Planning for an Uncertain Future

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MISO’s strategic objectives reflect our broad response to the nation’s changing energy landscape

MISO Vision – The most reliable, value-creating RTO

- **Market and Grid Positioning**
  - Portfolio Evolution (Environmental Policy and Economics)
  - Electric – Gas Coordination
  - Seams Optimization
  - Grid Technology Advancement
  - Infrastructure Development Enablement

- **Serve & Grow Membership**
  - Serve Existing Members – North/Central
  - Serve Existing Members – South
  - Strategic Member Expansion

- **Provide Independent Thought Leadership**
  - Regional Modeling & Analytics
  - Policy-Level Relationships, Reputation & Visibility
  - Platform Provider for Policy Implementation

**Strategic Objectives**

**Strategy Initiatives**

**Strategic Competencies**

- People
- Process
- Technology
MISO has gained experience with uncertainty while its focus has expanded from reliability and open access to value creation.
A key conduit of value creation is our transmission planning process, which we have advanced over time to account for a growing set of project drivers and future uncertainty.

Objective is to take a holistic look at multiple drivers to maximize the value of regional transmission:

- Changes in resource mix
- North/Central and South footprint diversity
- Reliability to address generation retirements
- Low cost energy delivery across footprint
- Federal and state energy policy compliance planning
Four years of executing that process culminated in a $5.6 billion Multi-Value Project portfolio being approved in 2011.
Key parameters have changed since 2011, but portfolio reviews continue to project benefits that exceed original estimates.

Benefit by Value Driver
(20 to 40 year present values; in 2016$, millions)

- Congestion & Fuel Savings: $33,400
- Operating Reserve Margin: $0
- Planning Reserve Margin: $1,900
- Transmission Line Losses: $700
- Wind Turbine Investment: $2,400
- Future Transmission Investment: $800
- Total Benefits: $39,200
- Total Costs (Sum of Annual Revenue Requirements): $16,000
- Net Benefits: $23,200
- MTEP 2011 Net Benefits: $19,900

* Value not updated for MTEP16 MVP Limited Review
While portions of that portfolio are still in progress additional change is occurring, with many factors pushing the industry towards a lower carbon future...

**Environmental / Regulatory**
- Mercury & Air Toxics Standards (MATS)
- Air-quality standards for ozone, SO₂, etc.
- *Potential* greenhouse gas regulations

**Economics**
- Low-cost natural gas
- Economic recovery
- Demand growth shift
- Infrastructure investment

**State & Federal Policy**
- Renewable portfolio standards
- Energy efficiency/demand-side management programs
- Tax credits
- FERC orders addressing demand response participation in wholesale energy markets

**Evolving Technologies**
- Wind power
- Solar energy
- Energy storage
- Distributed generation
- Load-modifying resources

**Electric Industry**

While portions of that portfolio are still in progress additional change is occurring, with many factors pushing the industry towards a lower carbon future...
...driving wind and gas generation, and forecasts for future utilization higher...

![Actual Wind Generation Graph]

Wind was 9% of total generation in 2015; 15,000 MW Capacity

![Gas Share Graph (MISO North/Central)]

Historical Actuals
Regional CPP Planning Scenario Forecast

6% 11% 8% 7% 12% 16% 40%

...and spurring greater potential for emerging technologies in the MISO footprint.

**Energy storage** evolving rapidly but not yet cost competitive in MISO.

Minimal **solar** penetration today, but economics and public policy are driving to higher penetration potential.

MISO’s use of **synchrophasor technology** will continue to evolve with technology maturation.

**HVDC technology** is both in-use and being evaluated for expanded use in the MISO footprint.
Adding to the challenge is uncertainty around long-term gas prices, state renewable goals and load growth, which significantly impacts long-term capacity needs.

*MTEP17 Gross and Net Peak Demand Forecasts*

* - *Net Forecasts* are the *Gross Forecasts* less economically selected energy efficiency programs; high and low forecasts reflect LRZ 9 Industrial load being modeled low and high (respectively)
To ensure preparedness for an uncertain future we are evaluating system needs under a range of outcomes, for which the projected generation mix varies significantly.
Many considerations remain to plan and position the region and industry for the changing energy landscape.

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<th>Driver</th>
<th>Implications</th>
<th>Considerations to address</th>
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| Policy | • Growing share of highly intermittent renewable energy  
       • Reducing share of stable carbon-intensive generation and capacity | How do we maintain reliability and efficiency as our resource portfolio evolves? |
| Technology | • Increasing intermittent solar investment and production at distributed and bulk energy levels  
             • Increasing storage use and demand response | How do we ensure sufficient capacity during this transition as resources are removed from the system faster than replacements are brought on-line? |
| Fuels | • Growing natural gas generation and, in turn, declining coal investment and generation  
       • Dropping nuclear generation potential | How do we overcome the differences in philosophy and methods between neighbors so that interregional opportunities can be seized? |
| Regulation | • Accelerating renewables growth, increasing coal generation costs, likely leading to coal retirements | How do Load Modifying Resources fit into the equation? |
| Markets | • Increasing need to incorporate many more generating units into market algorithms  
          • Rising need for better forecasting at bulk and distributed levels and operating flexibility to handle inevitable forecast errors | How does energy efficiency fit into the equation? |