MISO’s mission is to drive value creation through efficient reliability/market operations, planning and innovation

• **Footprint:**
  – 15 States
  – 1 Canadian Province
  – City of New Orleans
  – 42 million end-use customers
  – 65,800 miles of transmission

• **Generation Capacity:**
  – 175 GW (market)
  – 191 GW (reliability)

• >170 Members

• >430 Market Participants

*MISO is a “policy taker, not maker”…. a thought partner that provides independent assessment on policy choices*
MISO follows Transmission Planning Guiding Principles to ensure reliability, support policy requirements, and enable a competitive market to benefit all customers

1. Make the benefits of an economically efficient electricity market available to customers by identifying transmission projects which provide access to electricity at the lowest total electric system cost

2. Develop a transmission plan that meets all applicable NERC and Transmission Owner planning criteria and safeguards local and regional reliability through identification of transmission projects to meet those needs

3. **Support state and federal energy policy requirements by planning for access to a changing resource mix**

4. Provide an appropriate cost allocation mechanism that ensures that costs of transmission projects are allocated in a manner roughly commensurate with the projected benefits of those projects

5. **Analyze system scenarios and make the results available to state and federal energy policy makers and other stakeholders to provide context to inform regarding choices**

6. Coordinate planning processes with neighbors and work to eliminate barriers to reliable and efficient operations
MISO’s long-term planning process is designed to identify the most robust transmission plan across future scenarios.

Future Development
- Existing Fleet
- Accelerated Alternative Tech
- Policy Regulation

Long-term Transmission Strategy
- Overlay 1
- Overlay 2
- Overlay N

Regional Transmission Plan Development
- Conditions Precedent
  - Robust Business Case
  - Cost Allocation and Recovery
  - Regional Solution (collectively addressing multiple drivers)

A variety of policy and economic based Futures provides multiple long-term views of future resource mix.

Long-term overlay roadmaps guide near-term transmission decisions.

Long-term Strategy and conditions precedent frame regional transmission plan.

The graphics are for illustrative purposes ONLY.
MISO generation fleet is evolving with projected increases in renewables and gas-fired generation.
MISO’s Interconnection Queue requests are dominated by wind and solar which are projected to increase.

- **2015**
  - Natural Gas: 0.3 GW
  - Wind: 3.8 GW
  - Solar: 2.4 GW
  - Other: 3.9 GW
- **2016**
  - Natural Gas: 6.6 GW
  - Wind: 13.5 GW
  - Solar: 17.5 GW
- **2017**
  - Natural Gas: 39.4 GW
  - Wind: 0.1 GW
  - Solar: 13.6 GW

140 MW of battery storage is requesting interconnection. **Markets** serve as the integrator of the changing system.
Storage is converting energy to potential energy for use at a later time

Many types of energy storage systems exist each with different economics and capabilities:

- Short term storage - flywheels, batteries, fuel cells, compressed air
- Longer term storage – hydro, coal pile, linepack gas, nuclear fuel

The grid functions as an energy storage system

- Instantaneously use all intermittent energy and defer production from controllable resources
Policy decisions around storage must factor in both the purpose and the costs

Purpose of Storage:
- Reliability
- Renewable Integration
- Power Quality
- "Get off the grid"

An Illustrative Example:
150 MW utility with 1,000 GWh annual energy wants to become 100% renewable (self-generation)
Units = MW of hourly load and wind generation

….renewable generation does not align with load
Are batteries the most cost effective storage mechanism to increase renewable penetration?

**Total System Costs in Billions of Dollars**
*Includes upfront capital and intermittency management costs*

* Assumes… $1,000/kWh for battery costs, $1,616/kW for Wind and $2,058/kW for Solar
Existing resources are capable of operating flexibly to manage renewable intermittency

The grid has proven to be a technology enabler – wind, solar…storage

MISO is collaborating with stakeholders to develop strategies to enable storage resources on the grid

- MISO formed a stakeholder task force to prioritize and address storage initiatives
  - Review of energy storage categories/types
  - Continuing work on AGC enhancement for fast-ramping resources
- MISO launched a Renewable Integration Impact Assessment
- FERC is likely to issue a Final Rule with requirements and offer guidance on energy storage and distributed energy resources