



Resource Availability and Need (RAN)

MISO is improving the conversion of capacity
into energy during all hours of the year

PJM Fuel Security Senior Task Force

April 26, 2019

Purpose & Key Takeaways

Purpose: Provide an overview of MISO's Resource Availability & Need (RAN) initiative

Key Takeaways:

- MISO has had 21 days with Maximum Generation emergencies since June 1, 2016
- RAN grew out of stakeholder discussions focused on the conversion of capacity into energy all year
- FERC approved three recent tariff filings which provide relief and allow time for further efforts
- Fuel availability issues are being evaluated along with other relevant risks in the MISO markets such as those seen on January 30, 2019



MaxGen emergencies have occurred in all seasons but haven't yet surpassed step 2 of our EOP

- Two more occurred in late January 2019
- Includes MaxGen alerts, warnings and events



MISO's Maximum Generation Emergency Procedures



The RAN Issues Statement whitepaper published March 2018 analyzed sources of uncertainty which challenge the conversion of capacity to energy

Key industry trends

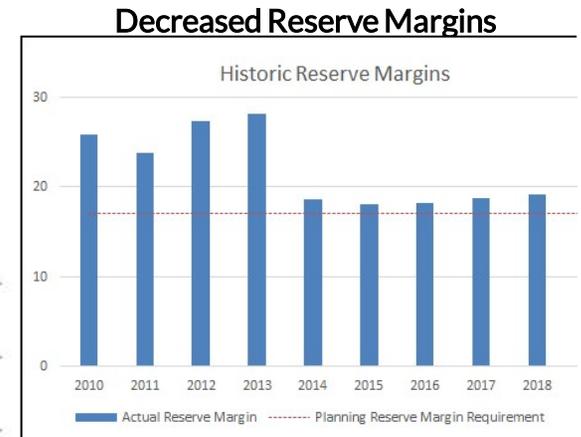
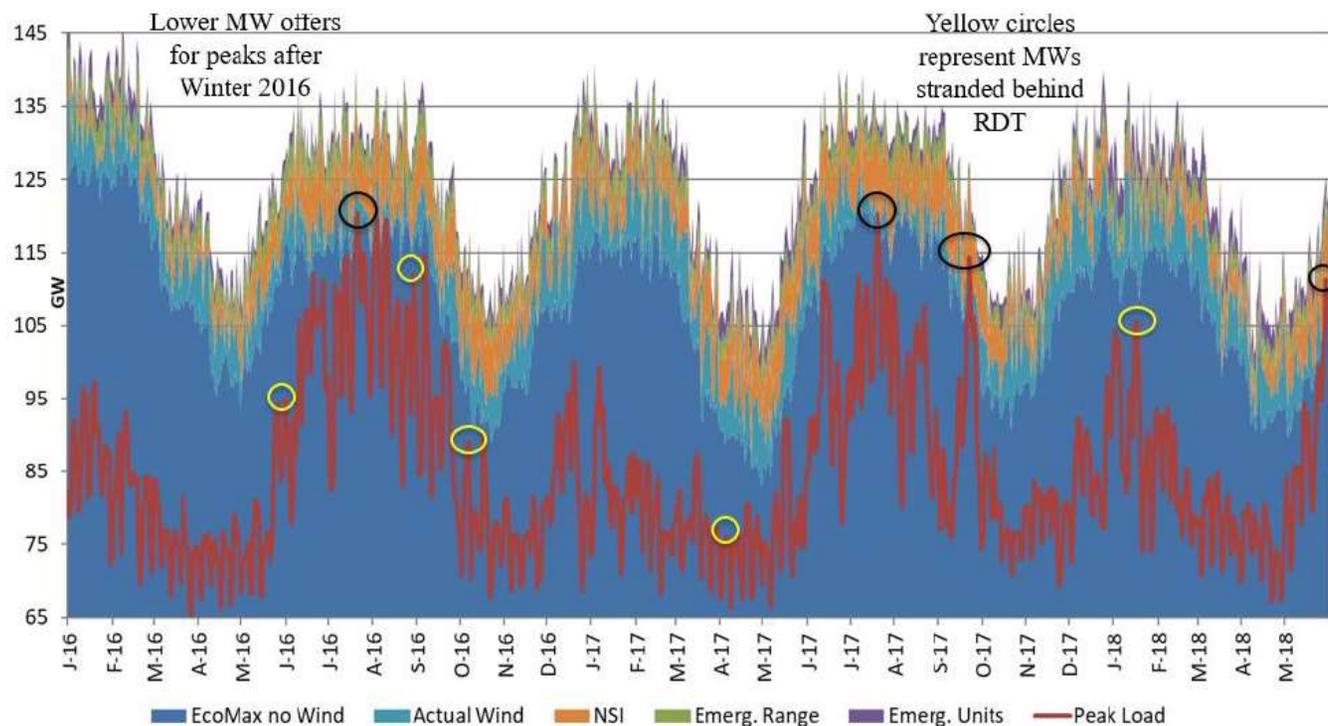
- Aging and retirement of the portfolio's generating units
- Outage correlation
- Growth in demand side and other emergency-only capacity as a percent of the overall portfolio
- Growing reliance on intermittent or unscheduled resources
- Growth of variable energy resources as a major element of the fleet



Areas for improvement in MISO processes



The RAN data illustrated how lower margins and the increasing volatility of supply and load were challenging reliability

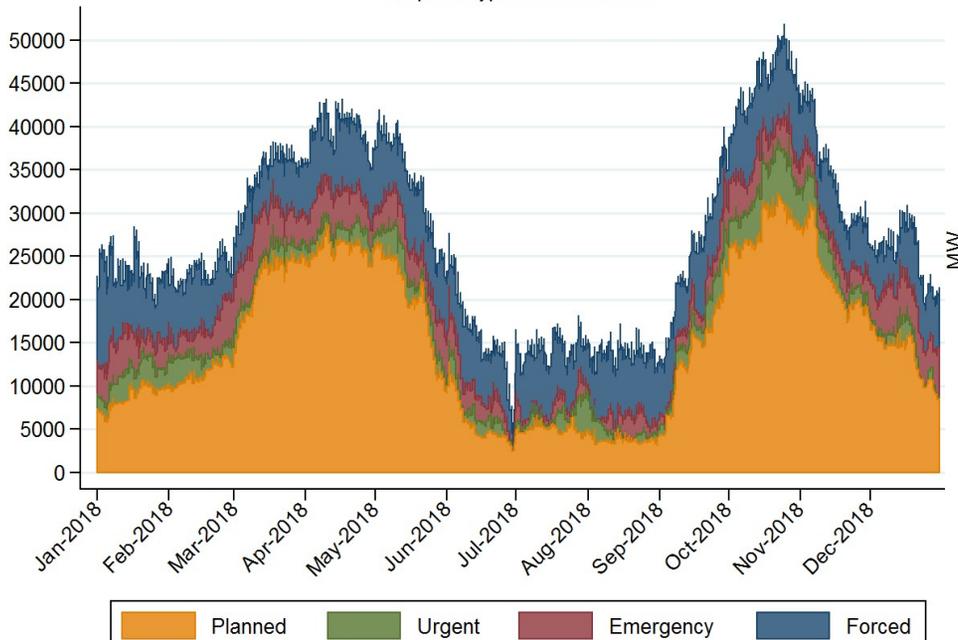


MISO increasingly reliant on interchange (NSI) and wind to meet load

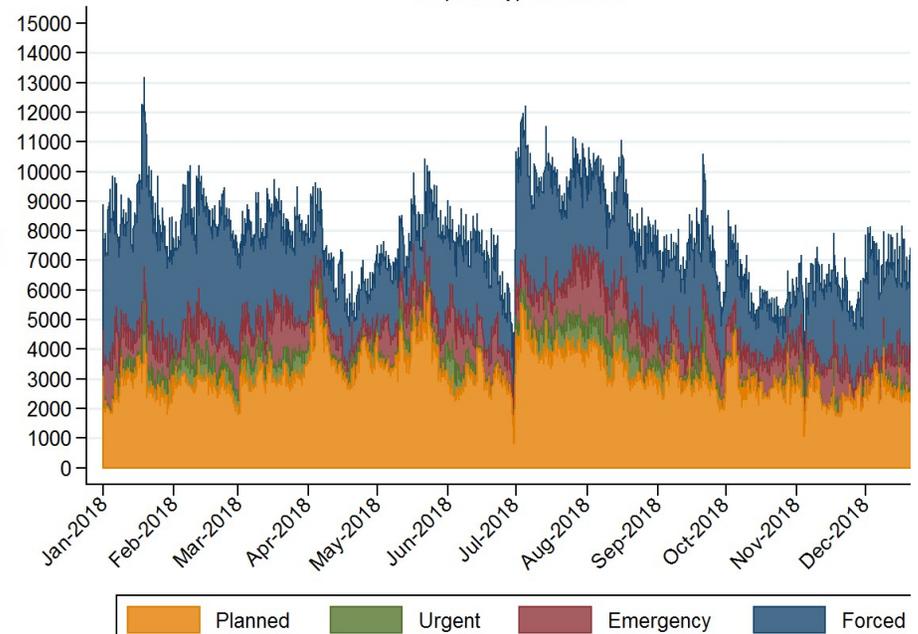
Outage data shows the correlation of planned outages in the shoulder seasons

- 2018 average 25-30GW on outage and another 10GW derated
- 2018/19 Planning Resource Auction (PRA): 142 GW offered, 135GW cleared
- 37GW average outages/derates is 27% of the 135GW cleared in the PRA
- Average of 33% on outage/derate in shoulder seasons

MISO Generation Hourly Outage by Priorities
Request Type: Out of Service

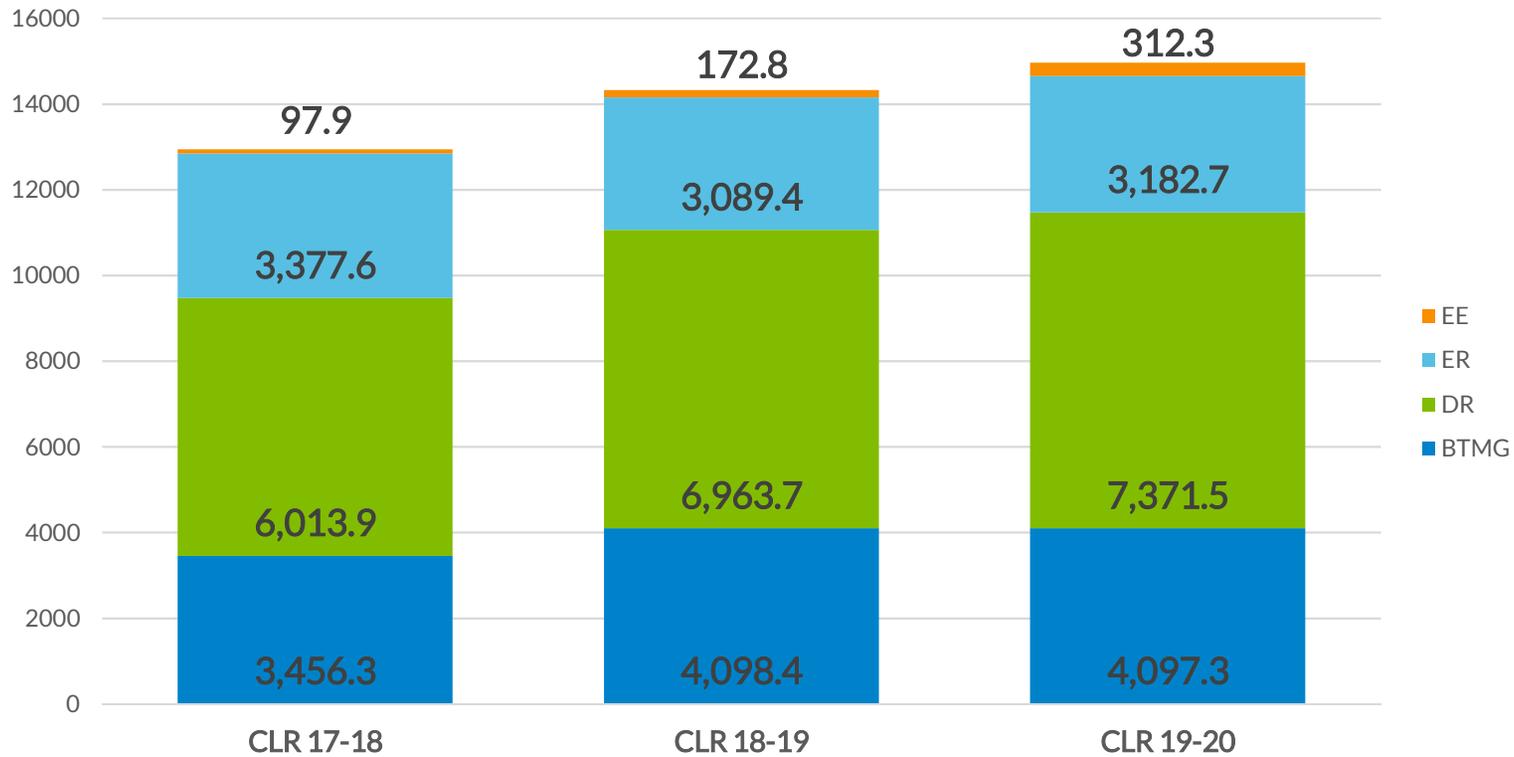


MISO Generation Hourly Outage by Priorities
Request Type: Deration



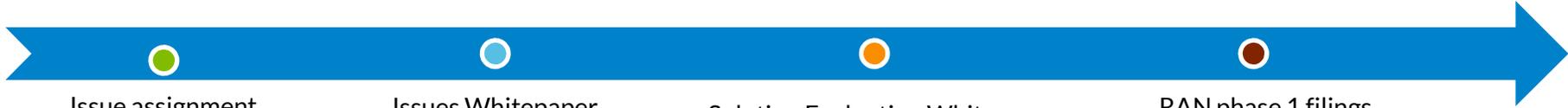
Increasing amounts of emergency-only Load Modifying Resources clear our PRA

BTMG, DR, EE & ER Cleared In Auctions (MW)



BTMG=Behind the Meter Generation, DR=Demand Response, EE=Energy Efficiency, ER=External Resources

Themes in stakeholder advice on solution options led to recently approved FERC filings related to LMRs and outage coordination



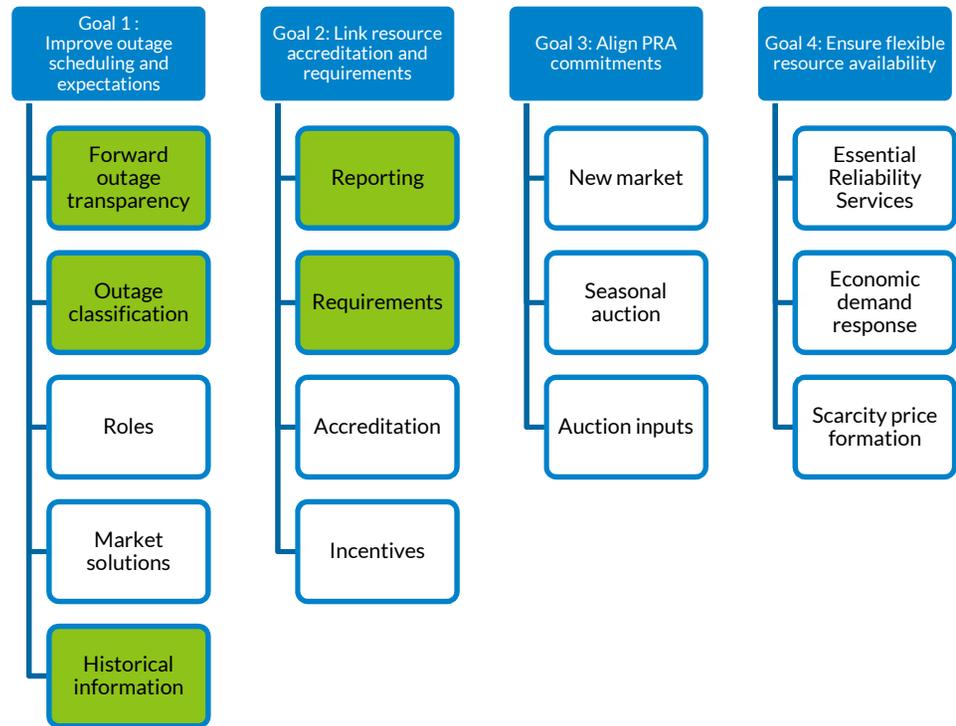
Issue assignment
January 2018

Issues Whitepaper
March 2018

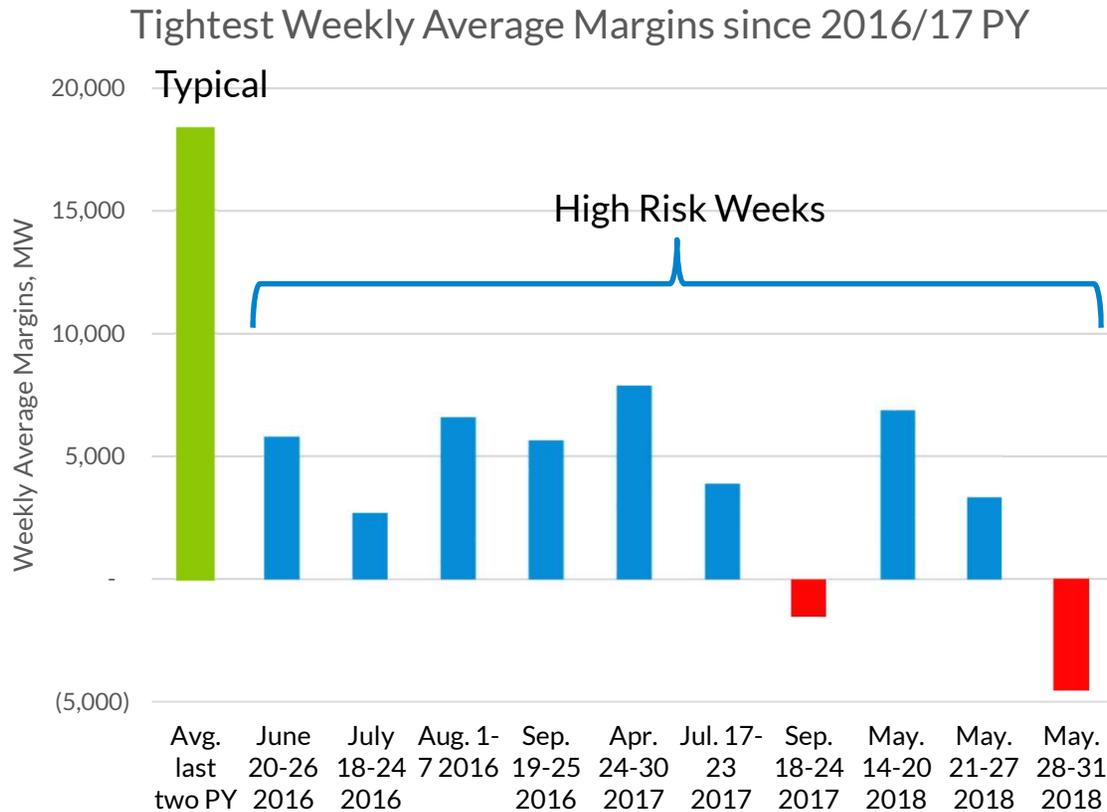
Solution Evaluation Whitepaper
September 2018

RAN phase 1 filings

| Solution | Ensure outage process matches resource expectations with commitments | Align accreditation and expected operating parameters, with an initial focus on LMRs | Evaluate PRA reforms, with a focus on needs throughout the year and link to availability | Ensure flexible resource availability to address changing fleet character | Est. Timeframe | Committee Recommend. | |
|--|--|--|--|---|----------------|----------------------|----------------------|
| 2.1.1 Forecast resource availability | 3 | 3 | 3 | 2 | medium | RSC | |
| 2.1.2 Improve load forecasting | 2 | 3 | 1 | 0 | long | | |
| 2.1.3 More effective outage rate accreditation | 3 | 3 | 3 | 2 | medium | | |
| 2.1.4 Incentive or penalty system | 2 | 3 | 3 | 1 | medium | | |
| 2.2.1 Refine requirements to enhance availability (emergency only resources) | 0 | 3 | 3 | 0 | medium | | |
| 2.2.2 Create accreditation which incentivizes desired performance | 0 | 4 | 4 | 2 | long | | |
| 2.2.3 Reorder emergency procedures | 0 | 4 | 2 | 0 | short / medium | | |
| 2.3.1 Location data for LMRs | 0 | 4 | 0 | 0 | short | | |
| 2.3.2 Implement metering and enhance tools | 0 | 4 | 0 | 0 | medium | | |
| 2.3.3 Address EDRLMR dual registration | 0 | 4 | 0 | 0 | short | | |
| 2.3.4 LMR blackout enhancement | 0 | 4 | 2 | 0 | short / medium | | |
| Solution | Ensure outage process matches resource expectations with commitments | Align accreditation and expected operating parameters, with an initial focus on LMRs | Evaluate PRA reforms, with a focus on needs throughout the year and link to availability | Ensure flexible resource availability to address changing fleet character | Est. Timeframe | | Committee Recommend. |
| 3.1.1 Holistic near term market mechanism | 3 | 3 | 3 | 3 | long | | RASC |
| 3.1.2 Implement seasonal auction | 0 | 4 | 4 | 3 | long | | |
| 3.1.3 Expand use of diversity contracts in PRA | 0 | 0 | 2 | 0 | medium | | |
| 3.1.4 Seasonal / monthly outage modeling in PRA | 3 | 3 | 4 | 0 | medium | | |



Phase 1 was targeted to deliver an additional 5-10 GWs of availability to mitigate the risk of tight operating margins



Near Term Objective:
Improved availability to 5 – 10 GWs will reduce risks

Associated MaxGens

- June 2016 Alert South
- July 2016 Event Step 1 for footprint
- August 2016 Alert Central and North
- April 2017 Warning and Alerts in South
- September 2017 Multiple Events up to Step 1b/c
- May 2018 Alert footprint

The filings focused on making better use of existing capabilities by enhancing transparency

Increase LMR transparency, align requirements, and improve processes

Align capability and requirements:
Required notification time and seasonal availability will be set to physical and retail tariff capability

Testing:
Adjust testing requirements for Demand Response to align with other resources

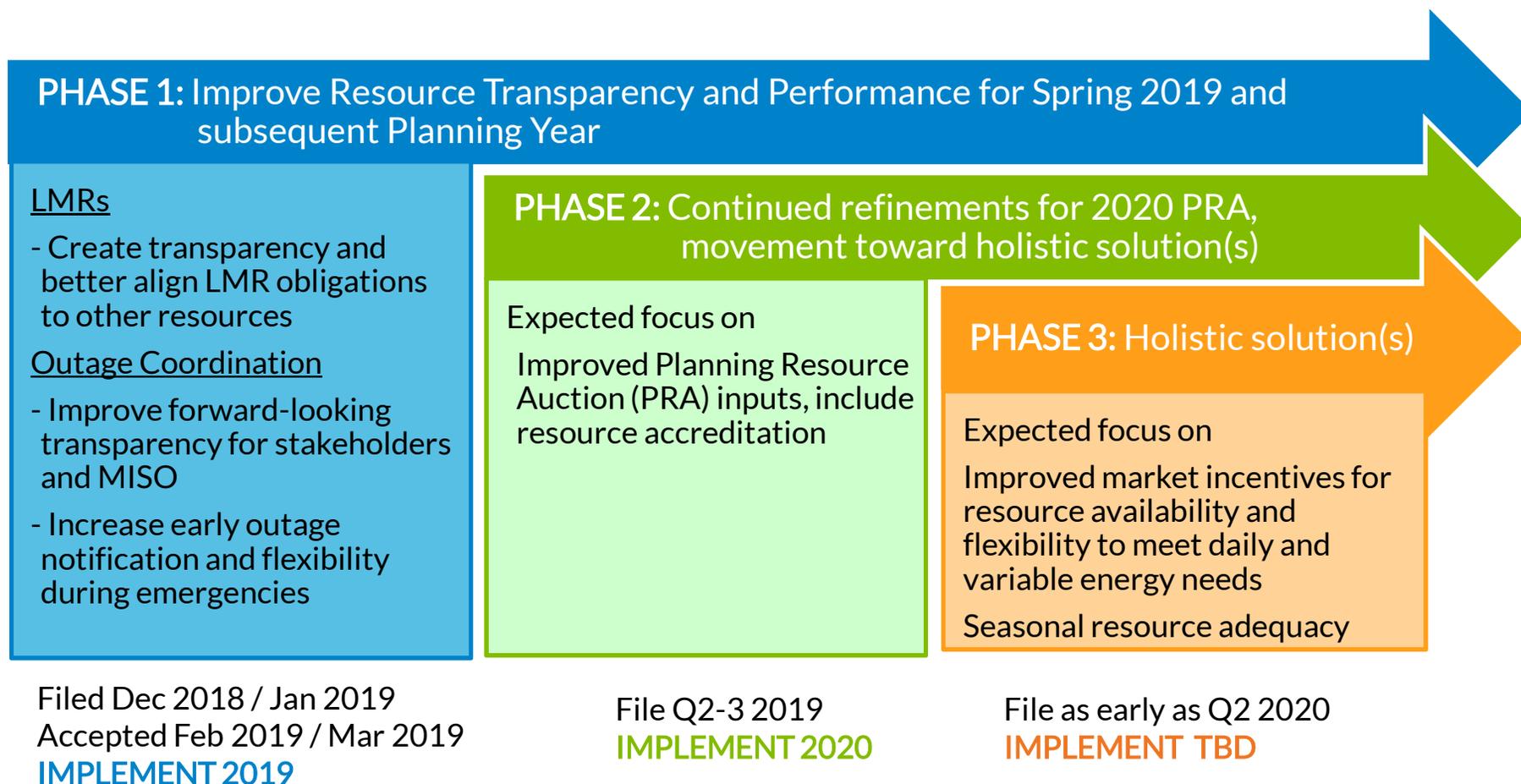
Operating Procedures:
LMRs called in anticipation of Emergency declaration

Improve planned outage transparency through forward signals and incentives

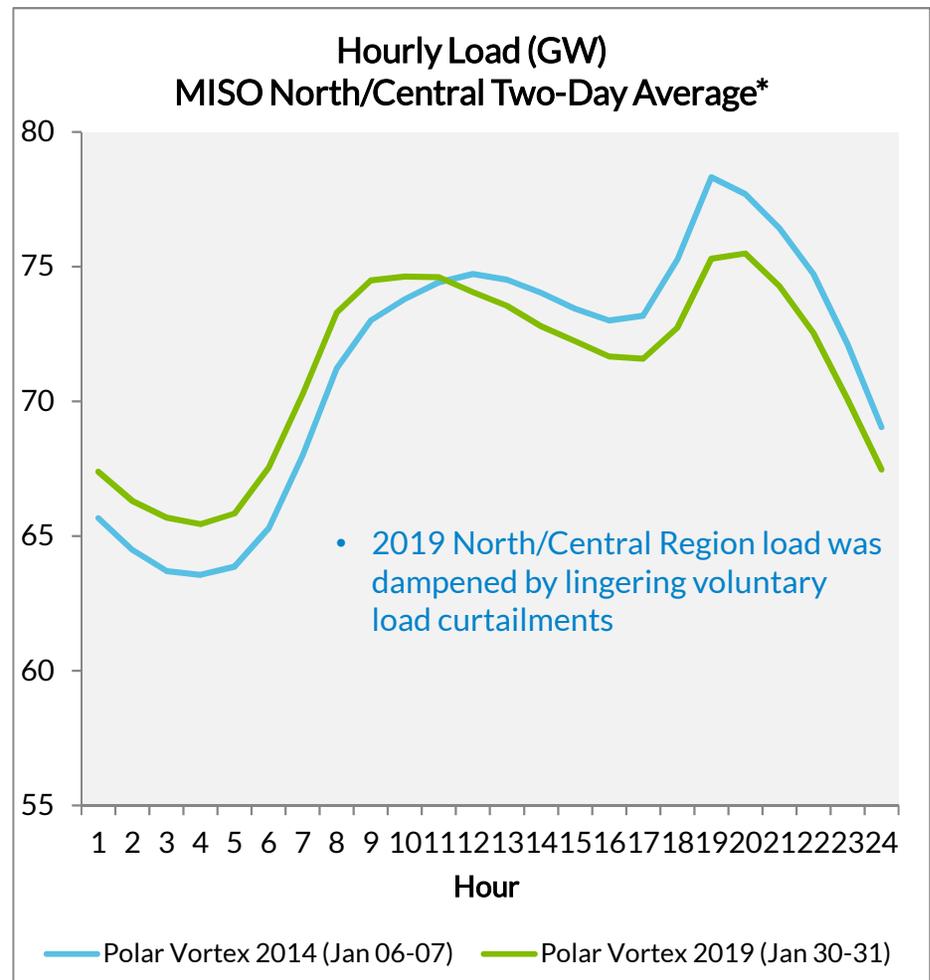
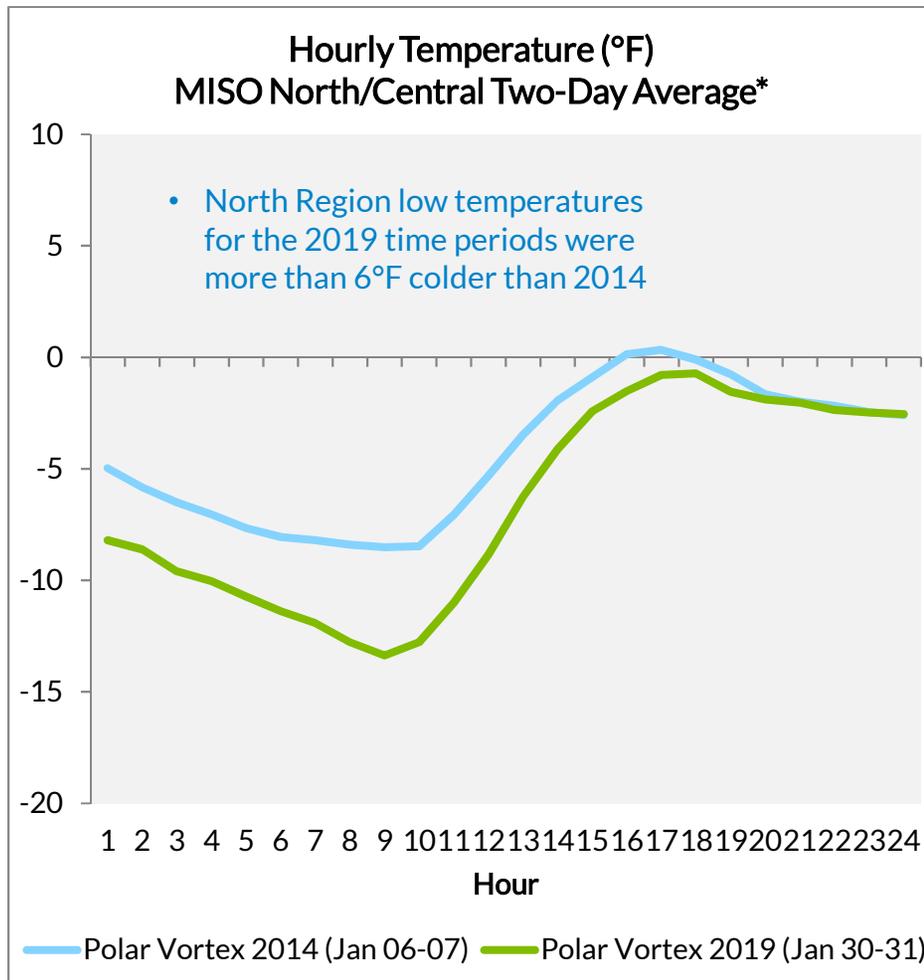
Incent forward scheduling and flexibility:
Consider short lead time outages scheduled over low margin, high risk times as forced, impacting accreditation

Transparency and Tool Improvement:
Increased information can inform Generator Owner's scheduling process; improving capability, use, and awareness of tools complements transparency

Work continues on short and long-term efforts needed to deliver reliable and efficient operations

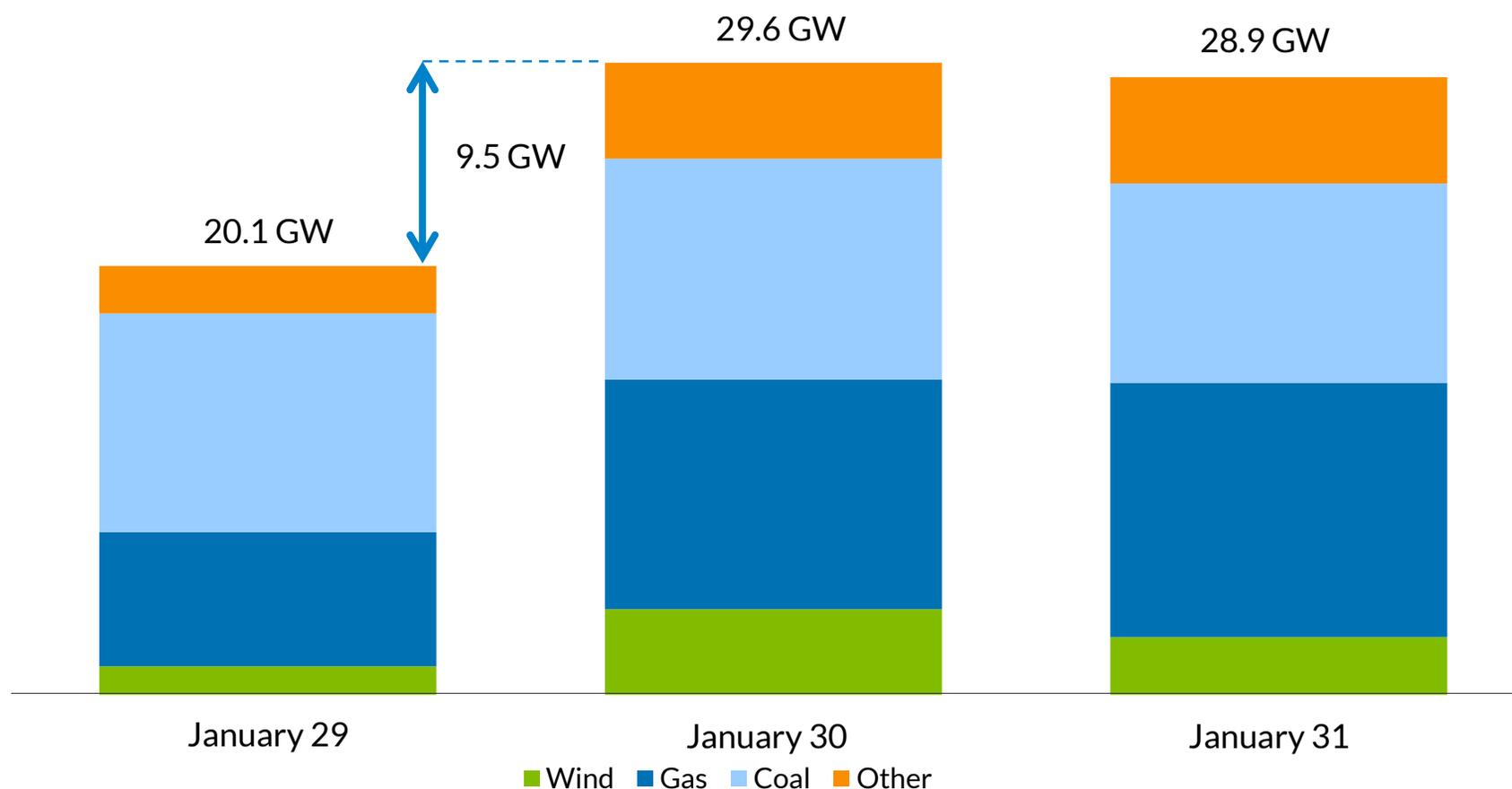


Our most recent MaxGen occurred January 30-31st due to high load and generation outages driven by extreme cold



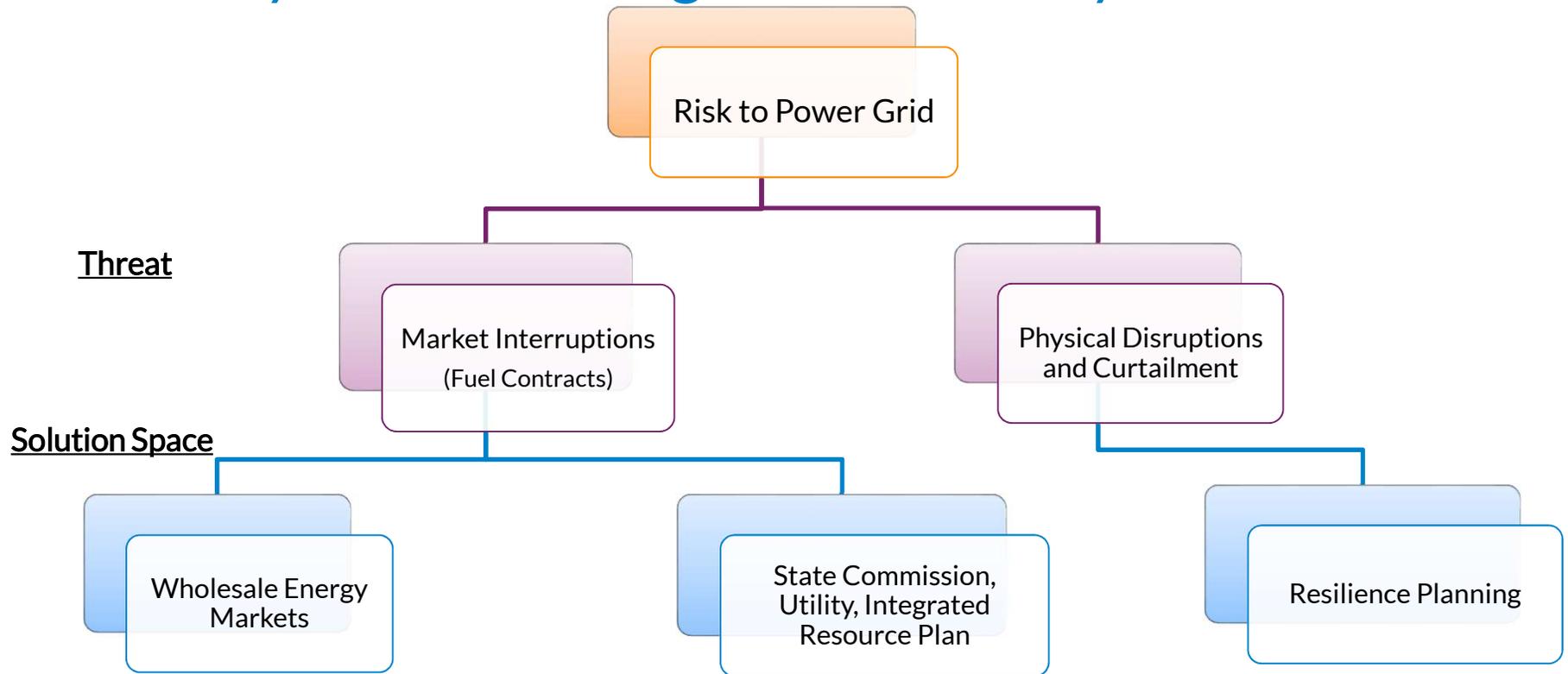
MISO observed unplanned gas outages ranging from 6 – 12 GW during the Cold Weather Event

MISO North/Central Daily Average Unplanned* Generation Outages



13 The outage chart reflects the data as it resided in the CROW Outage system on February 11, 2019
Wind often reported as derate over the time period

MISO is continuing its investigation into the risk to reliability from natural gas fuel delivery issues



- Over the past four years MISO has not found significant reliability impacts in its assessment of gas-related contingencies
- However, fuel availability related outages have contributed to the severity of maximum generation emergencies, most notably in January 2014 and 2019

Cold-related mechanical issues and fuel supply limitations affected all generation types

| MISO North/Central Region Unplanned* Outages (GW) | | | | | |
|--|---------------|---------------|--------------|--------------|---------------|
| | Coal | Gas | Wind | Other | Total |
| Installed Capacity (PRA cleared plus uncleared internal MISO generation that qualified for the 18-19 PY) | 48.4 | 31.9 | 14.2** | 18.2 | 112.7 |
| January 29 | 10.3 (21%) | 6.3 (20%) | 1.3 (9%) | 2.2 (12%) | 20.1 (18%) |
| January 30 | 10.3 (21%) | 10.8 (34%) | 4.0 (28%) | 4.5 (25%) | 29.6 (26%) |
| January 31 | 9.3 (19%) | 11.9 (37%) | 2.7 (19%) | 5.0 (28%) | 28.9 (26%) |

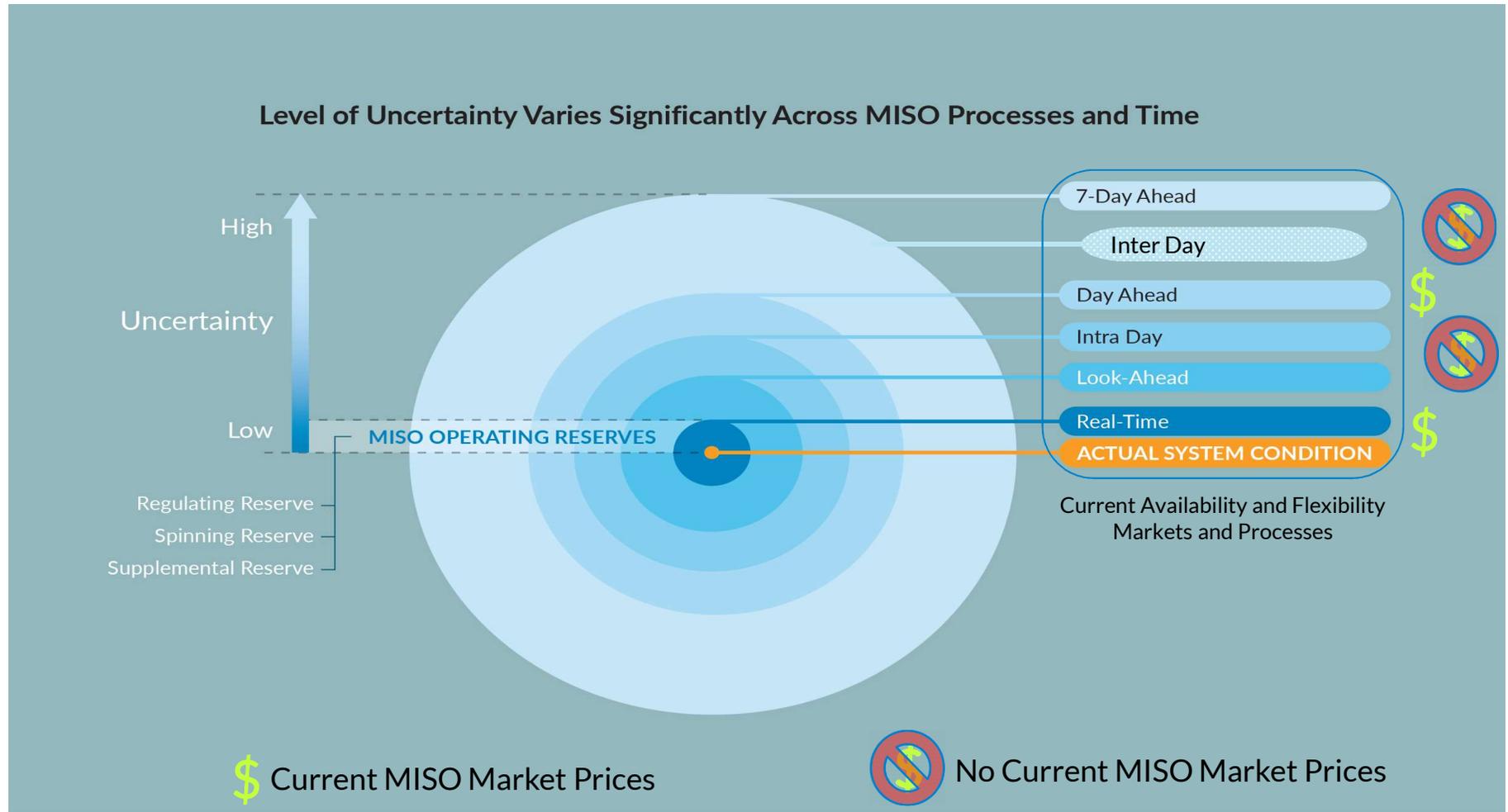
*Unplanned: Forced plus derates

RT imports from PJM tripled after the morning peak on January 30th

MISO Imports from PJM vs. Interface Price Difference on 1/30/19

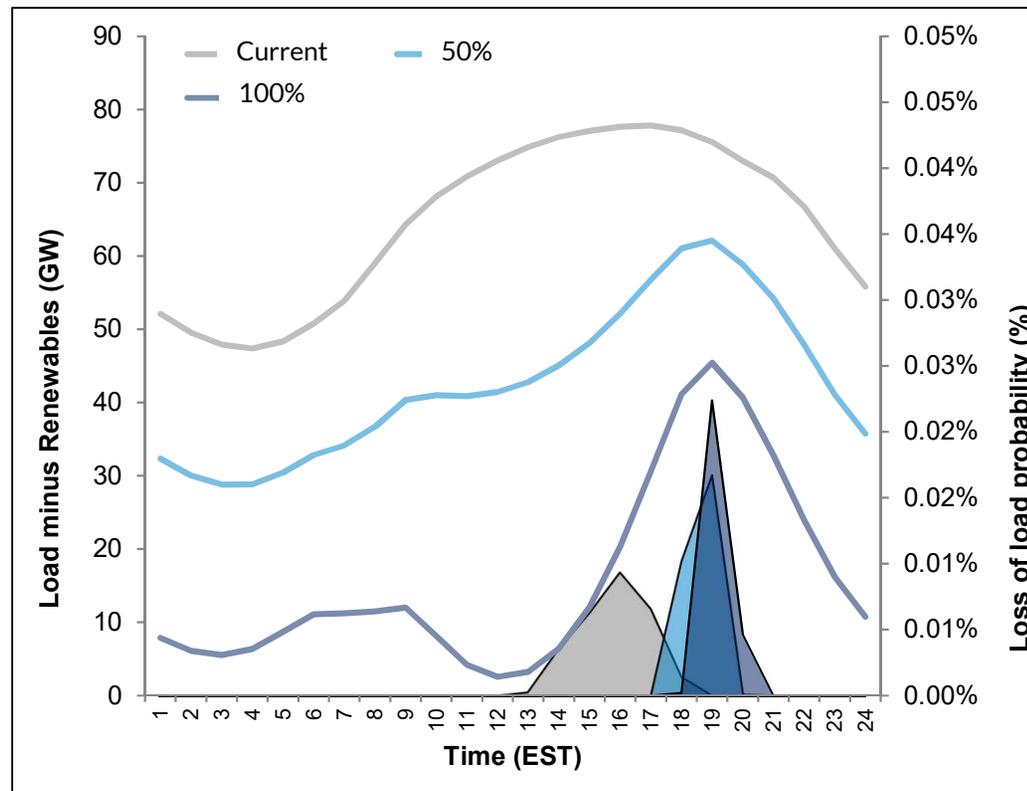


Going forward, MISO will work with stakeholders to ensure our markets and processes effectively manage uncertainty across various timeframes



For example, we are evaluating the impact of renewables growth which can shift risk by the minute, hour, day and season

Average Daily Load minus Renewables (GW)



Note 1: Renewable percentages are based on gross load

Note 2: Renewable scenarios assume 75/25 wind/solar penetration, and 50/50 penetration between utility scale and distributed solar

Questions?

- Issue tracking home for RAN
<https://www.misoenergy.org/stakeholder-engagement/issue-tracking/resource-availability-and-need-ran/>
- Summary document posted to MISO's Market Subcommittee
<https://cdn.misoenergy.org/20190117%20MSC%20Item%2008%20RAN%20Executive%20Summary%20310728.pdf>
- Issues Statement Whitepaper
<https://cdn.misoenergy.org/20180405%20RSC%20Item%2007%20RAN%20Issues%20Statement%20White%20Paper164746.pdf>
- Solution Evaluation Whitepaper
<https://cdn.misoenergy.org/Resource%20Availability%20and%20Need%20RAN%20Evaluation%20Whitepaper274537.pdf>
- Renewables Integration Impact Assessment (RIIA) update
<https://cdn.misoenergy.org/20181114%20PAC%20Item%2005a%20RIIA%20Update292120.pdf>

Dustin Grethen
Market Design Advisor
dgrethen@misoenergy.org