Winter Storm Fern

MIC

April 8, 2026

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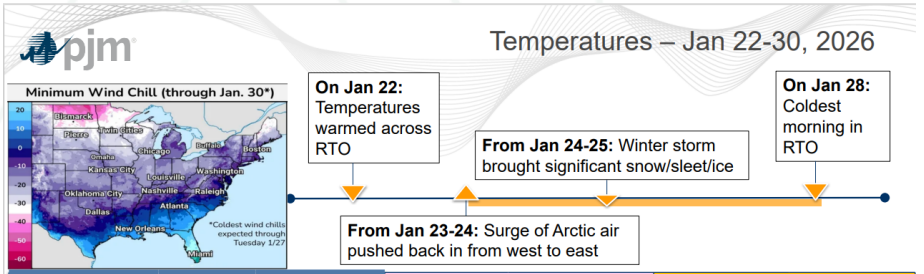
Monitoring Analytics

Winter Storm Fern

- **Winter Storm Fern occurred in the PJM footprint between January 23 and January 26.**
- **The region experienced temperatures at or below 10°F between January 22 and 30, 2026.**
- **For purposes of analyzing the results, the IMM focused on the period between Jan 24 through Feb 2.**



	Winter Storm Elliott Dec. 23-26, 2022		January 18-23, 2025 Cold Wave		January 22-30, 2026 Cold Wave #2	
Cities	Coldest Air Temperature	Coldest Effective Temperature	Coldest Air Temperature	Coldest Effective Temperature	Coldest Air Temperature	Coldest Effective Temperature
Chicago	-8°F	-26°F	-8°F	-19°F	-11°F	-26°F
Columbus	-7°F	-24°F	-3°F	-8°F	-8°F	-9°F
Louisville	-5°F	-22°F	4°F	-1°F	6°F	1°F
Philadelphia	7°F	8°F	10°F	2°F	11°F	2°F
Richmond	8°F	-3°F	13°F	10°F	9°F	7°F
RTO Ld.-Wtd. Avg	4°F	-7°F	5°F	0°F	6°F	0°F

Winter Storm Fern

- Similar to previous winter events (Winter Storm Gerri in 2024 and PV 2025), PJM implemented advanced scheduling to address supply uncertainty.
- Supply uncertainty due to:
  - Temperatures below some units' cold weather start/operating limits.
  - Gas commodity uncertainty.
- PJM also managed oil fired generation and dual fuel generation to conserve oil for the forecasted peaks.

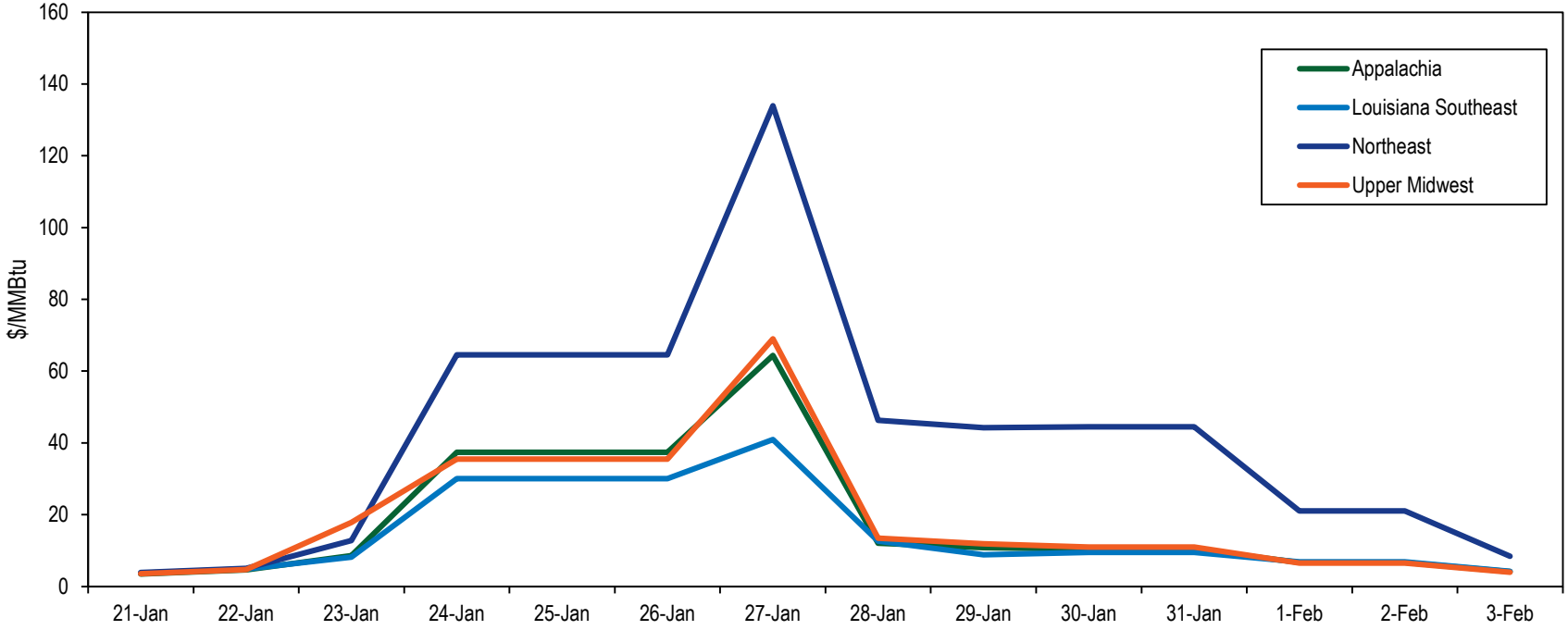
Winter Storm Fern

- **Load was forecasted to exceed the all time winter peak (147 GW) and to exceed 140 GWh for several days.**
  - **Actual load reached two of the top ten all time winter peaks but remained under 140 GWh.**
  - **PJM stated that possible reasons for the over forecast were:**
    - Forecasted temperatures much colder than actual.
    - Building closures due to the storm.
- **The 10 day period had an average load of 125,573 MWh.**
  - **This was 5.6% higher than any other 10 day period in PJM's history (118,961 MWh, Jun 22, 2025 - Jul 1, 2025).**
  - **This was 6.1% higher than any other 10 day winter period (118,370 MWh, Dec 30, 2017 – Jan 8, 2018).**

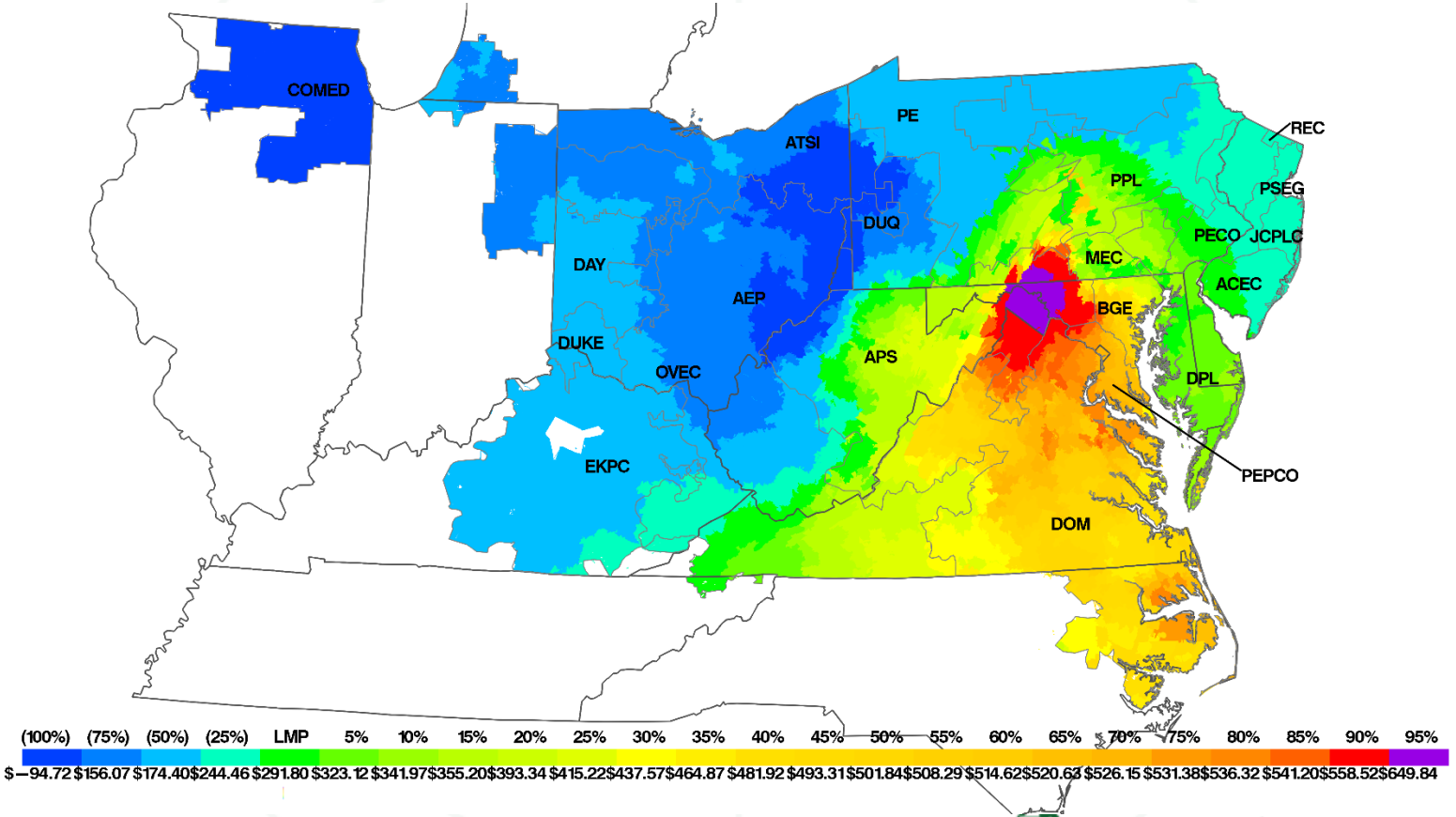
Winter Storm Fern

- RTO DA LMP averaged $362/MWh.
- RTO RT LMP averaged $290/MWh.
- Gas prices
  - Exceeded oil prices for most of the event.
  - Exceeded $100/MMBtu on Jan 27 in northeast hubs.
- Uplift costs were $805 million for the 10 day period.

Gas Prices


160
140
120
100
80
60
40
20
0
$/MMBtu
21-Jan
22-Jan
23-Jan
24-Jan
25-Jan
26-Jan
27-Jan
28-Jan
29-Jan
30-Jan
31-Jan
1-Feb
2-Feb
3-Feb
Appalachia
Louisiana Southeast
Northeast
Upper Midwest

Real-time load-weighted average LMP



Monitoring Analytics

Generation by fuel source (Avg MWh per hour)

	2026 Jan 24 - Feb 2		2025 Whole Year		Change in Output	
	AVG MWh	Share	AVG MWh	Share	AVG MWh	Percent
Coal	28,914	22.2%	16,647	14.5%	12,267	73.7%
Bituminous	24,054	18.5%	14,077	12.7%	9,978	70.9%
Sub Bituminous	3,967	3.0%	1,801	1.1%	2,166	120.3%
Other Coal	892	0.7%	770	0.7%	123	15.9%
Nuclear	33,628	25.8%	30,895	32.2%	2,732	8.8%
Gas	56,084	43.1%	42,149	44.5%	13,935	33.1%
Natural Gas CC	43,684	33.6%	37,664	40.3%	6,019	16.0%
Natural Gas CT	8,448	6.5%	2,626	2.5%	5,822	221.7%
Natural Gas Other Units	3,808	2.9%	1,736	1.6%	2,072	119.4%
Other Gas	144	0.1%	123	0.1%	22	17.6%
Hydroelectric	1,349	1.0%	1,765	1.9%	(416)	(23.6%)
Pumped Storage	638	0.5%	769	0.8%	(132)	(17.1%)
Run of River	487	0.4%	786	0.9%	(299)	(38.0%)
Other Hydro	224	0.2%	210	0.2%	15	6.9%
Wind	3,857	3.0%	3,680	3.7%	178	4.8%
Waste	400	0.3%	445	0.5%	(44)	(10.0%)
Oil	3,516	2.7%	604	0.5%	2,913	482.4%
Heavy Oil	312	0.2%	24	0.0%	288	1,215.8%
Light Oil	2,574	2.0%	371	0.3%	2,204	594.1%
Diesel	414	0.3%	13	0.0%	401	3,012.0%
Other Oil	216	0.2%	196	0.2%	21	10.5%
Solar	2,153	1.7%	2,855	2.1%	(701)	(24.6%)
Battery	14	0.0%	9	0.0%	5	50.8%
Biofuel	173	0.1%	140	0.1%	33	23.3%
Total	130,090	100.0%	99,189	100.0%	30,901	31.2%

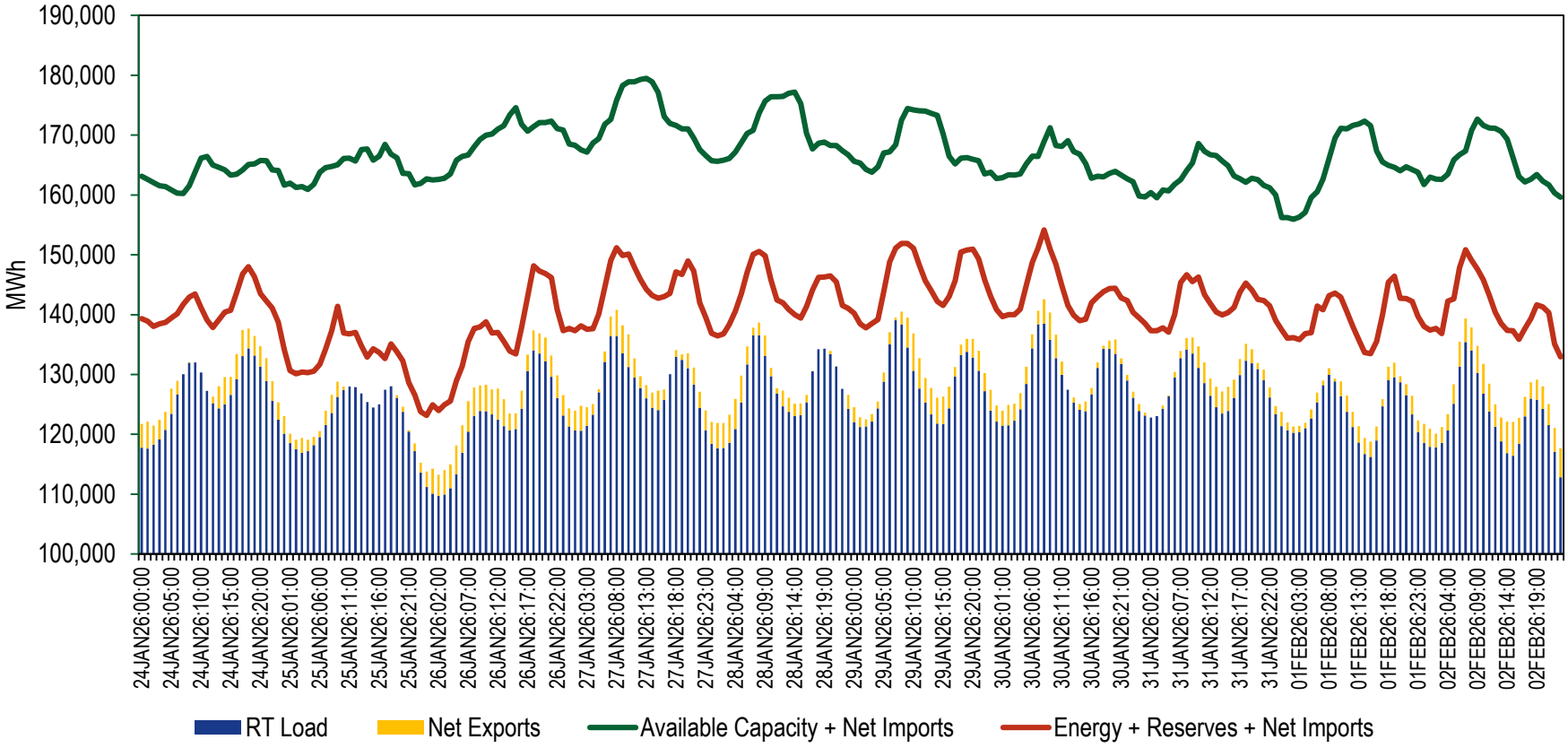
Total energy uplift credits by category

- **Total uplift for the relevant period reached $805 million.**

Uplift Category	Credits	Share
Day-Ahead	$123.4	15%
Balancing	$580.8	72%
LOC	$100.6	13%
Reactive	$0.0	0%
DD LOC	$0.1	0%
Total	$805.0	100%

- **51 units in ComEd (6,568 MW ICAP) received $247 million (31 percent of all uplift).**
- **Top 10 units (excluding ComEd units) with a combined ICAP of 5,188 MW received $272 million (34 percent of all uplift).**

Supply and Demand



Operating Parameter Exceptions

Minimum Run Time

Category	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb
Pipeline Restrictions	13,909	13,909	13,909	13,909	13,909	13,751	13,157	12,380	15,511	11,990

Turn Down Ratio

Category	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb
Mechanical	13,153	15,496	16,295	16,907	16,696	16,461	17,211	18,532	18,288	14,946
Other	3,103	3,103	4,610	4,610	4,610	4,610	4,610	3,677	3,677	3,677
Pipeline Restrictions	6,491	7,451	9,413	8,453	8,453	9,000	7,630	9,732	11,493	10,279

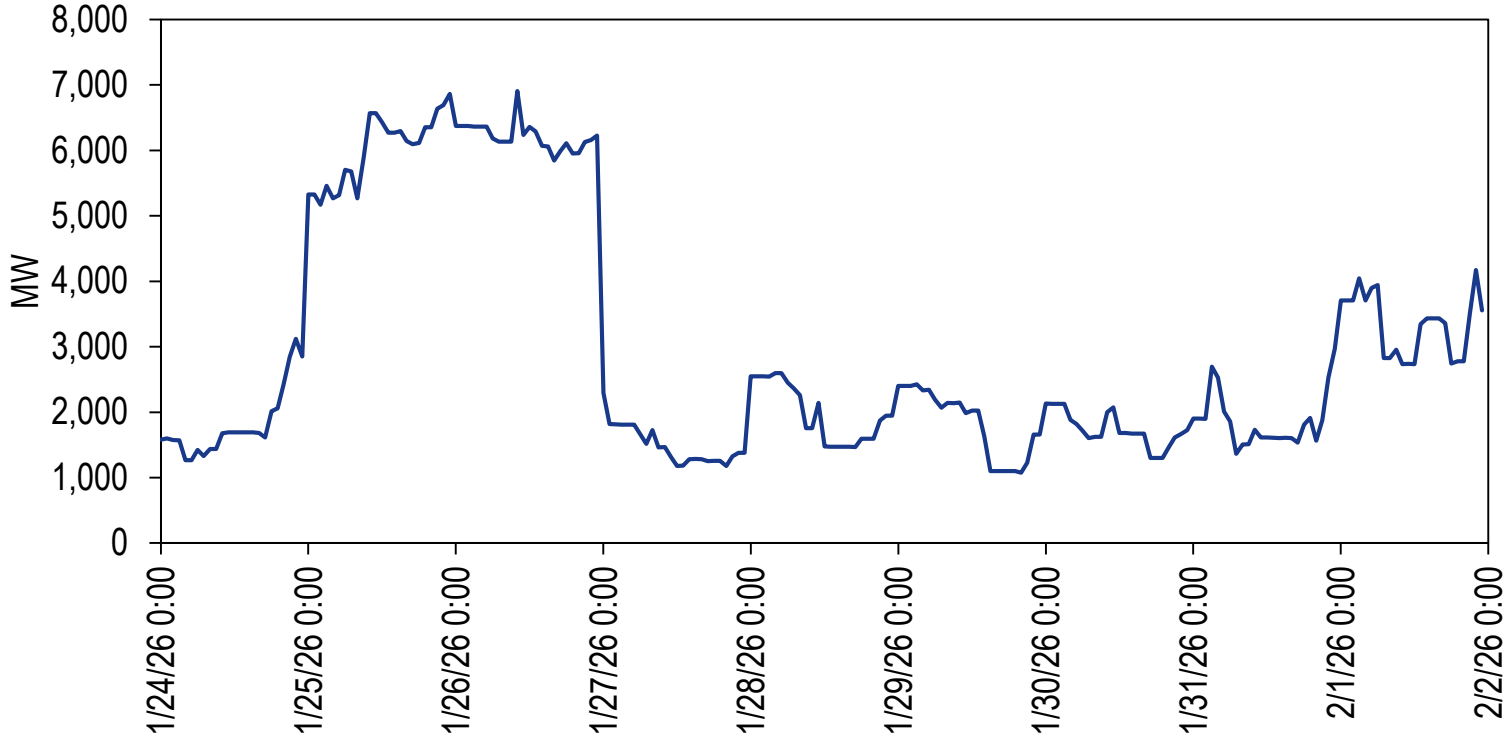
Notification Time

Category	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb
Pipeline Restrictions	13,812	13,812	13,812	13,812	13,812	13,799	13,381	13,270	16,357	13,270

Maximum Run Time

Category	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb
Low Inventory	2,139	2,152	2,096	2,096	2,417	2,417	2,204	2,700	3,432	3,586
Other	2,038	2,038	2,455	2,455	2,455	2,455	2,200	2,200	2,200	2,200

Maximum Emergency MW

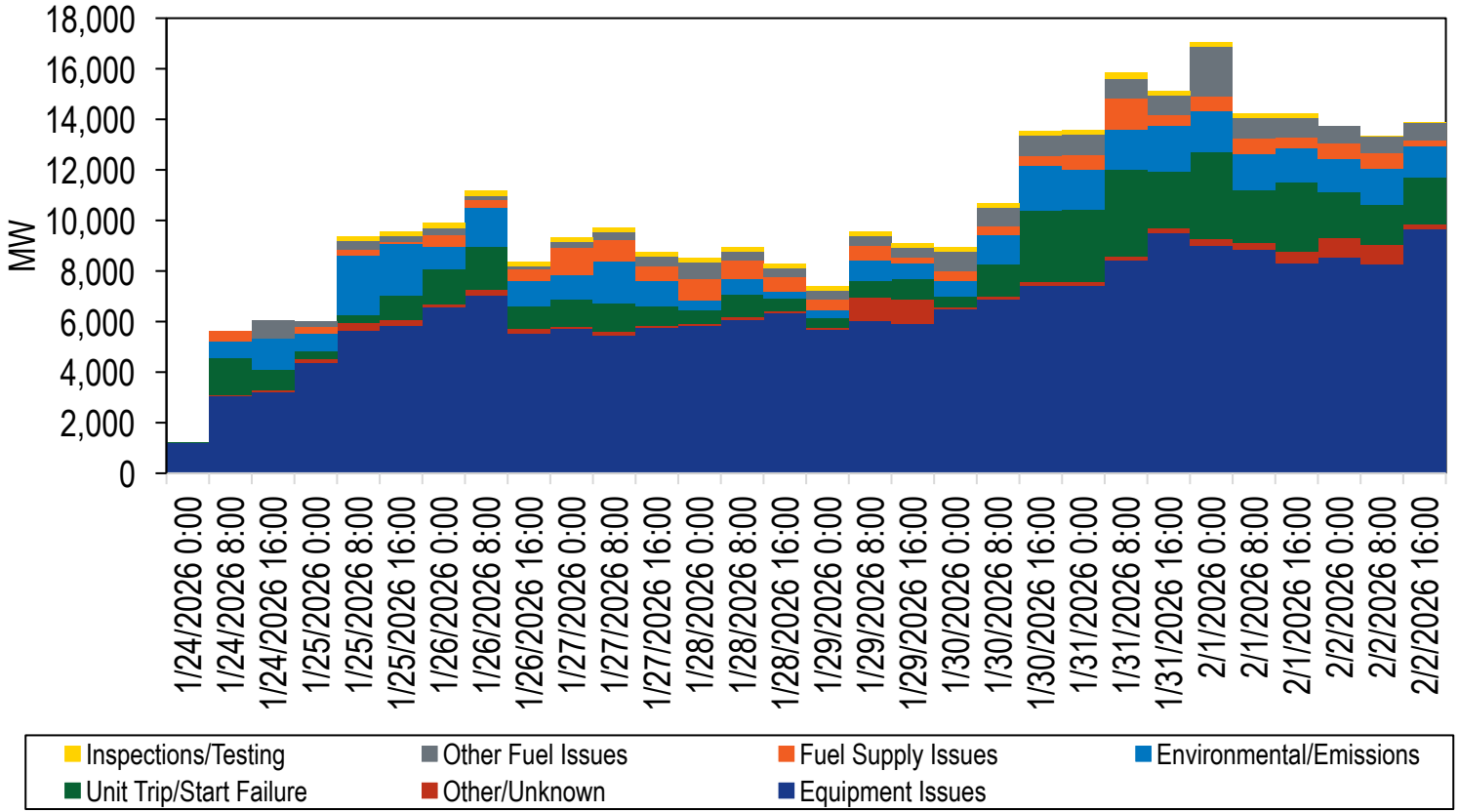


Cold Weather Operating Limits
2025 Survey Results

Temperature Range	Operating Temperature Limit ICAP (MW)	Starting Temperature Limit ICAP (MW)
20°F to 40°F	Confidential	
10°F to 20°F	3,948	9,052
0°F to 10°F	27,516	30,441
-10°F to 0°F	41,041	43,693
-20°F to -10°F	54,431	49,071
Below -20°F	35,416	28,720

- **About 4,000 MW cannot operate reliably between 10ºF and 20ºF.**
- **About 9,000 MW cannot start reliably between 10ºF and 20ºF.**
- **A small number of units cannot operate or start reliably between 20ºF and 40ºF.**

Outage Causes Submitted During Fern



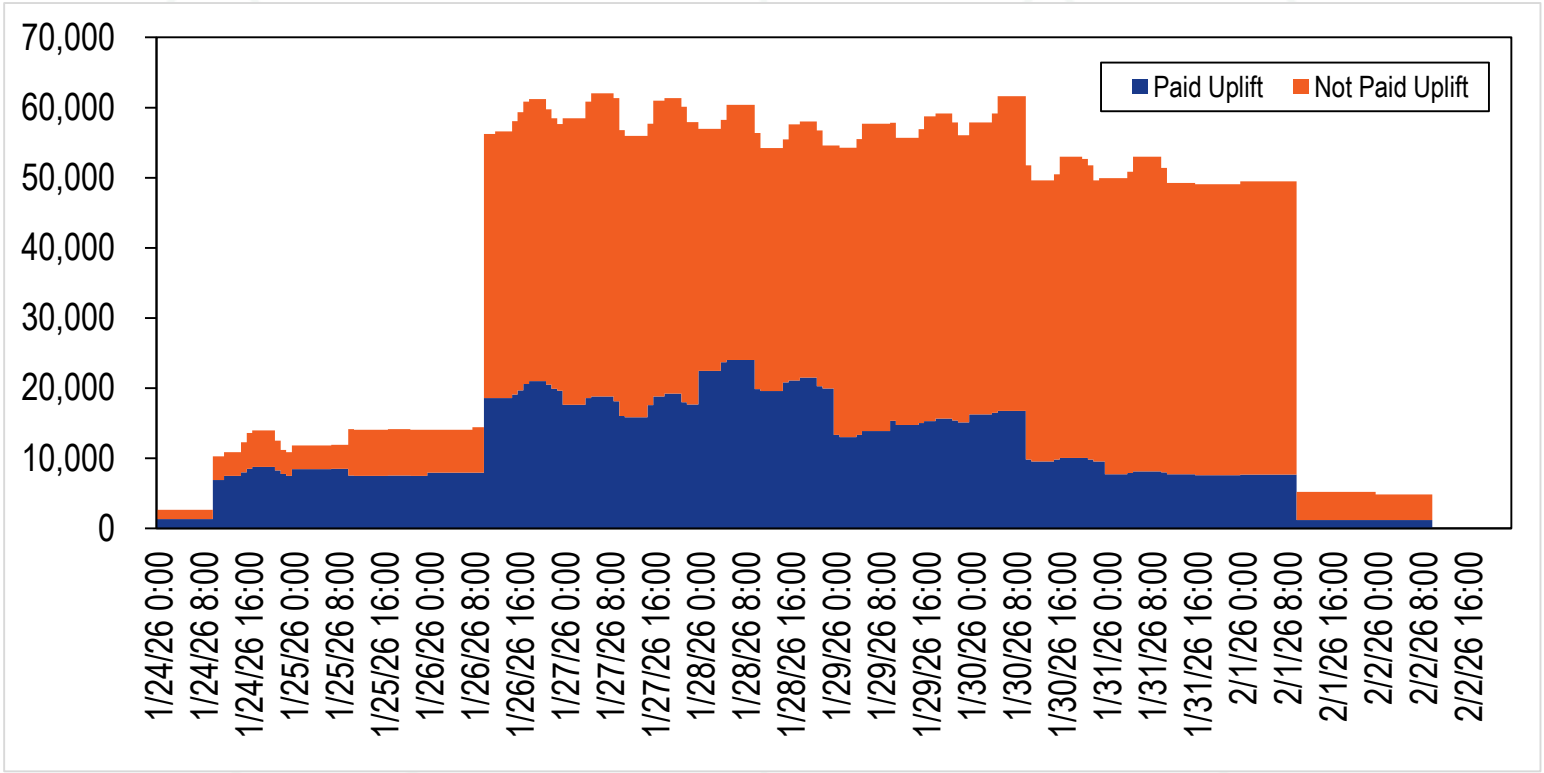
Conservative Operations

- **On April 9, 2025, the IMM presented its findings regarding the actions taken by PJM in January 2025 (Polar Vortex 2025).**
  - **https://www.monitoringanalytics.com/reports/Presentations/2025/IMM_RCSTF_2025_Polar_Vortex_20250409.pdf**
- **The IMM findings apply to the actions taken by PJM during Winter Storm Fern.**

Conservative Operations

- The IMM concluded that the root of the problem lies in the lack of clear requirements for capacity resources.
- Today, a Capacity Performance resource can be:
  - A resource that only has interruptible gas.
  - A resource that only provides energy when the sun is shining.
  - A resource, not base load, that takes 48 hours to start.
  - A resource with a 96 hour minimum run time.
  - A resource that cannot start when temperatures are below 10ºF.
  - A resource that has only 24 hours of fuel inventory.

Advanced Scheduled Units (Eco Max)



Conservative Operations

- **The IMM proposed two steps:**
  - **Accept the reality that PJM will have to make advanced, out of market, commitment decisions during critical days to reduce generation performance risks.**

    or
  - **Require capacity resources to be able to start within the DA market timeframe based on their approved operating parameter limits or to be online when alerts are in place.**

Accept Reality

- **The IMM and PJM are working on defining, improving and documenting PJM's process to schedule units in advance of the day-ahead market.**
  - **MIC Problem Statement Phase 2:**
  - **https://www.pjm.com/committees-and-groups/issue-tracking/issue-tracking-details.aspx?Issue=93900eb5-1665-49be-b717-1049fc94b652**

Define Capacity Resources

- **Create minimum operational requirements for capacity resources to ensure that these resources can be committed by the DA Market.**
- **Units that cannot start based on the DA Market timeframe will be required to be online based on alerts invoked by PJM.**
- **Failure to address this will continue to result in out of market actions that PJM must take in order to maintain the system reliable.**

Pricing Conservative Actions

- **There is a desire or goal from PJM and some stakeholders to reflect operator actions taken during conservative operations in energy and reserve market prices.**
  - **The details of how exactly they intend to accomplish that are nonexistent.**
  - **The overall impacts on pricing are misunderstood.**

Pricing Conservative Actions

- Energy prices are set at the marginal cost of production. Energy prices can be increased if additional constraints that affect power balance are modeled.
- Reserve constraints can affect power balance.
- If additional reserve constraints are modeled, the same MW can supply energy or reserves.
- When a resource is backed down to provide reserves, LMPs increase and MCPs increase.
  - LMPs reflect the cost of production of the marginal energy resource.
  - MCPs reflect the opportunity cost of the marginal reserve resource.

Potential Impact of Forcing Operator Actions into Pricing

- **If we assume that MCPs and LMPs have a 1:1 relationship, meaning that an MCP increase of $1/MW results in an increase in LMP of $1/MWh.**
  - **Make whole payments would decrease.**
  - **Energy costs would increase.**
  - **Reserve costs would increase.**
  - **LOC payments would increase.**

Potential Impact of Forcing Operator Actions into Pricing

- **Assuming a 30 minute reserve MCP of $200/MW and assuming an increase in LMP of $200/MWh:**
  - **Make whole payments decrease by $298 million.**
  - **Energy costs increase by $5.9 billion.**
  - **Reserve costs increase by $479 million.**

Potential Impact of Forcing Operator Actions into Pricing

30 Minute Reserve MCP	Make Whole Payments (millions)	Make Whole Payment Reduction (millions)	Average 30 Minute Reserves (MW)	30 Minute Reserve Costs Increase (millions)	Net Impact (millions)
$200	$366	$338	9,981	$479	$141
$400	$178	$527	9,981	$958	$432
$600	$88	$617	9,981	$1,437	$821
$850	$42	$662	9,981	$2,036	$1,374

30 Minute Reserve MCP	Average Real-Time Load (MWh)	Energy Costs Increase (billions)
$200	122,446	$5.9
$400	122,446	$11.8
$600	122,446	$17.6
$850	122,446	$25.0

Potential Impact of Forcing Operator Actions into Pricing

- These calculations were made by increasing the LMPs and 30 minute reserve MCPs
- Make whole payments are reduced by the increase in energy and reserve revenues to generators.
- Energy costs are increased by the increase in LMPs times the real-time load.
- Reserve costs are increased by the increase in MCPs times the amount of 30 minute reserves that PJM carried during the event.

Potential Impact of Forcing Operator Actions into Pricing

- A more robust analysis requires
  - Simulating the day-ahead energy market with a 30 minute reserve requirement that reflects actual 30 minute reserves cleared.
  - Simulating the day-ahead energy market with a 30 minute reserve requirement that results in the commitment of all units committed in advanced of the day-ahead energy market.
- PJM is equipped to perform such analysis.
- Such analysis will clearly show the benefits and costs of attempting to reflect conservative actions in pricing.

Turn Down Ratio Violation

- Some units operated in violation of their approved turn down ratio (TDR).
  - TDR=EcoMax/EcoMin
- Units can operate in violation of their approved turn down ratio when they:
  - Use the fixed gen flag.
  - Increase their eco min in violation of their turn down ratio.
- Some units were identified because they missed requesting a TDR exception based on pipeline ratable takes.
- Some units did not have a valid reason.

Maximum Emergency and Max Run Exceptions

- **Maximum emergency offers (max E) cannot be based on economic decisions. They must be driven by physical events that result in temporary interruptions beyond the control of the resource owner.**
- **Exceptions to the maximum run time operating parameter limit have to be based on actual or contractual constraints that cannot be rectified by commercial alternatives.**

Maximum Emergency and Max Run Exceptions

- Some units were placed in Maximum Emergency or decreased their max run times in order to:
  - Conserve fuel
  - Fell below 16h/32h threshold imposed by PJM.
- Maximum Emergency is valid if these restrictions were the result of supply interruptions outside of the control of the resource owner.
- The following are not valid reasons:
  - Failure to stock inventories in preparation for the event.
  - Exhausting inventory levels due to higher than normal operation.
  - Fuel conservation.

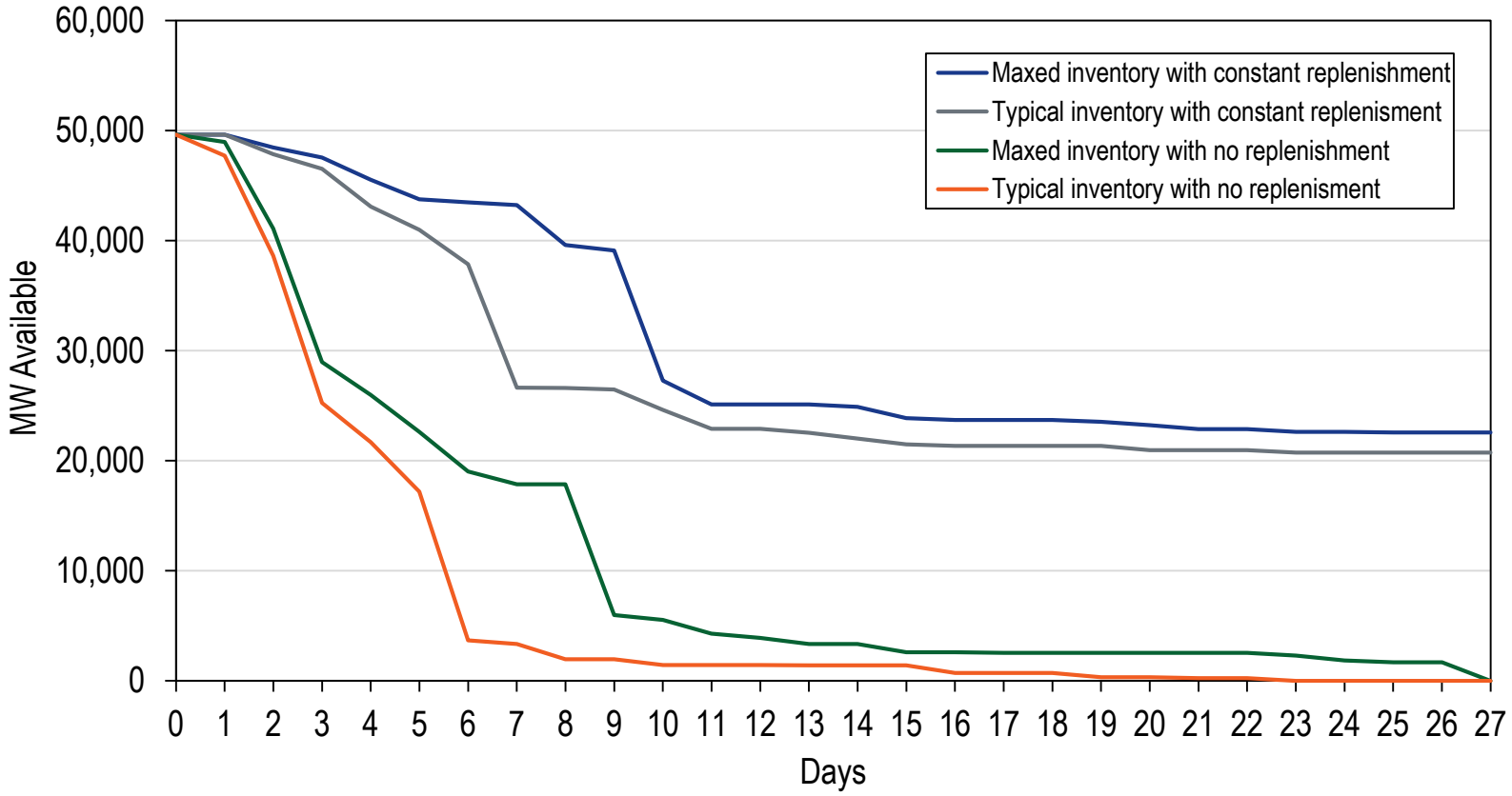
Maximum Emergency and Max Run Exceptions

- The IMM understands the reasons these actions were taken.
  - Conserve oil for forecasted peaks.
- Regardless, these actions are not consistent with the maximum emergency and operating parameter limited exception rules.
- These rules apply to all committed Capacity Resources.
- Specifically, these rules apply to resources that PJM labels as "Unlimited Resources."
- If these resources cannot meet their obligations as unlimited resources, they should not participate in the capacity market as such.

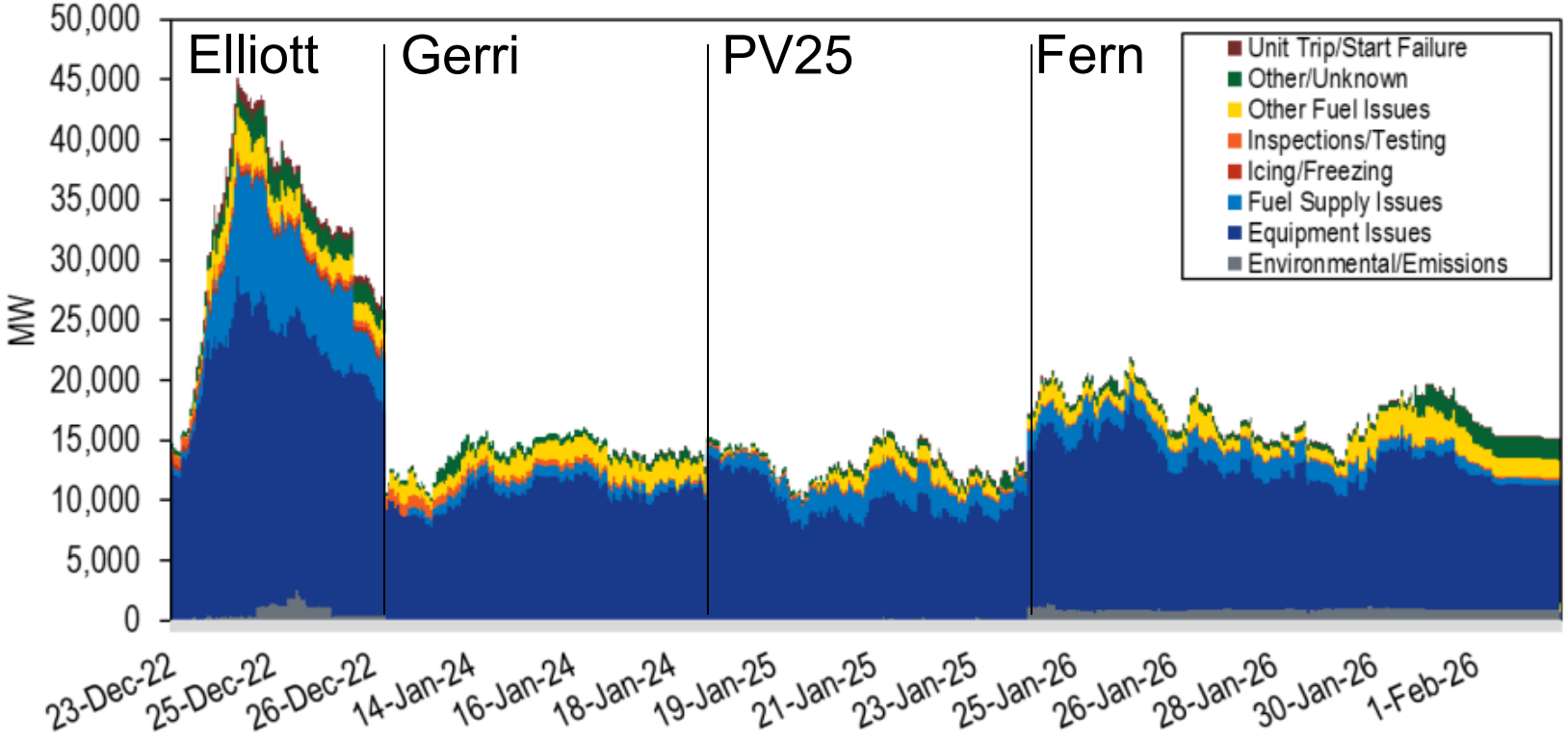
Oil Inventory

- PJM collects oil and nonconsumables inventory data from generator resources.
- PJM collects:
  - Maximum storage capacity
  - Typical inventory levels
  - Replenishment rates
- The variables can be use to calculate the amount of MW available under different assumptions.

Oil Inventory Scenarios



Winter Storms Outages



Outages

- **PJM conservative actions post Winter Storm Elliott have drastically decreased fuel related (e.g. natural gas) outages.**
  - **From about 9,500 MW in the peak of Winter Storm Elliott to about 1,600 MW in the peak of Winter Storm Fern.**
  - **A significant portion of the remaining outages are caused by units that cannot operate in the winter due to LDC restrictions.**
- **The next step should be addressing equipment issues. Equipment issues reached 28,000 MW in Winter Storm Elliott. Although significantly lower, they still reached 18,000 MW in the Winter Storm Fern.**

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