

MISO – Market Overview

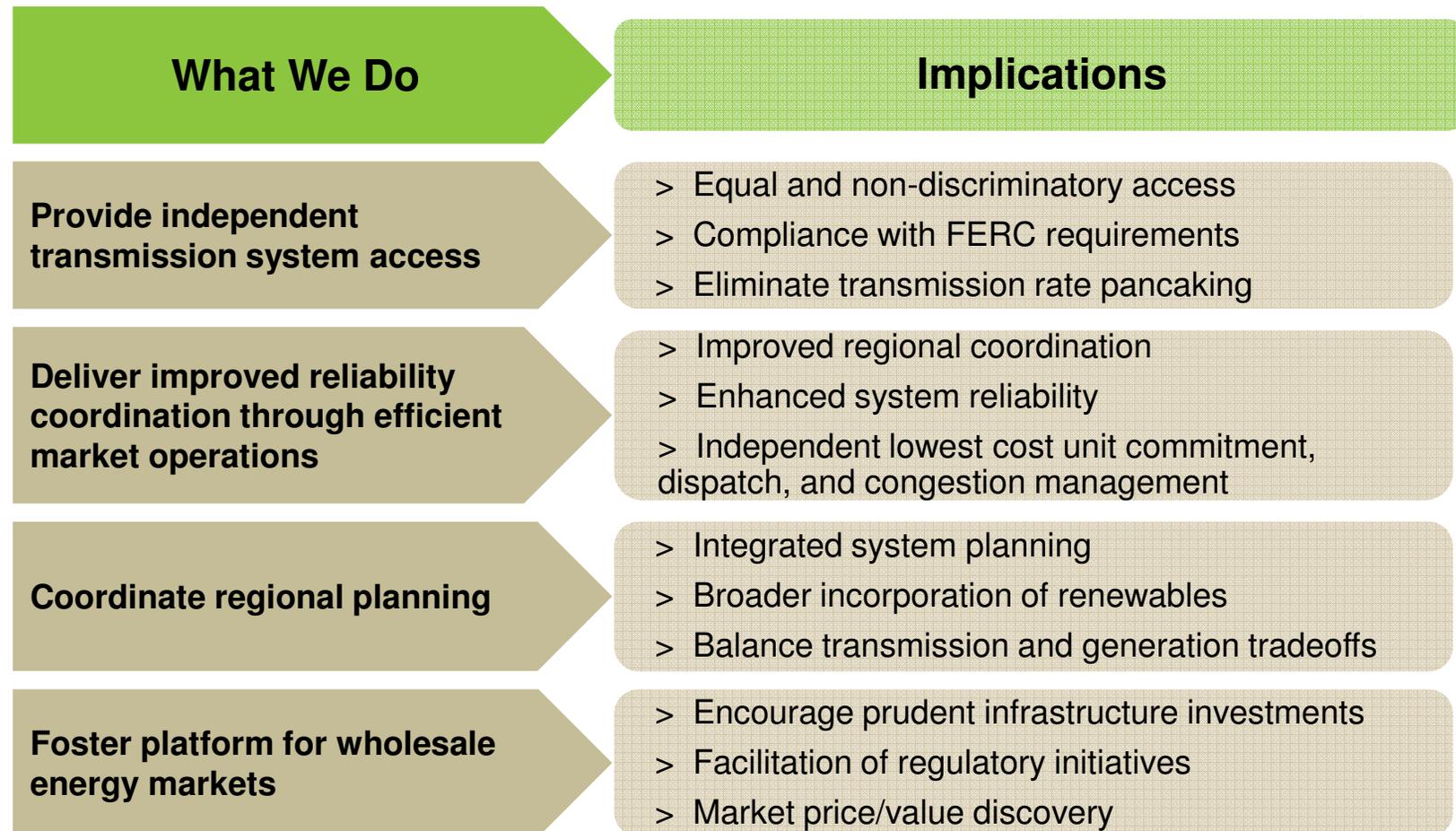
Western Area Power Administration



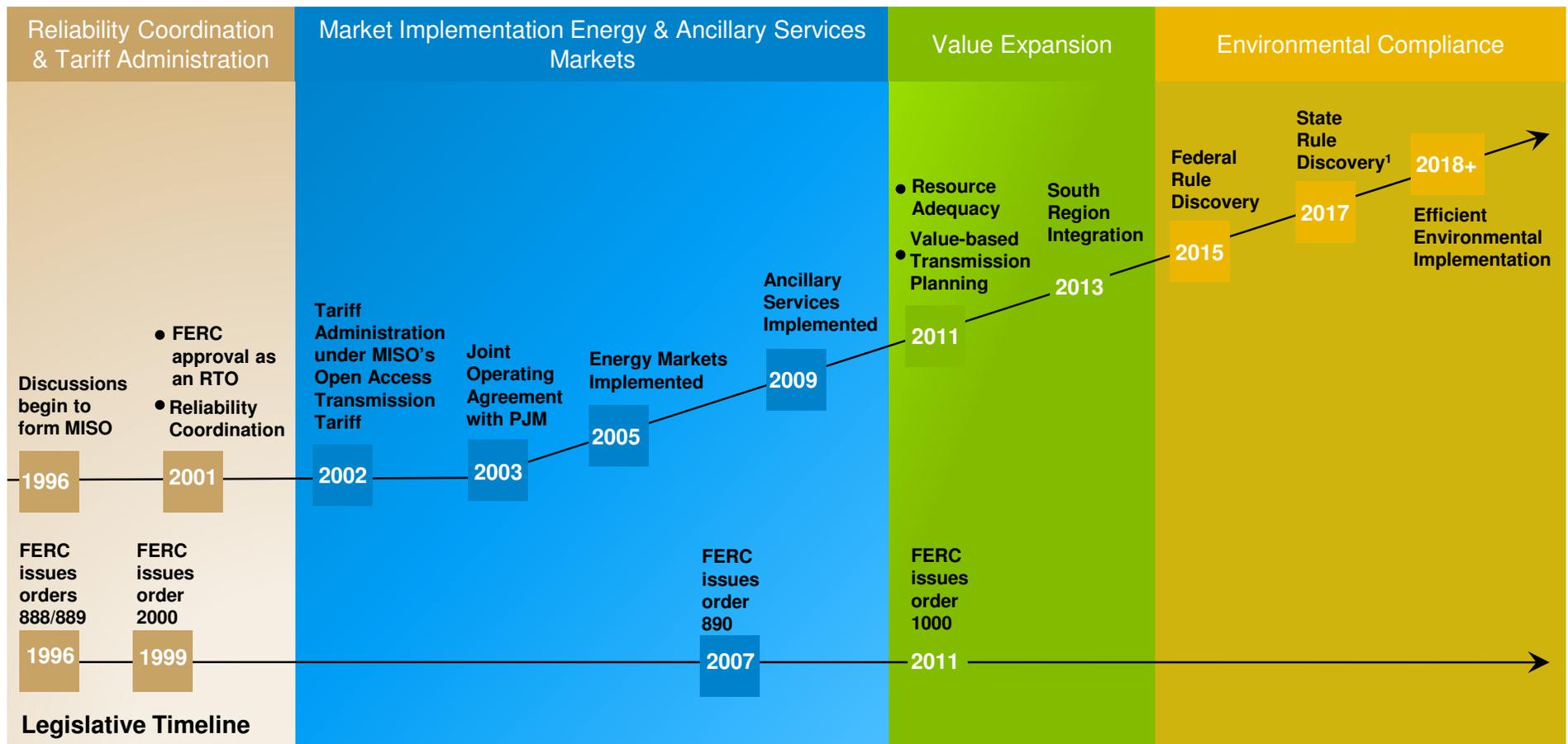
What is MISO?

- MISO stands for **Midcontinent Independent Transmission System Operator**
- MISO is a Regional Transmission Operator (RTO)
- An RTO is a Federal Energy Regulatory Commission (FERC)-regulated control area operator of the electric transmission grid
- MISO does not own any transmission or generation assets and cannot have affiliation with any members
- MISO is a non-profit organization
- Membership in MISO is voluntary

MISO's role is concentrated in a few key areas

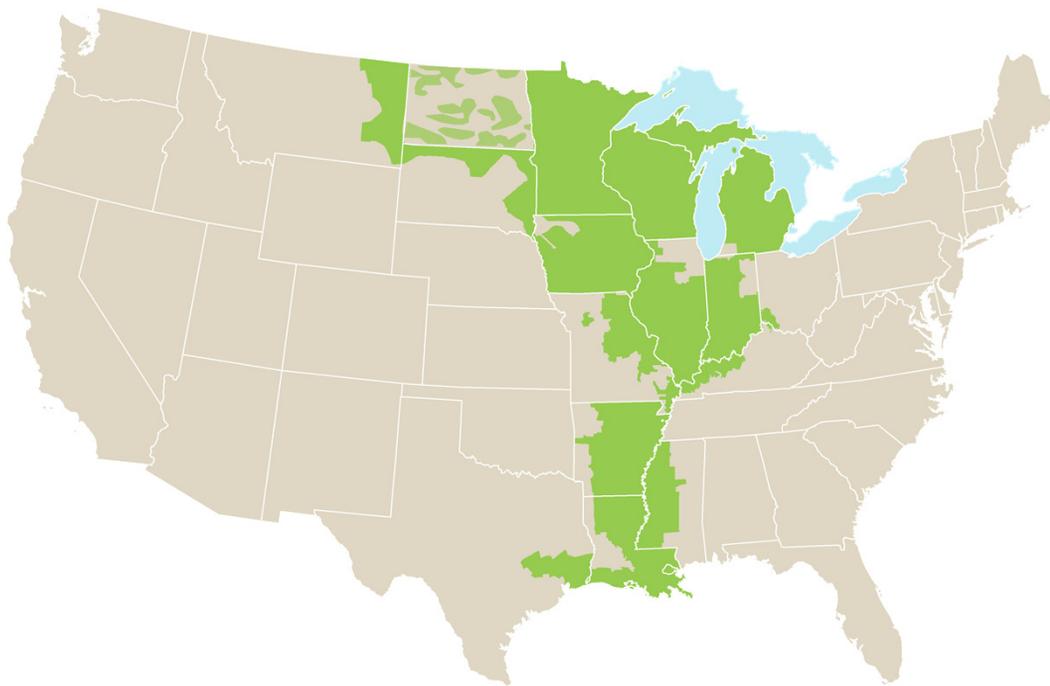


MISO was formed to open wholesale markets with growth based on reliability and value creation



¹ Due to CPP stay, timing for State Rule Discovery is unknown. Slide reflects timeline before the stay.

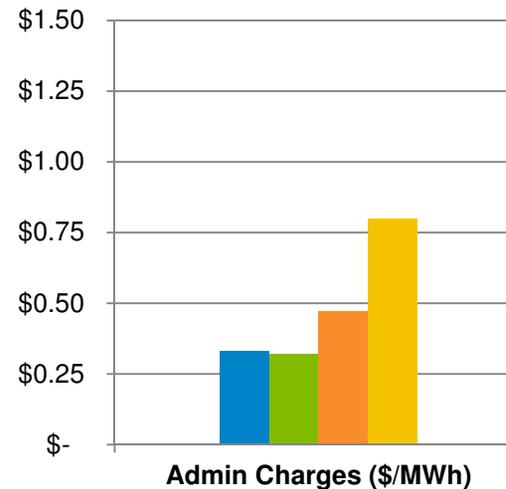
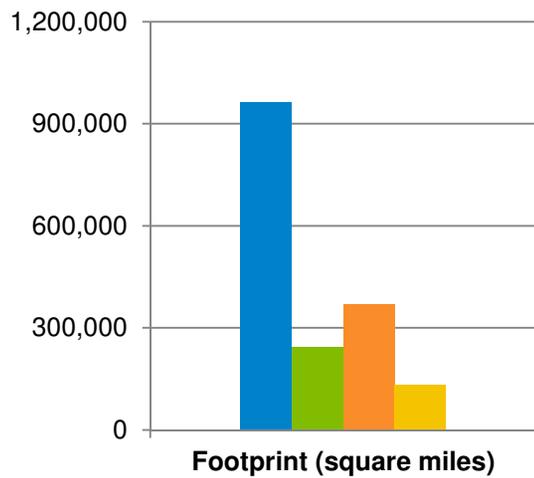
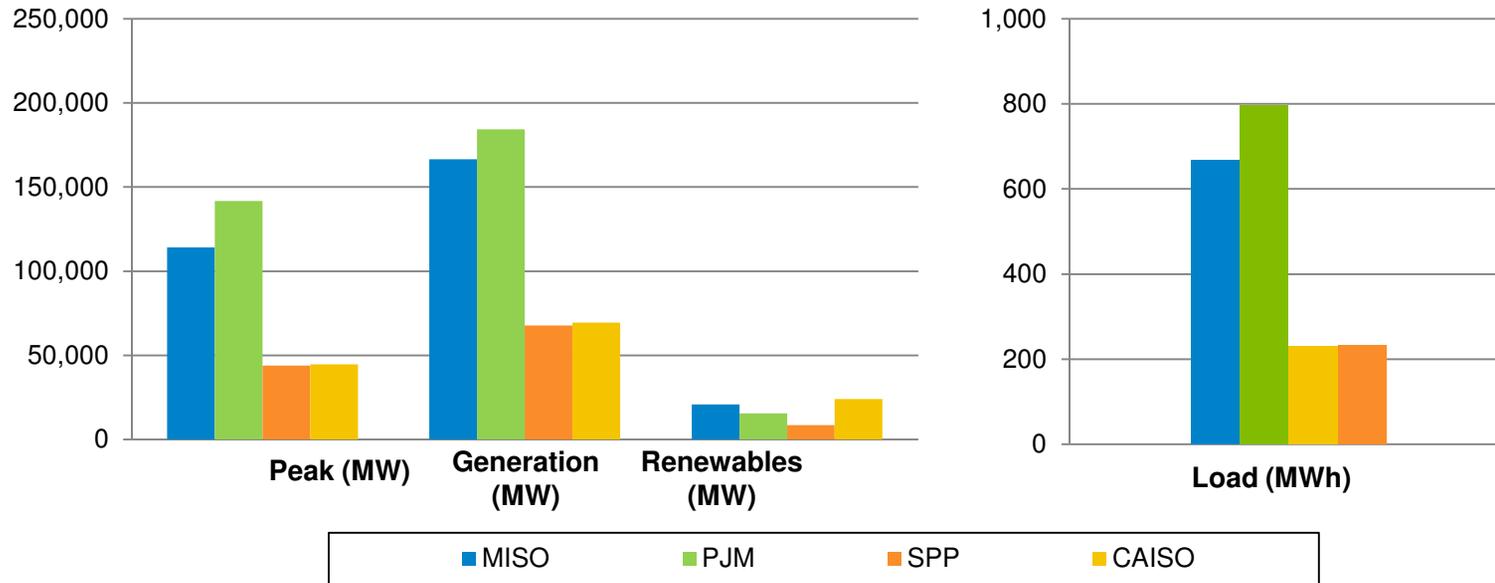
MISO is the Grid/Market Operator for 15 states in the Central U.S. plus the Canadian Province of Manitoba



	MISO	U.S.
High Voltage Transmission - miles	65,520	200,000 +
Installed Generation - GW	195	1,009
Installed Generation – # of Units	1700	19,000
Annual System Load – Billion kWh	670	3,900
People Served - Millions	42	320

MISO’s Vision – To be the most reliable, value-creating RTO

Grid Operator Comparison: Market Statistics



RTO Comparison: Structure & Governance

		MISO	CAISO	PJM	SPP
Structure	Formation timeline	1998: ISO 2001: RTO 2005: nodal 2009: ancillary service market	1997: ISO 1998: zonal 2009: nodal 2014: energy imbalance market (EIM)	1997: ISO 2001: RTO 2001: nodal	2004: RTO 2007: energy imbalance market 2014: nodal
	Territory	15 states + Manitoba	Nodal: 2 states EIM: 6 states	13 states + DC	14 states
	Corporate tax status	501(C)(4) Social welfare nonprofit	501(C)(3) Nonprofit to lessen gov't burden	Taxable limited liability corporation	501(C)(6) Nonprofit as business league
	Utility Oversight	Regulated except IL, MI (10%): retail choice	CA: retail choice NV: regulated	DC, PA, NJ, DE, MD: Retail choice	Regulated
Governance	Number of Directors	10, including CEO	5	10, including CEO	7, including CEO
	Director placement	<ul style="list-style-type: none"> Nominated by board Elected by MISO membership 	<ul style="list-style-type: none"> Governor appointed Confirmed by state senate 	<ul style="list-style-type: none"> 9 elected by PJM members CEO appointed by board 	<ul style="list-style-type: none"> 6 elected by SPP members President appointed by board
	Director term	3 years	3 years	3 years	3 years
	Regulator	FERC	FERC	FERC	FERC

RTO Comparison: Energy & Capacity Markets

		MISO	CAISO	PJM	SPP
Energy & Ancillary Service Markets	Hourly, Day-ahead	Co-optimized	Co-optimized	Co-optimized	Co-optimized
	Real-time	5-min co-optimized, dispatch, hourly settlement	5-min co-optimized, dispatch, 15-min settlement	5-min settlement & dispatch, based on DA/rebid offers, hourly co-optimization	5-min co-optimization, dispatch & settlement
	Virtual trades	Yes	Yes	Yes	Yes
	Must offer	Yes	Yes	No	Resources needed to meet RA requirement only
	Offer cap	\$1,000/MWh	\$1,000/MWh	\$2,000/MWh	\$1,000/MWh
	Ancillary Services	<ul style="list-style-type: none"> • Spin • Supplemental (nonspin) • Regulation 	<ul style="list-style-type: none"> • Regulation up • Regulation down • Spin • Nonspin 	<ul style="list-style-type: none"> • Regulation • Synchronized reserves (spin) • DA scheduling reserves (DASR) 	<ul style="list-style-type: none"> • Regulation up • Regulation down • Spin • Supplemental (nonspin)
Capacity Market	Auctions	Annual Capacity Auction	LSE resource adequacy requirement	Centrally Procured Capacity Markets Reliability Pricing Model	Supply must cover energy obligation daily
	Auction timelines	<ul style="list-style-type: none"> • LSE capacity obligation set by state or MISO • Voluntary capacity auction March prior to delivery year 	N/A	<ul style="list-style-type: none"> • Every May three years prior to delivery year • Incremental auctions 20, 10 & 3 months prior to delivery year 	N/A
	Demand curve	Vertical	N/A	Sloped	N/A

MISO Market Overview - Electricity Markets

MISO operates:

- A spot and forward commodity market for electric energy and related products
- Markets for related derivative products

The spot commodity market functions within context of an integrated regional transmission system that must be maintained within tightly controlled operational parameters. Since electric supply and demand must be balanced on an instantaneous basis, the physical delivery system is an integrated element of the electricity commodity market.

Reliability and Market Operations are Mutually Reinforcing...

Reliability

Reliable system operation is delivered by efficient markets

- Markets allow reliability to be managed cost effectively
- Prices provide strong incentives for generation and load behavior that fosters system reliability



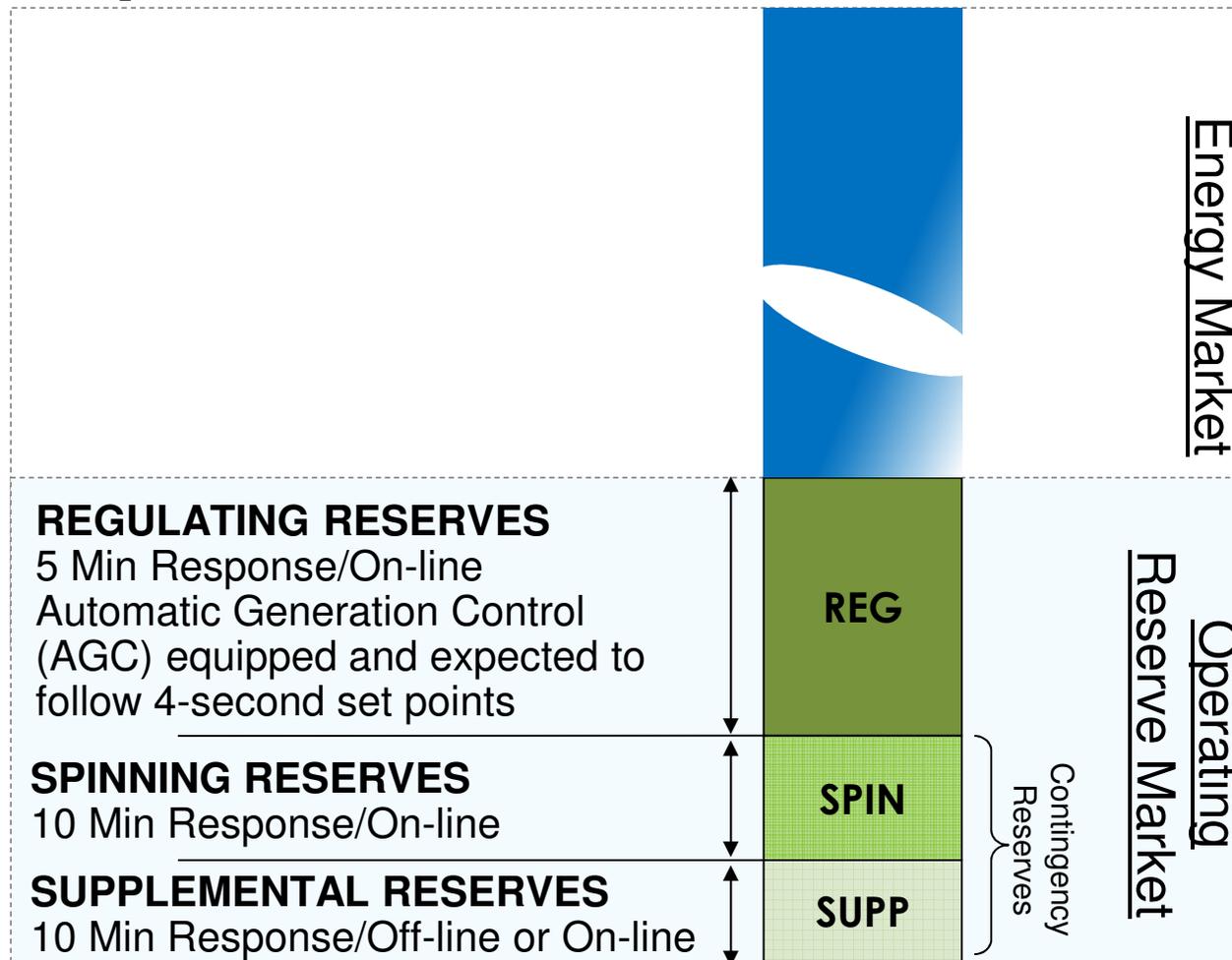
Market

Market enables market participants to pursue economic goals while maintaining reliable and efficient operations at all times

Four primary markets are MISO's tools to manage generation and transmission...



Day-Ahead and Real-Time markets include four products; price formation begins with the co-optimization of these resources...



Day-Ahead Market plans for the operating day and is financially binding...

Day-Ahead Market

Results in financially binding market clearing for next Operating Day

DA prices set for cleared supply and demand

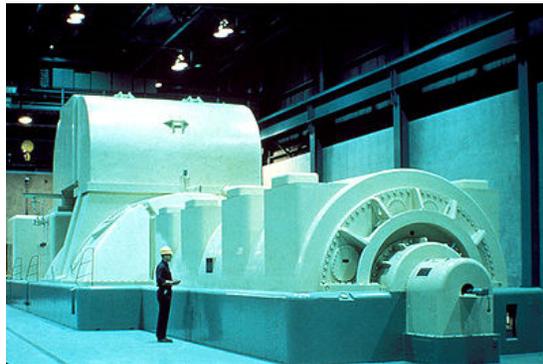
Reflects participants' expectations of next day

Unit commitment and hourly operating schedules

Pre-pay for energy, transmission, and operating reserves

Congestion arising from expected system conditions based on bids and offers, forecast transmission topology

Day-Ahead Market (OD-1) – Majority of Transactions Occur Here...



Generation Resources

Offers

1100hr

1500hr



Day-Ahead Supply and Demand Schedules

Day-Ahead LMPs and MCPs

Unit Start/Stop Instructions



Load Serving Entities

Bids



Mechanisms to participate in the energy market

Generation
Resource

Traditional, Intermittent,
Dispatchable Intermittent

Demand
Response
Resource
Type I and II

External
Asynchronous
Resource

Virtual
Transactions

Demand Bids

Stored Energy
Resource

Physical
Schedules

Financial
Schedules

Real-Time Market is a spot market for balancing current system conditions...

Real-Time Market

Addresses Real-Time system conditions

Dispatches lowest-cost resources every 5-minutes

Provides transparent economic signals

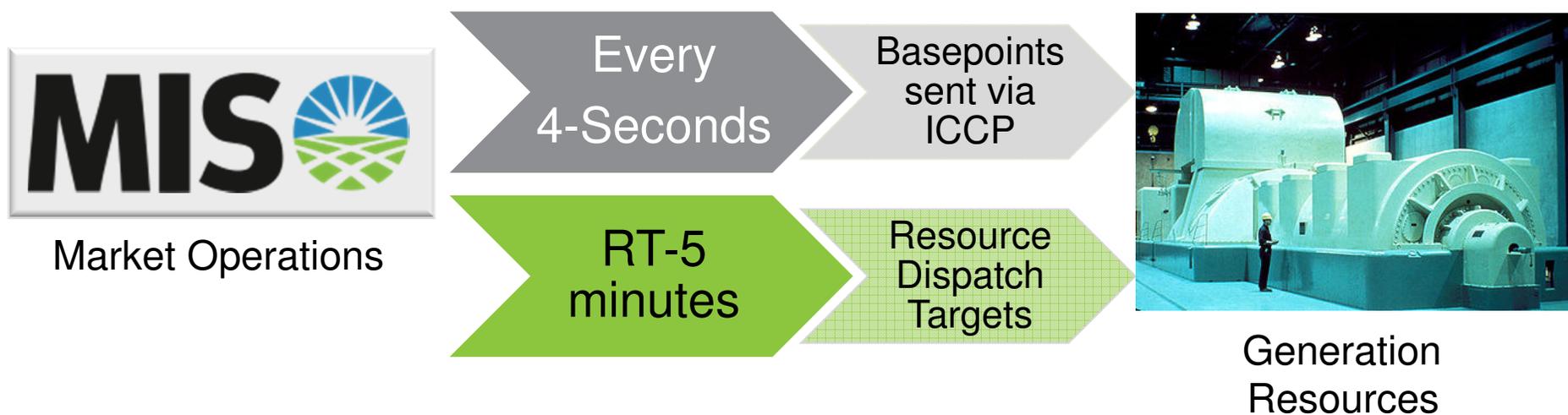
Balances RT supply and demands

Satisfies demand without overloading the network

Guides operational and investment decisions

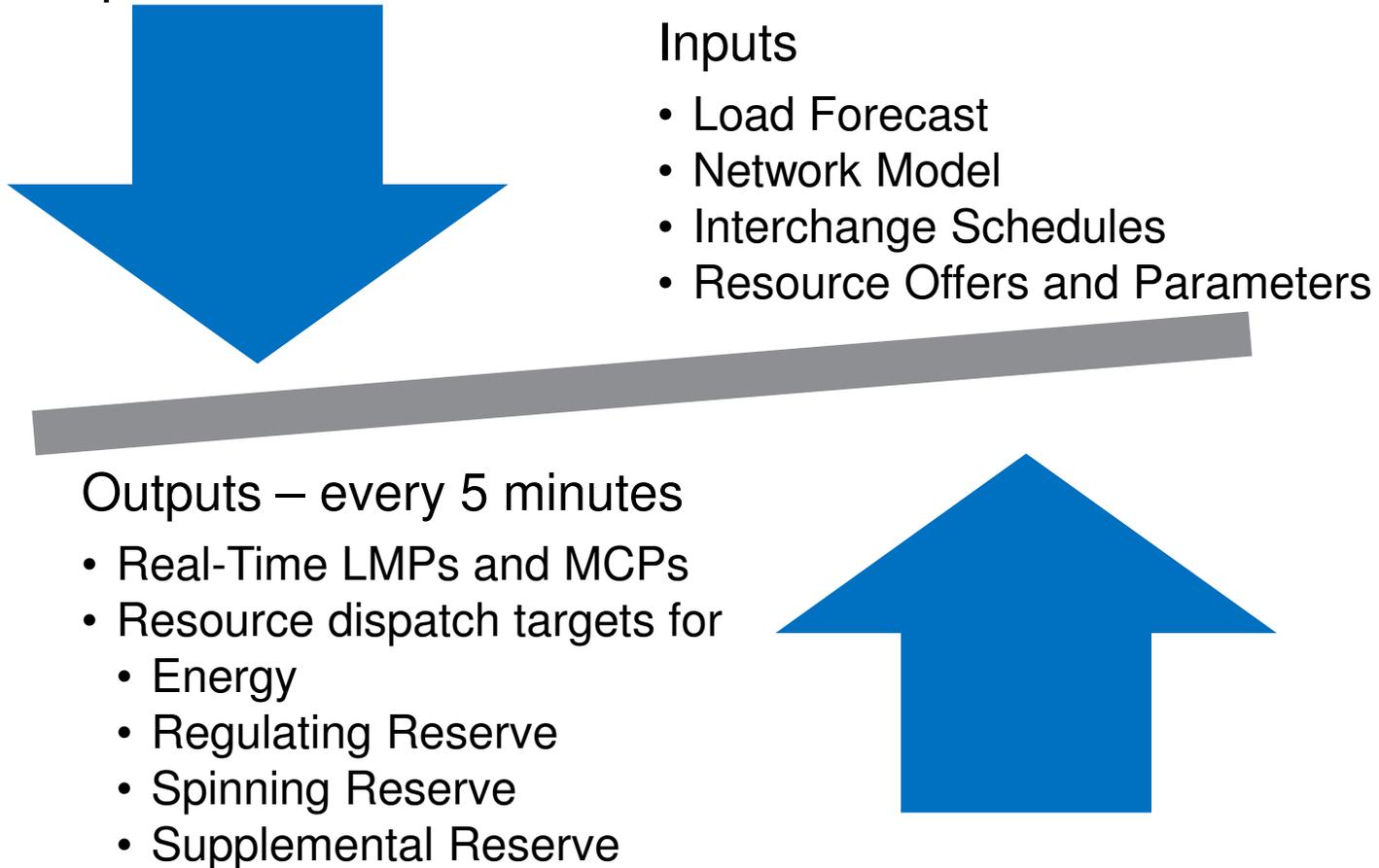
Real-Time Market – Operating Day...

- Based on the network model, updated supply offers, physical schedules and a load forecast, the MISO systems send dispatch targets

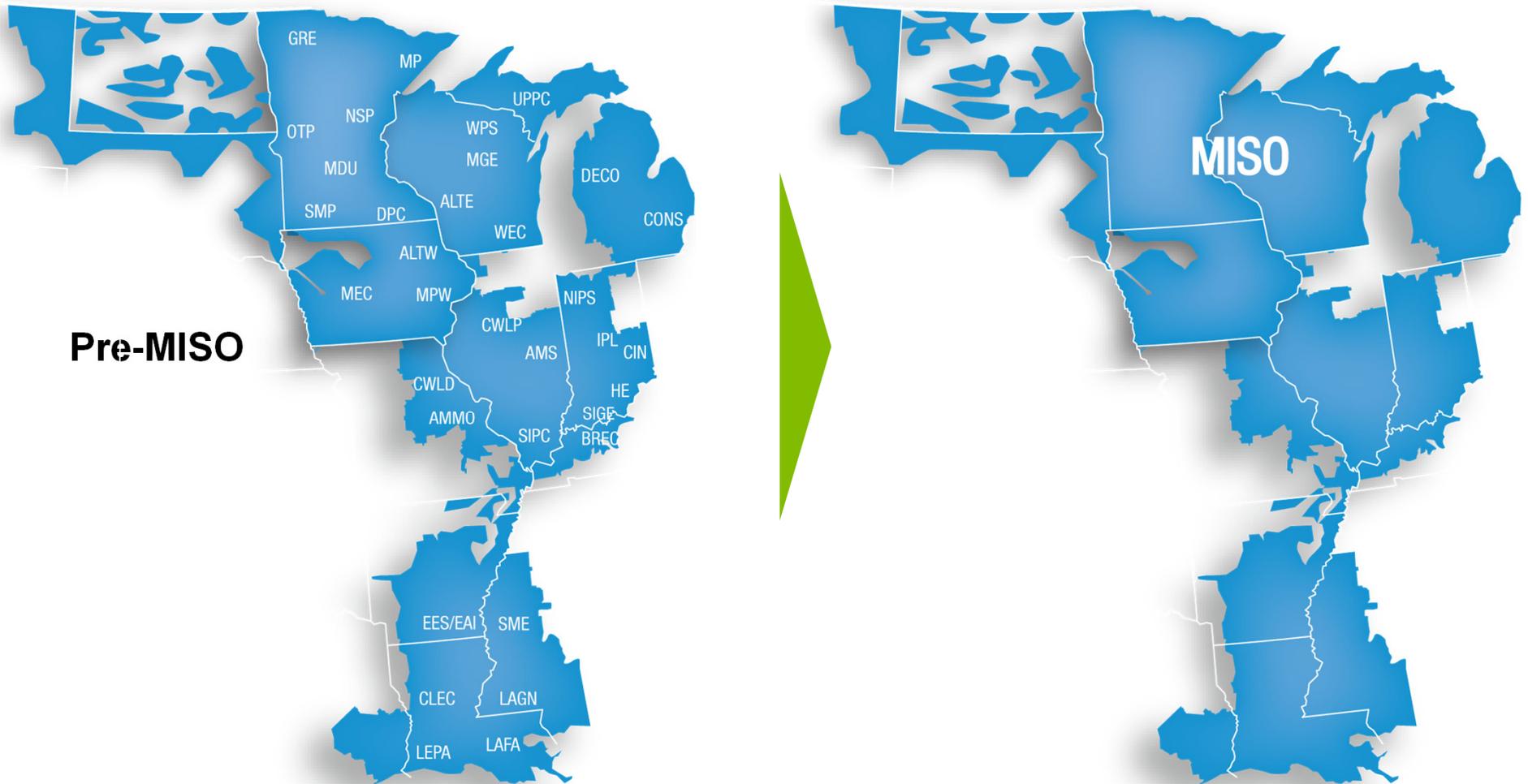


Real-Time Clearing Processes

MISO uses Security Constrained Economic Dispatch to balance the injections and withdrawals, manage the congestion, and set Real-Time prices

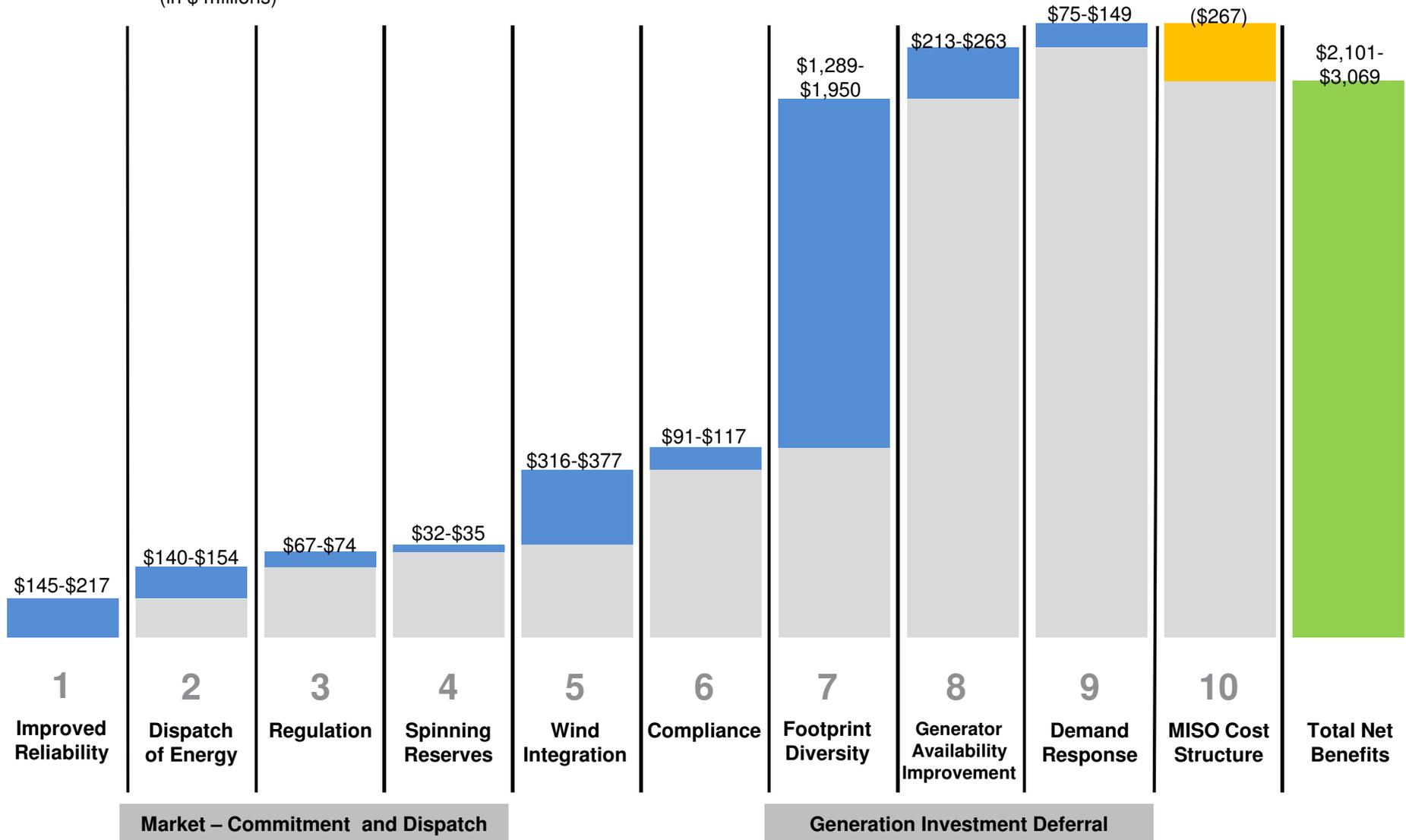


Value Proposition is an estimate of the value of running the MISO region through a central RTO vs traditional methods

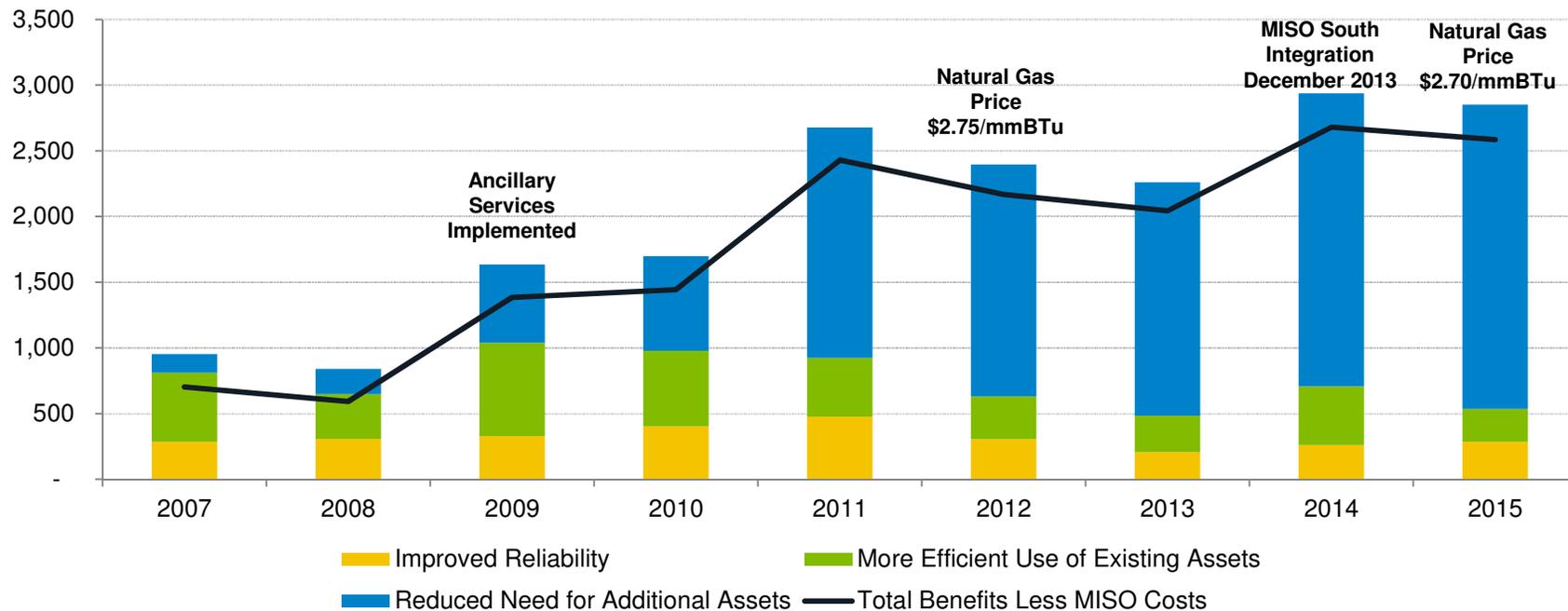


The MISO 2015 Value Proposition

Benefit by Value Driver
(in \$ millions)



MISO member net benefits are over \$16B since 2007



Improved Reliability	Reduced Need for Additional Assets	More Efficient Use of Existing Assets
<ul style="list-style-type: none"> Value of additional energy served based on RTO transmission performance versus non-RTO regions MISO has outperformed total RTO region reliability every year since 2012 Economies of scale in Compliance work 	<ul style="list-style-type: none"> Footprint diversity allows the pool to share resources reducing capacity need for reserves Generator availability improves with market reducing need for additional resources Demand response growth delays need for generation 	<ul style="list-style-type: none"> Security constrained energy dispatch ensures least cost generation is deployed first Ancillary Service Market frees cheaper capacity for energy and secures regulation service and reserves at competitive cost

Price and data transparency in the MISO market provides a host of benefits

	Before MISO	With MISO
Efficiency	<ul style="list-style-type: none">• Bilateral markets lacked price and data transparency, leaving participants searching for which plants are operating at what cost	<ul style="list-style-type: none">• Every market participant can see pricing and information, increasing market efficiencies
<hr/>		
Investment	<ul style="list-style-type: none">• Bilateral markets provided insufficient price signals which resulted in inefficient investment and placement of generation resources and transmission infrastructure	<ul style="list-style-type: none">• MISO's energy market price signals provide investors in generation assets the underlying data required to develop forecasts for future wholesale prices. Price forecasts, in turn, provide the necessary basis for market driven investments
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Reliability	<ul style="list-style-type: none">• Bilateral markets achieved reliability based on contractual rights and industry standards with little thought to economic impacts	<ul style="list-style-type: none">• MISO enhances reliability by informing all market participants of grid conditions and market operations through the public posting of electricity prices and other key system information• Prices in the MISO energy market reflect real-time system conditions, high market prices indicating where more generation is needed and lower market prices signifying the reverse

MISO's transmission planning process is focused on minimizing total cost of delivered power to consumers

Before MISO

Transmission Expansion Planning Model

- Reliability-based model
 - Focused primarily on grid reliability
 - Typically considers a short time horizon
 - Seeks to minimize transmission build

With MISO

- Value-based model
 - Focused on value while maintaining reliability
 - Reflects appropriate time scales
 - Seeks to identify transmission infrastructure that maximizes value
 - Identifies the comprehensive value (reliability, economic, and policy) of projects

Planning Scale and Efficiency

- Local view
 - Objective of expansion is to address local needs
 - 26 individual entities optimizing the system within their area

- Regional view
 - Objective of expansion is to address aggregate regional needs consistent with value-based plans in addition to meeting local needs
 - Offers opportunities to find efficiencies across multiple Transmission Owners

Cost Allocation

- Free rider issues caused by a lack of alignment between transmission cost and the causers and beneficiaries

- MISO helps facilitate the cost allocation of transmission to minimize free rider issues
- MISO regional cost allocation matches costs roughly commensurate with beneficiaries

MISO's role continues to evolve as the industry's requirements change

