A Changing Risk Environment Requires Extraordinary Action
A Bulk Power System Reliability Perspective

John Moura, Director of Reliability Assessment and Performance Analysis
The Kleinman Center for Energy Policy: Wholesale Power Markets, Reliability, and the Energy Transition
November 8, 2023
Across an Interconnected System: Less Resources Means More Reliance on Neighbors

2012 and 2022 Peak Capacity Resource Mix NERC-Wide

NERC-Wide Summer Peak Demand Changes 2012 and 2022

2012 Summer Peak Demand

2022 Summer Peak Demand

2025 Risk Areas

4% Decrease

3% Increase
**ERCOT, SPP, MISO:** A “wind drought” caused 60 GW of installed wind capacity to generate 300 MW

**PJM:** Transmission system during extreme cold weather limited the ability to export to support southern neighbors
Hours Without Operator-Initiated Firm Load Shed (%/year)

- 2021
  - 10 EEA-3 Alerts
  - 1.015 GWh unserved energy
  - Occurred February
Significant levels of incremental unplanned electric generating unit losses with top causes found to be mechanical/electrical, freezing, and fuel issues.

Significant natural gas production decreases occurred, with some areas of the country more severely affected.

Short-range forecasts of peak electricity demands were less than actual demands for some BAs in event area.
Hyper Complex Risk Environment

Rapidly Changing Resource Mix
- Retirements of traditional generation
- Natural gas interdependencies
- Inverter-Based Resource (IBR) integration
- DER performance and visibility

Extreme Weather Complexities
- Extreme not infrequent
- Broader deeper longer

Energy & Environmental Policy
- Electrification
- Emissions
- Transmission

Rapidly Evolving Threat Landscape
- S/W vulnerabilities
- Supply chain
- Ransomware
- Physical attacks
Hyper Complex Risk Environment Results in Increased BPS Reliability Risk

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Fuel assurance/uncertainties
- Natural gas
- Renewables

Loss of key “essential reliability services” with retirements
- Inertia/frequency response
- Reactive Power/voltage support
- Dispatchability

Appropriate level of investment in infrastructure for hardening & resilience
- Extreme weather
- Coordinated Physical attack
- Insufficient transfers

Expanding cyber attack surface
- Industry Control Systems (ICSs)
- IBRs/DERs/EV Charging

Sophistication of recent cyber attacks
- SolarWinds (one to many)
- Pipedream, Industroyer malware
Q&A -- Discussion
• 10-year Peak Demand and Energy growth showed largest increases in years
  ▪ Further increases from electrification and EV adoption are anticipated
• Peak demand growth is accelerating – Growth rate doubled in last two years
• Growth in some areas is affecting adequacy of reserves and seasonal energy risks
Managing the Pace of Generator Retirements

- Known generator retirements totaling over 110 GW
- New and proposed U.S. EPA regulations are expected to further accelerate retirements
- 2023 Long-Term Reliability Assessment will consider updated retirement information and scenarios for assessing future resource adequacy and reliability risks
Ontario
- Reserve Margins below target in 2025
- Planned retirements and nuclear work

MISO
- Reserve Margins below target in 2023
- 5,700 MW of thermal generation retirements since 2022

California-Mexico
- Load loss hours anticipated due to variable resource mix and demand
- Improving trend in metrics with recent capacity additions

U.S. West
- Unserved energy projections are increasing in summer months

New England
- Fuel risk in extended cold weather

ERCOT
- Energy risk shifts to winter due to potential impacts of extreme weather

SPP
- Energy shortfalls likely during low-wind and high demand periods
• **Executive Order N-79-20**: By 2035, 100 percent EV sales
• Charging millions of EVs will introduce significant new electric load
• By one estimate, up to 5,500 MW
• Early alignment and coordination needed

Projected 2030 Statewide PEV Charging Load for Intraregional Travel of 8 Million Light-Duty EVs

AB 2127 Report: [https://www.energy.ca.gov/programs-and-topics/programs/electric-vehicle-charging-infrastructure-assessment-ab-2127](https://www.energy.ca.gov/programs-and-topics/programs/electric-vehicle-charging-infrastructure-assessment-ab-2127)
On-Peak Resource Mix Changes through 2032
Must Wins:

1. **Manage the pace of transformation** through market mechanisms and inter-agency coordination on policies that impact generation
2. Develop sufficient **transmission**, to integrate renewables and distribute them, make the system more resilient
3. Maintain a robust fleet of **balancing resources**, with an ability to provide **Essential Reliability Services**
4. Ensure a robust **energy supply chain** for the balancing resources, with sufficient access to fuel and stored energy to withstand long-duration, wide-spread extreme weather events
5. **STATES**: Refine resource adequacy requirements that preserves energy assurance
Different Generators Provide Different Services to the Grid

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Frequency Excursion – Interconnection-wide Phenomena

Florida Event Replay with FNET Data [2/26/2008]
Time: 18:09:6.1 UTC  60.0013 Hz

[Graph and Map of the United States with markers indicating frequency excursion]
Trend in Transmission Projects: Steady

- Little change in transmission miles projections in past five years
- Most projects are initiated to support grid reliability
- Miles of transmission being planned or constructed for renewable integration increased from 1,589 mi to 2,376 mi since 2021 LTRA

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