A Look at MISO's Efforts to Understand Fuel Assurance Risks and Incentivize Availability

PJM Reserve Certainty

Senior Task Force

February 14th, 2024

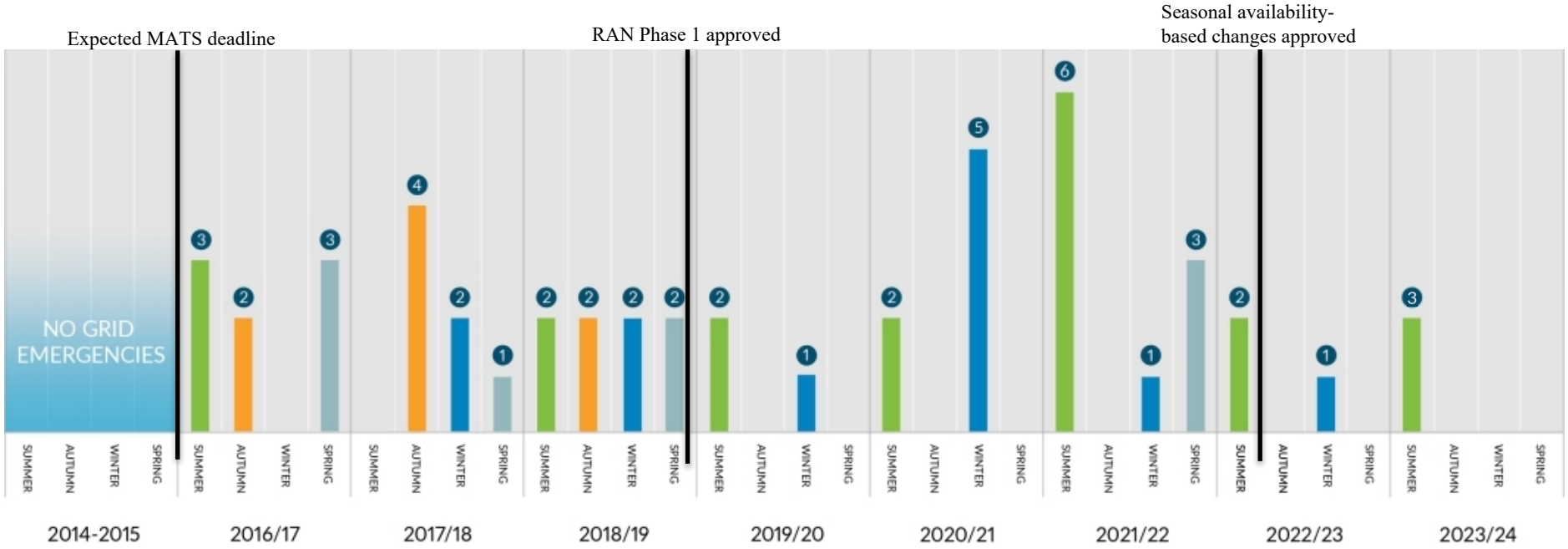
Purpose & Key Takeaways

Purpose: To review efforts by MISO and our stakeholders to mitigate fuel uncertainty risks and incentivize energy and reserves availability

Key Takeaways:

- Work began in earnest after the 2014 Polar Vortex and ramped up due to multiple capacity emergencies per year starting in 2016
- Progression of enhancements: Increase visibility-> Refine requirements-> Incentivize availability
- MISO continues to make progress toward uncertainty management aiding preparation for extreme weather when fuel risks are the highest
- The yearly fuel and winterization surveys help ensure winter reliability
- Dynamic requirements for Short-Term Reserve and Next-Day reserves are operationalized using the Net Uncertainty prediction model
- Under the Direct LOL (DLOL) proposal future class-level accreditation will better account for fuel assurance and flexibility attributes

MISO has been able to reduce the frequency of capacity emergencies by enhancing system operations and improving our markets



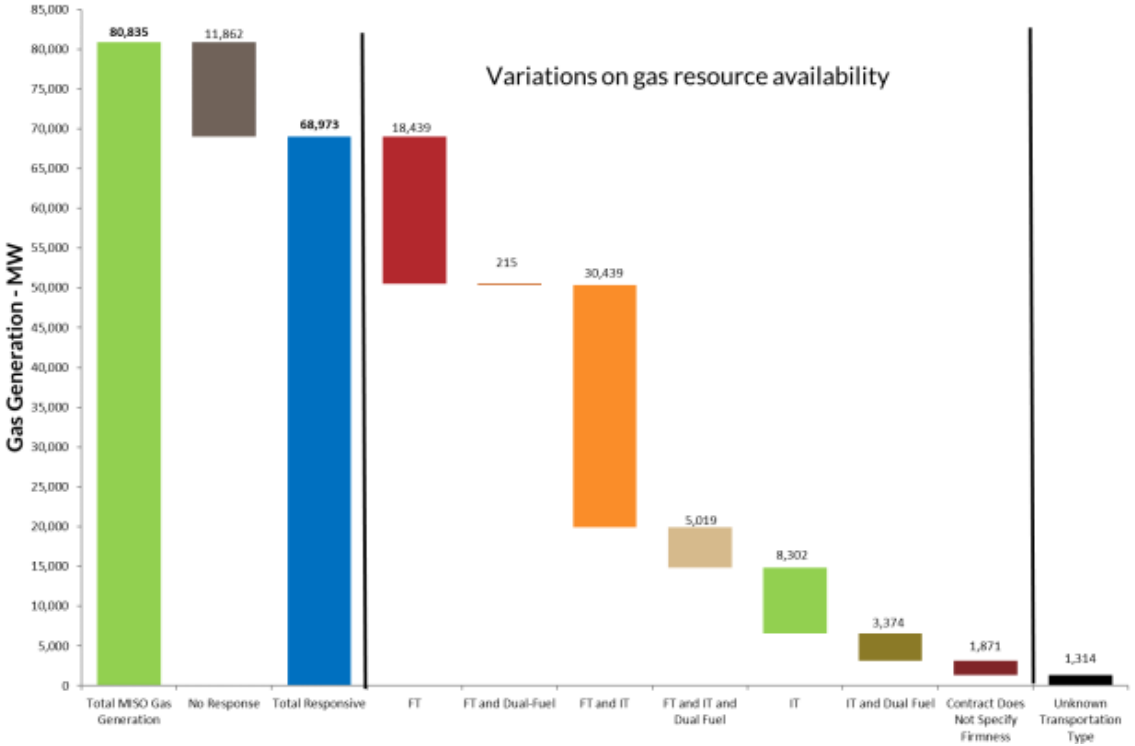
The chart indicates the number of operating days with a MaxGen alert, warning, or event

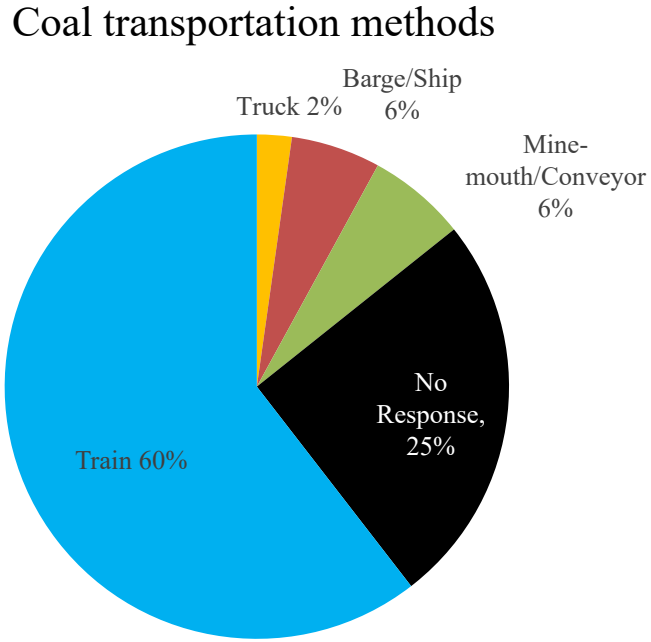
MATS = Mercury & Air Toxics Standards MaxGen = Capacity Emergency
RAN = Resource Availability & Need

Operational enhancements improve visibility of risks to fuel assurance

- Real-time operations uses gas generation specific data to
  - Associate generators with their specific gas pipelines
  - Monitor gas pipelines critical notices
  - Assess the impact of OFO (Operational Flow Orders) based on transport firmness
- Combining coal transportation methods with Fuel & Consumables data request can better assess risk to coal units
- Real-time operations uses temperature data to improve situational awareness
  - Assess expected performance of generators
  - Reach out to specific generators of concern

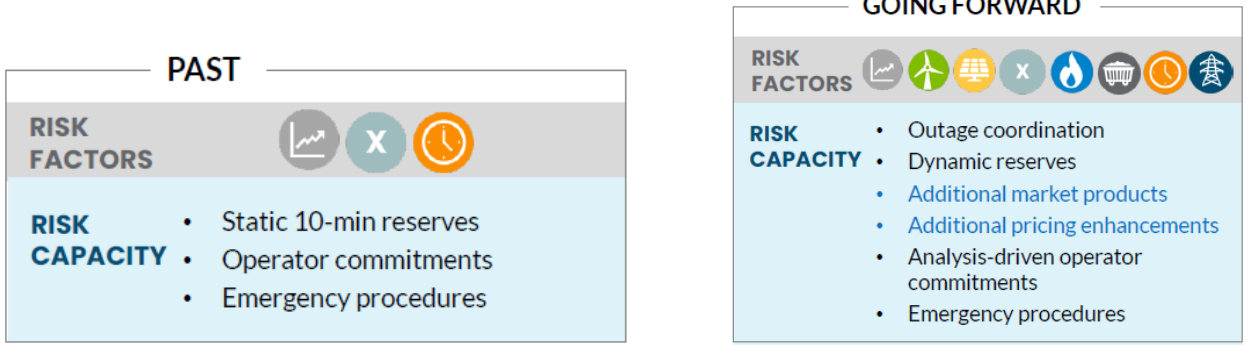
Results from the 2023 gas and coal fuel surveys





FT is Firm Transportation, IT is Interruptible Transportation

MISO is accounting for the new risk profiles resulting from ongoing changes to our resource portfolio



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

Characterize risks
using data analytics and meteo techniques
- Individual risks range from load, wind, solar, generation, Transmission, 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 Uncertainty Model was developed to quantify net uncertainty constituted from holistic risk components

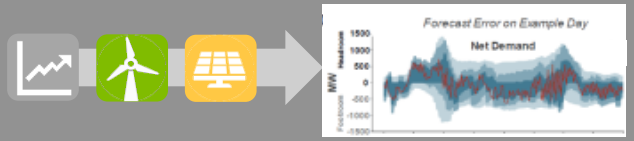
INDUSTRY PRACTICES

TRADITIONAL

Aggregate individual uncertainties with assumptions of correlations

RESEARCH MODEL*

Net load forecast error assembled from load, wind and solar

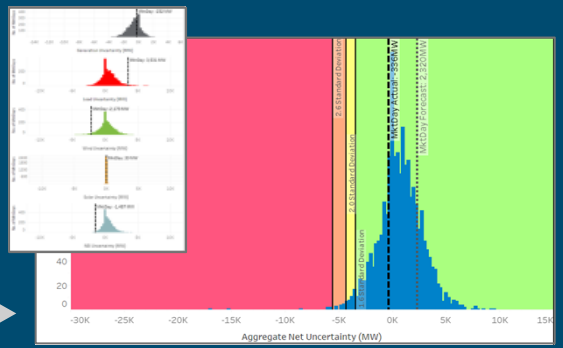


MISO INNOVATIONS

MISO MODEL

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

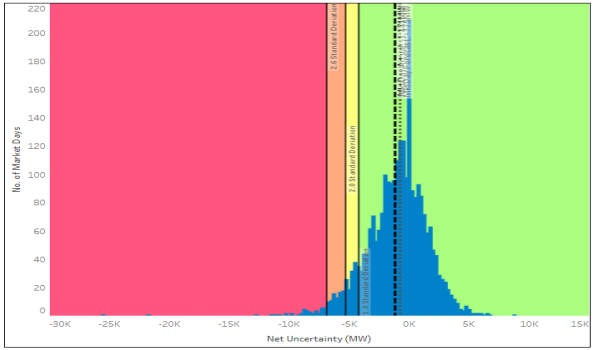
Data Platform → Data Ingestion → Machine Learning

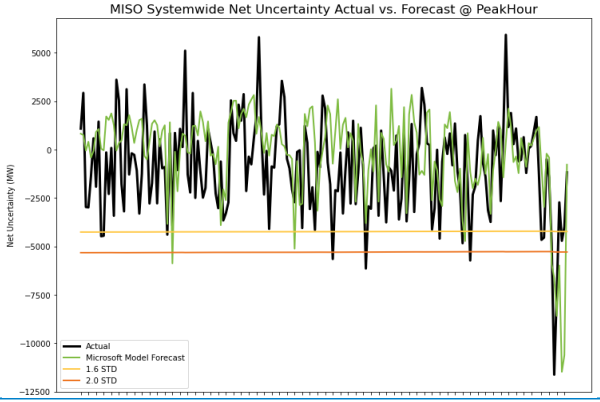


*Olson, ESIG Meteorology and Market Design for Grid Services Workshop, June 8, 2022
https://www.esig.energy/download/session-4-dynamic-reserve-calculation-with-e3s-reserve-model-arne-olson/

Dynamic requirements for Short-Term Reserve and Next-Day reserve margin threshold have been operationalized

- MISO has developed a robust methodology to quantify net uncertainty
  - Short-Term Reserve (STR): 30min-3hour 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*
- The Net Uncertainty prediction machine learning model has been established in Azure to predict H/M/L risk profiles
  - Net uncertainty is quantified and predicted at both the systemwide and sub-regional levels

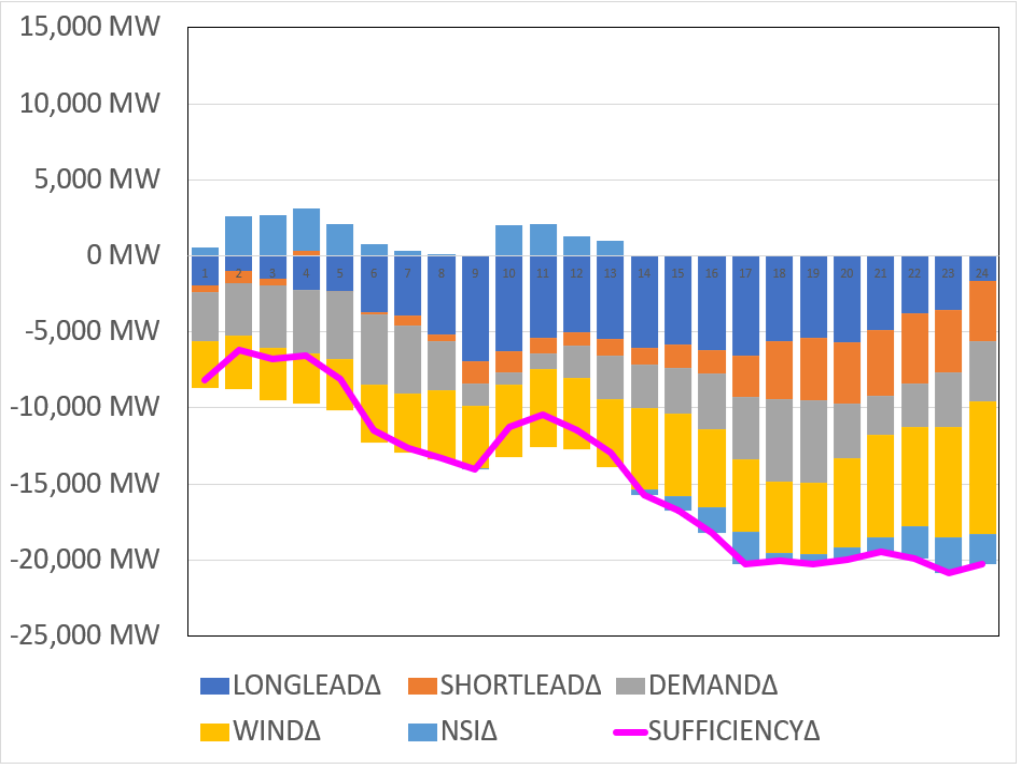




*Note: this is done through operations process as a market product does not exist but is being framed under our “Attributes” effort

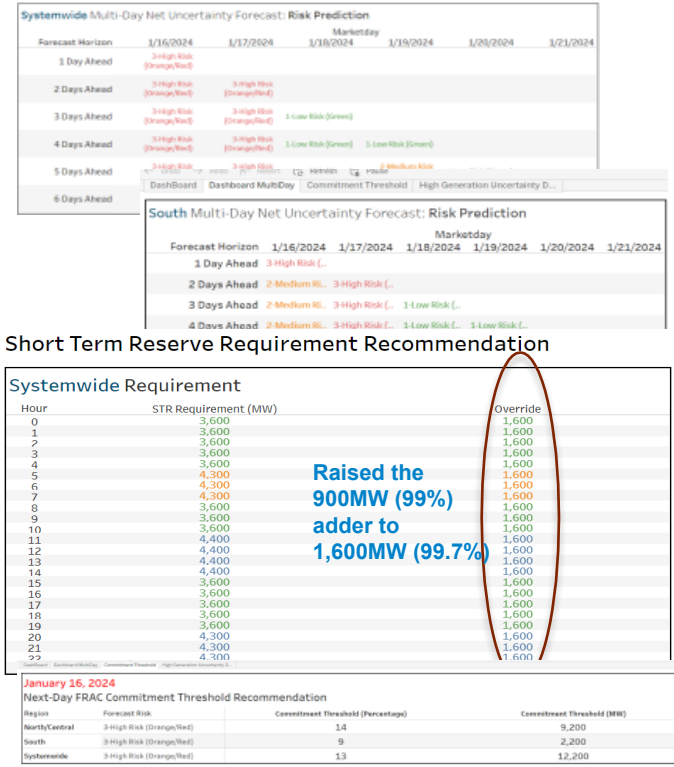
MISO was able to reliably support our neighbors during Winter Storm Elliott but it demonstrated how correlated risks compound uncertainty

- During Winter Storm Elliott MISO's system experienced multiple correlated risks to real time system reliability
- In addition to errors in demand and wind forecasts there were abnormally high levels of forced outages among both long-lead and short-lead resources
- The 20 GW erosion in Next Day sufficiency balance was unprecedented



During Winter Storm Heather MISO increased STR reserve requirements to align with its uncertainty model

- The prediction model successfully flagged for HIGH risk based on past events
- Given the potential for Winter Storm Elliott and Uri style cold and precipitation MISO raised the requirements to cover 99.7 percentile (3-sigma) of uncertainty for January 16th and 17th
- Accordingly, higher STR requirements and Next-Day reserve margin thresholds were used to procure reserves



MISO has developed an Attributes Roadmap signaling future work to deliver needed priority system attributes like fuel assurance

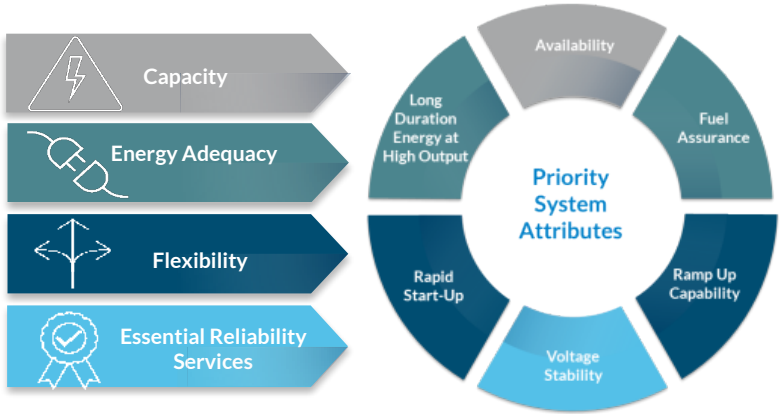
DEFINE AND REFINE
- Continue to refine the definition of the key system reliability attributes

DATA, METRICS, AND TOOLS
- Determine which data/metrics are most suitable to perform this quantitative analysis
- Determine which tools are appropriate for the analysis

SYSTEM NEEDS AND TRENDS
- Develop measurement methods to calculate attribute needs and trends

PROVISION AND AVAILABILITY
- Develop measurement methods to calculate attribute availability and provision
- Forecast attributes using the F2A portfolios

RESOURCE CONTRIBUTION
- Explore the provision of attributes from the various resources or resource types.



[Link to the Attributes Roadmap]

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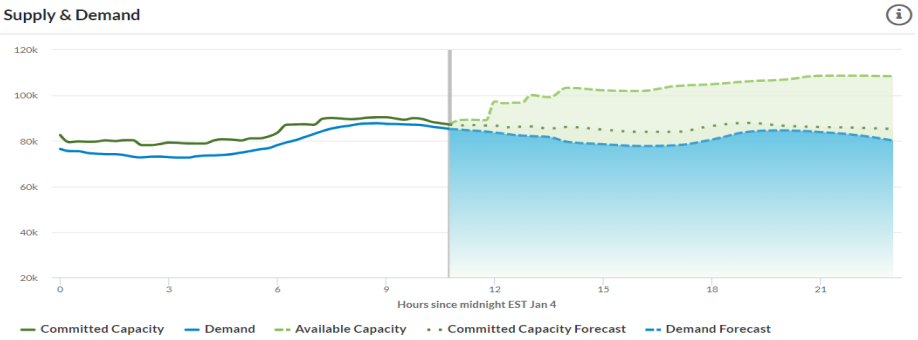
Appendix materials below

CSAT features a multi-day outlook, scenario analysis and supports external access to enhance member visibility

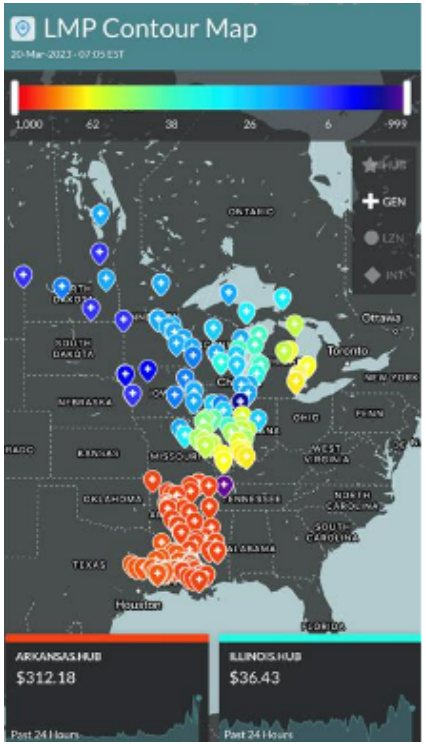
- The multi-day outlook deployed into CSAT, including
  - Scenario analysis capability
  - Tracks system condition changes
- External access to CSAT data enabled by MISO website to provide dynamic view of system conditions



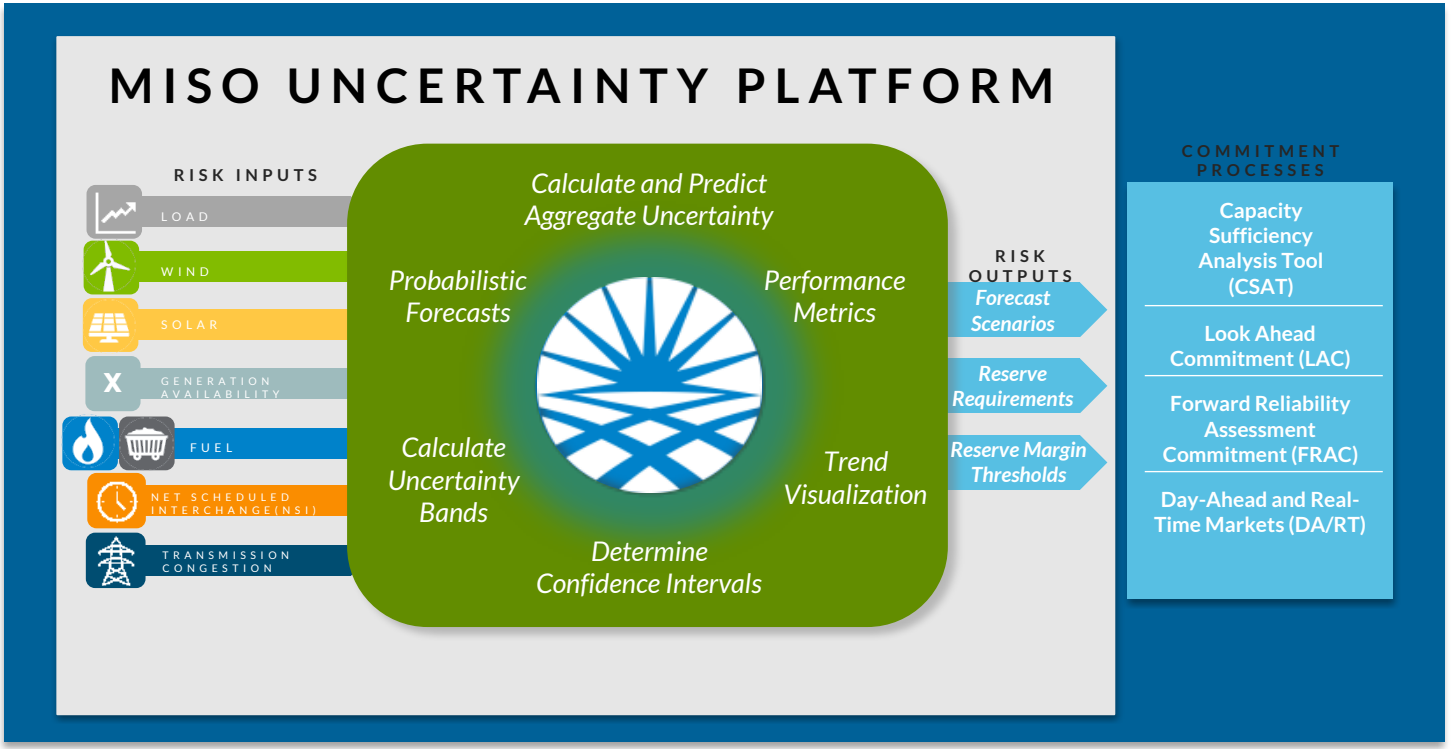
CSAT = Capacity Sufficiency Analysis Tool

Sub-regional net uncertainty is managed by Reserve Procurement Enhancement (RPE) to ensure deliverability

- RPE ensures post reserve deployment flow within transmission limits
- Shadow prices lead to reserve price separation reflective of sub-regional conditions
- Sub-regional uncertainty management captures both reliability and economics
  - Ensures cleared STR can be delivered to where it is needed upon uncertainty event



The Uncertainty Platform is being integrated with MISO's commitment processes



Total Winter ISAC calculated for PY 2023/24 was highly predictive of Real-Time offers during Winter Storm Elliott

- The Schedule 53 lookback period for PY 2023/24 is 9/1/2019 – 8/31/2022
- The first MaxGen that occurred after that lookback period was during Elliott on 12/23/2022
- RT offers from Schedule 53 resources were nearly identical to the ISAC earned by these resources

12/23/22 MaxGens	Emergency Offers From Schedule 53 Resources (MW)	UCAP (MW)	ISAC (MW)	UCAP Deviation	ISAC Deviation
South morning	31,547	33,983	31,363	7.7%	-0.6%
Footprint afternoon to evening	97,894	105,224	99,396	7.5%	1.5%

- The very low level of deviation mirrors what MISO posted and the IMM supported in MISO's response to FERC's 2022 deficiency letter asking MISO to show that the new methodology is more predictive than UCAP

Season	Region	Emergency Offers from Schedule 53 Resources during MaxGen Hours in PY2021/22	UCAP		ISAC	
			Seasonal UCAP MW	Deviation %	ISAC MW	Deviation %
Summer	N/C	73,280	79,026	7.8%	73,885	0.8%
Winter	S	30,588	37,322	22%	30,223	-1.2%

Availability during RA Hours is incentivized ~100 times more than non-RA Hours under Schedule 53

- There are 65 target RA Hours per season (~3% of hours)
- The lookback period for accreditation covers the last 3 instances of each season
- Therefore, each RA Hour is currently worth ~0.36% of total ISAC
  - 1hour/195 RA Hours in the lookback period x.7 weight = 0.358974%
  - 1hour/6,375 non-RA Hours in the lookback period x.3 weight = 0.004706%
- Missing one RA Hour is equivalent to missing more than 76 non-RA Hours
  - When the weight goes to 80% an RA Hour will be worth more than 132 non-RA Hours
- This provides a much stronger incentive to be available during times of need than the previous accreditation methodology where each hour on forced outage was worth only 0.0038% of annual UCAP

Resource Adequacy examples of Schedule 53 accreditation impacts for not being available during Winter Storm Elliott

Each RA Hour was worth ~0.36% of accreditation

- 1-day: A South region resource missing all 19 RA Hours on December 23rd would miss out on ~6.84% of its potential winter accreditation
- Event: A South region resource missing all 43 RA Hours during Winter Storm Elliot would miss out on ~15.5%
- A North/Central region resource missing all 51 RA Hours during Winter Storm Elliot would miss out on ~18.4%
- A North/Central region resource derated by 50% for the 51 RA Hours during Winter Storm Elliot would miss out on ~9.2%