Operationalizing Uncertainty

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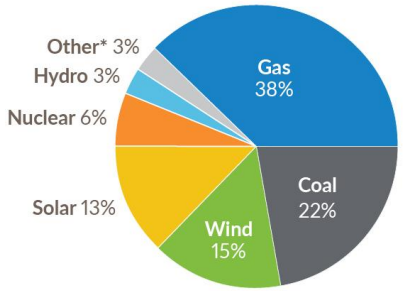
Meet MISO

MISO's reliability footprint and regional offices

KEY FACTS

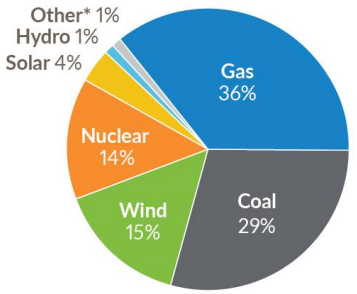
Area Served	15 U.S. States and Manitoba, Canada
Population Served	45 Million
Transmission Line	79,000 Miles
Generating Units	Approximately 2,000
Total MISO Members	230+
Market Participants	550+
Market Transactions	Over $53 billion in 2025
Carbon Reduction	Approximately 32% since 2014

INSTALLED CAPACITY
JUNE 2026



215 GW

ENERGY PRODUCTION
January-December 2025



663 Million MWh

*Other: Diesel, Biomass, Storage, Demand Response Resources

Data as of 6/8/2026

Operational Forecasting: Identifying risk and quantifying uncertainty to inform operational decisions and support reliability across the MISO footprint

- MISO Operations Risk Assessment is comprised of three core pillars – load forecasting, meteorology, and uncertainty.
- Traditional load forecasting methodology no longer sustainable in a very dynamic environment.
- Strategic direction that focuses on operational reliability, efficiency, reduction of risk, and process enhancements that position us to be more proactive and less reactive.
- Demands of the grid are changing - elevated uncertainty, significant increases in renewable generation assets, complex load pockets, and unprecedented load growth.
- Enhance forecasting product from DA through 7-day window.
- Improve intra-day risk and uncertainty visibility to operators.

The evolving system needs require sharpening the definition of Operational Risks

OPERATIONAL RISK	RISK CATEGORY	DESCRIPTION
Long Duration Outages	*Availability*	Prolonged resource unavailability from weather or fuel issues strains energy supply.
Net-Load Shape	*Ramp*	Evolving resources increase net load variability, requiring more flexible ramping.
System Stability	*Stability*	Fewer synchronous resources and more inverters reduce grid stability and complicate assessments.
Large Loads	*Stability* *Availability* *Ramp*	Rapid growth of large loads adds strain on planning for ramp, adequacy, and stability.
Load Pocket Adequacy	*Stability* *Availability* *Ramp*	Areas at the edge of the MISO system with limited import capability are reliant on local generation and face distinct risks.

Operationalizing Uncertainty: Uncertainty Platform – Similar Day Tool, Net Load, Gas Pipeline Risk, Neighbor Forecasts

- Additional additions to UP include net-load, similar days, gas pipeline risk, and neighbor forecasts
- Enhanced situational awareness and risk quantification, visibility to fuel supply risk for thermal generation
- Preposition MISO to make informed decisions as part of risk assessment process

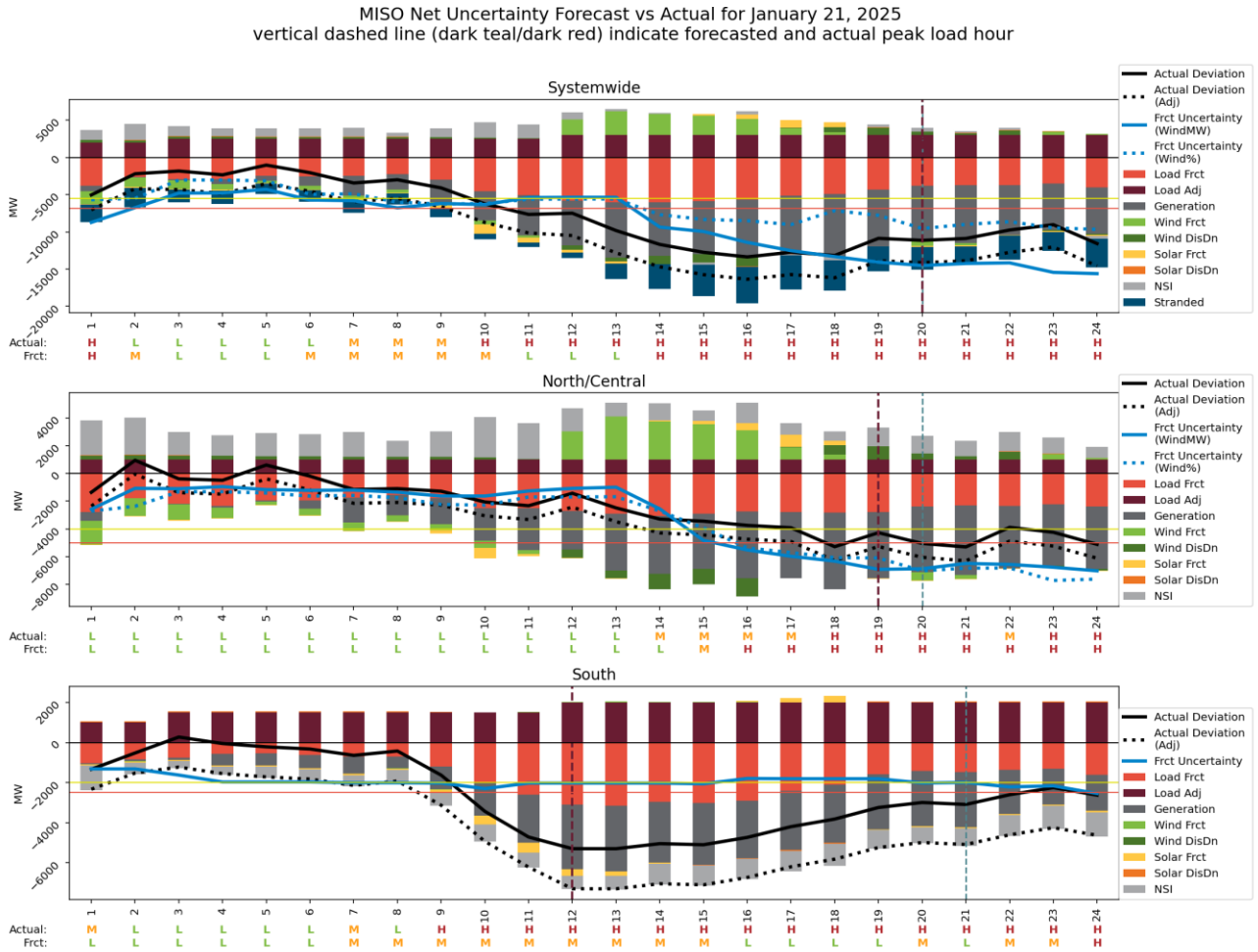
*Internal tools/screen capture

Operationalizing Uncertainty: Fail to Start Dashboard

- Uses MP survey results and historical performance of thermal generation fleet to highlight risk based on local temperature forecasts.
- Forward looking 7 days
- Risk profiles at generator level
- Quantifies generator risk and MW at risk

*Internal tools/screen capture

Operationalizing Uncertainty: Net Uncertainty



Next-Day FRAC Commitment Threshold Recommendation

Region	Peak Hour	Final Forecast Uncertainty	Commitment Threshold (MW)	Forecast Source
System	16	3-High (Orange/Red)	7000	Latest Non-Override
North/Central	17	1-Low (Green)	3400	Latest Non-Override
South	16	1-Low (Green)	1700	Latest Non-Override

Short Term Reserve Requirement Recommendation

System

Hour	Reserve	Override
1	4050	4750
2	4050	4750
3	4050	4750
4	3150	3850
5	4050	4750
6	4050	4750
7	4050	4750
8	4050	4750
9	5050	5750
10	5050	5750
11	5050	5750
12	5050	5750
13	4050	4750
14	3150	3850
15	3150	3850
16	3150	3850
17	3150	3850
18	3150	3850
19	3150	3850
20	3150	3850
21	3150	3850
22	4050	4750
23	4050	4750
24	4050	4750

North/Central

Hour	Reserve	Override
1	3000	
2	3000	
3	3000	
4	2300	
5	3000	
6	3000	
7	3000	
8	3000	
9	3850	
10	3850	
11	3850	
12	3850	
13	3000	
14	2300	
15	2300	
16	2300	
17	2300	
18	2300	
19	2300	
20	2300	
21	2300	
22	3000	
23	3000	
24	3000	

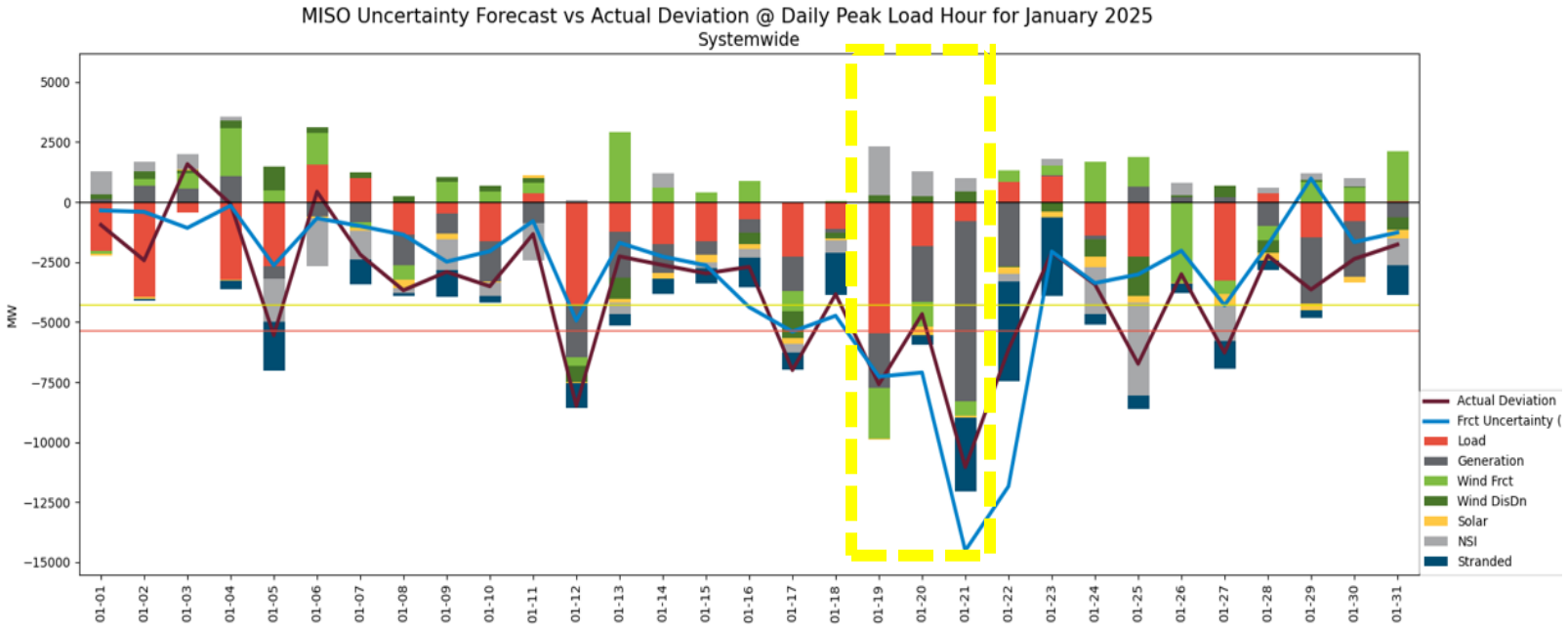
South

Hour	Reserve	Override
1	Default	
2	Default	
3	Default	
4	Default	
5	Default	
6	Default	
7	Default	
8	Default	
9	Default	
10	Default	
11	Default	
12	Default	
13	Default	
14	Default	
15	Default	
16	Default	
17	Default	
18	Default	
19	Default	
20	Default	
21	Default	
22	Default	
23	Default	
24	Default	

*Internal tools/screen capture

Operationalizing Uncertainty: Net-Uncertainty Model Performed Well During Winter Storm Enzo

- Dynamic Short-Term Reserve requirements and reserve margin thresholds helped preposition generation fleet for days with elevated uncertainty



*Internal tools/screen capture

Operationalizing Uncertainty: Net-Uncertainty All-Hours

Assess commitment threshold across all 24-hours, conditional on load and renewable levels.

A market day is labeled as low/medium/high based on:

- L/M/H at peak hour; or
- Count of M/H hours in a day

Using 3/16/2026 as example:

- Medium at Peak Hour HE 20
- High when counting M/H hrs
- Final determination: HIGH

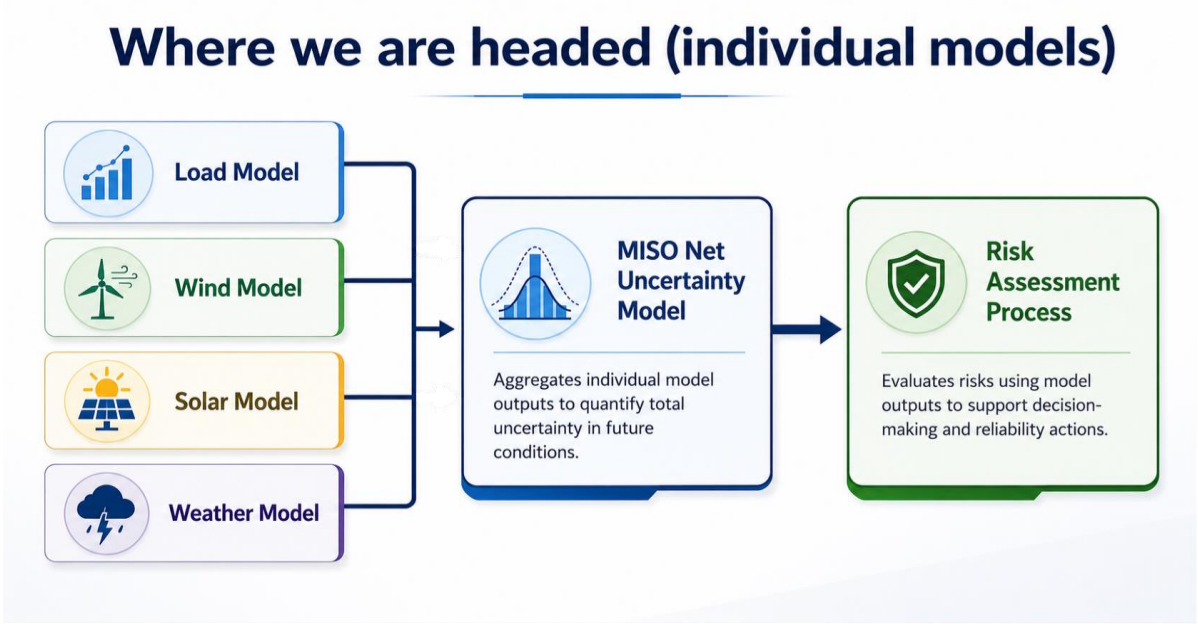
MKTDAY	HE	Uncertainty
3/16/2026	1	1-Low (Green)
3/16/2026	2	1-Low (Green)
3/16/2026	3	2-Medium (Yellow)
3/16/2026	4	2-Medium (Yellow)
3/16/2026	5	2-Medium (Yellow)
3/16/2026	6	2-Medium (Yellow)
3/16/2026	7	2-Medium (Yellow)
3/16/2026	8	2-Medium (Yellow)
3/16/2026	9	2-Medium (Yellow)
3/16/2026	10	2-Medium (Yellow)
3/16/2026	11	3-High (Orange/Red)
3/16/2026	12	3-High (Orange/Red)
3/16/2026	13	3-High (Orange/Red)
3/16/2026	14	3-High (Orange/Red)
3/16/2026	15	3-High (Orange/Red)
3/16/2026	16	3-High (Orange/Red)
3/16/2026	17	3-High (Orange/Red)
3/16/2026	18	3-High (Orange/Red)
3/16/2026	19	3-High (Orange/Red)
3/16/2026	20	2-Medium (Yellow)
3/16/2026	21	1-Low (Green)
3/16/2026	22	1-Low (Green)
3/16/2026	23	1-Low (Green)
3/16/2026	24	1-Low (Green)

Systemwide

HE	FORECAST MTLF Input	FORECAST WIND Input	Supplement Commitment Th..
1	64,554	3,206	
2	63,117	4,188	
3	62,404	5,571	
4	62,511	6,857	
5	63,927	7,451	
6	67,066	7,364	
7	70,746	7,136	
8	72,663	6,426	
9	72,780	5,304	
10	72,286	5,150	
11	72,026	5,713	
12	72,229	6,280	
13	72,676	6,894	
14	73,087	7,454	
15	73,161	7,970	
16	73,251	8,444	
17	73,457	8,653	
18	73,757	8,234	
19	73,888	7,108	
20	74,037	5,636	
21	73,804	4,892	
22	71,623	4,818	
23	68,270	4,676	
24	64,954	4,639	

*Internal tools/screen capture

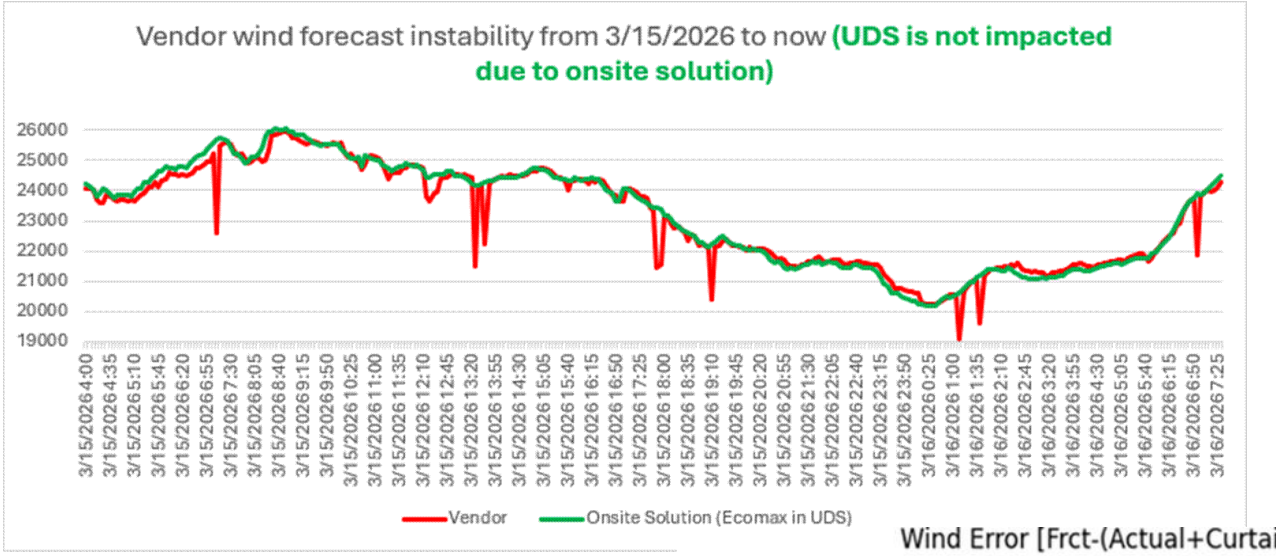
Operationalizing Uncertainty: Net-Uncertainty Model (current)

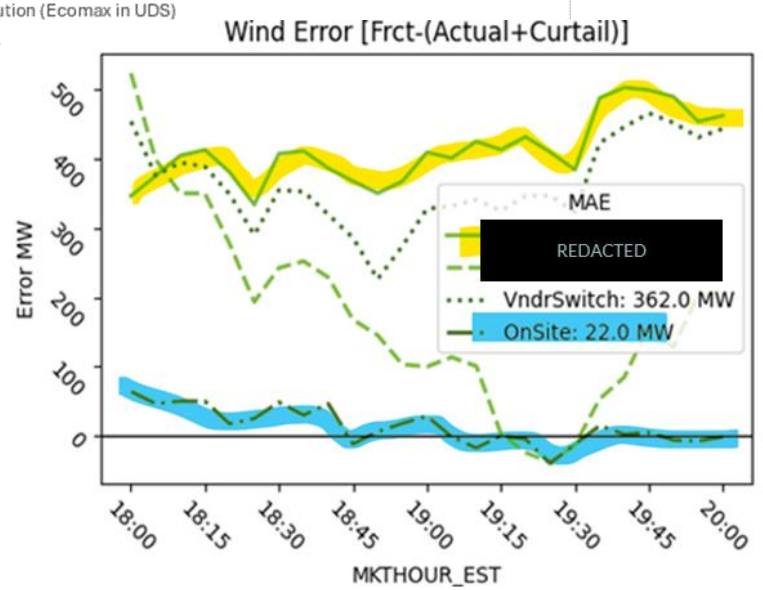


- Current uncertainty model is aggregated and limited visibility on contribution weight
- Individualized models provide probability weight into determination of L/M/H recommendation
- New methodology increases confidence and builds continued trust in model

Operationalizing Uncertainty: On-Site Solution, Renewable Vendor Switch

- MISO on-site 10-MA solution evaluates performance of vendor renewable forecast performance
- Instability, missing, or poor forecast triggers vendor-switch resulting in improved and stabilized forecast data to UDS.
- Revised DIR Ecomax logic in UDS logic eliminates the time lag of data transfer between MISO and vendor forecast systems
- In some cases, as much as ~350MW of avoided forecast wind error





*Internal tools/screen capture

Operationalizing Uncertainty: Enhanced Uncertainty Management Based on Learned Opportunities

- Enhanced uncertainty quantification methodology to derive seasonal reserve requirements
- Shift from Peak Hour to ALL HOUR process
- Assess all 24-hour ND-FRAC Net Uncertainty forecast to determine Low/Medium/High prediction for setting Commitment Threshold
- Assess Commitment Threshold across all 24-hour conditional on load and renewable level
- Prepare implementation of Dynamic Regulation Requirement expected June 2026
- Process development for optimizing vendor-provided renewable forecasts (future)
- Wind and Solar forecast enhancement (intraday) using hyper-local real-time meteorological vendor data (future)

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