
Dominion Energy Solution Package

Electric Gas Coordination Senior Task Force

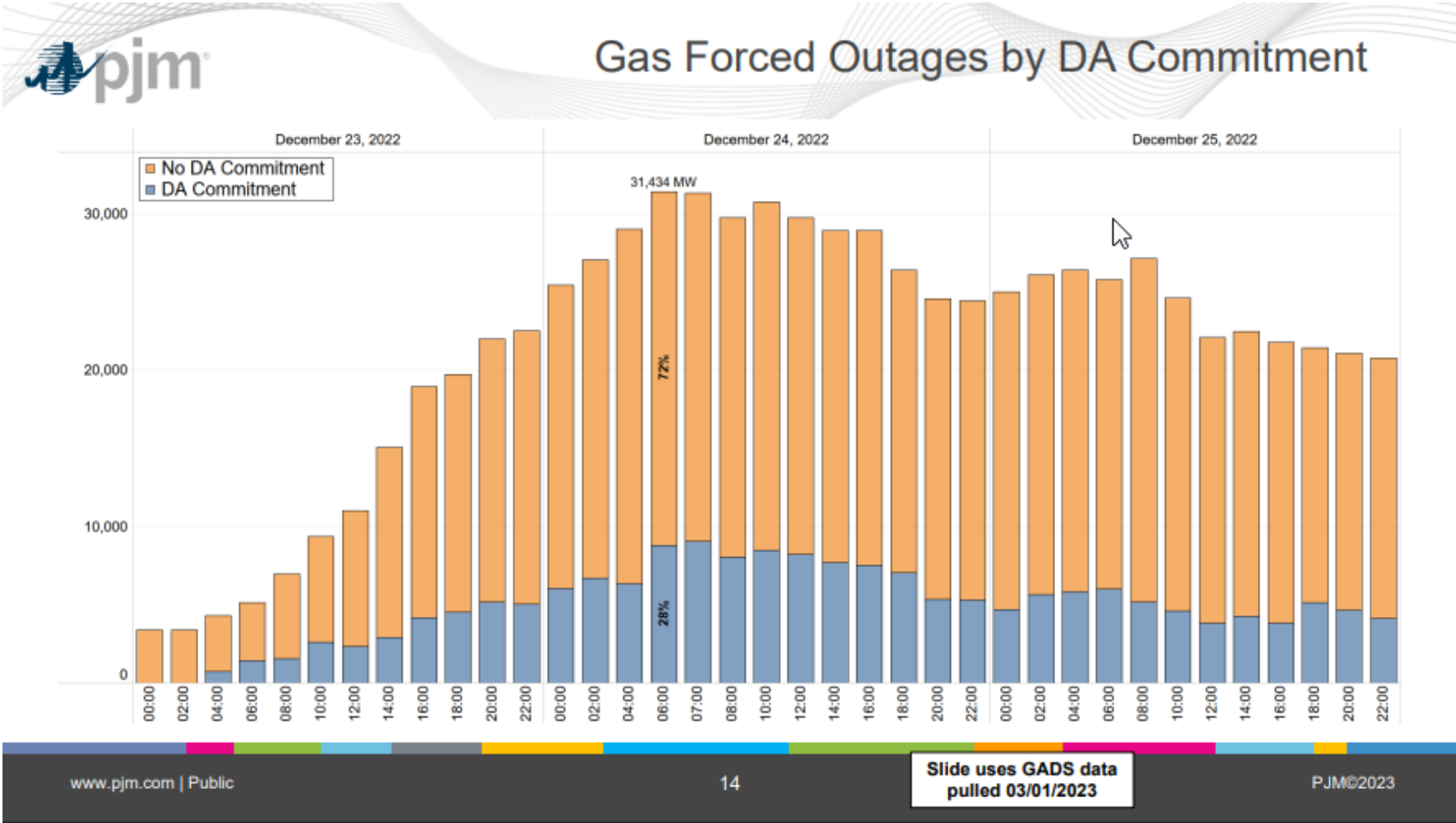
March 14, 2023

Dominion Energy Industry Comments

Dominion Energy's comments, in various regulatory forums and technical conferences, addressing electric grid impacts from cold weather events, have reoccurring themes:

1. RTOs increasingly dependent on gas-fired generation to balance the grid. However, natural gas pipelines are increasingly constrained, which limits the ability to address variability caused by load and increasing intermittent generation.
2. The electric market should appropriately incentivize/value generation flexibility.
3. Pipeline firm transportation, alone, does not guarantee adequate fuel deliveries. Pipeline operation and scheduling realities must be factored.
4. Peak demand and pricing periods highlight certain natural gas and electric market misalignments.
 - a. Multi-day (weekend gas market) vs. day ahead (electric market) pricing.
 - b. Need for increased communication between gas pipelines and RTOs.
 - c. Natural gas pipeline realities (flow rules, nomination deadlines, OFOs) should be reflected in RTO contingency planning and reserve margin calculations.

Winter Storm Elliott

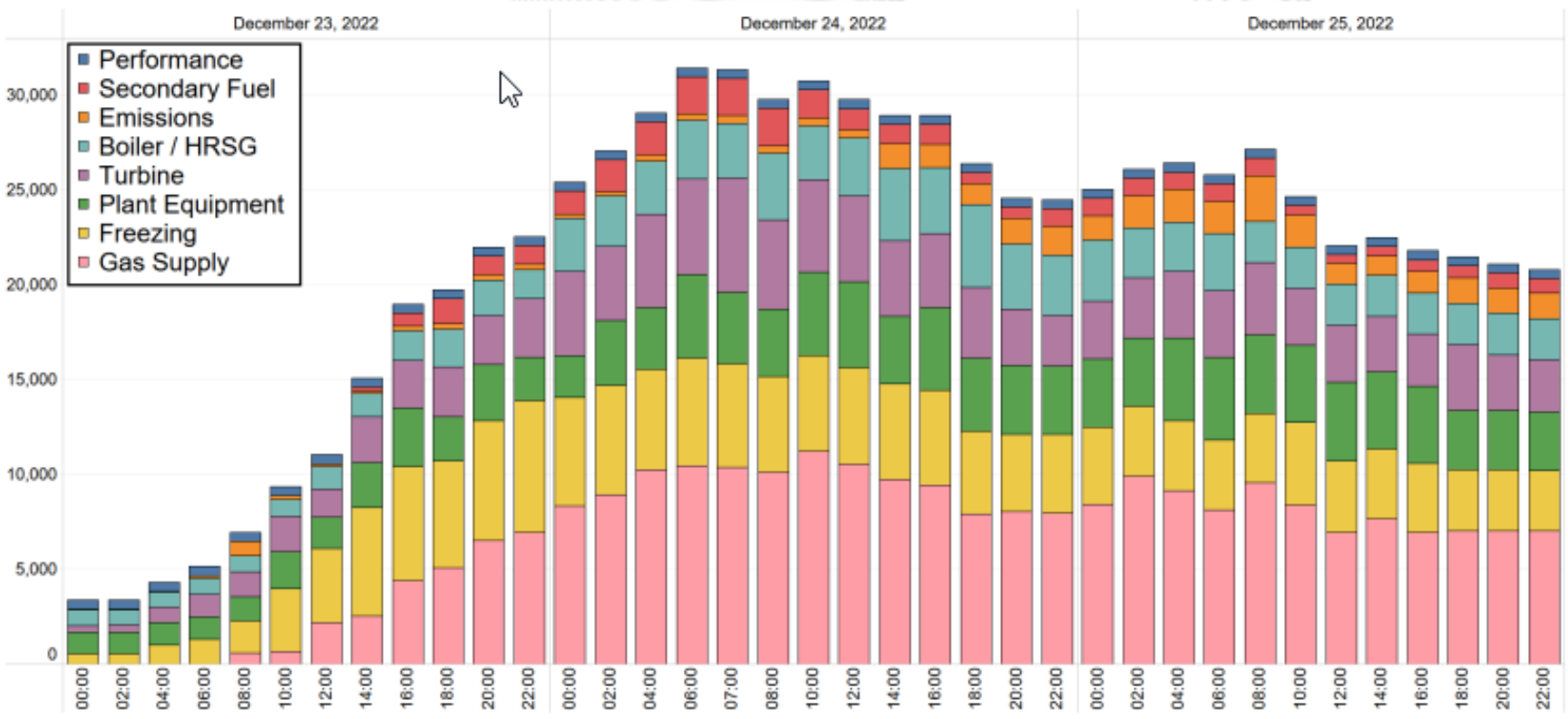


- 72% on (~22,600 MW) of the natural gas generation outage were from generators that were not committed by PJM in the Day Ahead.
- Can we infer that these generators did not buy the fuel on the Friday before the holiday?

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Gas - Forced Outages/Derates by Cause



- Does the lack of Gas Supply, or lack of fuel purchases from the previous slide explain the ~12,000 MW outages (pink shaded portion) on Christmas Eve illustrated here?

Note: Only even hours are shown for readability with the exception of 12/24/2022 07:00 which was the hour with the largest amount of forced outages and derates

Slide uses GADS data pulled 03/01/2023



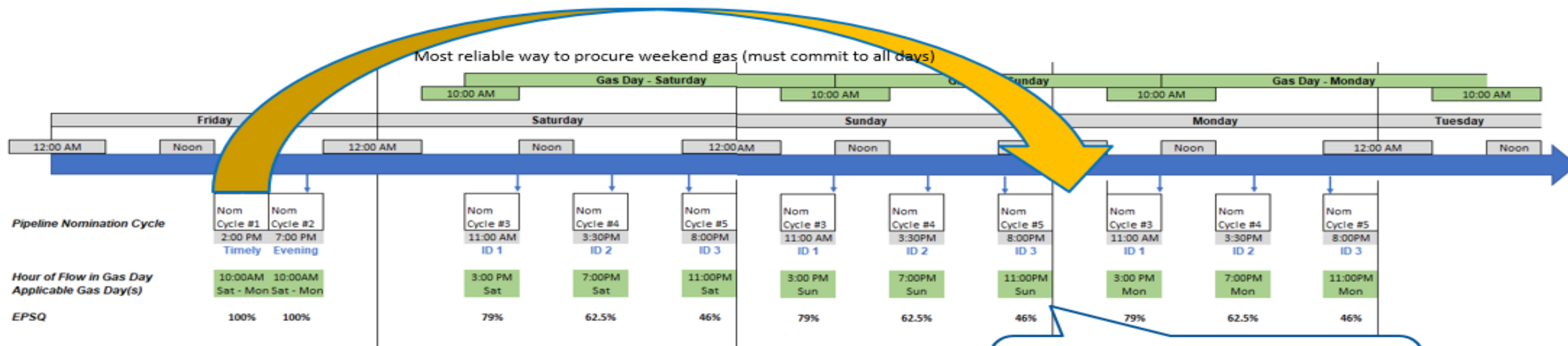
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Weekend gas is traded/scheduled in fixed volumes across all days of a weekend (no shaping)

Large gaps between nomination cycles and potential generation need

Friday - Before A Weekend

- Natural gas is traded and scheduled for 3 days: Saturday, Sunday, and Monday.
- Saturday, Sunday and Monday incremental supplies, sales opportunities and flexibility are limited by intra-day market availability and nomination cycle EPSQ %, and ID 3 “No Bump Rule.”



Buying gas outside of standard weekend procurement protocols in an attempt to shape weekend gas volumes is an **unreliable** fueling strategy

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Poor risk/reward discourages gas procurement when most needed

PJM hypothetical 12.6 heat rate CT peaking facility (~650MW)

Gas purchase volumes left to market participants with least information regarding overall system needs

	Gas cost	Power revenue	Profit/(loss)
Friday, December 23, 2022	\$ (11,963,004)	\$ 2,370,843	\$ (9,592,162)
Saturday, December 24, 2022	\$ (10,151,587)	\$ 4,983,791	\$ (5,167,796)
Sunday, December 25, 2022	\$ (10,151,587)	\$ 5,877,040	\$ (4,274,547)
Monday, December 26, 2022	\$ (10,151,587)	\$ 4,216,921	\$ (5,934,666)
Tuesday, December 27, 2022	\$ (10,151,587)	\$ 3,404,999	\$ (6,746,588)
Wednesday, December 28, 2022	\$ (4,229,828)	\$ 785,304	\$ (3,444,524)
	\$ (56,799,179)	\$ 21,638,897	\$ (35,160,282)

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Initial PAI penalty estimate

PJM hypothetical 12.6 heat rate CT peaking facility (~650MW)

Even with PAI penalties, CT's with heat rates above 12.6 were financially better off NOT procuring fuel

Heat rate	12.6				
Capacity	650				
	PAI Charge Rate				
	\$ 250.69	\$/MW day			
	\$ 3,008.33	\$/MWh			
	PAI \$	PAI start	PAI end	PAI hours	Balancing ratio
Friday, December 23, 2022	\$ (9,193,185)	17:30	23:00	5.50	0.8548
Saturday, December 24, 2022	\$ (27,719,336)	4:25	22:00	17.58	0.8062
Sunday, December 25, 2022					
Monday, December 26, 2022					
Tuesday, December 27, 2022					
Wednesday, December 28, 2022					
	\$ (36,912,521)				

Sources: PAI charge rates by LDA PJM website

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Elliott Winter Event Curiosities

Analyses should address

- How did natural gas supply disruptions disproportionately affect power producers?
 - Natural gas exports and LNG Feed gas activities continued during the event.
 - Industrials & ResComm gas consumption increased during the event.
- PJM penalty structure may have provided incentive for natural gas generators to ‘over burn’ scheduled volumes causing pressure issues on some interstate pipelines.
- PJM exported thousands of MW during the winter storm event.
 - How are MW exports considered in PJM capacity planning?
 - How do PJM exports or export forecast errors impact penalty calculations?
- It appears the gas generation sector is highly dependent on flowing gas supply with limited mechanisms to address production disruptions.
 - What pipeline services have been secured to address the volumetric variability of the generation sector?
- Significant forecast (load, interface & intermittent gen) inaccuracy risk.
 - What contingency planning addresses this risk given the high reliance on natural gas and the lack of pipeline flexibility?

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Elliott Winter Event Curiosities

Analyses should address

continued

- What importance does PJM place on its extreme (cold/hot) weather alerts?
 - Do these alerts carry the same weight as PAI alerts?
 - Is PJM's cold/hot weather alert a signal to purchase fuel in advance of the gas market settlement for that day?
 - Is purchasing fuel without sufficient, timely LMP signals, consistent with FERC market guidelines?

- Should gas generators be expected to behave outside of their best interests, if so to what extent?
 - Poor risk/reward discourages fuel procurement for power generation.

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Continued Misalignment

Problem Statement

Primary Problem (Market Design)

- Market design discourages fuel procurement.
- Corporate limitations at extreme prices that prevent fuel purchases.
- Market design limitations incentivize burning of back-up fuel for resources with dual-fuel capability.

Secondary Problem (Coordination and Operations)

- Greater limits on pipeline flexibility consequently limits flexibility provided by natural gas-fired generation.
- High demand, combined with decreased flexibility and onset of intermittent resources requires greater coordination for reliable operation of the electric system.
- Greater natural gas pipeline restrictions will hinder gas-fired generators' ability to operate and provide reserves during critical events.
- Lack of accounting of fuel limitations in economic dispatch signal.
- Persistent misalignment between gas and electric markets puts electric system at risk of failure as more intermittent resources added to the system.

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- Assumes existing PJM Tariff, economic and reliability modeling.
- Acknowledges generators' derate and forced outage options if day ahead or real-time PJM price signals do not adequately consider fuel costs and/or restrictions.
- *Suggests PJM improve situational awareness (through evaluations, tracking, analysis) of fuel supply and generator fuel costs in dispatch and reliability models.*

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“Specifics”

1. Quantify Fuel Sourcing for DA Awards

- Generators upload gas nominations and approved burn profiles.
- PJM to
 - document pipeline Tariff constraints and OFOs.
 - evaluate ratio of pipe nominations by cycle (reliance on ID2, ID3?)
 - evaluate aggregated DA fueling plan and review w/pipeline.
 - evaluate (make public) impact of RT dispatch on fuel plan.

2. Quantify, & Make Explicit, Reserve Fuel Sourcing Assumptions

- Quantify onsite & pipe source back-up fueling capabilities (vols, replenish sch).
- Evaluate (make public) overall reliability of reserve fueling plan & review w/ pipeline.

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“Specifics”

3. Energy market Signals vs. Fuel Costs for Fueling Planning Consistency
 - Does market signal (DA or RT following nomination cycles and flow rules) provide sufficient incentive to procure fuel consistent with existing pipeline Tariff requirements.
 - Evaluate market signal on backup fuel consumption.
 - Evaluate generator credit/cash flow implications during extreme events.

4. Performance After Periods of Stress
 - ACE performance (# & length of excursions).
 - Quantify amount & type of backup fuel consumed.
 - Make evaluations public.

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“Specifics”

5. Account for Gas Fueling Constraints in Gen Dispatch & Reserve Calculation

- If DA fueling plan is deemed unreliable, implement solutions:
 - ✓ If too much reliance on ID2/ID3 nomination cycles, consider awarding additional MW covered by pipeline timely nomination cycle (e.g., DA).
- Add fueling constraints to PJM’s reliability (re-offer) run.

6. Account for Fueling Constraints in RT Dispatch Price Signal

- Additional economic considerations applied if current LMP would cause in-place fuel plans to become unreliable.
 - Ex: If LMPs send unit to eco min/max in violation of pipeline imbalance parameters, unit must remain at planned levels.
 - Ex: If system emergency req unit to raise fuel consumption or come online, implement fuel reserve contingency.

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“Other Design Elements”

- ❑ Allow Market Sellers to make multi-day contingent offer for weekends and holidays during emergency conditions or PAIs.

- ❑ Generators will be allowed to recover the losses (if any) incurred for gas purchases for PJM dispatch directives but were then not called on in the real-time.
 - Resources that resources receive a DA award would be ineligible
 - Generators would have to demonstrate gas net losses to PJM and the IMM.