MISO reliability needs & patterns assessment

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Purpose & Key Takeaways

Purpose:

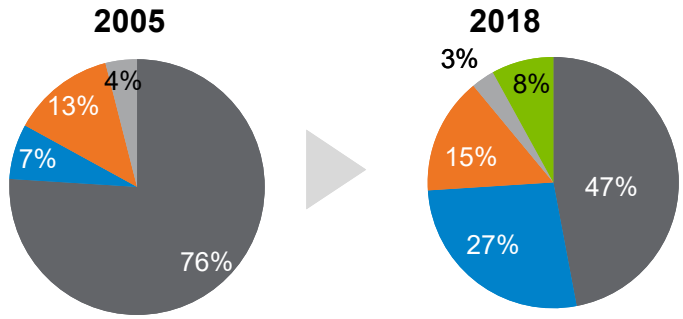
Assess reliability needs as the resource portfolio in MISO evolves.

Key Takeaways:

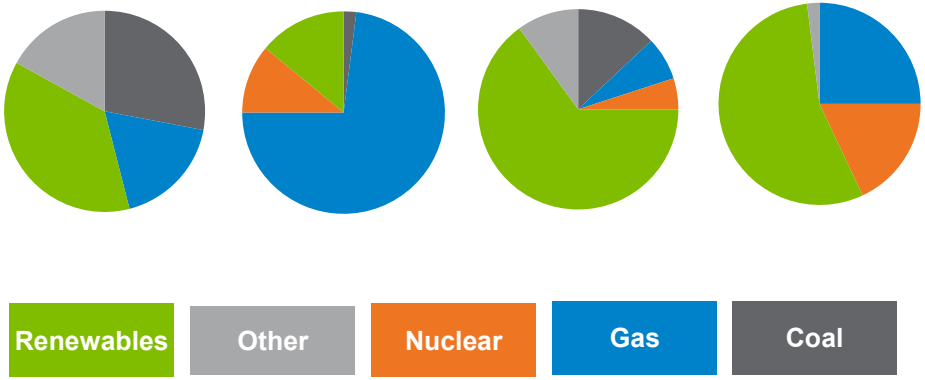
- The resource portfolio in the MISO region is undergoing a sizeable change with more variable resources coming online.
- Preliminary analysis indicates that system risks will shift outside of summer peak load hours and flexibility needs will grow.
- MISO is exploring potential changes in both Resource Adequacy and Energy and Ancillary Service Market constructs to capture the changing risk needs.

The resource mix in the MISO region has been evolving and the pace of changes could be faster in the next 10 years.

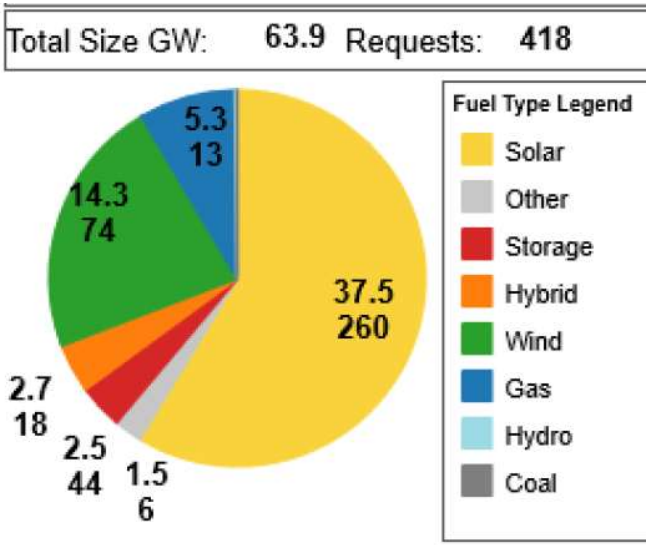
MISO Region Generation Portfolio Evolution (% of Energy)



Announced 2030 Members' Generation Mix * (% of Energy)



MISO GI (generation interconnection) Queue



** 2030 Energy projections (MWh) compiled from IRPs, investor reports and other sources*

MISO is evaluating the impact of portfolio evolution on system reliability needs.

Is there a problem?

- How do reliability needs change?
- What are the patterns of needs today and tomorrow?
- What drives these patterns?

- Does today's construct sufficiently capture risks across the year?
- Will today's construct be able to capture risks in future?
- Will the needed attributes be properly and timely procured & incentivized?

MISO 2020 Focus

Identify Reliability Needs ★

- Develop analytic methods to define reliability criteria, and identify needed attributes in additional to peak hour MWs

Planning Horizon

- Evaluate robustness of current planning constructs
  - Evaluate sub-annual planning + Planning Resource Auction
  - Reform resource accreditation

Operating Horizon

- Ensure market prices reflect underlying system conditions
  - Propose scarcity pricing reforms

MISO is using a combination of data analysis and simulation.

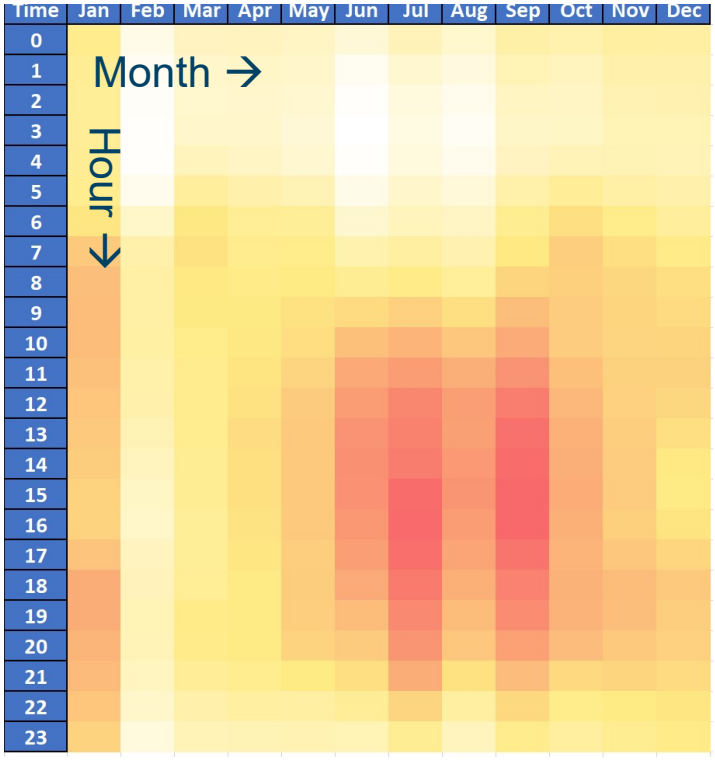
- Develop future scenarios with a range of resource combinations
- Use data analytics to deep dive into current portfolio and then extrapolate to the future
- Conduct early Resource Adequacy trials to understand different approaches and then move into more detailed analysis
- Use market simulation to confirm conclusions from data analytics and Resource Adequacy trials.

System Reliability Risk Patterns

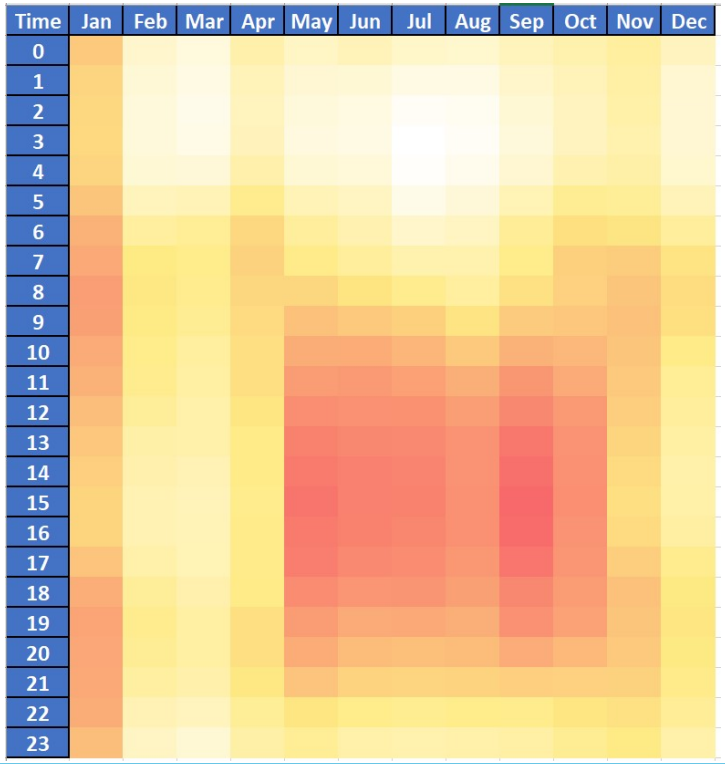
Preliminary analysis indicates shift of risks outside summer peak load hours for existing portfolio.

Margins = supply resources - obligations

"All-in" margin of year 2017



"All-in" margin of year 2018



"All-in" Margin = Available non-intermittent generation + intermittent generation + RDT limit + Net Scheduled Interchange + Load Resources (BTMG + LMR + EDR) - Load - Operating Reserve

Credits: Victor Ni and Chen-Hao Tsai

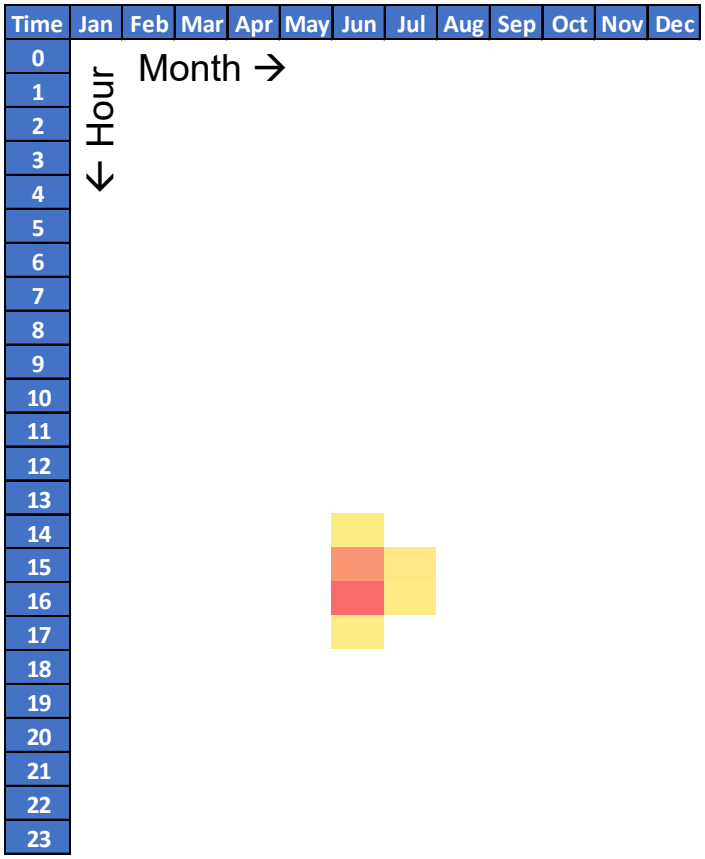
RDT = Regional Dispatch Transfer | BTMG = Behind the Meter Generation
LMR = Load Modifying Resources | EDR = Emergency Demand Response

Adjustment to modeling assumptions can better capture risk across the year.

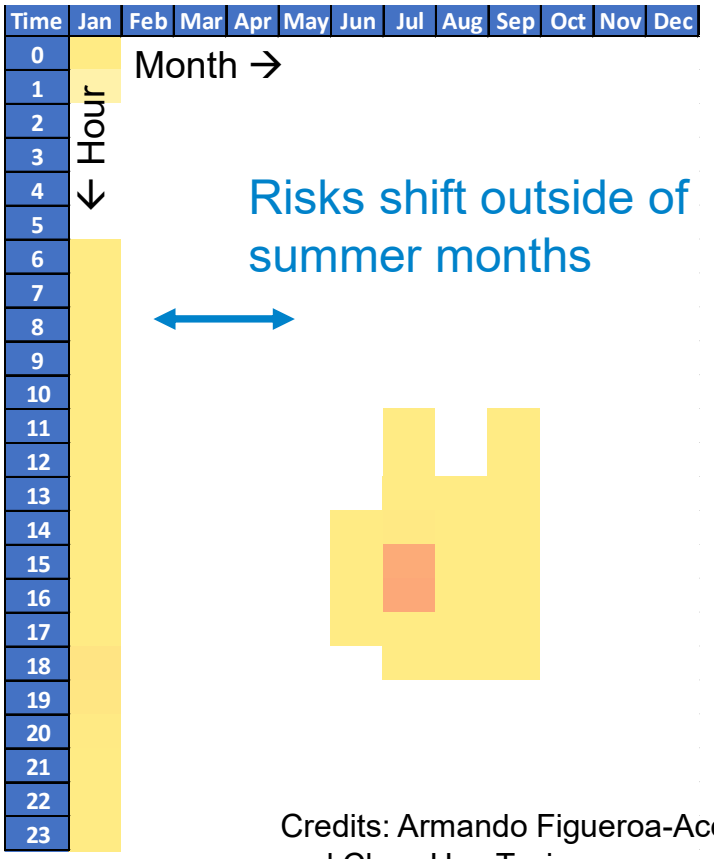
Modeled 2018 with LOLE target of 0.1

Loss of Load Expectation (LOLE) Pattern

Current Method



Trial Method (see Appendix)



Risks shift outside of summer months

Credits: Armando Figueroa-Acevedo and Chen-Hao Tsai

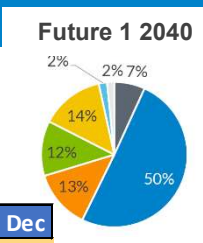
No risk | Moderate Risk | High Risk

MISO

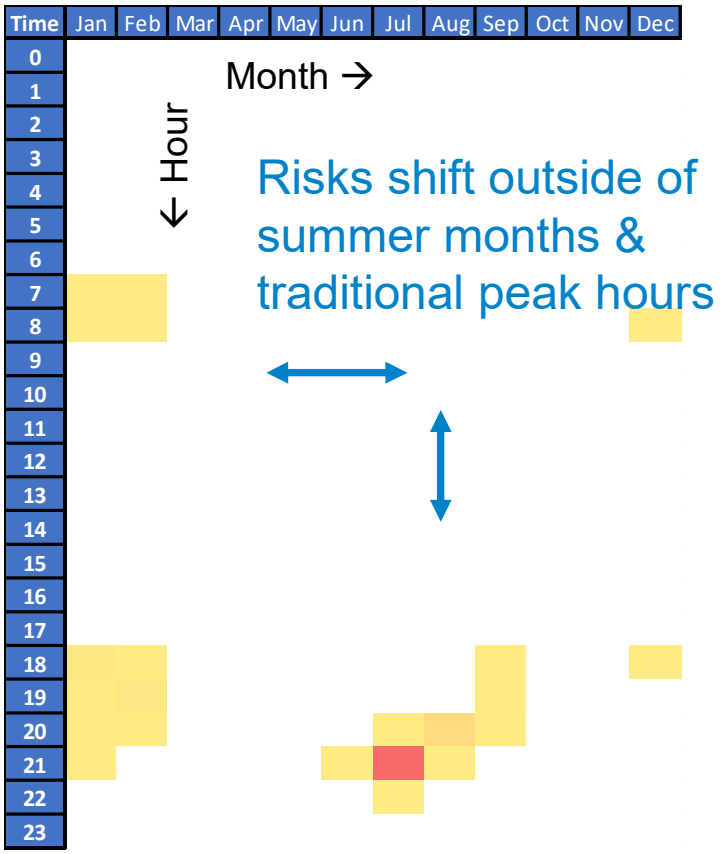
And the risk pattern changes seem to preserve for future resource mixes.

Draft results

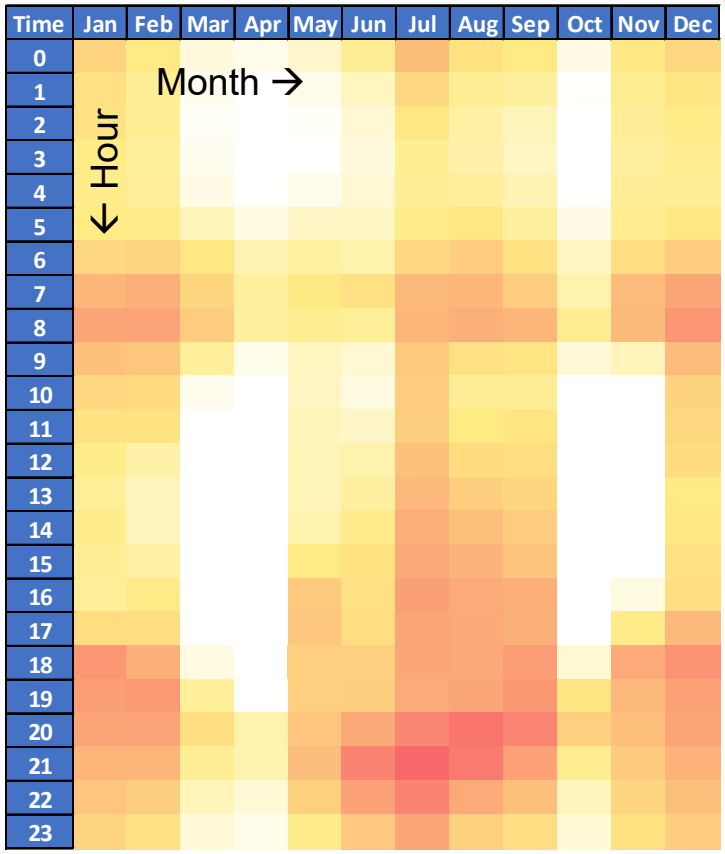
Loss of Load Expectation (LOLE) Pattern



0.1 Loss of Load Expectation



Proxy Operator Experience*



* LOLE targets is 0.6

No risk | Moderate Risk | High Risk

Credits: Armando Figueroa-Acevedo

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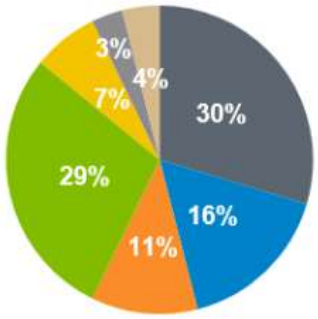
Flexibility needs

Team explored a range of future scenarios.

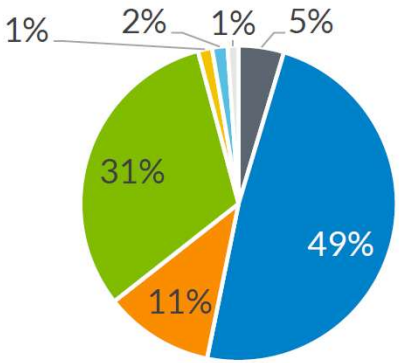
- The futures reflect many dynamics in the region
  - Changing fuel costs, clean energy commitments, aging fleet, electrification
- The analysis leveraged draft MTEPs (MISO Transmission Expansion Plan) as a starting point

MTEP 2019 AFC 2033
(760TWh)



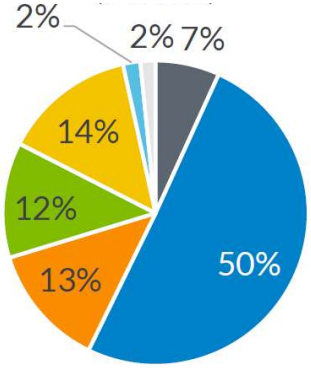
- Less coal retirement
- Reflects member plans*

Future III, 2030**
(954 TWh)



- Gas in lieu of coal
- High load

Future 1 2040
(825 TWh)



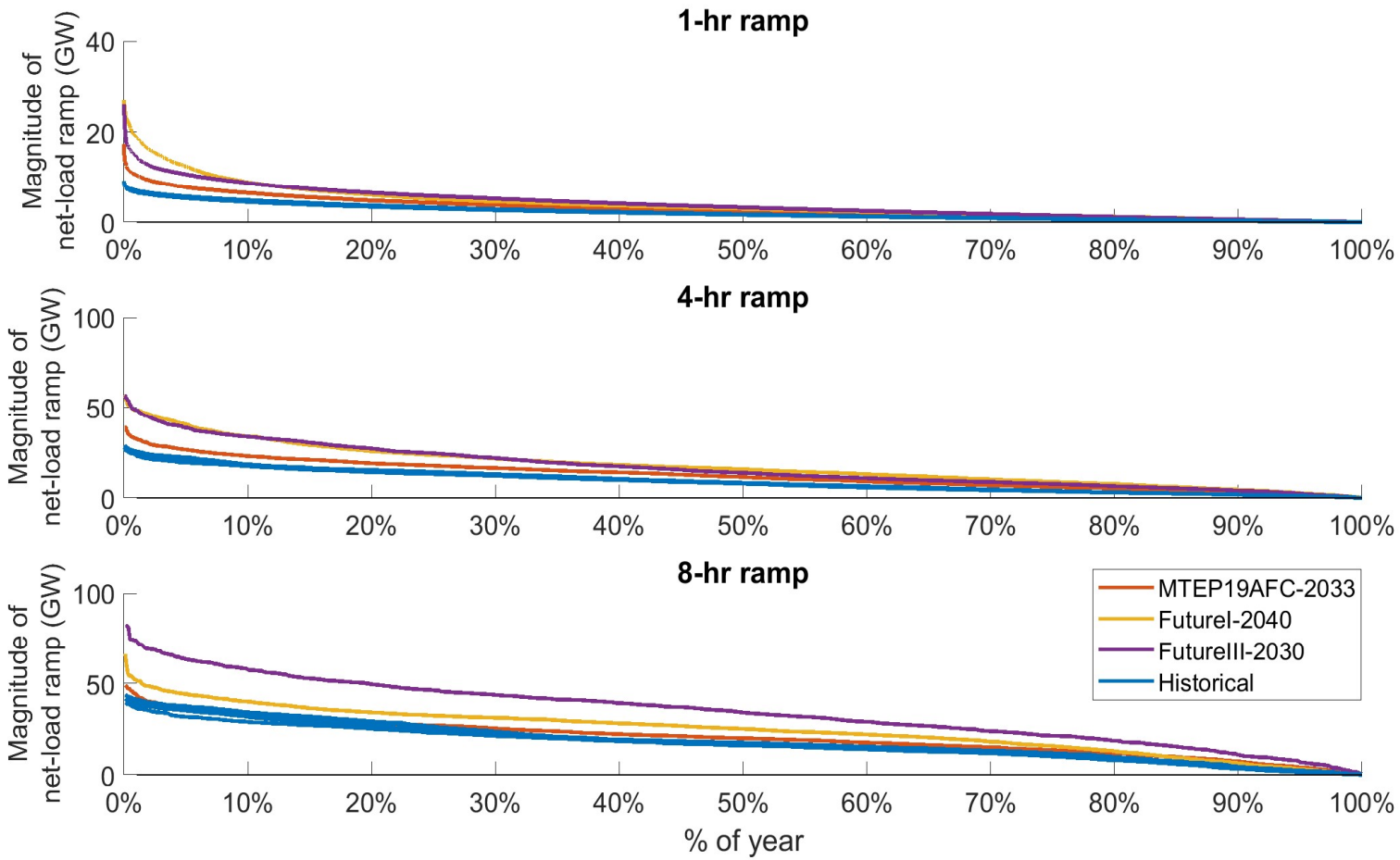
- Higher solar
- Middle load growth

Credits: Aditya Jayam Prabhakar and Hilary Brown

* As announced plans submitted to commissions

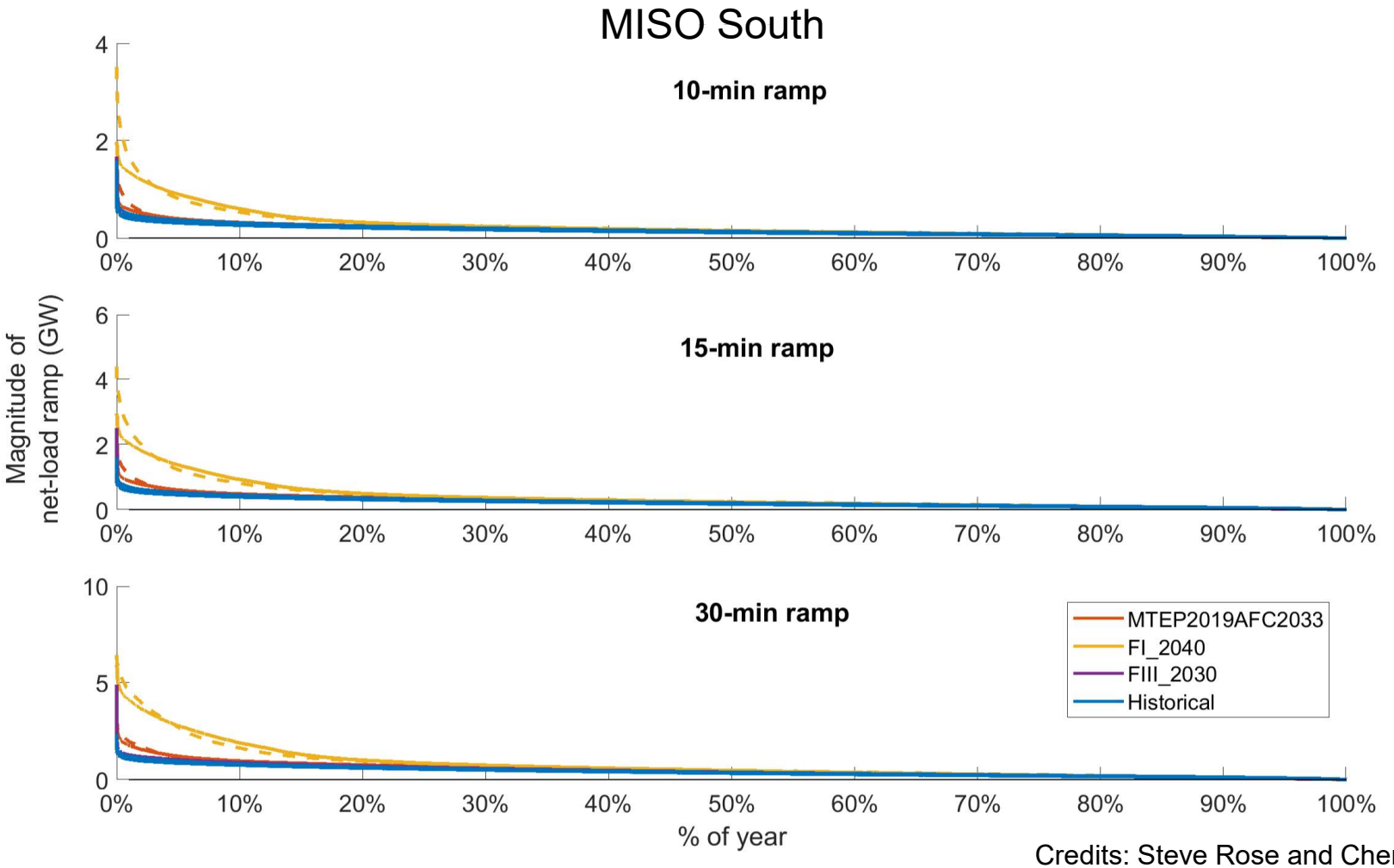
** Does not include very recent change in MTEP F3 that adjusts load growth from 60% to 50%.

Ramping needs will grow for all timeframes within MISO footprint in future.



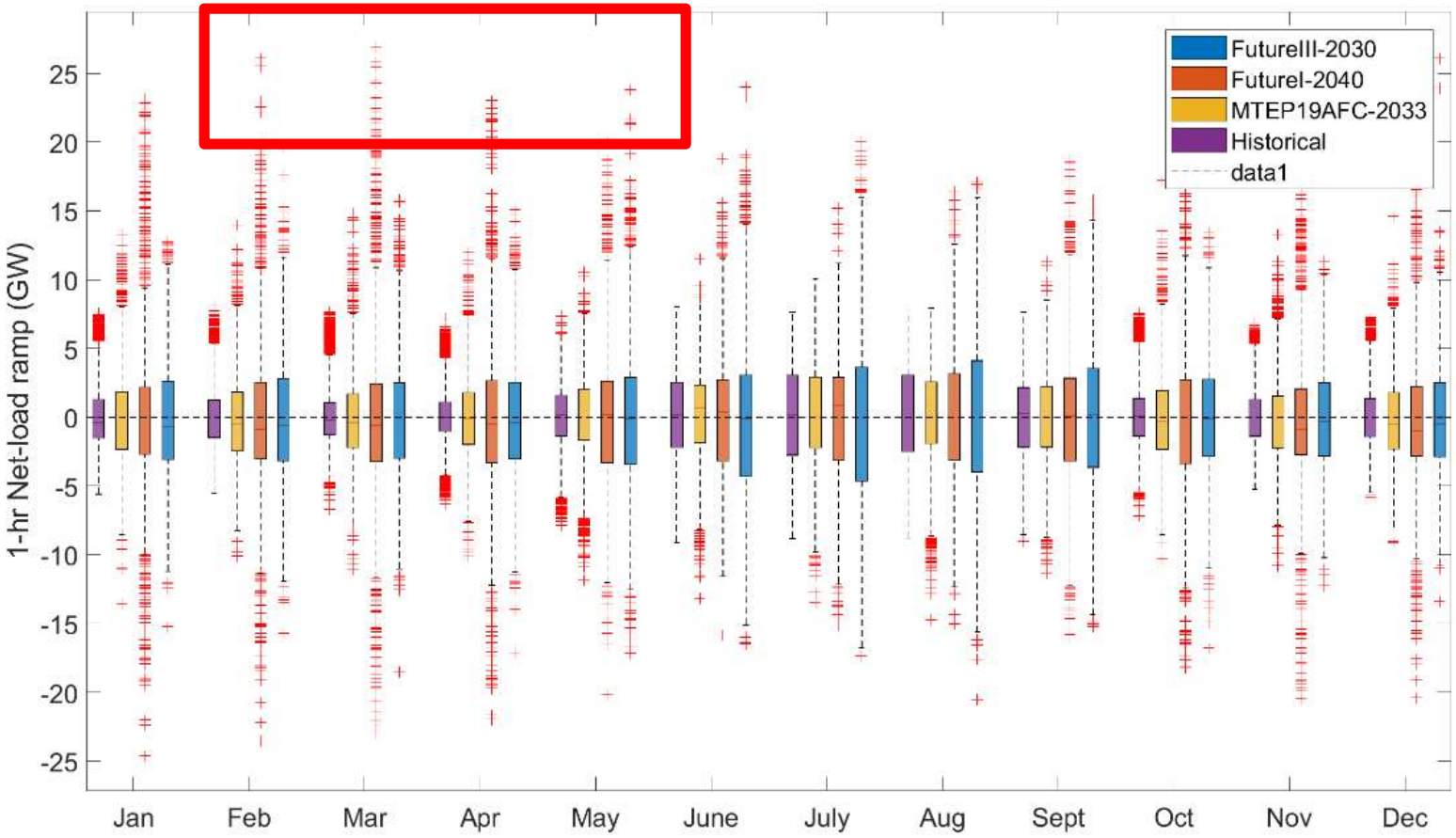
Credits: Steve Rose and Chen-Hao Tsai

While sub-hourly net-load ramp needs would increase for MISO system in all futures, high ramps in MISO south are particularly observed in solar-rich scenario.



Credits: Steve Rose and Chen-Hao Tsai

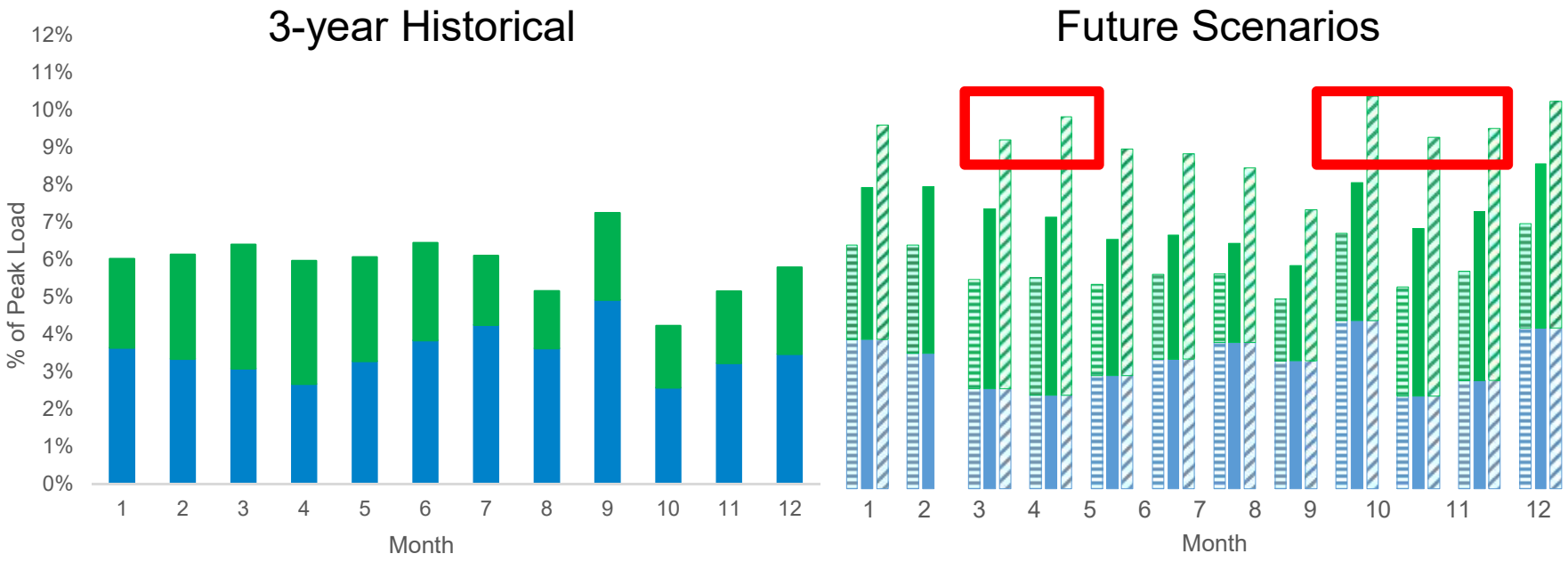
Within a year, the largest ramping needs move from summer to shoulder seasons, particularly for a solar-rich scenario.



Credits: Steve Rose and Chen-Hao Tsai

Increasing scale and complexity of uncertainties in future also indicate more challenges in shoulder months.

Monthly Average Aggregate Forecast Error *



Load Forecast Error

Wind Forecast Error

Future I 2040 – High Gas, Higher Solar, Mid Load Growth

MTEP19AFC-2033 – Increasing Solar, Coal Drops Slightly

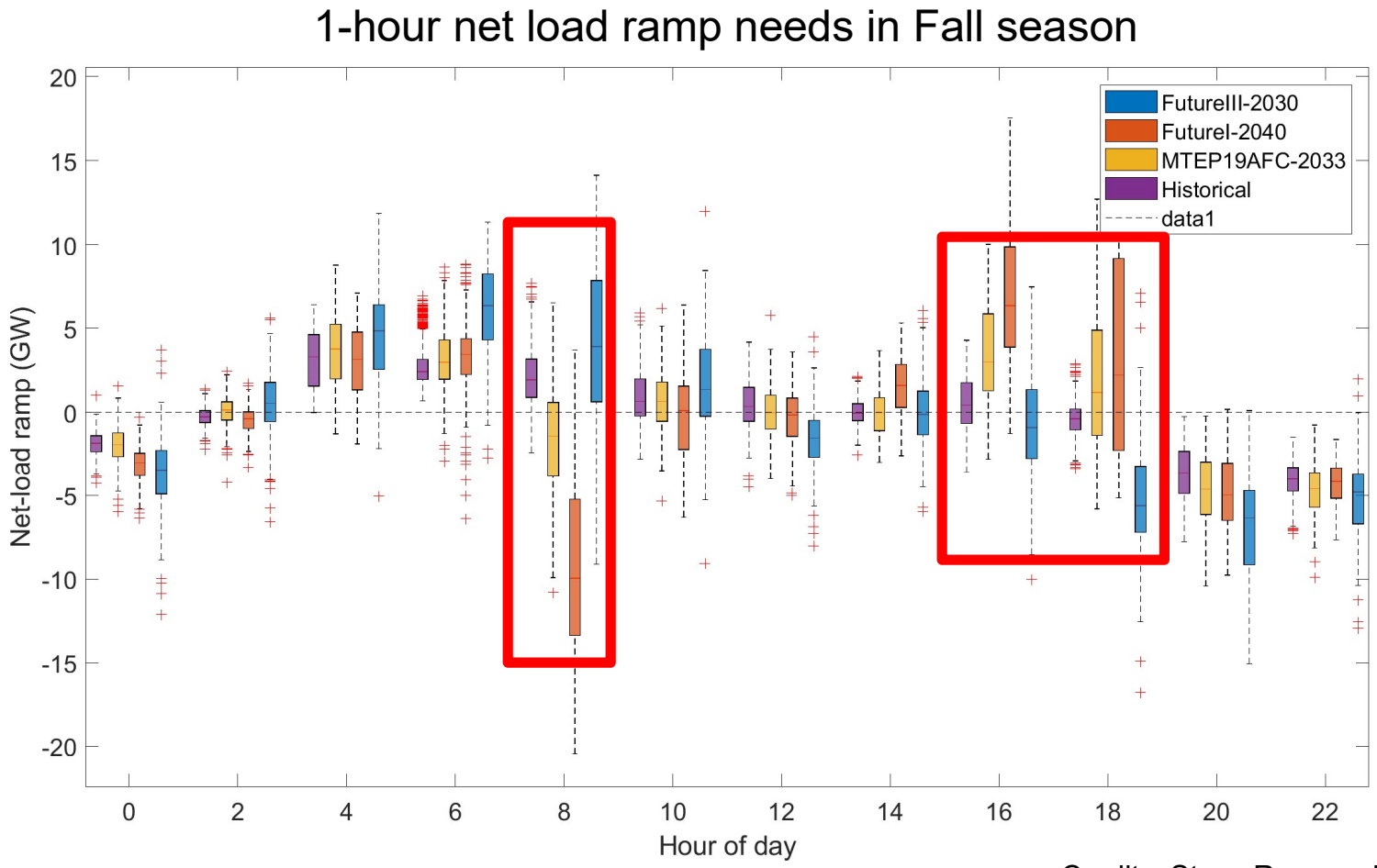
Future III 2030 – High Gas in lieu of Coal, High Load

Credits: Anupam Thatte and Steve Rose

*Forecast error reflects DA to RT differences. Reflects worst case scenario of additive errors.

MISO

And additional flexibility could be needed at particular hours of the day at same or opposite directions compared to today.



Credits: Steve Rose and Chen-Hao Tsai

The analysis will inform further evaluation of resource adequacy, market and operational approaches

Next Steps

- Continued stakeholder discussion in subcommittees and workshops
- Publish whitepaper of reliability needs “framing” by end of July, 2020
- Publish whitepaper of market enhancement opportunities “framing” by end of December, 2020

Questions?

Appendix. Adjustments to summer-Focused LOLE Modeling Assumptions

	Current Approach	Trial Analysis Assumptions
• **Intermittent resource capacity**	**Flat** capacity throughout the year based on summer performance.	Using **8760 profiles** corresponding to 2018 weather year.
• **Non-firm external support**	Adjustment to the PRM based on **imports during summer peak**.	Using **monthly average NSI** from the last 3 years, assuming a perfect unit.
• **Forced outage rates (FOR)**	Modelled as a **single average forced outage rate** for the entire year.	Modeled with **adders / subtractors at different date-hour** based on temperature correlation model using 3-years of historical data.
• **Planned outages**	Optimized to **avoid outages during peak summer load periods**.	Scheduled using a **90% optimality** (“best behavior”) assumption.