Who We Are

“Our mission is to deliver reliable, least-cost energy for end-use consumers.”

MISO provides reliable system operations through:

- **Real time operations**
  Safe and reliable operation of the electricity grid

- **Market operations**
  Open energy markets, including centralized scheduling and economic dispatch of generation to support reliable and efficient operation

- **Planning**
  For safe, reliable and economically efficient transmission expansion

MISO is an independent, non-profit organization responsible for maintaining reliable transmission of power in 15 states and the Canadian province of Manitoba.
What We Do

MISO’s role in the overall process is here – managing flows on the transmissions system by directing generator usage.

1. Generation
Power is generated by turning an energy source into electricity. In MISO, sources include coal, natural gas, nuclear and renewable power.

2. Transmission
Allowing the flow of electricity to bridge long distances, MISO’s member transmission lines and towers support more than 65,787 miles of electricity flow.

3. Distribution
Allows energy to be moved from transmission lines closer to end users, ensuring reliability and power quality.

4. Final Delivery
As travel distance decreases, smaller power lines are used to reach business, industrial and residential end use customers.
Scope of Operations

- **132,893 MW** historic peak load
- **201,390 MW** generation capacity
- **$20.3 billion** in Gross Market Charges
- **391** market participants who serve **42 million** people
North American Electric Grid Operators
MISO’s involvement in generating unit compliance with emission regulations results directly from its role in managing grid asset utilization

Supply offers submitted for generating units to MISO

Offers stacked by cost; cheapest units committed (scheduled) by MISO systems based on expected demand and constraints

Units dispatched - instructed to produce a specific amount of power – in real time by MISO systems

- Factors causing resources to become unavailable (retirement/suspension) would affect the amount of supply offered into the MISO Market to meet demand
- Factors impacting cost of plant operations (and thus offer) could affect frequency and magnitude of utilization in MISO Market
- Utilization by MISO systems will directly impact fuel usage, and thus the level of emissions produced by each plant
The generation fleet in MISO is being affected by timing, fuel prices and multiple phases of environmental regulations.

<table>
<thead>
<tr>
<th>Nature of Regulation</th>
<th>MATS</th>
<th>CSAPR &amp; CWIS</th>
<th>GHG</th>
<th>NAQQS &amp; Coal Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury and Air Toxics Standards</td>
<td>Cross State Air Pollution Rule and Water Regulations (316(b))</td>
<td>Carbon regulations (Clean Power Plan)</td>
<td>National Ambient Air Quality Standards? Coal Ash? Other?</td>
<td></td>
</tr>
<tr>
<td>Compliance Dates</td>
<td>2015 / 2016</td>
<td>As early as 2015</td>
<td>2020-2030</td>
<td>???</td>
</tr>
<tr>
<td>Impacts</td>
<td>• Significant coal retirements</td>
<td>• CSAPR is subject to ongoing litigation</td>
<td>• Draft Rule released June 2014</td>
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<tr>
<td></td>
<td>• Outage coordination challenges</td>
<td>• EPA sought lift of stay on CSAPR – could make rule effective as early as 2015</td>
<td>• Continued pressures on reserve margins</td>
<td></td>
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<tr>
<td></td>
<td>• Shrinking reserve margins around MISO</td>
<td>• Final water intake rule released May 2014.</td>
<td>• Increased dependence on natural gas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Growing dependence on natural gas</td>
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These factors will culminate in the erosion of reserve margins and an increase in reliability risk.
MISO’s 2011 EPA Impact Analysis findings set the stage for multi-faceted efforts to better understand and prepare for upcoming industry changes.
Plans and work to bring plants into compliance with the MATS rule are progressing...

Individual Technology Phases 1st Q 2014 Survey
Capacity, GW

<table>
<thead>
<tr>
<th>Technology</th>
<th>Work Required (GW)</th>
<th>Work Scheduled (GW)</th>
<th>Work Contracted (GW)</th>
<th>Outage Scheduled (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI</td>
<td>25.8</td>
<td>20.5</td>
<td>17.6</td>
<td>20.3</td>
</tr>
<tr>
<td>DSI</td>
<td>10.1</td>
<td>9.4</td>
<td>6.2</td>
<td>9.4</td>
</tr>
<tr>
<td>FGD</td>
<td>8.4</td>
<td>8.4</td>
<td>8.4</td>
<td>8.4</td>
</tr>
<tr>
<td>Baghouse</td>
<td>6.7</td>
<td>6.7</td>
<td>5.9</td>
<td>5.9</td>
</tr>
<tr>
<td>SCR</td>
<td>5.9</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>ESP</td>
<td>1.3</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**ACI:** Activated Carbon Injection; **DSI:** Dry Sorbent Injection; **FGD:** Flue Gas Desulfurization; **SCR:** Selective Catalytic Reduction; **ESP:** Electrostatic Precipitator
…but MISO’s quarterly survey of Asset Owners continues to indicate unit retirement will be the choice of many.

### Coal Resources Affected 1st Q 2014 Survey Capacity, GW

- **66.2** units: Total Coal, required action
- **17.0** units: No Action Required
- **49.2** units: Total Affected
- **3.1** units: Action Completed
- **35.5** units: Controlled Required
- **8.2** units: Uneconomic/Replace
- **98** units: TBD
- **1.0** units: No Response
- **294** units: Total Coal, Affected
- **245** units: Total Affected
- **101** units: Action Completed
- **1.4** units: TBD
- **1.0** units: No Response
The significant loss of capacity is driving an expected reserve margin shortfall in 2016. As of June 2, 2014

**Central & North Regions**

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<thead>
<tr>
<th></th>
<th>In GW</th>
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<tbody>
<tr>
<td>Unclaimed Merchant Resources</td>
<td>110.1</td>
<td>6.6</td>
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<tr>
<td>Reserves</td>
<td>112.4</td>
<td>14.5</td>
<td>2.3*</td>
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**South Region**

<table>
<thead>
<tr>
<th></th>
<th>In GW</th>
<th></th>
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<tbody>
<tr>
<td>2016 Resources</td>
<td>39.7</td>
<td></td>
</tr>
<tr>
<td>Reserves</td>
<td>37.2</td>
<td>2.5</td>
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<tr>
<td>Demand</td>
<td>32.2</td>
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*A shortfall figure means that the probability of a loss of load event increases. A 2.3 GW shortfall would result in a 12.5% PRM, resulting in approximately a .2 day/year probability of a loss of load event.
GHG regulation will be the next to impact supply; flexibility will be essential to achieve carbon reductions at lower costs.

Preliminary results show that, for given policy and economic conditions, certain combinations of carbon reduction strategies are more cost effective than others. Strategies modeled do not represent an exhaustive range of compliance options.

Each diamond indicates a carbon reduction strategy. Strategies modeled are examples, not recommendations.
Preliminary analysis indicates that one carbon management strategy alone may not be able to achieve emission reduction targets...
Achieving emissions reductions regionally is economically beneficial compared to sub-regional solutions

- $30B-$180B compliance cost (20-year NPV) for range of strategies that would enable a 30% reduction
- $3B-$5B savings annually, or $30-$50B over 20 years (NPV), under a regional implementation
GHG Regulation Impact Analysis

• **Study Initiation** – Planning Advisory Committee, May 2014

• **Purpose** - Inform stakeholders on potential carbon regulation impacts

• **Intent** of this study is to:
  – Understand the impacts of the carbon regulations on the generation fleet and load in the MISO footprint

• **Intent** of this study is **not** to:
  – Recommend any specific compliance plan to meet the regulation
  – Enable support or opposition to this regulation

• **First Look** – Initial results may lend to additional analysis, as appropriate and determined in collaboration with stakeholders
Stakeholders are an integral part of this study process...
Study Scope

Draft Rule → Modeling Assumptions → Analyze → Impact Analysis

Stakeholder Input and Review
Using Electric Generation Expansion Analysis System (EGEAS)

- Phase 1: Calculate compliance costs for Regional (footprint-wide) vs. Sub-regional (LRZ level) carbon management
  - Using the building blocks individually and in combination as proposed in the draft regulation
- Phase 2: Based on stakeholder feedback, examine the range of reduction achievable in various sensitivities

<table>
<thead>
<tr>
<th>July/August</th>
<th>September</th>
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<tbody>
<tr>
<td>Develop Scope</td>
<td>Preliminary Results</td>
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<tr>
<td>Data Validation</td>
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<tr>
<th>August/September</th>
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<tr>
<td>Analysis</td>
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</table>
Phase 1: An assessment of EPA’s building blocks

- **Building Block 1**
  - Cost of Compliance
  - Emissions Reduction Achieved

- **Building Block 2**
  - Cost of Compliance
  - Emissions Reduction Achieved

- **Building Block 3**
  - Cost of Compliance
  - Emissions Reduction Achieved

- **Building Block 4**
  - Cost of Compliance
  - Emissions Reduction Achieved

- **All building blocks**
  - Cost of Compliance
  - Emissions Reduction Achieved

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Regional (Footprint-wide)

Sub-Regional (Local Resource Zones)
Phase 2: Proposed Sensitivities

- **Demand and Energy Growth Rates**
  - BAU: 3.44
  - High: 5.16

- **Natural Gas Prices ($/MMBtu)**
  - Base RPS: 3.44
  - 15% Regional: 4.30
  - 20% Regional: 5.16

- **Carbon Costs ($/ton)**
  - Base RPS:
    - 0
    - 10
    - 25
    - 50

- **Additional Coal Retirements**
  - No additional
  - 25%
  - 50%

- **EE as a % of sales**
  - Base
    - 0.75%
    - 1.5%

- **Nuclear Retirements**
  - No Nuclear Retirements
  - 60-year life Nuclear