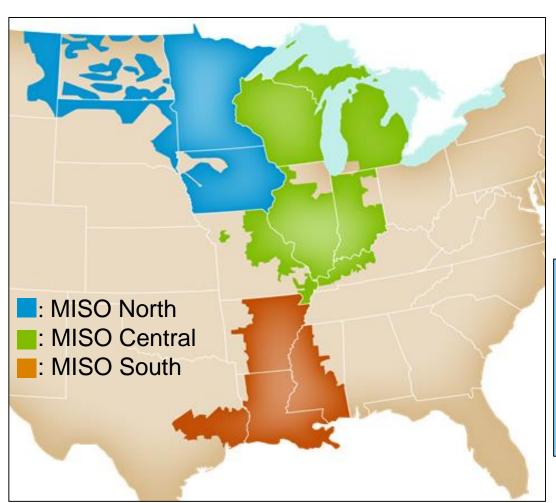


MISO Overview

Missouri Public Service Commission

November 21, 2017

MISO is an independent, non-profit organization in 15 U.S. States and one Canadian province



MISO by-the-numbers		
High Voltage Transmission	65,853 miles	
Installed Generation	177,388 MW	
Installed Generation	1,594 Units	
Peak System Demand	127,125 MW	

Mission

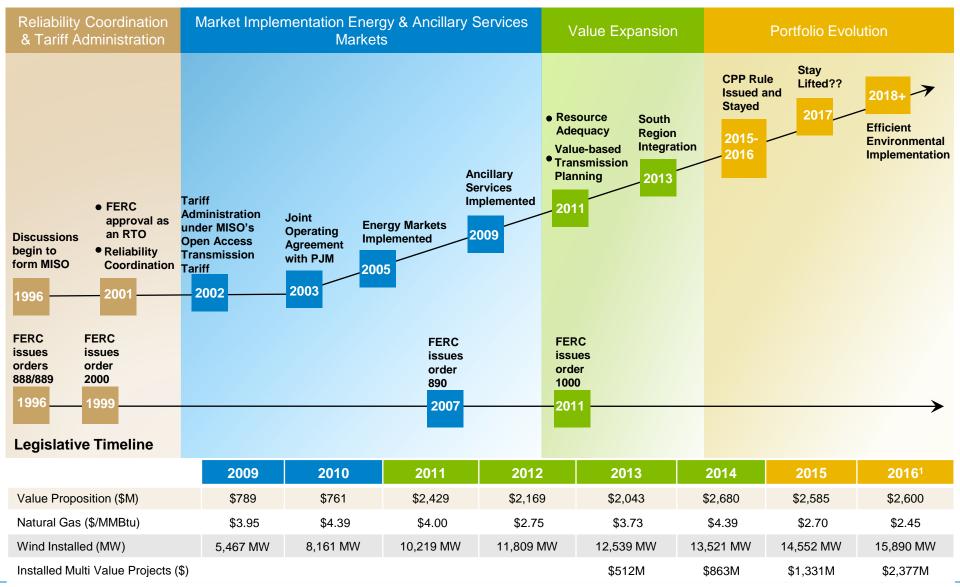
Work collaboratively and transparently with our stakeholders to enable reliable delivery of low-cost energy through efficient, innovative operations and planning.



North American Electric Grid Operators



MISO has gained experience with uncertainty while its focus has expanded from reliability and open access to value creation



Key MISO Functions and Benefits

What RTOs Do

Provide non-discriminatory open access transmission service

Platform for wholesale energy and capacity markets

Perform system operations through energy markets

Long-term transmission planning, resource adequacy constructs

Implications

Facilitates competition between generation resources

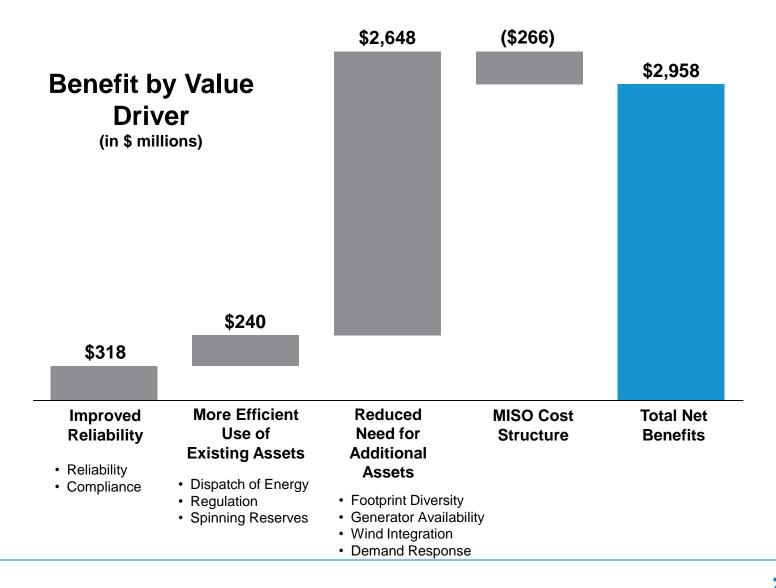
Incentivizes efficient and costeffect generation dispatch, and new generation investment

Least-cost dispatch that accounts for reliability needs

Enhanced long-term reliability



MISO's 2016 Value Proposition





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

Vision: To be the most reliable, value creating RTO

Strategic Objectives

Market and Grid Positioning

Serve & Grow Membership

Provide Independent Thought Leadership

Strategy Initiatives

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

- Serve Existing Members North/Central
- Serve Existing Members –
 South
- Strategic Member Expansion

- Regional Modeling & Analytics
- Policy-Level Relationships, Reputation & Visibility
- Platform Provider for Policy Implementation

Strategic Competencies

People

Process

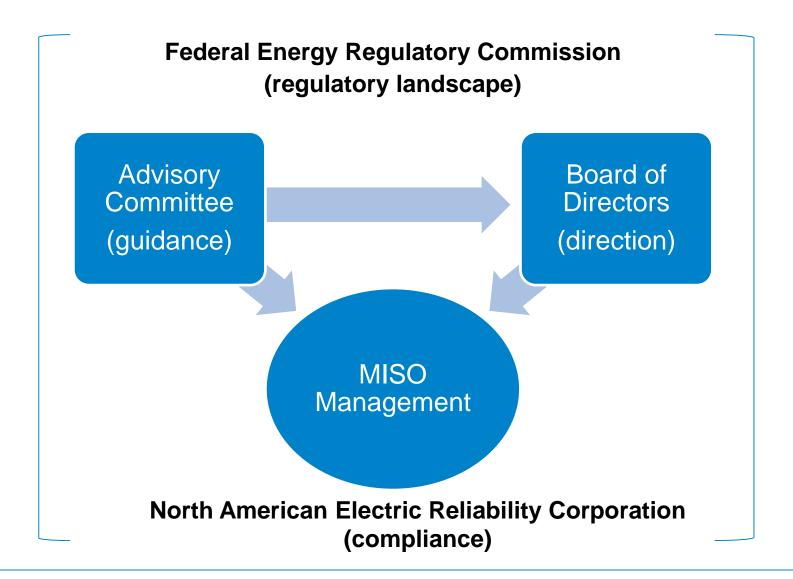
Technology



Governance



MISO Governance





MISO's Board of Directors



John R. Bear (MISO CEO)



H.B. "Trip" Doggett



Barbara J. Krumsiek



Todd M. Raba



Phyllis E. Currie



Baljit "Bal" Dail



Mark S. Johnson



Thomas M. Rainwater



Michael J. Curran



Paul J. Bonavia



Advisory Committee – 25 Representatives





^{*} Two members of Vertically Integrated Transmission Owners (VITOs), one member of MISO Stand-Alone Transmission Company (MSATs)

Business Areas



What We Do

MISO provides reliable system operations through:

- Real-time Operations (Keeping the Lights On)
 Safe & reliable operation of the electric grid
- Wholesale Market Administration
 Open energy markets, including centralized scheduling and economic dispatch of generation to support reliability and efficiencies across the system
- Transmission Planning
 For safe, reliable and economically efficient transmission expansion



Real-Time Operations



Real-Time Operations Functions

Balancing Authority

- Assumed responsibility from LBAs in 2009 with the incorporation of the Ancillary Service Market and Energy Market
- Responsible for the centralized operation of AGC

Reliability Coordinator

- Monitors Bulk Electric System with tools, processes and procedures to prevent or mitigate emergency operating situations
- Enable calculation of IROLs, and to operate within such limits

Transmission Service Provider

- Provide open access to the MISO transmission per the OATT
- Manage congestion, monitor flowgates, and operate under abnormal/emergency conditions

Interchange Coordinator

- Receives curtailments and redispatch requests from RCs for Arranged Interchange.
- Receives information on confirmed interchange interruptions from the BAs and communicates the confirmed interchange status/revisions to BAs, TSPs, RCs, and Purchasing-Selling LSEs.



Emergency Operations

MISO's Emergency Operations messages define the area(s) involved, duration, and projections of system conditions. The table below is a summary, and does not replace or redefine MISO's Emergency Operations messages.

Message	Communication Intent	Potential Member/MISO Actions
Conservative Operations Declaration	Alert for Situational Awareness: Reliability issues possible for defined area.	 Potentially suspend transmission maintenance Review outage plans for deferral, cancellation
Hot Weather, Cold Weather or Severe Weather Alert	Alert for Situational Awareness: MISO could be approaching tight supply conditions.	Review outage plans for deferral, cancellation
Min Gen Alert	Alert for Situational Awareness: MISO is forecasting a potential supply surplus.	Prepare for de-commitment (taking generation off- line), reduction in purchases or other actions
Max Gen Alert	Alert for Situational Awareness: MISO is forecasting a potential capacity shortage.	Declare Conservative System OperationsPrepare for possible Max Gen Event
Max Gen Warning	Warning to Prepare for Possible Event	 Curtail non-firm exports Schedule all available external resources into the MISO Market
Max Gen Event (Step 1)	Actions Taken to Preserve Operating Reserves: NERC Emergency Alert 1	 All available resources in use Generators instructed to start off-line resources Use of reserves not yet implemented
Max Gen Event (Steps 2, 3, 4)	Actions Taken to Preserve Firm Load: NERC Emergency Alert 2 (Step 2 declaration)	 Implement demand management programs Utilize Contingency Reserves Purchase Emergency Energy Issue Public Appeals Prepare for possible firm load shed
Max Gen Event (Step 5)	Event Occurring: NERC Energy Emergency Alert 3	Shed firm loadRolling brownouts or blackouts for defined area



Wholesale Market Administration

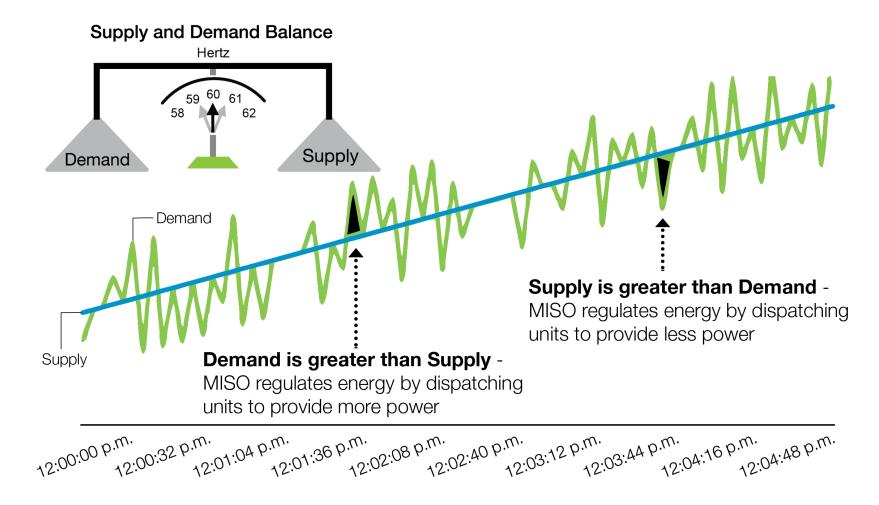


The Balancing Act

- Day-to-day MISO reliably and efficiently balances the needs of customers with available supply through centralized, competitive energy markets
- Long-term reliability
 (resource adequacy) is
 assured through mandatory reserve margin requirements
 (planning reserve margin)
 - Load Serving Entities must meet their load forecast plus their planning reserve margin – this can be done through:
 - Owned resources
 - Controlled resources
 - Planning Resource Auction



Balancing Electricity Supply and Demand Moment to Moment





Offers to Supply from Generators Facilitate Least Cost Dispatch and System Operation



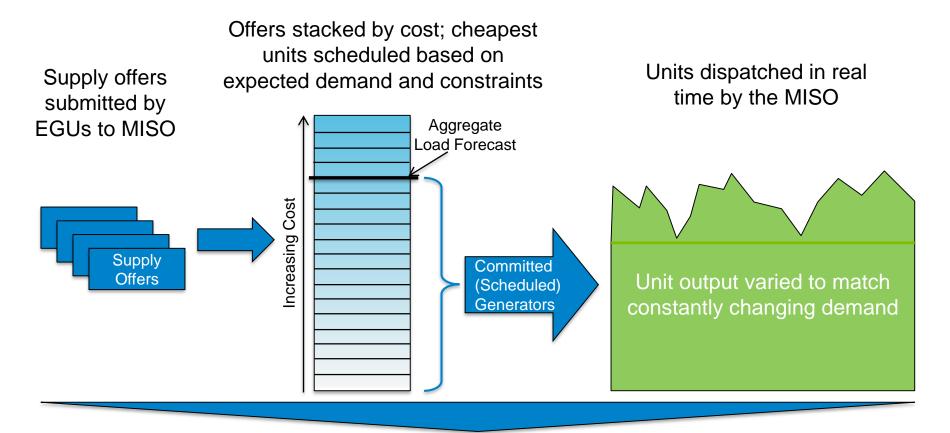
- Utilities seek to dispatch their systems at least cost
- Applies to vertically integrated utilities as well as organized markets

What goes into generators' bid?

- Fuel
- Variable O&M
- Emissions Costs



Overview of Generation Dispatch



- Electric Generating Unit (EGU) availability (limits, retirement) affects the amount of supply offered to meet demand
- Changing EGU costs (and thus offers) affect frequency and magnitude of utilization in RTO



The Balancing Act

- Day-to-day MISO reliably and efficiently balances the needs of customers with available supply through centralized, competitive energy markets
- Long-term reliability
 (resource adequacy) is
 assured through mandatory reserve margin requirements
 (planning reserve margin)
 - Load Serving Entities must meet their load forecast plus their planning reserve margin – this can be done through:
 - Owned resources
 - Controlled resources
 - Planning Resource Auction



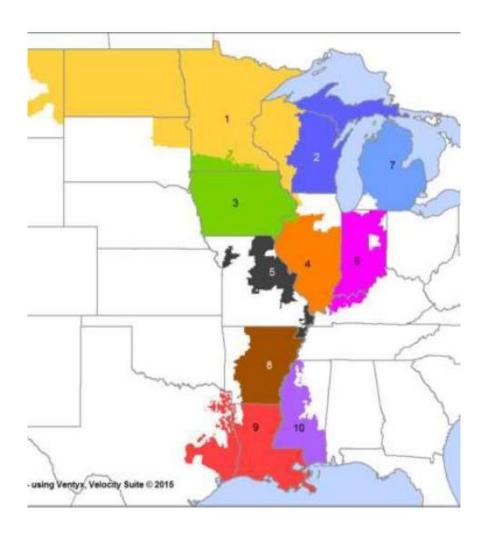
MISO's Resource Adequacy Construct

Annual Obligation for LSE's

- Planning Year period is from June 1st to May 31st
- Multiple methods of achieving and demonstrating resource adequacy, including self-supply, bilateral contracting and market-based acquisition via the Planning Resource Auction.

Overview of Planning Resource Auction

- Occurs two months ahead of Planning Year
- Residual Auction allows buyers and sellers to balance resource portfolio prior to Planning Year
- Includes a locational requirement indicating the amount of capacity that must be secured from resources within each zone to meet reliability standards





Overview of MISO Markets

Resource Adequacy

- Year ahead forward "planning reserve"
- Assures
 capacity exists
 to produce
 energy and
 ancillary
 products

Financial Transmission Rights Market

- Hedge risk of transmission congestion costs
- Preserves transmission rights through ARR allocation

Day-Ahead Market

- Forward energy and operating reserves
- Commits generation
- Establishes next day financial commitments by hour

Real-Time Market

- Spot energy and operating reserves
- Transparent economic signals
- 5-minute energy dispatch to satisfy system demand and manage transmission congestion

Ancillary Services

- Services generating units provide in addition to energy and operating reserves
- Procure regulating and contingency reserves minute-tominute in order to balance the grid and reliability

Annual Auction

Monthly/Seasonal/ Annual Auction and Annual Allocation Resource Offers,
Demand Bids and
Physical
Schedules

Resource Offers and Physical Schedules

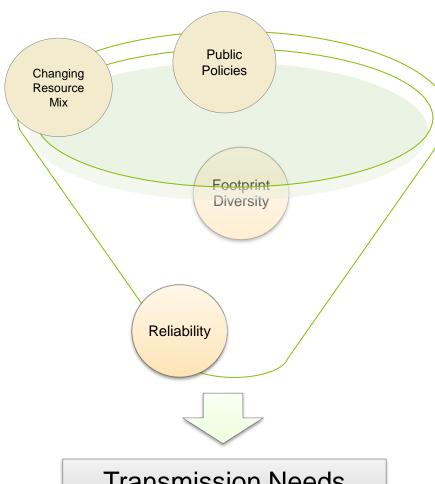
Regulating/
Spinning and
Supplemental
Reserves



Transmission Planning



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



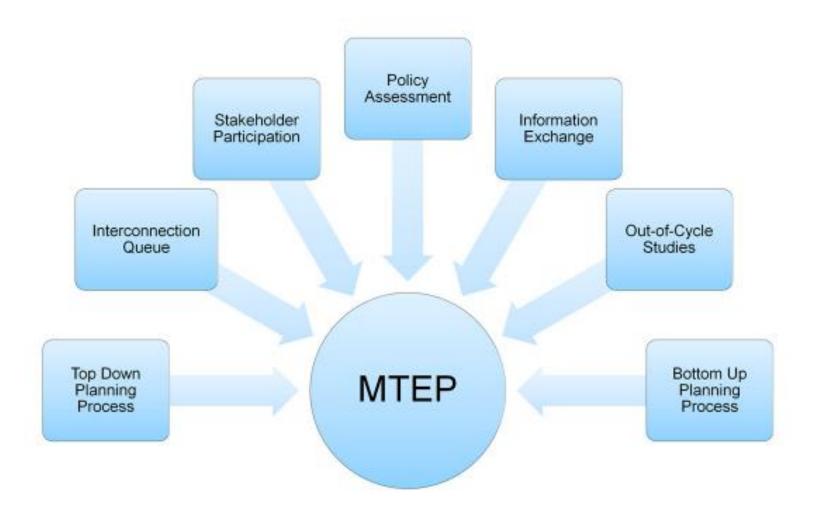
Transmission Needs

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



MISO Transmission Expansion Plan



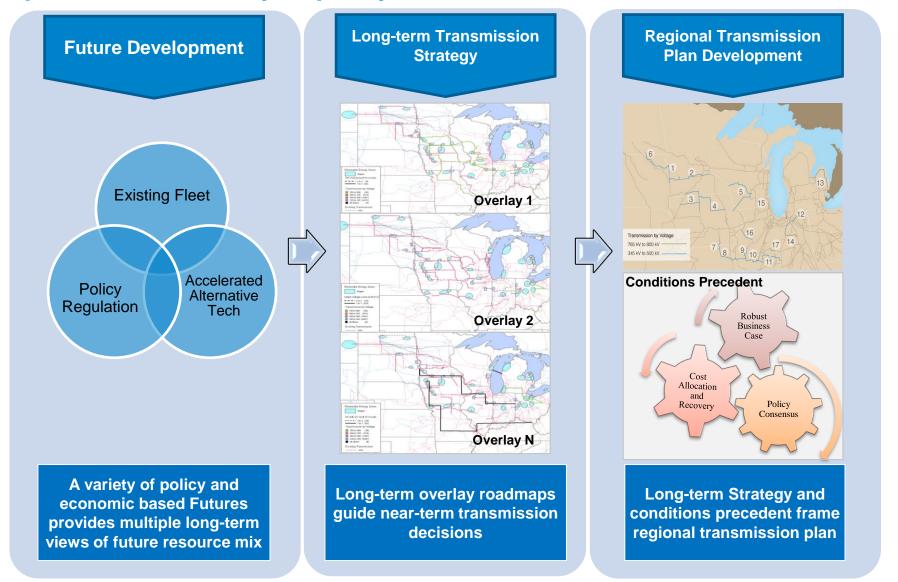


Types of Projects & Cost Allocation

Allocation Category	Driver(s)	Allocation to Beneficiaries
Participant Funded ("Other")	Transmission Owner identified project that does not qualify for other cost allocation mechanisms.	Paid by requestor (local zone)
Transmission Delivery Service Project	Transmission Service Request	Generally paid for by Transmission Customer; Transmission Owner can elect to roll-in into local zone rates
Generation Interconnection Project	Interconnection Request	Primarily paid for by requestor; 345 kV and above 10% postage stamp to load
Baseline Reliability Project	NERC Reliability Criteria	100% allocated to local Pricing Zone
Market Efficiency Project	Reduce market congestion when benefits are 1.25 times in excess of cost	Distributed to Local Resource Zones commensurate with expected benefits; 345 kV and above 20% postage stamp to load
Multi Value Project	Address energy policy laws and/or provide widespread benefits across footprint	100% postage stamp to load



Regional Transmission Overlay Study develops the most robust plan under a variety of policy and economic future scenarios





For Additional Questions:

Melissa Seymour <u>mseymour@misoenergy.org</u>

Bob Kuzman

bkuzman@misoenergy.org

