UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Transmission System Planning Performance	)	Docket No. RM22-10-000
Requirements for Extreme Weather	)	

COMMENTS OF PUBLIC INTEREST ORGANIZATIONS

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COMMENTS OF PUBLIC INTEREST ORGANIZATIONS

I. Introduction

Sustainable FERC Project, Natural Resources Defense Council, American Council on Renewable Energy, Sierra Club, Southern Environmental Law Center, Western Resource Advocates (together "Public Interest Organizations" or "PIOs") hereby submit these initial comments in response to the Federal Energy Regulatory Commission's ("FERC" or "the Commission") June 16, 2022, Notice of Proposed Rulemaking ("NOPR") proposing to direct North American Electric Reliability Corporation ("NERC") to modify Reliability Standard TPL-001-5.1 "to address reliability concerns pertaining to transmission system planning for extreme heat and cold weather events that impact the reliable operations of the Bulk-Power System."[1]

II. Executive Summary

PIOs support the Commission's new initiatives to address extreme weather. In February 2022, the United Nations Intergovernmental Panel on Climate Change ("IPCC") released a report stating that the effects of climate change are already widespread and pervasive.[2] This includes "more frequent and intense" extreme weather events that put stress on the grid.[3] The NOPR recognizes that extreme weather – particularly heat and cold weather events – are occurring more frequently, and "are projected to occur with even greater frequency in the future."[4] FERC provides ample evidence of how recent major extreme heat and cold weather

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[1] Transmission System Planning Performance Requirements for Extreme Weather, 179 FERC ¶ 61,195 (2022), 87 Fed. Reg. 38,020 (June 27, 2022).

[2] IPCC, *Climate Change 2022: Impacts, Adaptation and Vulnerability—Summary for Policymaker*s (Feb. 27, 2022), https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf.

[3] *Id.* at 7. *See also* NOPR at P 34, *citing* NOAA Website, *Climate Data Online* (NOAA Website, Climate Data Online), https://www ncdc noaa.gov/cdo-web/.

[4] NOPR at P 2, *citing* Envtl. Prot. Agency, *Climate Change Indicators: Weather and Climate* (May 12, 2021), https://www.epa.gov/climate-indicators/weather-climate (showing an upward trend in extreme heat and cold weather events).

events have affected the reliability of the Bulk-Power System.[5] For brevity, we will not repeat that evidence here.

Based on this evidence, FERC preliminarily finds that the impact of concurrent failures of generators and transmission equipment due to extreme weather can potentially cause cascading outages, and therefore "should be studied and corrective actions should be identified and implemented."[6] Reliability Standard TPL-001-4 and its successor, TPL-001-5.1 ("TPL-001"), establish transmission system planning performance requirements that ensure that the Bulk-Power System operates reliably over a broad spectrum of system conditions and following a wide range of probable contingencies, but do not specifically require that a performance analysis be conducted for extreme heat and cold weather.[7] Thus, FERC proposes to direct NERC to develop modifications to Reliability Standard TPL-001 to require: "(1) development of benchmark planning cases based on information such as major prior extreme heat and cold weather events or future meteorological projections; (2) planning for extreme heat and cold events using steady state and transient stability analyses expanded to [cover] a range of extreme heat and cold weather scenarios… including the expected resource mix's availability during extreme heat and cold weather conditions, and including the broad area impacts of extreme heat and cold weather; and (3) corrective action plans that include mitigation for any instances where performance requirements for extreme heat and cold events are not met."[8] FERC seeks comment on whether to extend these requirements to extreme drought conditions.[9]

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[5] NOPR at PP 4.
[6] *Id.* at PP 2, 24–36.
[7] *Id.* at PP 37–46. Reliability Standard TPL-001-4 is applicable to planning coordinators and transmission planners. For brevity, we use the term "responsible entities" to mean both entities in these comments.
[8] *Id.* at P 47.
[9] *Id.* at P 92.

PIOs support FERC's proposal to require NERC to modify the Reliability Standards to address extreme weather. As the effects of climate change worsen, extreme weather will become more frequent and put stress on the Bulk-Power System.[10] This is the exact type of situation envisioned by Federal Power Act section 215(d)(5), which allows the Commission to order NERC to modify the Reliability Standards to "address[] a specific matter."[11]

PIOs do not address every aspect of the proposals in the NOPR but focus our comments on a limited set of issues. First, FERC should provide additional guidance on how to ensure that entities that are likely to be impacted by the same types of extreme weather events use consistent benchmark events. Second, while we support FERC's proposal for the new Reliability Standard to require responsible entities to study concurrent generator and transmission outages, FERC must make clear that the studies and corrective action plans should account for correlated conventional generator outages and derates of *all types* of generation resources. Third, the revised Reliability Standard should require responsible entities to evaluate a range of potential solutions when creating corrective action plans, including transmission upgrades, improvements to transmission scheduling practices or seams coordination that increase transfer capacity, grid-enhancing technologies, battery storage, and energy efficiency and demand response. Finally, FERC must require that the revised Reliability Standard include drought as an extreme weather event.

In addition to discussing modifications to the Reliability Standard, PIOs recommend that FERC act expeditiously to require robust interregional transmission planning, improve

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[10] *See* Elec. Power Rsch. Inst., *A Starting Point for Physical Climate Risk Assessment and Mitigation: Future Resilience and Adaptation Planning* (Apr. 27, 2022), https://www.epri.com/research/products/000000003002024895?src=mail.

[11] 16 U.S.C. § 824o(d)(5).

transmission scheduling, and make changes to ensure that resource adequacy calculations account for the effects of extreme weather.

III. Comments on Modifications to TPL-001

A. Benchmark Planning Cases

FERC proposes to direct NERC to include benchmark events that responsible entities must study in the revised Reliability Standard, as well as guidelines regarding which range of sensitivities must be applied to these benchmark event scenarios but provides NERC flexibility in setting this standard. The proposal states that the "benchmark events should be based on prior events," such as the February 2011 Southwest Cold Weather Event and January 2014 Polar Vortex Cold Weather Event, "and/or constructed based on meteorological projections."[12] FERC states that it is important that responsible entities likely to be impacted by the same types of extreme weather events use consistent benchmark events. However, it also recognizes that extreme weather risks may vary from region to region and change over time and states that NERC should consider approaches to provide a uniform framework while still recognizing regional differences. As an example, FERC states that "NERC could define benchmark events around a projected frequency (*e.g.*, 1-in-50-year event) or probability distribution (95th percentile event)."[13]

PIOs strongly support FERC's proposal for NERC to set a benchmark event for studying extreme weather events. There is precedent for FERC directing NERC to develop standards that meet certain requirements. For example, Order No. 779 directed NERC to develop a standard on geomagnetic disturbances that both identifies benchmark geomagnetic events to be studied and

[12] NOPR at P 51.
[13] *Id.* at P 52.

specifies the type of solutions that must be considered in plans to address concerns identified in those reliability assessments.[14]

However, PIOs recommend that FERC set more specific requirements for the revisions to Reliability Standard TPL-001 and the reliability analysis it requires. First, FERC should provide specific direction to NERC about what severe weather events, including severe heat, cold, and drought events, must be evaluated as the benchmark events, and what other inputs and assumptions should be used for the reliability analysis conducted as part of the TPL-001 Standard. This will ensure the NERC Standard meets the identified reliability need and is effective in all regions.

To allow for regional variation while also ensuring that entities likely to be impacted by the same types of extreme weather events use consistent benchmark events, FERC should specify that the TPL-001 Standard be revised to require each Regional Entity to develop the benchmark severe weather events that will be evaluated by all Transmission Planners and Planning Coordinators in that region. The Regional Entities cover large regions but are often subject to the same type of extreme weather events, so they are well positioned to determine the benchmark for their regions. We recognize that some weather events cross multiple Regional Entities – such as Winter Storm Uri that traversed the seams between Texas Regional Entity, Midwest Reliability Organization, and Southeastern Electric Reliability Council ("SERC"). To account for this, the Regional Entities should be required to use the same event when the worst event (after accounting for loss of imports from the other Regional Entities) across the Regional Entities is the same. For those extreme weather events that occur wholly within a sub-region of a

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[14] Reliability Standards for Geomagnetic Disturbances, 143 FERC ¶ 61,147 (2013), 78 Fed. Reg. 30,747 (May 23, 2013).

Regional Entity, the revised Reliability Standard can allow a Regional Entity to specify different events for parts of their footprint if they can demonstrate events typically affect subregions differently. For example, SERC may need a benchmark hurricane scenario that affects the coastal areas but does not apply to the rest of its footprint. Another option would be to have NERC approve the benchmarks proposed by each Regional Entity for those events that affect either only part of the Regional Entity or cross multiple Regional Entities.

These benchmark events should be based on the best available data concerning the recent historical severe heat, cold, and drought events during which generating supply was most at risk of falling short of demand in that region. For example, FERC could specify that Regional Entities select the events during which operating reserves for the Balancing Authorities ("BAs") in that region fell to their lowest levels, or in which spot electricity prices were at a high level for multiple hours. However, simply using historical data, even recent historical data, is not sufficient. As explained in the NOPR, extreme weather events "are occurring with greater frequency, and are projected to occur with even greater frequency in the future."[15] Thus, FERC must also specify that TPL-001 should require the benchmark events account for how climate change is increasing their frequency and magnitude. FERC should clarify that NERC must take into account the best available science[16] regarding how climate change influences the likelihood of severe weather events. Likewise, FERC should encourage NERC to consult with leading experts on climate change and climate modeling, such as the National Center for Atmospheric Research and the National Weather Service Storm Prediction Center.

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[15] NOPR at P 2.

[16] *See, e.g.*, 33 U.S.C. § 1321(a)(27), defining "best available science" as "science that— (A) maximizes the quality, objectivity, and integrity of information, including statistical information; (B) uses peer-reviewed and publicly available data; and (C) clearly documents and communicates risks and uncertainties in the scientific basis for such projects."

The use of a common set of events will ensure consistent and comparable results among transmission planning conducted by neighboring BAs, which is essential for evaluating solutions that affect the entire region, like increases in interregional transfer capacity. As FERC explained in the NOPR, "it is important that transmission planners and planning coordinators likely to be impacted by the same types of extreme weather events use consistent benchmark events" in conducting their analyses.[17] FERC should go further and establish explicit requirements for consistent inputs and assumptions. As Commissioner Clements notes in her concurrence, "Consistency in the inputs and assumptions feeding these cases and scenarios will allow for neighboring transmission planners and planning coordinators to work together towards cost-effective corrective actions, like increasing transfer capability, that could otherwise be missed for lack of apples-to-apples comparisons."[18]

B. Using Probabilistic Approaches to Identifying Risk

PIOs support FERC's proposal to require responsible entities to use probabilistic planning in conducting the analysis of severe weather impacts. There is precedent for using probabilistic tools in assessing electric reliability. NERC has a Probabilistic Assessment Working Group, which regularly uses probabilistic assessments to identify the risk various factors pose to electric reliability.[19] Responsible entities should use a probabilistic approach to determine the long-term risks of extreme weather and to maximize economic and reliability net benefits under the corrective action plan. The long-term focus is important because the severe weather events that drive reliability risks do not occur in every year. Their frequency and

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[17] NOPR at P 52.
[18] *Id.* (Clements, Comm'r, concurring at P 9).
[19] *See, e.g.*, NERC, *2020 Probabilistic Assessment - Regional Risk Scenario Sensitivity Case* (June 2021), https://www.nerc.com/comm/RSTC/PAWG/2020%20ProbA%20Regional%20Risk%20Scenarios%20Report_final_approved.pdf.

magnitude are also increasing due to the impacts of climate change, so new extreme weather patterns require systemic analysis and solutions – such as transmission investment to increase transfer capacity – that take longer to plan and execute.

Current deterministic planning approaches, in which a region is found to either meet or fall short of reliability criteria in a specific year in the relatively near future, often do not provide sufficient flexibility to incorporate longer lead time solutions. The result is that long-term solutions that could reduce or eliminate the need for more costly and inefficient short-term solutions – such as out-of-market payments or increases in reserves – are excluded from consideration.

For this reason, PIOs support FERC's proposed use of probabilistic planning in conducting the analysis of severe weather impacts, even though there is inherent uncertainty in attempting to quantify the impact of events that occur relatively rarely and whose frequency and magnitude are being affected by climate change. The other option is to not consider these effects at all, which leaves reliability at risk. For example, recent analysis by Lawrence Berkeley National Lab confirms that extreme events account for the majority of the value of transmission in most regions.[20] Without accounting for these risks, planning done pursuant to TPL-001 will end up producing plans that do not actually protect reliability. This is happening now – many transmission planners and planning coordinators currently ignore or discount the impact of extreme events when conducting transmission benefit-cost analysis. Accounting for such events, even with uncertain estimates for their frequency and magnitude, will yield a more accurate analysis than ignoring them.

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[20] Lawrence Berkeley National Lab, *Empirical Estimates of Transmission Value using Locational Marginal Prices* (Aug. 1, 2022), https://eta-publications.lbl.gov/sites/default/files/lbnl-empirical_transmission_value_study-august_2022.pdf.

C. Study of Concurrent Generator Outages and Corrective Action Plans

The NOPR notes that "Generation resources that are sensitive to severe weather conditions may cease operation during extreme heat and cold events, thus contributing to wide-area concurrent outages."[21] It further notes that "the performance of power transformers, transmission lines, and other equipment degrades under extreme heat and cold and may have to be derated or come out of service." The NOPR provides extensive evidence of the effect extreme heat and cold can have on generation and transmission assets.[22] Therefore, FERC seeks to require NERC to modify TPL-001 to require modeling the loss of these generators and transmission equipment during extreme heat and cold weather events in a way that would allow planners to determine the effects of potential concurrent transmission and generator outages and study the feasibility (i.e., availability and deliverability) of external generation resources that could possibly be imported to serve load during such events, thereby minimizing the potential impact of extreme heat and cold events on customers.

PIOs support FERC's proposal to direct NERC to modify Reliability Standard TPL-001 to require planners to account for the effects of extreme weather on transmission and generation assets. In our comments, we address the assessment of correlated generator outages and derates in planning analyses and development of corrective action plans, given abundant evidence that correlated outages occur and pose a significant risk to reliability.[23] PIOs maintain that FERC must make clear that the revision to the NERC standards must account for correlated outages and derates of *all* types of generation resources. The NERC standard should also require correlated

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[21] NOPR at P 68.
[22] *See id.* at PP 68–72.
[23] *See* Sinnott J. Murphy, *Correlated Generator Failures And Power System Reliability*, Carnegie Mellon University (May 2019), https://www.cmu.edu/ceic/assets/docs/publications/phd-dissertations/2019/sinnott-murphy-phd-thesis-2019.pdf; Sinnott J. Murphy et. al*, Resource Adequacy Risks to the Bulk Power System in North America*, Applied Energy (Feb. 15, 2018), https://www.sciencedirect.com/science/article/pii/S0306261917318202.

outages of *all* types of generation resources to be accounted for in the development of corrective action plans under TPL-001.

In describing the need to study and remediate for correlated outages, the NOPR inappropriately, and hopefully inadvertently, focuses only on certain types of generating resources. In describing the overall need for reform, FERC describes the need to "model transmission and generator outages, including availability of wind, natural gas, and other resources sensitive to extreme cold conditions."[24] It notes that during Winter Storm Uri, 59% of the total generation losses were gas-fired generating units due to fuel issues[25] and "pipeline equipment failure, and 27% were wind generation due to blade icing."[26] However, in the section on correlated outages, FERC only addresses this issue as it relates to wind and solar resources, but fails to mention correlated outages that were faced by natural-gas fired and other types of fossil generation. FERC states that during Winter Storm Uri, "approximately 44% of generator outages were caused by freezing issues, 31% by fuel issues related to extreme cold weather, and another 21% were caused by mechanical/electrical failures related to cold weather."[27] What this language does not mention in this section, is that according to FERC's own reports, of the generating units that experienced incremental unplanned outages and derates during Uri, 58% of them were natural gas-fired generators, and of the 31% of outages and derates caused by fuel issues, natural gas fuel supply issues caused 87% of them.[28]

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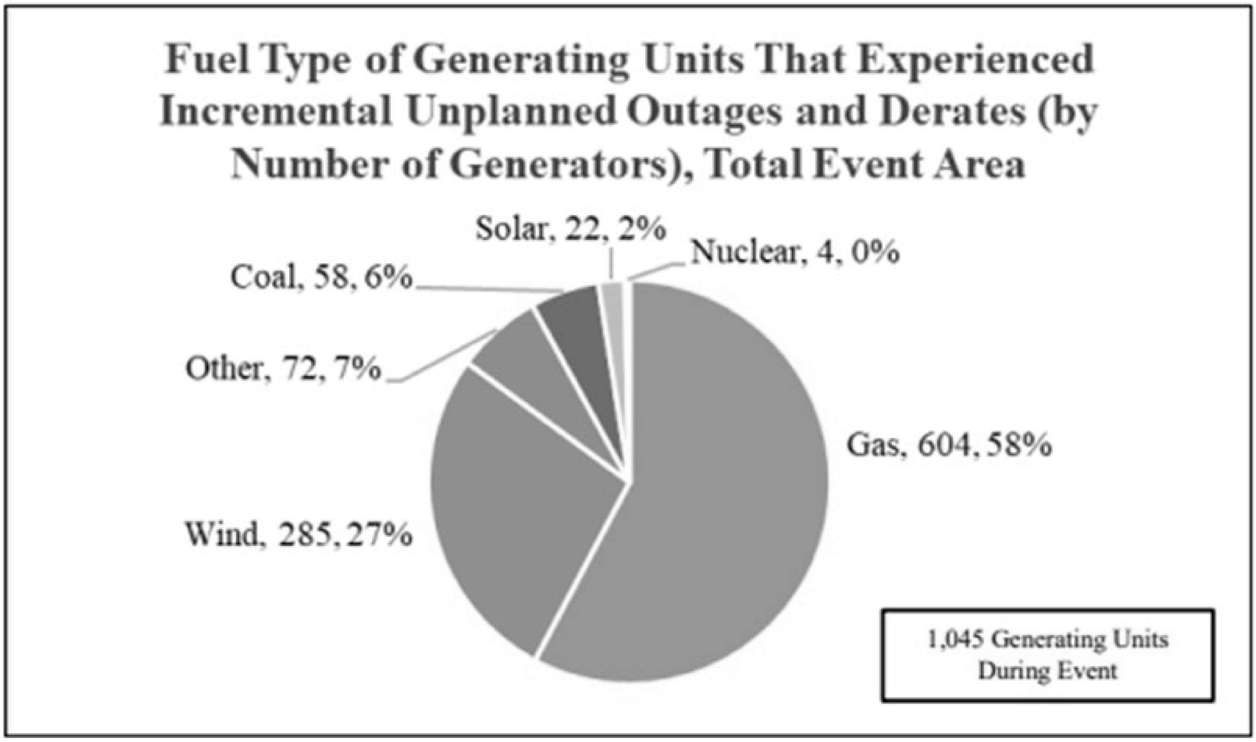
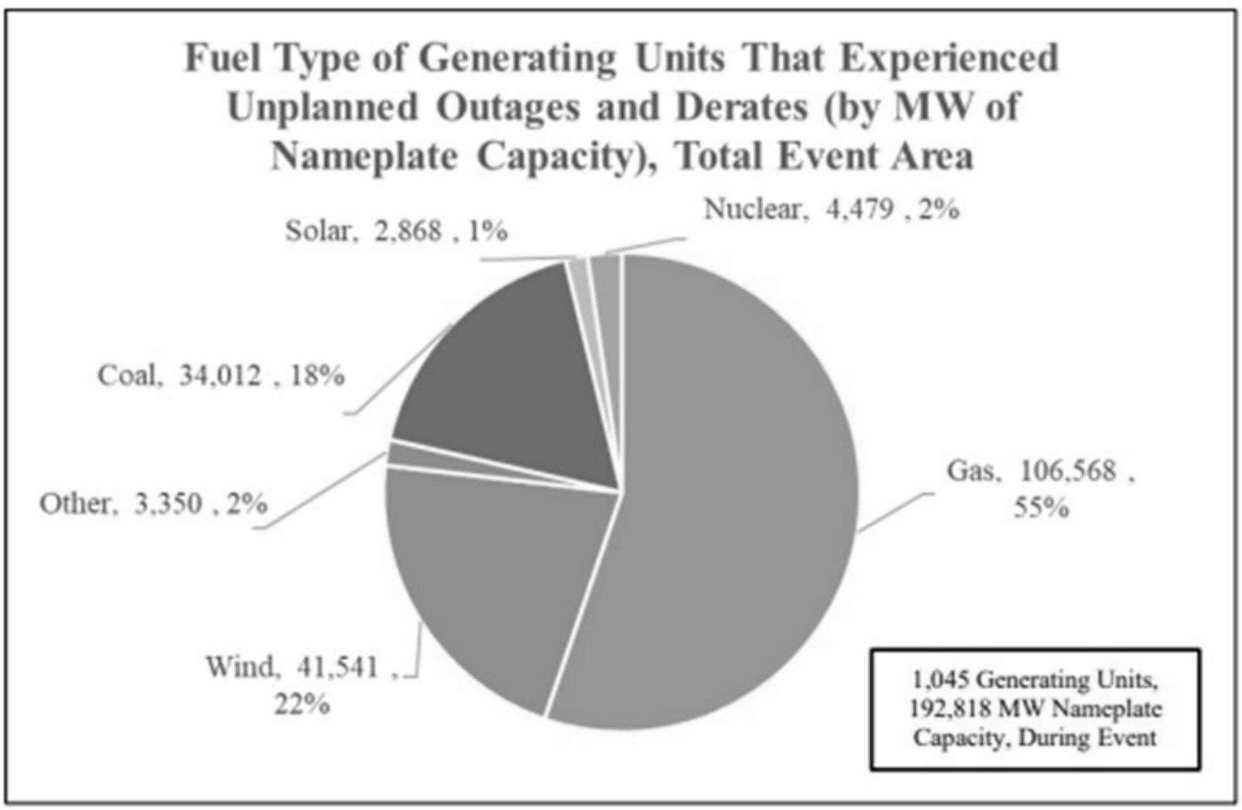
[24] NOPR at P 41.
[25] *Id.* FERC also notes that "Fuel issues included 87% natural gas fuel supply issues (decreased natural gas production, terms and conditions of natural gas commodity and transportation contracts, low pipeline pressure and other issues) and 13% other fuel issues." *Id.*
[26] *Id.*, *citing* FERC et. al, *The February 2021 Cold Weather Outages in Texas and the South-Central United States*, at 163 (Nov. 2021) ("2021 Cold Weather Event Report"), https://www.ferc.gov/media/february-2021-cold-weather-outages-texas-and-south-central-united-states-ferc-nerc-and
[27] *Id.* at P 70, *citing* 2021 Cold Weather Event Report.
[28] 2021 Cold Weather Event Report at 16.





Source: FERC, NERC, Regional Entity 2021 Cold Weather Event Report at 16.

PIOs assume this is an oversight and request that FERC make clear in the Final Rule that the revision to the NERC standards must account for correlated outages and derates of *all* types of generation resources to ensure that all issues affecting the reliability of the Bulk-Power System are studied and remediated.

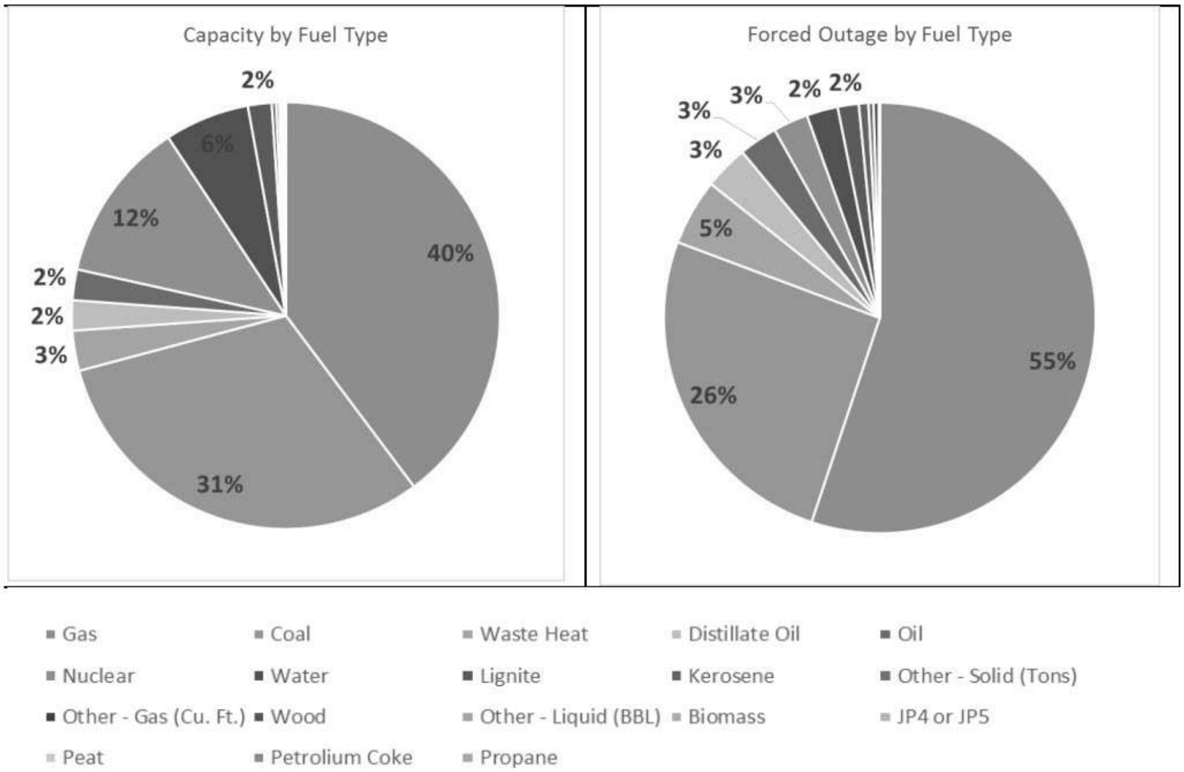
No single power source is perfect. Coal piles freeze, gas lines stop flowing, and nuclear plants need to shut down before a storm surge hits, thermal generation can be curtailed due to low water levels needed for cooling, and fossil generation experiences increased risk of mechanical failure during extreme heat and cold. Any NERC Reliability Standard addressing the effects of extreme weather needs to acknowledge this simple fact.

There is ample evidence that fossil fuel resources can struggle in cold weather. As stated above, the *2021 Cold Weather Event Report* showed that natural gas-fired generation suffered from concurrent outages during Winter Storm Uri. The University of Texas study following Winter Storm Uri further found that most of the thermal plants that failed in the cold did so at temperatures above their design ratings, which reflects only temperatures and neglected to consider the compounding impacts of high winds and humidity/icing.[29] In addition to the evidence from Winter Storm Uri in 2021, in 2019, when sustained cold weather battered the PJM region, "[n]atural gas and coal generators represented almost 85% of the outages, including 2,930 MW of gas generation that was idled because of a lack of fuel."[30] A similar outcome

[29] Univ. of Texas at Austin Energy Inst., *The Timeline and Events of the February 2021 Texas Electric Grid Blackouts*, at 35, App. C (July 2021), https://energy.utexas.edu/ercot-blackout-2021.
[30] Rich Heidorn Jr., PJM Weathers Arctic Blast, RTO Insider (Feb 3, 2019), https://www rtoinsider.com/articles/21783-pjm-weathers-arctic-blast.

occurred in the 2014 Polar Vortex, where 26% of the total outages were at coal plants and over 55% were at natural gas plants.[31]

Percentage of Net Dependable Capacity by Fuel Type (left); Percentage of Capacity Lost During Polar Vortex by Fuel Type (right) in Eastern and ERCOT Interconnections.



Source: NERC, Polar Vortex Review at 13.

FERC similarly focuses on the effect of extreme heat on only certain types of resources.[32] Heat and drought are less dramatic but longer-lasting disasters than dramatic winter storms, and compromise fossil plant performance in different ways. For example, this summer in the Electric Reliability Council of Texas ("ERCOT"), "thousands of megawatts of thermal power dropped

[31] NERC, *Polar Vortex Review*, at 13 (Sept. 2014), https://www nerc.com/pa/rrm/January%202014%20Polar%20Vortex%20Review/Polar_Vortex_Review_29_Sept_2014_Final.pdf.
[32] NOPR at PP 42, 71 ("Generally, extreme heat poses more of a threat to the functioning of a solar panel than extreme cold.").

offline" during a two-day period.[33] During that same time period, on one day wind generators performed at 230% of ERCOT's Seasonal Assessment of Resource Adequacy projections.[34] In extreme heat and drought, fossil plants suffer from cooling water availability and temperature constraints, but their efficiency is diminished by higher ambient temperatures.[35]

Thus, any new Reliability Standard must recognize that any type of generator can suffer concurrent outages due to extreme weather. Ensuring that the revisions to Reliability Standard TPL-001 require a resource-neutral look at correlated outages will be imperative to ensuring protection against extreme weather events. As discussed more fully in the next section, the revised standard must also properly account for the reliability risks of corrective action plans that rely on building more generation that is subject to the same correlated outage risks as existing generation. For example, building more gas generators supplied from the same gas field or from the same interstate pipeline that supplies existing gas generators may not be an effective tool for mitigating risk after accounting for the risk of correlated outages.

D. Corrective Action Plans

FERC proposes to direct NERC to modify Reliability Standard TPL-001 to require corrective action plans that include mitigation for any instances where performance requirements for extreme heat and cold events are not met. Specifically, a corrective action plan will be required to "help protect against system instability, uncontrolled separation, or cascading failures

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[33] Doug Lewin, *Plotting Texas' energy future in the dark*, Renewable Energy World (Aug. 1, 2022), https://www renewableenergyworld.com/solar/plotting-texas-energy-future-in-the-dark/. *See also* Markham Watson, Triple-digit Texas temperatures push ERCOT load to another record (S&P Global Platts) (July 12, 2022).
[34] Doug Lewin, *Plotting Texas' energy future in the dark*, Renewable Energy World (Aug. 1, 2022), https://www.renewableenergyworld.com/solar/plotting-texas-energy-future-in-the-dark/.
[35] Fontina Petrakopoulou, et al., *Impact of climate change on fossil fuel power-plant efficiency and water use*, Journal of Cleaner Production (2020); *see also* Melissa R Allen-Dumas et al., Extreme Weather and Climate Vulnerabilities of the Electric Grid: A Summary of Environmental Sensitivity Quantification Methods (Aug. 16, 2019),https://www.energy.gov/sites/prod/files/2019/09/f67/Oak%20Ridge%20National%20Laboratory%20EIS%20Response.pdf.

as a result of a sudden disturbance or unanticipated failure of system elements"[36] FERC states that the Reliability Standard should "provide responsible entities with the flexibility to determine the best actions to include in their corrective action plan to remedy any identified deficiencies in performance."[37] The NOPR proposes that a corrective action plan could include things like "planning for additional contingency reserves or implementing new energy efficiency programs to decrease load, increasing intra- and inter-regional transfer capabilities, transmission switching, or adjusting transmission and generation maintenance outages based on longer-lead forecasts."[38]

PIOs recommend that FERC direct NERC to require responsible entities to evaluate a range of potential solutions in developing corrective action plans, including portfolios of solutions, as part of their corrective action plans, and pick the solutions that offer the greatest net benefits for economics and reliability. FERC should specifically direct NERC to require responsible entities to evaluate transmission upgrades, improvements to transmission scheduling practices or seams coordination that increase transfer capacity, grid-enhancing technologies, battery storage, and energy efficiency and demand response as part of the development of corrective action plans.[39]

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[36] NOPR at P 83.
[37] *Id.* at P 84.
[38] Id.
[39] TPL-001-5 provides the following list of examples of actions that can be used to achieve required system performance after a deficiency has been identified. Examples of such actions include:

- "Installation, modification, retirement, or removal of Transmission and generation Facilities and any associated equipment.
- Installation, modification, or removal of Protection Systems or Remedial Action Schemes.
- Installation or modification of automatic generation tripping as a response to a single or multiple Contingency to mitigate Stability performance violations.
- Installation or modification of manual and automatic generation runback/tripping as a response to a single or multiple Contingency to mitigate steady state performance violations.
- Use of Operating Procedures specifying how long they will be needed as part of the corrective action plan.
- Use of rate applications, DSM, new technologies, or other initiatives."

As noted in the preceding section, adding new generation that is subject to the same correlated outage risks as existing generation is unlikely to be an effective solution to severe weather risk. However, increases in transfer capacity achieved through transmission upgrades, improvements to transmission scheduling practices or seams coordination that increase transfer capacity, or grid-enhancing technologies,[40] as well as solutions like battery storage, energy efficiency, and demand response, are not exposed to those correlated risks. Therefore, the Commission has a compelling justification for requiring responsible entities to at least evaluate those solutions.

Many grid-enhancing technologies are particularly well-suited to help address severe weather reliability risks.[41] Dynamic line rating technology offers particularly large benefits when transmission lines are being cooled by low temperatures and high winds, as is the case during many winter peak demand periods, but they can also help operate lines closer to their true operating limits during summer peak demand periods. Topology optimization and power flow devices also provide large net benefits under a range of severe weather events and can be particularly helpful for preserving the reliable and efficient flow of power if severe weather has altered usual flows on the transmission system.

For all of the same reasons PIOs recommend FERC require the use of a probabilistic approach to studying the risk of extreme weather, responsible entities should be required to use a probabilistic approach to determine the best long-term portfolio of solutions to maximize economic and reliability net benefits under the corrective action plan.[42] The long-term focus is

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[40] Michael Goggin, *Transmission Makes the Power System Resilient To Extreme Weather*, American Council on Renewable Energy (July 2021) ("Grid Strategies Report") https://acore.org/wp-content/uploads/2021/07/GS_Resilient-Transmission_proof.pdf.
[41] *See* WATT Coalition Comments, Docket No. RM21-17-000 (Aug. 26, 2022).
[42] *See supra* § III.B.

important to ensure that solutions consider the increasing risk of extreme weather and can take into account longer term solutions, such as transmission investment to increase transfer capacity.

FERC should also specify that the TPL-001 Reliability Standard be revised to require planners to develop corrective action plans that maximize economic and reliability net benefits over the long-term, such as a planning window of at least 20 years. We also agree with Commissioner Clements on the importance of coordinating with states in the development of corrective action plans, given that states have primary authority over the generation mix and transmission permitting.[43]

E. Drought Events Must Be Included in the Analysis of Severe Weather Risks

In the NOPR, FERC recognizes that long-term drought can "pose a serious risk" to reliability and "may cause or contribute to conditions that affect reliable operation of transmission systems such as transmission outages, reduced plant efficiency, and reduced generation capacity."[44] Therefore, FERC asks if drought should be included in the scope of Reliability Standard TPL-001-5.1. PIOs strongly believe that it should be included given the potential impact on hydroelectric and thermal resources documented in the NOPR.[45] As discussed more in the section on correlated outages, the U.S. has seen thermal resources forced offline or to operate at reduced output due to cooling water being in short supply or exceeding high temperature limits. And severe drought has significant impacts on both hydro and thermal

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[43] NOPR (Clements, Comm'r, concurring at P10).
[44] NOPR at P 90, *citing* U.S. Dept. of Energy, I*mpacts of Long-term Drought on Power Systems in the U.S. Southwest*, at 5 (July 2012), https://www.energy.gov/sites/prod/files/Impacts%20of%20Long-term%20Drought%20on%20Power%20Systems%20in%20the%20US%20Southwest%20%E2%80%93%20July%202012.pdf
[45] *See* NOPR at P 91.

generation.[46] As climate change worsens the frequency and severity of drought and extreme heat, these events are likely to become a greater risk to electric reliability.[47]

IV. Other Issues

While modifying the NERC Reliability Standards is a good first step toward addressing the effects of climate change and extreme weather on the power system, PIOs believe there is more to be done. In this respect, we agree with Commissioner Clements that FERC should consider additional action, including on (1) setting minimum interregional transmission standards, (2) improving transmission scheduling in non-RTO regions, and (3) ensuring that resource adequacy appropriately reflects extreme weather conditions.[48] We provide more detail on these topics below.

A. FERC Should Require a Minimum Amount of Interregional Transfer Capacity

PIOs urge the Commission to start a new rulemaking proceeding on interregional transmission planning as soon as possible to ensure that the grid evolves in an integrated, beneficial, and flexible manner across seams instead of as a patchwork of local and regional facilities. In our comments to FERC's Transmission NOPR,[49] PIOs advocated that FERC must create and mandate effective joint interregional planning requirements as an integral part of a single comprehensive and holistic transmission planning process.[50] We will not repeat the extensive comments explaining how the current interregional coordination process has failed to

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[46] See Christopher B. Harto et. Al, Analysis of drought impacts on electricity production in the Western and Texas interconnections of the United States, Argonne Natl. Lab. (Feb. 2021), https://www.osti.gov/biblio/1035461.
[47] *See, e.g.* Ariel Miara et. Al, *Climate-Water Adaptation for Future US Electricity Infrastructure*, Environmental Science & Technology (Nov. 20, 2019), https://pubs.acs.org/doi/abs/10.1021/acs.est.9b03037
[48] *See* NOPR (Clements, Comm'r, concurring at P 6).
[49] Comments of Public Interest Organizations, Docket No. RM21-17-000 (Aug. 17, 2022), Accession No. 20220817-5270 ("PIOs' Initial Transmission NOPR Comments").
[50] *Id.* At 75.

produce just and reasonable rates.[51] Rather, we will focus on the extensive benefit of interregional transmission to mitigate the negative effects of extreme weather.

The experiences during Winter Storm Uri highlight the benefits of interregional transmission during extreme weather events. Commission staff's own analysis shows that during the severe cold weather event in February 2021, interregional transfer capability kept the catastrophic and deadly situation from being even worse.[52] It is no exaggeration to say that this interregional transfer capacity likely saved lives. The FERC-NERC Cold Weather Report states that:

> Unlike ERCOT, which can only import slightly more than 1,000 MW over its direct current ties, SPP and MISO imported power from other Balancing Authorities to make up for their increasing load levels and generation shortfalls, because the eastern part of the Eastern Interconnection did not have the same arctic weather conditions. Specifically, MISO was able to import large amounts of power from neighbors to the east (e.g. PJM Interconnection, LLC), and SPP was able to transfer some of that power through MISO.[53]

Interregional transmission can help harness geographic diversity in load, generation, and renewable output between one Balancing Authority ("BA") and neighboring BAs to provide reliability in the face of large extreme weather systems. Transmission should be sized to optimize the net benefits from the reduction in peak capacity needs due to geographic diversity, as well as other benefits including production cost savings.

There is ample evidence of the benefits of geographic diversity to reliability. Analysis using publicly available Energy Information Administration ("EIA") data demonstrates that load and renewable output diversity benefits among BAs are quite large. By comparing stand-alone versus regionally-aggregated EIA hourly load and generation data for grid operators in the U.S.

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[51] *Id.* At 75–79.
[52] 2021 Cold Weather Event Report.
[53] *Id.* At 14.

portion of the Northwest Power Pool ("NWPP"),[54] the results showed a large reduction in peak capacity needs from aggregating diverse loads and renewable resources across the region. Even in 2020's worst-case scenario of a heat wave across much of the West, there were still significant geographic diversity benefits across the region. As shown in the load and net load duration curves below, the U.S. portion of the NWPP could have realized a 5 GW reduction in peak load and a 7 GW reduction in peak net load (from 2 GW of renewable diversity benefit) in 2020 if it aggregated diverse loads and renewable resources by evaluating resource adequacy on a regional basis. The 7 GW reduction in peak net load reduces the need for capacity by 11% and translates into regional savings of around $5 billion if the benefit were realized through a reduced need for new gas combustion turbine capacity.[55]

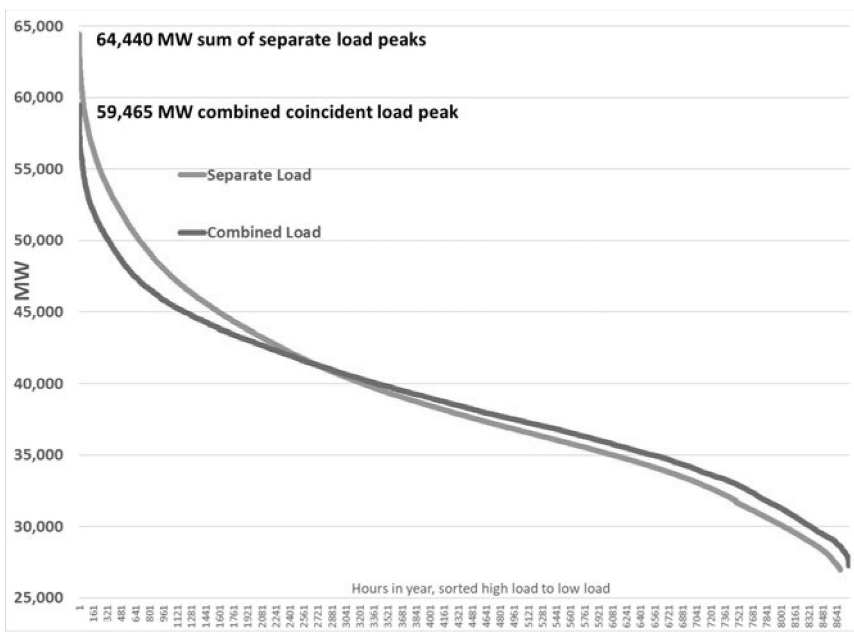

Figure 1: Peak load reduction by aggregating across US portion of NWPP

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[54] U.S. Energy Info. Admin., *Electric Grid Monitor*, January–June, July–December (last visited Aug. 24, 2022), https://www.eia.gov/electricity/gridmonitor/sixMonthFiles/EIA930_BALANCE_2020_Jan_Jun.csv; https://www.eia.gov/electricity/gridmonitor/sixMonthFiles/EIA930_BALANCE_2020_Jul_Dec.csv.

[55] Conservatively using an assumed $785/kW cost of a frame combustion turbine from U.S. Energy. Info. Admin., *Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2022* (Mar. 2022), https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf

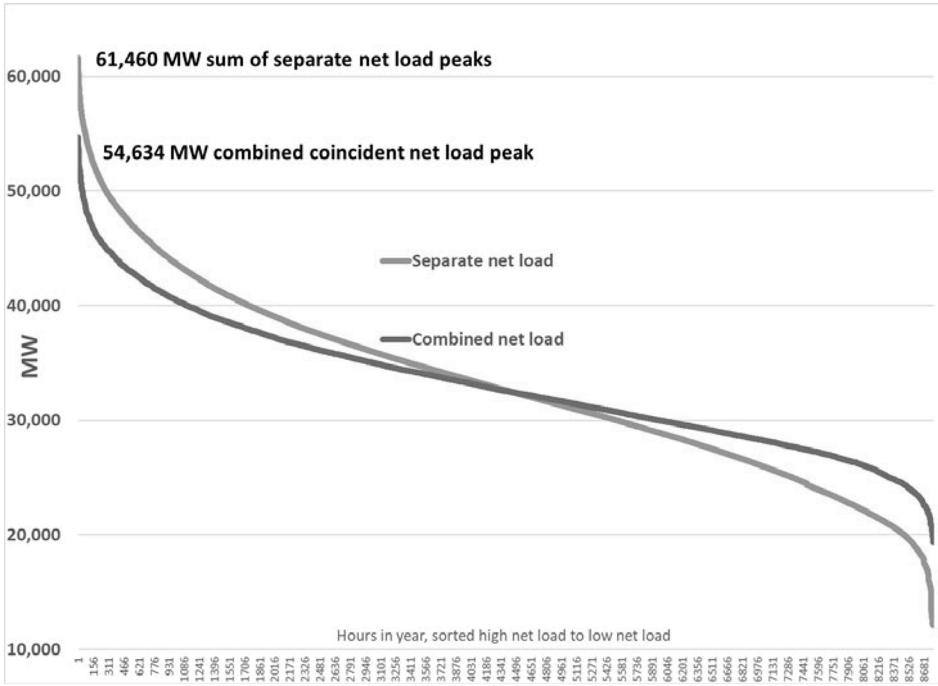

Figure 2: Peak net load reduction by aggregating across US portion of NWPP

Notably, this analysis does not account for weather and climate diversity that reduces correlations in generator outages and derates across large areas, as the hourly outage and derate data that is needed to quantify that benefit is not publicly available. Correlated outages and derates have been a major economic and reliability threat in a range of severe weather events.[56] Moreover, the August 2020 heatwave was an extreme anomaly for its geographic breadth, so these results should be viewed as an extremely conservative estimate of the benefits of geographic diversity. For California, the August 2020 heat wave was quantified as a 1-in-30-year event,[57] but the breadth of the heat across much of the West makes it even rarer. For example, the June 2021 Pacific Northwest heat wave was quantified as a "1-in-1,000-year event in today's

[56] *See, e.g.,* Grid Strategies Report; 2021 Cold Weather Event Report at 16.
[57] Cal. ISO, *Final Root Cause Analysis: Mid-August 2020 Extreme Heat Wave* (Jan. 13, 2021), http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf.

climate,"[58] yet the heat wave most severely affected California and the Pacific Northwest at different times, allowing each region to meet load using imports from the other region.

To ensure reliability and just and reasonable rates, it is important that a minimum interregional transfer capacity requirement apply to non-RTO areas and not just RTOs. The BAs in non-RTO regions tend to have less internal diversity in their loads and supply resources due to their small size, making transfer capacity with neighboring BAs even more valuable for reliability and economic benefits. For example, non-RTO regions in the Southeastern and Western U.S. have a mix of winter-peaking and summer-peaking BAs, making the load diversity benefit among those BAs even larger.

We agree with Commissioner Clements that coordination will be required with the Commission's parallel efforts to reform transmission planning and cost allocation.[59] Increases in transfer capacity between BAs inherently affect both BAs, and the Commission needs to develop a workable solution for allocating the cost of increasing transfer capacity.

In sum, FERC needs to move forward expeditiously to require robust interregional transmission planning. As discussed extensively in our comments to FERC's Transmission NOPR, the planning process must consider and then adopt plans to build projects that maximize the broadest array of benefits for the broadest number of markets and consumers. PIOs provide specific recommendations for such interregional planning in our comments to FERC's Transmission NOPR.[60]

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[58] Rebecca Lindsey, *Preliminary analysis concludes Pacific Northwest heat wave was a 1,000-year event…hopefully,* Climate.gov (July 20, 2021), https://www.climate.gov/news-features/event-tracker/preliminary-analysis-concludes-pacific-northwest-heat-wave-was-1000#:~:text=An%20international%20team%20of%20weather,year%20event%20in%20today's%20climate.
[59] NOPR (Clements, Comm'r, concurring at P 11).
[60] *See* PIOs' Initial Transmission NOPR Comments at 78–79.

B. FERC Should Take Action to Improve Transmission Scheduling

We agree with Commissioner Clements' concurrence that "[t]ransmission scheduling and coordination can potentially be improved both via mandating a transition to flowgate methodology for determining transmission capacity in areas that continue to use path-based methodologies, and via facilitation of economic redispatch and narrowing the circumstances under which transmission curtailment procedures are permissible."[61] Transmission scheduling capacity is larger and transaction scheduling is more reliable under the flowgate methodology. Schedules are less likely to be curtailed in real-time because they are confirmed under day-ahead conditions. In contrast, transmission schedules using contract paths do not reflect actual power flows over individual transmission facilities. In many cases there may be available, unused transfer capacity even though the contract path is fully scheduled.

C. Changes to Resource Adequacy to Account for Extreme Weather

Current resource adequacy methods do not accurately account for the risk of correlated outages[62] and derates of conventional generators. As discussed in more detail in the section of these comments concerning correlated outages, all resource types can be subject to correlated outages during extreme weather. It is important that the risk of these correlated outages be accounted for in both resource adequacy analysis and capacity value accreditation, as failure to include them in the former masks reliability risks while failure to include them in the latter can bias the resource selection to include a suboptimal mix of resources. In many regions, Effective Load Carrying Capability analyses account for correlated output profiles of wind, solar, and

[61] NOPR (Clements, Comm'r, concurring at P 18).
[62] *See id.* (Clements, Comm'r, concurring at P 26).

storage, but correlated outages of conventional generators are not accounted for.[63] This results in both reliability risk that is not accounted for and undue discrimination by overstating the reliability contributions of conventional generators relative to renewable and storage resources.

Grid operators and other experts have established methods for accounting for these correlated outage risks. PJM analysis found that actual peak generation outage rates on winter days were nearly five times higher than predicted by models that did not take correlated outages into account,[64] and as a result, PJM planning procedures were updated in 2018 to compensate by evaluating the need for additional reserves during the winter.[65] While such an approach preserves reliability, it socializes the costs of correlated outages to load rather than assigning them to the supply resources that cause the problem. Finally, utility consultant Astrape found that the current practices overstate the resource adequacy contribution of conventional resources in PJM by 13% - 20% in winter and 11% in summer after accounting for correlated outages and derates.[66] While this has likely been compensated for by PJM's very high reserve margins, if unaddressed, it leads to either socialized costs through higher reserve requirements or dangerously incorrect resource adequacy conclusions. Therefore, we agree that the risk of correlated outages of all types of resources should be accounted for in both resource adequacy analysis and capacity value accreditation.

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[63] *See*, *e.g.*, David B. Patton et. al, *2021 State of the Market Report for the N.Y. ISO Markets*, Potomac Economics (May 11, 2022), https://www nyiso.com/documents/20142/2223763/NYISO-2021-SOM-Full-Report-5-11-2022-final.pdf/5307870c-9b62-1720-1708-6b9c157211bb?t=1652365686905. *See also* Joel Dison et. al, *Accrediting Resource Adequacy Value to Thermal Generation*, Astrape Consulting (Mar. 30, 2022) ("Astrape Report"), https://info.aee net/hubfs/Accrediting%20Resource%20Adequacy%20Value%20to%20Thermal%20Generation-1.pdf.
[64] Patricio Rocha Garrido, *Winter Resource Adequacy*, at 9, PJM (Feb. 2, 2018), https://www.pjm.com/-/media/committees-groups/task-forces/sodrstf/20180202/20180202-item-06-winter-resource-adequacy-education.ashx.
[65] *See* PJM, *PJM Manual 20: PJM Resource Adequacy Analysis, Revision: 12*, at §§ 1.6, 3.3. https://www.pjm.com/-/media/documents/manuals/m20.ashx.
[66] *See* Astrape Report at 6, comparing "Standard Accounting Practice" with "Proposed Additional Considerations." Range of winter impacts reflects resources exposed or not exposed to natural gas supply risk.

V. Conclusion

PIOs appreciate the opportunity to provide these comments on the Commission's timely and important NOPR and ask that the Commission consider the recommendations made herein in this rulemaking.

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Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that the foregoing has been served in accordance with 18 C.F.R. § 385.2010 upon each party designated on the official service lists in these proceedings listed above, by email.

Dated: August 26, 2022

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