



Winter Storm Gerri Review January 13–22, 2024

Operating Committee
February 8, 2024

Operations Update

- Key Takeaways
- Emergency Procedures
- Unit Commitment
- Generation Commitment and Reserves (DA Markets vs. DA Operations)
- Weather, Temperature and Load Forecast Accuracy
- Scheduled Interchange
- Generation Performance
- Gas Performance
- Transmission Performance
- Outage Coordination
- Load Management

Peak Load 134,777 MW – January 17 @ 08:10

- Limited set of emergency procedures required
- Load forecast error within 3% threshold
- Significant level of exports to assist neighbors
- Strong generator performance
- Much better gas performance compared to Winter Storm Elliott
- Excellent transmission performance

- **Cold Weather Advisory Western Zone**
 - Jan 14, 2024, 00:01 through Jan. 22, 2024, 10:00 (800 MW Regulation)
- **Cold Weather Alert Western Region**
 - Jan 14, 2024, 00:01 through Jan 17, 2024, 23:59
 - Jan. 19, 2024, 16:00 through Jan 22, 2024, 10:00
- **Conservative Operations**
 - Jan. 13, 2024, 00:01 through Jan. 17, 2024, 23:59
- **NERC Transmission Loading Relief (TLR) 1**
 - Jan. 17, 2024, 07:00 through 22:45

Risk-based scheduling approach – load forecast, outages, natural gas availability

- Units with extended start times were evaluated and started early to ensure units were online before extreme cold weather settled in. Strategy was to have units warm and ready to ramp up.
- Evaluated units that have not operated in the past eight weeks for consideration for additional start time

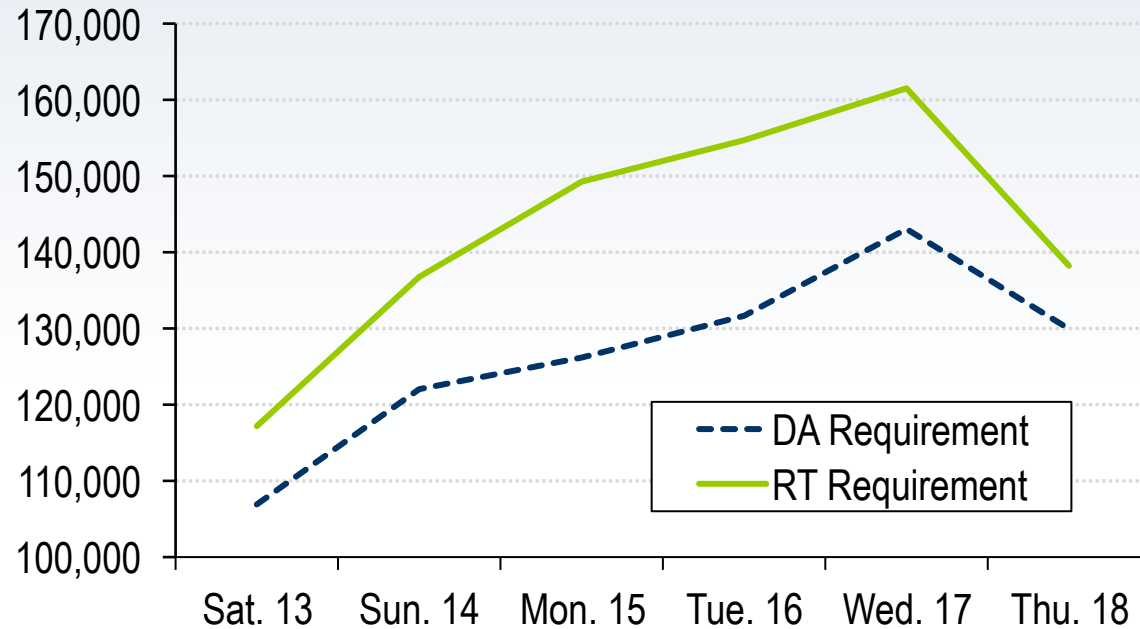
Reliability cases were conducted, and units were committed for reliability based on anticipated congestion and capacity projections.

Both Flexible and Inflexible Day-Ahead CTs were given advance notice for projected run period for additional time to procure fuel and to notify PJM if they would not be able to operate.

- Considerations were given to min. down time on units to determine if they would be able to come back in time for higher projected loads.
- Extended holiday weekend gas nomination period was considered when making commitments to gas units.

Generation Requirements

Day Ahead vs. Real-Time Generation Requirement (MW)

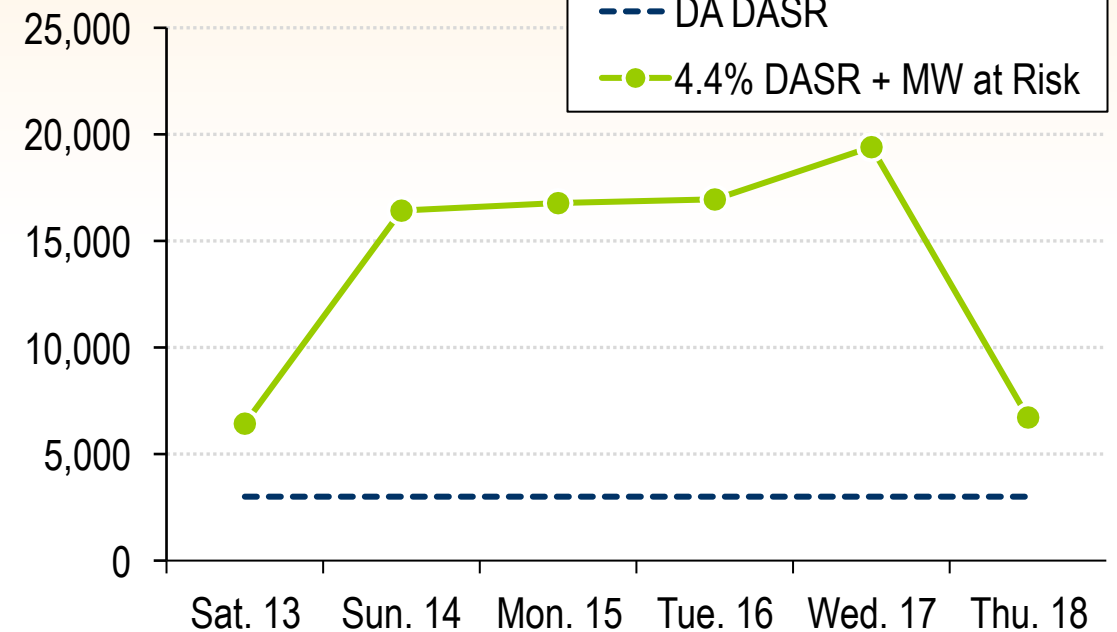


DA = DA Load + DA Exports + 3,000 MW DASR

RT = RT Forecast + DA Exports + 4.4% DASR + MW at Risk
(operating temperature)

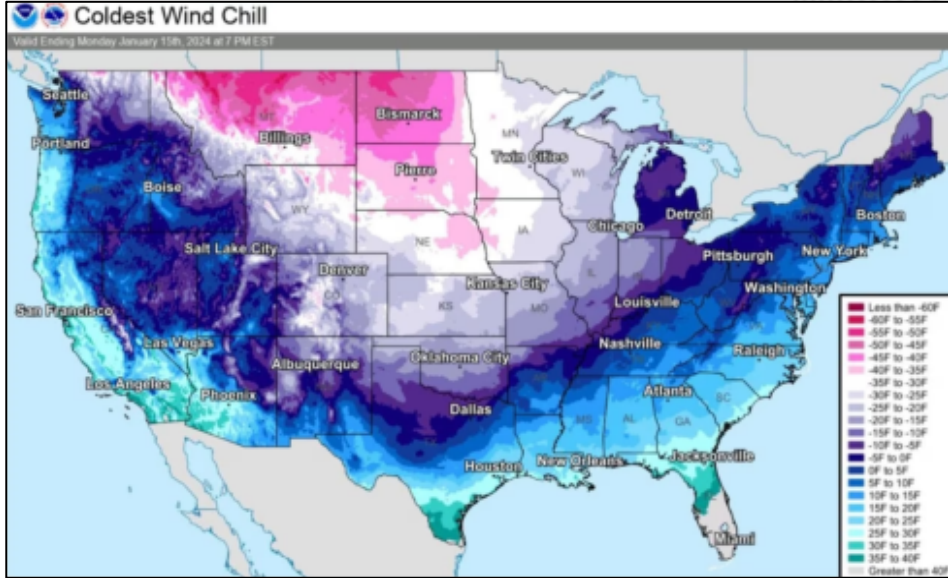
Scheduling Reserve

DA vs. RT Scheduling Reserve



DA Markets = 3,000 MW DASR

DA Operations = 4.4% DASR + MW at Risk
(operating temperature)



On Jan. 13: Arctic air pushed into Western Region

From Jan. 14–16: Air temperatures below zero degrees in COMED most hours

On Jan. 20: Arctic air surged back into RTO

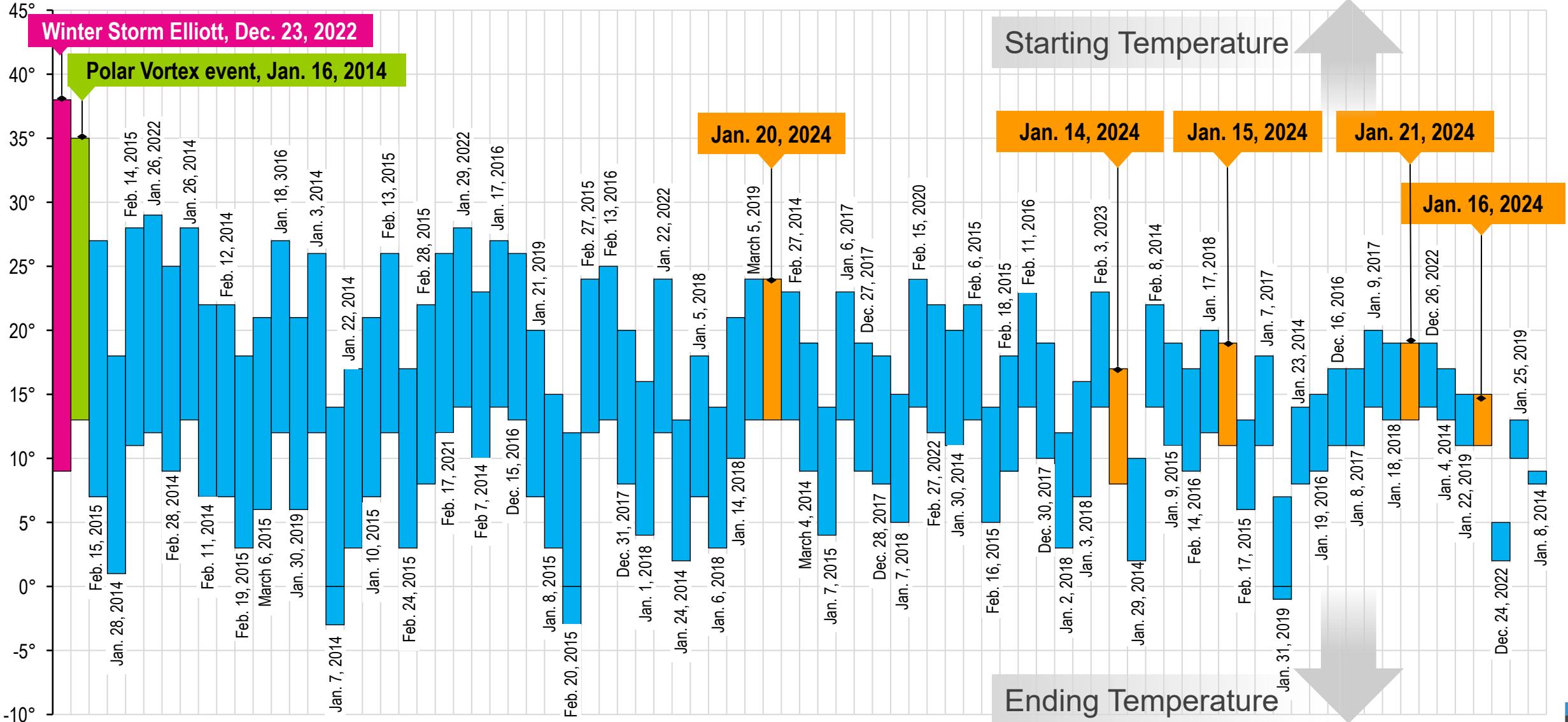
On Jan. 15: Coldest in much of Western Region

On Jan. 17: Coldest in Mid-Atlantic and Dominion regions

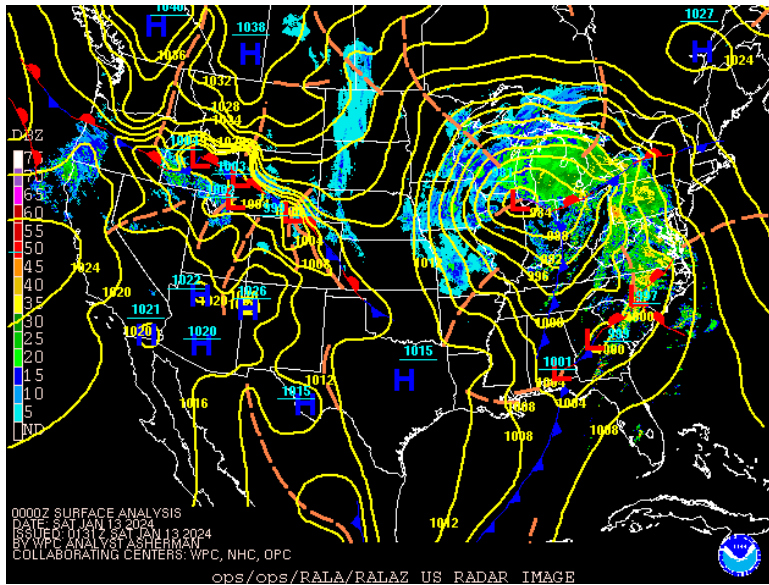
Winter Storm Elliott Dec. 23–26, 2022			January 13–22, 2024 Cold Wave	
Cities	Coldest Air Temperature	Coldest Wind Chill	Coldest Air Temperature	Coldest Wind Chill
Chicago	-8°F	-35°F	-10°F	-33°F
Columbus	-7°F	-34°F	6°F	-13°F
Louisville	-5°F	-31°F	3°F	-12°F
Philadelphia	7°F	-14°F	14°F	2°F
Richmond	8°F	-11°F	14°F	9°F



Historical Temperature Drops Under 15° 12-Hour RTO Temperature Drops From Jan. 1, 2014, to Jan. 31, 2024

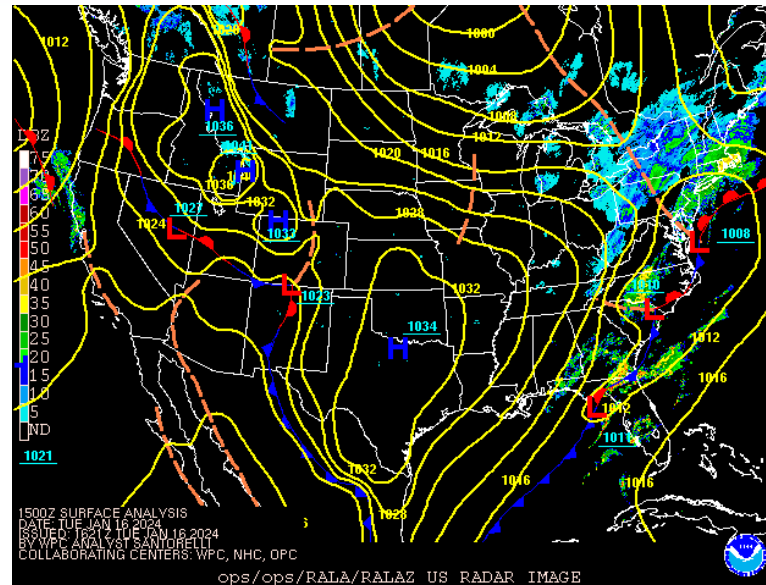


Storm #1 – “Gerri” January 12–13



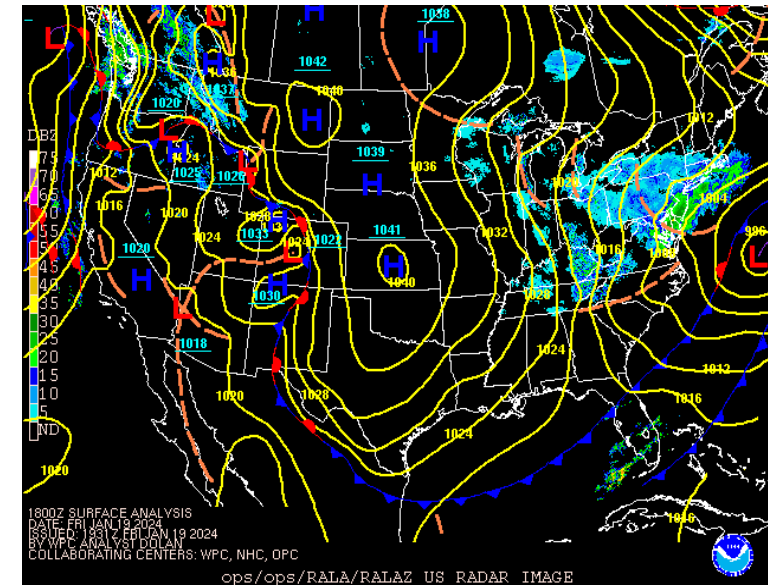
- Heavy snow in COMED, strong winds in Western Region
- Heavy rain & strong winds from Appalachians eastward

Storm #2 – “Heather” January 15–16



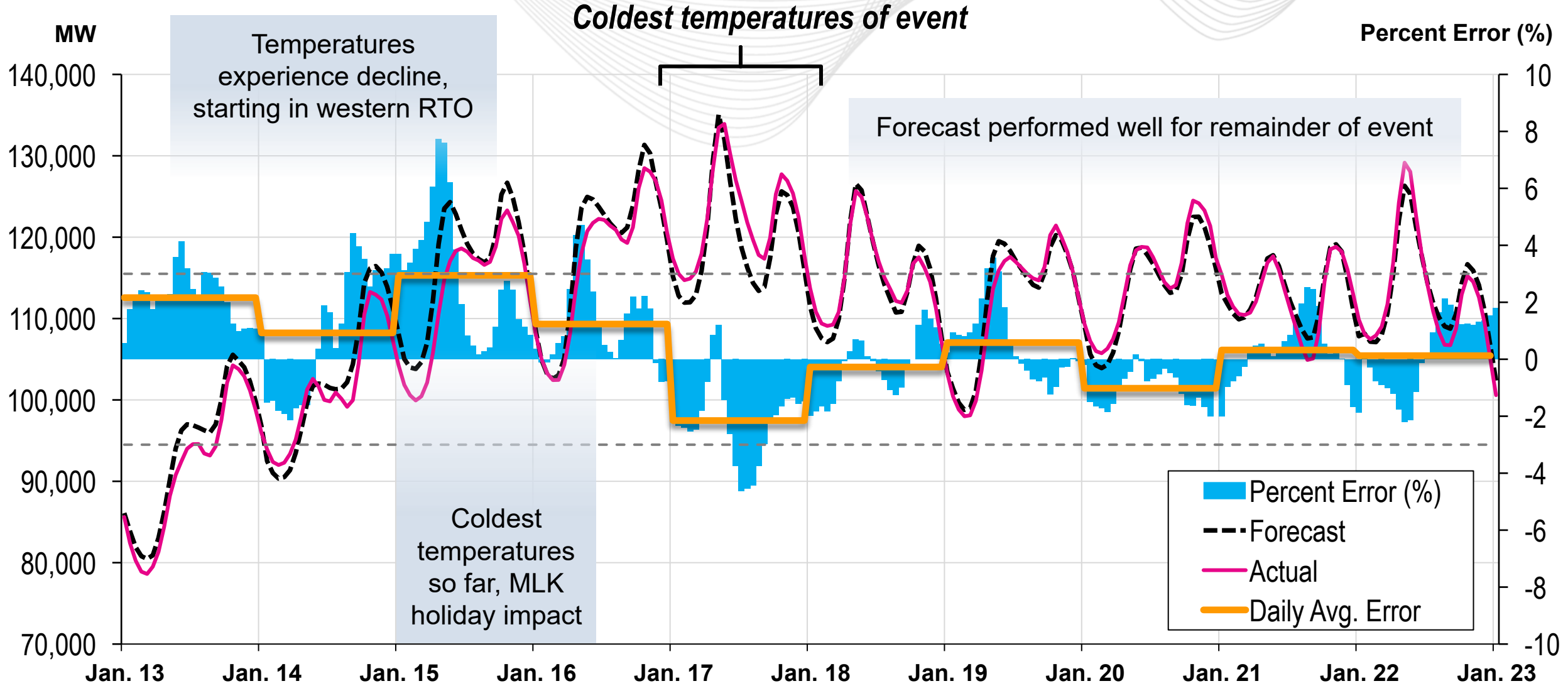
- Snow & ice from Ohio Valley eastward
- Nearly 2-year-old streaks of less than 1” of snow broken on I-95 corridor

Storm #3 – “Indigo” January 18–19

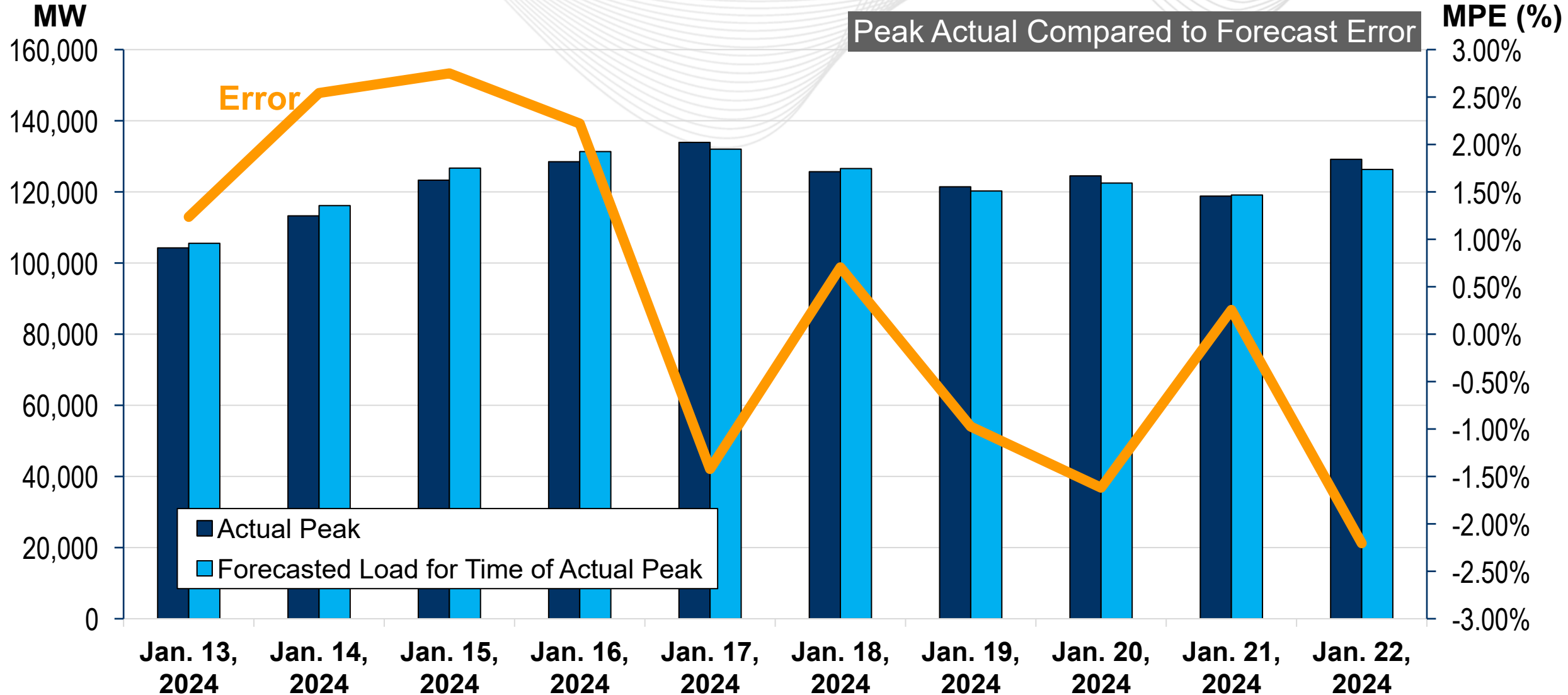


- Snow over much of RTO
- Heaviest snow over Mid-Atlantic

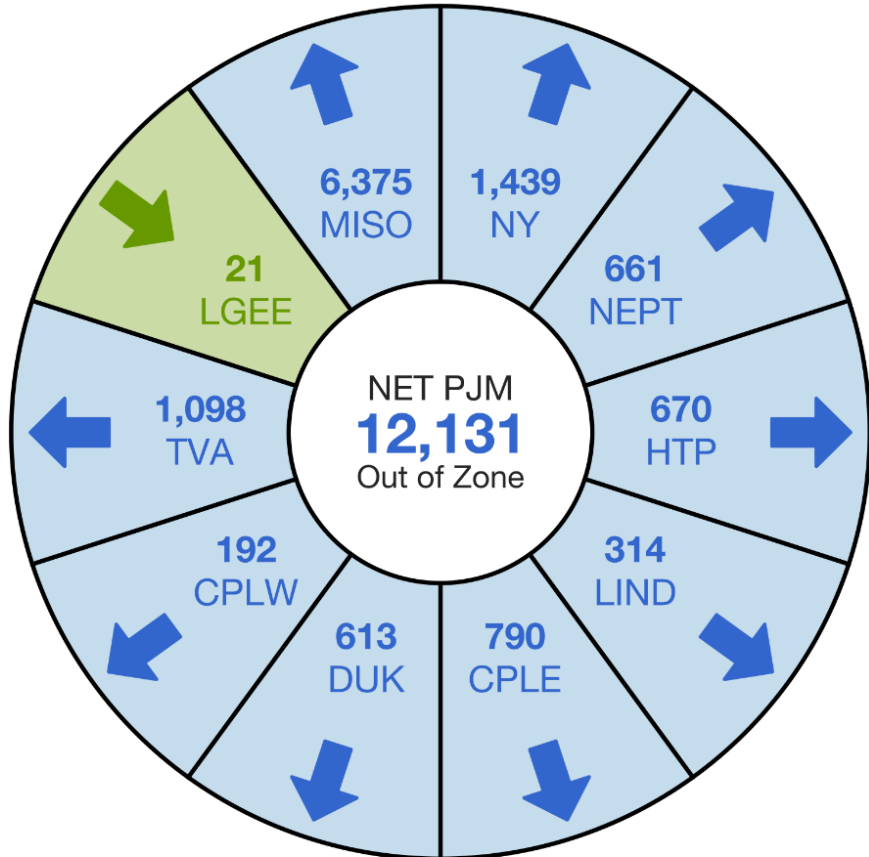
Forecast Performance During January Cold Spell



Forecast Error Trend for Jan. 13–22, 2024



As of Jan. 17, 2024, 9:35 a.m. EPT

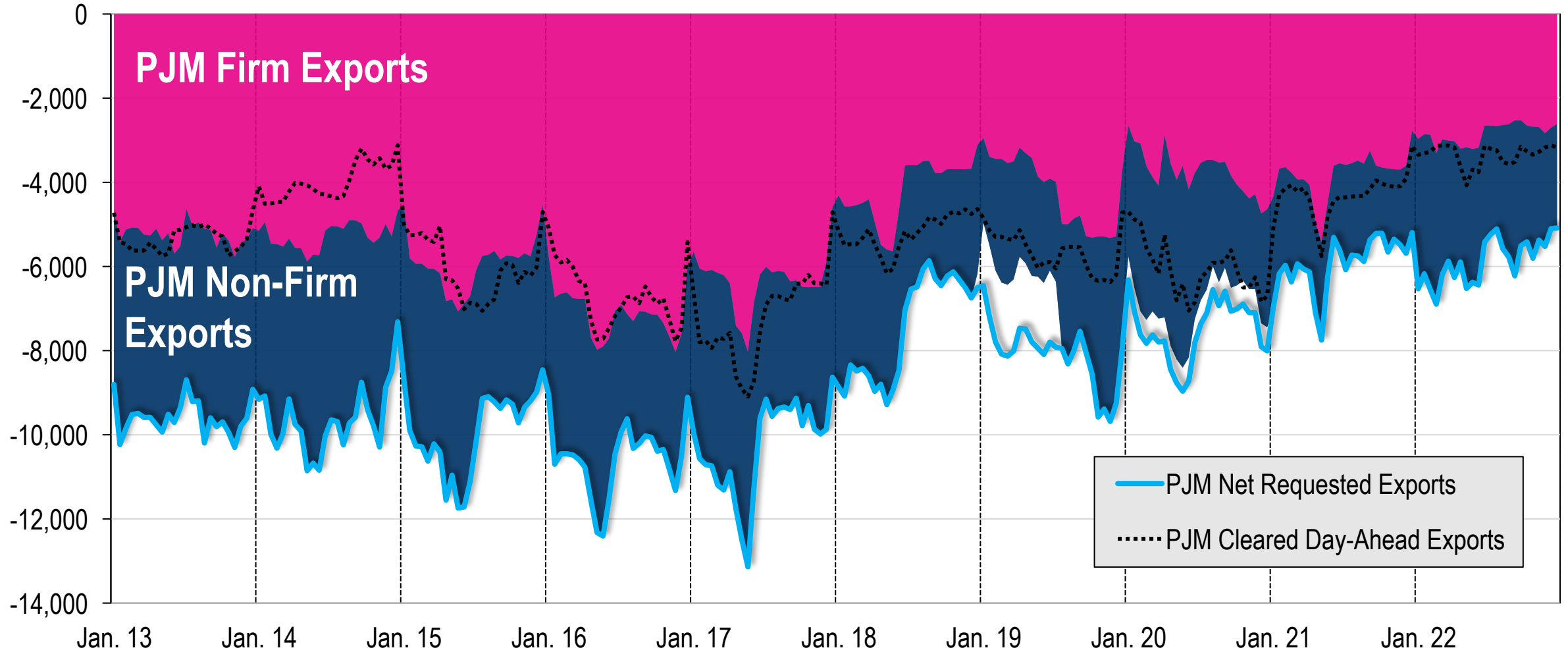


- Eastern Interconnection relies on mutual aid.
- PJM was able to aid neighbors at depth of cold snap, exporting nearly 10% of PJM's own needs.
- During 2014 Polar Vortex, roles were reversed, PJM imported power.

Actual
Imports: **21**
Exports: **12,152**

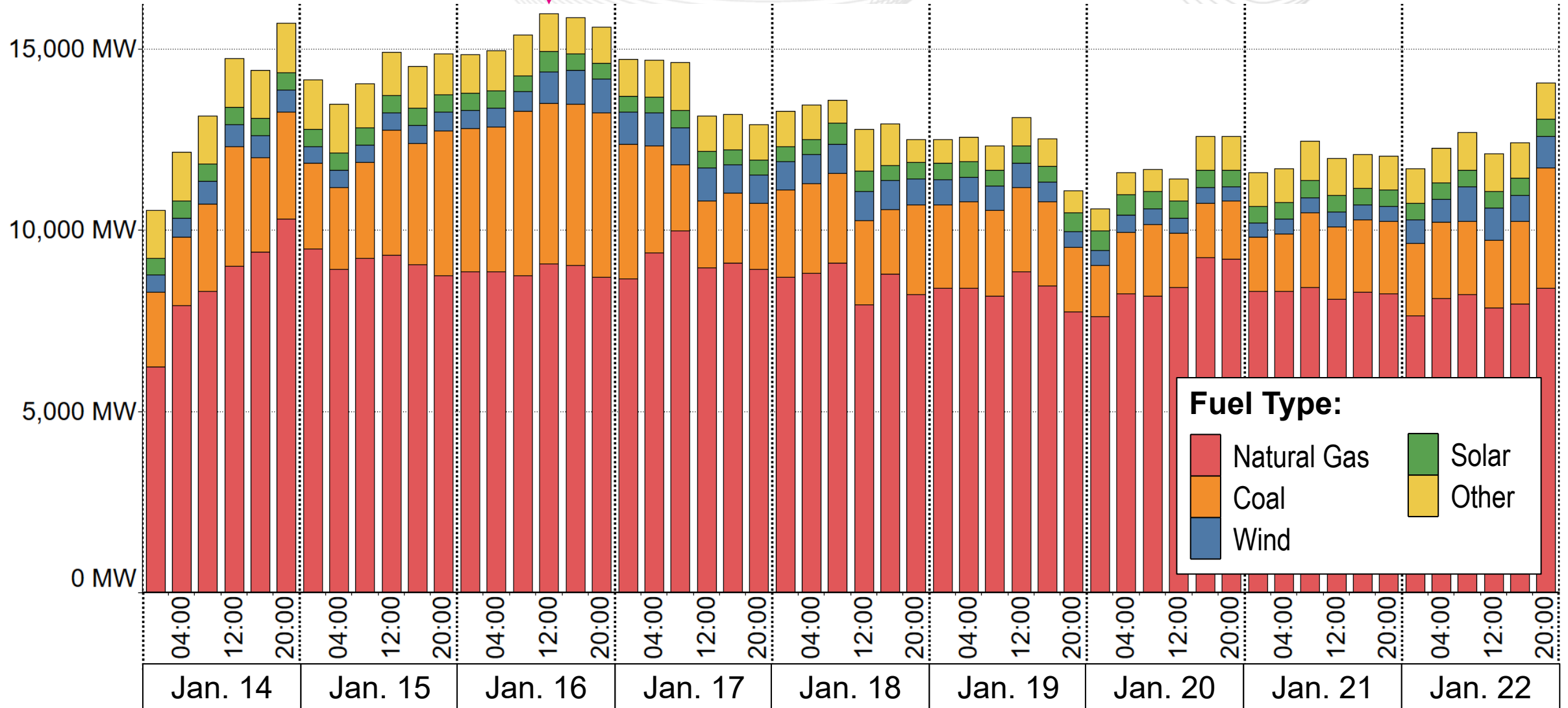
Scheduled
Imports: **71**
Exports: **11,827**

PJM Net Scheduled Export Interchange (MWh)

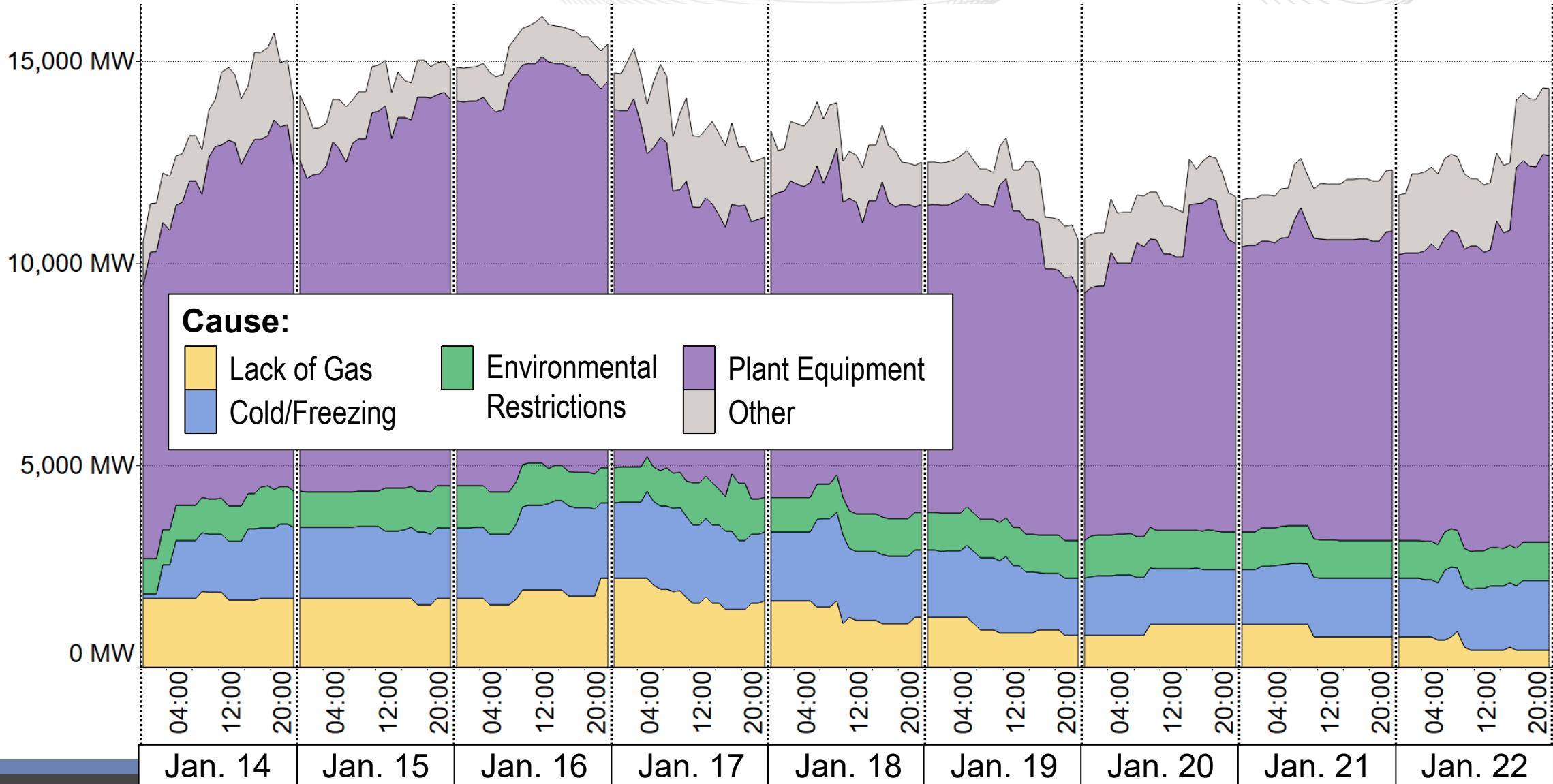


TOTAL
15,976 MW

WSG Forced Outages by Primary Fuel Type

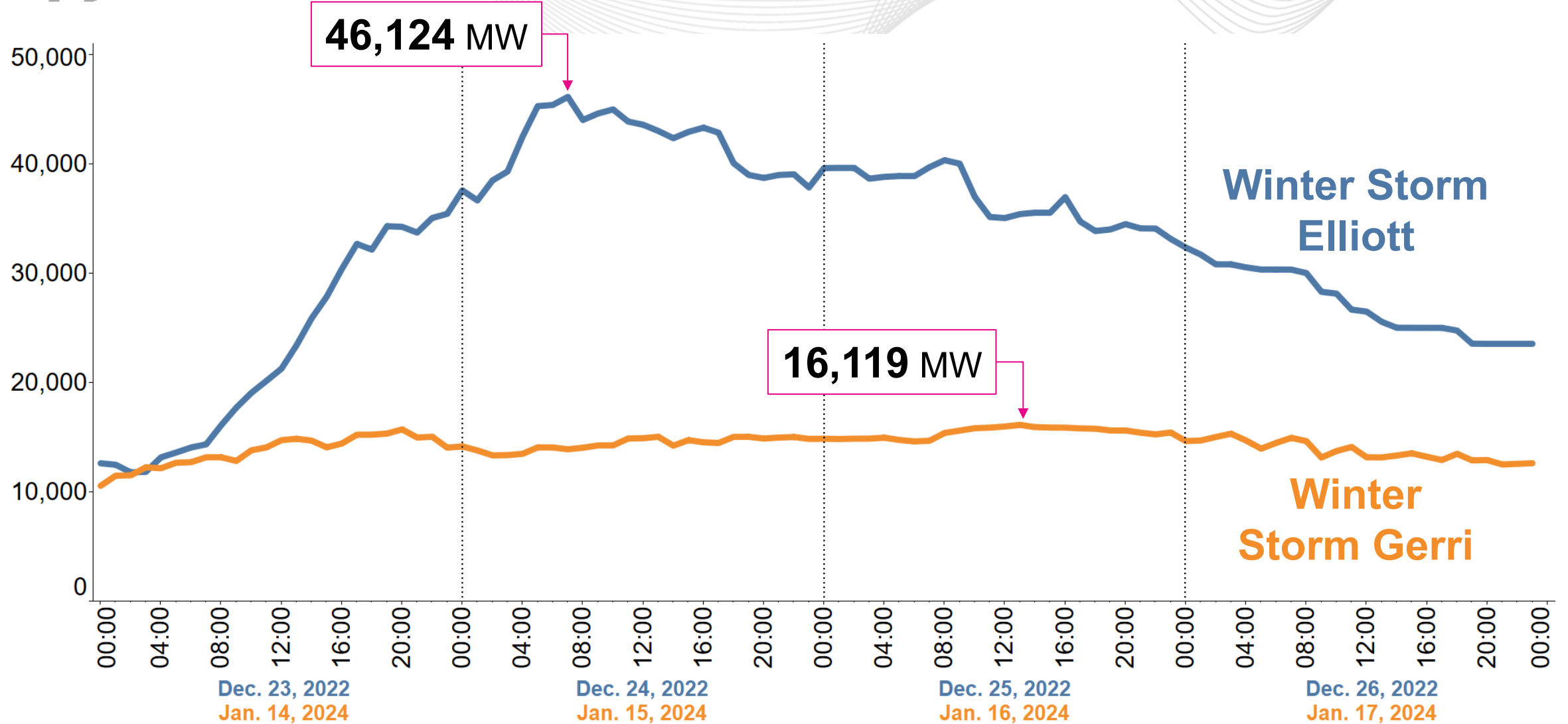


Note: Winter Storm Gerri outage data shown is collected from eDART and considered preliminary.



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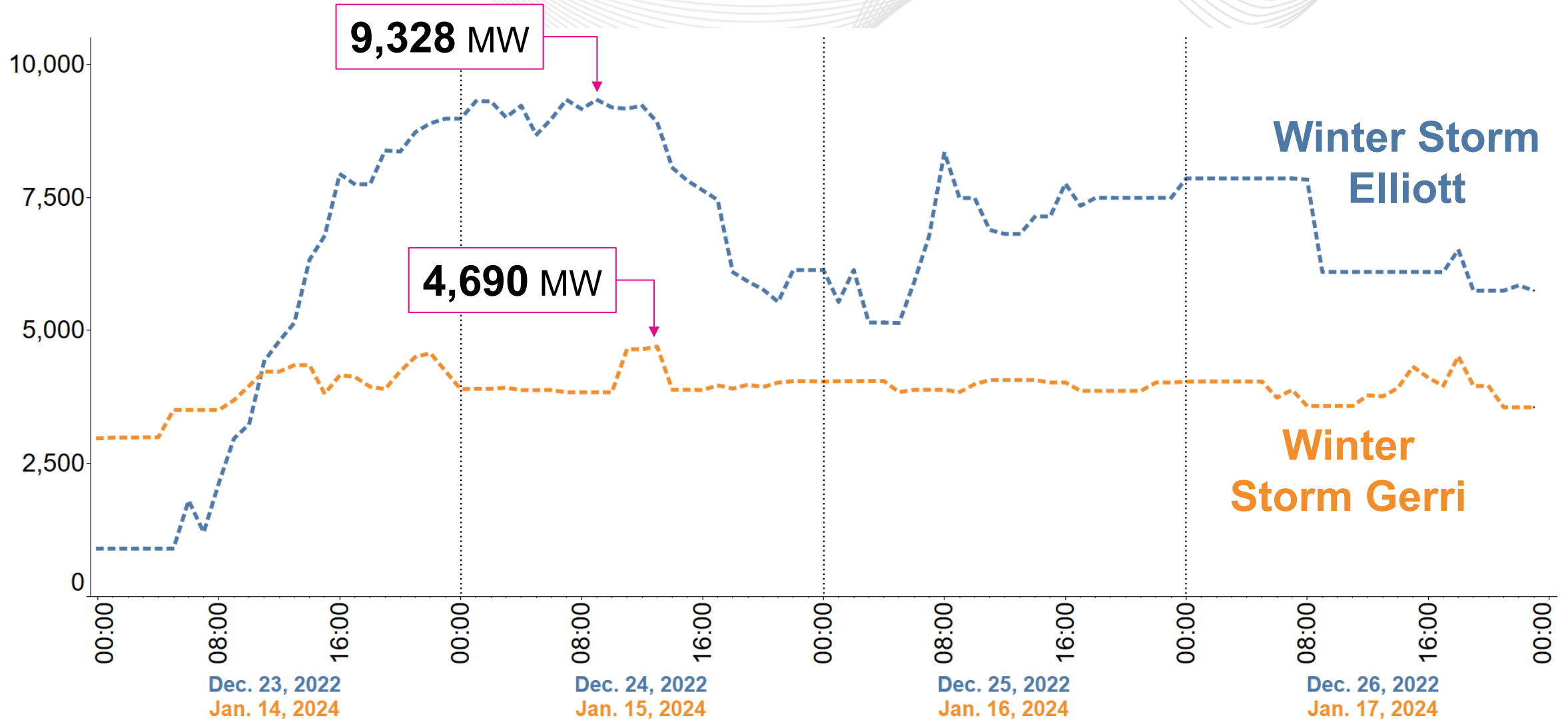
WSG vs. WSE Forced Outages Comparison



Note: 16,653 MW discrete generator outages modeled in winter OATF analysis. Winter Storm Gerri outage data shown is collected from eDART and considered preliminary.



WSG vs. WSE COMED Forced Outages Comparison



Note: 16,653 MW discrete generator outages modeled in winter OATF analysis. Winter Storm Gerri outage data shown is collected from eDART and considered preliminary.

- Much improved performance compared to WS Elliott
- Gas production losses focused in west and south, minimal losses in the northeast/Appalachian region.
- Strong pipeline performance with minimal capacity or pressure impacts
 - All pipelines were effectively “locked down” with various levels of daily and hourly capacity and contractual restrictions.
 - Mechanically only a couple of minor compressor station issues that were quickly rectified within a few hours with minimal impact on generation
- PJM Gas-Electric Team maintained continuous communication with the pipeline control centers to monitor and share operating conditions and forecasts.
- Spot gas prices spiked up during trading on Friday, Jan. 12, 2024, for MLK holiday weekend gas (Saturday through Tuesday) but not to the levels observed during WS Elliott.

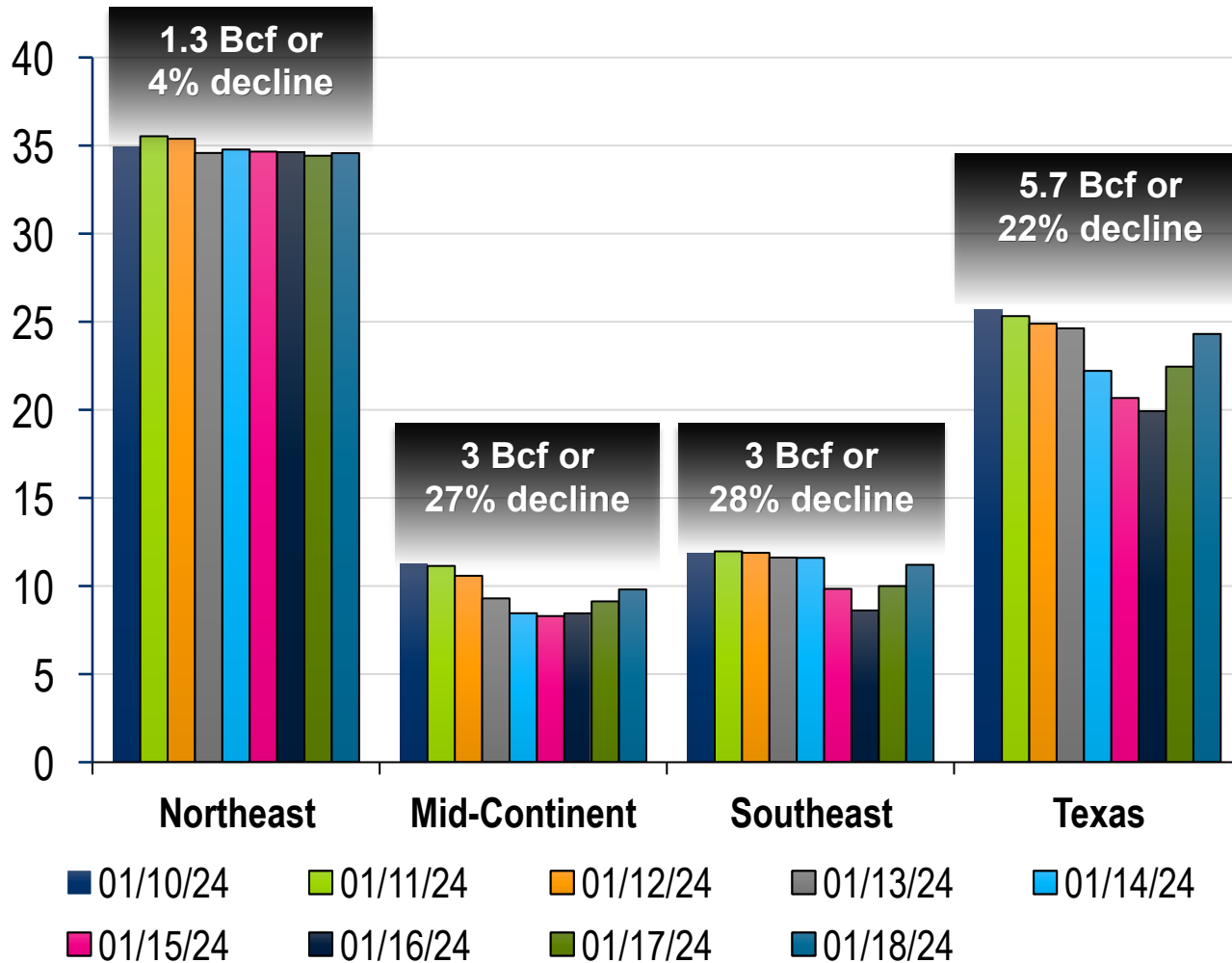
Winter Storm Gerri – 2024

	Jan. 16	Jan. 17	Jan. 18
Active Submissions	95	94	94
Percentage of Total Gas Units	22%	22%	22%

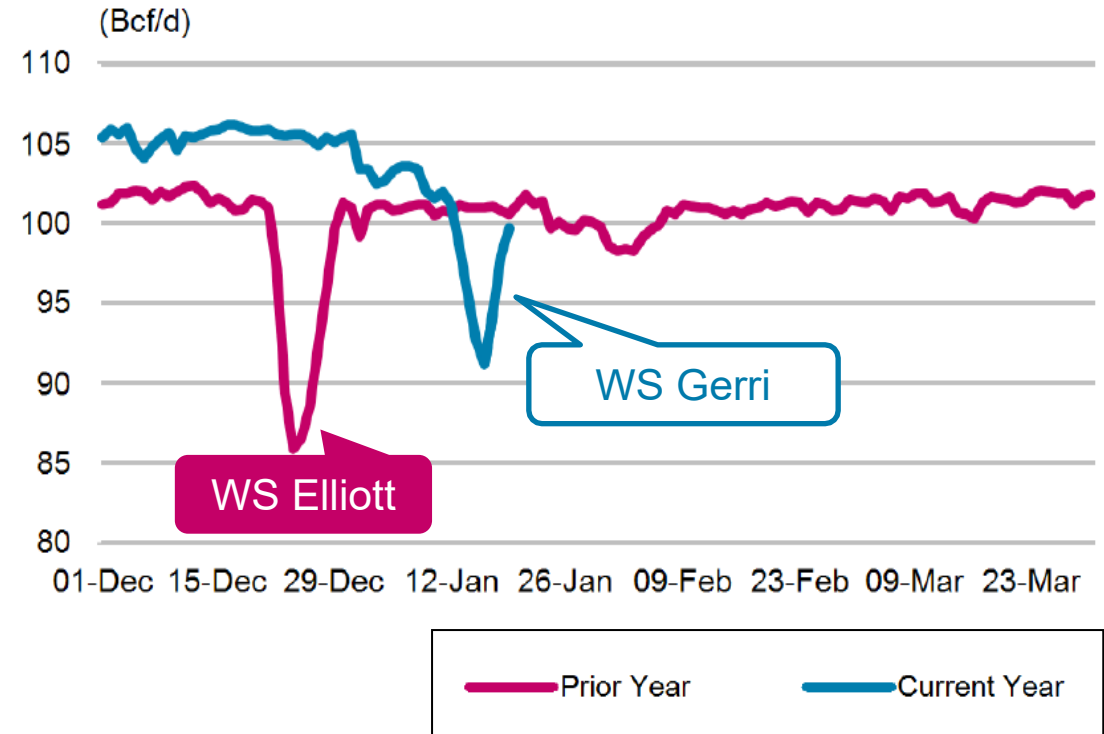
Winter Storm Elliott – 2022

	Dec. 22	Dec. 23	Dec. 24
Active Submissions	68	69	69
Percentage of Total Gas Units	16%	16%	16%

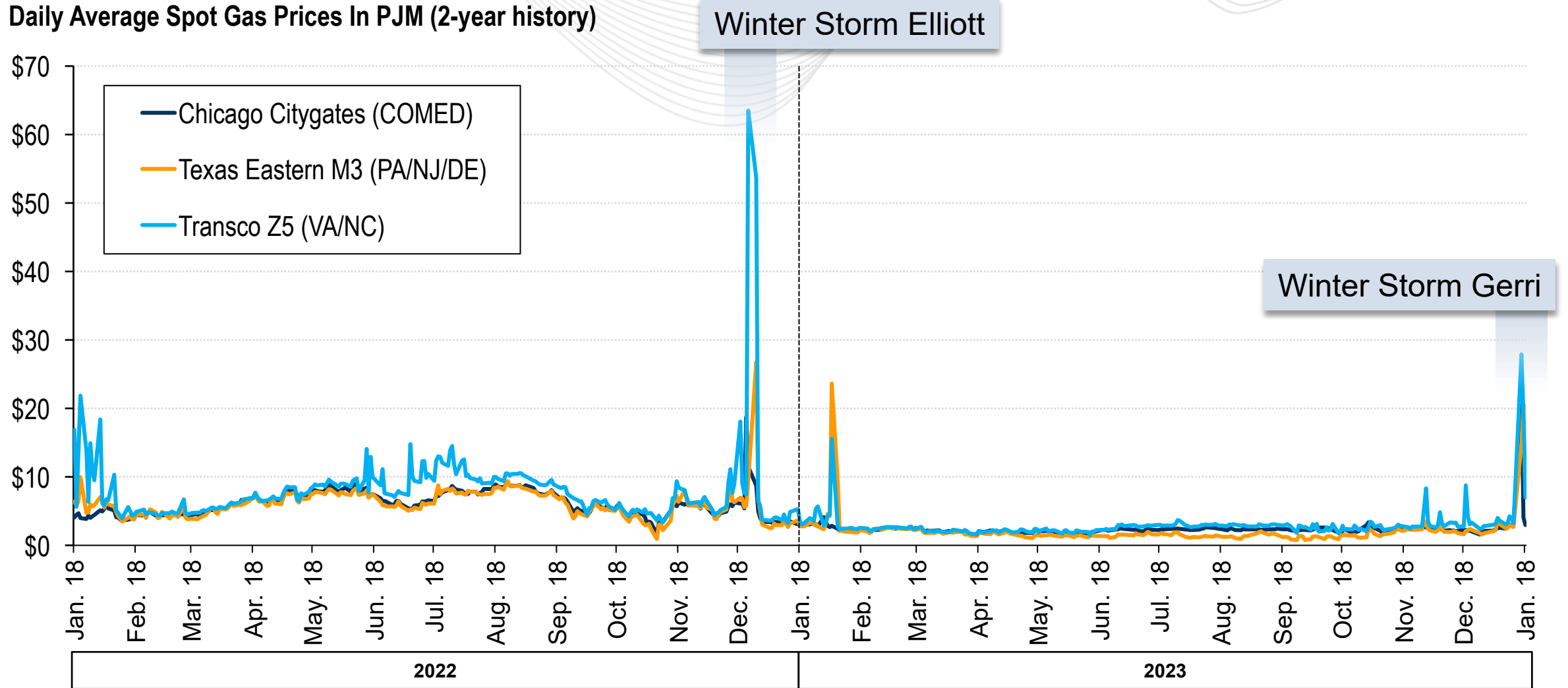
Daily Gas Production Losses Jan. 10–18, 2024 (Bcf/Day)



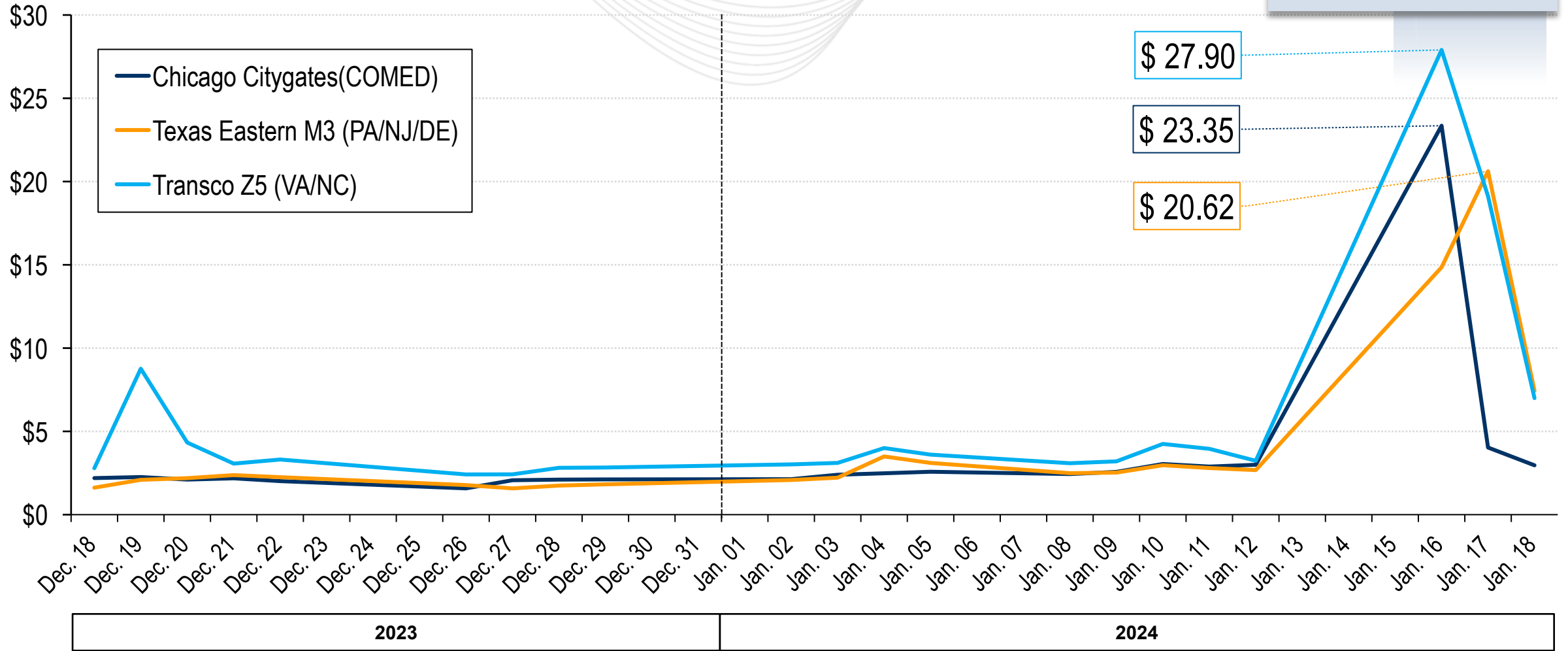
U.S. Dry Gas Production



Daily Average Spot Gas Prices In PJM (2-year history)



Daily Average Spot Gas Prices In PJM



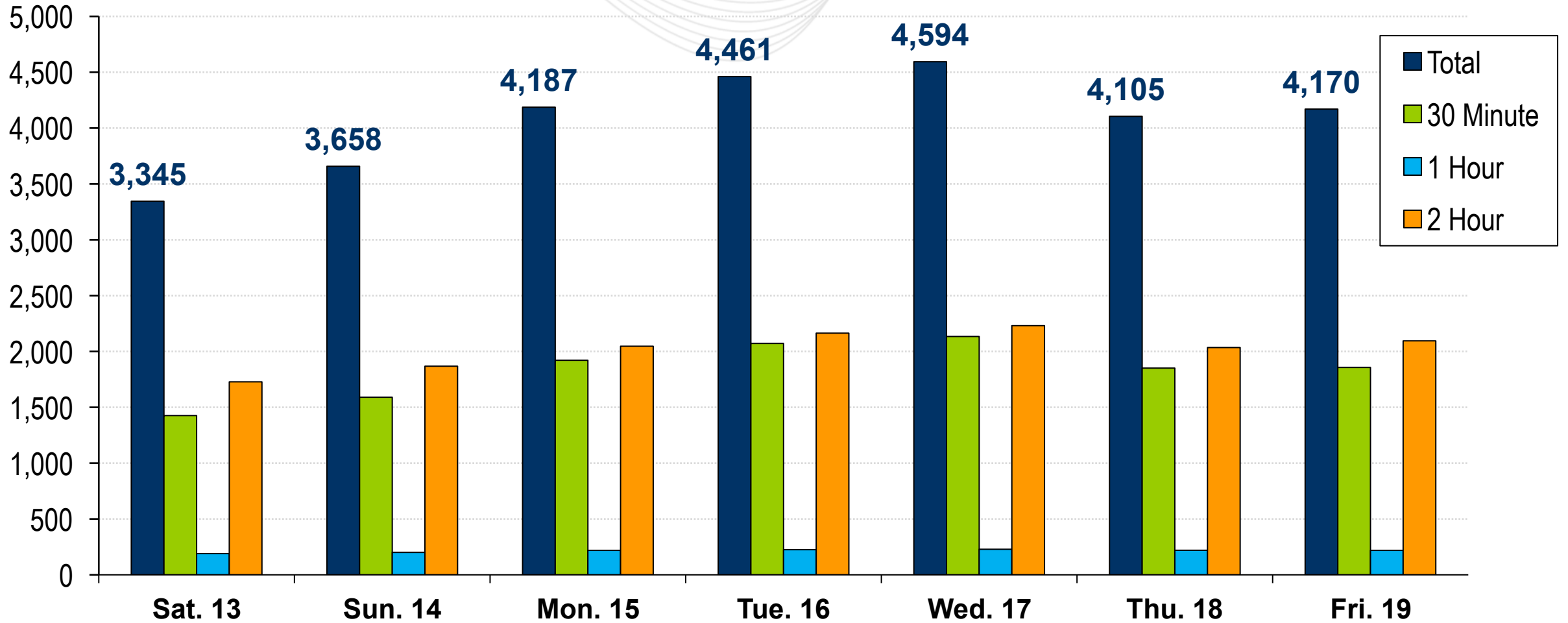
PJM coordinated with:

- Transmission Owners to reschedule ~40 scheduled maintenance transmission outages to periods of when more favorable system conditions were projected
- AEP to remove fixed 765 kV reactors to provide additional interface IROL margin
 - Reactors that were switched out of service are fixed 765 kV reactors in AEP. Transmission lines have to be removed to remove the reactor.
 - Study results show that the reactors out of service, provided an additional 300 MVARs of relief on the AEP/DOM interface.
 - Reactor switching has to be done strategically when loads are high enough and we would not have high voltages with the reactors out of service.

PJM coordinated with:

- Neighboring areas to place normally open EHV lines into service for more resiliency and transfer capability prior to the onset of anticipated cold weather
 - Studies at the higher projected loads indicted thermal and post contingency low voltages at specific portions of the system near interfaces with neighboring entities.
 - PJM utilized JOA language and operating procedures to place normally open 500 kV & 345 kV lines into service prior to the onset of higher anticipated loads.

Load Management Variation Through Winter Storm Gerri (MW)



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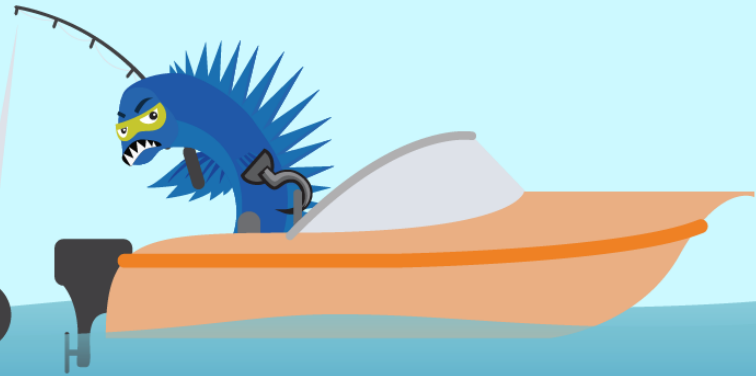
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**PROTECT THE
POWER GRID**

**THINK BEFORE
YOU CLICK!**



**BE ALERT TO
MALICIOUS PHISHING
EMAILS**



**Report suspicious email activity to PJM.
Call (610) 666-2244 or email it_ops_ctr_shift@pjm.com**

Appendix

