 2012 and 2011 level, partly driven by unforeseen transmission outages, topology differences between the FTR and Day-Ahead market models.
- May 2013 contributed the largest FTR shortfall during 2013 and was also the last month of the prior planning year. MISO FTR funding has increased after May 2013 due to the improved modeling assumptions for the 2013-2014 planning year.

Figure 18: Virtual Profitability Index[7]



- Hourly cleared virtual supply and virtual demand averaged 2,809 MW and 3,511 MW, respectively, in 2013. Profits for cleared transactions totaled $55.6 Million for a gross market index of $1.00/MWh. The gross market index increased 94.9% from 2012.
- Virtual supply was about twice as profitable as virtual demand but 2013 is the first year since 2005 that virtual demand was profitable.
- The profitability of virtual transactions is usually reduced by RSG charges to virtual transactions in the Day-Ahead and Real-Time Markets. In 2013, DDC[8] RSG charges decreased virtual supply profitability by approximately $0.43/MWh.

XI. Market Developments

MISO started its market in April 2005 and launched its Ancillary Services Market in January 2009. The first annual planning resource auction was held in March 2013. Throughout the years, many market development enhancements have been put in the market place and brought incremental value to the market, either reducing overall production cost, improving operation reliability, producing more efficient market outcomes, or providing fair compensation for the services provided. MISO has been engaging with stakeholders to work on a long-term market development vision to establish a repeatable process for identifying, evaluating,

[7] DEC INDX: Average profitability of cleared virtual demand; INC INDX: Average profitability of cleared virtual supply; MKT INDX: Average profitability of all cleared virtual transactions.
[8] Day-Ahead Deviation and Headroom Charge

prioritizing and communicating MISO's market development activities that align with MISO's Strategic Plan.

Figure 19: MISO Market Evolvement Milestones

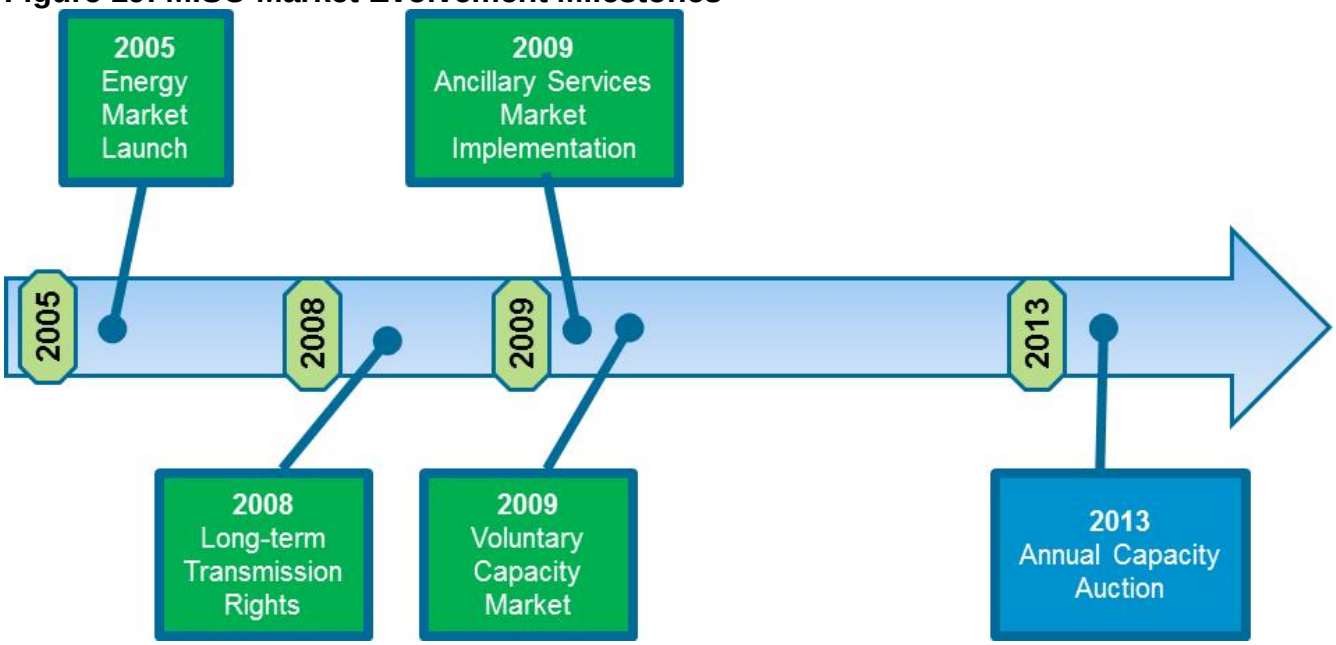
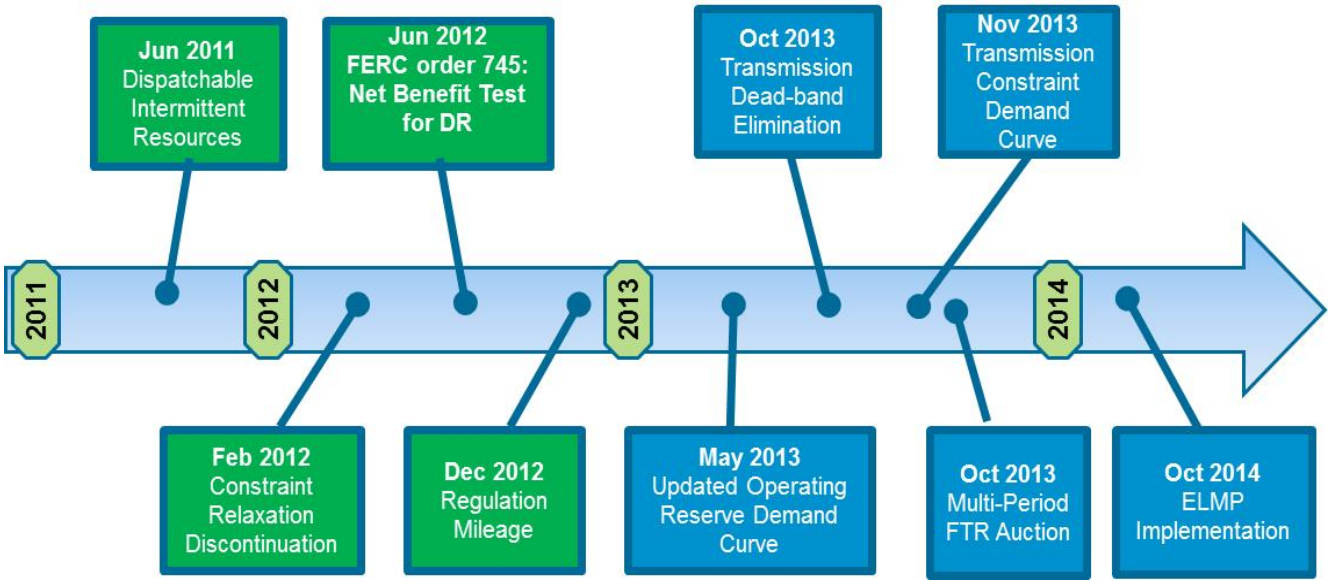


Figure 20: MISO Market Development Enhancement: 2011 to 2014



XII. South Integration

MISO South Region Market Participants successfully integrated into the MISO market on December19, 2013 after more than two years of intensive planning and training. The integration extends MISO's operational and market footprints from Manitoba, Canada to the Gulf of Mexico.

Figure 21: MISO Market Footprint

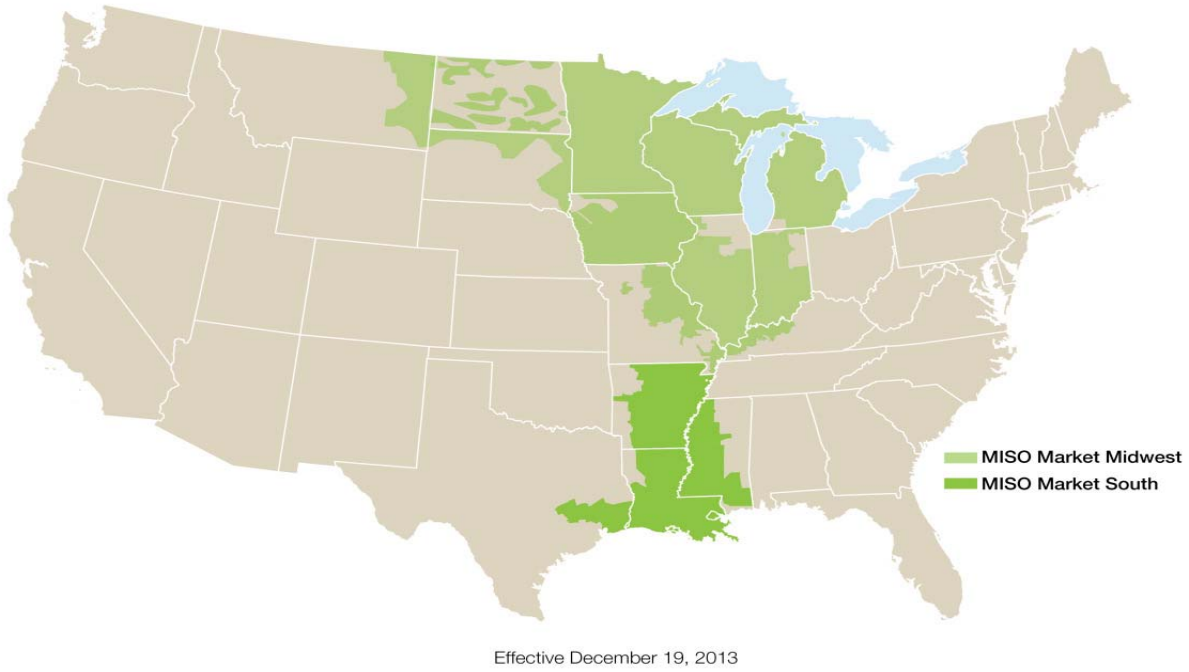


Table 4: Comparison Before and After South Integration

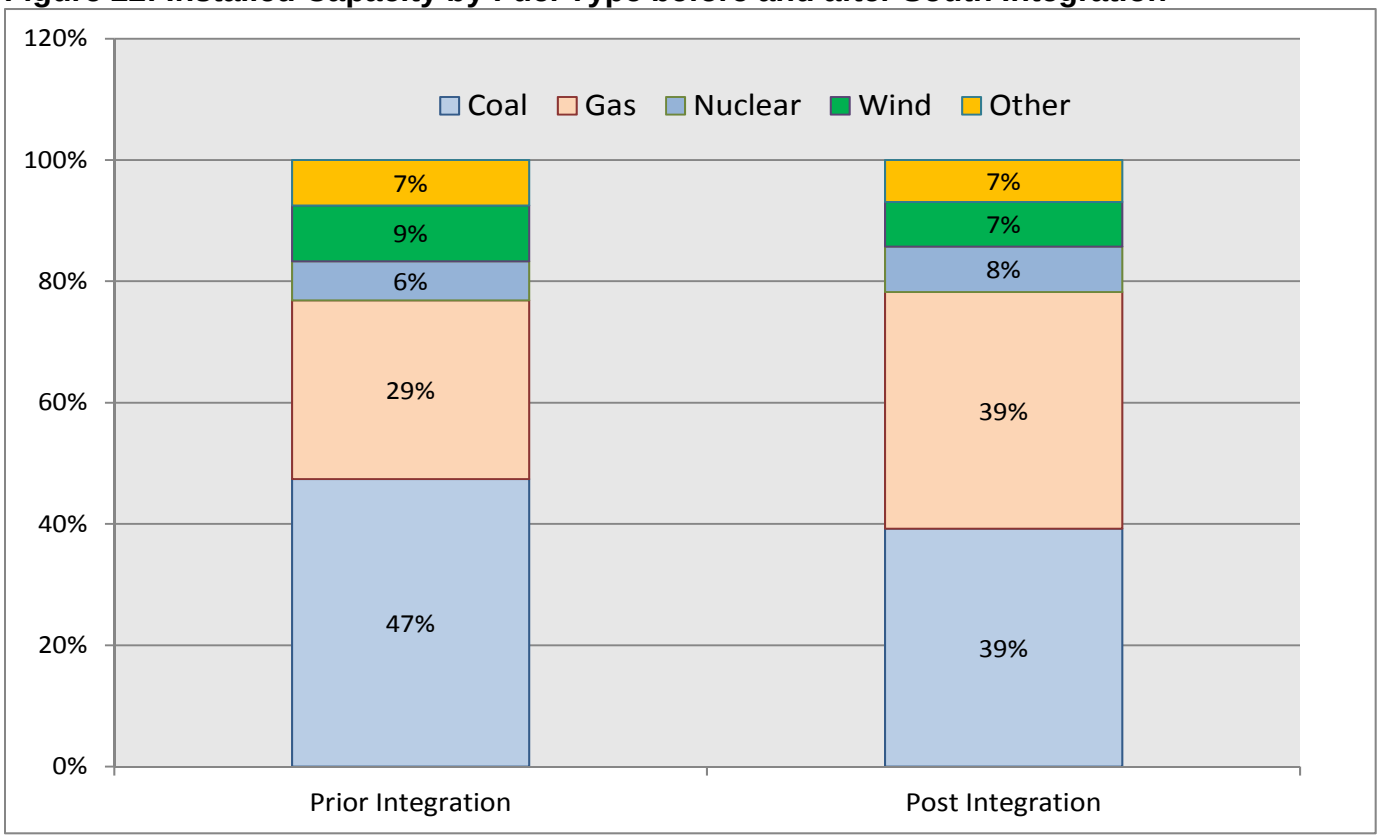
	Prior Integration	Post Integration	Increase (%)
Transmission Owners	36	46	28%
Transmission Lines (Miles)	50,000	66,000	32%
Local Balancing Authorities	28	34	21%
Market Participants	359	391	9%
Total Market Capacity* (GW)	132	177	34%
Coincident Hourly Integrated Peak Load(GW)	98	126	29%

**From Asset Administration database*

South integration provides the MISO's Midwest region easier access to natural gas and nuclear generation in the south region, reducing the MISO's dependence on coal. After south

integration, coal resources in MISO market accounted for 39% of total installed capacity, reducing from 47% recorded prior integration.

Figure 22: Installed Capacity by Fuel Type before and after South Integration



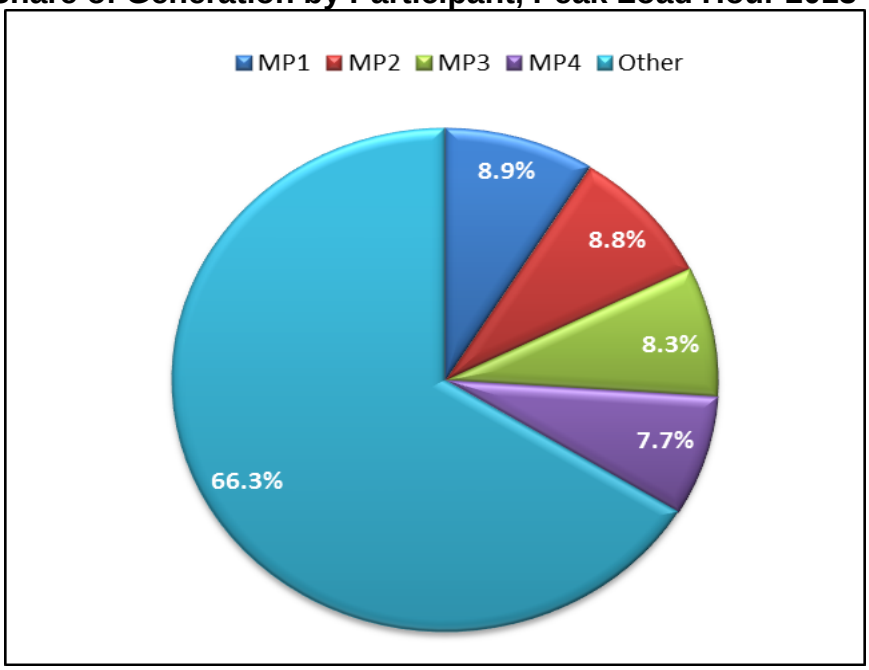
Note: *Other is comprised of Hydro, Oil, Other, Pet Coke, and Waste. Gas includes units with gas and gas/oil fuel type. Installed capacity extracted from Asset Registration database*

XIII. Market Competitiveness Evaluation

In this section, MISO assesses overall market competitiveness using two quantitative measures: Market Share and Residual Supply Index (RSI).

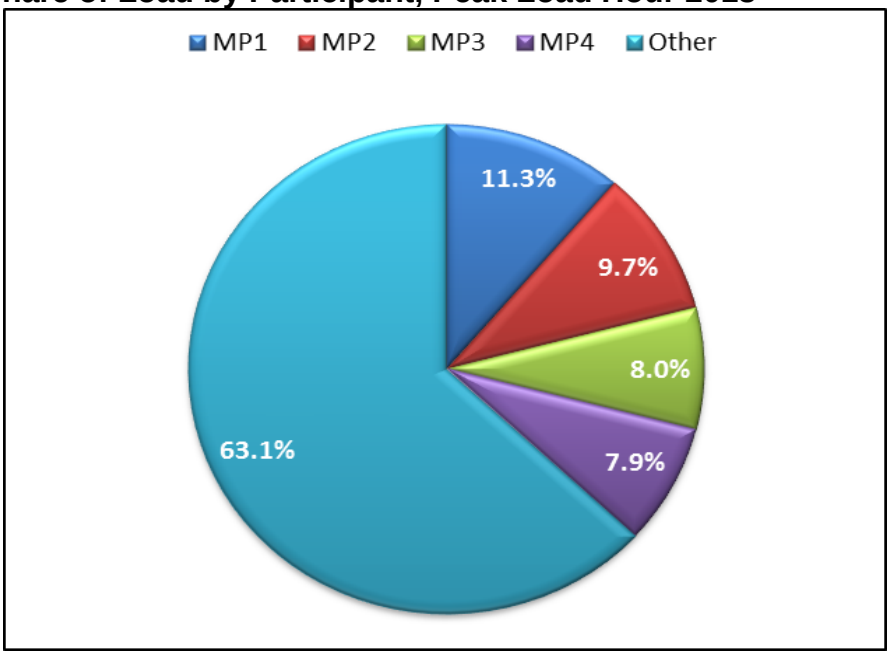
- **Market Share** is the percentage of the market controlled by the four-largest market participants. MISO assesses the market share of generation and demand during the peak load hour.
- **Residual Supply Index (RSI)** assesses the sufficiency of supply available to meet demand after removing the capacity owned by one or more market participants. MISO assesses the system-wide hourly residual supply index during 2013.

Figure 23: Market Share of Generation by Participant, Peak Load Hour 2013



- The four-largest generation suppliers provided 33.7% of the total electricity produced in the MISO region for the 2013 peak load hour, while the remaining market participants provided 66.3% of the electricity generated in that hour.

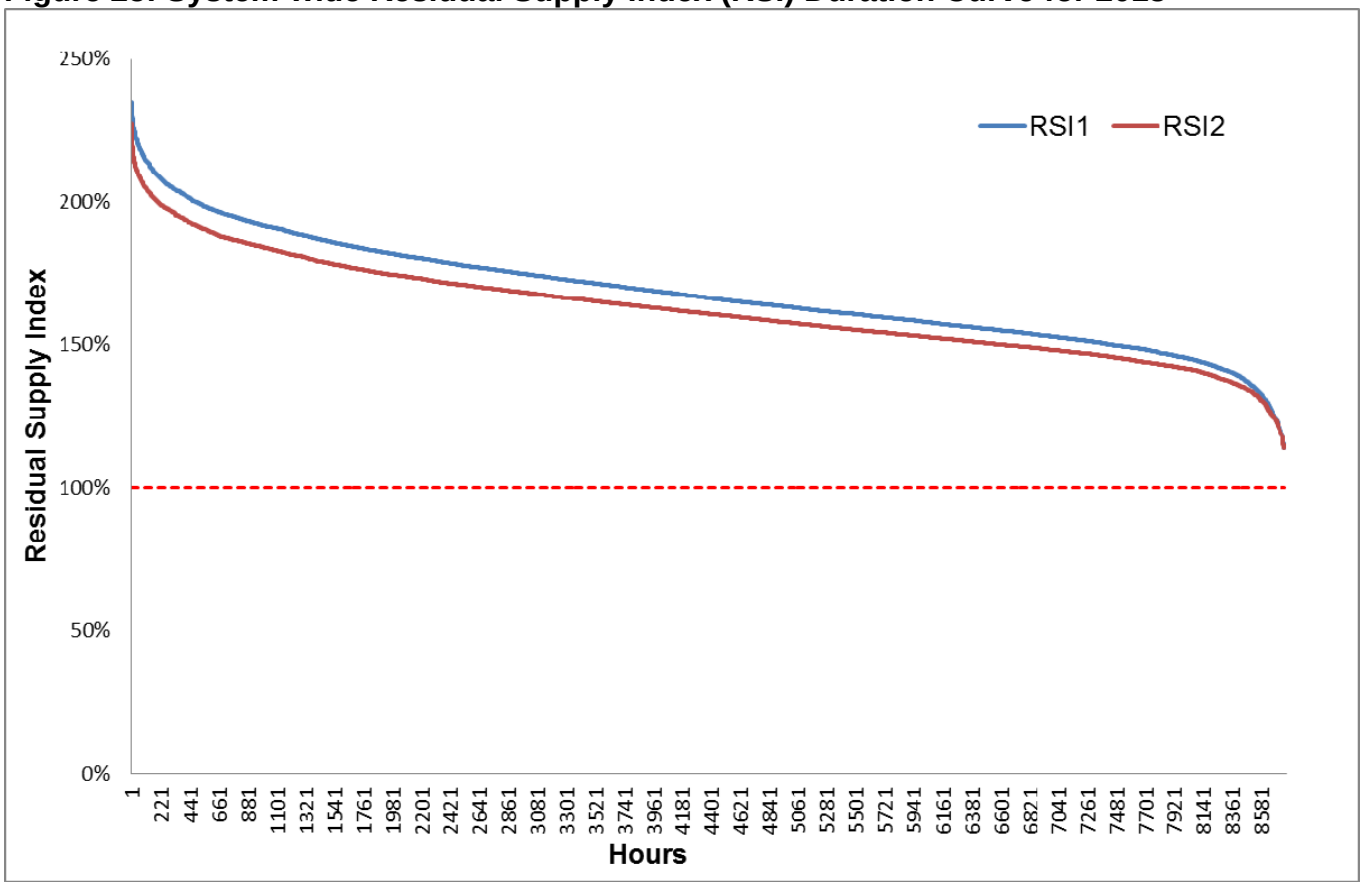
Figure 24: Market Share of Load by Participant, Peak Load Hour 2013



- The participants with the four-largest load obligations served 36.9% of the total system load for the 2013 peak load hour, while all other market participants served 63.1% of the total load in that hour.

- The four-largest generating participants and the four largest load obligation participants control less than forty percent of the total supply and demand in the MISO market. The top three of the largest generation suppliers also serve the top three largest demand users. This indicates that MISO market is competitive overall.

Figure 25: System-wide Residual Supply Index (RSI) Duration Curve for 2013



- The system-wide Residual Supply Index (RSI) measures the percentage of load obligation in a given hour (in megawatt-hours) that can be met without any available capacity from the largest supplier. When the RSI exceeds 100%, the system has sufficient capacity from other suppliers to meet demand without any capacity from the largest supplier. RSI below 100% indicates ability for a supplier to exercise market power.
- When the residual supply index is calculated by excluding the largest supplier the measure is RSI1. Excluding the two largest suppliers refers to the measure as RSI2.
- Overall, the RSI analysis for 2013 suggests that suppliers at the system level had very limited ability to exercise market power as there did not exist any hour when RSI was below 100%.
- Since the largest suppliers also have large load obligations in the MISO market, MISO has sufficient capacity from other suppliers to meet demand without any capacity from one or two largest suppliers.