Written Testimony of Michael Goggin

Executive Vice President, Grid Strategies LLC

U.S. House of Representatives Committee on Energy and Commerce: Subcommittee on Energy

March 17, 2026

Chairman Latta, Ranking Member Castor, and Members of the Subcommittee,

Thank you for the opportunity to testify today. My testimony makes the following main points:

-Renewable resources performed well during Winter Storm Fern, while fossil generation did not.

-In all recent extreme winter weather events gas accounted for the majority of generator outages, followed by coal.

-Natural gas prices spiked during Winter Storm Fern and other recent extreme cold events, costing consumers billions of dollars.

-A diverse generation mix increases resilience. Each resource type has distinct outage risks, so a diverse mix reduces the economic and reliability risk to ratepayers.

-Expanding transmission increases resilience and saves Americans money by tapping into diversity among regions in the timing of peak demand and generator outages.

Based on the data, I respectfully offer the following policy recommendations:

-Let the market dictate market entry and market exit to build a more economic, reliable, and diverse generation portfolio.

> **-Do not use federal mandates to retain uneconomic generation.**
>
> **-Do not allow permitting obstacles to block market entry from wind, solar, and battery resources that account for over 90% of what the market is trying to build.**

-Remove barriers to building transmission, which is essential for the interconnection of all generation and load and providing consumers with low-cost and reliable power.

I. Wind and solar generation performed well during Winter Storm Fern

As shown in Table 1 below, during Winter Storm Fern in January 2026, wind and solar generation provided around 20-27% of the electricity during the peak demand hours in the Southwest Power Pool (SPP)[i] and Midcontinent Independent System Operator (MISO)[ii] grid operating areas in the Midwest. In the Electric Reliability Council of Texas (ERCOT) footprint, wind and solar provided over 15% of generation during the peak demand hour on January 26, and 24% on January 27.[iii]

Table 1: Wind and solar as a share of total generation during WS Fern peak demand

	Total generation on peak	Wind and solar generation on peak	Wind and solar share of total on peak
SPP Jan 24	47,500	9,400	20%
SPP Jan 25	47,000	12,700	27%
ERCOT Jan 26	75,300	11,400	15%
ERCOT Jan 27	75,200	18,200	24%
MISO Jan 26	102,700	23,400	23%
MISO Jan 27	104,500	23,700	23%

Figure 1 below shows how wind and solar contributed during the peak demand periods of Winter Storm Fern in SPP. Renewable output was particularly high during SPP's highest demand on January 24-26, as shown on the left side of Figure 1. Renewables reduced SPP's need for conventional generating capacity during Winter Storm Fern from nearly 47,500 MW (the highest point of the orange shaded area on the left side of the chart) to 38,000 MW (where the orange area meets the blue area below that point). This 9,437 MW reduction in the need for generating capacity during Winter Storm Fern is worth more than $12 billion at the current cost of generating capacity.[iv] MISO realized similar benefits, with wind and solar bringing peak need down from nearly 104,500 MW to 95,200 MW, capacity savings worth nearly $12 billion at the current cost of capacity.

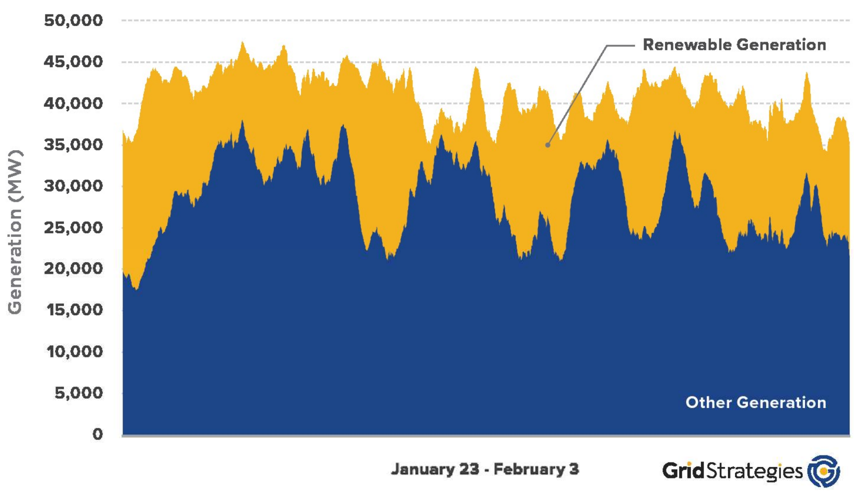

Figure 1: Renewable and other generation in SPP during Winter Storm Fern

Renewable resources contributed significantly in other regions as well. The 572 MW of the under-construction Vineyard Wind offshore project that are currently operational provided a 75% average capacity factor (actual output as a percent of maximum output) during Winter Storm Fern,[v] holding down power prices in New England as the price of natural gas spiked. The 132 MW South Fork offshore wind project near Long Island operated at a 52% capacity factor in January 2026, also reducing power prices during Winter Storm Fern. As discussed below, these levels of output are comparable to the performance of coal and gas generators during Winter Storm Fern. If more offshore wind capacity had been allowed to come online by now, the benefit would have been even greater.

II. Gas generators underperformed due to high outage rates

Table 2 shows that during the peak demand periods of Winter Storm Fern, wind and solar greatly exceeded the level of output that grid planners expect and power markets pay them to provide, while coal and gas generators fell short. In MISO, wind and solar exceeded the output level they are paid to provide in MISO's capacity market by 14,413 MW, picking up some of the slack as gas underperformed its accredited output level by 21,515 MW and coal by 3,000 MW. In SPP, wind and solar exceeded their accredited capacity by 5,675 MW, while gas underperformed by 16,466 MW and coal by 2,626 MW. Comparing resources' actual output against what grid planners expect and what power markets pay them to provide is the best metric of performance.

Table 2: Output during Winter Storm Fern peak demand compared to accredited capacity

SPP+MISO+PJM	**Actual MW**	**Accredited MW**	**MW Under (-) or Over (+) performance**	**Output as % of expected**
Gas	**114,136**	**166,122**	**-51,986**	**69%**
Coal	**77,556**	**84,494**	**-6,939**	**92%**
Wind+Solar	**38,396**	**21,107**	**17,289**	**182%**
SPP[vi]	Actual MW	Accredited MW	MW Under (-) or Over (+) performance	Output as % of expected
Gas	14,837	31,303	-16,466	47%
Coal	17,347	19,973	-2,626	87%
Wind+Solar	11,055	5,380	5,675	205%
MISO[vii]	Actual MW	Accredited MW	MW Under (-) or Over (+) performance	Output as % of expected
Gas	36,476	57,991	-21,515	63%
Coal	28,887	31,887	-3,000	91%
Wind+Solar	23,543	9,130	14,413	258%
PJM[viii]	Actual MW	Accredited MW	MW Under (-) or Over (+) performance	Output as % of expected
Gas	62,823	76,829	-14,006	82%
Coal	31,321	32,634	-1,313	96%
Wind+Solar	3,798	6,597	-2,799	58%

Generator outages and derates were the primary reason fossil generators underperformed. Table 3 shows each resource type's outage rate as a percent of its installed capacity[ix] during each region's period of peak demand during Winter Storm Fern. In PJM,[x] gas generators were 1.8 times more likely than wind generators to experience an outage, while coal was 2.7 times more likely. In SPP,[xi] gas and coal had a 28 and 13 times higher outage rate, respectively, than wind; in MISO,[xii] gas and coal had a 4 and 6 times higher outage rate, respectively, than wind.

Table 3: Generator outage rate during WS Fern peak demand in each region, by fuel type

Outage rate %	Gas	Coal	Wind
SPP	25%	11%	1%
MISO	7%	11%	2%
PJM	12%	18%	7%

This is consistent with fossil generators' underperformance during other recent winter peak demand events. FERC-NERC reports and regional analyses have documented that widespread outages and derates of gas generators were the primary cause of reliability problems during all recent extreme cold weather events including Winter Storm Elliott in December 2022,[xiii] Winter Storm Uri in February 2021,[xiv] the 2018 Bomb Cyclone,[xv] the 2018 South Central Cold Snap,[xvi] and the 2014 Polar Vortex.[xvii] In particular, gas accounted for 63% of unplanned outages and derates during Winter Storm Elliott, and 55% during Winter Storm Uri and the 2014 Polar Vortex, while coal accounted for a large share of the remainder.

Table 4 below presents SPP data showing repeated underperformance by fossil generators and overperformance of wind generation during winter storms.[xviii] SPP's market monitor documented that last winter, gas resources averaged the highest outage rate of any fuel type at 25%, compared to coal at 17% and 14% for wind, further noting that "Natural gas outages were fairly correlated with weather events, primarily winter storms as defined by the National Weather Service. Outage causes for these resources reflects their vulnerability with a greater proportion of forced outages caused by fuel supply disruptions, which are common during winter weather events."[xix] Correlated outages and derates of gas generators have also played a major role in reliability concerns during extreme heat, including the 2022[xx] and 2020[xxi] heat waves in California.

Table 4: SPP table showing performance by fuel type relative to its accredited capacity

Fuel type	Winter Storm Uri load shed hours	Winter Storm Elliott average	Winter Storm Gerri average
Gas	43%	82%	82%
Coal	77%	66%	69%
Wind	100%	350%	235%

PJM now accounts for the repeated widespread outages of fossil generators during peak demand periods in the capacity accreditation it uses to determine generators' capacity market revenue. As a result, gas combustion turbines receive only 67% of their nameplate capacity as accredited capacity, comparable to the 60% capacity accreditation for offshore wind resources, while gas combined cycle generators are accredited at 78% of their nameplate capacity.[xxii]

Correlated gas generator outages during these events have occurred due to power plant equipment failures, shortages of gas supply due to the freezing of wellheads, and pipeline failures or constraints. PJM notes that during Winter Storm Fern, nationally there was a 10 billion cubic foot (bcf) per day drop in natural gas production due to gas wells freezing.[xxiii] PJM also shows during both Winter Storms Uri and Elliott, gas production dropped by around 20% nationally, or 20 bcf/day.[xxiv] As a point of reference for the magnitude of this drop, the ongoing closure of the Strait of Hormuz has shut in about 20% of global oil supply, so this is a comparable disruption.

III. Increasing dependence on gas generation poses both an economic and reliability risk

While gas supply interruptions during Winter Storm Fern were not large enough to repeat the rolling blackouts that occurred during Uri and Elliott, ratepayers were not spared from an economic hit. PJM notes that "Spot gas prices through this event reached historic levels throughout the eastern U.S. with many hubs trading well over $100/mmbtu with prices in NY and New England approaching $300/mmbtu."[xxv] These prices are 30-90 times the average price of gas in 2025. As fuel costs flow through into electric bills, this will translate into billions of dollars in additional costs for homeowners and businesses, on top of billions of dollars in additional costs for the gas they used for building heating and other purposes. As gas prices spiked across the eastern U.S., many generators switched to oil to save money on fuel.

Natural gas prices have always been volatile during extreme winter weather, but they are increasingly affected by global events. The ongoing rapid expansion of Liquified Natural Gas exports is tethering the domestic gas price to global prices, exposing ratepayers to geopolitical risks like Russia's invasion of Ukraine and Iran's ongoing blockade of oil and gas shipping through the Strait of Hormuz. Expanding renewable energy provides a valuable hedge against all forms of natural gas price volatility and uncertainty, as the wind and sun will always be free.

IV. Coal generators also underperformed during Winter Storm Fern

Coal plants are also susceptible to extreme cold and extreme heat. Winter weather can freeze the coal piles at power plants, and frozen rivers can block barge deliveries of coal. Extreme heat or drought can also derate or even take coal plants offline because their cooling water is too hot, or rivers are too low for coal barges to get through.[xxvi] Coal deliveries via railroad have also been disrupted by rail traffic congestion in some regions.[xxvii] All power plants are subject to equipment failures, and these rates go up in extreme heat and extreme cold. Thermal power plants that rely on water to produce electricity are susceptible to frozen pipes. Different types of power plants have different risks, so a diverse generation mix reduces the risk of correlated outages. Wind and solar plants do not need deliveries of fuel or cooling water, and thus are immune to these reliability risks.

Coal units that have received Department of Energy (DOE) mandates to continue operating performed particularly poorly during Winter Storm Fern, as documented by DOE's own data shown in the table below.[xxviii] These availability rates are lower than wind's contributions in many regions during Winter Storm Fern, as documented above. This poor performance is to be expected for coal plants that were slated for retirement because their equipment has reached the end of its useful life. In many cases their owners have also deferred maintenance and capital expenditures in anticipation of their retirement, further exacerbating their performance.

Table 5: DOE performance data for MISO coal units that received DOE mandates

	Nameplate MW	DOE claim for minimum MW output during Fern	Output as % of nameplate
Campbell	1,561	650	42%
Schahfer	847	285	34%
Culley[xxix]	104	30	29%

The data also confirm these coal units were not needed to maintain reliability. The output from these three MISO coal units sum to 965 MW. Data released by MISO show that it had significantly more spare capacity than that throughout the event.[xxx] MISO only reached Energy Emergency Alert stage 2 during Winter Storm Fern, which is step 2 out of 5 on its emergency procedures. Steps 3 and 4 involve additional load management, emergency energy purchases, and deploying operating reserves, so MISO had many more tools in its belt before it would have resorted to shedding load in Step 5.

V. The economic and reliability benefits of expanding transmission

Increased electricity transmission capacity would have protected consumers from localized price spikes during Winter Storm Fern. The map below shows the value ratepayers could have received over the period January 23-February 3, 2026, by expanding transmission ties between each of the following regions by one gigawatt (GW), which is comparable to the capacity of one new transmission line. The savings are calculated from the differences in power prices among the MISO,[xxxi] ERCOT,[xxxii] PJM,[xxxiii] SPP,[xxxiv] and Western markets,[xxxv] then reduced for price elasticity on both ends.[xxxvi]

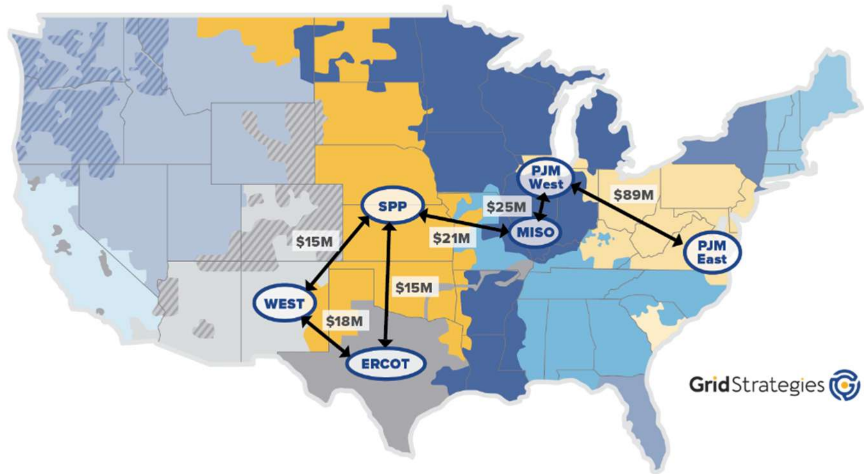

Figure 2: Value during Winter Storm Fern from expanding transmission ties by 1 GW

The left map below shows a snapshot of these locational power prices on January 23 as the cold was moving into the central U.S., while the right map shows power prices once the cold had reached the eastern U.S. on January 25.[xxxvii] Red dots indicate high prices, while blue dots indicate low prices. On January 23, additional transmission could have delivered low-cost electricity to MISO from SPP, ERCOT, and PJM, while on January 25 additional transmission could have delivered power to the East Coast from MISO and western PJM.

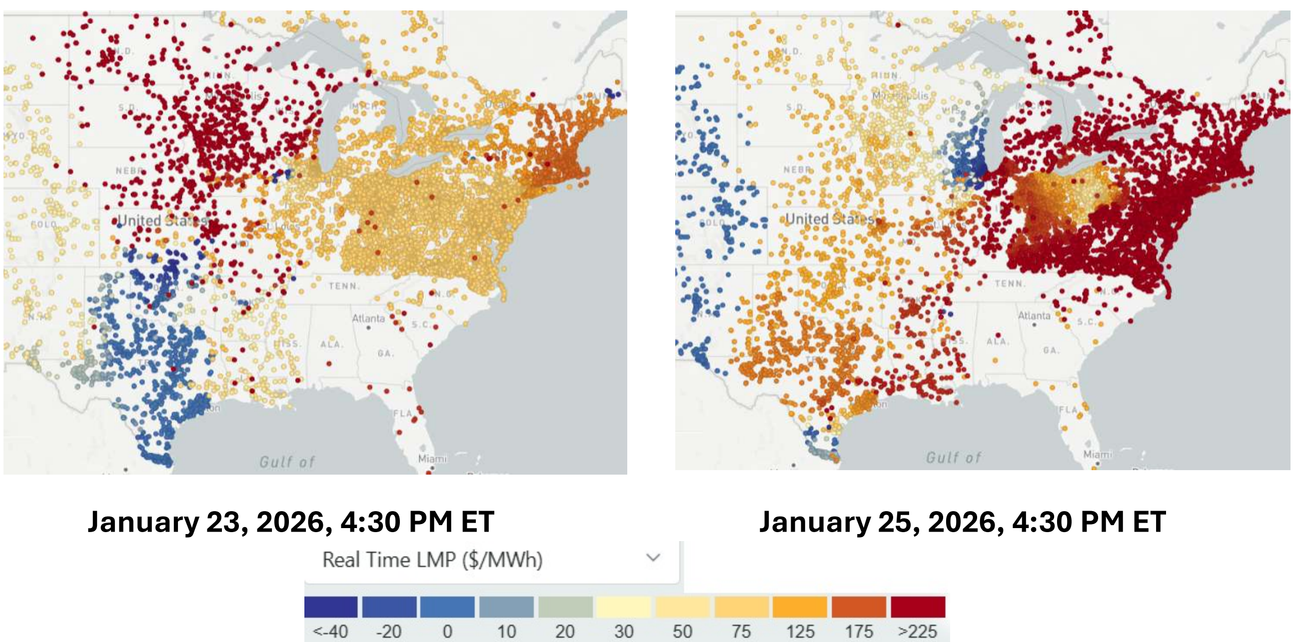

Figure 3: Differences in power prices during Winter Storm Fern

The chart below shows that throughout Winter Storm Fern, there were large differences in the price of electricity between western PJM (northern Illinois) and eastern PJM (Virginia). Once the cold moved eastward on January 24, power prices were persistently higher in eastern PJM, so additional transmission could have delivered low-cost power from western PJM. In past events the prevailing flows and pricing patterns were reversed, like when Winter Storm Uri hit the middle of the country but spared the coasts.[xxxviii] Other events like Winter Storm Elliott saw power flows change as the weather systems moved over time.[xxxix] In part because it is bidirectional, transmission expansion acts like an insurance policy against severe weather impacts, as a region that is spared in one weather event will likely be affected by another event in the future.

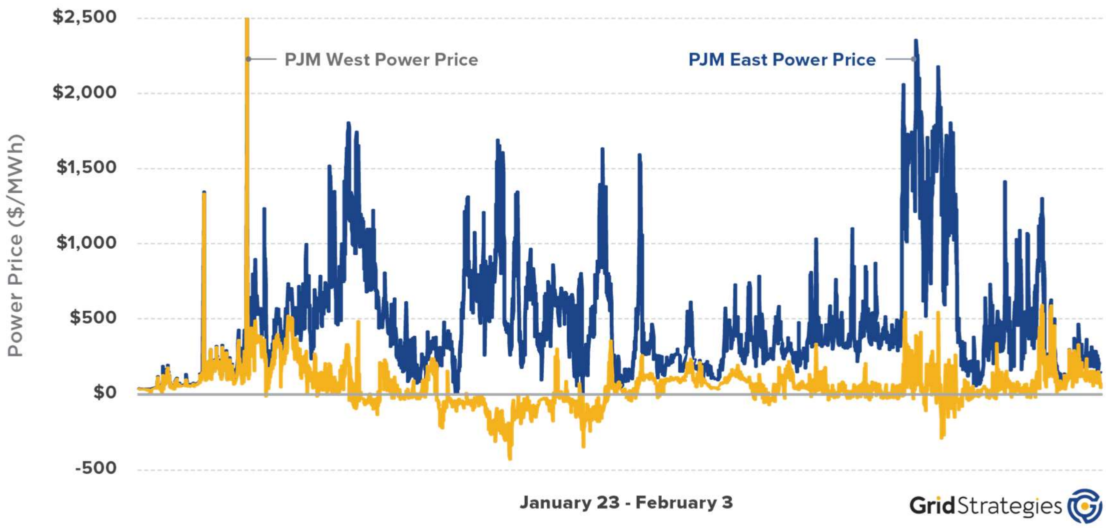

Figure 4: Power prices in eastern and western PJM during Winter Storm Fern

Wind and solar projects in some areas faced significant curtailment during Winter Storm Fern because there was not enough transmission capacity to deliver power to customers experiencing peak demand. For example, the curtailed wind and solar generation in SPP alone could have saved MISO consumers nearly $37 million if there were enough transmission to deliver it.[xl]

However, most of transmission's value is from providing consumers with more reliable and lower cost power, unrelated to renewable energy. If there is enough transmission to aggregate electricity supply and demand over a larger area, the total need for generating capacity is less than the sum of the parts from each individual utility. This is due to diversity in when regions experience peak demand or supply shortfalls. The table below shows how, for the extreme weather event shown in each row, different regions experienced their peak need at different times.[xli] Extreme weather events tend to be at their most severe in a limited geographic area, and they also move over time, so imports from neighboring regions that are less affected are a key tool for cost-effectively keeping the lights on during extreme weather. By making the grid bigger than the weather, transmission reduces the need for each region to overbuild generating capacity for these outlier events.

Each region's net load during severe weather events, as a percent of that region's maximum net load across all nine years

	ERCOT	SPP	MISO S	TVA	MISO N	PJM	NYISO	ISO-NE	Carolinas	SOCO	Florida
1/17/2014 7 AM ET	58%	60%	74%	86%	75%	100%	68%	64%	88%	87%	60%
1/17/2018 10 AM ET	60%	67%	100%	81%	61%	70%	61%	63%	56%	85%	61%
1/18/2018 6 AM ET	58%	50%	65%	76%	55%	66%	51%	55%	63%	100%	79%
2/15/2021 10 AM ET	100%	99%	83%	61%	69%	63%	56%	59%	58%	68%	55%
12/23/2022 6 PM ET	68%	87%	88%	99%	86%	85%	60%	56%	88%	91%	65%
12/24/2022 6 AM ET	63%	87%	87%	91%	77%	85%	49%	50%	100%	95%	66%

Figure 5: Differences in the timing of peak need among regions during 2014 Polar Vortex, 2018 Bomb Cyclone, Winter Storm Uri in 2021, and Winter Storm Elliott in 2022

My analysis in the table above found that over a nine-year period, building enough transmission to aggregate supply and demand across these subregions of the Eastern U.S. and Texas would reduce the need for generating capacity by 137 GW, which at the current cost of generating capacity would provide more than $175 billion in savings.[xlii] Said another way, the 137 GW in savings is roughly twice the capacity required to meet the expected increase in electricity demand from data centers, so expanding interregional transmission can provide more than enough spare capacity to maintain reliability while meeting load growth.

Diversity across these regions in the timing of peak load and conventional generator failures drove more than 87% of the capacity benefit of expanding interregional transmission ties in the analysis above, with diversity in renewable resource output accounting for only 13% of the benefit.[xliii] As gas generation grows to provide a larger share of our peaking capacity, interregional transmission ties to counteract regional generator outages or disruptions to the gas supply will become more valuable.

NERC's Interregional Transfer Capability Study similarly identified 35 GW of "prudent additions" to interregional transmission that are needed to maintain reliability.[xliv] Notably that study was published in 2024, so the identified transmission need predates nearly all of the recent upswing in load growth projections.

VI. What is the outlook for grid reliability, and what should be done about it?

Electricity demand is increasing, though there is considerable uncertainty about how quickly it will grow. NERC's 2025 Long Term Reliability Assessment likely overstates the risk of generation shortfalls, as Grid Strategies documented in a recent report.[xlv] The report likely underestimates the addition of new generating resources and may overstate growth in electricity demand because it is based on utility projections that in some cases are out of date. The report also does not account for imports from neighboring grid operators due to diversity among regions in the timing of peak demand and generator outages, which as discussed above have played a key role in keeping the lights on during extreme weather events.

The primary solution to reliably meeting load growth is to let markets work and to respect utility planning and regulatory processes. Electricity markets are inherently self-correcting as they send price signals to increase supply when demand is growing faster than supply. State utility commissions oversee planning processes that have successfully kept pace with growing demand for more than a century, including periods of load growth that were faster than today's.

Interfering with those market and state regulatory processes can only result in less efficient outcomes. The current Administration has been using permitting obstacles to block market entry for new low-cost resources that increase the diversity of the generation mix, and mandates to block market exit for uneconomic and underperforming coal generation. Renewable and storage account for 92% of the resources trying to interconnect to the grid.[xlvi] Building more gas generation that is dependent on the same gas supply fields exposes consumers to more risk of correlated outages and price volatility. Diversity builds a more economic, reliable, and resilient generation mix.

---

[i] SPP, *Generation Mix Historical*, https://portal.spp.org/pages/generation-mix-historical

[ii] MISO, *Generation Fuel Mix*, https://www misoenergy.org/markets-and-operations/real-time--market-data/market-reports/#nt=/MarketReportType:Summary/MarketReportName:Generation%20Fuel%20Mix%20(xlsx)

[iii] ERCOT, *Interval Generation by Fuel Report*, https://www.ercot.com/files/docs/2026/02/09/IntGenbyFuel2026 xlsx

[iv] Using a cost of capacity of $1,280/kW, per PJM, *CONE, Operating Parameters for Net EAS, and Net CONE Updates,* https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250822-special/cone-operating-parameters-for-net-eas-and-net-cone-updates.pdf, at 4

[v] M. Gallucci, *Offshore wind showed up big during the East Coast's brutal cold*, https://www.canarymedia.com/articles/offshore-wind/offshore-wind-showed-up-big-east-coast

[vi] Actual generation during peak (from endnote i) divided by accredited capacity from SPP, *2025 SPP Winter Season Resource Adequacy Report,* https://www.spp.org/documents/75520/2025%20spp%20winter%20resource%20adequacy%20report.pdf, at 7

[vii] Actual generation during peak (from endnote ii) divided by accredited winter capacity from MISO, *2025 PRA Results*, https://cdn misoenergy.org/2025%20PRA%20Results%20Posting%2020250529_Corrections694160.pdf, at 41

[viii] Actual generation during peak from PJM, *Generation by Fuel Type*, https://dataminer2.pjm.com/feed/gen_by_fuel, divided by January 2026 installed capacity from EIA, *Preliminary Monthly Electric Generator Inventory*, https://www.eia.gov/electricity/data/eia860m/, times PJM accreditation from PJM, *ELCC Class Ratings for the 2025/2026 Third Incremental Auction*, https://www.pjm.com/-/media/DotCom/planning/res-adeq/elcc/2025-26-3ia-elcc-class-ratings.pdf

[ix] EIA, *Preliminary Monthly Electric Generator Inventory: January 2026,* https://www.eia.gov/electricity/data/eia860m/

[x] PJM, *January Cold Weather Operations*, https://www.pjm.com/-/media/DotCom/committees-groups/committees/oc/2026/20260205/20260205-item-03---cold-weather-update.pdf, at 11

[xi] SPP, *Capacity of Generation on Outage*, https://portal.spp.org/pages/capacity-of-generation-on-outage

[xii] MISO, *Overview of Winter Storm Fern*, https://cdn misoenergy.org/20260217 RSC Item 05 Winter Storm Fern Report741721.pdf, at 7. MISO only provided a fuel type breakdown for the 17.2 GW of "same-day outages," so those outage rates are used.

[xiii] FERC and NERC, *December 2022 Winter Storm Elliott Grid Operations: Key Findings and Recommendations*, https://www ferc.gov/news-events/news/presentation-ferc-nerc-regional-entity-joint-inquiry-winter-storm-elliott

[xiv] FERC and NERC*, The February 2021 Cold Weather Outages in Texas and the South Central United States*, https://www ferc.gov/media/february-2021-cold-weather-outages-texas-and-south-central-united-states-ferc-nerc-and, at 17

[xv] EIA, *January's Cold Weather Affects Electricity Generation Mix in Northeast, Mid-Atlantic,* https://www.eia.gov/todayinenergy/detail.php?id=34632

[xvi] FERC and NERC, *2019 FERC and NERC Staff Report: The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018*, https://www nerc.com/pa/rrm/ea/Documents/South_Central_Cold_Weather_Event_FERC-NERC-Report_20190718.pdf, at 57-58, 96-97

[xvii] NERC, *Polar Vortex Review,* *https://www.nerc.com/pa/rrm/January%202014%20Polar%20Vortex%20Review/Polar_Vortex_Review_29_Sept_2014_Final.pdf,* at iii

[xviii] Garrett Crowson, *System Operations, January 2024 Winter Storm Gerri*, https://www.spp.org/Documents/71037/ORWG%20Meeting%20Materials%2020240208.zip (file 11 Winter storm Gerri MOPC ORWG.pptx, slides 21-23)

[xix] SPP Market Monitoring Unit, *Winter 2025 Resource Adequacy Season Review,* https://www.spp.org/documents/74810/winter%202024-2025%20resource%20adequacy%20season%20review.pdf, at 16

[xx] Regenerate California, *California's Underperforming Gas Plants*, https://caleja.org/wp-content/uploads/2023/06/2023-Regenerate-Heat-Wave-Report.pdf

[xxi] CAISO, *Root Cause Analysis: Mid-August 2020 Extreme Heat Wave*, http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf.

[xxii] PJM, *ELCC Class Ratings for the 2028/2029 Base Residual Auction*, https://www.pjm.com/-/media/DotCom/planning/res-adeq/elcc/28-29-bra-elcc-class-ratings.pdf

[xxiii] PJM, *January Cold Weather Operations*, https://www.pjm.com/-/media/DotCom/committees-groups/committees/oc/2026/20260205/20260205-item-03---cold-weather-update.pdf, at 38

[xxiv] *Id.*, at 40

[xxv] *Id.,* at 38

[xxvi] H. Northey and P. Behr, *Severe heat, drought pack dual threat to power plants*, https://www.eenews.net/articles/severe-heat-drought-pack-dual-threat-to-power-plants/

[xxvii] A. Larson, *Poor Rail Service Causing "Coal Supply Crisis,"* https://www.powermag.com/poor-rail-service-causing-coal-supply-crisis/

[xxviii] DOE, *Fact Sheet: Energy Department Prevented Blackouts & Saved American Lives During Winter Storms,* https://www.energy.gov/articles/fact-sheet-energy-department-prevented-blackouts-saved-american-lives-during-winter-storms

[xxix] DOE indicates its MW output figure for Culley is an average while the MW levels for the other coal units are their minimum output.

[xxx] MISO, *Overview of Winter Storm Fern,* https://cdn.misoenergy.org/20260217%20RSC%20Item%2005%20Winter%20Storm%20Fern%20Report741721.pdf, at 5

[xxxi] MISO, *Real-Time 5-Min ExAnte LMPs*, https://www.misoenergy.org/markets-and-operations/real-time--market-data/market-reports/#nt=%2FMarketReportType%3AHistorical%20LMP%2FMarketReportName%3AReal-Time%205-Min%20ExAnte%20LMPs%20(xlsx)&t=10&p=2&s=MarketReportPublished&sd=desc

[xxxii] ERCOT, *Historical RTM Load Zone and Hub Prices*, https://www.ercot.com/mp/data-products/data-product-details?id=NP6-785-ER

[xxxiii] PJM, *Real-Time Five Minute LMPs*, https://dataminer2.pjm.com/feed/rt_fivemin_hrl_lmps

[xxxiv] SPP, *LMP By Location,* https://portal.spp.org/pages/rtbm-lmp-by-location

[xxxv] Grid Status, *Nodal Analysis REEVES_1_REEVES3GNODE,* https://www.gridstatus.io/nodes/loc_caiso_f87af1bfde1b8851?time_filter=2026&dataset=caiso_lmp_real_time_5_min

[xxxvi] J. Kemp *et al.*, *Electric transmission value and its drivers in United States power markets*, https://www.researchsquare.com/article/rs-3957695/v1, at 10

[xxxvii] Grid Status, *Nodal Map*, https://www.gridstatus.io/map

[xxxviii] M. Goggin, *Transmission Makes the Power System Resilient to Extreme Weather*, https://acore.org/wp-content/uploads/2021/07/GS_Resilient-Transmission_proof.pdf

[xxxix] M. Goggin and Z. Zimmerman, *The Value of Transmission During Winter Storm Elliott*, https://acore.org/wp-content/uploads/2023/02/ACORE-The-Value-of-Transmission-During-Winter-Storm-Elliott.pdf

[xl] SPP, *VER Curtailments*, https://portal.spp.org/pages/ver-curtailments

[xli] M. Goggin *et al.*, *Quantifying a Minimum Interregional Transfer Capability Requirement*, https://gridstrategiesllc.com/wp-content/uploads/2023/05/GS_Interregional-Transfer-Requirement-Analysis-final54.pdf, at 4

[xlii] PJM, *CONE, Operating Parameters for Net EAS, and Net CONE Updates,* https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250822-special/cone-operating-parameters-for-net-eas-and-net-cone-updates.pdf, at 4

[xliii] M. Goggin *et al.*, *Quantifying a Minimum Interregional Transfer Capability Requirement,* https://gridstrategiesllc.com/wp-content/uploads/2023/05/GS_Interregional-Transfer-Requirement-Analysis-final54.pdf, at 5

[xliv] NERC, *Interregional Transfer Capability Study*, https://www.nerc.com/globalassets/initiatives/itcs/itcs_final_report.pdf, at xiii, xvii

[xlv] A. Brooks *et al.*, *Review of NERC's 2025 Long-Term Reliability Assessment,* https://gridstrategiesllc.com/wp-content/uploads/FINAL-2025-LTRA-Review.pdf

[xlvi] J. Rand *et al.*, *Queued Up: 2025 Edition*, https://emp.lbl.gov/publications/queued-2025-edition-characteristics