

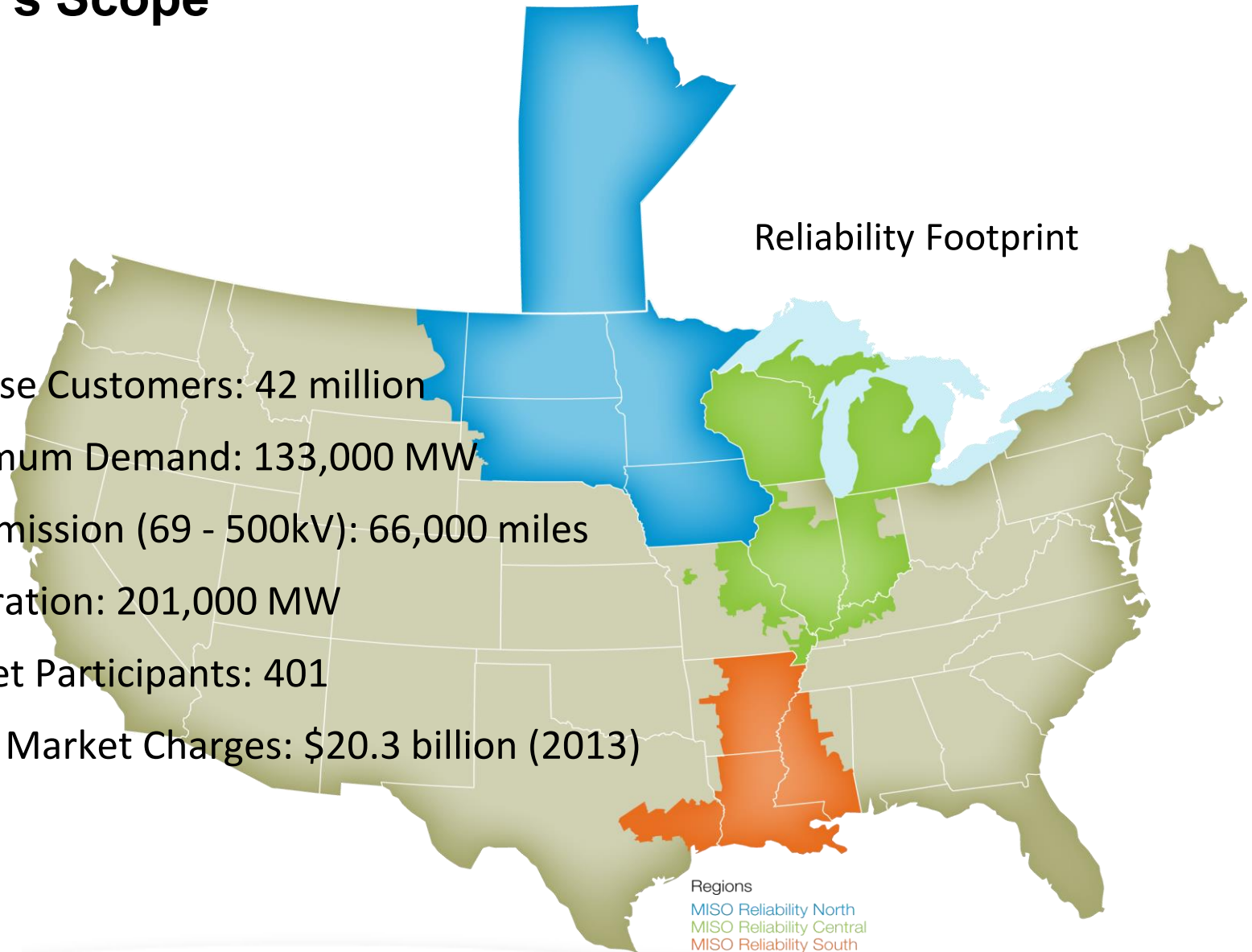
A large, light gray, stylized sunburst or fan-like graphic is centered on the page. It is composed of numerous triangular segments radiating from a central point, creating a semi-circular shape.

Quadrennial Energy Review

September 8, 2014

MISO's Scope

- End-use Customers: 42 million
- Maximum Demand: 133,000 MW
- Transmission (69 - 500kV): 66,000 miles
- Generation: 201,000 MW
- Market Participants: 401
- Gross Market Charges: \$20.3 billion (2013)



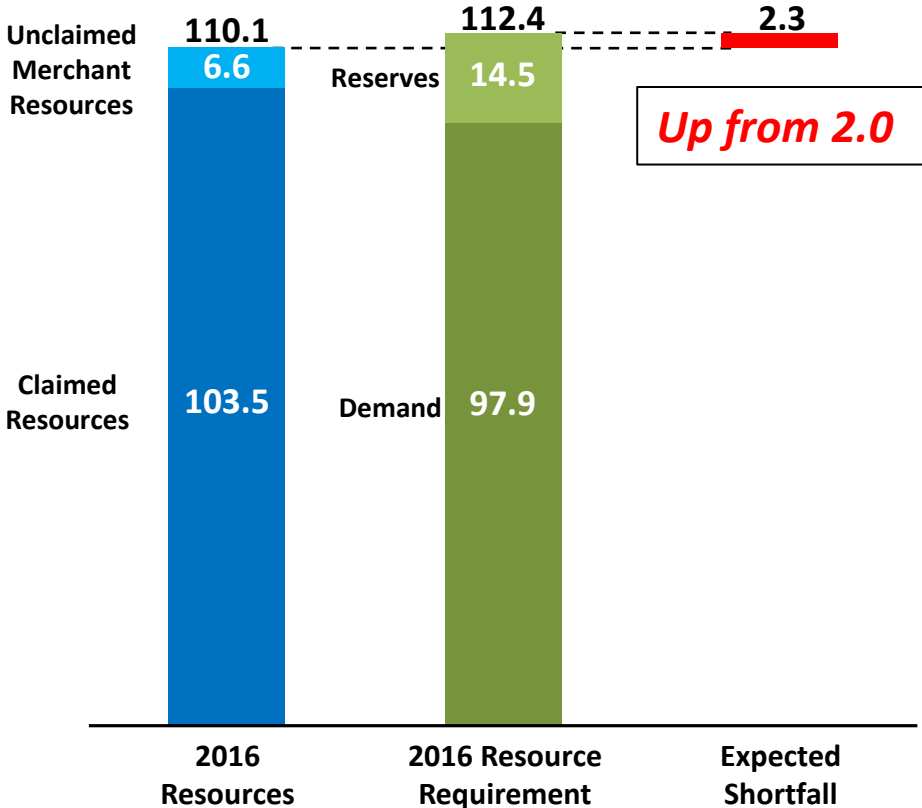
MISO's ultimate mission is to maintain the reliability of the power grid, so the nation's changing energy landscape has our full attention

- Resource Adequacy / Changing Fleet
 - Renewables Integration
 - Coal Retirements
 - Nuclear Challenges
 - Gas Growth and Cost Reduction
- Gas – Electric Coordination – To address growing reliance on gas as a generation fuel
- Seams Optimization – To continue to improve the efficiency of operations between regions

The removal of resources from the system are driving an expected reserve margin shortfall in MISO in 2016...

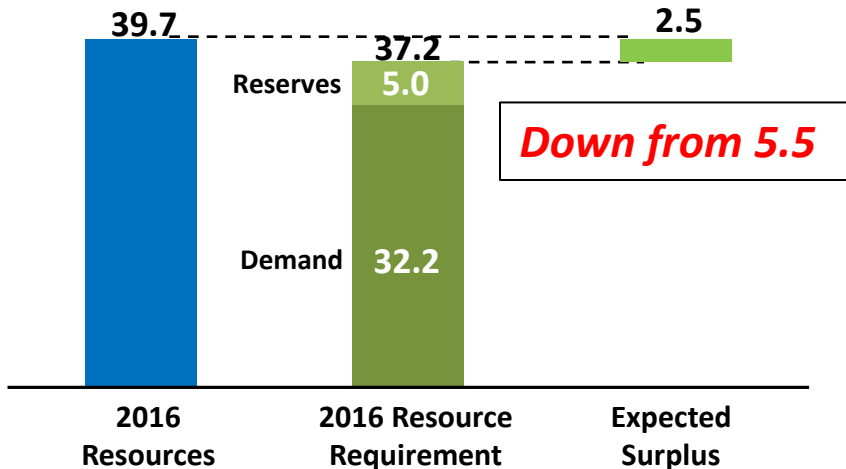
Central & North Regions

In GW



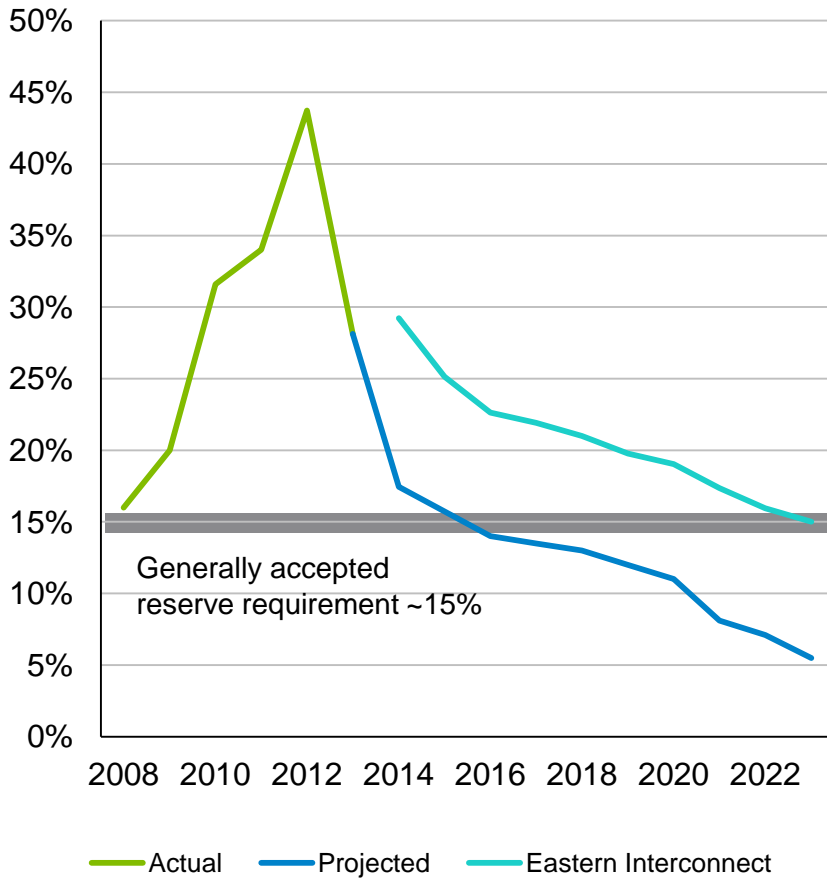
South Region

In GW



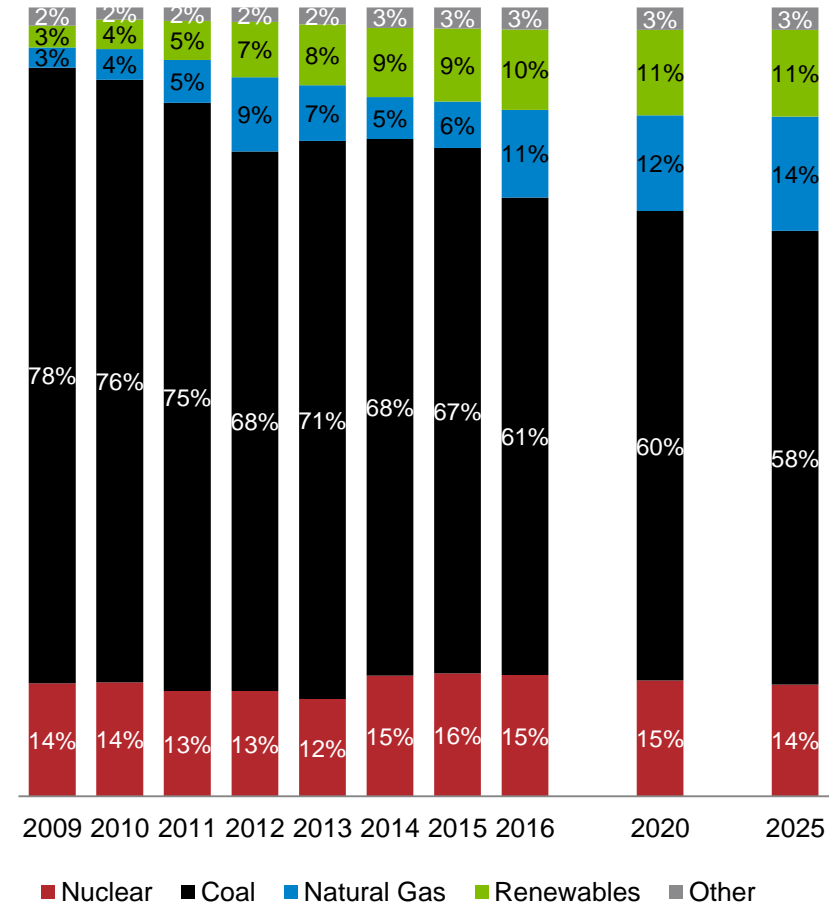
As a result of retirements and lower cost gas, MISO reserve margins will narrow and gas dependence will rise

MISO Reserve Margin



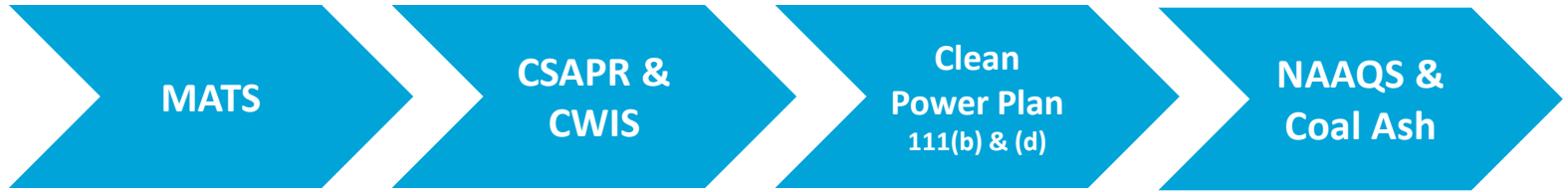
Source: Historical NERC Summer Reliability Assessments; projections from MISO and NERC 2013 Long Term Reliability Assessment for Eastern Interconnect

MISO Annual Energy Contribution by Fuel Source



Source: MISO TAM, including 2015 MTEP "Business as Usual" case for projections

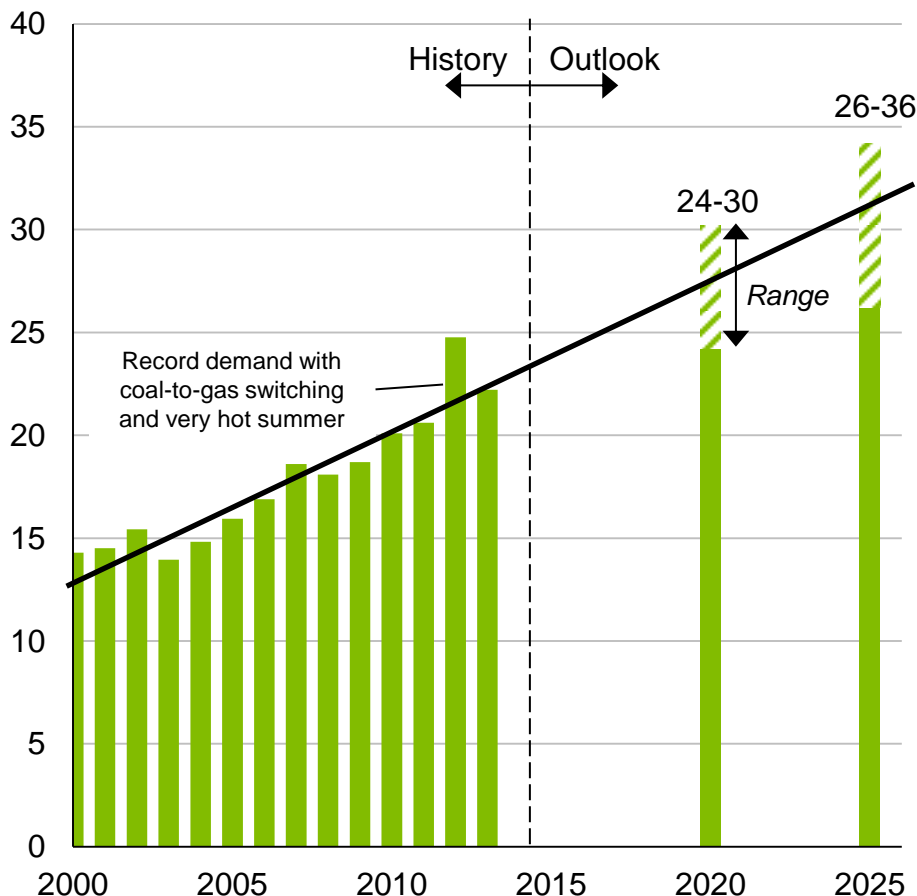
Additional environmental regulations would accelerate this trend



Nature of Regulation	Mercury and Air Toxics Standards	Cross State Air Pollution Rule and Cooling Water Regulations (316(b))	CO ₂ from existing and new power plants	New air quality standards/ Coal ash storage
Compliance Dates	2015 / 2016	As early as 2015	2015/16 (New) 2020 & beyond (Existing)	???
Impacts	<ul style="list-style-type: none"> • Significant coal retirements • Outage coordination challenges • Shrinking reserve margins around MISO • Growing dependence on natural gas 	<ul style="list-style-type: none"> • NO_x requirements tightened • Higher plant compliance costs influence retirement decisions 	<ul style="list-style-type: none"> • New coal requires CCS; baseload capacity options reduced • Significant coal retirements • Increased dependence on gas and carbon neutral resources 	<ul style="list-style-type: none"> • Increased costs • Other potential impacts depend on regulations

As the gas demand for power generation grows...

Gas Demand for U.S. Power Generation (Bcf per day)



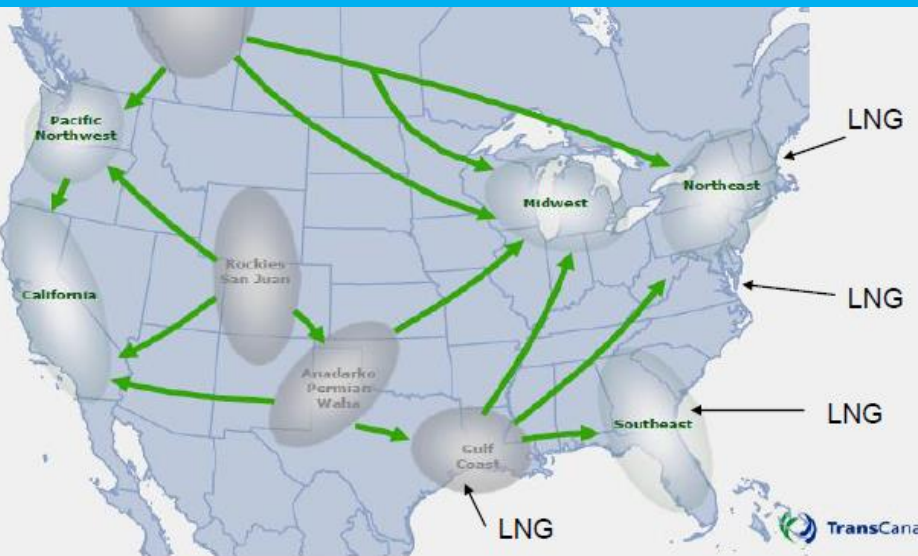
Expected demand growth through 2025 on par with past 10-15 years:

- Coal retirements
- Nuclear retirements
- Increased capacity factors for new gas units (gas-coal prices spreads)

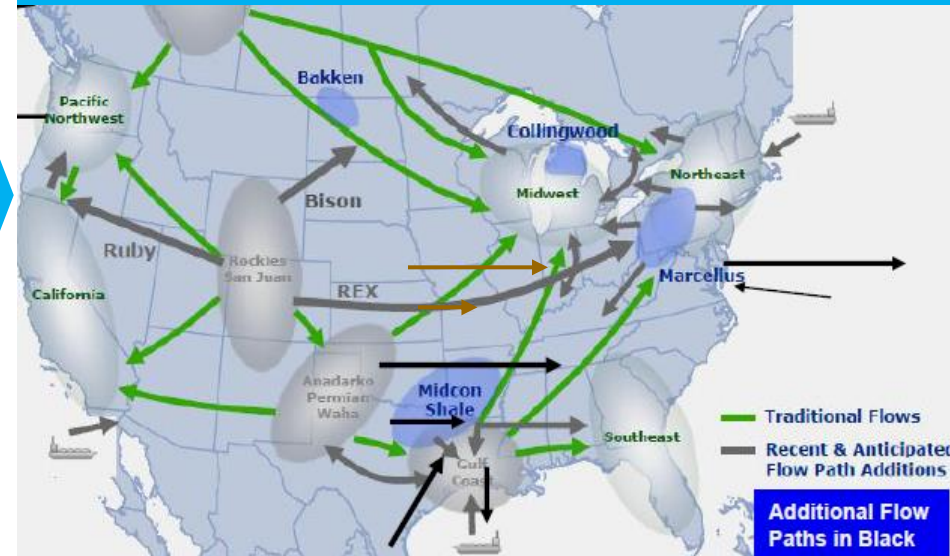
Historical data and projection from CERA May 2014 Outlook; other reference forecasts in 2020 and 2025 ranges include EIA AEO2014, UBS Gas Demand Outlook June 2014 (hereafter "UBS Outlook"), Bentek per MISO Phase III: Natural Gas-Fired Electric Power Generation Infrastructure Analysis December, 2013 (hereafter "Bentek")

... and gas basins and transportation patterns evolve...

Historic Flow Patterns and LNG Imports



Developing “Grid” Flow Patterns & LNG Exports¹



- Legacy pipelines rapidly adding firm bi-directional flow capabilities for very large volumes (instead of previously limited “displacement” options) to enable partial reverse flows
 - Notably from Northeast markets (Marcellus/Utica shale) towards Midwest and Southeast
 - Key pipeline examples towards Midwest markets: Rockies Express, ANR, and Texas Eastern
 - Key pipeline examples towards Gulf Coast markets: Tennessee Gas Pipeline, Columbia Gulf, Texas Eastern, TRANSCO, Trunkline, and Texas Gas
- Large pipeline infrastructure is also being constructed for similar objectives and also to provide new options to the east coast

¹ Graphics per TransCanada/ANR pipeline per MISO Phase I: Gas and Electric Infrastructure Interdependency Analysis, February, 2012

... which will require additional gas – electric coordination to ensure reliability and economic efficiencies

- Daily Transactional Coordination
- Informational Consolidation and Access
- Forward Outage / Maintenance Coordination
- System Operations and Optimization
- Expansion Planning

Continued enhancement of seams coordination will improve reliability and economic efficiencies – particularly as reserve margins tighten

- MISO's goal – Enable the bi-direction flow of both energy and capacity to the location where it has the most economic value – while ensuring continuous reliability
- PJM Seam – Joint and Common Market process is making progress on a number of issues
 - Interchange Optimization
 - Coordinated Transaction Scheduling
 - Cross Border Planning
- SPP Seam – On-going efforts include
 - Transmission Capacity Sharing
 - Market-to-Market Congestion Management – Spring 2015 implementation planned
 - MISO-SPP Coordinated System Plan Study
- Active discussions are also on-going with other seams partners

Policymakers can significantly impact the effectiveness of the electric industry's planning efforts

- Targeted at maximizing the industry's planning capabilities, MISO offers the following for consideration:
 - Expanded coordination and consultation between EPA, FERC and DOE
 - Rule making processes and timelines that allow ample time to explore and address unintended consequences