



What Did MISO See?

2021 Meteorology & Market Design for
Grid Services Workshop

June 04, 2021

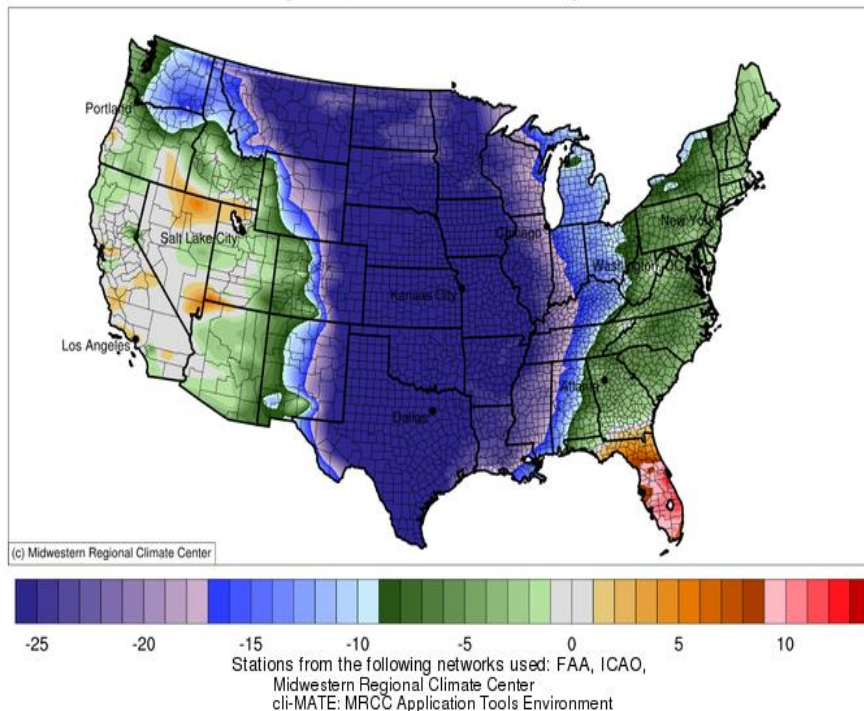
Executive Summary



- Extreme weather conditions led to tight supply and demand conditions and transmission challenges
- MISO collaborated with its members to manage the conditions through advanced preparation, coordinated operations and emergency operating procedures
- Experiences emphasized the urgency of MISO's Reliability Imperative to manage current and future challenges

Arctic weather pattern led to extreme cold across MISO, especially in its South

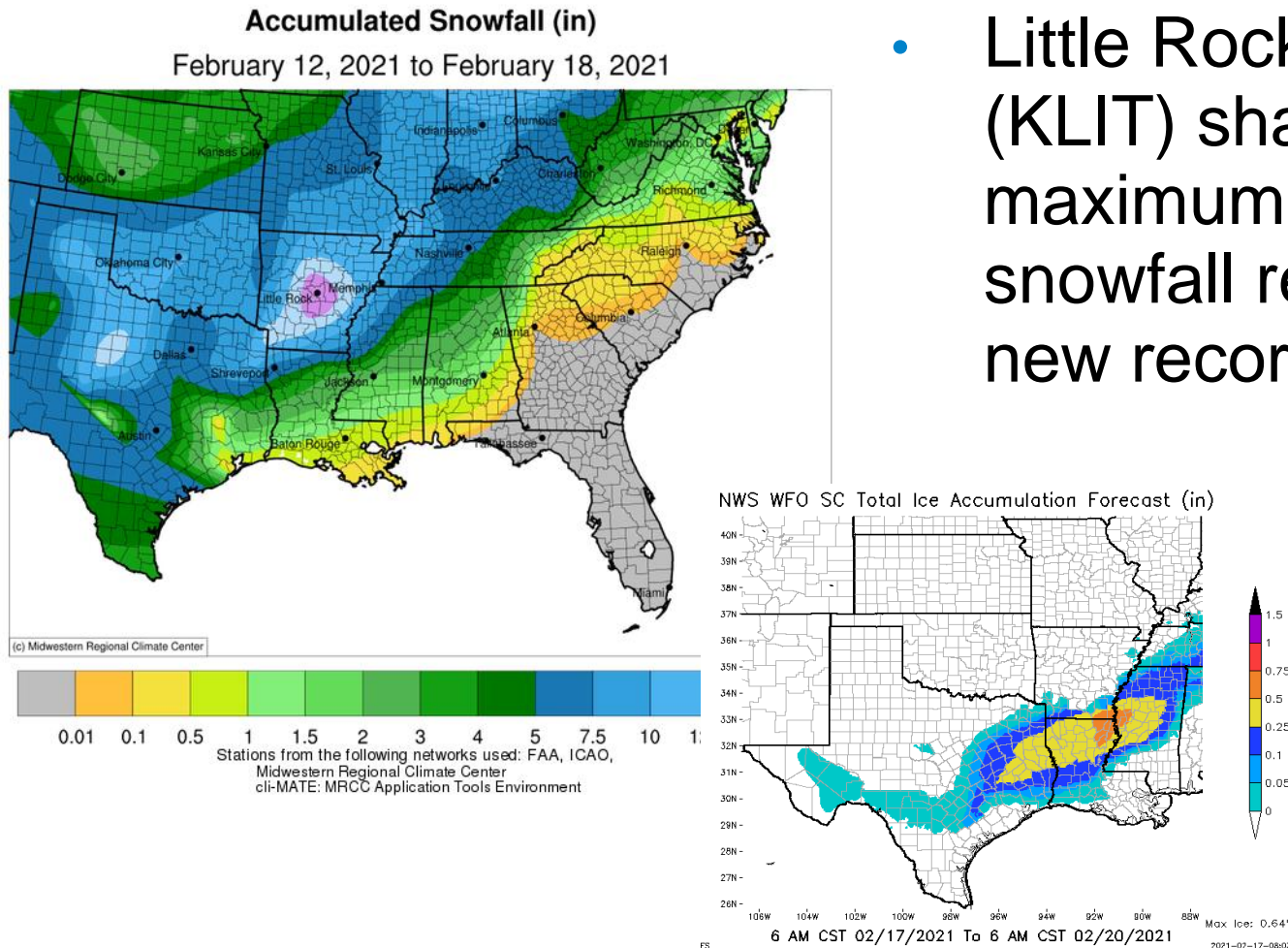
Average Temperature (°F): Departure from 1981-2010 Normals
February 12, 2021 to February 18, 2021



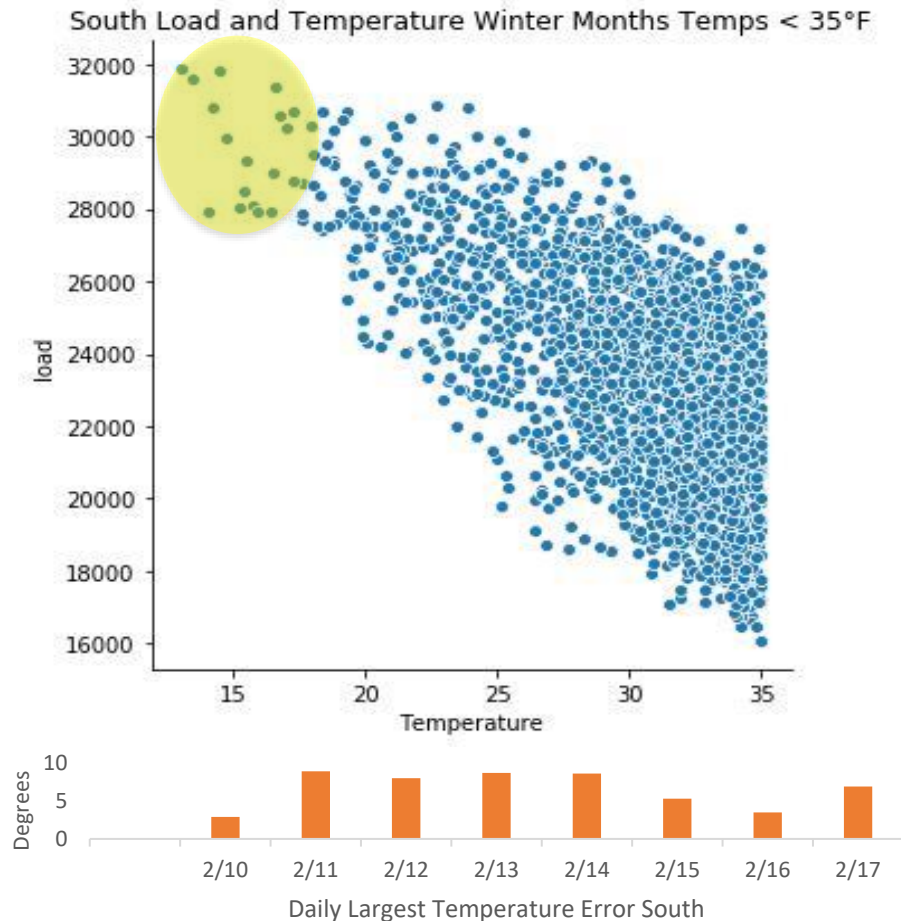
- One of the most extreme weather events in the last 30 years
- Temperatures averaged 30 degrees below normal or even lower
 - **Houston (KIAH)** recorded coldest 3 day stretches (Feb15-17) since Dec 1989
 - **Little Rock Airport (KLIT)** recorded its coldest average temperature stretch at 12.7°F since Dec 1989

Heavy snow and ice accumulated through the MISO South and Central Regions

- Little Rock Airport (KLIT) shattered its maximum 3-day total snowfall record with a new record of 19.5"



Forecasting under extreme weather or load conditions creates new challenges

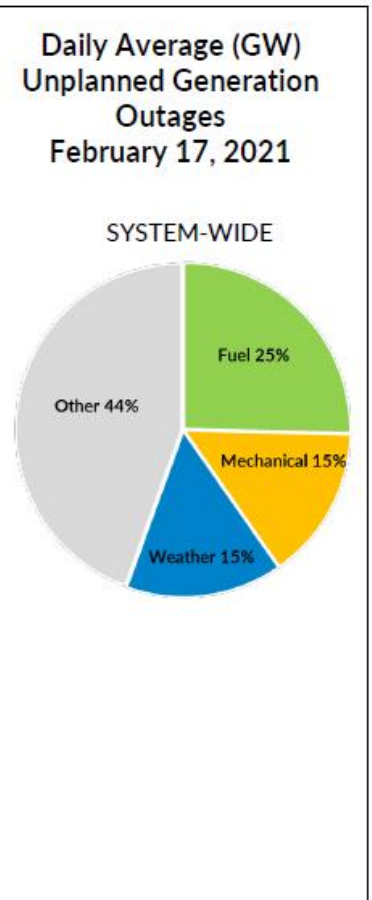
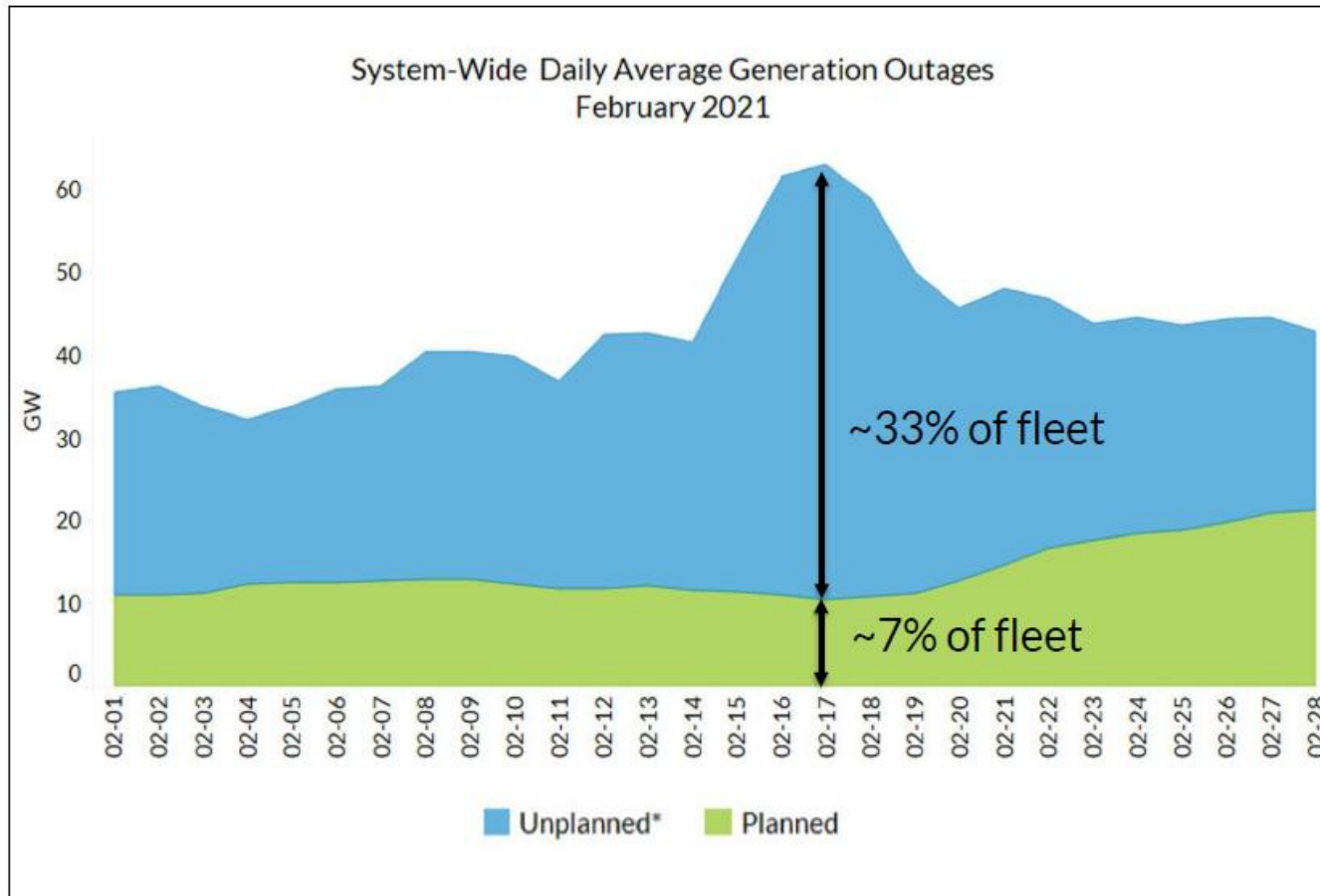


Event Peak 31.6 GW

All time Peak 32.7 GW (summer)

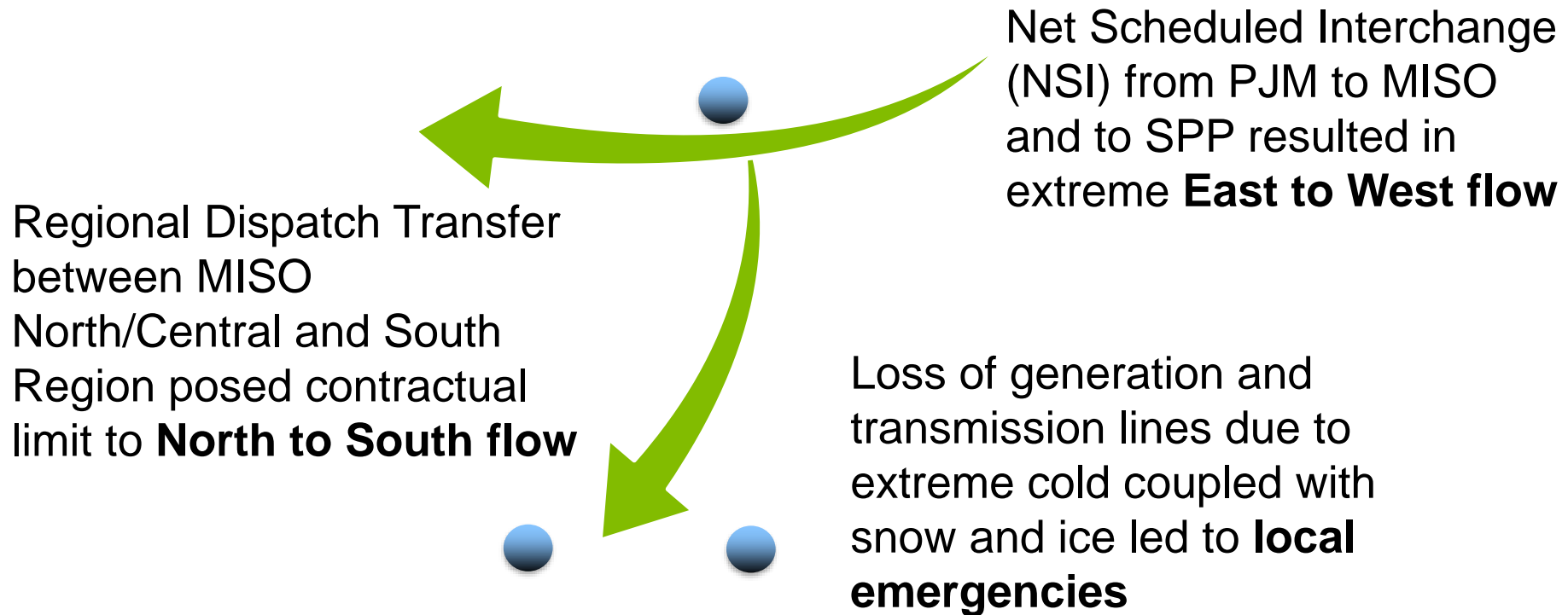
- Limited extreme data available for load forecasting model
- Weather forecast error contributed to load forecast error
- Demand activities such as school closures further introduced uncertainties

As the cold weather deepened, up to ~ 40% of installed resources were unavailable



Transmission system was challenged by outages and extreme flow

Transmission is vital to move generation to load



Advanced preparation is critical to effectively manage the extreme conditions

Years to Months Ahead

- Winter Readiness Workshop (e.g., Generator Winterization Annual Gas Fuel Survey)
- Operations Drills
- Enhancements based on past Extreme Events (e.g., include cold weather cutoff in wind forecasting)
-

Weeks, Days to Hours Ahead

- Monitor developing weather situation and evaluate evolving risks and forecasting
- Discuss outage and gas-electric coordination with members
- Communicate with members on system conditions and request update on availability and offers
-

MISO and its members took collaborative operating actions to maintain reliability

- Committed additional generation with lead time based on assessed risks
 - Enabling members to procure fuel
- Extended the start/stop times for generation resources to avoid start failures due to cold weather
 - Ensuring availability during peak load times
- Emergency Operating Procedures used to address situations that have the potential to, or actually negatively impact system reliability
 - Local Transmission Emergency
 - Transmission System Emergency
 - Market Capacity Emergency

Experiences emphasized the urgency to address MISO's Reliability Imperative*

Changing Landscape further challenges grid operation

- **Resource portfolio** shifting rapidly and more prone to weather
- **A different risk profile** stemming from weather dependent resources and more frequent extreme weather
- Stressing needs of **adequate, rampable and deliverable supply**

MISO's responses to its Reliability Imperative

- Market Redefinition: Sub-annual Resource Adequacy and Resource Accreditation
- Long Range Transmission Planning
- Operations of the Future: Effectively forecast system conditions, assess uncertainties and integrate unknowns in operation decisions
- Market System Enhancement