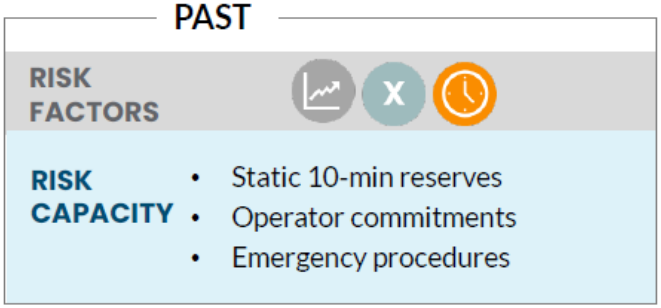
MISO Uncertainty Management

ESIG

June 11-13, 2024

Transitioning fleet is driving a new risk profile for Grid and Market Operations



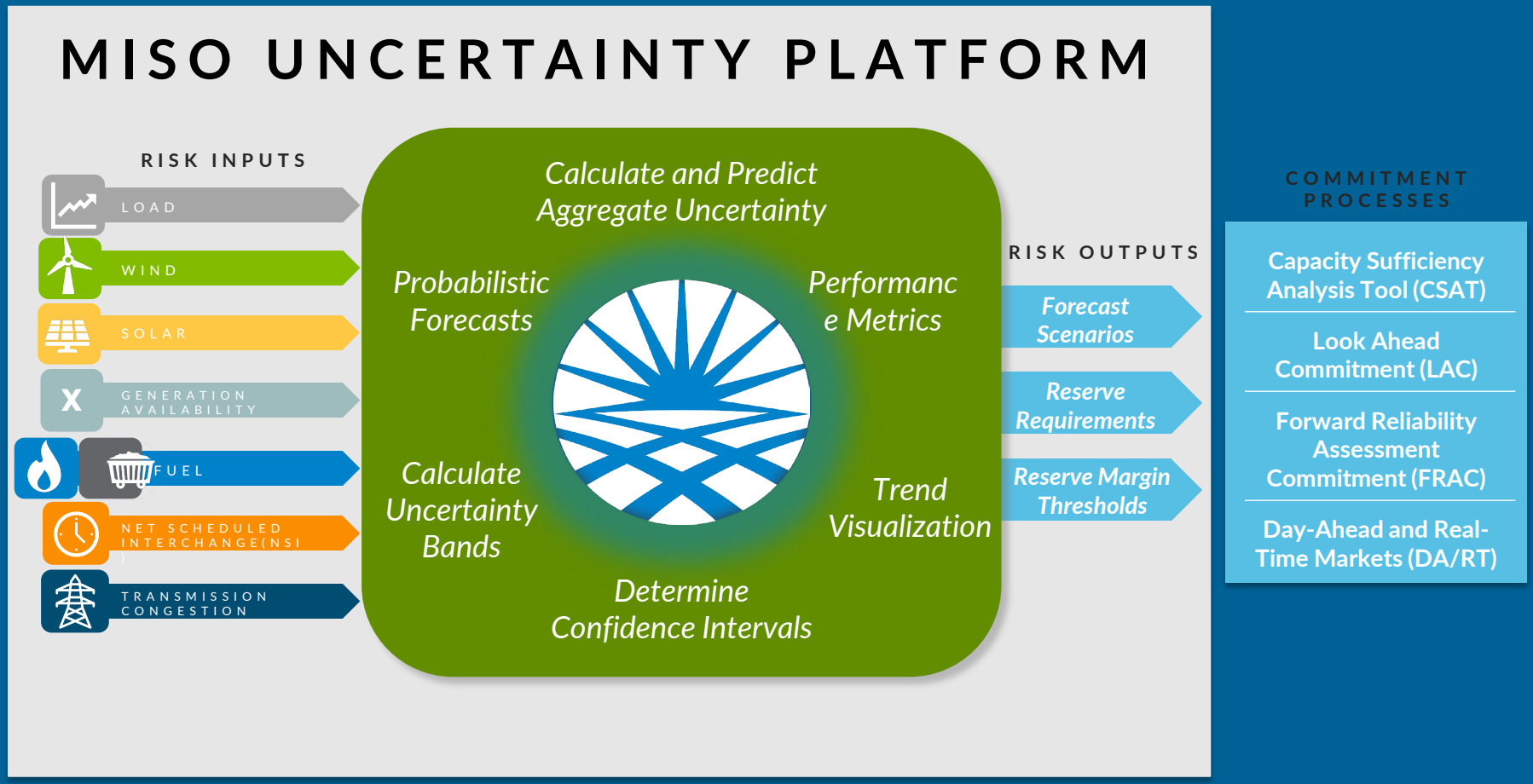
Reliability is not only to meet the projected load obligation but to manage uncertainties

Characterize risks
using data analytics and meteo techniques
- Individual risks range from load, wind, solar, generation, Txx, etc.
- Establish probabilistic forecasts

Integrate risks
into operations planning and situational awareness
- Establish centralized visual of risks dynamically and with regional granularity
- Provide risk updates for ops planning and unit commitment

Manage risks
through market products or dynamic reserves
- Quantify net uncertainty across different timeframes and predict H/M/L risks
- Operate dynamic reserves for existing market products

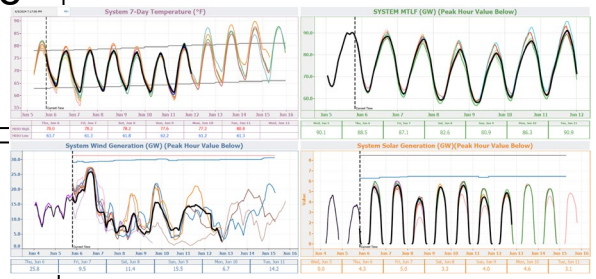
The cloud-based Uncertainty Platform is aimed to transform deterministic grid operations to probabilistic



The platform will establish probabilistic forecasts and risk analytics to quantify individual risk factors

LOAD

Weather scenario-based load forecast Derive load forecast scenarios from multiple NWP models and assess uncertainty spread



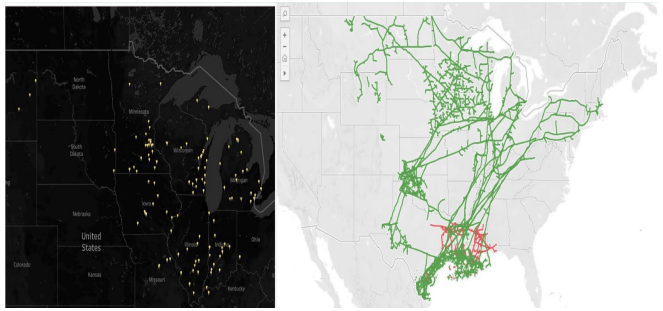
WIND

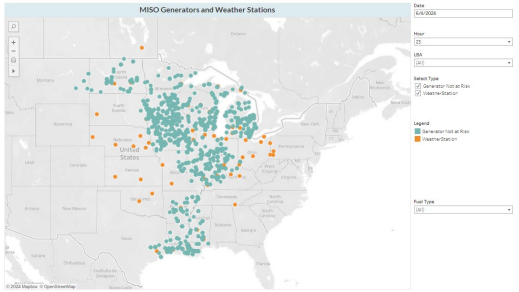
SOLAR

Operationalize 2nd renewable vendor Build infrastructure to host multiple vendors and multiple wind and solar forecast scenarios

X GENERATION AVAILABILITY

FUEL



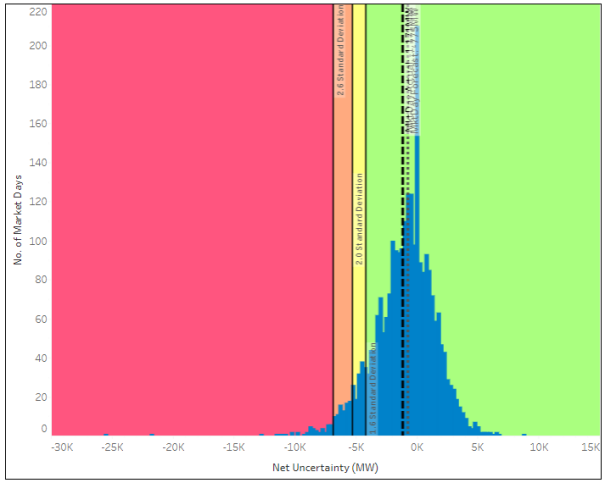


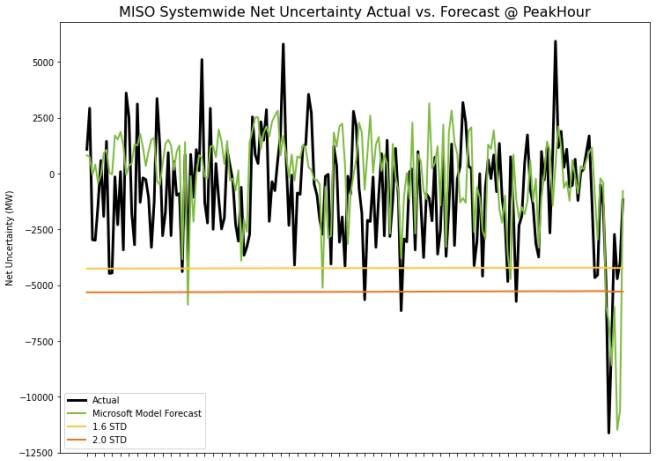
NET SCHEDULED INTERCHANGE(NSI

*NWP: Numerical Weather Prediction model

Dynamic requirements for Short-Term Reserve and Next-Day Reserve Margin threshold are operationalized

- MISO developed robust methodology to quantify Net Uncertainty
  - Short-Term Reserve: 30min-3hr net uncertainty managed by 30min rampable online capacity and eligible 30min offline fast start resources
  - Next-Day Reserve Margin Threshold: next-day net uncertainty managed by online capacity and 4hr offline short lead units*
- Net Uncertainty prediction machine learning model is established in Azure to predict H/M/L risk profile
  - Net uncertainty quantified and predicted at both systemwide and sub-regional levels
- Operating Procedure and dynamic reserve process established and operated





*Note: this is done through operations process as a market product does not exist but is being framed under Attributes

MISO's net uncertainty model considers the holistic risk profile including thermal generation outage/derates, imports/exports…

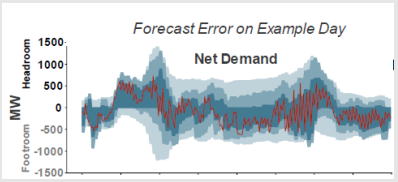
INDUSTRY PRACTICES

TRADITIONAL

Aggregate individual uncertainties with assumptions of correlations

E3 OLSON MODEL

Net load forecast error assembled from load, wind, and solar



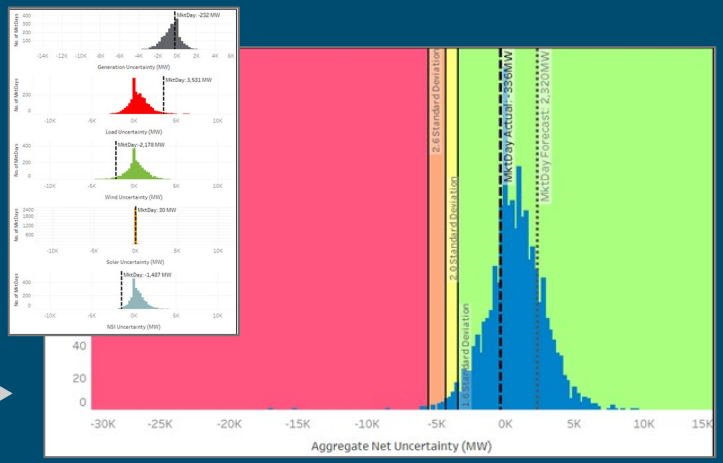
MISO INNOVATION

MISO MODEL

Net uncertainty constituted from load, wind, solar, generation derates/forced outages and NSI

Azure Data Strategy

Data Platform → Data Ingestion → Uncertainty Management



Performed as expected during winter storm Heather, allowing pre-position with adequate reserves to manage uncertainties

- The Net Uncertainty prediction model successfully flagged HIGH risk based on historically experienced large uncertainty in like-weather conditions
- High STR requirement and Next-Day threshold were used accordingly to procure reserves
- Given Elliot/Uri like cold/precip, we further raised the requirements to cover 99.7 percentile (3-sigma) for Jan 16-17

Systemwide Multi-Day Net Uncertainty Forecast: **Risk Prediction**

Forecast Horizon	Marketday 1/16/2024	1/17/2024	1/18/2024	1/19/2024	1/20/2024	1/21/2024
1 Day Ahead	3-High Risk (Orange/Red)					
2 Days Ahead	3-High Risk (Orange/Red)	3-High Risk (Orange/Red)				
3 Days Ahead	3-High Risk (Orange/Red)	3-High Risk (Orange/Red)	1-Low Risk (Green)			
4 Days Ahead	3-High Risk (Orange/Red)	3-High Risk (Orange/Red)	1-Low Risk (Green)	1-Low Risk (Green)		
5 Days Ahead						
6 Days Ahead						

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DashBoard | Dashboard MultiDay | Commitment Threshold | High Generation Uncertainty D...

South Multi-Day Net Uncertainty Forecast: **Risk Prediction**

Forecast Horizon	Marketday 1/16/2024	1/17/2024	1/18/2024	1/19/2024	1/20/2024	1/21/2024
1 Day Ahead	3-High Risk (..					
2 Days Ahead	2-Medium Ri..	3-High Risk (..				
3 Days Ahead	2-Medium Ri	3-High Risk (	1-Low Risk (			

Short Term Reserve Requirement Recommendation

Systemwide Requirement

Hour	STR Requirement (MW)	Override
0	3,600	1,600
1	3,600	1,600
2	3,600	1,600
3	3,600	1,600
4	3,600	1,600
5	4,300	1,600
6	4,300	1,600
7	4,300	1,600
8	3,600	1,600
9	3,600	1,600
10	3,600	1,600
11	4,400	1,600
12	4,400	1,600
13	4,400	1,600
14	4,400	1,600
15	3,600	1,600
16	3,600	1,600
17	3,600	1,600
18	3,600	1,600
19	3,600	1,600
20	4,300	1,600
21	4,300	1,600
22	4,300	1,600
23	3,600	1,600

Raised 900MW (99%) adder to 1600MW (99.7%)

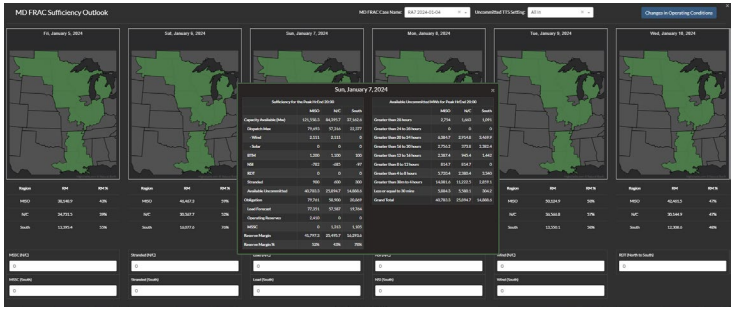
January 16, 2024

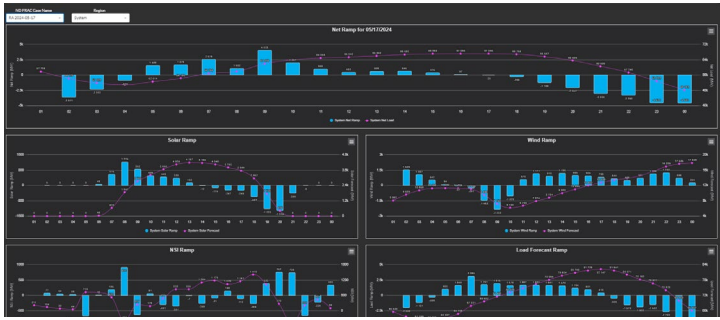
Next-Day FRAC Commitment Threshold Recommendation

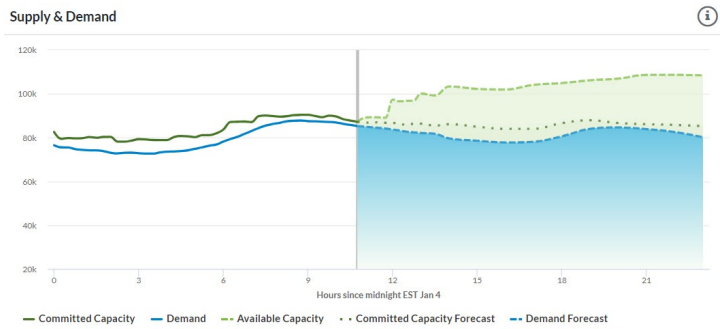
Region	Forecast Risk	Commitment Threshold (Percentage)	Commitment Threshold (MW)
North/Central	3-High Risk (Orange/Red)	14	9,200
South	3-High Risk (Orange/Red)	9	2,200
Systemwide	3-High Risk (Orange/Red)	13	12,200

CSAT* provides control room and members situational awareness of Operating Reserve Margin and supports scenario analysis

- Provides **Operating Reserve Margin outlook** every 15 minutes up to seven days for systemwide, South and North/Central
- Establishes **source of truth for critical foresight** including Resource availability, Load, wind/solar, NSI, etc. and Emergency resources
- Improves **usability** including graphic and tabular visualization and operator interaction for preliminary scenario analysis
- External access to CSAT data enabled by MISO website to provide dynamic view of system conditions







*Note: Capacity Sufficiency Analysis Tool

Contacts

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