Strategy Update: Reliability Imperative

MISO Board of Directors

March 21, 2024
Executive Summary

- The updated Reliability Imperative report focuses on the urgent and coordinated action needed to ensure grid reliability.
- The entire electric industry is facing the challenge of a hyper-complex risk environment.
- To address these challenges, utilities, states, other stakeholders and MISO must work together and move urgently to find solutions.
- Executing on the Reliability Imperative will continue to increase the ‘Value Proposition’ MISO provides to its members.
MISO’s Response to the Reliability Imperative highlights the urgent and coordinated action needed to ensure reliability

- First introduced in 2020, the fourth update to the Reliability Imperative report addresses:
  - Pace of change is faster than predicted
  - Magnitude and complexity of change is greater than expected

- Urgent and coordinated action is needed to address these challenges

- The Reliability Imperative continues to build off the tremendous work done with stakeholders...but there is much more to do

The entire electric industry is challenged by a hyper-complex risk environment.
The increasing risk and complexity require significant transformational changes to our grid, markets, operations and technology.

Potential long duration wind droughts

MISO Hourly Wind Output
January & February - 2020 (MW)

- Long duration wind droughts can occur again
- Current storage solutions are helpful for shorter term, but not longer-term wind droughts

~ 40 hours of essentially zero wind

Shifting net load shapes

Future System Net Load
Average Summer Day - 2032 (GW)

- ‘Duck curve’ effect will increase with higher solar penetration
- Operating conditions will require increased flexibility (~ 40 GW of ‘up-ramp’ capability)

High ramp need in early evening
Because resources and load are changing faster and more profoundly than anticipated, the transition is posing adverse challenges to reliability.

<table>
<thead>
<tr>
<th>Load Additions &amp; Growth</th>
<th>Resource Accreditation Changes</th>
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<tbody>
<tr>
<td><strong>Issue</strong>&lt;br&gt;New energy-intensive facilities and electrification trends could dramatically increase load needs</td>
<td><strong>Issue</strong>&lt;br&gt;Accurately forecasting a resource’s availability to contribute to meeting future reliability needs is vital</td>
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<tr>
<td><strong>Issue</strong>&lt;br&gt;Ability to meet both economic development and policy goals simultaneously may be challenged</td>
<td><strong>Issue</strong>&lt;br&gt;Resource accreditation that reflects their true availability during high-risk periods is increasingly important</td>
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<table>
<thead>
<tr>
<th>Pace of Resource Additions</th>
<th>Pace of Resource Retirements</th>
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<tr>
<td><strong>Issue</strong>&lt;br&gt;Even resources with full interconnection approval can experience significant delays in coming online</td>
<td><strong>Issue</strong>&lt;br&gt;Dispatchable resources may retire prematurely due to environmental regulations and clean energy policies</td>
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<td><strong>Issue</strong>&lt;br&gt;Potential delays in plans for new resource additions with the necessary capabilities may imply a lack of sufficient reliability attributes going forward</td>
<td><strong>Issue</strong>&lt;br&gt;Need to maintain transition resources and moderate retirements until new technologies are viable at grid scale</td>
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Large new loads, including manufacturing facilities and high-demand data centers, are not yet fully reflected in Load Serving Entity forecasts.

Announced Manufacturing Facilities since January 2021

U.S. Department of Energy observations¹:
- 200+ new manufacturing facilities for transportation and clean energy industries have been announced since the Inflation Reduction Act was passed.
- Parts of MISO, especially Michigan and Indiana, are highlighted by DOE as being areas where the $100 billion investment is concentrated.

MISO observation:
- The near-term load addition and growth is likely understated in MISO’s current load forecasts (e.g., OMS²-MISO Survey), especially in MISO South with heavy industrial presence.

¹ U.S. Department of Energy, Building America’s Clean Energy Future, as of February 25, 2024
² Organization of MISO States (OMS)
Because those forecasts do not fully accommodate new loads, requests for expedited transmission solutions are increasing.

**Expedited Project Reviews (EPR) Requests & Drivers**

- **Requests by Region**
  - 2020: Central 5, East 10, North 15, South 10
  - 2021: Central 5, East 10, North 15, South 10
  - 2022: Central 5, East 10, North 15, South 10
  - 2023: Central 5, East 10, North 15, South 10

- **Request Drivers**
  - Load
  - Retirement
  - Reliability
  - DOT construction (Department of Transportation)

**Observations by Grid Strategies**

- A significant portion of the increased level of Expedited Project Review requests are to accommodate large load additions.
- The timing of EPRs can limit available solutions versus planning over a longer time horizon for a higher load forecast.
- A MISO load forecast update in 2023 showed a modest 0.3% increase for 2028, indicating limited inclusion of new large loads.

*Grid Strategies: “The Era of Flat Power Demand is Over,” December 2023*
Solar accreditation will decline as penetration increases, so accurate accreditation is critical

As higher levels of solar penetration shift risk into the early evening hours, solar accreditation values fall off

1 Assumption used in Future 2A. Assumes 50% solar accreditation through 2027 and a 3%/year decline starting in 2028, leveling off at 20% in 2037 and beyond, MISO Futures Report, Nov. 2023

2 Indicative trend in accreditation using proposed Direct Loss of Load (DLOL) method, Resource Accreditation White Paper, V.2
The potential for new additions of accredited capacity may be optimistic given recent trends and improved accreditation for solar and wind resources.

### 2023 OMS-MISO Survey: Potential New Capacity Additions + GIAs

<table>
<thead>
<tr>
<th>Year</th>
<th>Potential New Capacity Additions</th>
<th>GIA Projects</th>
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<tbody>
<tr>
<td>2024</td>
<td>6.9 GW/yr</td>
<td>2.9 GW/yr</td>
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<tr>
<td>2025</td>
<td>13.0 GW/yr</td>
<td>7.0 GW/yr</td>
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<tr>
<td>2026</td>
<td>23.0 GW/yr</td>
<td>10.9 GW/yr</td>
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<tr>
<td>2027</td>
<td>29.0 GW/yr</td>
<td>11.7 GW/yr</td>
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<tr>
<td>2028</td>
<td>33.0 GW/yr</td>
<td>11.9 GW/yr</td>
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- **Implications**
  - Recent experience with new capacity additions has been 2–3 GW/year of new accredited capacity.
  - Potential new capacity in OMS²-MISO Survey may be overstated.
  - Applying new accreditation method implies an even slower pace of accredited capacity additions, especially solar.

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1. Generator Interconnection Agreement (GIA) signed or being negotiated
2. Organization of MISO States (OMS)
Policy direction is driving MISO members to accelerate thermal unit retirements which increases near-term risk and the need for reliability enhancing transition resources.

- Member/state clean energy and decarbonization goals
- U.S. Environmental Protection Agency (EPA) regulations:
  - Carbon Rule (proposed)
  - Good Neighbor Rule
- Inflation Reduction Act and Infrastructure Bill

Retirements are being accelerated by headwinds like EPA regulations, which may drive significant dispatchable resource reductions in 2032 and 2035 when key compliance deadlines occur.
The Reliability Imperative outlines transformative work across MISO to reliably support and enable member and state goals and strategies.

**RELIABILITY CHALLENGES**

- Attributes needed to ensure reliability will become more scarce
- Extreme weather events are more frequent and severe
- Large single-site load additions and incremental load growth
- Fuel-assurance issues with gas pipelines and other energy infrastructure
- Supply chain and permitting issues are delaying generation projects
- Investor preferences to/not to finance new energy projects

**KEY INITIATIVES**

<table>
<thead>
<tr>
<th>MARKET REDEFINITION</th>
<th>Resource Accreditation</th>
<th>Reliability Attributes</th>
<th>Pricing Reforms</th>
<th>Forecast Uncertainties</th>
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<tbody>
<tr>
<td>OPERATIONS OF THE FUTURE</td>
<td>Uncertainty &amp; Variability</td>
<td>Planning &amp; Preparedness</td>
<td>Situational Awareness &amp; Critical Communications</td>
<td></td>
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<tr>
<td>TRANSMISSION EVOLUTION</td>
<td>Long Range Transmission Planning</td>
<td>Generator Interconnection</td>
<td>Joint Transmission Planning^{2}</td>
<td></td>
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<tr>
<td>SYSTEM ENHANCEMENTS</td>
<td>Hybrid Cloud Capability</td>
<td>Fortify Cybersecurity</td>
<td>Advanced Data Analytics Capabilities</td>
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^{1}Partial listing of initiatives;  
^{2}Includes Joint Targeted Interconnection Queue (JTIQ)
With stakeholder engagement to prioritize and sequence critical work, we expect to make significant progress on key initiatives.

**Examples of deliverables in 2024**

### MARKET REDEFINITION

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Scarcity Pricing</th>
<th>Reliability Metrics</th>
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<td><em>Integrate and prioritize solutions identified in the Attributes Roadmap across multiple areas of the business</em></td>
<td><em>Send right signals about the value of energy and other products leading up to and during scarcity conditions</em></td>
<td><em>Recognize the limitations of the Loss of Load Expectation metric to determine system adequacy</em></td>
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**Deliverables**

- Further modernize the Resource Adequacy construct
- Focus market signals on emerging flexibility needs
- Require capabilities to strengthen the grid

### TRANSMISSION EVOLUTION

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<th>LRTP</th>
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<td><em>Tranche 2 requires the need to plan quickly and develop a robust, least regrets portfolio of projects</em></td>
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**Deliverables**

- Complete additional analysis, robustness testing and business case
- Seek Tranche 2 approval in 2024

### MARKET REDEFINITION

**Reliability Metrics**

- Evaluate new or additional risk metrics for resource adequacy assessments and their potential to improve underlying risk models

**LRTP**

- Present proposed changes to relevant pricing curves for stakeholder feedback
- File proposed Tariff revisions with FERC
Executing on the Reliability Imperative will continue to increase the value MISO provides

**2023 Analysis**

- **Annual benefits** grew more than 20%, from $4 billion in 2022 to: $4.9 billion
- **Cumulative benefits** since 2007 are: $45 billion
- **Benefit-to-cost ratio** grew from 12:1 in 2022 to: 15:1

**'Forward View' projection***

- **Annual benefits in 2040** expected to be: ~$13 billion

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*Results are illustrative for 2040, based on how the region is expected to grow and change as the resource fleet evolves. Report at [https://www.misoenergy.org/meet-miso/MISO_Strategy/miso-value-proposition/](https://www.misoenergy.org/meet-miso/MISO_Strategy/miso-value-proposition/)*
Conclusion

• Urgent and coordinated action is needed to ensure grid reliability is the major focus of the Reliability Imperative

• The hyper-complex risk environment is a challenge shared by the entire electric industry

• Utilities, states other stakeholders and MISO must work together and move faster to find solutions and prioritize critical work

• Collaboratively addressing industry challenges and executing the Reliability Imperative will increase the value of working with MISO