





Development of a Competitive Energy Market in the Midwest

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For Effective Competition

- Many buyers, many sellers
 - No dominant players
- Independence no relationships
- Price transparency
- Relatively easy entry to and exit from the market







Midwest Market History

- In the Midwest, a market has been created to facilitate effective competition in the wholesale market
- In Wisconsin, the development of a competitive wholesale energy market evolved over years
- For many years, Wisconsin was primarily served by vertically-integrated, investor-owned utilities
- Regulated monopolies, with no competition







Independent Power Producers (IPP) Allowed

- Wisconsin law amended to allow an IPP to construct new generation
- An IPP needs to obtain a certificate to construct a power plant, but there is no showing-of-need requirement







In the 1990s, the Federal government (FERC) encouraged open access to the transmission system









American Transmission Company (ATC)

 In 1998, Wisconsin law was changed to allow the formulation of an independent, stand-alone transmissiononly utility, ATC







Background

- Electric power system: generation, transmission & distribution
- Transmission similar to interstate highway system with highvoltage electricity traveling on wires like vehicles on highway.
- Transmission costs are about 6 percent of a customer's bill.

Mog A. Watts NRG4 Electric Ave. Reliaville, WI	Transmiss
Generation & Fuel Costs	Distribution Costs









ATC's Formation

- Before ATC aging or inadequate transmission infrastructure, insufficient access to developing energy markets
- ATC started business January 1, 2001, as the first multi-state transmission-only utility in the U.S.
- Companies that transferred transmission assets or cash to ATC are ATC equity owners (now over 30 owners)
- ATC owns, operates, maintains and builds transmission facilities in portions of Wisconsin, Michigan, Minnesota and Illinois
- Owns 9,350 miles (15,047 km) of transmission lines
- ATC regulated by FERC for rates, by state commissions for siting and construction















ATC Advantages

- ATC crosses local distribution company service territories, and can effectively plan, design, permit, and implement needed transmission projects at least cost
- Before ATC, it was uncommon for two or more utilities to collaborate on a given project at a given time
- ATC has been able to develop successful, repeatable processes that allow transmission projects to be built







Midwest Market History

- With additional independent generation, a stand-alone transmission utility and open access to transmission, Wisconsin and the Midwest could pursue a more competitive energy market
- This led to the creation of the Midwest Independent System Operator, MISO







Midwest ISO

 Midwest ISO is the independent, non-profit reliability coordinator for the generation and transmission of high voltage electricity across all or parts of 15 states and Manitoba, Canada







Midwest ISO Footprint

Key Midwest ISO Milestone

1995	Discussions began to form Midwest ISO
1998	FERC Approves startup
1999	Elected first Board
2001	Approved by FERC as first RTO
2005	Launched energy markets
2008	Ancillary Services Market launch



Midwest ISO Regional Reliability Area







Who is MISO?

- Independent, non-profit organization responsible for maintaining reliable transmission of power in 15 states and one Canadian province
- First Regional Transmission Organization (RTO) approved by the Federal Energy Regulatory Commission (FERC)
- An RTO is an organization of Transmission Owners, Users, and other entities who coordinate transmission planning, expansion, operation, and use







MISO is also an Independent Transmission System Operator (ISO)

- Non-profit organization that controls transmission, but does not own transmission assets
- Provides non-discriminatory access to the grid, managing congestion, maintaining the reliability and security of the grid, and providing billing and settlement services
- Controls dispatch of power plants to match supply with demand







Why Do We Need ISOs and RTOs?

- 1965 Blackout led to the formation of NERC
- Congress passed the 1978 National Energy Act, in part, to guide bulk electricity system designs
- The goals of ISOs and RTOs are:
 - Providing reliable electricity at the most economical cost
 - Transmission congestion management
 - Transmission planning to ensure a continued supply infrastructure for load growth







ISOs and RTOs









What is the Role of Midwest ISO?



- Midwest ISO is a service company and it provides reliability to the electric grid
- Midwest ISO administers the "market" for electricity producers and users on a wholesale level
- Midwest ISO does not generate electricity, nor does it buy electricity for Midwest ISO







Midwest ISO Statistics

- Generation Capacity 130,000 MW (market) and 159,000 MW (reliability)
- Peak Load (set July 31, 2006) of 109,157 MW (market) and 124,479 MW (reliability)
- 93,600 miles (150,634 km) of transmission lines
- 15 states and one Canadian province
- Footprint covers 920,000 square miles (2,382,790 square km)
- 5,329 generating units in the network model
- 1,896 pricing nodes







Midwest MISO Statistics

- Operates an energy market that processes just under \$3 billion per month
- Five-minute dispatch
- Offers locked in 30 minutes prior to the scheduling hour
- Spot market prices calculated every 5 minutes
- <15-minute ramp rate at 1,000 MW
- 280 Market Participants who serve 40+ million people
- 728 full-time employees







Midwest ISO Governance

Governance

- The Midwest ISO is governed by an independent eight-member board of Directors, with seven independent directors elected by the membership, plus the president of Midwest ISO
- No board member may have been a director, officer or employee of a member, user, or affiliate of a member or user for two years before or after election to the Board
- Under the Midwest ISO's Standards of Conduct, all Midwest ISO board members, employees, and their immediate family members are required to divest of any holdings in member or user companies







Midwest ISO Board of Directors Transmission Planning Principles

- Make the benefits of a competitive energy market available to customers by providing access to the lowest possible electric energy costs
- Provide a transmission infrastructure that safeguards local and regional reliability
- Support state and federal renewable energy objectives by planning for access to all such resources (e.g. wind, biomass, demand-side management)
- Create a mechanism to ensure investment implementation occurs in a timely manner
- Develop a transmission system scenario model and make it available to state and federal energy policy makers to provide context and inform the choices they face







Midwest ISO Membership

- 30 Transmission Owners with \$14.4 billion in transmission assets under Midwest ISO's functional control
- 89 Non-transmission owners
- Membership Sectors
 - Transmission Owners
 - Vertically Integrated
 - Stand-Alone Transmission Companies
 - Coordination Member
 - Power Marketers







Midwest ISO Membership

- Membership Sectors (continued)
 - Independent Power Producers/Exempt Wholesale Generators
 - Municipals/Cooperatives/Transmission-Dependent Utilities
 - End-Use Customers
 - Environmental Groups
 - State Regulatory Authorities
 - Public consumer Groups















State Regulatory Committee Organization of MISO States (OMS)

OMS PURPOSE

The Organization of MISO States, Inc. (OMS) is a non-profit, selfgoverning organization of representatives from each state with regulatory jurisdiction over entities participating in the Midwest Independent System Operator, Inc. (MISO), a regional transmission organization as defined by the Federal Energy Regulatory Commission (FERC). The purpose of the OMS is to coordinate regulatory oversight among the states, including recommendations to MISO, the MISO Board of Directors, the FERC, other relevant government entities, and state commissions as appropriate.







Who Are MISO's Customers?

- Transmission Owner Owns and maintains transmission lines
- Customer Anyone who conducts business within the Midwest ISO region. This is a financial relationship
- Market Participant Same as a customer, also referred to as an "MP." Explicitly refers to participation in the Midwest Market
- Member An entity that has voting rights within the Midwest ISO committee structure
- Stakeholder Any entity (or person) who is interested in activities at the Midwest ISO. Primarily refers to those who participate in committee meetings







Customer Roles May not have assets Marketer Generation

Generation Owner Transmission Owner Load Serving Entity







Midwest Markets Overview

- The Midwest ISO manages one of the world's largest energy markets using security-constrained economic dispatch of generation. Market operations include a Day-Ahead Market, a Real-Time Market, and a Financial Transmission Rights (FTR) Market
- These markets are operated and settled separately







Midwest Market Overview

The Midwest ISO market consists of three components:

- Day Ahead Energy Market
- Peal Time Energy Market
- Financial Transmission Rights Market (FTR)









The MISO Wholesale Energy Market

How Does it Work?

- MISO provides price transparency
- How MISO energy markets work
 - Generators offer in at a price
 - Distributors place bid in for load
 - MISO facilitates the sale















Midwest Market Day Ahead

Day Ahead Market

- A process to balance generation and demand at least cost while recognizing operating conditions
- Commits the optimal amount and type of generation to meet hourly load for the next day
- The Day Ahead market is the primary market for utility energy purchases







Midwest Market Real Time

Real Time Market

- A continuous process of balancing generation and demand at least cost while recognizing current operating conditions
- Manage congestion via Locational Marginal Pricing and Generation Redispatch at a nodal level every 5 minutes
- Checks reliability with a "one transmission line out" contingency every 5 minutes







Midwest Market Financial Transmission Rights (FTR)

- Provides a mechanism for Market Participants to manage the risk of congestion
- FTRs apply to the Day Ahead Market only
- Financial Mechanism ONLY; not tied to physical delivery
- FTRs hedge against congestion only not losses







How Does the MISO Market Price Energy?

- Location Marginal Pricing (LMP), or the price at a particular location, reflects the cost to meet the next MW of demand at the location
- LMP is a tool for managing congestion on the grid, correlated to the price of wholesale energy
- LMP is the pricing method used by MISO to
 - Assign prices to energy purchases and sales
 - Assign congestion costs and losses needed to move energy
- Defined as the cost of supplying the next MW of load at a specific location







Locational Marginal Pricing

- What is Locational Marginal Pricing (LMP)?
 - LMP is a method of calculating the marginal price for energy, including congestion and losses, at all points on the grid
- Marginal pricing is the idea that the market price of any commodity should be the cost of bringing the next unit of that commodity – the one that balances supply and demand – to market
- In the Midwest Market, LMP reflects how this marginal price may vary at different times and locations based on transmission congestion and losses on the system. With LMP, market participants will know the marginal price at every location on the system







LMP Basics

- LMP Basic Concepts
 - Hourly LMPs are posted for each Commercial Pricing (CP) Node for the Day Ahead Market
 - 5 Minute and time-weighted hourly LMPs are posted for each CP Node for the Real Time Market
 - In an unconstrained system with no losses, all LMPs are equal
 - Due to physical realities, Congestion and Loss factors cause LMPs to differ by time and location
 - At a particular node, LMPs are the same whether you are buying or selling into the market















How is LMP used?

- Generators get paid at generation nodes LMP
- Loads pay at load nodes LMP
- Excluding losses, these LMP's are:
 - Equal when the transmission is unconstrained
 - Unequal when transmission is constrained
- MISO pays generators and collects from loads
- LMP is designed to account for congestion, price energy appropriately at each node, and yield the most economical approach to energy delivery for the system as a whole







Benefits of LMP

- Balances supply and demand for electric power
- Provides a comparable basis for pricing transmission use
- Encourages new generators to locate where the power they produce is of the most value to the load they serve
- Encourages new loads to consider locations cost-effectively
- Highlights where new transmission facilities would relieve congestion on the power grid in the most efficient way possible
- Provides pricing transparency to the market and its customers







Real Time, Balanced Energy Market









Intermediate Clearing Price

(loss driven small gradient prices, no congestion)









Higher Intermediate Clearing Price

(loss driven small gradient prices, no congestion)









Peaking Clearing Price

(loss driven small gradient prices , no congestion)









Near-Base Clearing Price

(loss driven and mild congestion prices)









Congestion is Predominant

(steep gradient in prices and wide price range)









Real-Time LMP Prices



	Hourly Day Ahead		5-Minute Real Time			Delta			Last Hour Estimated				
Location		HE 21		20:15						HE 20			
	LMP	MLC	MCC	LMP	MLC	MCC	LMP	MLC	MCC	LMP	MLC	MCC	
AEBN	53.27	-0.75	-3.23	62.51	-3.25	-0.58	-9.24	2.5	-2.65	66.18	-3.09	-0.27	1
AEC	52.93	-1.14	-3.18	62.69	-3.07	-0.58	-9.76	1.93	-2.6	66.20	-3.07	-0.27	•
AECI	50.85	-2.09	-4.31	62.81	-2.5	-1.03	-11.96	0.41	-3.28	72.03	-2.66	5.15	i
AEP	52.71	-1.18	-3.36	62.67	-3.08	-0.59	-9.96	1.9	-2.77	66.35	-2.92	-0.27	1
ALTE.COLUMBAL1	63.83	-0.19	6.77	67.01	1.25	-0.58	-3.18	-1.44	7.35	70.87	1.61	-0.27	1
ALTE.EDGG5G5	59.74	-0.6	3.09	67.32	1.56	-0.58	-7.58	-2.16	3.67	71.07	1.80	-0.27	1
ALTW.DAEC	22	-2.5	-32.75	61.31	-1.55	-3.48	-39.31	-0.95	-29.27	67.47	-1.80	-0.27	1
ALTW.FPL_DAEC	22	-2.5	-32.75	61.31	-1.55	-3.48	-39.31	-0.95	-29.27	67.47	-1.80	-0.27	1
ALTW.OTTUMW1	46.95	-3.33	-6.97	64.36	0.77	-2.75	-17.41	-4.1	-4.22	69.73	0.46	-0.27	1
AMRN.CALLAWAY1	50.34	-3.66	-3.25	61.28	-4.48	-0.58	-10.94	0.82	-2.67	56.08	-4.61	-8.86	i
AMRN.LABADIE3	50.02	-3.98	-3.25	60.55	-5.21	-0.58	-10.53	1.23	-2.67	59.10	-5.21	-5.22	4
AMRN.LABADIE4	50.08	-3.92	-3.25	60.62	-5.14	-0.58	-10.54	1.22	-2.67	59.16	-5.16	-5.22	4
AP	52.71	-1.18	-3.36	62.67	-3.08	-0.59	-9.96	1.9	-2.77	66.35	-2.92	-0.27	1
BCA	53.05	- 1	-3.2	62.57	-3.19	-0.58	-9.52	2.19	-2.62	66.10	-3.17	-0.27	1
BREC	54.06	0.05	-3.24	62.56	-3.2	-0.58	-8.5	3.25	-2.66	66.20	-3.07	-0.27	1
CE	52.71	-1.18	-3.36	62.67	-3.08	-0.59	-9.96	1.9	-2.77	66.35	-2.92	-0.27	1
CIN.CAYUGA.1	50.63	-3.36	-3.26	60.38	-5.38	-0.58	-9.75	2.02	-2.68	64.10	-5.17	-0.27	1
CIN.CAYUGA.2	50.88	-3.1	-3.27	60.7	-5.06	-0.58	-9.82	1.96	-2.69	64.44	-4.83	-0.27	1
CIN.GIBSON.1	48.84	-5.15	-3.26	58.28	-7.48	-0.58	-9.44	2.33	-2.68	61.86	-7.41	-0.27	1
CINERGY.HUB	53.01	-0.99	-3.25	62.47	-3.29	-0.58	-9.46	2.3	-2.67	66.23	-3.04	-0.27	1
CISO	51.41	-2.26	-3.58	63.23	-1.46	-1.65	-11.82	-0.8	-1.93	78.00	-1.84	10.30	j
CLEC	52.91	-1.16	-3.18	62.75	-3.01	-0.58	-9.84	1.85	-2.6	66.25	-3.02	-0.27	1
CONS.18MCVCV	52.84	-1.26	-3.15	62.97	-2.79	-0.58	-10.13	1.53	-2.57	66.85	-2.42	-0.27	1
CONS.CETR	54.56	0.44	-3.13	64.55	-1.21	-0.58	-9.99	1.65	-2.55	68.54	-0.73	-0.27	1
CONS.PALISA2A1	52.43	-1.59	-3.23	62.46	-3.3	-0.58	-10.03	1.71	-2.65	66.20	-3.07	-0.27	1
CPLE	53.14	-0.89	-3.22	62.5	-3.26	-0.58	-9.36	2.37	-2.64	66.15	-3.12	-0.27	1
CPLW	53.35	-0.68	-3.22	62.47	-3.29	-0.58	-9.12	2.61	-2.64	66.11	-3.15	-0.27	•

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Market Settlements

- Objectives of Market Settlements
 - Assigns financial charges and credits to Market Participants and Asset Owners based upon their participation in the Day-Ahead (DA), Real-Time (RT), and Financial Transmission Rights (FTR) Markets
 - Enables Market Participants to review and validate the charges and credits that will be billed to them on upcoming invoices
 - Provides a mechanism for Market Participants to compare charges and credits to their own shadow Settlement System







Settlements in its simplest form

- Generators are paid for providing energy
- Load pays to receive energy
- Midwest ISO is revenue neutral
 - Recovers cost of operating the Market through Administrative charges









Reliability at Midwest ISO















Reliability at Midwest ISO

- Reliability
 - Improved reliability and coordination with neighboring entities
 - ✓ Improved Reliability
 - ✓ Seams Management
 - ✓ Regulatory Compliance









Congestion Management

- Ensure the transmission system does not overload
- Managed in real time
- By generation redispatch









Balancing Authority Functional Alignment

- Balancing Authority Functional Alignment
 - Develop roles and responsibilities between Midwest ISO and Balancing Authorities
 - Align NERC Standards and requirements to support Ancillary Services Markets
- Approved by all Balancing Authorities







What is a Balancing Authority?

- Balancing Authority (BA) An electric power system or combination of electric power systems bounded by interconnection metering and telemetering
- What are the duties of the BA?
 - Balance the Supply and Demand within their area
 - Maintain the interchange of power with other Balancing Authorities
 - Maintain the frequency of the electric power system within reasonable limits







Ancillary Services Markets



- What are Ancillary Services?
 - A collection of secondary services offered to help ensure the reliability and availability of energy to consumers.
 - These services include:
 - \checkmark Regulation
 - ✓ Contingency Reserves
 - Spinning
 - Supplemental (non-spinning)
 - The Contingency Reserve services are often referred to as Operating Reserves







What do Ancillary Services Provide?

- Flexible Capacity to be available when needed to maintain secure operation of power system due to:
 - Loss or increase of Load
 - Loss or increase of Resources









What is a Contingency?

- A contingency is a transmission line tripping, a generator tripping, loss of load or some combination of these events
- This contingency in turn causes other problems, such as a transmission line overload, an over or under voltage in an area, over or under frequency or frequency instability
- Contingency Reserves are a specified percentage of generation capacity resources held back or reserved to meet emergency needs







MISO provides an Institutional Structure to Facilitate a Competitive Wholesale Market

- Many sellers (generators)
- Many buyers (load-serving entities)
- Independent market facilitator, responsible for dispatch (MISO)
- Price transparency
- Fairly easy to become a market participant
- Open tariffs
- Stakeholder participation