UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

PJM Interconnection, LLC	**)**	**Docket No. ER24-99**
	)	

LIMITED PROTEST OF THE SIERRA CLUB, NATURAL RESOURCES DEFENSE COUNCIL, AND THE SUSTAINABLE FERC PROJECT

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INTRODUCTION

Pursuant to Rule 211 of the Federal Energy Regulatory Commission ("the Commission" or "FERC") Rules of Practice and Procedure, the Sierra Club, Natural Resources Defense Council, and the Sustainable FERC Project (collectively "Public Interest Organizations" or "PIOs") respectfully submit this limited protest of PJM Interconnection, LLC's ("PJM") proposal titled "Capacity Market Reforms to Accommodate the Energy Transition While Maintaining Resource Adequacy."[1]

Overall, PJM's Accreditation Filing is a flawed solution to a genuine problem. The filing would appropriately adjust the capacity accreditation of thermal generation plants to reflect their poor performance during extreme winter weather. Thermal plants' poor performance stems from pervasive mechanical problems as well as the failure to obtain fuel supplies. As shown in both PJM and Commission analyses, thermal failures during winter storms have been the single greatest threat to reliability in this region, and PJM's proposal to reflect those risks in accreditation is an important and long overdue step in the right direction.

However, just because a filing under section 205 of the Federal Power Act ("FPA") may reflect an improvement over the status quo is not sufficient to make the resulting rates just and reasonable. As explained below, PJM's proposal ignores crucial defects with the method it proposes for accrediting all capacity resources. Its proposed implementation of marginal Effective Load Carrying Capacity ("ELCC") accreditation will create numerous reliability, market efficiency, and cost-allocation issues that PJM fails to address in its filing. For example,

[1] PJM, Capacity Market Reforms to Accommodate the Energy Transition While Maintaining Resource Adequacy, Docket No. ER24-99 (Oct. 13, 2023) ("Accreditation Filing"), Accession No. 20231013-5157. Because capacity accreditation is a core component of this filing, PIOs will abbreviate this filing as PJM's "Accreditation Filing." In another docket, ER24-98, PIOs will also protest PJM's simultaneous proposal titled "Proposed Enhancements to PJM's Capacity Market Rules – Market Seller Offer Cap, Performance Payment Eligibility, and Forward Energy and Ancillary Service Revenues." Because reforms to the Market Seller Offer Cap ("MSOC") are a core component of that filing, PIOs abbreviate that filing as PJM's "MSOC Filing."

PJM's proposal makes no effort to ensure that the benefits to consumers from a transition to marginal ELCC will flow to the consumers whose investment caused those benefits, which creates significant free-rider problems and flouts fundamental principles of cost-causation. Similarly, PJM fails to demonstrate that its proposed class ELCCs will be accurate or send appropriate market signals given the prospect of widespread—but non-transparent—unit-specific adjustments to ELCC.

Nor has PJM adequately supported its proposal to reduce the Capacity Performance stop-loss provision. While PJM's proposed testing procedures will help address some causes of generator non-performance, these procedures are only a partial solution and do not obviate the need for a strong financial signal that capacity resources must be available during grid emergencies. Finally, we note numerous flaws and unanswered questions with respect to PJM's risk modeling. While the move to hourly risk modeling is a significant improvement, PJM's filing reveals that the modeling reflects several unsupported and questionable assumptions that will tend to result in inaccurate accreditations and procurement levels.

Because PJM's filing ignores serious flaws with its proposal, PJM fails to carry its burden under section 205 of the FPA to demonstrate that its tariff reforms are just, reasonable, and not unduly discriminatory.[2] Accordingly, PIOs respectfully request that the Commission reject PJM's filing. However, because PJM's proposal would address the single greatest threat to reliability in the region by accounting for the poor performance of thermal generators, PIOs also request that the Commission provide clear explanations as to what errors PJM must correct for a similar filing to be just and reasonable.

[2] While certain components of PJM's proposal are an improvement over the status quo, that is not adequate to render the proposal just and reasonable. *See PJM Interconnection, L.L.C.*, 180 FERC ¶ 61,089 at P 47, n.111 (2022) ("*IRD Order*") (finding that even if PJM's contention that its Intelligent Reserve Deployment proposal is an improvement over its current approach is correct, that does not render the proposal just and reasonable).

BACKGROUND

I. PJM BEARS THE BURDEN OF PROVING THAT ITS PROPOSED TARIFF IS JUST AND REASONABLE.

Under section 205 of the FPA, the Commission must ensure that "[a]ll rates and charges . . . by any public utility for or in connection with the transmission or sale of electric energy" are "just and reasonable."[3] The Commission must also ensure that utilities do not "make or grant any undue preference or advantage to any person or subject any person to any undue prejudice or disadvantage" or "maintain any unreasonable difference in rates."[4] A utility proposing to change its rates bears "the burden of proof to show that the increased rate . . . is just and reasonable."[5]

Under this standard, where PJM proposes tariff changes to "better align prices" with periods of potential risk, "PJM must show that any such proposed methodology produces just and reasonable rates."[6] If PJM "fail[s] to substantiate that its proposed [methodology] will achieve that purpose," the Commission will find that PJM has failed to carry its burden under section 205 of the FPA and will reject PJM's proposal.[7] To "show that [a proposed change] is just and reasonable," PJM must do more than merely show "an improvement over the [existing] approach," especially where the PJM grid "will remain reliable without implementing the [new] proposal."[8] Instead, PJM must demonstrate that that its proposal properly accounts for "actual system conditions" and does not "produce a misalignment between prices and actual system conditions" that will "result in artificially inflated prices and thus prevent PJM from achieving a least cost [] solution" to the issues before it.[9]

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[3] 16 U.S.C. § 824d(a).
[4] *Id.* § 824d(b).
[5] *Id.* § 824d(e).
[6] *IRD Order*, 180 FERC ¶ 61,809 at P 51.
[7] *Id.*
[8] *Id.* at P 47.
[9] *Id.*

II. RECENT WINTER STORMS REVEALED THREATS TO RELIABILITY THAT PJM HAS STRUGGLED TO ADDRESS IN ITS CAPACITY MARKET DESIGN.

PJM's proposed tariff revisions grapple with significant threats to reliability revealed by severe winter storms. During two major events in the last decade, numerous thermal resources with capacity obligations failed when winter storms struck the PJM region. In January 2014, when the Polar Vortex hit the PJM region, causing "prolonged, deep cold" and setting "a new wintertime peak demand," a whopping twenty-two percent of PJM's generation capacity failed to perform.[10] As PJM reported, that forced outage rate "was two to three times higher than the normal peak winter outage rate" over the prior five years.[11] These outages were overwhelmingly concentrated among fossil fuel power plants. As shown in Figure 1, coal and gas accounted for 81% of the 40,200 megawatts ("MW") of forced outages during the Polar Vortex.[12]

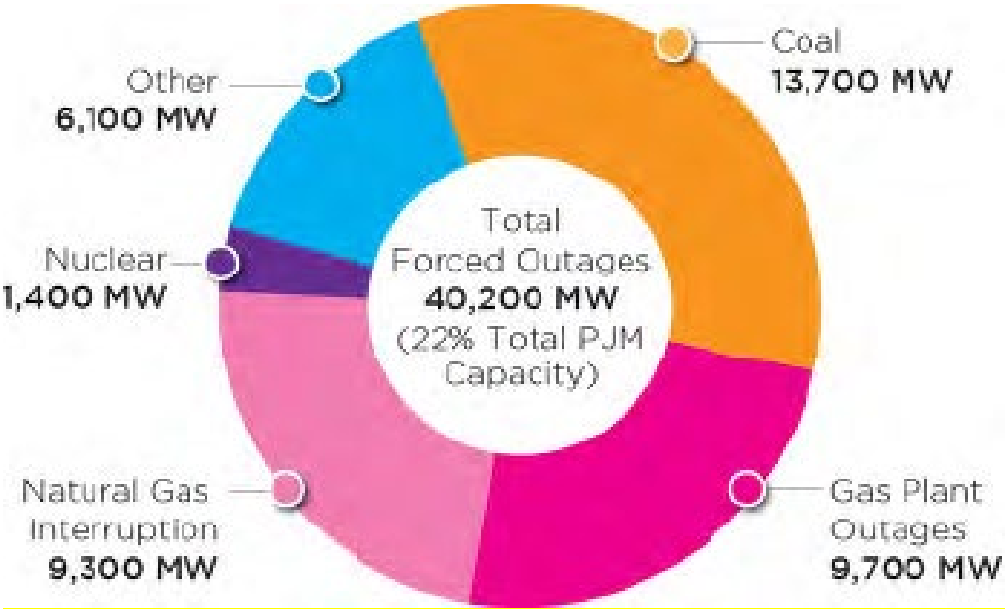

Figure 1: Polar Vortex Outages by Primary Fuel[13]

[10] PJM, Analysis of Operational Events and Market Impacts During the January 2014 Cold Weather Events, at 4 (May 8, 2014) ("Polar Vortex Report"), https://www.hydro.org/wp-content/uploads/2017/08/PJM-January-2014-report.pdf. This report is also attached in Volume 1 of Attachments to this protest; *see* ATT-161.
[11] *Id.*
[12] *Id.* at 26.
[13] *Id.*

After the Polar Vortex, PJM proposed a new Capacity Performance ("CP") system to provide incentives for capacity resources to perform during emergencies. During emergencies, or Performance Assessment Intervals ("PAI"), the CP system assesses penalties, or Non-Performance Charges, that fund bonuses, or Performance Payments, to resources that actually do ensure reliability.[14] When proposing the CP system in 2015, PJM reasoned that its prior system "fail[ed] to provide adequate incentives for resource performance," which "can threaten the reliable operation of PJM's system and force consumers to pay for capacity without receiving commensurate reliability benefits."[15] The CP system aimed to address the core problem that, without the threat of penalties for non-performance, "a seller can earn substantial revenues through PJM's capacity auctions by committing its resource as capacity, with little concern that it will lose much of that revenue even if it performs poorly."[16] The Commission approved PJM's new CP system, finding that "capacity must carry with it meaningful performance obligations, and corresponding incentives and penalties, to ensure that those resources actually deliver [capacity] when needed."[17] The Commission found it appropriate that "capacity resources in PJM will face new and substantial penalties for non-performance that [the Commission] conclude[d] will help ensure the reliability of the PJM system."[18] In subsequent litigation, the D.C. Circuit upheld the CP system's methods of addressing the problem of power plants "making capacity commitments but not providing electricity when it was needed."[19]

[14] *See generally PJM Interconnection, LLC*, 151 FERC ¶ 61,208 (2015) ("*CP Order*").
[15] *Id.* at P 5.
[16] *Id.* at P 25.
[17] *Id.* at P 9.
[18] *Id.* at P 15.
[19] *Advanced Energy Mgmt. All. v. FERC*, 860 F.3d 656, 660 (D.C. Cir. 2017).

PJM instituted the CP system because it anticipated that events like the Polar Vortex could plausibly recur,[20] and because the increasing prevalence of gas in the region made it critical to incent better performance than the unacceptably high rate of failures during the Polar Vortex.[21] In 2018, better performance from capacity resources during a milder cold snap suggested that the CP system was contributing to reliability.[22] However, FERC proved unfortunately prescient when it noted in its order approving the CP system that "it is not uncommon for performance to improve after an event, only to trail off later."[23]

Roughly eight years after the Polar Vortex, Winter Storm Elliott struck the PJM region in December 2022 and caused problems remarkably similar to those PJM experienced in 2014.[24] In fact, even more capacity resources failed to perform during Winter Storm Elliott than during the Polar Vortex. Roughly 47,000 MW of generation resources, or twenty-four percent of PJM capacity, failed during Winter Storm Elliott, which is greater than the roughly 40,000 MW, or twenty-two percent, that failed during the Polar Vortex.[25] Again, these outages were overwhelmingly concentrated among fossil fuel power plants. As depicted in Figure 2, of the

[20] *CP Order*, 151 FERC ¶ 61,208 at P 36 (noting that the Polar Vortex was not "a one-time event that could not be duplicated in the future").
[21] *Id.* at PP 42–43 (noting the significant poor performance of gas plants and finding that "[the] significant ongoing changes to the resource mix in PJM and the demonstrated deterioration in existing resource performance in recent years together provide sufficient justification for PJM's [CP] proposal").
[22] PJM Interconnection, PJM Cold Snap Performance: Dec. 28, 2017 to Jan. 7, 2018, at 1–2 (Feb. 26, 2018) ("Cold Snap Report"), https://www.pjm.com/-/media/library/reports-notices/weather-related/20180226-january-2018-cold-weather-event-report.ashx (noting a lower forced outage rate of 12.1% and attributing this to several factors including "milder weather" and "improved performance incentives"). This report is also attached in Volume 1 of Attachments to this protest; *see* ATT-230.
[23] *CP Order*, 151 FERC ¶ 61,208 at P 44.
[24] While the scale and nature of outages during Winter Storm Elliott and the Polar Vortex were quite similar, PIOs are not aware of any unit-specific analysis that evaluates whether outages occurred at the same facilities in both instances. It is possible that units that failed during the Polar Vortex improved their performance and that a different set of units failed during Winter Storm Elliott. Alternatively, the Commission may have been correct that performance could have improved after the Polar Vortex "only to trail off later." *Id.*
[25] PJM, Winter Storm Elliott: Event Analysis and Recommendation Report, at 49 (July 17, 2023) ("Winter Storm Elliott Report"), https://www.pjm.com/-/media/library/reports-notices/special-reports/2023/20230717-winter-storm-elliott-event-analysis-and-recommendation-report.ashx. This report is also attached in Volume 1 of Attachments to this protest; *see* ATT-3.

nearly 47,000 MW of forced outages, eighty-six percent involved coal or gas plants.[26] These outages were particularly challenging for PJM because "in 92% of generator outages, PJM operators had an hour's notice or less," and "in most cases, PJM was informed of outages when dispatchers called generators to request them to turn on."[27]

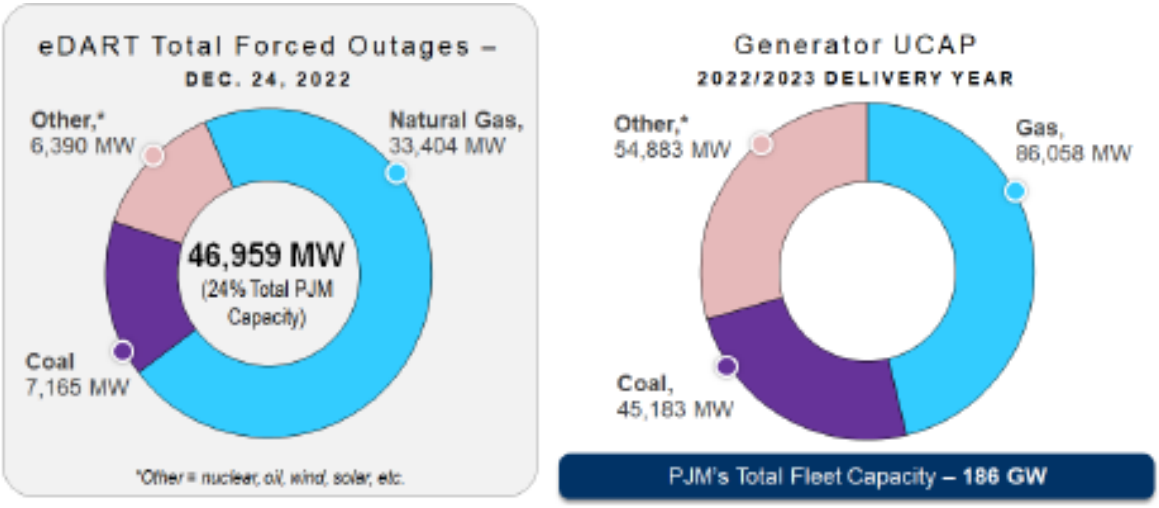

Figure 2: Winter Storm Elliott Outages by Primary Fuel[28]

Facing widespread failures of capacity resources during Winter Storm Elliott—particularly among gas and coal plants—PJM took numerous, prudent emergency measures that maintained reliable electric service. PJM's efforts included calling on non-capacity resources, obtaining emergency authorization for power plants to exceed pollution-control limits in Clean Air Act permits, calling on all demand response resources, and calling on consumers to voluntarily reduce electricity consumption.[29]

[26] *Id.*
[27] *Id.* at 2.
[28] *Id.* at 49.
[29] *Id.* at 1–2, 5; *see also* PJM, Request for Emergency Order Under Section 202(c) of the Federal Power Act, at 4 (Dec. 24, 2022), https://www.pjm.com/-/media/documents/other-fed-state/20221224-doe-202c-filing.ashx (requesting authorization for power plants to exceed permitted limits on "sulfur dioxide, nitrogen oxide, mercury, carbon monoxide, wastewater release, and other air pollutants").

The remarkable failure rate of capacity resources during Winter Storm Elliott led to the largest CP penalties that PJM has ever assessed. "[R]oughly 750 resources with final performance shortfall[s]" received "approximately $1.80 billion" in penalties, which funded payments for resources that actually performed during the storm. Critically, however, even accounting for these penalties, unreliable capacity resources *still earned $370 million in capacity revenues*. As PJM reported, "the 1.80 billion in Non-Performance Charges represents 83% of the 2.17 billion in [capacity] auction credits collectively received by these under-performing resources for the 2022/2023 Delivery Year."[30] Moreover, although PJM's CP system includes a "stop-loss" provision, which caps the maximum annual penalty, "[f]or all CP resources involved in the Winter Storm Elliott performance assessment event, the calculated Non-Performance Charge for the event was below the maximum yearly Non-Performance Charge."[31] Hence, PJM did not "apply the stop-loss provision to any CP resource for the Winter Storm Elliott performance assessment event."[32]

III. PJM'S RESPONSE TO WINTER STORM ELLIOTT

As it did after the Polar Vortex, PJM responded to Winter Storm Elliott by deciding to change the rules of the capacity market. Although PJM had convened stakeholders in a Resource Adequacy Senior Task Force in 2021 to discuss broad capacity market reforms, PJM's Board of Managers ("Board") sent a letter in February 2023 that instituted a Critical Issue Fast Path ("CIFP") to accelerate the reform process and narrow its scope.[33] PJM's Board directed staff and

[30] Winter Storm Elliott Report, *supra* note 25 at 110.
[31] *Id.* at 111.
[32] *Id.*
[33] Letter from Mark Takahashi, Chair, PJM Board of Managers, to PJM stakeholders (Feb. 24, 2023), https://www.pjm.com/-/media/about-pjm/who-we-are/public-disclosures/20230224-board-letter-re-initiation-of-the-critical-issue-fast-path-process-to-address-resource-adequacy-issues.ashx. This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-267.

stakeholders to address four issues: (1) enhanced risk modeling; (2) potential modifications to the CP system; (3) improved accreditation; and (4) synchronizing capacity market rules with Fixed Resource Requirement ("FRR") rules.[34] The Board directed PJM to aim to file proposed reforms with FERC by October 1, 2023.[35]

Consistent with the Board's directive to enhance risk modeling, PJM staff modeled how correlated outages among thermal power plants contribute to reliability risks at different times of year. Contrary to PJM's prior assumption that summer peak load was the riskiest period for the region, PJM's updated modeling showed much greater risks during winter, driven principally by correlated outages at thermal power plants.[36] Notably, PJM found that high demand caused by cold weather was not the "primary driver of new winter risk."[37] Instead, PJM found that "winter risk is driven by extreme correlated outage potential," in particular the risk that "thermal forced outages increase during colder temperatures, and can reach extreme levels."[38]

Following its finding that winter risks from unreliable thermal plants exceed summer risks associated with peak loads, PJM began designing a seasonal capacity market. However, while numerous stakeholders supported the general idea of a seasonal market, the CIFP's tight timeline meant that PJM was unable to build stakeholder support for its particular seasonal market design in time for the October filing target.

PJM staff also followed through on the Board's instruction to improve accreditation by accounting for correlated outages of thermal plants. PJM reasoned that "[a]ccreditation that over-states resources' contribution to reliability artificially inflates supply, depresses clearing prices

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[34] *Id.* at 2.
[35] *Id.*
[36] PJM, Update on Reliability Risk Modeling, at 9–13 (May 30, 2023), https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230530/20230530-item-03---reliability-risk-modeling-5-30-2023-cifp-meeting.ashx. This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-425.
[37] *Id.* at 11.
[38] *Id.* at 12.

… and harms reliability."[39] As such, PJM proposed to account for all supply-side risks, such as correlated outages, in capacity accreditation. PJM also proposed to move to a marginal ELCC system for all resources.[40]

As to its CP system of penalties and bonuses, in the wake of Winter Storm Elliott, PJM has taken or proposed changes that will significantly alter how many penalties are assessed and what resources receive bonuses. For example, in Docket ER23-1996, PJM proposed tariff changes, which the Commission accepted, that will "limit the determination of future [PAIs]" by "narrow[ing] the definition of Emergency Action" that would trigger a PAI.[41] At the same time, PJM opted not to file a stakeholder proposal that would reduce penalty rates during PAIs, finding that reducing the penalty rate without increasing "qualification or performance requirements does not provide sufficient incentives for resources to perform during a PAI and ultimately risks reliability to the PJM system."[42] Still, while PJM did not alter the penalty rate, limiting the triggers for PAIs will make them rarer and reduce penalties for unreliable capacity resources.

Similarly, after unreliable capacity resources challenged PJM's assessment of penalties during Winter Storm Elliott, PJM proposed a joint settlement along with many affected generators, which would, if approved by the Commission, substantially reduce those penalties. All told, that settlement would reduce the penalties assessed during Winter Storm Elliott by

[39] PJM, Capacity Market Reform: PJM's Proposal, at 20 (June 14, 2023) ("Capacity Market Reform: PJM's Initial Proposal"), https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230614/20230614-item-02---pjm-cifp-stage-3-proposal.ashx. This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-270.
[40] PJM, Executive Summary: PJM Seasonal and Annual Proposals, at 5 (Aug. 23, 2023), https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230823/20230823-item-01a---20230823-cifp-stage-4---pjm-exec-summary.ashx. This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-443.
[41] Proposed Revisions to Prospectively Refine the Definition of Emergency Action, Request for Shortened Comment Period and Expedited Commission Action, at 4, Docket No. ER23-1996 (Aug. 28, 2023), Accession No. 20230828-5201.
[42] *Id.* at 22.

31.7%, or roughly $570 million.[43] If approved, this settlement would mean that underperforming capacity resources will have earned roughly $940 million for one delivery year despite failing to provide reliability when needed.[44]

PJM's current proposals would further significantly alter the CP system by limiting what resources are eligible for Performance Payments and by reducing the cap on annual penalties. Although PJM recognizes that the recipients of payments from Winter Storm Elliott include resources "that did not clear the capacity market or receive capacity revenues in the first instance, yet performed when needed and ultimately provided PJM with critical supply,"[45] PJM now proposes (in its MSOC Filing) to restrict bonuses so that only capacity resources that clear the capacity auction are eligible. Although this docket only involves one change to the CP system—a reduction in the cap on annual penalties—the full context of PJM's changes to the CP system is important to the Commission's evaluation of the change proposed in this proceeding.

DISCUSSION

I. PJM'S PROPOSAL WOULD PROPERLY ACCOUNT FOR FOSSIL OUTAGES IN ACCREDITATION AND PUT CAPACITY RESOURCES ON A MORE EVEN FOOTING.

PJM's Accreditation Filing would improve the capacity market by more accurately accrediting thermal resources to reflect their poor performance during extreme winter weather—which is the single greatest threat to reliability in this region. Because fossil resources comprise

[43] PJM, Offer of Settlement, at 4, 7 (Sept. 29, 2023) ("Settlement Proposal"), https://pjm.com/-/media/documents/ferc/filings/2023/20230929-er23-2975-000.ashx.
[44] *See id.* (noting a 31.7% reduction in the $1.8 billion in penalties, or $570 million); *see also* Winter Storm Elliott Report, *supra* note 25 at 110 (noting that "the 1.80 billion in Non-Performance Charges represents 83% of the $2.17 billion in [capacity] auction credits collectively received by these under-performing resources," meaning that underperforming resources still earned roughly $370 million even before any reduction in penalties from a settlement).
[45] Settlement Proposal, *supra* note 43 at 4.

roughly three-quarters of PJM's capacity fleet,[46] the threat from their inability to perform when needed is in some sense obvious. However, the threat to reliability from underperforming fossil generators—especially gas plants—is even greater than their share of the capacity fleet suggests. For example, as PJM noted, during Winter Storm Elliott, "while gas units ma[d]e up roughly half of committed generation capacity, they represented 71.8% of all shortfall megawatts."[47] Combined, gas, coal, and oil plants represented 92.2% of all generation shortfalls.[48]

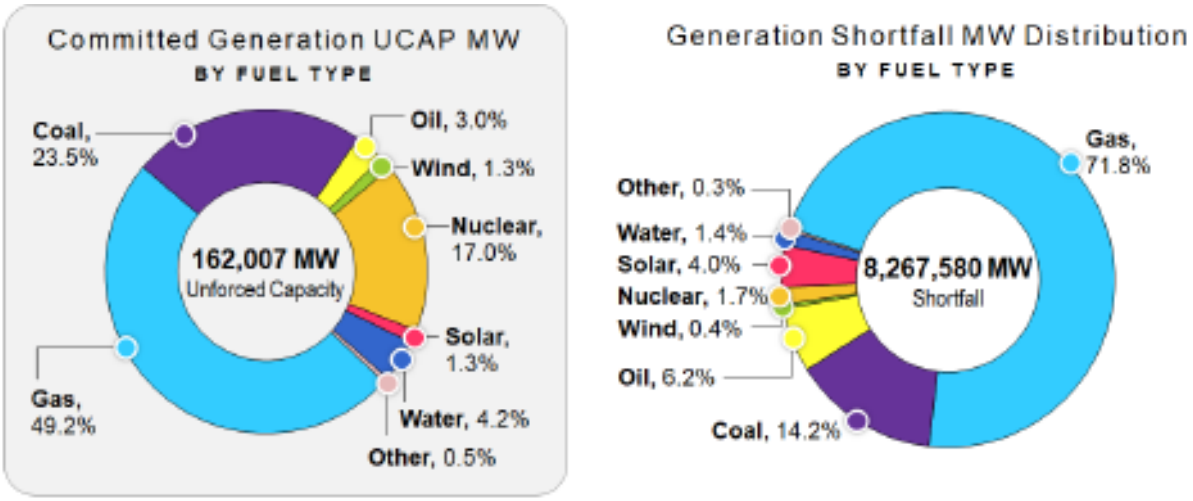

Figure 3: Winter Storm Elliott Generation Shortfalls Compared to Capacity Commitments[49]

A similar pattern played out during prior winter storms. During the Polar Vortex, "gas-fired plants represent[ed] 29 percent of total generation (in megawatts)" but "accounted for 47 percent of the unavailable megawatts."[50] And even during the milder cold snap of 2018, gas plants accounted for 22% of PJM's capacity fleet but represented 58.9% of outages.[51] And

[46] *See* Winter Storm Elliott Report, *supra* note 25 at 108 (noting that of the capacity fleet, gas constitutes 49.2%, coal constitutes 23.5%, and oil constitutes 3%. In total, these fossil resources comprise 75.7% of PJM's capacity fleet.).
[47] *Id.* at 107.
[48] *Id.* at 108.
[49] *Id.*
[50] Polar Vortex Report, *supra* note 10 at 25.
[51] Cold Snap Report, *supra* note 22 at 13, 15 (depicting that gas plant outages represented 8,096 MW and gas supply outages represented 5,913 MW, which together reflect 58.9% of the total 23,751 MW of outages).

although gas supply has been a significant cause of outages in each major winter storm, mechanical failures at gas plants caused a greater share of outages in each instance.[52]

Mechanical failures, rather than fuel supply, were also the overwhelming cause of the unacceptably high failure rate of coal plants during winter storms in PJM. For example, during Winter Storm Elliott, fuel supply problems accounted for only 3% of coal unit outages, while mechanical problems at boilers *alone* accounted for 53%.[53] Similarly, during the Polar Vortex, non-gas fuel supply issues accounted for only 2% of outages, while mechanical problems caused vastly more plant failures.[54] Critically, mechanical failures are not only preventable, but are exactly the type of problem that PJM set out to solve when it established its CP system.[55]

Correlated outages at thermal plants are the greatest current threat to reliability in PJM. Although PJM has historically assumed that the greatest reliability risk coincides with summer peak load,[56] when PJM uses a model that "capture[s] correlated outages more accurately," the "results show significantly more risk in the winter."[57] In particular, because correlated outages at thermal plants in winter lead to a greater level of Expected Unserved Energy ("EUE") than occurs during outages driven by summer peak loads, PJM projects that "expected summer loss-of-load events [will be] more common but less impactful from a magnitude standpoint than those expected to occur in winter."[58] Indeed, PJM expects that "approximately 64%" of the risk to

[52] *See id.* at 15 (depicting that gas plant outages exceeded gas supply outages in 2014 and 2018); *see also* Winter Storm Elliott Report, *supra* note 25 at 50–51 (noting that "plant and mechanical failures, including freeze-related issues, were the major reasons units were unavailable" and depicting the various causes of gas plant outages).
[53] Winter Storm Elliott Report, *supra* note 25 at 55 (depicting outages in terms of megawatt hours by fuel type and cause).
[54] Polar Vortex Report, *supra* note 10 at 25 (depicting causes of forced outages).
[55] *See CP Order*, 151 FERC § 61,208 at P 45 ("Without more stringent penalties, PJM has shown there is little incentive for a seller to make capital improvements, or increase its operating maintenance for the purpose of enhancing the availability of its unit during emergency conditions.").
[56] Accreditation Filing, *supra* note 1 at 15.
[57] *Id.* at Attachment E, Affidavit of Dr. Patricio Rocha-Garrido on Behalf of PJM Interconnection, L.L.C. ("Rocha-Garrido Aff.") P 45, PDF p. 705.
[58] *Id.*

reliability, measured in EUE, will occur in winter, while only 36% will occur in summer.[59] As noted below in section IV, there is reason to believe that PJM's model may somewhat overstate the degree of shift in risk to the winter. Nevertheless, PJM is moving in the right direction by recognizing the clear pattern of thermal generators' correlated outages in winter, which its own modeling shows is the greatest threat to reliability.

In contrast, while PJM suggests that "[t]he need for enhancements to the capacity market [is] primarily driven by the evolution in the resource mix,"[60] the addition of clean energy to PJM's grid has not imperiled reliability. Instead, during the Polar Vortex and Winter Storm Elliott, wind power exceeded its calculated capacity and "contributed to PJM's ability to maintain reliability."[61] And although PJM assessed penalties against solar resources for not generating electricity at night during Winter Storm Elliott (despite knowing that solar generators obviously never generate electricity at night), this reveals that PJM's penalties are unreasonable rather than indicating any defect in solar performance.[62] Indeed, PJM reports that "[d]uring Winter Storm Elliott, the wind and solar resources performed as the near-term forecasts projected, based upon wind speed and solar irradiance throughout the [Regional Transmission Organization ("RTO")]."[63] Hence, in contrast to fossil resources, whose preventable mechanical

[59] *Id.*
[60] *Id.* at 9.
[61] Polar Vortex Report, *supra* note 10 at 21; Winter Storm Elliott Report, *supra* note 25 at 58 ("[W]ind generation on average performed above its expected capacity.").
[62] *See generally* Complaint of SunEnergy1, LLC, Docket No. EL23-58 (April 5, 2023), Accession No. 20230405-5181; *see also* Combined Protest and Answer of Sierra Club to Complaints Regarding Nonperformance Penalties During Winter Storm Elliott, at 21–25, Docket No. EL23-58-0000 (May 26, 2023) ("Combined Protest and Answer of Sierra Club"), Accession No. 20230526-5234. This document is also attached in Volume 3 of Attachments to this protest; *see* ATT-590.
[63] PJM, Winter Storm Elliott: Frequently Asked Questions, at 6 (Apr. 12, 2023) ("Winter Storm Elliott FAQ"), https://www.pjm.com/-/media/markets-ops/winter-storm-elliott/faq-winter-storm-elliott.ashx. This document is also attached in Volume 1 of Attachments to this protest; *see* ATT-139.

failures drove outages that threatened reliability, wind and solar performed properly and contributed to reliability.

PJM's proposed changes to accreditation will improve reliability by more accurately accounting for the poor performance of fossil fuels during winter weather. PJM's current approach to accrediting fossil generators, an Equivalent Demand Forced Outage Rate ("EFORd") method, falsely assumes that outages at thermal plants are not correlated.[64] As described above and as PJM recognizes in its current filing, the consistent pattern of repeated, widespread outages at thermal plants during winter storms amply proves that outages at these plants are in fact correlated.[65] The false assumption of uncorrelated outages leads to inaccurate accreditation of the majority of PJM's fleet, which "artificially inflates supply," skews the signals that the capacity market is intended to send, and "harms reliability.[66]

PJM proposes to correct its skewed accreditation of thermal generators by switching to an ELCC methodology. PJM intends this ELCC methodology to function "as a reliability backstop, preventing the PJM Region from over-relying on resources that do not perform consistently during periods of risk at the expense of system reliability."[67] As PJM recognizes, "correlated outages must be considered in risk modeling and accreditation in order to properly anticipate the performance of these resources, particularly during the winter, and to understand how the

[64] Accreditation Filing, *supra* note 1 at 34–35 (noting that "unplanned outages" at thermal plants "were generally assumed to be random" and as a result PJM's current accreditation system does not consider "the chance of having a large amount of these resources on an outage simultaneously [to be] a major factor in resource adequacy planning").
[65] *See id.* at 13 (noting that "PJM resources have demonstrated outage correlation with weather," that "specifically, cold weather has been demonstrated to be a significant driver of resource adequacy risk," and that "correlated outages must be considered in risk modeling and accreditation"); *see also id.* at Rocha-Garrido Aff. P 13, PDF p. 689 (explaining that "recent events have demonstrated" that the assumption that "unplanned outages" at thermal plants "are random" is not correct, and instead that outages at thermal plants have "non-random nature and [] established patterns") (internal quotation omitted).
[66] Capacity Market Reform: PJM's Initial Proposal, *supra* note 39 at 20.
[67] Accreditation Filing, *supra* note 1 at 24.

common-mode failures can drive resource adequacy risks."[68] Unlike PJM's current EFORd methodology, the ELCC approach does not ignore "resource adequacy risk patterns" such as the pattern of outages at thermal plants during winter storms.[69] Instead, "the amount of correlated outages," which PJM recognizes are "substantial drivers of supply-side risk," "will be captured" by the proposed ELCC approach.[70] Because PJM's proposed ELCC approach will correct the current accreditation system's failure to account for the greatest threat to reliability in the region, PJM's proposal to use an ELCC methodology reflects a significant step toward improving regional reliability.

PJM's proposal to use an ELCC methodology to accredit thermal resources also significantly reduces the risk of undue discrimination among resource types during accreditation. The EFORd system's flawed premise that thermal resources do not experience correlated outages not only renders this accreditation unreasonable,[71] but also discriminates in favor of these resources by placing them at a competitive advantage by artificially suppressing their offer prices and creating the false perception that thermal resources are more reliable than they really are.[72] This flawed accreditation method also allows fossil resources to sell more capacity than they are actually capable of delivering. In contrast, PJM's current accreditation of renewable and storage resources does account for their correlated unavailability, such as solar plants not generating electricity at night or wind plants not generating electricity without wind.[73] Because PJM's current accreditation system thus fails to account for the correlated outages of thermal resources

[68] *Id.* at 13.
[69] *Id.* at 25.
[70] *Id.* at Rocha-Garrido Aff. P 10, PDF p. 688.
[71] *Id.* at P 14, PDF p. 690 ("the logic underlying use of EFORd as the main accreditation metric assumes that unplanned outages experienced by [thermal resources] are random and thus each resource's forced outage pattern is independent from other [resources'] forced outage patterns, and we now know this to not be the case").
[72] *See id.* at Keech Aff. P 16, PDF p. 623 ("Under the current rules it could be argued that certain resource classes may be advantaged, or disadvantaged, just because of the accreditation approach that is applied to them.").
[73] *See id.* at 25–26 (discussing PJM's current use of an average ELCC approach for "Variable Resources").

but does account for the correlated unavailability of renewables or storage, the current approach to accreditation is discriminatory. And because that discrimination rests on the false premise of the ostensible randomness of thermal outages, the discrimination lacks any reasoned basis and is thus undue. Fortunately, PJM's proposal would reduce undue discrimination in accreditation by using a comparable, and more accurate, methodology for all resources.

II. PJM FAILS TO DEMONSTRATE THAT ITS PROPOSED MARGINAL ELCC ACCREDITATION, INCLUDING ITS PROCESS FOR UNIT-SPECIFIC ADJUSTMENTS, IS JUST, REASONABLE, AND NOT UNDULY DISCRIMINATORY.

A. PJM Fails to Demonstrate That Unit-Specific Adjustments to Class ELCCs Will be Just and Reasonable and Send Appropriate Market Signals.

PJM's proposal to apply an ELCC method to accrediting thermal resources is long overdue and commendable. However, thermal resources raise distinct considerations from renewables when applying ELCC methods, because many factors affecting thermal resources' availability are under management control, and the performance of individual units may diverge from simulated or modeled expectations.[74] For example, a gas plant with firm fuel transportation arrangements, or that chooses to nominate gas in the day-ahead markets when it sees a winter storm coming, will likely have better availability during hours of system risk, especially in the winter. For example, during Winter Storm Elliott, PJM gas units with firm fuel supply arrangements performed significantly better than units without firm fuel, experiencing forced outages at a maximum of 16% of their Installed Capacity ("ICAP") on PJM's system, compared

[74] Brattle, Capacity Resource Accreditation for New England's Energy Transition: Report 1: Foundations of Resource Accreditation, at 26 (June 2, 2022) ("Brattle Report 1"), https://www.mass.gov/doc/capacity-resource-accreditation-for-new-englands-clean-energy-transition-report/download ("Incorporating elements of performance-based accreditation is especially important for traditional thermal resources, whose performance is strongly affected by these management factors, not just weather distributions.") This report is also attached in Volume 3 of Attachments to this protest; *see* ATT-501.

to a 45% outage rate of the ICAP of gas plants with single fuel and no firm gas contracts.[75] Similarly, a coal plant that has weatherized its equipment and stringently adheres to maintenance practices to avoid malfunctions in extreme temperatures will be more available when it matters most.[76] To incentivize the investment and operational practices that are needed for reliability, it is vital that an accreditation approach distinguish between resources that are in the same class, to reward suppliers that beat the average and penalize those that don't.[77]

PJM does propose to use a Resource Performance Adjustment ("RPA") to the ELCC class ratings "that is intended to differentiate good performers from poor performers,"[78] but its method for implementing this adjustment is unclear. In particular, it is unclear how much these adjustments will rely on simulated performance of individual resources, versus supplier-submitted documentation. It is also not apparent from PJM's filing how adjustments made to individual resource performance will flow through to PJM's Reserve Requirement Study, its

[75] Brian Fitzpatrick, Winter Storm Elliott Natural Gas Fuel Supply Issues, at 9 (Apr. 13, 2023), https://www.pjm.com/-/media/committees-groups/committees/oc/2023/20230413/20230413-item-04---winter-storm-elliott-fuel-supply-issues.ashx. This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-413.

[76] Winter Storm Elliott Report, *supra* note 25 at 51, Figure 32 (showing causes of coal outages that held steady around 10 GW throughout Winter Storm Elliott). As recently as June 2023, PJM staff was considering a minimum weatherization requirement, exceeding the NERC standard, for any facility to qualify to sell winter capacity. *See* Capacity Market Reform: PJM's Initial Proposal, *supra* note 39 at 18.

[77] Brattle, Capacity Resource Accreditation for New England's Clean Energy Transition: Report 2: Options for New England, at 21 (June 28, 2022) ("Brattle Report 2"), https://www.brattle.com/wp-content/uploads/2022/06/Capacity-Resource-Accreditation-for-New-Englands-Clean-Energy-Transition-Report-2-Options-for-New-England.pdf ("By not rewarding individual over-performance, this approach provides no additional incentive (beyond energy market price signals and Pay-for-Performance incentives) for resources to pursue technological upgrades or operational changes to maximize performance during shortage events. . . . A well-designed adjustment creates the incentive for resources to maximize their performance during high-risk hours, and it will sharpen the capacity market's investment and retirement signals."). This report is also attached in Volume 3 of Attachments to this protest; *see* ATT-554. *See also* Brattle Report 1, *supra* note 74 at 46 (guiding principles for accreditation include "help[ing] incent resource owners to enhance, maintain, and operate their facilities to be able to perform when needed most, by reflecting demonstrated performance in their accreditation"); Brattle Report 2, *supra* note 77 at 25 ("will new resources/investments be incentivized to pursue upgrades or operational changes that result in improved going-forward performance?"); Brattle Report 1, *supra* note 74 at 24 ("assigning the same value to all resources in a given class would be inaccurate, given each resource's unique technologies, configurations, innovations, and operations causing different abilities to reduce shortages. Individualized adjustments are necessary and could be implemented in numerous ways. . . .").

[78] Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. P 36, PDF p. 702.

Capacity Performance Quantifiable Risk ("CPQR") estimates, and other interrelated components of the overall market design.

1. PJM must ensure that unit-specific adjustments do not render class ELCCs meaningless.

PJM describes the RPA as an adjustment to the ELCC class rating based on a particular resource's modeled output during certain hours of the year, weighted by the probability of lost load in those hours, to yield an adjustment based "on how well the resource performed in the hours with high resource adequacy risk."[79] While this approach is conceptually sound, many aspects of PJM's implementation are unclear and the approach risks unreasonable and discriminatory accreditations if not implemented properly.

PJM describes this adjustment as being based on modeled output but does not seem to examine the modeled output using the same inputs that otherwise produce the ELCC class ratings. PJM's procedures for administering the marginal ELCC approach, in Schedule 9.2, Section J, requires capacity suppliers to submit data that would inform the ELCC analysis: "The required information may include relevant physical parameters, relevant historical data such as weather data and actual or estimated historical energy output, and documentation supporting such parameters and historical data."[80] PJM would then "evaluate, validate, and approve the foregoing information," which may or may not include an assessment of "the consistency of such information with observed conditions."[81] The Reliability Assurance Agreement ("RAA") goes on to explain that PJM "will coordinate with the Generation Capacity Resource Provider of the

[79] *Id.* at 50–51; *id.* at Proposed Schedule 9.2, Section D(2), PDF pp. 362–363.
[80] *Id.* at Proposed Schedule 9.2, Section J, PDF pp. 365–366.
[81] *Id.*

ELCC Resource to understand the information and observed conditions before making a determination regarding the validity of the applicable parameters."[82]

This description of PJM's process is unclear about several points that are crucial to the efficacy and fairness of PJM's approach to unit-specific adjustments. As a result, PJM has failed to carry its burden of proof to establish that the proposed tariff provisions will result in just and reasonable, and not unduly discriminatory rates. First, it is unclear why PJM would rely on suppliers for weather data at all, given the centrality of weather data to PJM's entire risk modeling and accreditation framework and the risks posed by inconsistencies in that data. Second, it is unclear how PJM will decide to use generator-supplied information instead of relying upon "observed conditions." This decision creates the risk of inequitable treatment of generators and of inaccurate information being injected into PJM's process. For that reason, it is critical that there be transparency regarding what adjustments PJM makes based on generator-supplied data and parameters. This is not to say that generator-supplied data is inherently suspect—indeed it may better reflect recent improvements to a generator's flexibility or performance, or operational practices into which PJM has less visibility.[83] But PJM's explanation for what it will consider "valid" data is utterly lacking, especially combined with the absence of transparency and reporting on what kinds of adjustments are made and on what basis.[84]

Third, there is no apparent mechanism to guarantee consistency. If PJM determines that individual generators have submitted data supporting adjustments in accreditation, that data should flow back into and adjust the class ELCC rating (and possibly the ratings for resources in

[82] *Id.*

[83] Brattle Report 1, *supra* note 74 at 26, n.38 ("Where available, actual observations are superior to simulated values because simulation models cannot possibly account for all operational differences, especially for thermal, hydro, battery, and hybrid resources.")

[84] PIOs understand that such adjustments may need to be aggregated to protect confidential business information, but confidentiality considerations should not preclude reporting of information essential to evaluating whether PJM's RPA process is being implemented in an even-handed and reasonable way.

other classes). PJM's filing, tariff, and manuals are silent on this issue, raising significant doubts as to the reasonableness of its overall approach to accreditation.

2. Accurate Resource Performance Adjustments are Necessary to Properly Incentivize Firm Fuel Arrangements and Weatherization.

As part of the CIFP, PJM initially considered ELCC classes that distinguished gas plants with and without firm fuel supply arrangements, in what it labeled its Fuel Assurance Accreditation proposal.[85] Among the objectives of this proposal were to "add accreditation factors to effectively value resources which commit to enhanced fuel security capital investment" in order to "recognize and incent the additional level of reliability that can be obtained through investment in fuel security measures."[86] This proposal also would have established a class for dual-fuel gas resources.

Less than two weeks later, PJM retreated from the proposal to differentiate based on firm fuel arrangements (but not dual fuel) based on a lack of information.[87] However, PJM committed to gathering this information for future updates to the accreditation framework through "attestations to provide data needed for ELCC determinations and any potential future implementation of [firm transportation] vs. [interruptible transportation] accreditations."[88]

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[85] PJM, PJM Capacity Market Fuel Assurance Accreditation (June 28, 2023), https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230628/20230628-item-02b---pjm-fuel-security-cifp-proposal-final.ashx. This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-396.

[86] *Id.* at 2; *see also* Brattle Report 2, *supra* note 77 at 19 ("Applying marginal ELCC to thermal resources may require the RTO to group thermal resources into granular resource classes according to the nature of their fuel supply arrangements, the number of days of firm fuel, and weatherization attributes or even modeling some thermal resources on a resource-specific basis. The accuracy of the resulting reliability modeling would need to be extensively back-tested relative to realized historical performance and system-wide reliability/scarcity metrics during tight winter periods.").

[87] *See, e.g.*, PJM, PJM Capacity Market Fuel Assurance Accreditation, at 6 (July 10, 2023), https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230710/20230710-item-02a---pjm-fuel-security-cifp-proposal-final-(003).ashx ("PJM plans to collect data on this with the intention of further analyzing it to support any beneficial class-level distinction in transportation service level in the future."). This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-404.

[88] *Id.* at 6. PJM's draft proposed attestation is available at PJM, Elements of Fuel Security Attestation, https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230601/20230601-item-05b---cifp-elements-of-gas--fuel-security-attestation.ashx (last visited Nov. 7, 2023).

Unfortunately, PJM's filing includes no requirements for such attestations or indeed any discussion of data-gathering efforts that PJM might undertake, meaning that PJM will be in the same information-impoverished state regarding the impacts of firm fuel on accreditation for the foreseeable future.

Fuel supply was an important factor in the staggering forced outage rates observed during Winter Storm Elliott, and whether a generator had firm fuel transport influenced whether they could perform during that emergency.[89] If PJM's reforms to accreditation are to meaningfully address the shortcomings observed during Winter Storm Elliott, it is critical that PJM differentiate among resources based on their likelihood of having fuel during emergencies. Because PJM has declined to create ELCC classes based on fuel supply arrangements, PJM is left with only the Resource Performance Adjustment to ensure this differentiation. PJM fails to make clear whether or how PJM's RPA process would ensure that investments in better fuel supply or weatherization are rewarded. As noted above, that process is opaque and not well-documented. PJM was not responsive to stakeholder requests during the CIFP to produce estimates of the extent to which final ELCCs might vary within the gas and coal ELCC classes based on unit-specific characteristics or performance. As a result, parties to this proceeding and the Commission are left without any reassurance that the wide variation in performance among thermal resources will actually show up in accreditation. Reflecting fuel-supply related performance in accreditation would send better signals for poorly performing resources to retire or improve their fuel arrangements, and for better-performing resources to enter or remain.

A larger problem with PJM's reliance solely on RPAs is that the approach does not enable generators to be awarded on a prospective basis for making such investments. A gas plant

[89] Winter Storm Elliott Report, *supra* note 25 at 59 ("[G]as units with firm and non-firm fuel supply arrangements experienced forced outage rates of 13.8% and 33.9%, respectively.").

that performed poorly during Winter Storm Elliott because of an interruptible fuel arrangement and that decides to invest in firm fuel transportation going forward will not see that decision rewarded in accreditation in any meaningful way. The better performance it experiences in the first delivery year with the better fuel supply arrangement will only incrementally improve its accreditation under the RPA process, which looks at 11 years of data to begin with, and eventually many more.[90] In contrast, PJM's earlier proposal to create separate classes for gas plants with firm fuel would have enabled the gas plant to "jump the class" and see an immediate accreditation boost for that investment. PJM's proposal will not meaningfully enhance the price signal that the capacity market sends for improved fuel supply arrangements, leaving only its now-weakened CP rules to incentivize generators to make investment decisions that benefit reliability.

More stringent accreditation for thermal resources that accounts for correlated outages is essential, but not sufficient, to correct the issues seen in Winter Storm Elliott. PJM must also ensure that its accreditation scheme rewards better performance by thermal resources, which still make up the overwhelming majority of committed capacity resources in PJM. Reliability threats illuminated by Winter Storm Elliott will not be addressed unless PJM's rules promote the replacement of unreliable resources with those that can perform. If PJM has data demonstrating that its approach of relying on Resource Performance Adjustments will sufficiently capture the variability within the gas and coal fleets, it should produce that information for consideration.

[90] *See* Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. P 20(c), PDF p. 692 ("[F]orced outage modeling of Unlimited Resources in the proposed ELCC/RRS model would include resource performance data back to June 1, 2012, with data from each passing Delivery Year added to the model.").

3. *PJM must account for Resource Performance Adjustments in other aspects of market implementation.*

PJM's process for Resource Performance Adjustments must also be rigorous and transparent for another reason—these adjustments can broadly affect other components of PJM's market design. However, PJM's proposed RAA language and transmittal letter provide no reassurance that the RPAs will be reflected in other analyses that PJM undertakes.

For instance, PJM should ensure that any overall adjustment to the Class ELCC rating for combined cycle resources that may emerge after the Resource Performance Adjustment process is reflected in the calculation of the Net Cost of New Entry for purposes of the Variable Resource Requirement ("VRR") curve.[91] As recently approved by the Commission, the reference resource for the VRR curve has numerous characteristics that may give it better-than-average performance, including firm fuel supply and the latest turbine technology, which may result in a higher capacity value than the ELCC Class Rating in practice.[92]

PJM has also not explained, across the Accreditation and MSOC filings, whether changes that it makes under the Resource Performance Adjustment mechanism will be reflected in PJM's calculation of the CPQR, or its review of the seller-supplied CPQR. As PJM describes its approach to the default CPQR calculation, it will assess how well a particular unit is likely to perform during periods of modeled system risk.[93] This assessment must reflect any adjustments that PJM makes to the ELCC value of a particular resource under the RPA, lest a supplier represent better performance to PJM for purposes of accreditation and worse performance for

[91] *See* Accreditation Filing, *supra* note 1 at 79 (explaining role for Class ELCC rating of combined cycle gas plants in the parameters for the VRR curve).
[92] *PJM Interconnection, LLC*, Transmittal Letter at 12–14, Docket No. ER22-2984-000 (Sept. 30, 2022), Accession No. 20220930-5374.
[93] PJM, Proposed Enhancements to PJM's Capacity Market Rules – Market Seller Offer Cap, Performance Payment Eligibility, and Forward Energy and Ancillary Service Revenues, at 13, Docket No. ER24-98 (Oct. 13, 2023) ("MSOC Filing"), Accession No. 20231013-5141 ("Under this approach, PJM would conduct a probabilistic analysis of unit-specific performance under a range of system conditions for each resource . . . .")

purposes of obtaining a higher market seller offer cap. While this issue is primarily relevant to the validity of PJM's CPQR calculation and PIOs are therefore raising it in our protest filed in ER24-98, it also reflects on the internal consistency and rigor of PJM's accreditation approach, insofar as PJM has not included RAA provisions that ensure consistency in unit-level accreditation across all procedures in which that accreditation is an input.

B. Marginal ELCC Can Be Viable Under Certain Circumstances and If Properly Implemented.

PJM proposes to apply a marginal ELCC approach to determine the capacity value of all generation capacity and demand resources offering into its capacity market.[94] This approach has some benefits that PJM has articulated, but also important limitations that flow from it disconnecting accredited value from resources' peak load-carrying value and expected energy contributions.[95]

The Commission has weighed the advantages and disadvantages of marginal ELCC only once before, in approving the marginal ELCC proposal brought forward by the New York Independent System Operator ("NYISO").[96] However, the NYISO capacity market has several important differences from the PJM capacity market, and these differences were material to the Commission's decision. Thus, the Commission's consideration of PJM's marginal ELCC proposal is a matter of first impression in significant part (despite PJM's failure to acknowledge these key differences in its reliance on the *NYISO* order).

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[94] *Id.* at 26 (PJM notes that the only exception to this is energy efficiency resources).
[95] Nick Schlag et al., Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy, Energy and Env't Econ., Inc., at 11 (Aug. 2020), https://www.ethree.com/elcc-resource-adequacy/. This report is also attached in Volume 3 of Attachments to this protest; *see* ATT-478.
[96] *New York Independent System Operator, Inc.*, 179 FERC ¶ 61,102 (2022) ("*NYISO*").

Most notably, PJM runs a three-year forward auction in a fairly liquid market, where offer prices matter, not all offered resources clear, and the cleared resource mix is not known before auctions are complete. In contrast, in NYISO's very tight month-ahead spot market, the vast majority of resources "do not submit price-sensitive offers" and instead "clear in every spot auction in which they participate," making it possible for NYISO to accurately anticipate the cleared resource mix before running auctions.[97] This structure means that PJM has more uncertainty regarding the resource mix for the delivery period than NYISO does. In rejecting arguments that NYISO's marginal ELCC proposal risked inaccurate accreditation, the Commission "agree[d] . . . that the *nature of NYISO's Spot Market Auction mitigates concerns* that the resource fleet used to calculate Capacity Accreditation Factors would not closely resemble the resource fleet that clears the Spot Market Auction."[98] This is because in NYISO, the resources in the resource adequacy model "almost exactly align with the resources that receive capacity supply obligations."[99] The Commission also found that "there is little to no risk that NYISO's proposal would cause a disconnect between the resource fleet assumed by the [model] and the resource fleet that clears the auction" because "the vast majority of resources offer into the Spot Market Auction at $0/kW-month (i.e., as price takers) because there is little incentive for resources to submit price sensitive offers into a Spot Market Auction."[100] In contrast, the outcomes in PJM's capacity market can differ substantially compared to the mix that offers into the auction or that PJM expects to be available three years in advance, which is the information on which PJM plans to calculate marginal ELCCs.[101]

[97] Motion for Leave to Answer and Answer of the New York Independent Operator, Inc. Market Monitoring Unit, at 16, Docket No. ER22-722 (Feb. 11, 2022) ("NYISO Market Monitor Answer"), Accession No. 20220211-5224.
[98] *Id.* at P 78.
[99] *Id.*
[100] *Id.*
[101] Accreditation Filing, *supra* note 1 at 54.

PJM's Reliability Pricing Model ("RPM") design also includes incremental auctions between the base residual auction and the delivery year, where suppliers can buy out of their obligations and where PJM can buy or sell capacity to the extent that the load forecast changes. Each of these transactions would affect the portfolio of resources procured for the delivery year in a way that would affect the ELCCs of each class and resource. The Commission did not have to consider this complication when addressing the viability of marginal ELCC for NYISO but will need to for PJM.

In *NYISO*, the Commission also rejected arguments that the marginal capacity accreditation framework would risk reliability. NYISO's market monitoring unit had countered claims of such risks by noting that NYISO's market does not rely on capacity payments or obligations to incentivize performance.[102] The Commission concluded that "NYISO's proposed marginal capacity accreditation method would not risk reliability by failing to incentivize resource performance because NYISO's operating reserve demand curves will send a strong signal for resources to perform during shortage conditions regardless of their capacity payment."[103] This stands in stark contrast to the approach in PJM, which considers capacity obligations (and associated capacity performance penalties) to be a critical incentive for resources to perform.

In short, the Commission has never approved marginal ELCC for a market like PJM's—where auctions are conducted three years before the delivery year with little certainty as to how closely the cleared resource mix will resemble what was offered, and where the RTO relies heavily upon Unforced Capacity ("UCAP")-based capacity obligations that will be ineffective to

[102] NYISO Market Monitor Answer, *supra* note 97 at 11–12 ("In fact, the modest effects on capacity revenues of not performing during tight conditions exist[ed] [before marginal accreditation] without the NYISO's proposed marginal capacity accreditation framework.").
[103] *NYISO*, 179 FERC ¶ 61,102 at P 81.

incent performance for resource classes that face significant derates under a marginal ELCC approach. Nor has the Commission had an opportunity to consider a final, important difference between NYISO and PJM. Whereas NYISO is a single-state RTO where new entry is guided by a comprehensive, overarching state policy to shape the resource mix, PJM comprises 14 different jurisdictions with a wide diversity of state energy policies shaping the resource mix. This has important implications for cost allocation under marginal ELCC, an issue the Commission did not need to confront with NYISO's filing, and which is discussed further in Section II(D), below.

The marginal ELCC approach has many potential merits in terms of sending accurate signals about the capacity value of new entry, but it must be properly implemented to achieve these objectives without causing unintended harm. As discussed in the remainder of this section, there are numerous omissions in PJM's proposed approach to marginal ELCC that undermine its effectiveness and will result in rates that are not just and reasonable.

C. PJM Fails to Explain How Marginal ELCC Can Be Integrated With Existing Market Structures In a Just and Reasonable Manner.

The concept of unforced capacity is fundamental to RPM. UCAP is the product transacted in RPM, and is currently defined as the amount of energy a resource delivers[104] on average, after accounting for outages. Averaging over a reasonably large number of resources, a MW of UCAP is a MW of expected energy. This allows for straightforward market design: UCAP requirements are set at forecast peak load plus a reserve margin, resources are required to deliver an amount of energy equal to their cleared UCAP, capacity costs are allocated based on peak load, the transmission system can deliver UCAP up to its physical constraints, and UCAP is fungible.

[104] Or, for demand response, avoids consuming.

However, with PJM's proposed switch to marginal ELCC accreditation, UCAP is no longer the equivalent of a MW of expected energy, even in theory. Nor is it the amount of peak load a resource can serve.[105] Instead, UCAP is now a measure of a resource's "expected incremental reliability contribution."[106] The virtue of this is that it aligns market signals with changing system needs as the resource mix evolves.[107] The downside is that all of the market design features listed in the previous paragraph are no longer valid.[108]

The proposed market reforms fail to update many aspects of RPM to make them compatible with marginal accreditation. As detailed below, the result is a market design where resource obligations are insufficient to guarantee reliability, the penalty and bonus structure results in arbitrary payments from resource to resource, capacity costs are not allocated based on causation, and the cleared resource mix may not provide desired levels of reliability.

1. PJM's proposed accreditation methodology is inconsistent with the existing Capacity Performance system.

a. Resource obligations under Marginal ELCC are insufficient to guarantee reliability.

Resources often produce more energy than their marginal ELCC accreditation value. At times, reliability will depend on them doing so: PJM finds that under marginal ELCC and current system conditions, it will need only procure UCAP equal to 97.2% of forecast peak load,[109] even before accounting for the benefit of imports.[110] Such a system will not be reliable unless some

[105] Accreditation Filing, *supra* note 1 at 25–26.
[106] *Id.* at Attachment D, Affidavit of Dr. Walter Graf on Behalf of PJM Interconnection, L.L.C. ("Graf Aff.") P 23.
[107] *Id.* at 29.
[108] Although PJM asserts that each megawatt of capacity is "substitutable one-for-one with other megawatts," *id.* at 31, this is only true at the margin. Once the quantity of capacity involved is large enough to change ELCC values, capacity is no longer substitutable. *See id* at Graf Aff. P 28, PDF p. 640 ("[Marginal accreditation] allows for a substitutable product definition where accredited capacity can be exchanged *on the margin* with no expected change in reliability.") (emphasis added). *See also infra* § II(C)(2).
[109] PJM's forecast peak load is the 50/50 peak, i.e., the load that is expected to be exceeded in half of the years.
[110] Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. PP 51–52, PDF p. 707.

suppliers can be counted on to deliver more than their UCAP during peak hours. During peak hours, the system will require energy equal to 103% of committed UCAP, even ignoring the requirement to maintain any operating reserves.

Under current conditions, combustion turbines are likely the main driver of this issue, as they are substantially downrated due to their risk of correlated outages in the winter,[111] but counted on to produce near their full ICAP during summer peak conditions. The magnitude of this effect will grow as resource saturation reduces marginal ELCC values.[112] For example, as increasing amounts of solar move risk hours into the evening, the marginal ELCC of solar decreases but the system's dependency on solar increases. The Commission explains this effect in the *NYISO* Order, finding that resources have peak load carrying capacity in excess of their marginal ELCC, which is offset by reduced UCAP requirements.[113]

Suppliers' obligations in RPM are based on their committed UCAP. A resource is charged penalties when its output during a Performance Assessment Interval is less than its committed UCAP times a Balancing Ratio. The Balancing Ratio is never greater than 1.0.[114] Thus, no capacity resource is ever obligated to provide more energy than its UCAP. If a capacity auction were held today under the proposed rules and cleared the target amount of capacity, PJM would only have enforceable rights to energy equal to 97.2% of their forecast peak load. *Under the proposed rules, blackouts are possible even if load is within forecasts and all suppliers meet*

[111] *Id.* at PP 10, 45, 48, PDF pp. 688, 704–707.
[112] Affidavit of Nick Pappas at P 8, Figure 6 (Nov. 8, 2023) ("Pappas Aff.").
[113] *NYISO*, 179 FERC ¶ 61,102 at P 77. It is worth nothing that although this issue appeared to be the subject of considerable debate, it largely boiled down to NYISO inadvertently omitting the calculation to adjust UCAP requirements from their initial filing. *Id.* at P 82.
[114] Accreditation Filing, *supra* note 1 at Proposed Tariff, Attachment DD, Section 10A(c), PDF p. 253. This is not changed in the parallel MSOC Filing.

their obligations. We submit that this fact on its own requires the Commission to find the Accreditation Filing unjust and unreasonable.[115]

This issue did not arise in the NYISO filing. The primary reason for this is that NYISO does not rely on capacity obligations to incent performance.[116] However, even disregarding this, NYISO's supplier obligations are consistent with its accreditation framework. Capacity supplier obligations in NYISO are for "the Installed Capacity Equivalent of the amount of Unforced Capacity it is supplying to the [New York Control Area]."[117] Because supplier obligations are expressed in ICAP in NYISO, those obligations are independent of accreditation changes. A reduced capacity accreditation will allow a supplier to provide less UCAP, but the Installed Capacity Equivalent will remain the same. Supplier obligations in NYISO's implementation of marginal ELCC are consistent with reliability. Those proposed in the Accreditation Filing are not.

b. Under Marginal ELCC, the Capacity Performance Penalty and Bonus structure is largely arbitrary and incents behavior that undermines reliability.

Current Capacity Performance rules set resources' Expected Performance based on their cleared UCAP and assess penalties or bonuses when resources perform below or above that value during Performance Assessment Intervals.[118] This is reasonable because in the existing market construct UCAP corresponds to expected energy.

[115] Under PJM's existing rules, CP bonuses could incentivize performance from non-capacity resources to make up this shortfall. However, PJM also proposes in Docket ER24-98 to render such resources ineligible for CP bonuses, meaning that this incentive would no longer apply.
[116] *See supra* Section II.B.
[117] NYISO, Manual 4: Installed Capacity Manual, at 69, Section 4.8 (Apr. 27, 2023), https://www.nyiso.com/documents/20142/2923301/icap_mnl.pdf/234db95c-9a91-66fe-7306-2900ef905338.
[118] Accreditation Filing, *supra* note 1 at Proposed Tariff, Attachment DD, Section 10A, PDF p. 252.

The changing energy grid requires more sophisticated approaches. As PJM notes, "a major downside of average accreditation methods [is that] consumers pay for performance on average rather than specifically for performance during resource adequacy risk periods."[119] ELCC accreditation is proposed as a remedy for those ills: "[ELCC] compares the expected hourly output of a resource (or resource class) against expected hourly load for all hours of a planned year. It captures variations in hourly variable resource availability, any correlation in hourly output with load patterns, seasonal variations, and the limited duration characteristic associated with the dispatchability of the storage component."[120]

The ELCC methodology fully incorporates expected variations in resources' energy output into their accreditation, and resources' expected energy output at any particular time can be very different from their accredited UCAP value. In this context, PJM's legacy bonus and penalty structure makes little sense: resources will routinely be paid bonuses or charged penalties for doing exactly what they were expected to do. Because resource limitations are already incorporated into their capacity accreditation, capacity suppliers will also be charged penalties for failing to deliver a product they are not being paid for. Storage resources are accredited and paid based on their ability to provide energy for a certain time period, but penalized for not providing energy beyond that time period. Gas-fired plants are accredited and paid considering some risk that pipeline compressor stations may freeze during intense cold, but penalized when that happens. Solar is accredited and paid for the value of daytime energy, but penalized at night. None of these are just or reasonable outcomes. In each case, capacity accreditation and thus the level of payment a resource receives is based on the resource's level of expected performance—

[119] *Id.* at Keech Aff. P 18, PDF p. 624.
[120] *Id.* at 24. *See also id.* at Rocha-Garrido Aff, P 27, PDF pp. 695–700 (describing the extensive consideration of variable output over time in the ELCC model).

but under PJM's proposal, resources' performance obligations and penalty risks no longer correspond to this level of expected performance.

The reverse is also true. Periods when resources are expected to perform well are already considered in capacity accreditations, and there is no justification for paying bonuses to resources that are merely fulfilling expectations. The facts that solar performs well during the daytime and gas plants have few fuel-related outages in the summer are already part of the level of service reflected by their UCAP payments, but those resources earn bonus payments under those conditions anyway. Applying the existing bonus/penalty structure in the context of marginal ELCC does not create an incentive for resources to perform as expected, but instead merely creates arbitrary windfalls and risks for suppliers, raising costs for no benefit. Because PJM's proposed changes do not address how capacity performance needs to be reformed to reflect the move to marginal accreditation, it will result disjointed rules that do not ensure resource adequacy and create excessive costs to consumers.

Worse, the mismatch between the performance expected in the ELCC model and that demanded by the penalty structure creates incentives for suppliers to act in ways that undermine reliability. Consider 4-hour energy storage. PJM reports that this resource class is expected to have a marginal ELCC Class Rating of 67% for the 2024/25 delivery year.[121] For example, a 4-hour storage facility capable of delivering 10MW for 4 hours will receive a UCAP of 6.7MW. That means that PJM plans on receiving 10 MW of power, or 150% of UCAP, from a 4-hour storage resource. But because the penalty/bonus structure is based on the storage resource providing 100% of its UCAP at all times, in the face of an emergency, the optimal strategy for the storage owner is to only provide that amount (67% of its available power), so as to save

[121] *Id.* at Rocha-Garrido Aff. P 48, PDF p. 706.

charge to avoid possible penalties if the emergency extends into a fifth or sixth hour.[122] This leaves PJM short on energy that planning models relied on to meet reliability targets. Similar logic applies to any energy-limited resource and to gas-fired resources nominating expensive supply ahead of possible winter emergencies.

Capacity Performance and marginal ELCC accreditation are not incompatible. For example, simply adopting NYISO's practice of basing obligations on "ICAP in service" rather than "energy at UCAP" would fix many of the issues raised here. PIOs agree that a robust system of ensuring suppliers meet their obligations is a critical component of RPM.[123] However, for the market to be just and reasonable—or simply to function—there must be alignment between the performance assumed by planners, the performance suppliers are paid for via accreditation, and the performance suppliers are required to deliver.[124] The Accreditation Filing proposes needed reforms to the first two, but entirely neglects the third. If approved as it stands, the result will be a capacity market that does not guarantee reliability and arbitrarily inflates costs.

2. PJM's proposal to calculate Marginal ELCC before clearing capacity auctions sends inaccurate market signals.

A primary attraction of marginal valuation is efficient price signals, especially under circumstances where the resource adequacy value of a resource class declines with increasing deployment.[125] By selecting each increment of capacity based on which provides the least-cost increase in system reliability, a marginal approach finds the lowest cost resource mix to meet reliability targets. This approach has proven particularly suitable in an integrated resource

[122] While the storage owner is forgoing bonus opportunity, since procured UCAP is less than expected peak loads there will be more overperformance than underperformance in all but the direst situations. Asset owners can confidently plan for the penalty rate to be higher than the bonus rate.
[123] *See, e.g.*, *CP Order*, 151 FERC ¶ 61,208 at PP 41–50.
[124] Combined Protest and Answer of Sierra Club, *supra* note 62 at 21–25 (discussing the need for alignment between accreditation and obligations).
[125] Accreditation Filing, *supra* note 1 at 29.

planning ("IRP") context, where existing resources are largely maintained through cost of service or similar structures, and decision makers must compare the cost effectiveness of candidate resource procurements.[126]

Marginal ELCC's accurate price signal can be equally valuable in market-based resource adequacy systems, but only if implemented correctly. Applying marginal ELCC to RPM broadens the scope of the task in two relevant ways: the entire resource adequacy portfolio is essentially rebuilt from scratch with each auction,[127] and the market must send efficient price signals for retention or retirement of existing resources. In developing an IRP, ELCC must be calculated for discrete options against a relatively static background of the existing fleet. In a market, ELCC values will change depending on the cleared resource mix,[128] and the clearing process must find the optimal resource mix considering the going-forward costs of existing resources.

In theory, an accurate way to accomplish that goal would be iterative: calculate all resources' ELCC as if they were the only resource on the system and clear the first resource based on those values. Recalculate all remaining resources' ELCCs against a fleet consisting of the first cleared resource, clear the second resource, and so on. This would be a computationally demanding process. The Accreditation Filing proposes to simplify market administration by calculating ELCC values using "a forecasted resource portfolio which includes all units that are

[126] Pappas Aff., *supra* note 112 at PP 10, 14. *See also, e.g.*, S. Cal. Edison et al., Updated Joint IOU Proposal to Use Effective Load Carrying Capability Methodology for RPS Procurement, at Attahcment 1, PDF p. 11 (May 31, 2017), https://www.astrape.com/wp-content/uploads/2022/03/R.15-02-020_Joint-IOUs-Update-on-ELCC_5-31-17.pdf.

[127] Pappas Aff., *supra* note 112 at P 17.

[128] The correct base for calculating ELCC values is the cleared resource mix, not the installed resource mix. Because uncleared resources can only add additional energy beyond what cleared resources provide, they can only increase reliability. If uncleared resources were considered in determining ELCC values, they would reduce the accreditation of the cleared resources and so incorrectly increase the amount of ICAP needed.

likely to offer into a given RPM Auction"[129] and applying those ELCC values to all resources. However, this simplification introduces several potential errors, as detailed below.

a. Accrediting all resources based on a fleet determined without regard for auction clearing sends inaccurate price signals that can distort results.

The proposed approach sets the ELCC values of all resources in a class based on the marginal resource adequacy value of an additional resource in a class. This approach fails when saturation moves a resource class from economic to uneconomic—the exact situation marginal accreditation is intended to address. In that situation, the job of accreditation and market clearing is to find the amount of that resource class that is economic, which requires considering changes in marginal ELCC as the amount cleared increases. While PJM is correct that "marginal-value compensation is fundamental to the design of efficient wholesale markets,"[130] its proposed mechanism does not use marginal value when it matters most. In the context of auction clearing, the relevant value is incremental load carrying capacity of adding to the set of resources cleared so far, not the total installed fleet. For example, even in a system fully saturated with solar resources, the first MW of solar has high resource adequacy value and is almost certainly part of the least-cost reliable mix.

The result of PJM's proposed approach is that when saturation of a resource class reaches the point where the market should signal that no more of that resource is needed, it instead signals that all resources in that class should retire, as the low accreditation value is applied to every unit in the class. So, for example, if the system had so many gas-fired plants that it was fuel-constrained, additional gas-fired plants would add little value. This would be correctly

[129] Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. P 34, PDF p. 701.
[130] *Id.* at Graf Aff. P 24, PDF p. 640.

reflected through a low marginal ELCC. However, the proposed design would apply this to all gas plants, causing many to incorrectly not clear the market. The correct result would be to clear gas units until their declining value made other resources more economic, but because PJM does not propose to adjust the marginal ELCC value as part of the clearing process, this will not happen. In the extreme case, where marginal ELCC falls to zero, none of the affected resource class would clear.

It is not clear how PJM intends this to work. Of course, in reality unit-specific differences in accreditation and economics will not make this a stark all-or-nothing result, but the real risk remains that RPM auctions will incorrectly fail to clear large segments of a resource class. PJM's proposed implementation may send correct long-term entry/exit signals, but it will not correctly clear auctions under any circumstance where the distinction between marginal and average ELCC is relevant.

This issue was not of practical concern in NYISO, where nearly all resources offer at zero and clear the market. In essence, NYISO's capacity market does not select a resource mix, so it's irrelevant if it can serve that function or not.[131]

b. Resource accreditation will become inaccurate when the cleared resource mix differs from the modeled resource mix.

PJM proposes to calculate ELCCs based on its estimation of what units are likely to offer into a given auction. Since not all offered resources will clear, this almost inevitably results in incorrect accreditation. It is also not clear how PJM will determine the quantity of intermittent, storage, and demand resources that are likely to offer, as those resource types do not have a must-offer requirement. Both of these differences are potentially significant: as much as 20% of

[131] *NYISO*, 179 FERC ¶ 61,102 at P 78.

offered demand response does not clear, and the amount of wind offered into PJM's capacity auctions has fallen roughly 49% from 2022/23 to 2024/25,[132] even though no wind resources deactivated in that time period.[133] In general, the quantity of resources cleared will be less than or equal to the estimate used in ELCC modeling and so errors will consistently be in the direction of undervaluing resources and understating UCAP requirements relative to the cleared resource mix.

We acknowledge that PJM faces a chicken and egg problem, where it needs ELCC values to clear the auction, and needs auction results to calculate ELCC values. While resolving this issue may be technically challenging,[134] PJM has not even addressed this in its filing, and the Accreditation Proposal provides no check to prevent these errors from becoming material, or even any system to monitor and report on the final accuracy of ELCC values. By failing to provide any safeguards to ensure that its *a priori* calculation of marginal ELCC and reserve requirements proves accurate, PJM ignores the real possibility that erroneous ELCC values may compromise reliability or cause excessive costs to consumers. Hence, PJM has failed to carry its burden of demonstrating that its proposed marginal ELCC methodology is just and reasonable.

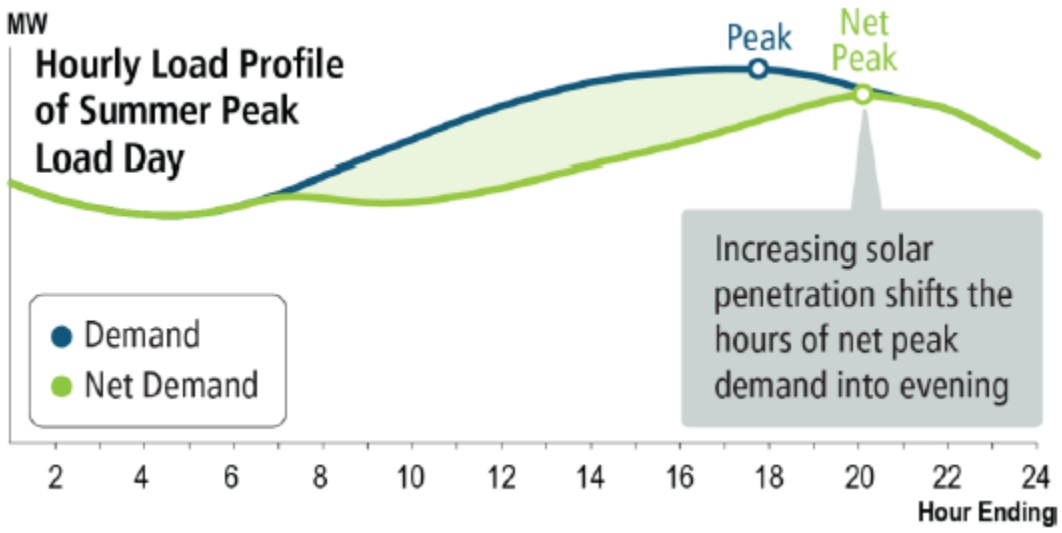
c. Because capacity needs are calculated based on a particular supply mix, clearing results may not meet reliability targets.

A basis of market design is that resources are substitutable. In the RPM context, that means that any set of resources with a UCAP that sums to the same total should provide the same resource adequacy value. With marginal ELCC, this is no longer true. Because UCAP no longer

[132] PJM, 2024/2025 Base Residual Auction Report, at 11, Table 7, https://www.pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2024-2025/2024-2025-base-residual-auction-report.ashx (last visited Nov. 7, 2023).
[133] *See* PJM, Generation Deactivations, https://www.pjm.com/planning/service-requests/gen-deactivations (last visited Nov. 8, 2023) (Selecting "wind" in this tool under the "Deactivated Generators" tab reveals the deactivation of only one wind plant in 2015).
[134] Resolving this issue may actually be simpler than it initially appears; as early as 2012, PJM proposed a regulation market that dynamically incorporated declining marginal values into clearing. *See* PJM, Tariff Filing, at 5–8, Docket No. ER12-2391 (Aug. 2, 2012), Accession No. 20120802-5133.

directly expresses the ability to serve load, the amount of UCAP needed to meet reliability targets can only be determined in the context of the particular resource mix used to calculate ELCC.[135]

This means that if the resource mix that clears the auction is different than the one modeled, resource adequacy targets might not be met. Consider PJM's illustrative example, reproduced here.[136]



In this example, sufficient solar has been installed so that system risk has been moved to close to sunset. As a result, the solar's UCAP has become very small, and the system UCAP requirement set to reflect the amount of load at the point labeled "Net Peak." However, this system still depends on solar to provide significant energy during the daytime.[137] The entire difference between load at Net Peak and load at Peak is carried by solar resources but not reflected in UCAP values. If instead of clearing the expected solar resources, an auction cleared

[135] Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. PP 17–19, PDF p. 690–691. *See also* NYISO Market Monitor Answer, *supra* note 97 at 6–9 (describing how NYISO uses accreditation values to determine UCAP requirements). *See also* Pappas Aff., *supra* note 112 at P 25.
[136] Accreditation Filing, *supra* note 1 at 15, Figure 1.
[137] Pappas Aff., *supra* note 112 at P 22 ("these inframarginal contributions, which are on-going reliability contributions that are not accredited under a marginal accreditation framework, continue to play an important role in ensuring the reliability of the system . . . .").

the same amount of UCAP from resources with a different hourly profile, the system would be unable to serve peak load.

The errors described here compound to make this situation more likely. As a resource class' marginal ELCC decreases, more of its load carrying capability is inframarginal and is reflected through a reduction in UCAP requirements.[138] The error that would be introduced by substituting UCAP from a different resource class increases. At the same time, the reduction in marginal ELCC is what creates the risk of incorrect retirement signals and clearing results described in section a. above.

At the extreme, the market design simply fails if the marginal ELCC of any resource class approaches zero. Since the capacity market offers these resources little revenue, they will have little reason to offer into the market. Resources under a must-offer requirement would have a very high offer price, since their avoidable costs would be divided by their near-zero UCAP. The result would be few, if any, of the near-zero marginal ELCC resources clearing. Since those resources were accredited at very little UCAP, only a tiny shortfall would be visible to the market clearing engine, and it would procure de minimis replacement resources. The result is that no resource is obligated to provide energy that was relied on in setting UCAP requirements. This gap may be large. If, as appears likely, solar is the first class to reach zero marginal ELCC, this missing energy will be on the order of the difference between daytime and nighttime loads.

In *NYISO*, the Commission determined that these concerns were mitigated by the prompt nature of NYISO's Spot Market Auction and by facts presented by NYISO that auction clearing results "almost exactly" match the resources considered in the resource adequacy model.[139] In

[138] *Id.* at P 24.
[139] *NYISO*, 179 FERC ¶ 61,102 at P 78.

contrast, PJM's auction is held three years in advance, and the difference between model inputs and auction results is much larger:

Capacity Year	NYISO alignment between IRM Model and capacity obligations*	PJM alignment between capacity offered and capacity obligations**
2019	99.6%	90.2%
2020	99.8%	90.0%
2021	98.8%	87.7%
* NYISO Deficiency Response, Document Accession #: 20220311-5224, p16. ** PJM 2024/2025 Base Residual Auction report, Table 6		

Recent RPM results in the DPL-S Locational Deliverability Area demonstrate that inconsistencies between modeling assumptions and actual offers can result in wildly inaccurate auction results and litigation that erodes confidence in markets.[140] If the problems listed here are not addressed, they open the door to a repeat of that situation.

The issues identified in this section are easily resolved. All PJM needs to do is, as part of the auction process, perform analysis to determine the difference between *ex ante* and actual ELCC values, and confirm that the cleared resource mix meets reliability targets. That analysis, combined with a tariff provision to iteratively re-run ELCC and Reserve Requirement Study models and auction clearing until errors fall below an acceptable threshold will provide cheap insurance against the risk of awkward future scenarios that pit retroactive ratemaking against system reliability. Despite readily available solutions, PJM ignores these significant defects in its implementation of marginal ELCC and thus fails to carry its burden of demonstrating that its proposal is just and reasonable.

[140] *See PJM Interconnection, LLC*, 182 FERC ¶ 61,109 at P 178 (2023) (accepting tariff revisions to "prevent[] consumers from being charged unnecessarily high capacity prices that do not reflect actual reliability needs or supply and demand fundamentals").

D. PJM's Allocation of the Costs and Benefits Associated With Marginal ELCC Fails to Follow Basic Cost-Causation Principles.

The cost-causation principle, which aims to "mak[e] sure that burden is matched with benefit,"[141] is "foundational and a basic tenet of ratemaking" under the FPA.[142] The FPA mandates that "[a]ll rates and charges" must be "just and reasonable,"[143] and "[f]or decades, the Commission and the courts have understood this requirement to incorporate a 'cost-causation principle.'"[144] The cost-causation principle has numerous applications in ratemaking. It prevents rates that charge consumers a share of a project's costs that is greater than the benefits consumers will see from that project.[145] It prevents unreasonable disparities in consumers' costs even where consumers pay the same single rate.[146] And it prevents unreasonable cross-subsidization, such as occurs when rates ignore either a project's regional or local benefits.[147] The fundamental analysis underlying the cost-causation principle is that benefits and costs must be "at least roughly commensurate."[148]

1. Without conforming changes, PJM's capacity cost allocation is not just or reasonable.

A central theme of the Accreditation Filing is that "the rise of renewable generation will shift the hours of risk on the system."[149] This is a driving force behind the accreditation

[141] *BNP Paribas Energy Trading Gp v. FERC*, 743 F.3d 264, 268 (D.C. Cir. 2014).
[142] *El Paso Elec. Co. v. FERC*, 76 F.4th 352, 357 (5th Cir. 2023) (cleaned up).
[143] 16 U.S.C. § 824d(a).
[144] *Old Dominion Elec. Coop. v. FERC*, 898 F.3d 1254, 1255 (D.C. Cir. 2018).
[145] *See id.* (noting that the Commission "'generally may not single out a party for the full cost of a project, or even most of it, when the benefits of the project are diffuse'").
[146] *Ala. Elec. Coop., Inc. v. FERC*, 684 F.2d 20, 27–28 (D.C. Cir. 1982) (noting that "a single rate design may also be unlawfully discriminatory," such as "charging the same price to two purchasers where the seller's costs with respect to each differ") (internal quotations omitted).
[147] *Long Island Power Auth. v. FERC*, 27 F.4th 705, 713–14 (D.C. Cir. 2022) (noting that where "regional and local benefits are both substantial," the Commission is "compelled by precedents" to devise a system that provides "significant weight" to both local and regional benefits); *see also Ill. Com. Comm'n v. FERC*, 576 F.3d 470, 475 (7th Cir. 2009) ("[T]he fact that one group of utilities desires to be subsidized by another is no reason itself for giving them their way.").
[148] *Ill. Com. Comm'n*, 576 F.3d at 477.
[149] Accreditation Filing, *supra* note 1 at 14.

changes.[150] The filing is unambiguous that load during hours of risk, not hours of peak load, are now the main drivers of capacity costs.[151] PJM reports that 64% of system risk on an EUE basis is now during winter, when loads are relatively low and only 36% of risk is during summer peak load periods.[152] The need for capacity is no longer driven by system peak loads. PJM proposes to adapt to this new reality by adopting "a more temporally granular, hourly framework for assessing risk drivers and probabilities of resource and energy inadequacy throughout the year rather than only during periods associated with peak loads, as under PJM's current approach."[153]

Despite this significant change in how PJM will identify the need for capacity, the Accreditation Filing proposes no changes to how capacity costs are allocated to load serving entities. Current rules allocate capacity costs solely based on load during the single peak hour of the year.[154] Given everything PJM has said about what now drives capacity costs, this runs afoul of established precedent that "approved rates reflect to some degree the costs actually caused by the customer who must pay them."[155] While the Commission is not required to allocate capacity costs with exacting precision, the fact that PJM has already provided a chart showing hourly risk allocations to three decimal places[156] suggests there are no technical barriers to allocating capacity costs according to causation, and that any variance from this at the very least requires explanation.

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[150] *Id.* at 24.
[151] *See, e.g.*, *id.* at Graf Aff. P 44, PDF p. 645 ("the fundamental definition of capacity…is focused on hours of operational risk.").
[152] *Id.* at Rocha-Garrido Aff. P 47, PDF p. 705.
[153] *Id.* at 16.
[154] PJM, PJM Manual 18: PJM Capacity Market, at 142–43, Section 7.2 (July 26, 2023) ("PJM Manual 18"), https://www.pjm.com/~/media/documents/manuals/m18.ashx.
[155] *Midwest ISO Transmission Owners v. FERC*, 373 F.3d 1361, 1368 (D.C. Cir. 2004).
[156] Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. P 47, Figure 1, PDF p. 706.

2. The move to Marginal ELCC requires PJM to adjust overall capacity procurement targets, but the proposed method for doing so improperly socializes investments in electricity supply.

Under the Accreditation Filing, or any marginal approach, a significant portion of the benefits of supply investments are represented through the reduction in UCAP requirements.[157] PJM estimates that the proposed reforms will reduce the Forecast Pool Requirement from around 109% of peak load to around 96%.[158] RTO-wide, this translates into a nearly 20 gigawatt ("GW") reduction in UCAP requirements, a large amount by nearly any measure. Most of these reductions are attributable to the shift to marginal accreditation.[159] The reduction in the UCAP procurement target is a necessary feature of any marginal approach to accreditation, as it ensures corresponding changes are made to both the supply of and demand for capacity.[160] The Accreditation Proposal does not discuss how those reductions are apportioned to load serving entities, instead allowing them to flow into existing mechanisms where they serve as inputs to the RTO-wide reliability requirement.[161]

Many of the resources expected to come online in PJM are renewable and storage resources supported by state energy policies; consumers in these states pay for those policies through retail rates or taxes. State policy-driven investments in supply, especially solar, directly result in net peak load reduction for load-serving entities in that state and shift risk to hours of lower load. Ratepayers in that state should rightfully be able to enjoy the lower capacity costs that flow from their investment. Because of the declining marginal ELCC curves for renewable

[157] Pappas Aff., *supra* note 112 at P 17–22.
[158] Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. P 53, PDF pp. 707–08.
[159] *Id.*
[160] Pappas Aff., *supra* note 112 at P 21. *See also, e.g.*, NYISO Market Monitor Answer, *supra* note 97 at 9 ("a reduction of total accredited UCAP for a given resource mix would result in a proportionate reduction of the UCAP requirement").
[161] *See* PJM Manual 18 at 142 ("the reliability requirement is forecasted on an aggregate basis prior to the clearing of the RPM Auctions as an input into the clearing process").

and storage resources, much of the benefit they bring to the system will be reflected in the reduction in the UCAP procurement target.

Investment in supply altering regional capacity requirements is a new phenomenon. Prior to the advent of marginal accreditation, capacity benefits of investment in supply were fully accounted for by the capacity value of the resources created. Traditionally, investments in supply create two benefits: reduction in prices, which flow to all market participants, and capacity revenues which flow to the new supply and are disbursed according to whatever arrangements were made by the state. With marginal accreditation, those two benefits remain, and a third is added: risk may shift to lower load hours, reducing the overall need for capacity.

The Accreditation Filing fails to consider how to justly and reasonably allocate this reduction in overall capacity procurement targets, and instead simply reduces procurement targets across the entire RTO. In essence, PJM asks the Commission to diffuse the benefits of a project that a single party has voluntarily funded. As further explained in the attached affidavit of Nick Pappas ("Pappas Affidavit"), this is a transfer of value to parties that played no part in creating it.[162] The policies here are similarly situated to programs to encourage peak shaving or behind the meter generation, where the quantity (as opposed to price) benefits flow entirely to the host utility. We are aware of no case where a portion of, say, the peak reductions of a utility's energy efficiency programs are used to lower the capacity obligations of other utilities in the same RTO. To be sure, reductions in capacity prices are regional benefits and appropriately so, but the change in load shape and the corresponding reduction in capacity needs are local benefits and should be allocated as such.[163]

[162] Pappas Aff., *supra* note 112 at P 25.
[163] *See Long Island Power Auth.*, 27 F.4th at 713–14 (noting that where "regional and local benefits are both substantial," the Commission is "compelled by precedents" to devise a system that provides "significant weight" to both local and regional benefits).

As the Accreditation Filing stands, however, that local benefit would be socialized across all of PJM. As detailed in the Pappas Affidavit,[164] the result is "significant uncompensated contributions from states with aggressive decarbonization targets (VA, NJ, DC) and significant benefits accrued by larger states with less aggressive decarbonization targets."[165] This approach violates cost-causation principles in several ways. First, this system wrongly deprives consumers that have invested in renewable energy of the benefits of their investments.[166] Second, by providing the benefit from one state's clean energy investments—i.e. a reduced capacity obligation—to consumers in another state that has not made such investments, PJM wrongly forces states that have invested in clean energy to subsidize those that have not.[167] And third, and most fundamentally, by providing the benefits of clean energy investments to those who have not made those investments, PJM's proposal fails to ensure that benefits and costs are commensurate.[168]

Equitable benefit allocation would require that the output of resources supported by state energy policies be netted against the load curves of utilities in that state prior to determining their resource adequacy needs, to the extent consistent with resources' location and transmission constraints.[169] This would produce outcomes consistent with those that would be obtained if the resources were 'physically netted' by being collocated with load.[170] It is also consistent with

[164] Pappas Aff., *supra* note 112 at P 33–39.
[165] *Id.* at P 37.
[166] *See Old Dominion Elec. Coop.*, 898 F.3d at 1255 (noting that the Commission "'generally may not single out a party for the full cost of a project, or even most of it, when the benefits of the project are diffuse'").
[167] *See Ill. Com. Comm'n*, 576 F.3d at 475 ("[T]he fact that one group of utilities desires to be subsidized by another is no reason in itself for giving them their way.").
[168] *Id.*
[169] *See* Pappas Aff., *supra* note 112 at PP 33–42 (describing the inequitable allocation of benefits under PJM's proposed approach). In cases where resources supported by state policy are not netted against utility load curves, a financial adjustment could instead be made.
[170] Although not dispositive, we suggest that a market design that results in significant differences in value for otherwise similar resources, depending on if they are co-located with load or participating in wholesale markets, is likely flawed.

much of the literature on marginal ELCC from western states, which places heavy weight on the need to serve net demand.[171]

In any event, the burden is on PJM to demonstrate that reducing the capacity procurement requirement for all states in the RTO based on investments made by only certain states is just and reasonable. By failing to address the issue, PJM has not met this burden.

III. PJM IS CORRECT TO REQUIRE MORE TESTING OF CAPACITY RESOURCES BUT FAILS TO JUSTIFY REDUCING THE STOP-LOSS PROVISION OF CAPACITY PERFORMANCE REQUIREMENTS.

PJM's proposal would pair an increased testing requirement for capacity resources with a decrease in the CP stop-loss, which is the annual cap on penalties for unreliable capacity resources that fail to perform during emergencies. However, while the proposal to require increased testing of capacity resources is well-founded, there is no inherent link between increased testing and a decreased stop-loss, as PJM suggests. Nor does the data that PJM cites support reducing the stop-loss. Instead, reducing the stop-loss would make PJM less reliable, reduce performance incentives for capacity resources, and inappropriately shift the risk of non-performance onto consumers.

A. Additional Testing May Improve Reliability by a Limited Increment.

PJM's proposal to increase the requirement for testing of capacity resources is—on its own—just and reasonable. Currently, PJM only requires capacity resources to perform a single performance test during the summer and extrapolates resources' purported ability to perform in winter using "ambient temperature adjustments."[172] However, as PJM notes, this system does not accurately predict winter performance.[173] In light of the consistent pattern of widespread failures

[171] *See, e.g.*, Accreditation Filing, *supra* note 1 at 14–15. *See also* Pappas Aff., *supra* note 112 at P 14.
[172] Accreditation Filing, *supra* note 1 at 82.
[173] *Id.* at 83 ("[T]he current method of extrapolating winter capability from summer capability through ambient temperature adjustments is not suitable to determine the true winter capability of a generation resource.").

among fossil resources during Winter Storm Elliott and prior winter storms, the need to better predict winter performance by thermal resources is itself a sufficient justification for the increased testing that PJM proposes. Similarly, the need for thermal resources to prove through testing that they are actually capable of performing during winter amply justifies PJM's proposal to assess penalties against resources that repeatedly fail the new tests.[174]

Data from Winter Storm Elliott indicates that increased testing of capacity resources' seasonal performance may incrementally improve reliability. As PJM notes, "over 80% of the outages experienced during Winter Storm Elliott were mechanical in nature," rather than caused by fuel-supply issues.[175] In light of the prevalence—and preventable nature—of mechanical failures, it is reasonable for PJM to predict that additional testing may identify and correct "*some* mechanical issues that can help to bolster fleet performance during actual capacity emergencies."[176]

However, it is important not to overstate the degree to which increased testing may improve reliability. While the data that PJM cites shows a very high forced outage rate of 70.52% among resources that last ran more than four weeks before Winter Storm Elliott, the same data also shows an unacceptably high 45.49% outage rate among resources that last ran less than four weeks before the storm.[177] Importantly, this data considered only "forced outage rates during Elliott for units that had not run in the weeks leading up to the event."[178] For such units, this data suggests that increased testing could potentially improve the performance of this limited

[174] *See id.* at 87–89 (describing penalties for failing seasonal performance tests). PJM also rationally explains that these testing requirements exclude Variable Resources because their capacity varies principally "as a function of its energy source" rather than due to preventable mechanical failures, and because their accreditation relies chiefly on "historical output rather than a claimed installed capacity level." *Id.* at 83, n.218.
[175] *Id.* at Attachment C, Affidavit of Adam Keech on Behalf of PJM Interconnection, L.L.C. ("Keech Aff.") P 29, PDF p. 627.
[176] *Id.* (emphasis added).
[177] *Id.* at P 27, PDF pp. 626–627.
[178] Winter Storm Elliott Report, *supra* note 25 at 10.

subset of capacity resources by as much as 25% (i.e. the difference between a 70.52% and 45.49% outage rate). However, the actual improvement in reliability among this subset of resources will almost certainly be smaller; indeed, PJM's proposal for penalties for resources that fail tests is a recognition that some such resources will continue to prove unreliable when tested. Moreover, this data also reveals that resources that seldom run have an extremely high forced outage rate—more than twice the overall forced outage rate of 24% during Winter Storm Elliott[179]—*even when those resources ran less than four weeks prior to the storm*. Hence, the data cited by PJM indicates that while increased testing may incrementally improve reliable performance among a limited subset of capacity resources, the capacity resources that seldom run in the PJM region will in all likelihood continue to experience an unacceptably high rate of forced outages.

B. PJM Fails to Justify Reducing the Stop-Loss.

PJM's proposal to reduce the maximum level of penalties for unreliable capacity resources that fail to perform during emergencies is not justified by its proposal to increase testing requirements or by any other capacity market reforms. PJM provides three nominal rationales for its change to the stop-loss, but none withstands scrutiny.

At the outset, it is important to note the extreme degree of PJM's proposed reduction in the stop-loss. PJM proposes to change the stop-loss by indexing it to the capacity auction clearing price rather than the net Cost of New Entry ("CONE").[180] As PJM recognizes, the capacity market's clearing price is often far below net CONE; for delivery year 2022/2023, the clearing price of roughly $18,250/MW-year was roughly 20% of the net CONE of $90,000/MW-

[179] *See id.* at 49 (discussing the overall "24% forced outage rate").
[180] Accreditation Filing, *supra* note 1 at 93.

year.[181] Hence, PJM's proposal could reduce the cap on penalties for unreliable resources by a whopping 80%.[182] This reduction in maximum penalties would diminish the incentive for generators to perform, or to make investments to improve their performance. PJM nowhere suggests that other incentives its reforms may create would counteract the effect of reducing the stop-loss by increasing reliability to a similar degree. As such, PJM's proposal is likely to reduce maximum penalties well out of proportion to any incremental increase in reliability.

PJM offers several flawed reasons why dramatically reducing the maximum penalties for unreliable capacity resources purportedly "will not affect resource performance during emergency conditions."[183] First, PJM observes that it is not proposing to change the penalty rate, meaning that penalties "will still be tied to net CONE."[184] However, the disparity between a penalty rate tied to net CONE and a penalty cap tied to the auction clearing price means that PJM's proposal significantly reduces the number of intervals during which resources can possibly earn penalties. In other words, under PJM's proposal, underperforming resources will reach the penalty cap much more quickly. By reducing both the maximum penalty exposure and the maximum number of intervals during which resources can earn penalties, PJM's proposal would reduce performance incentives and undermine the purpose of the CP system.

Second, PJM erroneously suggests that its changes to accreditation and risk modeling support reducing the stop-loss, because those other changes "provide increased confidence that PJM will procure resources that are capable of providing capacity during emergencies."[185] However, reductions in accreditation reflecting fossil resources' poor performance does not

[181] *Id.* at 93–94.
[182] While PJM's proposed stop-loss would vary each year based on the market clearing price, the magnitude of the reduction in the maximum penalties is likely to be similar. The market clearing price has been substantially lower than net CONE for many years.
[183] Accreditation Filing, *supra* note 1 at 95.
[184] *Id.* at 95–96.
[185] *Id.* at 96.

reflect "increased confidence" in these resources, but instead reflects a *lowered expectation* for their performance. Lowering the expectations for fossil resources' performance is a poor reason to reduce the maximum penalties that these resources might pay if they fail to perform *at the lower level their accreditation reflects*. Instead, PJM will need resources to perform at the level their accreditation reflects, and the existing stop-loss mechanism is a strong incentive to do so.

Similarly, PJM wrongly suggests that increased testing supports reducing the stop-loss. However, as discussed above, the data cited by PJM indicates that increased testing may improve reliability by a much smaller increment and for a limited subset of resources.[186] In contrast, PJM's proposal to limit the stop-loss would reduce performance incentives by a much larger degree and for all capacity resources. Moreover, increased testing will not address the problem of thermal resources failing to obtain fuel, which was a significant driver of outages during Winter Storm Elliott.[187] Significant penalties are still needed to incentivize generators to buy fuel necessary to perform during emergencies, and reducing the stop-loss would undermine that incentive.

Third, PJM suggests that reducing the stop-loss is justified by changes that will make PAIs rarer. However, the changes that made PAIs rarer already reduced the threat of penalties for underperforming capacity resources, and thus reduced the incentive to perform. Reducing performance incentives once by making penalties rarer does not justify reducing performance incentives again by reducing the maximum possible penalty exposure. If anything, the fact that PAIs will only be triggered by genuinely dire emergencies indicates that resources that consistently fail to perform during PAIs are a serious threat to reliability, meaning that the threat of high maximum penalties is a necessary incentive to perform.

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[186] *Supra* section III.A.
[187] Winter Storm Elliott Report, *supra* note 25 at 50–51 (depicting causes of gas plant outages).

PJM also misguidedly suggests that the current penalty cap may "deter or chill future investments in PJM's capacity market."[188] As an initial matter, this argument rests on the false contention that "Winter Storm Elliott illustrated that indexing the stop-loss to net CONE exposes resources to a level of annual Non-Performance Charges that may equal many years of capacity revenues."[189] While the stop-loss was designed to allow penalties to substantially exceed annual capacity revenues,[190] Winter Storm Elliott demonstrated that this prospect is exceedingly unlikely. The penalties associated with Winter Storm Elliott were the largest in PJM's history, but *non-performing resources still earned hundreds of millions of dollars in net revenues from a single year's sales in the capacity market even after these historic penalties.*[191] Moreover, those post-penalty net revenues are in addition to the many years of revenues that these same unreliable resources earned in prior years during which no PAIs occurred. Hence, the prospect that penalties could substantially exceed annual revenues is not only a beneficial deterrent to resources being chronically unreliable, but is also a sufficiently remote contingency that it cannot serve as a reasonable basis for reducing the stop-loss.

Furthermore, PJM's speculation that the current stop-loss may deter investments in the PJM capacity fleet is not only unsupported by any record evidence, but also belied by history and the state of the PJM interconnection queue. In 2015, the Commission rejected a similar argument—that a stop-loss pegged to net CONE would create a "'draconian' penalty structure that will force resources to retire or not participate in the capacity market"—as "speculative and

[188] Accreditation Filing, *supra* note 1 at at 95.
[189] *Id.* at 93.
[190] *See CP Order*, 151 FERC ¶ 61,208 at P 165 (noting that one of the "very performance incentives that the [CP] design is intended to create" is to prevent the prospect that "a non-performing resource could earn positive net capacity revenues *over the long run*") (emphasis added); *see also PJM Interconnection, L.L.C.*, 155 FERC ¶ 61,157 at PP 75, 78 (2016) ("*CP Rehearing Order*") (rejecting a contention that PJM should have indexed the stop-loss to the auction clearing price and finding that the larger "annual stop-loss" pegged to net CONE "is reasonable as it protects resources against exceedingly large penalties from an unforeseen event").
[191] Winter Storm Elliott Report, *supra* note 25 at 110.

unsupported by the record."[192] The facts are even worse for this argument now. Since the Commission approved the current CP system, vast quantities of new resources have come online in the PJM region, including 31 GW of gas plants between 2015 and 2022.[193] Moreover, a whopping 230 GW of new resources are in PJM's interconnection queue.[194] Both because significant development of new resources in PJM *actually occurred* after PJM instituted a CP system with a stop-loss indexed to net CONE, and because significant investment in new resources in this region is ongoing, the notion that the current CP system stifles investment in the capacity market is not supported by the record.

C. Reducing the Stop-Loss Shifts Risks of Non-Performance to Consumers.

One core function of CP penalties is to "hold[] capacity resources accountable for delivering on their capacity commitments" and thus "provide greater certainty that consumers will receive the service for which they paid through PJM's capacity market."[195] An animating principle underlying CP is that "PJM's customers should pay only for resources that perform when they are needed."[196] Reducing the stop-loss cuts against these fundamental principles underlying the CP system. A reduced stop-loss increases the risk that there may be periods during which unreliable resources fail to perform during emergencies but face no penalties, which would occur if a resource had already reached the stop-loss during a prior emergency. Particularly because PJM's proposal would reduce the cap but leave the penalty rate intact, this

[192] *CP Rehearing Order*, 155 FERC ¶ 61,157 at P 88.
[193] *See* PJM, *Energy Transition in PJM: Resource Retirements, Replacements & Risks*, at 11 (Feb. 24, 2023), https://www.pjm.com/-/media/library/reports-notices/special-reports/2023/energy-transition-in-pjm-resource-retirements-replacements-and-risks.ashx.
[194] Accreditation Filing, *supra* note 1 at 11.
[195] *CP Rehearing Order*, 155 FERC ¶ 61,157 at P 18.
[196] *Id.* at P 33.

proposal would increase the odds of unreliable resources unjustifiably retaining capacity revenues despite failing to perform.

Although PJM notes that capacity resources would be unlikely to trigger the stop-loss during *a single event* like Winter Storm Elliott—because PJM has also changed the CP system to make it rarer to assess penalties in the first instance—this reasoning fails to account for the possibility of multiple severe weather events during a single delivery year.[197] The prospect of multiple serious winter storms is not remote: Winter Storm Elliott occurred in late December, the Polar Vortex occurred in January, and Winter Storm Uri occurred in February. There is no reason to assume that only one severe winter storm might hit the PJM region in a delivery year, but reducing the stop-loss would leave PJM's CP system poorly prepared to assess penalties to capacity resources that fail to perform during multiple such events. Similarly, if multiple serious events occur in one year, a lowered stop-loss may diminish the pool of Performance Payments and thus undermine an important incentive for other resources to perform during emergencies. The Commission previously rejected PJM's proposal to include a monthly stop-loss limit for analogous reasons, finding that a monthly stop-loss would "significantly weaken[] the incentives created by the Non-Performance Charge by allowing under-performance without consequence once a resource has reached the monthly stop-loss limit."[198]

For all these reasons, the Commission should reject PJM's proposal to reduce the stop-loss. However, if the Commission approves this proposal, it should also require PJM to monitor and make publicly available aggregated, anonymized data about how many resources reach the stop-loss in any delivery year or how close resources come to reaching the stop-loss (for example

[197] *See* Accreditation Filing, *supra* note 1 at 97 ("[T]he change to the triggers to focus on the most extreme risk periods lowers the probability of a PAI occurring, let alone enough PAIs to make the current stop-loss binding for any Capacity Market Seller").
[198] *CP Order*, 151 FERC ¶ 61,208 at P 165.

expressed as a percentage of the stop-loss penalty cap). This information is essential to determining whether the reduced stop-loss actually results in unreliable capacity resources evading penalties despite failing to perform during emergencies.

IV. PJM'S RISK MODELING INCLUDES MANY UNEXPLAINED AND QUESTIONABLE ELEMENTS THAT PREVENT IT FROM SERVING AS AN ACCURATE FOUNDATION FOR ACCREDITATION AND PROCUREMENT CHANGES.

An important component of PJM's Accreditation Filing is the adoption of a more granular hourly risk model that will enable PJM to better plan for periods of risk and tailor accreditation of capacity resources to best address those risks. We strongly support PJM's overall direction in improving its risk modeling. However, these changes are extensive and require careful review to ensure that they accurately describe the periods of risk that PJM faces. If the modeling is inaccurate, the capacity market will send the wrong signals for investment, and consumers could end up paying far more than is needed to maintain resource adequacy.[199]

In the attached testimony, economist James F. Wilson identifies several ways in which PJM has not adequately explained decisions made in the course of overhauling its risk modeling. Mr. Wilson has been reviewing and engaging on PJM's load forecasts, Reserve Requirement Studies, and related analyses for over a decade, and thus has considerable expertise on these issues. In Mr. Wilson's opinion, and described below, PJM has not supported several significant changes to its risk modeling. Because this risk modeling is the foundation for PJM's accreditation framework and will largely determine capacity market prices going forward, it is

[199] Affidavit of James F. Wilson in Support of the Protest of the Public Interest Entities, at P 9 (Nov. 8, 2023) ("Wilson Accreditation Aff.") ("If the reliability risk is inaccurate or distorted, accreditations and reliability requirements are distorted, leading to treating resources unfairly and procuring an inefficient resource mix through PJM's [RPM] capacity construct."); *id.* at P 20 (describing negative impacts of inaccurate risk modeling); *see also* Brattle Report 1, *supra* note 74 at 5 ("Rather than resource accreditation, it is accurate modeling of shortage risks that is the most fundamental challenge for ensuring adequate supply.")

vital that this risk modeling neither overstate nor understate risks. PJM bears the burden of proof as to the reasonableness of its modeling, and has failed to support its filing in the following respects.

First, PJM fails to account for upward temperature trends within the 30 years of weather data that it uses, despite having discussed with stakeholders methods of accounting for such trends in the 50-year data set it previously anticipated relying on.[200] Because winter and summer extreme temperatures "drive the summer and winter peak loads that are critical assumptions in the resource adequacy analysis. . . [i]gnoring the temperature trends leads to inaccurate assumptions about the likely future level and volatility of the future summer and winter extreme temperatures."[201] Failing to adjust for these temperature trends leads to understating summer risk, and overstating winter risk, and creates false load volatility, which in turn will drive higher (and unnecessary) reserve margins.[202] Finally, ignoring rising temperature trends "unfairly distorts [ELCCs] in favor of winter resources and against summer resources, and leads to acquiring a resource mix skewed more toward winter resources than is justified by an accurate representation of seasonal risks."[203] Mr. Wilson emphasizes that accounting for these adjustments is not the same as incorporating estimates of climate change impacts into the weather data; it is simply about accounting for trends in long-term data sets.[204]

Second, PJM fails to examine whether historic data regarding power plant performance is a good indicator of future performance.[205] Following the 2014 Polar Vortex, when forced outage

[200] Wilson Accreditation Aff., *supra* note 199 at PP 25, 29.
[201] *Id.* at P 27.
[202] *Id.* at P 27.
[203] *Id.* at P 28.
[204] *Id.* at P 31.
[205] *Id.* at PP 33–34; *see also* Brattle Report 1, *supra* note 74 at 15 ("Outage rates and correlations might be informed by historical data, such as each resource's performance during the 2014 Polar Vortex. However, data from the past may be unrepresentative of resources' current condition and management practices for making the plant and fuel available.").

rates among thermal plants were extremely high, "PJM regularly performed analysis to see how the plants that performed poorly in [the Polar Vortex] performed under similar extreme cold conditions, and found that these same plants had in subsequent years were performing much better under similar circumstances."[206] As a result, PJM decided to "exclud[e] that data for purposes of developing plant performance assumptions for its annual resource adequacy analysis underlying the Reserve Requirements Study."[207] PJM has now decided to reintroduce that data, rejecting without explanation its prior determinations that intervening changes, including the incentives created by the CP construct introduced after the Polar Vortex can be ignored. Mr. Wilson concludes that further "analysis is needed to identify to what extent it may be appropriate to include the [] PV14 data without any adjustment . . . in establishing assumptions for future delivery years," to avoid an overstatement of the region's reserve requirement.[208] Likewise, the forced outages seen during Winter Storm Elliott may reflect some unique elements of that event, rather than just the exact temperatures. PJM should therefore make an adjustment to the probability assigned to these data, in order to accurately forecast future performance of generators at specific temperatures.[209]

Finally, the affidavit of Patricio Rocha-Garrido raises numerous questions about various assumptions in PJM's risk modeling. For instance, Dr. Rocha-Garrido states that the modeling will assume that some planned generator outages will occur during high-risk periods, which has apparently been the historical practice.[210] This assumption is not realistic regarding PJM's likely future policies for scheduling planned outages, given the increased awareness around winter

[206] Wilson Accreditation Aff., *supra* note 199 at P 35.
[207] *Id.*
[208] *Id.* at P 38.
[209] *Id.* at PP 39–41.
[210] Accreditation Filing, *supra* note 1, at Rocha-Garrido Aff. P 27, PDF p. 697.

risks. As such, this assumption likely contributes to overstating winter risks.[211] Likewise, Dr. Rocha-Garrido describes PJM's approach to developing resource performance histograms, by grouping performance data by temperature, and reveals that temperature bins with very little data will be merged. The lack of further explanation or production of underlying data is troubling because, as Mr. Wilson explains, "[e]xtreme temperatures often drive results, and there are few observations of such temperatures, so how they are grouped for analysis purposes can have a large impact."[212] With respect to load forecasts, Mr. Wilson notes that the new hourly load distribution PJM is using differs sharply from prior distributions, and has two significant kinks in it, which is "not expected" in "distribution[s] based on large amounts of weather and load data."[213] Because of the impact these distributions have on the reserve requirement, additional transparency and consideration of the analysis underlying this distribution is essential.[214] The same holds for a cryptic statement by Dr. Rocha-Garrido that daily loads in the risk model are adjusted upward by a random value to account for error in the PJM load forecast. Dr. Rocha-Garrido does not explain which load forecast is referred to here, or provide any data to establish that these errors are symmetric and therefore support the symmetric adjustment that PJM is making.[215]

The details of PJM's risk modeling matter greatly for whether or not PJM's capacity market rates are just and reasonable. As Mr. Wilson's affidavit shows, PJM's modeling is rife with questionable assumptions or completely unexplained, but highly consequential, decisions. As such, PJM has not met its burden of proof to support its filing. The Commission must require

[211] Wilson Accreditation Aff., *supra* note 199 at PP 41–42.
[212] *Id.* at P 45.
[213] *Id.* at P 46.
[214] *Id.*
[215] *Id.* at P 47.

PJM to produce additional information to substantiate these decisions, without which it cannot approve PJM's accreditation rules as just and reasonable.

V. FURTHER REFORMS WILL BE NEEDED TO PROTECT CONSUMERS AND ENSURE PRICE SIGNALS THAT IMPROVE RELIABILITY.

PJM's Accreditation Filing takes important steps by developing a more granular risk model and updating accreditation to make long overdue changes that will improve price signals and ensure consumers are getting what they pay for. However, as PJM notes in its transmittal letter,[216] and consistent with direction from its Board of Managers,[217] PJM's capacity market will need to continue to evolve.

Chief among the ongoing needs for improvement in the capacity market from PIOs' perspective is for PJM to move to a seasonal capacity market design.[218] PJM's Chief Economist Dr. Walter Graf notes the need for a "seasonal or other more granular capacity market design"[219]—a direction with broader stakeholder support during the Critical Issues Fast Path and earlier processes.[220] A well-designed seasonal capacity market will help PJM address the distinct issues that arise in different periods of the year with more precision—to the benefit of

[216] Accreditation Filing, *supra* note 1 at 20.
[217] Letter from Mark Takahashi, Chair, PJM Board of Managers, to PJM Interconnection, L.L.C. Stakeholders (Sept. 27, 2023), https://www.pjm.com/-/media/about-pjm/who-we-are/public-disclosures/20230927-pjm-board-letter-re-its-decision-within-the-cifp-ra.ashx. This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-452.
[218] Wilson Accreditation Aff., *supra* note 199 at P 19 ("As winter risk increases and the resource mix increasingly includes seasonal resources such as solar, wind, and gas-fired, it will become important to procure a resource mix for each season that will perform well during the risk periods of that season. PJM recognizes the importance of a seasonal capacity market and has prioritized this further work.").
[219] Accreditation Filing, *supra* note 1 at Graf Aff. P 160, PDF p. 679.
[220] *See* Letter from Charlotte Mitchell, President, Organization of PJM States, Inc., to Mark Takahashi, Chair, PJM Board of Managers (Aug. 30, 2023), https://www.pjm.com/-/media/about-pjm/who-we-are/public-disclosures/20230830-opsi-letter-re-cifp-proposals.ashx; *see also* Letter from Public Interest Organizations to Manu Asthana, President and CEO, PJM Interconnection, L.L.C. (Sept. 1, 2023), https://www.pjm.com/-/media/about-pjm/who-we-are/public-disclosures/20230905-several-environmental-entities-and-consumer-advocates-letter-re-cifp-proposals.ashx.

consumers.[221] PJM staff had introduced two different proposals for a 2-season market design during the Critical Issues Fast Path,[222] and several other stakeholders came forward with other sub-annual designs,[223] but the compressed schedule and large number of issues that stakeholders had to consider did not enable resolution on a seasonal market design with broad support. As PJM's risk modeling shows, PJM faces significant risk in the winter.[224] During the stakeholder process, PJM produced estimated ELCC Class Ratings that show significant variation in the accredited capacity different resource types could offer in various seasons.[225] While the seasonality of wind and solar resources is generally understood, PJM's analysis also showed large differences in the performance of gas combined cycle and combustion turbine resources: combined cycle resources had an estimated ELCC of 97% in summer but only 75% in winter, while combustion turbines showed 98% in summer and only 62% in winter.[226] This variation across seasons shows the urgency of tailoring procurement to each season, so that PJM can procure the right resource mix to address the risks in each season.

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[221] Brattle Report 1, *supra* note 74 at 2 (Among recommendations that are "necessary to facilitate industry transformation while maintaining reliability at minimum costs to consumers," Brattle includes: "Break the annual construct into seasons to enable more precise targeting of unique seasonal risks. Even with improvements to winter resource adequacy modeling, a single annual approach is ill-suited to address both summer and winter reliability risks.")

[222] *See* Capacity Market Reform: PJM's Initial Proposal, *supra* note 39; *see also* PJM, Capacity Market Reform: PJM Proposal, at 524 (July 27, 2023) ("Capacity Market Reform: PJM's Second Proposal"), https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230727/20230727-item-02a---cifp---pjm-proposal-update---july-27.ashx (PJM's second, simplified proposal). This document is also attached in Volume 2 of Attachments to this protest; *see* ATT-317.

[223] *See, e.g.*, Capacity Coalition, Long Term Capacity Market Changes (Aug. 1, 2023), https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230807/20230807-item-02d---leeward---long-term-capacity-market-final.ashx; Steven Lieberman, AMP's Views on a Seasonal Capacity Concept (June 23, 2022), https://www.pjm.com/-/media/committees-groups/task-forces/rastf/2022/20220623/item-03a---seasonal-capacity-perspectives---amp.ashx; James F. Wilson, Framework for RPM as a Fully Seasonal Construct (Aug. 8, 2022), https://www.pjm.com/-/media/committees-groups/task-forces/rastf/2022/20220808/item-03a---seasonal-capacity-perspectives---wilson-energy-economics.ashx.

[224] Accreditation Filing, *supra* note 1 at Rocha-Garrido Aff. P 47(a), PDF p. 705.

[225] Capacity Market Reform: PJM's Second Proposal*, supra* note 222222222 at 61.

[226] *Id.*

Moving a seasonal or other more granular market design has other benefits as well, including obligating resources at a level closer to their actual expected performance in each season. This is critical for establishing reasonable capacity performance obligations on strongly seasonal resources like wind and solar, which would make participation in the capacity market more viable for these growing resource classes.

Dr. Graf's affidavit highlights another much-needed update to PJM's foundation for accreditation and risk modeling: "the need for models that accurately capture the real-world complexities and limitations of resources."[227] As Dr. Graf explains:

> [C]ertain resources have prolonged start-up times or specific forward notification requirements. These operating parameters can impact how they respond to operator direction or market signals and, consequently, their contribution to system reliability. Models that do not factor in these operational limitations may over-estimate such resources' contribution to resource adequacy, and, in turn, relatively under-estimate the capacity contribution of more flexible resources. The difficulty of incorporating and implementing reasonable assumptions regarding operators' imperfect information about future conditions—be it changing weather patterns, sudden spikes in demand, or unexpected outages—further compounds the challenge.[228]

PIOs have been advocating for such improvements to the risk and accreditation models for PJM and other RTOs, and it is critical that the Commission and RTOs commit the resources needed to build out this capability. This modeling is not only important for slow-start resources like coal plants, but also for gas plants that have lengthy notification periods to obtain gas supply.[229] Gas-

[227] Accreditation Filing, *supra* note 1 at Graf Aff. P 164, PDF p. 680.
[228] *Id.* at Graf Aff. P 165, PDF p. 680.
[229] Several complaints filed with the Commission following PJM's assessment of penalties during Winter Storm Elliott vividly illustrate the constraints imposed by the gas nomination cycles. *See, e.g.*, Complaint of the Coalition of PJM Capacity Resources, at 17, Docket No. EL23-55 (Apr. 4, 2023), Accession No. 20230404-5249 (asserting that gas markets were "closed" beginning on the afternoon of December 23 and through Winter Storm Elliott, during "which time generators were substantially limited in their ability to obtain and nominate gas."); Complaint of Nautilus Entities, at 8, Docket No. EL23-53 (Mar. 31, 2023), Accession No. 20230331-5217 (asserting that "gas-fired generators are to be given at least a day's notice that they will have to be online in order to address cold weather-related operating issues.").

electric coordination cannot resolve the physical limitations of the gas pipeline system to provide just-in-time service, and system operators cannot have perfect foresight. This leaves a significant gap in terms of system operators' ability to respond when risks arise on short notice.

A recent report by Synapse Energy Economics explains the risks posed to the ISO New England system by over-accreditation of long lead time resources, where considerable risks from forced outages or load forecast error can arise within the lengthy start-up times of thousands of megawatts of capacity on the system.[230] During Winter Storm Elliott, ISO New England found itself unable to rely upon 8,600 MW of capacity to address an emergency situation that arose on short notice.[231] PJM faced similar limitations in seeking to rely on 3,000 MW of long lead-time capacity resources at a critical moment during Elliott.[232] The Synapse Paper explores possible means of incorporating these lead times into capacity accreditation, noting the need for system models that can account for commitment and dispatch as well as forecast and forced outage uncertainty.[233]

CONCLUSION

For all the reasons described above, PJM has failed to carry its burden of demonstrating that its Accreditation Filing would result in rates that are just, reasonable, and not unduly discriminatory. PIOs respectfully request that the Commission reject the Accreditation Filing and

[230] Jason Frost et al., Synapse Energy Economics, Inc., The Impact of Resource Inflexibility on Capacity Accreditation in New England (Mar. 7, 2023) ("Synapse Paper"), https://www.synapse-energy.com/sites/default/files/Capacity%20Accreditation%20for%20Inflexible%20Resources%202023_03_07.pdf.
[231] Memorandum from Jonathan Gravelin, Manager, Control Room Operations to NEPOOL Markets Committee, NEPOOL Reliability Committee, Implementation of ISO-NE Operating Procedure #4 on Saturday December 24, 2022 (Dec. 29, 2022), https://www.iso-ne.com/static-assets/documents/2022/12/op4-report-nepool-committees-12-24-22.pdf.
[232] Winter Storm Elliott FAQ, *supra* note 63 at 5 ("Operators also looked at long-lead-time resources that were beyond the window for calling on, which was about 3,000 MW going into the weekend.").
[233] Synapse Paper, *supra* note 230230 at 17–19.

provide clear explanations as to what errors PJM must correct for a similar filing to be just and reasonable.

Respectfully submitted this 9th day of November, 2023.

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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 in the official service list compiled by the Secretary in this proceeding, by email.

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Dated: November 9, 2023

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

PJM Interconnection, L.L.C.	)	Docket No. ER24-99-000

AFFIDAVIT OF JAMES F. WILSON
IN SUPPORT OF THE PROTEST OF
THE PUBLIC INTEREST ENTITIES

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I. Introduction

1. My name is James F. Wilson. I am an economist and independent consultant doing business as Wilson Energy Economics. My business address is 4800 Hampden Lane Suite 200, Bethesda, MD 20814.

2. I have forty years of consulting experience in the electric power and natural gas industries. Many of my past assignments have focused on the economic and policy issues arising from the introduction of competition into these industries, including restructuring policies, market design, market analysis and market power. Other recent engagements have included resource adequacy and capacity markets, contract litigation and damages, forecasting and market evaluation, pipeline rate cases and evaluating allegations of market manipulation. I also spent five years in Russia in the early 1990s advising on the reform, restructuring, and development of the Russian electricity and natural gas industries for the World Bank and other clients. I have submitted affidavits and presented testimony in proceedings of the Federal Energy Regulatory Commission ("Commission"), state regulatory agencies, and U.S. district court. I hold a B.A. in Mathematics from Oberlin College and an M.S. in Engineering-Economic Systems from Stanford University. My curriculum vitae, summarizing my experience and listing past testimony, is Attachment JFW-1 attached hereto.

3. I have been involved in electricity restructuring and wholesale market design for over twenty years in PJM, New England, Ontario, California, MISO, Russia, and other regions. With regard to the PJM system, I have also been involved in a broad range of market design and planning issues over the past several years.

4. With regard to the capacity market issues that are the subject of this proceeding, I have been involved in these issues in PJM, New England, New York, California, the Midwest, and other regions. Since PJM Interconnection, L.L.C. ("PJM") proposed the Reliability Pricing Model ("RPM") capacity construct in 2005, I have prepared numerous affidavits, reports, and analyses of RPM and RPM-related issues.

5. On October 13, 2023, PJM filed in this docket (ER24-99) capacity market reforms to accommodate the energy transition while maintaining resource adequacy ("PJM Filing"), supported by the affidavits of Dr. Walter Graf ("Graf Affidavit") and Dr. Patricio Rocha-Garrido ("Rocha-Garrido Affidavit"). In a second filing on the same date, Docket No. ER24-98, PJM filed other capacity market changes that I address in a separate affidavit.

6. This affidavit was prepared at the request of Sierra Club and Earthjustice. My assignment was to evaluate the tariff changes proposed by PJM and to make recommendations.

II. Summary and Recommendations

7. Resource adequacy is presently in good shape in PJM at the RTO level, with an amount of capacity well in excess of reliability requirements already cleared for the period through May 31, 2025 (there are some serious resource adequacy issues in some constrained zones, discussed further below). In preparation for the anticipated transition in the resource mix over the coming decade, PJM has been working with stakeholders to develop the needed changes to its energy, ancillary services, and capacity markets, and to the supporting interconnection and planning processes.

8. With regard to the capacity market, PJM is updating its resource adequacy model that plays a central role in identifying the times of the year when there is reliability risk, and the resources that provide capacity value at those times, to update accreditation. This will ensure that

PJM can procure a resource mix to maintain the target level of resource adequacy as the resource mix changes. While the proposed structural changes to PJM's resource adequacy analysis are correct, I have concerns about assumptions PJM plans to use in the modeling.

9. It is critically important that the new resource adequacy model's identification of reliability risk be reasonably accurate, in order that resource accreditation and identification of seasonal reliability needs be accurate. If the reliability risk is inaccurate or distorted, accreditations and reliability requirements are distorted, leading to treating resources unfairly and procuring an inefficient resource mix through PJM's Reliability Pricing Model ("RPM") capacity construct.

10. In resource adequacy modeling, perhaps some light fingers on the scale are appropriate to ensure the analysis is conservative and risks are not understated. Unfortunately, however, following the trauma of Winter Storm Elliott, PJM's approach has not had a light touch. First, PJM issued its "Energy Transition: Resource Retirements, Replacements, and Risks" report;[1] my review of this report found that it needlessly worried stakeholders and policy makers with unrealistic, drastically low reserve margin scenarios based on invalid "balance sheet" calculations that ignored PJM's own capacity market.[2] And now PJM proposes to change resource adequacy assumptions in ways that would greatly exaggerate winter risk and distort accreditations toward resources that perform relatively well during the winter on the traditionally summer-peaking PJM system. I also conclude that PJM overstates the urgency of these changes; as I will further explain, resource adequacy is in good shape at the RTO level on the PJM system at present. This false

[1] PJM, *Energy Transition in PJM: Resource Retirements, Replacements and Risks*, February 2023, ("R4 Report"), available at https://www.pjm.com/-/media/library/reports-notices/special-reports/2023/energy-transition-in-pjm-resource-retirements-replacements-and-risks.ashx.

[2] Wilson, James F. *Maintaining the PJM Region's Robust Reserve Margins* ("R4 Report Critique"), prepared for Sierra Club and Natural Resources Defense Council, May 2023, available at https://www.sierraclub.org/sites/www.sierraclub.org/files/2023-05/Wilson%20R4%20Report%20Critique%20Revised.pdf.

urgency should not lead the Commission to hasty decisions about these important proposals that would have large and lasting impacts.

11. The focus of my affidavit is on several areas where the assumptions PJM proposes to use in the resource adequacy model are inaccurate, and other areas where PJM has not supported its proposed approach and more data and analysis would be needed to determine whether the approach is reasonably accurate. Throughout my affidavit I will identify assertions that are not supported, supporting data that was not provided, and missing analysis that the Commission would need to evaluate the proposals and determine whether they are just and reasonable. In particular, my affidavit raises the following issues about proposed assumptions:

1. Historical temperature data reflects warming trends that must be recognized; ignoring these trends distorts the analysis, overstating winter risk;
2. Power plant performance (outage rate) assumptions should reasonably reflect likely future performance; details of past extreme events warrant careful analysis to ensure the use of this data leads to accurate assumptions for future periods;
3. I question the assumption that planned outages will be scheduled during future high-risk winter periods; and
4. I also raise questions about load shapes and binning rules.

12. I also raise concerns about how all the changes may affect smaller zones. At present there are some serious resource adequacy issues in some constrained zones,[3] and other zones are

[3] See, for instance, letter from David W. Souder, Executive Director, System Planning, PJM, to Dale Lebsack, President, Brandon Shores LLC, June 1, 2023 *re: Deactivation Notice for Brandon Shores 1&2* (requesting the owner to continue operation under a Reliability Must-Run (RMR) arrangement from the requested deactivation date of June 1, 2025 until transmission upgrades can be completed to resolve identified reliability issues, in "approximately five years"), available at https://www.pjm.com/-/media/planning/gen-retire/deactivation-notices/pjm-response-letter-brandon-shores.ashx.

also relatively susceptible to price spikes and exercise of market power as a result of small changes in supply or demand. PJM has provided very little information about how all of the changes will affect supply, demand, prices and costs in smaller zones, making it difficult to evaluate the proposals.

13. The remainder of this affidavit is organized as follows. The next section explains that resource adequacy is in good shape at the RTO level at present and through at least May 31, 2025. Section IV explains that PJM is heading in the right direction with its reforms, and Section V emphasizes the importance of accurate assumptions in future resource adequacy analyses. Section VI identifies the areas of concern about the accuracy of assumptions.

III. Resource Adequacy is in Good Shape at the RTO Level

14. As a preliminary observation, RTO-level resource adequacy has been in good shape in PJM for many years, with reserve margins far in excess of the target levels considered needed for resource adequacy.[4] Through the RPM capacity construct, PJM has already acquired capacity for the next two delivery years, 2023-2024 and 2024-2025, with reserve margins far above the target levels considered to represent adequate resources, and at very low clearing prices.[5] And PJM's sensitivity analysis of the RPM auction for the 2024-2025 delivery year shows that there

[4] For a more detailed discussion of the over-procurement problem, see my 2020 paper on the topic: *Over-Procurement of Generating Capacity in PJM: Causes and Consequences*, February 2020, prepared for Sierra Club and Natural Resources Defense Council, available at https://www.sierraclub.org/sites/www.sierraclub.org/files/blog/Wilson%20Overprocurement%20of%20Capacity%20in%20PJM.PDF.

[5] R4 Report Critique p. 4 Figure 2.

was at least 6,000 additional megawatts that failed to clear in the auction that also offered at quite modest prices.[6]

15. While there are some serious resource adequacy issues in constrained zones (as noted above), and a new wave of retirements is expected over the coming decade, at present only a few major retirements have been announced for the period beyond May 31, 2025 for which capacity is already procured.[7] While relatively little new capacity has come online recently, this is understandable given interconnection queue and supply chain hurdles, along with the lack of need signaled by RPM (excess cleared capacity and low prices). There is a large amount of capacity well along in the interconnection process, including solar, wind, and also natural gas,[8] and many of these projects can be expected to advance to operation once there is a clearer need for the capacity. Again, as noted above, there are smaller constrained zones where large anticipated retirements and delays in new generation and transmission are likely to have costly impacts in the near term.

16. As is clear from the filing, PJM is now very focused on winter risk, and believes that its current modeling understates winter risk.[9] While a close look at winter risk is warranted, it is important to be aware that this is not a new issue for PJM. Under an Issue Charge approved

[6] PJM, *Scenario Analysis for Base Residual Auction*, Scenario # 4 (remove 6,000 MW of supply from bottom of supply curve in region outside of MAAC; showing that the impact would be less than 1,000 MW reduction in cleared capacity, and the RTO Region price rising to $56.26/MW-day); see also discussion in R4 Report Critique p. 11.

[7] PJM, *List of Future Deactivations,* accessed November 2, 2023 (showing, with deactivation dates beyond May 31, 2025, 2,123 MW in the BG&E zone (Brandon Shores and Wagner) and 579 MW in DPL (Indian River and Vienna).

[8] PJM's interconnection queues show over 15 GW of active projects with completed Interconnection Service Agreements. Accessed November 2, 2023.

[9] See, for instance, Rocha-Garrido Affidavit, P. 47b ("the current resource adequacy model understates winter risk").

by the PJM Markets and Reliability Committee in November 2016,[10] PJM staff worked on winter resource adequacy and load forecasting over the 2017-2019 period, and made some changes.[11] In particular, PJM implemented a new approach to representing forced outage rates under winter peak conditions for determining reliability requirements (but not accreditation), taking into account correlated outages of gas-fired resources.[12]

17. A major transition in the PJM resource mix will occur over the coming decade, and this will require numerous changes to PJM's capacity, energy, and ancillary services markets and planning processes. PJM has been working with stakeholders for years to prepare for this transition.[13]

[10] Issue Charge, *Winter Season Resource Adequacy and Capacity Requirements*, brought forward by Maryland Office of People's Counsel, New Jersey Division of Rate Counsel, and Delaware Division of the Public Advocate, approved by the Markets and Reliability Committee at its meeting on November 17, 2016, available at https://www.pjm.com/-/media/committees-groups/committees/mrc/20161117/20161117-agenda.ashx (only the agenda is available, the issue charge and voting report have been removed from the PJM website).

[11] See Tom Falin, PJM, *Winter Resource Adequacy Analysis Status Report*, Markets and Reliability Committee Meeting October 26, 2017, Item slide 3 (noting, as areas of investigation, common mode failures and correlation of generator performance with load levels). This file is no longer available on the PJM website.

[12] See, for instance, PJM, *2022 Reserve Requirements Study*, p. 39 (describing the approach to forced outages rates for the winter peak week and stating that "This practice ensures that common mode outages due to rarely occurring extreme weather are captured in the winter peak week.")

[13] PJM, *Energy Transition in PJM: Frameworks for Analysis,* December 2021, available at https://www.pjm.com/-/media/library/reports-notices/special-reports/2021/20211215-energy-transition-in-pjm-frameworks-for-analysis.ashx; *Energy Transition in PJM: Emerging Characteristics of a Decarbonizing Grid*, May 2022, available at https://www.pjm.com/-/media/library/reports-notices/special-reports/2022/20220517-energy-transition-in-pjm-emerging-characteristics-of-a-decarbonizing-grid-white-paper-final.ashx.

IV. PJM's Proposed Capacity Market Reforms Are Heading in the Right Direction

18. While resource adequacy at the RTO level is in good shape over the near term, changes are needed to ensure the resource mix continues to satisfy reliability targets, and the instant filing is generally heading in the right direction, with updates to resource adequacy modeling and updated accreditation for all resource types. The proposed changes address some current issues in the PJM markets and begin to prepare the RPM capacity construct for the anticipated transition in the resource mix. Among other key changes, marginal accreditation for all resource types ensures that as penetration of any resource type increases, the accreditation likely declines, and the resources most needed for reliability will have the highest accreditations.

19. One critically important change is not proposed in the current filing – enhancements to RPM to procure on a seasonal basis. As winter risk increases and the resource mix increasingly includes seasonal resources such as solar, wind, and gas-fired, it will become important to procure a resource mix for each season that will perform well during the risk periods of that season. PJM recognizes the importance of a seasonal capacity market and has prioritized this further work.[14]

V. The Assumptions Used for Resource Adequacy Modeling and Accreditation Must Be Accurate

20. The resource adequacy modeling identifies the times of year and hours of the day with resource adequacy risk; this determines the extent to which various types of resources contribute to resource adequacy (accreditation), and it determines the quantity of capacity needed

[14] PJM Filing p. 20 ("PJM and its stakeholders are committed to continuing to assess the design of PJM's capacity construct, including whether and how a seasonal capacity construct could help support reliability and efficiency for the PJM Region."); see also Graf Affidavit P 160: ("Thus, there are a number of elements that PJM anticipates will continue to evolve in the pursuit of "more perfect" markets, including, at least: seasonal or other more granular capacity market design;…).

for resource adequacy. Consequently, it is critically important that the resource adequacy modeling be accurate. If this modeling is inaccurate or distorted, this has multiple negative impacts:

1. accreditations are incorrect (too high or low), which treats resources unfairly;
2. reliability requirements are incorrect, which leads to procuring wrong amounts of capacity and potentially excess cost to consumers;
3. the incorrect accreditations and reliability requirements lead to procuring an inefficient, suboptimal resource mix through RPM, and one that might not meet resource adequacy targets.

21. Accordingly, the structure and assumptions used in the resource adequacy modeling should be as accurate as feasible. The main issue is the assumptions used rather than the structure of the model. The model needs to characterize uncertainties such as future load levels and power plant performance. These assumptions are generally based on historical data, under the assumption that past outcomes are indicative of what can be expected in the future. However, there can be situations where the past is not a good predictor of the future, because conditions have changed, and some adjustment to historical data is warranted for the forward-looking analysis to be reasonably accurate. For example, historical energy or capacity prices in a small, constrained zone would not be indicative of likely future prices if a new transmission line has recently eliminated the constraints.

22. There can of course be judgment calls and grey areas in how assumptions about future delivery years are set based on historical data. Within a range of reasonable assumptions, it is reasonable to err on the conservative side, preferring to overstate rather than understate risk. And there can be approaches that are not in a grey area – approaches that clearly fall outside a

reasonable range and bias the modeling in a particular direction. In these cases, such assumptions require some adjustment or modification to bring the results back toward accuracy.

23. The remainder of my affidavit identifies areas where the assumptions PJM proposes to use appear to be inaccurate, and other areas where PJM has not supported its proposed approach and more data and analysis would be needed to determine whether the approach is reasonable or not. I identify assertions that are not supported, supporting data that was not provided, and missing analysis that the Commission would need to evaluate the proposals and determine whether they are just and reasonable.

VI. Concerns about Proposed Assumptions for the Resource Adequacy Modeling

24. The following sections identify concerns about assumptions PJM proposes to use in the resource adequacy modeling, which also affect accreditation and identification of Reliability Requirements.

A. Historical temperature data reflects warming trends that must be recognized

25. Historical weather data (mainly, temperatures) is used to develop the hourly load shapes by season used in the resource adequacy model. In the stakeholder process leading up to the current filing, PJM had multiple times stated its intention to use 50 years of historical weather data,[15] and presented alternative ways to take temperature trends into account.[16] However,

[15] See, for instance, PJM, CIFP-RA Stage 2 meeting March 29, 2023, Item 04: *PJM CIFP-RA Initial Proposal - Stage 1 Posting*, slide 5 ("Expand weather history in reliability modeling to 50+ years to better represent the full distribution of summer and winter weather outcomes.") available at https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230329/20230329-item-04---pjm-cifp-ra-initial-proposal---stage-1-posting.ashx.

[16] See, for instance, PJM, *Update on Reliability Risk Modeling*, July 17, 2023 Critical Issue Fast Path meeting, slides 5-6 (showing alternative ways to use 50 years of data and take temperature trends into account), available at https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230717/20230717-item-03---reliability-risk-modeling---july-update-v2-copy.ashx.

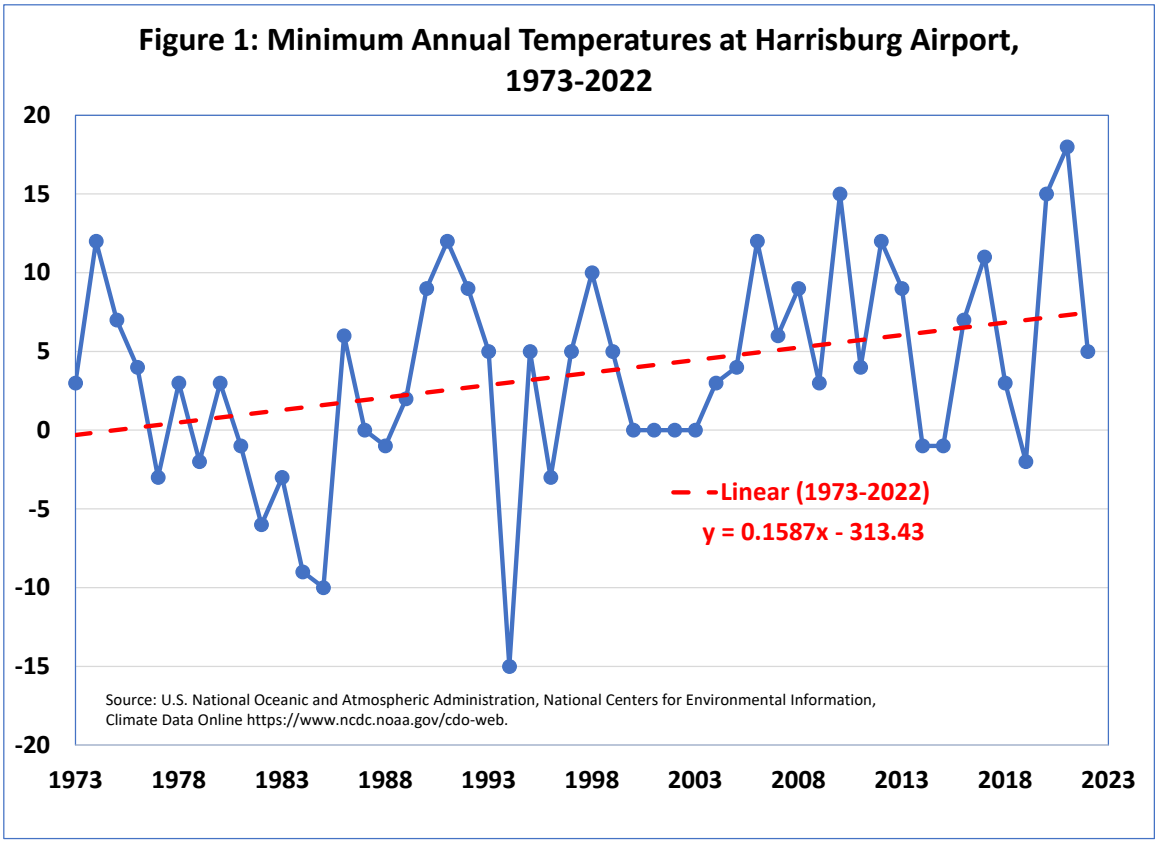
ultimately, PJM proposes to instead use only 30 years, and to ignore the upward trends in the temperatures in the data set.

26. The Rocha-Garrido Affidavit claims that "when analyzing PJM-region temperature data starting June 1, 1993, no clear consistent trend is observed in the period 1993-2022."[17] He presents no data or analysis to support this assertion. To the contrary, in my work on load forecasting in the PJM footprint and elsewhere in North America, I have consistently found upward trends in the seasonal extreme temperatures.[18] As one example from the PJM footprint, Figure 1 shows the minimum annual temperatures at the Harrisburg, Pennsylvania Airport, chosen as a point near the center of the PJM footprint.[19] The trend line suggests an increase in the minimum annual temperature of one degree about every 6.3 years (1 / 0.1587) over the past 50 years; and the trend is stronger, about one degree every three years, over the past thirty years. I have found that summer extreme temperatures are also increasing, of course, but generally at a slower rate than winter extreme temperatures.

[17] Rocha-Garrido Affidavit P. 20.a

[18] See, for instance, Wilson, James F. *Load Forecasting and Resource Planning for Extreme Cold,* Florida Public Service Commission Workshop on Ten-Year Site Plans, June 1, 2022, p. 15 (figure showing increasing minimum temperatures at Miami Airport by one degree every five or six years since 1976); Wilson, James F. *Evidence on Behalf of the Nova Scotia Consumer Advocate*, July 21, 2021, p. 27 Figure 2 (showing upward trends in annual minimum temperatures at Shearwater Airport over the past 70 and 30 years); Wilson, James F. *Direct Testimony on Behalf of Georgia Interfaith Power and Light and the Partnership for Southern Equity*, May 6, 2022 p. 51 Figure JFW-5 (showing an upward trend in minimum temperatures on the Southern Company system of about 9 degrees over 60 years).

[19] Historical weather data is available from the U.S. National Oceanic and Atmospheric Administration, National Centers for Environmental Information, Climate Data Online https://www.ncdc.noaa.gov/cdo-web.



27. Summer and winter extreme temperatures drive the summer and winter peak loads that are critical assumptions in the resource adequacy analysis. Ignoring the temperature trends leads to inaccurate assumptions about the likely future level and volatility of summer and winter extreme temperatures. Failing to reflect the upward trends in extreme temperatures in both summer and winter exaggerates *winter* risk relative to summer risk in three ways:

1. Failing to reflect increasing summer extreme temperatures understates summer extreme temperatures and load levels, understating summer risk;
2. Failing to reflect increasing winter extreme temperatures understates winter extreme temperatures, which leads to *overstating* winter extreme load levels (winter loads are higher at lower temperatures) and overstating winter risk;

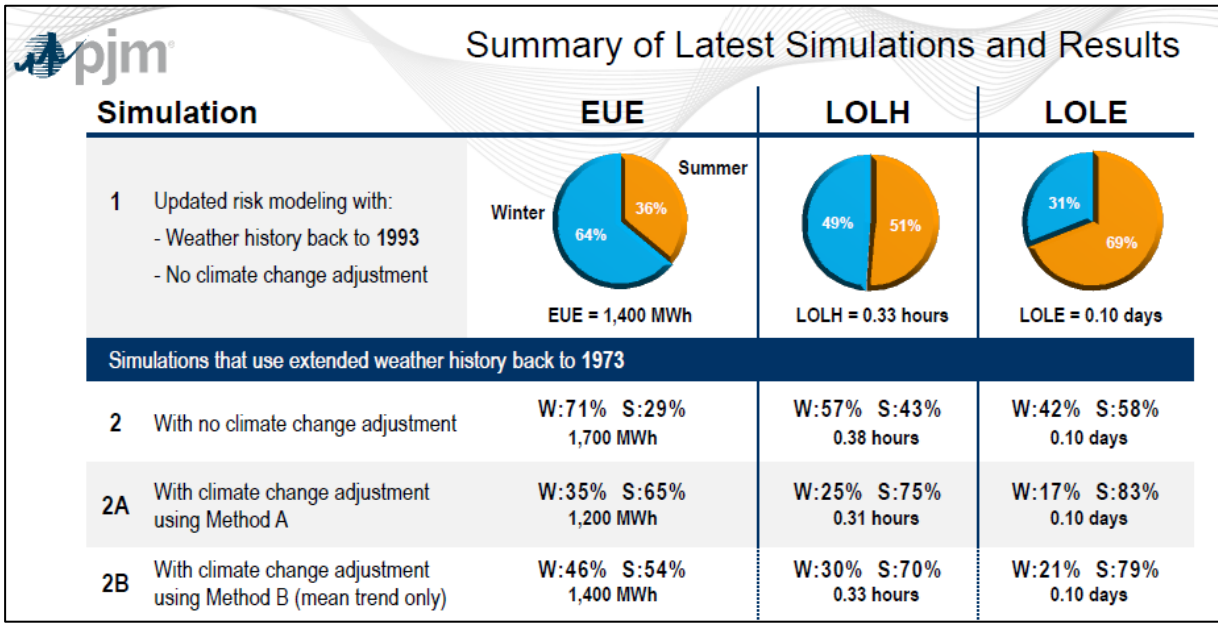
3. Estimating the variability of extreme temperatures without reflecting the upward trend over time leads to overstating the variability at any point in time, leading to overstating temperature and load volatility and the reserve margins needed to meet adequacy targets; this affects winter risk more than summer, because winter loads are more volatile and have shown a stronger upward trend.

28. Ignoring the temperature trends and overstating winter risk inaccurately and unfairly distorts accreditations in favor of winter resources and against summer resources, and leads to acquiring a resource mix skewed more toward winter resources than is justified by an accurate representation of seasonal risks.

29. In the stakeholder process leading up to the PJM filing, PJM had identified an effective approach for reflecting temperature trends in the resource adequacy analysis.[20] Simulation 2A (Climate Change Adjustment Using Method A, Trends in Extremes), presented on July 17, 2023 (shown in Figure 2 below) used 50 years of data and reflected the trends that matter – in the summer and winter extreme temperatures. This approach led to estimated seasonal risk (Expected Unserved Energy) of 65% in summer and 35% in winter, compared to PJM's current resource adequacy model that suggests nearly all risk is in summer when loads are much higher. However, PJM ultimately chose to use less historical data (30 years), and to ignore temperature trends, leading to flipping the seasonal risk to 36% in summer, 64% in winter.

[20] PJM, *Update on Reliability Risk Modeling*, July 17, 2023 Critical Issue Fast Path meeting, slide 6 Simulation 2A (Climate Change Adjustment Using Method A, Trends in Extremes), available at https://www.pjm.com/-/media/committees-groups/cifp-ra/2023/20230717/20230717-item-03---reliability-risk-modeling---july-update-v2-copy.ashx.

Figure 2: Slide 6 from PJM's July 17, 2023 CIFP presentation



30. Climate scientists are evaluating the possibility that extreme weather events may become more frequent due to climate change, but there is not yet a consensus on that question.[21] The Graf Affidavit states (P. 161) that "PJM plans to continue to evaluate potential approaches to enhance and improve our understanding of the distribution of potential delivery-year weather outcomes in the presence of climate change." While PJM certainly should be doing that, note that the present issue is not about projecting climate change into the future, and the complex meteorological models used for such forecasts: The issue I have raised is simply about using a long-term historical data set that reflects a trend, where the present time is at one end of that trend.

[21] See, for instance, Washington Post, Dec. 23, 2022, *Scientists say Arctic warming could be to blame for blasts of extreme cold* ("Research suggests that climate change is altering the jet stream, pushing frigid air down to southern climes more frequently. But the scientific jury is still out."), available at https://www.washingtonpost.com/climate-environment/2022/12/23/climate-change-impact-cold-weather/.

31. Ignoring the trend results in an inaccurate estimation of both the mean and standard deviation applicable to the present time and future periods. I've seen that utilities are taking different approaches to dealing with trends in the historical temperatures they use for load forecasting:

1. Some reduce the historical period to, say, ten years, so that the averages reflect recent times.
2. A better approach is to reflect the trends, focusing on the extreme temperatures that drive peak load estimates.
3. Some utilities have taken the further step of projecting well-established trends forward at least a few years.

32. While these practices deal with historical temperature trends in different ways, using a relatively long-term history, and ignoring trends (as PJM proposes to do) is not a reasonable approach and, as I have explained, exaggerates winter risk relative to summer, creating a distorted picture of reliability risk, and biasing the seasonal accreditations.

B. Power plant assumptions should reflect reasonably likely future performance

33. The resource adequacy model must represent the future performance of power plants on the PJM system; most importantly, the forced outage rates of all resources due to all causes. PJM proposes to use twelve years of historical data, with no special treatment for the extraordinary circumstances of the polar vortex in January 2014 ("PV14") or of Winter Storm

Elliott in December 2022 ("WSE22"). In both of these incidents, power plant outage rates were extraordinarily high compared to other historical extreme cold events with similar temperatures.[22]

34. As noted above, it is reasonable to use historical data to develop the assumptions for future periods when and to the extent we believe future performance is likely to reflect the past performance. When there are good reasons to expect future performance may be very different, this may warrant exclusion or adjustment to the historical data, or another approach to developing the assumptions, to ensure the model realistically represents likely future performance under similar conditions. Because power plants generally perform well over a wide range of conditions, special circumstances where very poor performance occurred in the past (such as PV14 and WSE22) can have a large impact on the statistics used to represent future periods. For this reason, it is important to examine the details of these extreme events and what they tell us about likely future generation performance under similar temperature conditions.

1. PV14: Most power plants have since weatherized; some adjustment to this outage data is warranted

35. As is well known, in PV14 many plants were out of service, largely because many were not prepared for the extreme cold weather that had not been seen for a long time. Subsequently, many of the plants that performed poorly have been weatherized and made other changes; and in addition, the Capacity Performance incentives were put in place. In the years following PV14, PJM regularly performed analysis to see how the plants that performed poorly in PV14 performed under similar extreme cold conditions, and found that these same plants were

[22] PJM, *Winter Storm Elliott Event Analysis and Recommendation Report,* July 17, 2023 ("WSE Report"), available at https://www.pjm.com/-/media/committees-groups/committees/mrc/2023/20230724/20230724-winter-storm-elliott-event-analysis-and-recommendation-report.ashx.

performing much better under similar circumstances.[23] Ultimately, in 2017 PJM staff decided that the evidence showed that PV14 forced outage data was no longer reflective of likely future performance, and PJM began excluding that data for purposes of developing plant performance assumptions for its annual resource adequacy analysis underlying the Reserve Requirements Study.[24]

36. However, following WSE22, PJM announced that it would no longer follow this practice of removing the PV14 data from its historical data set.[25] At multiple Resource Adequacy Analysis Subcommittee ("RAAS") and Planning Committee ("PC") meetings this year, I asked PJM to support this decision: to provide an update of its analysis from 2016 and 2017 that had found much improved plant performance, to identify to what extent those plants were now performing poorly, and to compare the causes of poor performance in PV14 and WSE22. This analysis was never produced; only comparisons at the aggregate level have been provided, which do not reveal how power plants in service during PV14 performed in the WSE22.[26]

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[23] See, for instance, Paul McGlynn, PJM, Inside Lines, February 14, 2019, *How PJM Remained Reliable During Record Cold* ("Evidence from this winter and last suggests that system performance continues to improve. During the 2014 Polar Vortex, for example, PJM faced forced generation outages of up to 22 percent. Last winter, the extended Cold Snap we faced produced outages of just 12 percent; during the recent cold weather of Jan. 30 and Jan. 31, we saw outages down to 8.6 percent and 10.6 percent, respectively."), available at https://insidelines.pjm.com/how-pjm-remained-reliable-during-record-cold/; PJM, *PJM Cold Snap Performance Dec. 28, 2017 to Jan. 7, 2018,* Feb. 26, 2018, page 1 ("There was a significant reduction in forced outages between the recent cold snap and the 2014 Polar Vortex."), available at https://www.pjm.com/-/media/library/reports-notices/weather-related/20180226-january-2018-cold-weather-event-report.ashx.

[24] See PJM, *2018 Reserve Requirements Study*, p. 64 ("For the winter peak week, the cumulative capacity outage probability table is created using historical actual (DY 2007/08 – DY 2017/18) RTO-aggregate outage data (data from DY 2013/14 will be dropped and replaced with data from DY 2014/15)."); similar language is found in the Reserve Requirements Study reports for 2019, 2020, 2021 and 2022.

[25] PJM, *2023 Reserve Requirement Study (RRS) Assumptions*, Resource Adequacy Analysis Subcommittee meeting May 12, 2023 (stating that "Given the resource performance during winter storm Elliott", this year PJM will no longer exclude the 2013-2014 data).

[26] See, for instance, WSE Report pp. 49-56.

37. The Rocha-Garrido Affidavit states that the proposed approach "would allow PJM to capture the large volume of forced outages observed during January 7, 2014 (Polar Vortex event of 2014) and Winter Storm Elliott as well as the better performance observed during a similarly cold event, February 20, 2015 by assuming that such RTO-wide outage levels would be repeated under similar weather conditions in the future, with a certain probability level."[27] This approach would apparently ignore the improved performance after PV14 that PJM had previously confirmed due to the many actions power plant owners and PJM took after that event (such as winterization, and Capacity Performance). PJM's proposed approach – including PV14 data without any recognition that the world changed after that event – essentially assumes that neither power plant owners, nor PJM, learned anything, or did anything, in response to PV14.

38. While it is appropriate to include data from PV14 in the data set to develop assumptions about future power plant performance under extreme cold conditions in some manner, it must be recognized that many of the power plants that performed poorly in PV14 no longer exist in that (non-weatherized) form. While the WSE22 experience raises new questions about performance under extreme cold, analysis is needed to identify to what extent it may be appropriate to include the rather extreme PV14 outage data without any adjustment to either the magnitude or frequency of the outage rates, in establishing assumptions for future delivery years. The PV14 outage data was shown in the past to have a substantial impact on reliability requirements and customer cost, and now it also affects accreditation.

[27] Rocha-Garrido Affidavit P. 20b.

2. WSE22: Poor performance occurred due to an extraordinary combination of circumstances; the probability assigned to this data warrants adjustment

39. As is well known, in WSE22 we again saw very high outage rates under extreme cold conditions.[28] The outages occurred for some of the same causes as in PV14, and some additional and different causes. Circumstances contributing to the poor performance in WSE22 included the timing of the extreme cold, arriving at the beginning of a holiday weekend,[29] and in the form of a very rapid drop in temperatures;[30] PJM's grossly erroneous load forecasts;[31] unprecedented natural gas well freeze-offs,[32] and many plants failing to clear in the day-ahead market, largely due to the low load forecast, and then not being able to acquire firm fuel;[33] among other circumstances.

40. As noted above, at multiple RAAS and PC meetings I asked PJM to explore how the same plants performed in PV14, WSE22, and other extreme cold events over the past decade, and to identify causes for outages, but this analysis was not provided.

41. While it is appropriate to include WSE22 data in the data set rather than excluding it as anomalous, allowing this outage data to be probability-weighted in the natural way (equally weighted with other dates) overstates the likelihood of the combination of events that came together in WSE22 and led to such poor performance. And as after PV14, PJM will again take

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[28] WSE Report p. 2.

[29] WSE Report p. 62 (explaining that the event occurring at the start of a long holiday weekend exacerbated gas supply issues).

[30] WSE Report p. 41 (the temperature drop was the most drastic in the past ten years).

[31] WSE Report pp. 38-39 (load forecasts for December 23 and 24 were low by over 9,000 MW).

[32] WSE Report p. 22 (stating that compared to typical losses due to well freeze-off conditions ranging from around 2 to 3 Bcf (billion cubic feet) per day in the Appalachian region, the actual supply loss was closer to 10 Bcf).

[33] WSE Report p. 53 (explaining that a large amount of gas-fired generation had no Day-Ahead Market commitment on Dec. 24, which led forced outages due to lack of fuel).

multiple actions to strengthen generator performance.[34] For the WSE22 data to contribute to forecasts of future performance in an accurate way, some adjustment to either the outage rates or the probability assigned to this data would be necessary.

C. Planned outages during high risk periods

42. The Rocha-Garrido Affidavit states that the resource adequacy modeling will assume a portion of future planned outages will be scheduled during high-risk periods.[35] While in the past PJM has approved some planned outages during winter periods, this has reflected the enormous excess capacity on the PJM system during winter. Under PJM's procedures, planned outages are not permitted during the summer peak period, and are only approved in the winter after checking against a "Winter Weekly Reserve Target" that is essentially based on a zero winter risk standard.[36] PJM did not provide a description of its policies for reviewing and approving requests for planned maintenance during high-risk winter periods; nor was historical data on planned maintenance during high-risk winter periods provided.

43. The assumption that there will be planned outages during future high-risk periods is not a realistic reflection of PJM's likely policies in future years when there is non-zero winter risk, and it will lead to overstating winter risk. It is impossible to fully evaluate this assumption without more explanation of PJM's policies and how they will be applied going forward, and historical data on past planned outages during high risk periods.

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[34] See, for instance, letter from Michael E. Bryson, Sr. V. P., Operations, to PJM Members, October 19, 2023 ("Moreover, PJM is preparing to support the recommendations calling for prompt efforts to "strengthen generators' ability to maintain extreme cold weather performance" and NERC "monitoring of implementation of currently-effective and approved cold weather Reliability Standards[.]"), available at https://go.pjm.com/e/678183/er-to-Members-re-WSE-Recs-ashx/b76db/940780737/h/YMEPE6GLS9NBNUlv-DmscaPWNfiF3txOeH8pAkxH_R4.

[35] Rocha-Garrido Affidavit, pp. 12-13.

[36] PJM, 2023 Reserve Requirements Study, p. 33.

44. To the extent there may be certain resources that require long-duration planned maintenance that must extend through high-risk periods, these resources should be required to arrange replacement resources; MISO's tariff includes such a requirement.[37]

D. Other questions about assumptions used in the resource adequacy modeling

1. Binning rules for temperature data in modeling resource performance

45. The Rocha-Garrido Affidavit describes a process to develop resource performance histograms applying "binning rules" to group data by temperature, while also noting that where bins contain "very few observations" they will be "merged."[38] The histograms are not provided, the principles for merging small bins are not described, nor are the particular bins that were merged identified. Extreme temperatures often drive results, and there are few observations of such temperatures, so how they are grouped for analysis purposes can have a large impact. It is impossible to understand whether these details matter, or determine whether the approach is reasonable, without the information identified above.

2. Use of the PJM load forecast distributions

46. The Rocha-Garrido Affidavit states that the new resource adequacy model will use hourly load scenarios produced as part of the PJM Load Forecast.[39] However, PJM made major changes to its load forecasting methodology recently, and the new (2023) peak load probability

[37] MISO Electric Tariff Section 69A.3.1.h Retirement, Suspension and Replacement of Planning Resources (any generator on planned outage for more than 31 days must arrange replacement capacity or will be subject to a Capacity Replacement Non-Compliance Charge).

[38] Rocha-Garrido Affidavit, P. 27 and footnote 9.

[39] Rocha-Garrido Affidavit, P. 25.

distribution is sharply different from the prior (2022) distribution.[40] In particular, the 2023 distribution has two significant "kinks" in it (at about the 87.5% and 92% points) not seen in the 2022 distribution. These distributions are based on large amounts of weather and load data. As a result, such distributions are generally very "smooth", that is they change slowly and consistently; the kinks seen in the 2023 distribution are not expected. I have asked many questions about this change, and received some answers, but more information about the changes to these calculations would be needed to become comfortable with the odd shape of the new distribution and its substantial impact on Reliability Requirements.[41]

3. Additional load forecast uncertainty

47. The Rocha-Garrido Affidavit describes PJM's proposal to adjust daily loads by a random value with standard deviation 1.2%, to account for error in the "PJM Load Forecast."[42] It is not clear what PJM load forecast is referred to here; PJM prepares forecasts years in advance, and one week ahead, and days and hours before any operational hour. The different forecast forward periods differ in the forecast errors and in the potential relevance to resource adequacy modeling. It is not clear that adjusting loads based on such errors is appropriate. And no data was provided on the historical errors that apparently support the 1.2% value; if the errors are asymmetric (for example, biased toward over-forecasting), a symmetric adjustment may be

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[40] See, for instance, PJM Markets and Reliability Committee meeting, October 25, 2023, Item 2: *2023 Reserve Requirement Study (RRS) Results*, slide 11 (showing a very large difference between the 2023 and 2022 distributions, which contributed to the very large change in the Forecast Pool Requirement; available at https://www.pjm.com/-/media/committees-groups/committees/mrc/2023/20231025/20231025-item-02---1-pjm-2023-rrs-results---presentation.ashx.

[41] PJM, *2023 Reserve Requirement Study (RRS) Results*, Markets & Reliability Committee, October 25, 2023, slides 5-6, (showing a recommended increase in the target Installed Reserve Margin from 14.7% to 17.6%, which equates to an increase in Reliability Requirements of about 3,700 MW, of which increase about 2/3 is attributed to the load model; available at https://www.pjm.com/-/media/committees-groups/committees/mrc/2023/20231025/20231025-item-02---1-pjm-2023-rrs-results---presentation.ashx.

[42] Rocha-Garrido Affidavit, P. 26.

inappropriate. It is impossible to determine whether this provision is reasonable without more information about what exactly is proposed and its potential impact on accreditations, reliability requirements, and consumer cost.

4. Capacity Benefit of Ties ("CBOT")

48. It is also important to reasonably accurately model the capacity benefit of the Eastern Interconnection (the assistance available during emergency conditions through PJM's interties with adjacent regions, also called CBOT, Capacity Benefit of Ties). This potential assistance varies with conditions, and under circumstances when other regions are also under stress can be low. That means that within the probabilistic resource adequacy analysis, this capacity benefit should be represented probabilistically (as are all other resources), identifying different levels of available assistance and assigning probabilities (including perhaps zero MW as one possibility).

49. While PJM has not proposed changes to the CBOT assumption in its filing, PJM staff had earlier proposed to set CBOT to zero (an obviously inaccurate assumption), and this was only stopped by action of the PJM Board.[43]

50. Note that to reflect CBOT in the resource adequacy analysis is not to "rely on" this resource in the analysis. Indeed, the concept of "rely on" has no place in the probabilistic resource adequacy analysis, where all resources are represented probabilistically, all are assumed to be unavailable with some probability, and none are "relied upon." To ignore CBOT is to distort the analysis substantially; the results cannot be considered to estimate the intended "one day in ten

[43] PJM Board, BOARD LETTER SUBSTANTIVE DIRECTION, September 27, 2023, p. 2 ("The Board has directed PJM to maintain the status quo provisions in the Reliability Assurance Agreement (RAA) regarding the consideration of Capacity Benefit of Ties (CBOT) in the determination of the Installed Reserve Margin (IRM) at this time.") available at https://www.pjm.com/-/media/about-pjm/who-we-are/public-disclosures/20230927-pjm-board-letter-re-its-decision-within-the-cifp-ra.ashx.

years" standard if this significant source of assistance is ignored. And to the extent ignoring this assistance is proposed as a conservative policy choice, that policy choice should be subject to approval by policy makers, and transparently documented, not buried in modeling assumptions. Again, the goal of the resource adequacy modeling should be accuracy.

5. Capacity Benefit of Energy-Only Resources ("CBEOR")

51. Another inaccurate assumption in the resource adequacy modeling, as proposed by PJM, is that it totally ignores the increasingly important contribution to reliability of so-called "energy-only" resources (those resources on the system that operate without a capacity commitment). This includes the many thousands of MW of on-system capacity that offer into RPM but fail to clear in the auctions (and do not retire), in addition to other resources that choose not to participate in RPM. This capacity benefit ("CBEOR", Capacity Benefit of Energy-Only Resources) should, like CBOT, be represented probabilistically in resource adequacy analysis, in the interest of accuracy.

52. Energy-only resources contributed over 10,000 MW on average during the emergency conditions in the Winter Storm Elliott event.[44] The quantity of energy-only resources on the system will likely rise due to higher expected energy and ancillary services prices, lower accreditation for some resource types, higher perceived Capacity Performance risk, and market power mitigation that allows reflecting this risk in offers (among other changes). These changes create the ability and incentive for many resources to choose to earn their revenue in energy and ancillary services markets, while not serving as a capacity resource.

[44] WSE Report p. 114 (Explaining that the average bonus megawatts eligible for bonus credits for the Winter Storm Elliott performance assessment event was 34,318 MW per interval, of which approximately 30% came from energy-only resources including net energy imports).

53. As with CBOT, to reflect CBEOR is not to "rely on" these resources in the resource adequacy analysis because the concept of "rely on" has no place in the probabilistic resource adequacy analysis. Again, to the extent ignoring these resources is proposed as a conservative policy choice, that policy choice should be subject to approval by policy makers, and transparently documented, not buried in modeling assumptions.

E. Concerns about the application of the new approaches to LDAs

54. The Rocha-Garrido Affidavit briefly describes how the new approaches would be adapted to the circumstances of Locational Deliverability Areas ("LDAs"; the zones defined for RPM purposes).[45] PJM calculates reliability requirements for zones based on a more stringent, 1-day-in-25 year resource adequacy standard, and the LDA reliability requirements reflect the estimated transmission available to the zone (Capacity Emergency Transfer Limit, "CETL"). Some LDAs are quite small and have been seen to be highly vulnerable to price spikes due to minor changes in supply or demand, or exercise of market power.

55. I have a general concern that the large package of changes proposed in this docket and the companion docket may render smaller zones even more susceptible to price spikes, with or without exercise of market power. But PJM has provided very little information about how all of the changes might affect the demand and supply balances of the various PJM zones and LDAs. Directionally, the changes to resource adequacy and accreditation will tighten supply-demand balances, likely worsening the situation in zones such as BG&E that already face constrained and anticipated high costs. More information and analysis about the impact of the many changes on

[45] Rocha-Garrido Affidavit P. 22B, PP. 41-42.

smaller zones would be needed to evaluate whether the proposals are reasonable, or whether some adjustments may be needed to mitigate impacts on zones.

56. This concludes my affidavit.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

PJM Interconnection, L.L.C.	)	Docket No. ER24-99-000

VERIFICATION

I, James F. Wilson, pursuant to 28 U.S.C. § 1746, state, under penalty of perjury, that I am the same James F. Wilson referred to in the foregoing document entitled "Affidavit of James F. Wilson in Support of the Protest of the Public Interest Entities," that I have read the same and am familiar with the contents thereof, and that the facts set forth therein are true and correct to the best of my knowledge, information, and belief.

James F. Wilson

Dated: November 8, 2023

James F. Wilson
Principal, Wilson Energy Economics

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SUMMARY

James F. Wilson is an economist with over 35 years of consulting experience, primarily in the electric power and natural gas industries. Many of his assignments have pertained to the economic and policy issues arising from the interplay of competition and regulation in these industries, including restructuring policies, market design, market analysis and market power. Other recent engagements have involved resource adequacy and capacity markets, contract litigation and damages, forecasting and market evaluation, pipeline rate cases and evaluating allegations of market manipulation. Mr. Wilson has been involved in electricity restructuring and wholesale market design for over twenty years in California, PJM, New England, Russia and other regions. He also spent five years in Russia in the early 1990s advising on the reform, restructuring and development of the Russian electricity and natural gas industries.

Mr. Wilson has submitted affidavits and testified in Federal Energy Regulatory Commission and state regulatory proceedings. His papers have appeared in the *Energy Journal*, *Electricity Journal*, *Public Utilities Fortnightly* and other publications, and he often presents at industry conferences.

Prior to founding Wilson Energy Economics, Mr. Wilson was a Principal at LECG, LLC. He has also worked for ICF Resources, Decision Focus Inc., and as an independent consultant.

EDUCATION

MS, Engineering-Economic Systems, Stanford University, 1982

BA, Mathematics, Oberlin College, 1977

RECENT ENGAGEMENTS

- Analysis of provisions to enhance resource fuel security in day-ahead and real-time wholesale electricity markets.
- Evaluated peak electric load forecasts and enhancements to load forecasting methodologies.
- Evaluated a probabilistic analysis to determine the electric generating capacity reserve margin to satisfy resource adequacy criteria.
- Evaluated the potential impact of an electricity generation operating reserve demand curve on a wholesale electricity market with a capacity construct.
- Developed wholesale capacity market enhancements to accommodate seasonal resources and resource adequacy requirements.
- Evaluation of wholesale electricity market design enhancements to accommodate state initiatives to promote state environmental and other policy objectives.
- Evaluation of proposals for natural gas distribution system expansions.
- Various consulting assignments on wholesale electric capacity market design issues in PJM, New England, the Midwest, Texas, and California.
- Cost-benefit analysis of a new natural gas pipeline.
- Evaluation of the impacts of demand response on electric generation capacity mix and emissions.

- Panelist on a FERC technical conference on capacity markets.
- Affidavit on the potential for market power over natural gas storage.
- Executive briefing on wind integration and linkages to short-term and longer-term resource adequacy approaches.
- Affidavit on the impact of a centralized capacity market on the potential benefits of participation in a Regional Transmission Organization (RTO).
- Participated in a panel teleseminar on resource adequacy policy and modeling.
- Affidavit on opt-out rules for centralized capacity markets.
- Affidavits on minimum offer price rules for RTO centralized capacity markets.
- Evaluated electric utility avoided cost in a tax dispute.
- Advised on pricing approaches for RTO backstop short-term capacity procurement.
- Affidavit evaluating the potential impact on reliability of demand response products limited in the number or duration of calls.
- Evaluated changing patterns of natural gas production and pipeline flows, developed approaches for pipeline tolls and cost recovery.
- Evaluated an electricity peak load forecasting methodology and forecast; evaluated regional transmission needs for resource adequacy.
- Participated on a panel teleseminar on natural gas price forecasting.
- Affidavit evaluating a shortage pricing mechanism and recommending changes.
- Testimony in support of proposed changes to a forward capacity market mechanism.
- Reviewed and critiqued an analysis of the economic impacts of restrictions on oil and gas development.
- Advised on the development of metrics for evaluating the performance of Regional Transmission Organizations and their markets.
- Prepared affidavit on the efficiency benefits of excess capacity sales in readjustment auctions for installed capacity.
- Prepared affidavit on the potential impacts of long lead time and multiple uncertainties on clearing prices in an auction for standard offer electric generation service.

EARLIER PROFESSIONAL EXPERIENCE

LECG, LLC, Washington, DC 1998–2009.
Principal

- Reviewed and commented on an analysis of the target installed capacity reserve margin for the Mid Atlantic region; recommended improvements to the analysis and assumptions.
- Evaluated an electric generating capacity mechanism and the price levels to support adequate capacity; recommended changes to improve efficiency.
- Analyzed and critiqued the methodology and assumptions used in preparation of a long run electricity peak load forecast.
- Evaluated results of an electric generating capacity incentive mechanism and critiqued the mechanism's design; prepared a detailed report. Evaluated the impacts of the mechanism's flaws on prices and costs and prepared testimony in support of a formal complaint.
- Analyzed impacts and potential damages of natural gas migration from a storage field.
- Evaluated allegations of manipulation of natural gas prices and assessed the potential impacts of natural gas trading strategies.
- Prepared affidavit evaluating a pipeline's application for market-based rates for interruptible transportation and the potential for market power.
- Prepared testimony on natural gas industry contracting practices and damages in a contract dispute.
- Prepared affidavits on design issues for an electric generating capacity mechanism for an eastern US regional transmission organization; participated in extensive settlement discussions.

- Prepared testimony on the appropriateness of zonal rates for a natural gas pipeline.
- Evaluated market power issues raised by a possible gas-electric merger.
- Prepared testimony on whether rates for a pipeline extension should be rolled-in or incremental under Federal Energy Regulatory Commission ("FERC") policy.
- Prepared an expert report on damages in a natural gas contract dispute.
- Prepared testimony regarding the incentive impacts of a ratemaking method for natural gas pipelines.
- Prepared testimony evaluating natural gas procurement incentive mechanisms.
- Analyzed the need for and value of additional natural gas storage in the southwestern US.
- Evaluated market issues in the restructured Russian electric power market, including the need to introduce financial transmission rights, and policies for evaluating mergers.
- Affidavit on market conditions in western US natural gas markets and the potential for a new merchant gas storage facility to exercise market power.
- Testimony on the advantages of a system of firm, tradable natural gas transmission and storage rights, and the performance of a market structure based on such policies.
- Testimony on the potential benefits of new independent natural gas storage and policies for providing transmission access to storage users.
- Testimony on the causes of California natural gas price increases during 2000-2001 and the possible exercise of market power to raise natural gas prices at the California border.
- Advised a major US utility with regard to the Federal Energy Regulatory Commission's proposed Standard Market Design and its potential impacts on the company.
- Reviewed and critiqued draft legislation and detailed market rules for reforming the Russian electricity industry, for a major investor in the sector.
- Analyzed the causes of high prices in California wholesale electric markets during 2000 and developed recommendations, including alternatives for price mitigation. Testimony on price mitigation measures.
- Summarized and critiqued wholesale and retail restructuring and competition policies for electric power and natural gas in select US states, for a Pacific Rim government contemplating energy reforms.
- Presented testimony regarding divestiture of hydroelectric generation assets, potential market power issues, and mitigation approaches to the California Public Utilities Commission.
- Reviewed the reasonableness of an electric utility's wholesale power purchases and sales in a restructured power market during a period of high prices.
- Presented an expert report on failure to perform and liquidated damages in a natural gas contract dispute.
- Presented a workshop on Market Monitoring to a group of electric utilities in the process of forming an RTO.
- Authored a report on the screening approaches used by market monitors for assessing exercise of market power, material impacts of conduct, and workable competition.
- Developed recommendations for mitigating locational market power, as part of a package of congestion management reforms.
- Provided analysis in support of a transmission owner involved in a contract dispute with generators providing services related to local grid reliability.
- Authored a report on the role of regional transmission organizations in market monitoring.
- Prepared market power analyses in support of electric generators' applications to FERC for market-based rates for energy and ancillary services.
- Analyzed western electricity markets and the potential market power of a large producer under various asset acquisition or divestiture strategies.
- Testified before a state commission regarding the potential benefits of retail electric competition and issues that must be addressed to implement it.

- Prepared a market power analysis in support of an acquisition of generating capacity in the New England market.
- Advised a California utility regarding reform strategies for the California natural gas industry, addressing market power issues and policy options for providing system balancing services.

ICF RESOURCES, INC., Fairfax, VA, 1997–1998.
Project Manager

- Reviewed, critiqued and submitted testimony on a New Jersey electric utility's restructuring proposal, as part of a management audit for the state regulatory commission.
- Assisted a group of US utilities in developing a proposal to form a regional Independent System Operator (ISO).
- Researched and reported on the emergence of Independent System Operators and their role in reliability, for the Department of Energy.
- Provided analytical support to the Secretary of Energy's Task Force on Electric System Reliability on various topics, including ISOs. Wrote white papers on the potential role of markets in ensuring reliability.
- Recommended near-term strategies for addressing the potential stranded costs of non-utility generator contracts for an eastern utility; analyzed and evaluated the potential benefits of various contract modifications, including buyout and buydown options; designed a reverse auction approach to stimulating competition in the renegotiation process.
- Designed an auction process for divestiture of a Northeastern electric utility's generation assets and entitlements (power purchase agreements).
- Participated in several projects involving analysis of regional power markets and valuation of existing or proposed generation assets.

IRIS MARKET ENVIRONMENT PROJECT, 1994–1996.
Project Director, Moscow, Russia

Established and led a policy analysis group advising the Russian Federal Energy Commission and Ministry of Economy on economic policies for the electric power, natural gas, oil pipeline, telecommunications, and rail transport industries (*the Program on Natural Monopolies,* a project of the IRIS Center of the University of Maryland Department of Economics, funded by USAID):

- Advised on industry reforms and the establishment of federal regulatory institutions.
- Advised the Russian Federal Energy Commission on electricity restructuring, development of a competitive wholesale market for electric power, tariff improvements, and other issues of electric power and natural gas industry reform.
- Developed policy conditions for the IMF's $10 billion Extended Funding Facility.
- Performed industry diagnostic analyses with detailed policy recommendations for electric power (1994), natural gas, rail transport and telecommunications (1995), oil transport (1996).

Independent Consultant stationed in Moscow, Russia, 1991–1996

Projects for the WORLD BANK, 1992-1996:

- Bank Strategy for the Russian Electricity Sector. Developed a policy paper outlining current industry problems and necessary policies, and recommending World Bank strategy.
- Russian Electric Power Industry Restructuring. Participated in work to develop recommendations to the Russian Government on electric power industry restructuring.
- Russian Electric Power Sector Update. Led project to review developments in sector restructuring, regulation, demand, supply, tariffs, and investment.
- Russian Coal Industry Restructuring. Analyzed Russian and export coal markets and developed forecasts of future demand for Russian coal.
- World Bank/IEA Electricity Options Study for the G-7. Analyzed mid- and long-term electric power demand and efficiency prospects and developed forecasts.

- Russian Energy Pricing and Taxation. Developed recommendations for liberalizing energy markets, eliminating subsidies and restructuring tariffs for all energy resources.

Other consulting assignments in Russia, 1991–1994:

- Advised on projects pertaining to Russian energy policy and the transition to a market economy in the energy industries, for the Institute for Energy Research of the Russian Academy of Sciences.
- Presented seminars on the structure, economics, planning, and regulation of the energy and electric power industries in the US, for various Russian clients.

DECISION FOCUS INC., Mountain View, CA, 1983–1992
Senior Associate, 1985-1992.

- For the Electric Power Research Institute, led projects to develop decision-analytic methodologies and models for evaluating long term fuel and electric power contracting and procurement strategies. Applied the methodologies and models in numerous case studies, and presented several workshops and training sessions on the approaches.
- Analyzed long-term and short-term natural gas supply decisions for a large California gas distribution company following gas industry unbundling and restructuring.
- Analyzed long term coal and rail alternatives for a midwest electric utility.
- Evaluated bulk power purchase alternatives and strategies for a New Jersey electric utility.
- Performed a financial and economic analysis of a proposed hydroelectric project.
- For a natural gas pipeline company serving the Northeastern US, forecasted long-term natural gas supply and transportation volumes. Developed a forecasting system for staff use.
- Analyzed potential benefits of diversification of suppliers for a natural gas pipeline company.
- Evaluated uranium contracting strategies for an electric utility.
- Analyzed telecommunications services markets under deregulation, developed and implemented a pricing strategy model. Evaluated potential responses of residential and business customers to changes in the client's and competitors' telecommunications services and prices.
- Analyzed coal contract terms and supplier diversification strategies for an eastern electric utility.
- Analyzed oil and natural gas contracting strategies for an electric utility.

TESTIMONY AND AFFIDAVITS

In the Matter of the Application of Ohio Edison Company, the Cleveland Electric Illuminating Company, and the Toledo Edison Company for Authority to Establish a Standard Service Offer Pursuant to R.C. 4928.143 in the Form of an Electric Security Plan, Public Utilities Commission of Ohio Case No. 23-301-EL-SSO, Direct Testimony on behalf of the Office of the Ohio Consumers' Counsel, October 23, 2023.

In the Matter of the Application of Pacific Gas and Electric Company for Adoption of Electric Revenue Requirements and Rates Associated with its 2024 Energy Resource Recovery Account, California Public Utilities Commission Application 23-05-012, Direct Testimony on behalf of Small Business Utility Advocates, September 6, 2023.

Virginia Electric and Power Company's 2023 Integrated Resource Plan filing, Virginia State Corporation Commission Case No. PUR-2023-00066, Direct Testimony on behalf of Appalachian Voices, August 8, 2023; testimony at hearings, September 19, 2023.

In the Matter of the Application of Ohio Power Company for Authority to Establish a Standard Service Offer in the Form of an Electric Security Plan, Public Utilities Commission of Ohio Case No. 23-23-EL-SSO, Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, June 9, 2023; Testimony Recommending Modification of the Stipulation, September 20, 2023; testimony at hearings, October 11, 2023.

Essential Power OPP, LLC, et al. v. PJM Interconnection, L.L.C, FERC Docket No. EL23-53 (Winter Storm Elliott complaint cases), Affidavit in Support of the Comments of Sierra Club, May 26, 2023.

PJM Interconnection, L.L.C., FERC Docket No. ER23-1609 (RPM auction delay), Affidavit in Support of the Comments of Sierra Club, May 2, 2023.

In the Matter of the Application of The Dayton Power and Light Company d/b/a AES Ohio for Approval of Its Electric Security Plan, Public Utilities Commission of Ohio Case No. 22-900-EL-SSO, Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, April 21, 2023; deposition, April 26, 2023; testimony at hearings May 3, 2023.

PJM Interconnection, L.L.C., FERC Docket No. ER22-2984 (RPM Quadrennial Review), Affidavit in Support of the Comments of the Public Interest Entities, October 21, 2022; Reply Affidavit in Support of the Reply Comments of the Public Interest Entities, November 4, 2022.

In the Matter of the Application of Pacific Gas and Electric Company for Adoption of Electric Revenue Requirements and Rates Associated with its 2023 Energy Resource Recovery Account, California Public Utilities Commission Application 22-05-029, Direct Testimony on behalf of Small Business Utility Advocates, September 7, 2022.

In the Matter of the Application of DTE Electric Company for Approval to Implement a Power Supply Cost Recovery Plan for the 12 months ending December 31, 2022, Michigan Public Service Commission Case No. U-21050, Direct Testimony on behalf of Michigan Environmental Council, August 3, 2022.

In Re: Washington Utilities and Transportation Commission v. Avista Corporation d/b/a Avista Utilities; In the Matter of the Electric Service Reliability Reporting Plan of Avista Corporation d/b/a Avista Utilities; Dockets UE-220053, UG-220054, and UE-210854 (Consolidated), Joint Testimony in Support of the Full Multiparty Settlement on behalf of Small Business Utility Advocates, July 8, 2022; Supplemental Joint Testimony in Support of the Colstrip Tracker and Schedule 99, July 29, 2022; Testimony at hearings September 21, 2022.

In Re: Georgia Power Company's 2022 Integrated Resource Plan and 2022 Application for the Certification, Decertification, and Amended Demand- Side Management Plan; Georgia Public Service Commission Docket Nos. 44160 and 44161; Direct Testimony on behalf of Georgia Interfaith Power & Light and the Partnership For Southern Equity, May 6, 2022; testimony at hearings May 26, 2022.

Clean Air Council et al. v. Pennsylvania Department of Environmental Protection, Environmental Hearing Board Docket No. 2021-055, *Review and Evaluation of the Need for and Alternatives to the Proposed Renovo Energy Center Power Plant*, report prepared on behalf of Clean Air Council, Citizens for Pennsylvania's Future, and the Center for Biological Diversity, filed March 30, 2022; additional affidavit, June 29, 2022.

Appalachian Power Company and Wheeling Power Company, Petition for Commission Consent and Approval to Enter into Ownership and Operating Agreements for the Mitchell Plant, Public Service Commission of West Virginia Case No. 21-0810-E-PC, Direct Testimony on Behalf of West Virginia Citizen Action Group, Solar United Neighbors, and Energy Efficient West Virginia, March 28, 2022.

In the matter of the Application of DTE Electric Company for Reconciliation of its Power Supply Cost Recovery Plan for the 12-month Period Ending December 31, 2020, Michigan Public Service Commission Case No. U-20528, Direct Testimony on behalf of Michigan Environmental Council, November 23, 2021.

In the Matter of the Application of San Diego Gas & Electric Company for Approval of its 2022 Electric Sales Forecast, California Public Utilities Commission Application 21-08-010, Direct Testimony on behalf of Small Business Utility Advocates, October 1, 2021.

In the Matter of the Nova Scotia Power Inc. 2021 Load Forecast Report, Nova Scotia Utility and Review Board Matter No. M10109, Evidence on behalf of the Nova Scotia Consumer Advocate, July 21, 2021.

In the Matter of the Application of DTE Electric Company for Approval to Implement a Power Supply Cost Recovery Plan for the 12 months ending December 31, 2021, Michigan Public Service Commission Case No. U-20826, Direct Testimony on behalf of Michigan Environmental Council, June 6, 2021; Surrebuttal Testimony September 8, 2021.

Independent Market Monitor for PJM v. PJM Interconnection, LLC, FERC Docket No. EL19-47-000, and Office of the People's Counsel for District of Columbia et al v. PJM Interconnection, LLC, FERC Docket No. Docket No. EL19-63-000, Affidavit in Support of the Reply Brief of the Joint Consumer Advocates, June 9, 2021.

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October 2023

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

PJM Interconnection, LLC	**)**	**Docket No. ER24-99**
	)	

AFFIDAVIT OF NICK PAPPAS

1. My name is Nick Pappas. I am an independent consultant retained by the Natural Resources Defense Council ("NRDC"). I prepared this affidavit at the request of NRDC, Sierra Club, and the Sustainable FERC Project to provide an independent analysis of the filing by PJM Interconnection, LLC ("PJM") titled "Capacity Market Reforms to Accommodate the Energy Transition While Maintaining Resource Adequacy."

2. In this affidavit, I identify and discuss the policy implications of PJM's proposed transition to marginal Effective Load Carrying Capability ("ELCC") for use in the Reliability Pricing Model ("RPM"). PJM's proposed use of Marginal ELCC for capacity accreditation would represent the first use of marginal accreditation in a multi-state capacity market regulated by the Federal Energy Regulatory Commission (FERC), introducing novel and complex questions regarding resource compensation and cost-allocation between states and customer groups with heterogeneous resource portfolios. Throughout the filing, I provide both qualitative context and policy considerations as well as quantitative analysis intended to provide a directional illustration of the effects described.

3. The affidavit is structured as follows:

    a. **Section 1 – Fundamental Mechanics of ELCC:** In this section, I introduce the basic mechanics of ELCC.
    b. **Section 2 – Common Applications of ELCC in Planning, Policy and Markets:** In this section, I identify the methods with which ELCC is applied to different planning, policy, and market processes in the electric sector, identifying the consistent allocation of inframarginal benefits to resources across existing use cases for ELCC.
    c. **Section 3 – Proposed Application of Marginal ELCC to FERC-Jurisdictional Capacity Markets:** In this section, I discuss the novel conceptual application of marginal ELCC to all resources, as recently approved for NYISO and proposed here by PJM, articulating the mechanics of reallocating inframarginal resource contributions from capacity awards to load through a demand adjustment.
    d. **Section 4 – Illustrative Analysis of Distributional Impacts from Reallocation of Inframarginal Benefits to Load:** In this section, I provide a quantitative example illustrating the distribution of benefits between two utilities when one

invests in resources with declining marginal benefits under both average and marginal accreditation frameworks, identifying the reallocation of benefits between the utilities as a result of the single utility's investment in new resources.

e. **Section 5 – Comparative Impacts Between Single-State and Multi-State Capacity Markets:** In this section, I articulate the differential implications of the benefits reallocation between a single-state market like NYISO, in which relatively homogenous resource portfolios effectively align the demand adjustment with capacity contributions, and PJM, in which heterogenous utilities operating in different state policy environments will result in a misalignment between the customer groups contributing inframarginal reliability benefits and the customer groups receiving demand adjustments associated with those inframarginal benefits.

f. **Section 6 – Illustrative Analysis of Distributional Impacts within PJM:** In this section, I provide a quantitative example utilizing current PJM state-level clean energy policies and load share to estimate the distribution of benefits between PJM state customer groups on a system with significant levels of clean resources providing both marginal and inframarginal benefits, finding a wide range of beneficiaries and benefactors across the region.

Qualifications

4. I have been employed as an independent consultant since 2021. As a consultant, I advise clients on issues related to resource planning, policy development, and market design in the electric sector. Among other areas of engagement, I provide analytical and policy support to clients on the use, application, and interpretation of ELCC and related capacity accreditation issues in restructured electricity markets as well as vertically-regulated jurisdictions. Prior to my role as an independent consultant, I served in various roles leading regulatory and legislative strategy on behalf of load-serving entities operating within the California Independent System Operator ("CAISO"), engaging on issues related to resource planning, resource adequacy, clean energy procurement, and retail choice, among other areas.

5. I received a Bachelor of Arts degree in Economics and a Master of Science degree in Energy Systems from the University of California Davis.

Section 1: Fundamental Mechanics of Effective Load Carrying Capability

6. ELCC is an increasingly prominent method for analyzing the reliability contributions of resources, with specific uses and methodologies in capacity markets, resource adequacy programs, integrated resource planning, and commercial evaluations, among other areas. While ELCC is not perfect – like any method, its accuracy is a function of its implementation, with associated data and methodological risks – it is generally viewed among the most robust methods for assessing reliability contributions, with particular

benefits in comparing the relative contributions of resources with distinct operating characteristics.

7. While ELCC refers to a range of accreditation frameworks[1], all applications of ELCC follow the same core principles. ELCC analyses assess the contribution of a resource or group of resources through a probabilistic reliability model in the context of a specific system (load and resources) over a specific study horizon, comparing the contributions of the study resource(s) against a counterfactual of "perfect capacity", which is a hypothetical resource with full availability and no operational constraints. Perfect capacity is commonly used as a unit of measurement for capacity denoted as "PCAP." As an example, currently, PJM analyzes solar resources as a technology class to determine the total contributions of the solar fleet in terms of PCAP. The total PCAP provided by the solar fleet is divided by the nameplate value of the solar fleet to determine its ELCC, expressed as a percent, which is then used to determine the accredited capacity contributions of individual solar resources participating in the PJM capacity market.

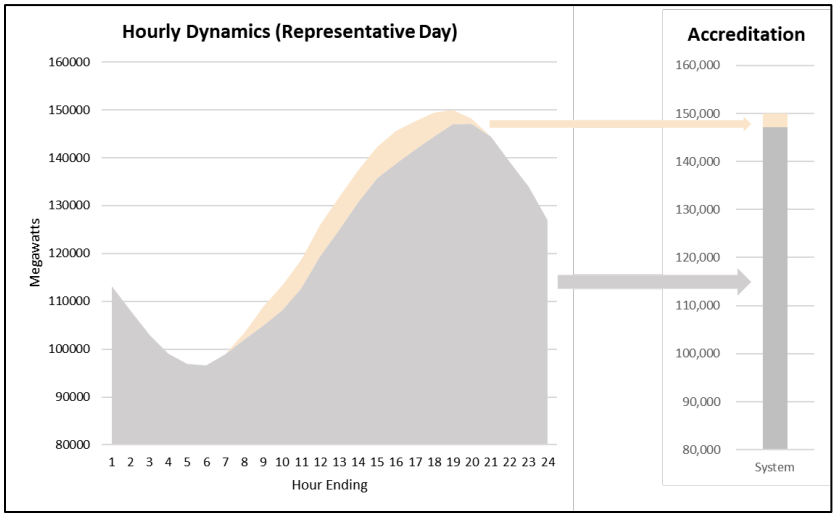


Figure 1: ELCC Mechanics for a Representative July Day with Low Levels of Solar Penetration (10,000 MW)[2]

a. Figure 1 provides an illustrative example of ELCC application on a system with low levels of solar resource penetration. Figure 1 illustrates the mechanics by which solar resources reduce the net peak and receive corresponding accreditation value within the PJM capacity market. In this example, production from the

[1] Practical Application of Effective Load Carrying Capability in Resource Adequacy, Energy and Environmental Economics, August 2020. https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf

[2] This and subsequent figures utilize load and renewable profiles observed on the PJM system in July 2023 where applicable, but are intended to be conceptual rather than specific or precise to the PJM system.

10,000MW solar fleet reduces the residual resource need by approximately 3,000MW, resulting in a 30% ELCC rating for the resource class (3,000MW of PCAP / 10,000 MW of nameplate = 30%).

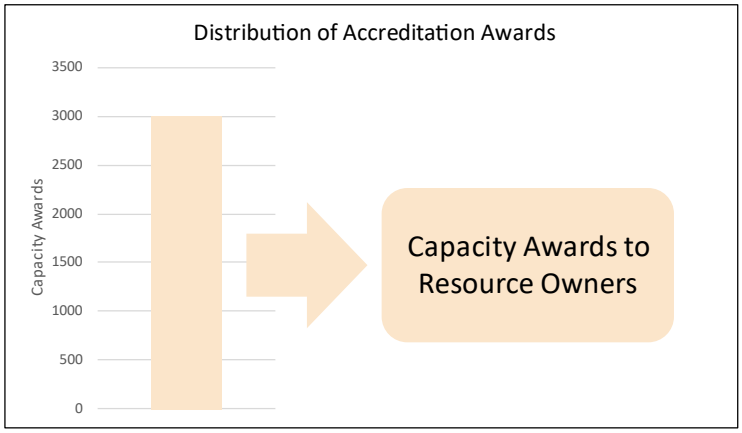


Figure 2: Allocation of Reliability Compensation to Solar Fleet under Existing Average ELCC Accreditation

b. With a 30% ELCC rating, market participants with ownership or other contractual rights to the 10,000MW of solar resources could bid 3,000MW of capacity into the PJM capacity market, and, if cleared, would receive corresponding awards reflecting the total capacity contribution (in PCAP) of the solar fleet. This result, which is intuitive and reasonably aligns with the principle of compensating market participants for the contributions they provide, is illustrated in Figure 2.

c. An additional 10,000MW of solar (20,000MW), included in Figures 3 and 4, increases the total perfect capacity contributed by the solar fleet to 4,000MW. This reduces the ELCC rating of the solar fleet to 20%, reflecting the total reliability contribution of the entire solar fleet. The additional solar resources, in the absence of complementary resources like 4-hour storage, demand response, or energy-limited hydroelectric, have a declining marginal contribution, which is reflected in their declining ELCC accreditation.

d. The declining marginal value of solar resources is a reflection of "saturation effects,"[3] a dynamic in which a given resource becomes less effective as a function of its penetration. Saturation effects are predominant among resources with correlated availability limitations, such as solar, wind, storage, and demand response. While these resources tend to have very high effectiveness for initial tranches of investment, effectiveness can drop rapidly once certain saturation

[3] Practical Application of Effective Load Carrying Capability in Resource Adequacy, Energy and Environmental Economics, August 2020. P. 5. https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf

levels have been achieved. While saturation effects can occur for conventional resources, such as thermal resources experiencing correlated outage risk or correlated fuel supply risk, these effects are far more limited than saturation effects for clean energy and storage resources.

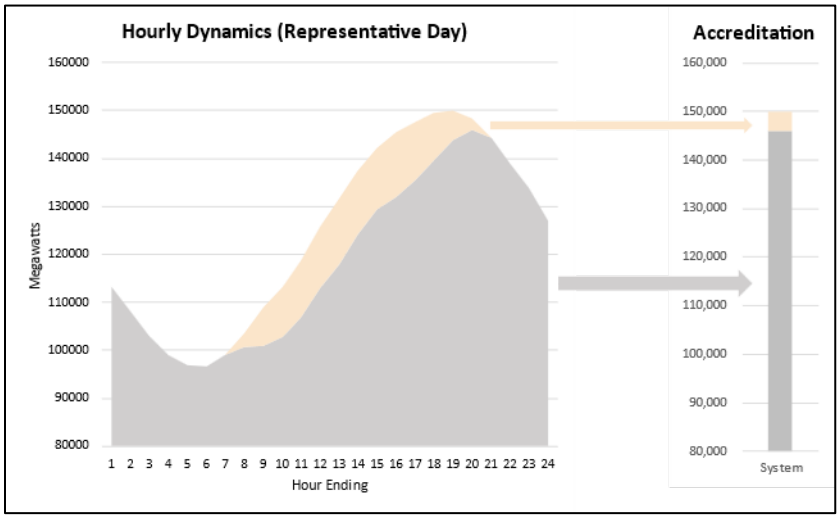


Figure 3: ELCC Mechanics for a Representative July Day with Low Levels of Solar Penetration (20,000 MW)

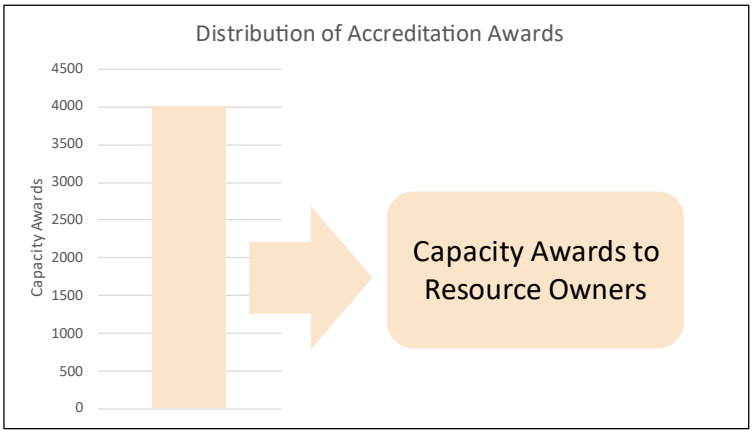


Figure 4: Allocation of Reliability Compensation to Solar Fleet under Existing Average ELCC Accreditation

e. Under this average ELCC approach, at any given capacity market interval, the total contribution of the solar fleet aligns with its capacity accreditation and consequent awards in the capacity market. The accreditation of the resource class as a whole, which determines the compensation to resource owners, is equivalent to the reliability contributions of the resource class as a whole, which determines the benefits of the class to the achievement of PJM's reliability policy targets.

Section 2: Common Applications of ELCC in Planning, Policy and Markets

8. ELCC is a broad category encompassing a range of subsidiary analytical and accreditation frameworks including average ELCC metrics (*class average ELCC* and its variant *adjusted class-average ELCC*) and marginal ELCC metrics (*marginal ELCC* and its variant *vintaged marginal ELCC*)[4]. All methods utilize the same underlying modeling framework, which incorporates a comprehensive reliability analysis across the entire study period (including both at-risk and surplus hours) and incorporates complex interactions between resources and load within the model (including critical interactions between resources). However, each methodology reports different metrics for use in resource accreditation which flow through to, depending on the context, accreditation within a capacity market or resource adequacy program, input assumptions for use in a resource planning exercise, or equivalent market comparison to support resource evaluation in commercial transactions.

9. As a categorical differentiation, average accreditation methods assess the contributions of a class of resources as a whole, assessing the entire load carrying capability of the resource category against a counterfactual of perfect capacity, as illustrated in the prior section. In effect, average accreditation identifies the full contributions of the resource class and allocates it proportionally across all resources of the resource class. The proliferation of resources being analyzed through ELCC (solar, storage, wind, etc.) that have important interactive effects has required the development of methods to assess and allocate both synergistic and antagonistic effects through an assessment of the portfolio of all resource classes.

10. With the acceleration of clean energy and storage resource development, marginal accreditation methods emerged to support utilities and resource planners in the process of assessing which resources would be most effective (and cost-effective) to add to the system. Marginal accreditation methods produce a point estimate of the contributions of the ultimate resource within the category. Until recently, marginal accreditation was largely limited to use cases in the context of resource planning exercises (e.g., Capacity Expansion modeling), commercial processes (e.g., bid evaluation), and resource procurement mandates, each of which uses a Vintaged Marginal ELCC approach.

11. Vintaged Marginal ELCC is an alternative method to average ELCC which has become prominent in resource planning and commercial decision-making for utilities and planners. Vintaged marginal ELCC, in contrast to average ELCC, differentiates the accreditation of resources within the technology class based on development timeline, allocating the saturation effects (and other effects, such as interactive effects) directly to

[4] Practical Application of Effective Load Carrying Capability in Resource Adequacy, Energy and Environmental Economics, August 2020. P.11. https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf

each resource tranche. Vintaged marginal ELCC differentiates resources by the period in which they are installed.

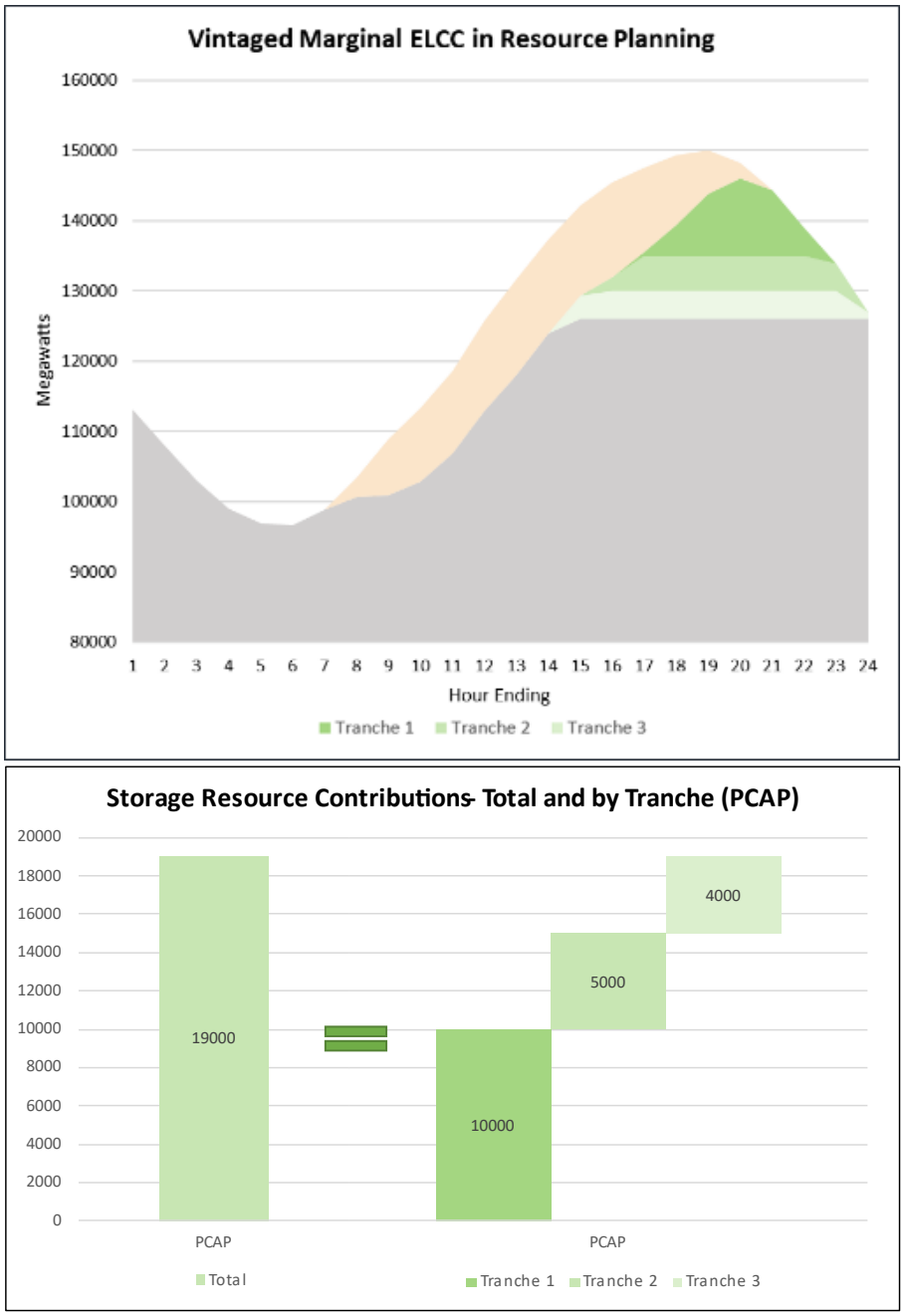


Figure 5: Vintaged Marginal ELCC Illustrated through Multiple Tranches of Storage Resource Investments

12. A generalized approach to Vintaged Marginal ELCC is illustrated in Figure 5 using three periods of storage investment as the vintaged tranches of procurement. Each tranche reflects 10,000MW (nameplate) of 4-hour storage. In this example, each tranche provides

less effective capacity (PCAP) than the prior tranche. The first tranche provides 10,000MW; the second tranche provides 5,000MW, while the third tranche provides 4,000MW. This is intuitive – the first 10,000MW of 4-hour storage resources will be highly effective at eliminating risk during a 4-hour net peak regardless of whether the next 10,000MW of 4-hour storage is less effective as the net peak widens. The Vintaged Marginal ELCC applied to each tranche is as follows:

a. Tranche 1: 100% (10,000MW of PCAP / 10,000MW of Nameplate)
b. Tranche 2: 50% (5,000MW of PCAP / 10,000MW of Nameplate)
c. Tranche 3: 40% (4,000MW of PCAP / 10,000MW of Nameplate)
d. Marginal ELCC at the Conclusion of Tranche 3: ~35%

The total PCAP provided to the portfolio by the storage fleet as a whole is equivalent to the sum of the contributions provided by each tranche, providing 19,000MW of reliability (10,000MW + 5,000MW + 4,000MW), resulting in a 63% Average ELCC for the portfolio.

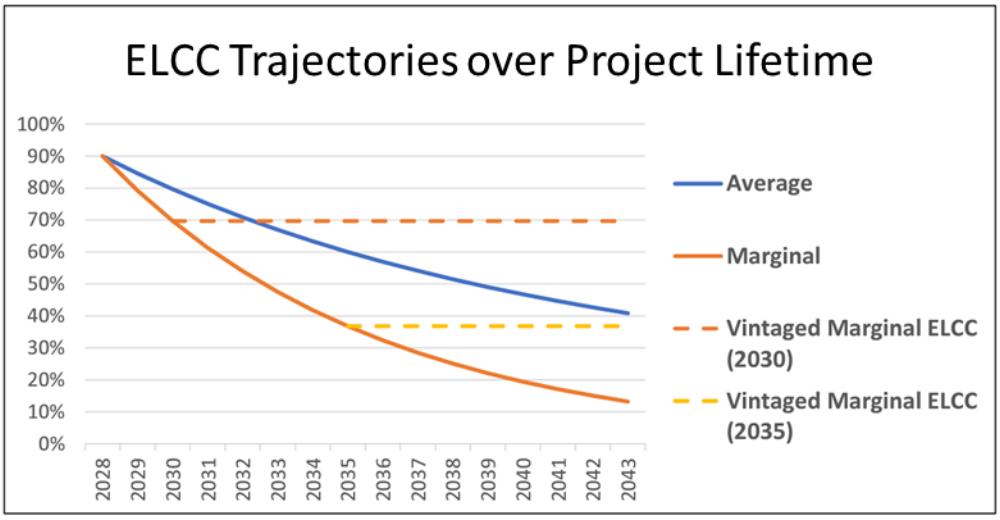


Figure 6: Saturation Effects Across Average, Marginal, and Vintaged Marginal Accreditation

13. In Figure 6, the declining ELCC trajectory dynamic illustrated in Figure 5 is visualized over the life of a project, with declining marginal ELCC contributions from new resources as additional like resources are added to the system. *Average ELCC* (blue curve) represents the perfect capacity served by the storage class as a share of its nameplate value, with declining contributions as high-value early investments are diluted by lower-value contributions which must stretch the resources' energy limits over lengthening durations. *Vintaged Marginal ELCC* (dotted lines) reflect the marginal contribution of a resource entry decision in 2030 and 2035 – the value which would serve as an input to a utility or regulator's review of a proposed resource as one element of a

long-term contract to construct and operate that resource on the system. *Marginal ELCC* (orange curve) reflects the contribution of each subsequent resource.

Average Methods	Vintaged Marginal Methods	Non-Vintaged Marginal Methods
Resource Adequacy (RA) and Capacity Market Programs • California Public Utilities Commission (CPUC) / California Independent System Operator RA Program[5], Midcontinent Independent System Operator (wind)[6],	**Resource Planning and Commercial Evaluation**[7] • PNM IRP[8] and Solicitation[9], Portland General Electric IRP[10], Idaho Power IRP[11], PSCO IRP[12] **Policy Frameworks** • CPUC IRP Filing Requirements[13] and Procurement Mandates[14]	**Capacity Market Programs:** • NYISO (Adopted) • PJM (Proposed)

Figure 7: Examples of Average, Vintaged Marginal, and Non-Vintaged Marginal ELCC Observed in Utility Policy and Market Frameworks

14. With the exception of NYISO's recent transition to marginal ELCC, policy and commercial applications of marginal accreditation have been limited to the use of Vintaged Marginal ELCC frameworks in which the inframarginal benefits are retained by

[5] ELCC Rules at Other ISO-RTOs, PJM, p. 6. https://www.pjm.com/-/media/committees-groups/task-forces/ccstf/2020/20200407/20200407-item-05-elcc-at-otherisortos.pdf
[6] ELCC Rules at Other ISO-RTOs, PJM, p. 14. https://www.pjm.com/-/media/committees-groups/task-forces/ccstf/2020/20200407/20200407-item-05-elcc-at-otherisortos.pdf
[7] Practical Application of Effective Load Carrying Capability in Resource Adequacy, Energy and Environmental Economics, August 2020. P. 9. https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf
[8] PNM 2020-20240 Integrated Resource Plan Resource Adequacy Deep Dive. P. 56. https://www.pnmforwardtogether.com/assets/uploads/2020-IRP-091520-FINAL-FINAL.pdf
[9] Direct Testimony of Roger Nagel, PNM. P.32 https://www.pnmresources.com/~/media/Files/P/PNM-Resources/rates-and-filings/2026%20Resource%20Filing/Application/9%20%20Direct%20Testimony%20of%20Roger%20Nagel.pdf
[10] PGE 2019 Integrated Resource Plan, p. 164. https://downloads.ctfassets.net/416ywc1laqmd/6KTPcOKFlLvXpf18xKNseh/271b9b966c913703a5126b2e7bbbc37a/2019-Integrated-Resource-Plan.pdf
[11] Idaho Power IRP, p. 12-14
[12] 2021 ELCC Study, PSCo 2021 Electric Resource Plan Filing, p. 1. https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Resource%20Plans/Clean%20Energy%20Plan/HE_114-KLS-2-ELCC_Study_Report.pdf
[13] Reliability Filing Requirements for Load Serving Entities' 2022 IRPs, California Public Utilities Commission. July 29, 2022. P. 38 https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/20220729-updated-fr-and-reliability-mag-slides.pdf
[14] Incremental ELCC Study for Mid-Term Reliability Procurement, California Public Utiltiies Commission, P. 7. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/20230210_irp_e3_astrape_updated_incremental_elcc_study.pdf

each resource tranche. The primary use cases are listed below: use of marginal accreditation for resource planning and commercial evaluation and use of marginal accreditation to establish policy requirements, such as procurement mandates. In each of these cases, the marginal accreditation value is assessed for application to a specific resource or tranche of resources and is, for all intents and purposes, fixed for the life of the resource.

a. **Utility Planning Exercise.** Within a vertical utility (or similar) resource planning exercise, ELCC curves or surfaces are used which apply the marginal ELCC at the time of the resource's development to that resource over the resource's lifetime. For example, a resource built in 2030 would be 'credited' within the Capacity Expansion model (or other reliability planning framework) for its current and on-going contribution over the course of the modeling exercise, and the resource would be selected if that contribution (among other factors) provided the necessary reliability benefits. In effect, the resource's capacity accreditation would follow the 2030 Vintaged Marginal ELCC line (dashed orange in Figure 6).
b. **Commercial Project Evaluation:** Similarly, a commercial evaluation and negotiation process would assess the resource's current and forward-looking contributions along a vintaged marginal line, a value which would be reflected within the resource's compensation structure (for instance, fixed payments from a Power Purchase Agreement). Compensation to the resource owner does not decline as a result of the utility deciding, at a later date, to build additional resources which reduce the value of the initial resource.
c. **Resource Procurement Mandates:** Finally, marginal ELCC was recently utilized by the California Public Utilities Commission ("CPUC") to establish a new build resource mandate for Load-Serving Entities ("LSEs") under its jurisdiction, with requirements established in terms of forecast marginal ELCC values at the time of the resource's completion and delivery to the grid. Again, this method effectively affixes the accreditation value of the resource to the period during which it is installed for the purposes of compliance with the procurement mandate (resource compliance with the CPUC's Resource Adequacy program is measured in average ELCC).

15. In each of these cases, the full value of the resource class is recognized within the reliability construct as the stacked effect of the marginal reliability contributions of the resources at the time of their development.

Section 3: Application of Marginal ELCC to FERC-Jurisdictional Capacity Markets

16. In 2021, NYISO became the first FERC-regulated capacity market to adopt a marginal accreditation framework for the accreditation of resources. NYISO's approach, which is conceptually and analytically parallel to that proposed by PJM, introduced a novel

application of marginal ELCC which departs significantly from the use of marginal ELCC in in utility planning exercises, commercial project evaluation, or resource procurement mandates, as described above.

17. In contrast to a Vintaged Marginal ELCC framework, which assigns each resource its marginal reliability contribution at the time of its development, NYISO's (and PJM's proposed) accreditation framework applies the contemporary marginal value of each resource class to *all resources* of the resource class, refreshing with each capacity auction to reflect new resource entry and exit. As a result, resources do not have any fixed capacity accreditation under this approach; instead, resources' capacity accreditation will change with each capacity auction.

18. The mechanics of this accreditation method are illustrated below in Figure 8, which returns to the prior example with three storage investment periods. As illustrated, the diminishing marginal returns of 4-hour storage, resulting from its limited duration, result in lower PCAP contributions for each subsequent tranche, declining from 100% effectiveness for the first 10,000MW to 40% effectiveness for the 3rd tranche of 10,000MW (from 20,000MW to 30,000MW). The 30,001st MW of storage has an effectiveness of approximately 35%.

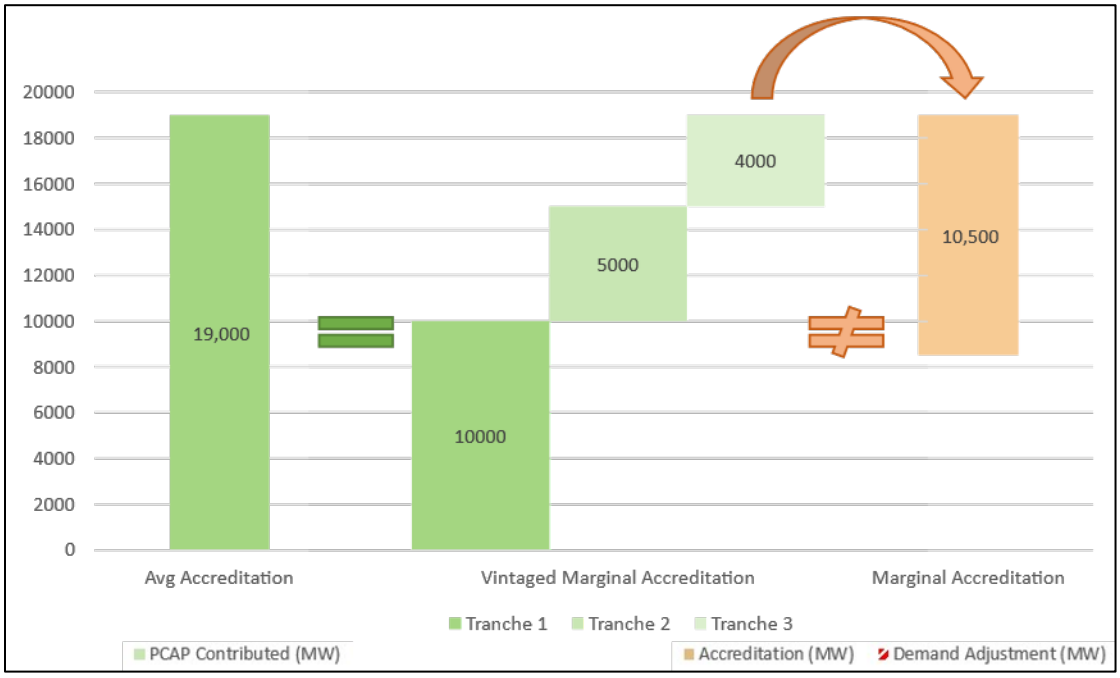


Figure 8: Application of Marginal Accreditation to Storage Resources at 30,000MW Compared with Average, Vintaged Marginal Accreditation (excluding Demand Adjustment)

19. In its adopted tariff, NYISO established a new framework for the application of marginal accreditation, applying the marginal value (in this example, 35%) to the entire class of 4-hour storage resources, despite total contributions from the class resulting in an average accreditation of 63%. This approach truncates the accredited value of the resource class, eliminating any inframarginal contributions from the resource accreditation process.

20. NYISO's move to accredit the resource class at a level considerably below its total resource contributions established a gap between the total quantity of accredited resources and the total quantity of perfect capacity necessary to meet NYISO's desired reliability standard. To remedy this gap, NYISO reduced the total capacity procurement requirement to align with the sum of accredited resources.

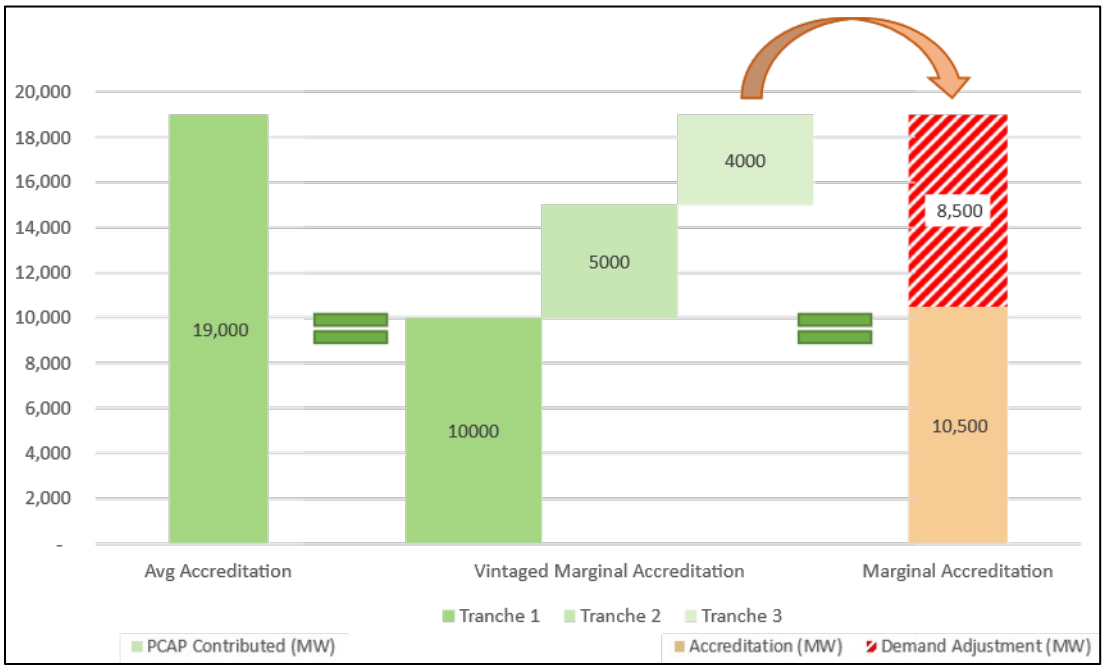


Figure 9: Application of Marginal Accreditation to Storage Resources at 30,000MW Compared with Average, Vintaged Marginal Accreditation (including Demand Adjustment)

21. In this example, the 30,000MW storage fleet would provide 19,000MW of average ELCC (63%) to the system, but would receive a marginal ELCC accreditation of 10,500MW (35%). The difference between the average and marginal accreditation necessitates a demand adjustment of 8,500MW, equivalent to 45% of the total capacity value of the storage fleet.

22. It is important to recognize that these inframarginal contributions, which are on-going reliability contributions that are not accredited under a marginal accreditation framework, continue to play an important role in ensuring the reliability of the system regardless of

their limited accreditation under a marginal framework. However, by nature of their existence, previous at-risk periods occurring during the peak (solar) or net peak (storage) have reduced the effectiveness of the subsequent unit.

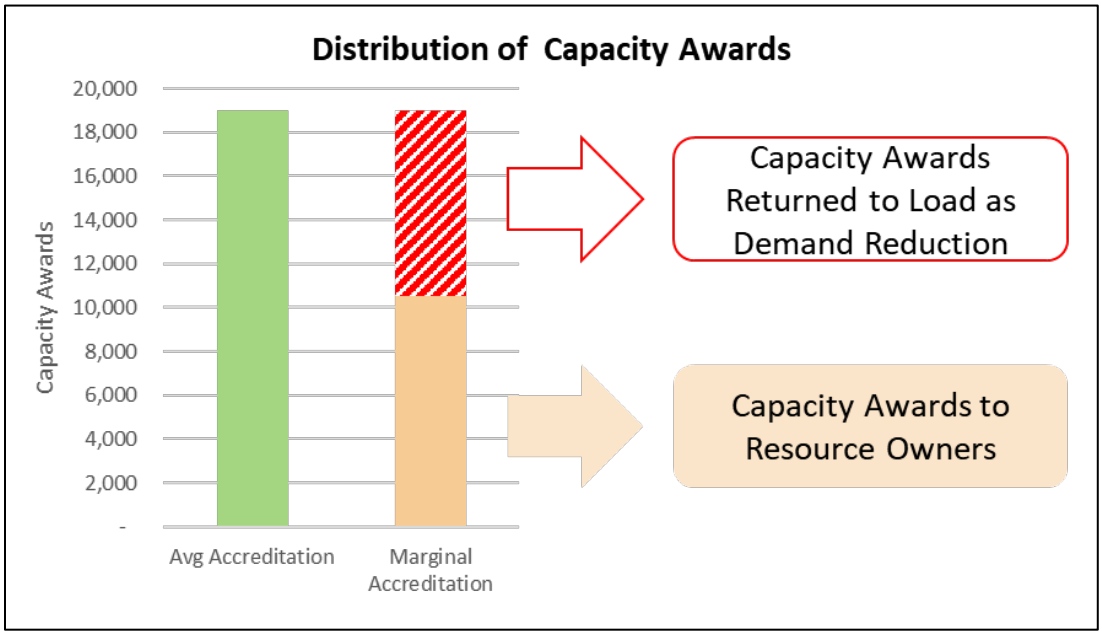


Figure 10: Bifurcation of Reliability Value between Resources and Load

23. In making this reduction, NYISO established a new framework for the distribution of benefits between market participants, bifurcating compensation for reliability contributions between resources (through capacity awards) and load (through demand reductions. This is illustrated in Figure 10.

24. At this time, the expected magnitude of inframarginal benefits within PJM territory is unknown. While PJM has provided indicative marginal ELCC values,[15] these reflect a range of methodological changes, including a significant shift in risk hours from summer to winter reflecting real-world limitations of thermal resources not previously considered in the modeling process. As such, they are not directly comparable to prior analysis from PJM analyzing average ELCC for solar, wind, and storage resources.

    While inframarginal benefits are likely relatively low today, given PJM's low penetration of solar, storage, and wind resources, they will grow rapidly as clean energy resources proliferate on the system. This expectation is informed by more robust analysis in other regions. In 2022, NRDC contracted with GE Energy Consulting to estimate accreditation results under different methodologies, finding marginal accreditation values 41% and

[15] Affidavit of Dr. Patricio Rocha-Garrido, p. 21-22.

52% lower than average values in 2028 and 2040, respectively[16]; results are reproduced in Figure 11 below. This is similar to preliminary analysis in MISO, indicating over three-quarters of solar benefits would be inframarginal with 10,000MW of solar resources, with an average ELCC of 20% and a marginal ELCC of only 4%[17]. These analyses suggest a significant share of resource value is inframarginal and will be returned to load as a demand adjustment rather than as compensation to the resource owner (or its utility counterparty).

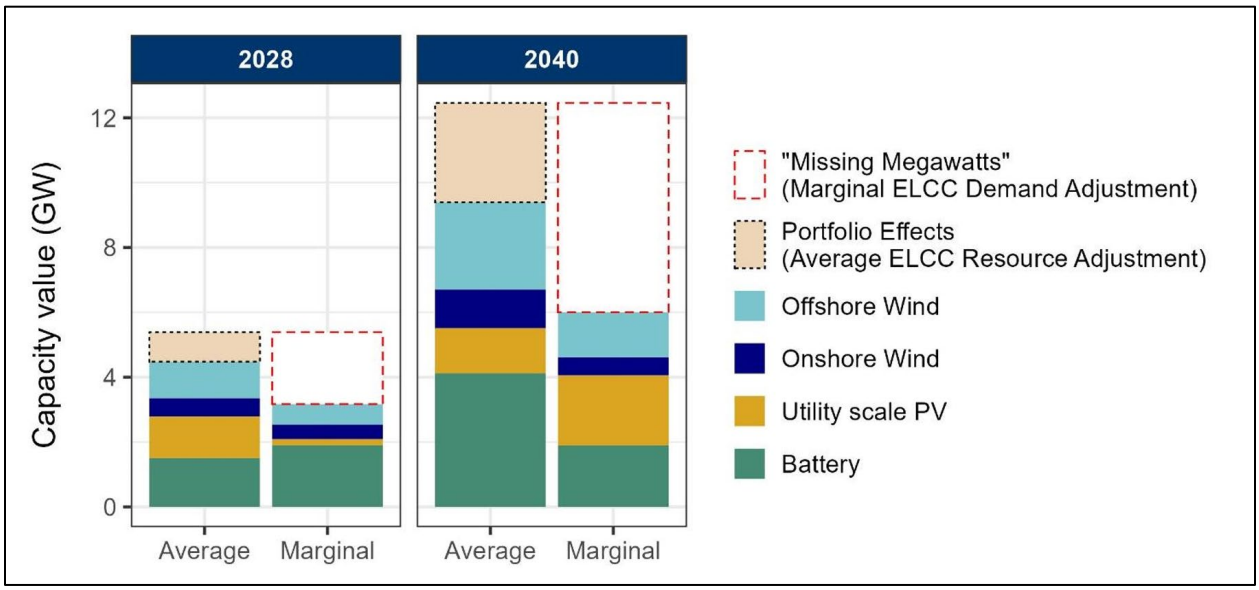


Figure 11: Estimated Accreditation of Clean Resources under Average and Marginal ELCC in ISO-NE in 2028 and 2040[18]

Section 4: Illustrative Analysis of Distributional Impacts from Reallocation of Inframarginal Benefits to Load

25. To conceptualize this framework, the storage example is overlaid with two identical utilities operating in two jurisdictions, both of which participate in the same capacity market framework. Utility A has developed 30,000MW of storage resources while Utility B intends to continue to serve its load with conventional resources not experiencing saturation effects. Both utilities sell a portfolio of owned and contracted resources

[16] Evaluation of ELCC Methodology in the ISO-NE Footprint, GE Energy Consulting on behalf of the Natural Resources Defense Council. P. xi. https://www.iso-ne.com/static-assets/documents/2022/10/a09b_mc_2022_10_12-13_rca_nrdc_report.pdf

[17] Marginal vs. Average Capacity Accreditation, Potomac Economics, p. 5. https://cdn.misoenergy.org/20220921%20Non%20Thermal%20Accreditation%20Workshop%20IMM%20Presentation626397.pdf

[18] Evaluation of ELCC Methodology in the ISO-NE Footprint, GE Energy Consulting on behalf of the Natural Resources Defense Council. P. xi. https://www.iso-ne.com/static-assets/documents/2022/10/a09b_mc_2022_10_12-13_rca_nrdc_report.pdf

equivalent to their capacity requirement into the auction, with accredited capacity returned to ratepayers through a regulated cost-of-service framework.

a. Prior to Utility A's storage investment, both utilities meet their full capacity requirement obligations with their portfolio of owned and contracted resources equivalent to 75,000MW of PCAP each. This capacity position is illustrated in Figure 12, indicated below.

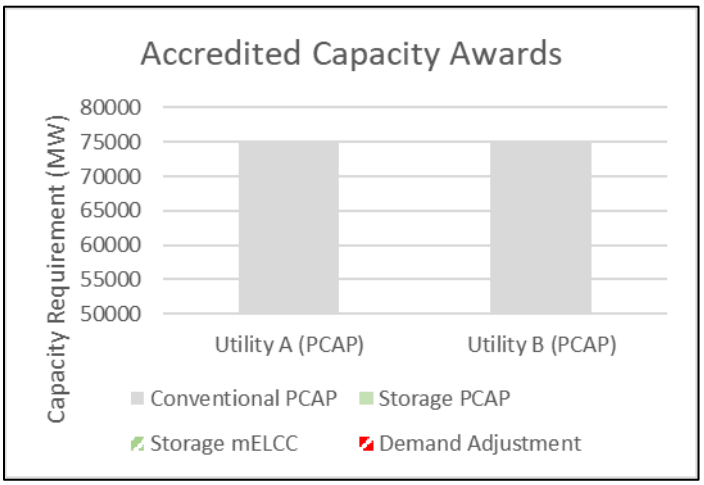


Figure 12: Two-Utility Example, Pre-Investment Period

b. Utility A's 30,000MW storage investment provides 19,000MW of PCAP to the system, enabling a corresponding 19,000MW of conventional capacity to exit the system. As the storage investments align with planned retirements in Utility A's Integrated Resource Plan, Utility A reduces its firm showing to 56,000MW of conventional resource capacity (PCAP) and 19,000MW of storage capacity (PCAP). Both utilities continue to sell 75,000MW of PCAP into the capacity market auction.

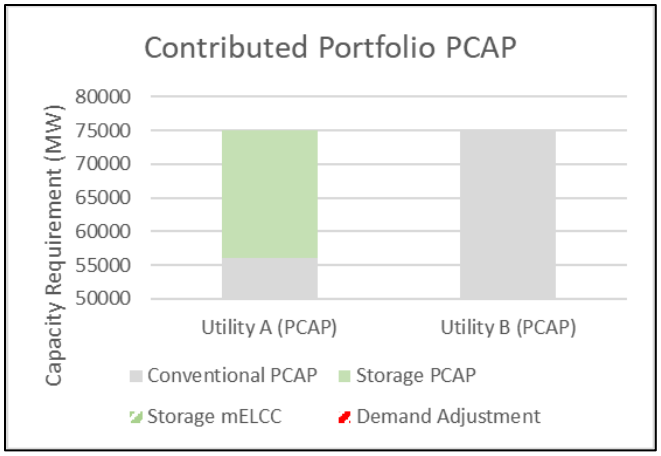


Figure 13: Two-Utility Example, Post-Investment Period Capacity Contributions

c. While Figure 13 reflects how Utility A and Utility B would be compensated under the current framework, the transition to marginal accreditation would reduce Utility A's accreditation for its 19,000MW of PCAP to 10,500MW to reflect the effectiveness of future storage resource development of 35%. This would leave Utility A with a portfolio accredited at 66,500MW (despite providing 75,000MW of PCAP), leaving it with an open position of 8,500MW in the capacity market (prior to the demand adjustment).

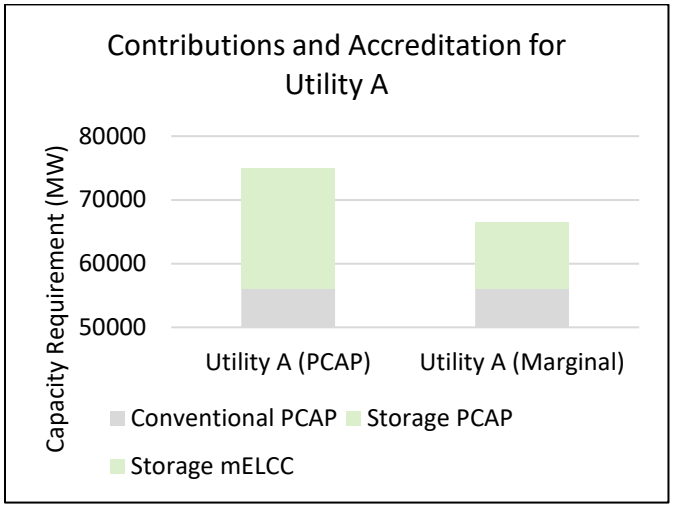


Figure 14: Average and Marginal Accreditation for Utility A

d. To address the storage portfolio's unaccredited 8,500MW, PJM would make an adjustment to the total demand in the capacity auction, equivalent to pro rata cost reductions across the two utilities. The 4,250MW demand adjustment would leave

Utility A with a net short position of 4,250MW, equivalent to the 4,250MW of PCAP from its storage fleet offered to Utility B as a demand reduction.

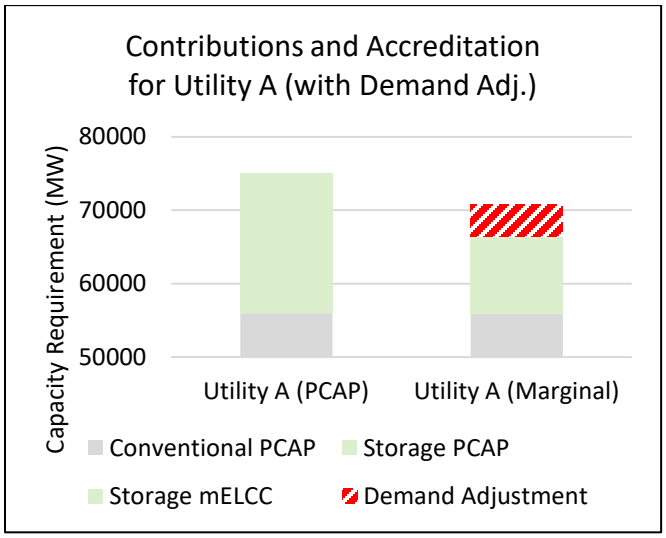


Figure 15: Average and Marginal Accreditation for Utility A with Demand Reduction

e. In parallel, Utility B, which has made no change to its portfolio, would be experiencing parallel shifts in its net position – like Utility A, it receives a pro rata share of the demand reduction associated with the unaccredited, inframarginal benefits of Utility A's storage investments.

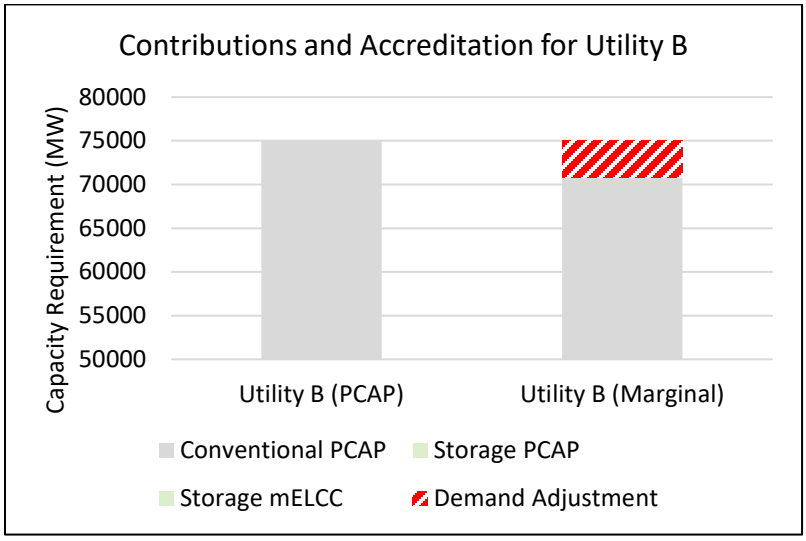


Figure 16: Average and Marginal Accreditation for Utility B

f. Following the accreditation and demand adjustments, Utility A enters the capacity auction with 75,000MW of PCAP and 66,500MW of accredited capacity, 4,250MW short of its new 70,750MW load obligation. Utility B enters the capacity market with 75,000MW of PCAP and 75,000MW of accredited capacity, 4,250MW long of its new 70,750MW load obligation.

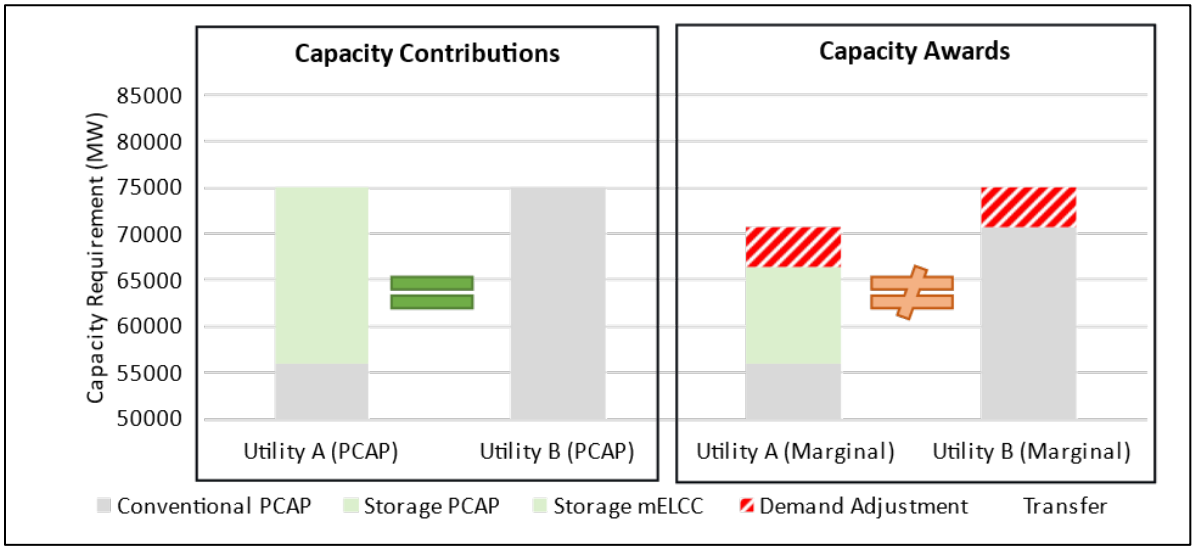


Figure 17: Capacity Auction Contributions and Awards

g. To clear the market, Utility A's customers must purchase an additional 4,250MW of accredited capacity to fill the gap between its contributions and accredited value. In parallel, Utility B's reduced load obligation has left it with an excess 4,250MW of conventional firm capacity to sell into the market.

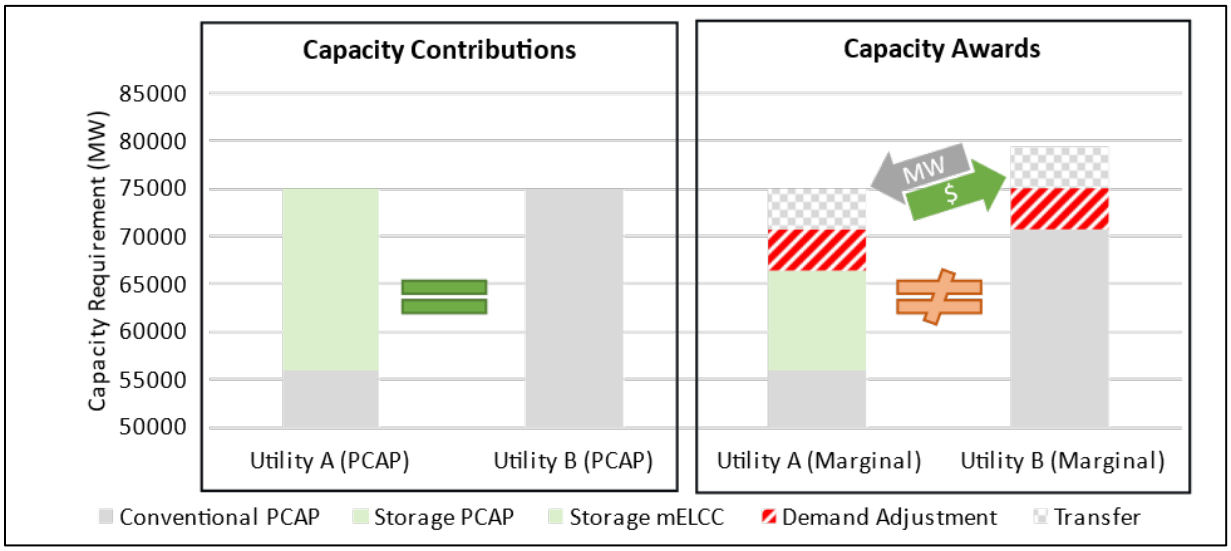


Figure 18: Clearing the Capacity Auction – Transfer Between Utilities

26. In sum, while Utility A's investment in new storage resources which displaced 19,000MW on the system, the marginal accreditation framework returned only 10,500MW in capacity awards, allocating the remaining 8,500MW proportionally between Utility A and Utility B. Consequently, Utility A was required to purchase the uncompensated 4,250MW allocated to Utility B through the capacity auction, resulting in its customers paying twice for the same capacity – first to invest in the development of the physical capacity and second to pay for their share of the capacity's reliability contributions which were socialized to other utility customers.

Section 5: Comparative Impacts Between Single-State and Multi-State Capacity Markets

27. In support of its filing, PJM's filing identifies the precedent established by FERC's adoption of NYISO's marginal accreditation proposal[19]. However, the appeal to precedent fails to recognize significant differences between the NYISO and PJM systems which introduce novel issues which were not present, or at minimum, far less present, than in PJM.

28. NYISO has two major elements which differentiate it from PJM which ameliorate the concerns raised above regarding the compensation and cost allocation between customer groups. First, NYISO represents a single state with homogenous resource procurement policies, meaning that the impacts from the transition to marginal accreditation will likely have similar impacts across all utilities within the state. Second, and even more significant, the vast majority of clean energy resources experiencing saturation effects are procured centrally on behalf of all customers through the New York State Energy Research and Development Authority ("NYSERDA"). Consequently, while a significant share of resource value may be socialized to customers through adjustments to load, the socialization of value falls to the same customer groups in the same proportion as resource investments. Given the single-state nature of the NYISO system, complex questions regarding cost-causation and cost-allocation associated with the demand adjustment were not in focus in FERC's approval of NYISO's marginal ELCC tariff proposal[20].

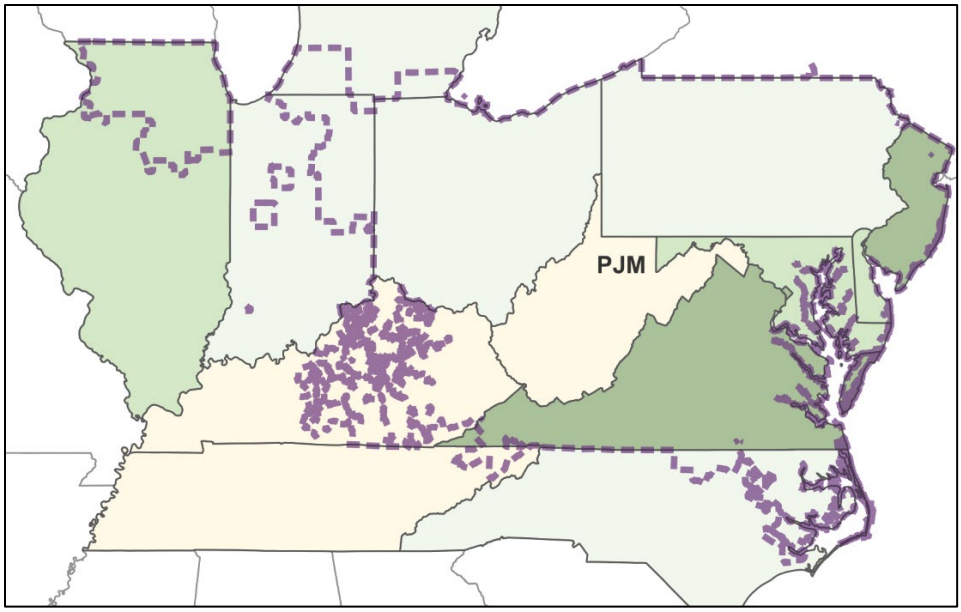
[19] PJM Filing, p. 31-33.
[20] Order Accepting Tariff Revisions Subject to Condition. ER22-772-001, May 10, 2022. P.34-36, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=E0055AC9-92C5-C102-89D0-80B0B5400000

State	NYISO Load Share	RPS/CES Target	By Year
NY	100%	100%	2040

Figure 19: NYISO Footprint Overlaid with Single-State Clean Energy Policy Requirements[21,22]

29. However, the PJM region is distinct from NYISO in ways that make it critical to consider how to allocate costs and benefits associated with the implementation of marginal ELCC. From the perspective of PJM market participants, this change may have significant effects. PJM comprises customers in 13 states and the District of Columbia, including the entirety or near-entirety of Ohio, Pennsylvania, New Jersey, West Virginia, Virginia, Maryland, Delaware, the District of Columbia, and the Chicagoland region of Illinois, as well as small pockets of Michigan, North Carolina, Indiana, Kentucky, and Tennessee.

[21] The NYISO service territory in Pennsylvania and New Jersey overlays with PJM service territory; it is unclear that any meaningful quantities of load are served beyond New York state borders.
[22] Senate Bill S6599, 2019. https://www.nysenate.gov/legislation/bills/2019/S6599



State	PJM Load Share	RPS/CES Target	By Year
VA	17.0%	100%	2045
NJ	9.1%	100%	2035
DC	1.1%	100%	2032
IL	11.7%	50%	2040
MD	7.8%	50%	2030
DE	1.5%	40%	2035
PA	19.4%	18%	2021
MI	0.6%	15%	2021
NC	0.5%	13%	2021
IN	2.9%	10%	2025
OH	20.1%	9%	2026
WV	4.8%	0%	NA
KY	3.0%	0%	NA
TN	0.2%	0%	NA

Figure 20: PJM Footprint Overlaid with Multi-State Clean Energy Policy Requirements[23,24,25,26]

30. In contrast to NYISO, PJM's member states reflect a range of policy trajectories with regard to resource procurement strategies. Approximately half of PJM load is served in

[23] PJM Load by State – 2023. Monitoring Analytics. July 10, 2023. https://www.monitoringanalytics.com/data/pjm_load.shtml
[24] Renewable and Clean Energy Standards, DSIRE, NC Clean Energy Technology Center. November 2022. https://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2022/11/RPS-CES-Nov2022.pdf
[25] https://dnrec.alpha.delaware.gov/climate-coastal-energy/renewable/portfolio-standards/
[26] https://www.environmentenergyleader.com/2023/02/nj-commits-to-100-clean-energy-by-2035/#:~:text=On%20February%2015%2C%202023%2C%20New,garnered%20a%20lot%20of%20attention.

states with clean energy requirements exceeding 50% (a quarter is in states with existing 100% requirements), while the other half is in states with requirements below 20% (8% have no clean energy requirements whatsoever).

RPS/CES Targets	Load Share
100%	27.3%
40-50%	21.0%
1-20%	43.6%
0%	8.1%

Figure 21: Distribution of Clean Energy Policy Requirements Within PJM States

31. While resource owners (developers, utilities, other counterparties) have historically been directly compensated for the reliability contributions of the resources they bring to the PJM capacity market, as PJM moves to marginal ELCC accreditation, the value of these resources will be split between a value stream directly compensated to resource owners and one which is returned to all load on a pro rata basis.

32. This difference is illustrated in Figure 22, which provides an overview of how capacity benefits and compensation are applied under different frameworks. Notably, NYISO's adopted and PJM's proposed mechanisms are the sole frameworks which do not assign inframarginal benefits to resources, and PJM's is the first to do so in a complex, multi-state market with heterogeneous states, utilities, and customer groups.

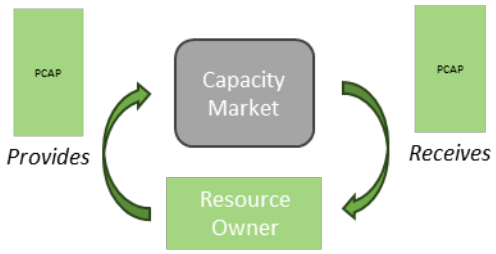
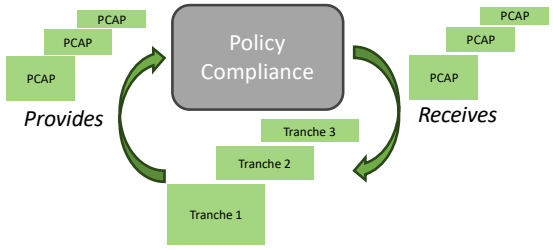
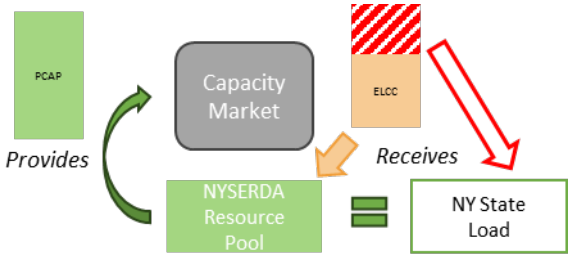
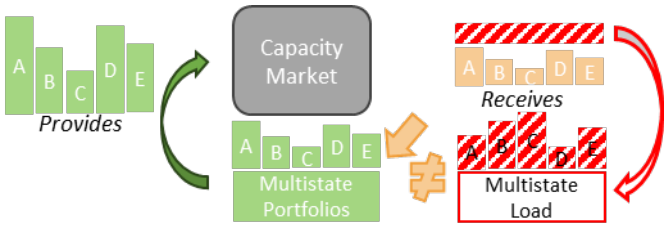
Capacity Benefits and Compensation Under Different ELCC Frameworks		
Average ELCC (RA Programs, Capacity Markets)		*In an average ELCC framework, the full contributions (including marginal and inframarginal) are directly allocated to the resource owner.*
Vintaged Marginal ELCC (Planning, Commercial Valuation, Policy Mandates)		*In a conventional marginal ELCC framework, inframarginal contributions are allocated directly to resources through compensated (i.e. via PPA) or reliability accounting (i.e. in a planning exercise) with differentiation by tranche.*
Single-Jurisdiction Non-Vintaged Marginal ELCC (NYISO)		*Under NYISO's unique single-state framework, the distribution of inframarginal benefits approximately aligns with contributions as most resources are procured centrally (and all utilities share equivalent policy requirements).*
Multi-Jurisdiction Non-Vintaged Marginal ELCC (PJM proposal)		*Under PJM's multistate framework, the distribution of inframarginal benefits is not inherently proportional to the contributions, as state-by-state contributions (and pro rata returns) vary widely.*

Figure 22: Comparative Table of ELCC Benefit and Compensation Mechanisms

Section 6: Illustrative Analysis of Distributional Impacts within PJM

33. Utilizing these four categories of state resource-procurement targets, it is possible to illustrate the distributional effects of marginal accreditation with PJM in the context of the prior example of the 30,000MW storage resource. However, to reflect the broader ambition and longer time-horizon of the states' clean energy policies, the example below assumes an 80,000MW portfolio of solar, wind and storage resources providing 40,000MW of PCAP (50% average ELCC) accredited at 20,000MW (25% marginal ELCC).

Group	States	PJM Load Share	CES Target	Share of CES Demand
100%	VA, NJ, DC	27%	100%	63%
40-50%	IL, MD, DE	21%	49%	24%
1-20%	PA, MI, NC, IN, OH	44%	13%	13%
0%	WV, KY, TN	8%	0%	0%

Figure 23: Distribution of Clean Energy Policy Requirements Within PJM States

34. As a preliminary simplification, jurisdictions are categorized based on their current RPS / CES policy statutory requirements as indicated in Figure 23. The clean energy portfolio is assigned to each group in proportion to its share of long-term demand for clean energy resources (as defined by current statute) while its load share is used to assign demand adjustments associated with the inframarginal benefits of the ELCC portfolio.

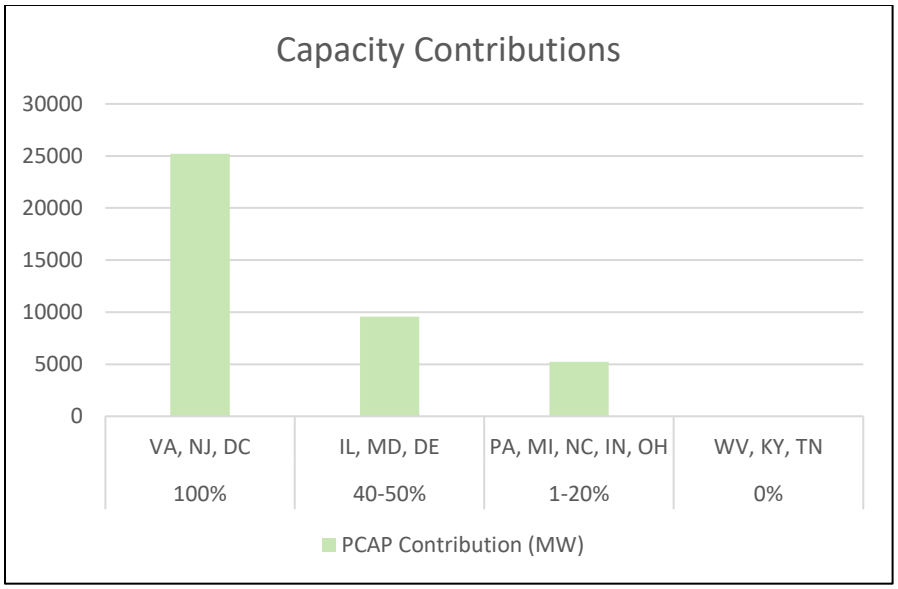


Figure 24: Hypothetical Distribution of Capacity Contributions based on Current Policies

35. Based on current clean energy policies, resources procured by Virginia, New Jersey, and the District of Columbia would contribute 63% of the clean resource fleet, followed by 24% from Illinois, Maryland, and Delaware, with the final 13% coming from the Pennsylvania, Michigan, North Carolina, Indiana, and Ohio. West Virginia, Kentucky, and Tennessee, which do not currently have minimum clean energy requirements, are not assumed to contribute to the clean resource fleet.

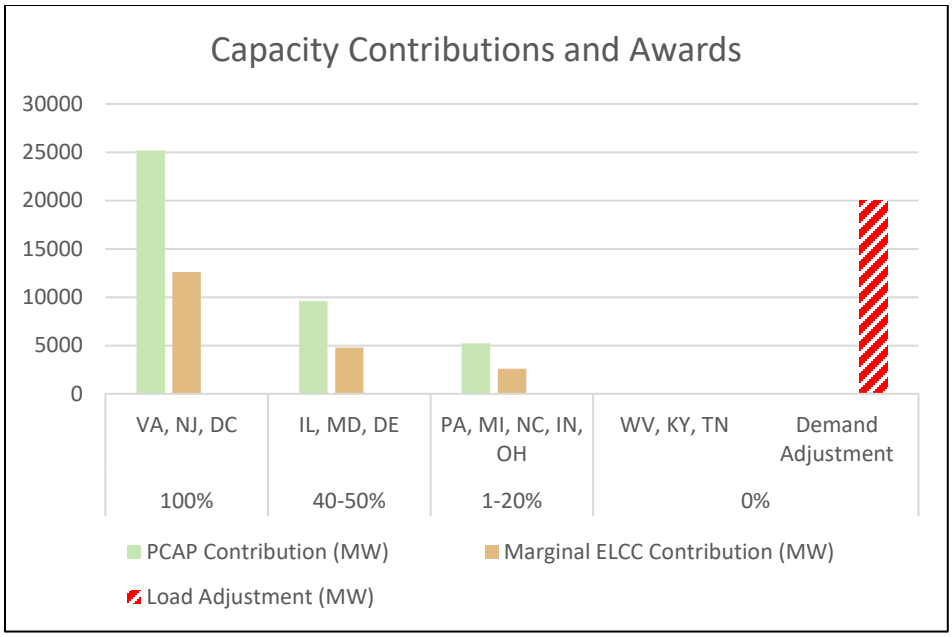


Figure 25: Hypothetical Distribution of Capacity Contributions and Awards based on Current Policies

36. However, as inframarginal benefits would not be compensated under a marginal accreditation framework, 20,000MW of the PCAP provided by contributing states would be transferred from capacity awards to demand adjustment within the auction, reflecting the difference between the 50% average ELCC and 25% marginal ELCC of the portfolio. PJM would distribute this reduction in the capacity procurement target across the entire region.

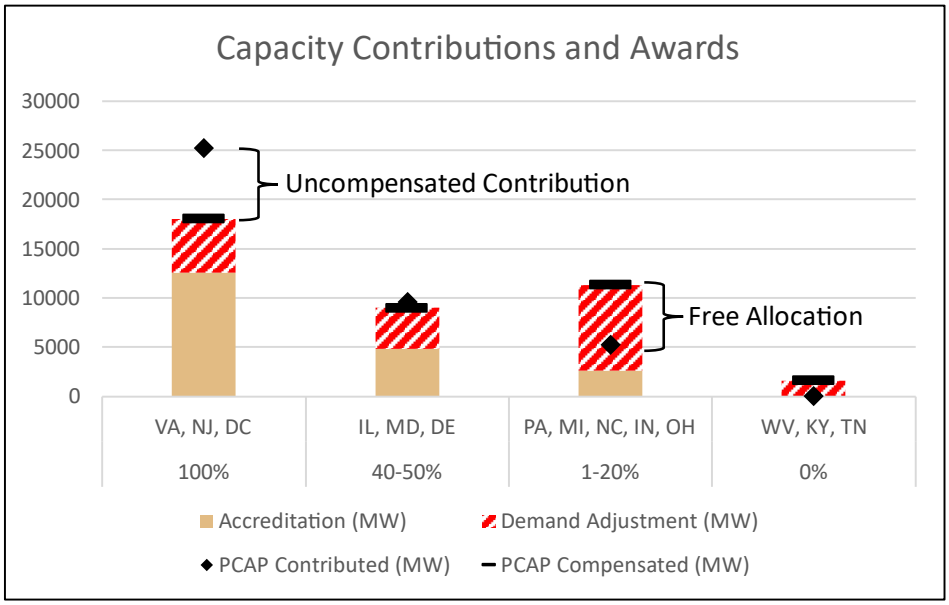


Figure 26: Hypothetical Distribution of Capacity Contributions and Awards based on Current Policies, with Demand Adjustment

37. After accounting for the demand adjustment, the distributional effects of socializing inframarginal benefits can be assessed, with significant uncompensated contributions from states with aggressive decarbonization targets (VA, NJ, DC) and significant benefits accrued by larger states with less aggressive decarbonization targets (PA, MI, NC, IN, OH). These effects are likely to be significant – in this example, VA, NJ and DC contribute over 7,100MW of PCAP more than they receive in compensation, while PA, MI, NC, IN, and OH receive over 6,100MW of PCAP more than they contribute. This equates to 28% of the capacity contributions by VA, NJ, and DC going uncompensated, while PA, MI, NC, IN, and OH receive 117% more in free allocations than they contribute. Despite contributing none of the capacity, WV, KY, and TN receive over 1,600MW of benefits.

38. State-level effects are reproduced below. Variation within each group is driven primarily by each state's load share within PJM, with larger states receiving more benefits than smaller states, as the demand adjustment benefits are allocated pro rata.

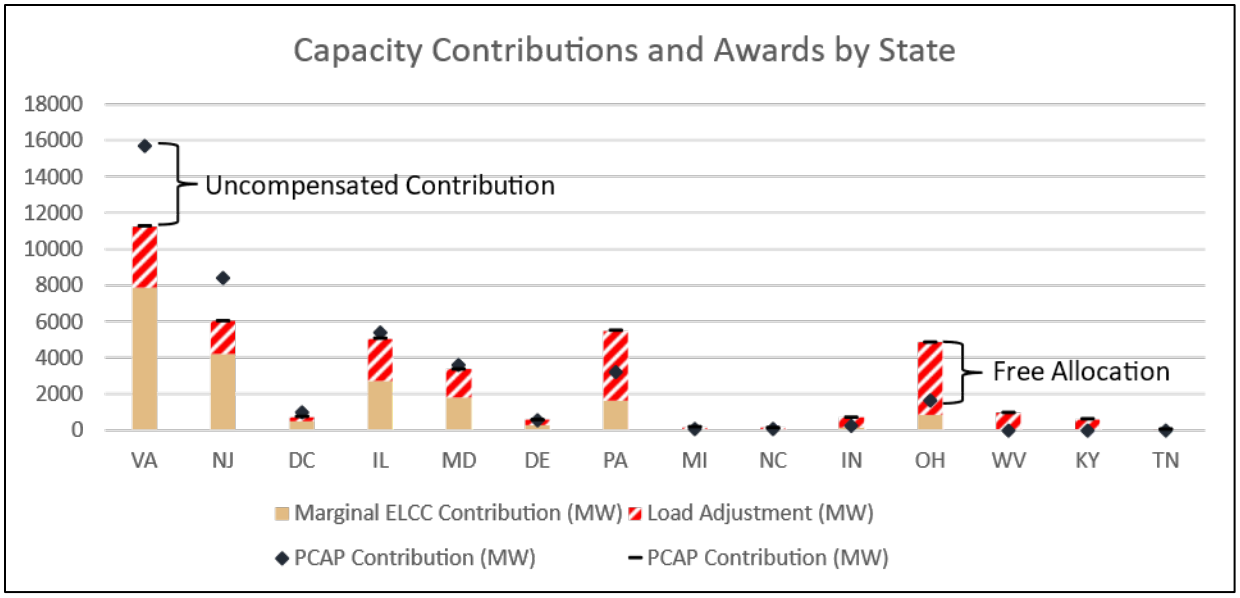


Figure 25: Hypothetical Distribution of Capacity Contributions and Awards based on Current Policies, with Demand Adjustment, by State

39. As indicated in Figure 25, the benefits received by each state can vary considerably relative to the contributions of that state, with VA as the biggest loser (4,453MW) and OH the biggest winner (3,184MW), receiving a free allocation almost double its initial contribution (1,671MW). PA is another notable beneficiary, receiving a free allocation of 2,267MW, while WV receives nearly a gigawatt of free capacity despite having made no contribution to the resource investments. Results are reproduced below in Figure 26.

State Characteristics				Reliability (PCAP)	Accreditation (ELCC MW)			
States	PJM Load Share	CES Target	Share of CES Demand	PCAP Contribution (MW)	Marginal ELCC Contribution (MW)	Load Adjustment (MW)	Total Benefits (MW)	Transfer Benefits / (Losses) (MW)
VA	17.00%	100%	39%	15,706	7,853	3,400	11,253	(4,453)
NJ	9.10%	100%	21%	8,407	4,204	1,820	6,024	(2,384)
DC	1.10%	100%	3%	1,016	508	220	728	(288)
IL	11.70%	50%	14%	5,405	2,702	2,340	5,042	(362)
MD	7.80%	50%	9%	3,603	1,802	1,560	3,362	(242)
DE	1.50%	40%	1%	554	277	300	577	23
PA	19.40%	18%	8%	3,226	1,613	3,880	5,493	2,267
MI	0.60%	15%	0%	83	42	120	162	78
NC	0.50%	13%	0%	60	30	100	130	70
IN	2.90%	10%	1%	268	134	580	714	446
OH	20.10%	9%	4%	1,671	836	4,020	4,856	3,184
WV	4.80%	0%	0%	-	-	960	960	960
KY	3.00%	0%	0%	-	-	600	600	600
TN	0.20%	0%	0%	-	-	40	40	40

Figure 26: Hypothetical Distribution of Capacity Contributions and Awards based on Current Policies, with Demand Adjustment by State

Conclusion:

40. As demonstrated in this affidavit, PJM's proposal to move to a marginal ELCC accreditation methodology introduces novel compensation and cost allocation issues which have not been clearly articulated or addressed in PJM's filing. PJM's proposal, like NYISO's proposal before it, proposes a novel methodology for applying marginal ELCC which departs from traditional ELCC applications in its disposition of inframarginal benefits. In contrast to PJM's proposal, traditional applications of ELCC, including marginal ELCC as used in resource planning, commercial evaluations, or policy mandates, do not incorporate retrospective adjustments to existing resources to reallocate inframarginal benefits from resource to load.

41. While PJM's proposal conceptually aligns with NYISO's approved marginal ELCC accreditation framework, including its proposed mechanism for adjusting demand to address inframarginal benefits not assigned to resources, the novel cost allocation issues introduced in PJM were not materially present in NYISO's single-state market. In contrast to NYISO, PJM is comprised of a diverse set of utilities and states with a wide range of resource development trajectories, ranging from jurisdictions seeking to achieve 100% clean energy targets in the early 2030s to states with no clean energy policies whatsoever. As these states' resource portfolios shift, the socialization of inframarginal benefits between utilities will result in a significant transfer of benefits from states developing resources with declining marginal reliability benefits to states which are not.

42. Despite the significance of this dynamic, PJM's filing does not engage with this issue, failing to the Commission and stakeholders with the necessary context, analysis, and justification regarding this transfer of benefits. While I have provided conceptual and directional analysis to illustrate the existence and potential magnitude of the benefit transfer, an analysis of these issues from PJM using real-world data would be far more effective in providing the Commission the information necessary to ensure its filing is just and reasonable.

43. This concludes my affidavit.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct. Executed on November 8, 2023.

Nick Pappas

Nick Pappas

925.262.3111 | Nick@NPEnergyCA.com | LinkedIn

SUMMARY

Electric sector consultant providing strategy and expertise to stakeholders building the 21st century grid. Mission-driven focus on the development and implementation of policy, market, and technology solutions to rapidly decarbonize global energy systems.

EXPERIENCE

NP Energy LLC, Truckee, CA 03/2021-Present
Principal

- Lead a boutique consulting firm focused on supporting utility sector decarbonization, with particular emphasis on the intersection of reliability and decarbonization in utility resource planning.
- Provide synthesis, analysis, and strategy for clients adapting to structural changes in the energy market and policy ecosystem, with expertise in integrated resource planning, reliability markets and programs, and clean energy policies, and lifecycle emissions analysis
- Develop and implement regulatory and legislative strategies for clean energy deployment; recent engagement and advocacy focused in western states (CPUC, OPUC, PUCN, WRAP) and wholesale markets (PJM, MISO, ISO-NE).
- Advise clean energy startups on product and go-to-market strategy in the highly complex utility industry.

California Community Choice Association (CalCCA), Sacramento, CA / San Francisco, CA 01/2019-03/2021
Director of Strategic Initiatives and Outreach

- Led CalCCA's resource planning and procurement efforts, including internal policy development and consensus-building, policymaker and stakeholder engagement, and thought leadership on the suite of electric sector policy and market transformations impacting competitive retailers in California's hybrid electricity market.
- Developed and managed CalCCA's energy data program, the engine of CalCCA's data-driven policy advocacy, communications, and internal benchmarking efforts across over twenty member CCAs.

UC Davis Energy Graduate Group (UCD), Davis, CA 09/2016-01/2019
Masters Student, Energy Systems & Graduate Student Researcher, UCD Department of Economics

- Augmented public policy career with interdisciplinary deep dive into 'hard skills' – theory, methods, data analysis, and other aspects of economics, policy, and engineering disciplines related to energy, transportation, and climate.
- Conducted research on electric sector policy design and transportation electrification under faculty advisors from Economics (Prof. James Bushnell) and Civil and Environmental Engineering (Prof. Alissa Kendall).

Energy and Environmental Economics (E3), San Francisco, CA 06/2018-09/2018
Summer Associate (Internship)

- Developed E3 policy research, strategic analysis, and recommendations for California's retail choice transition.
- Contributed data analysis, visualization, and financial modeling for joint-utility building electrification study.

Southern California Edison (SCE), Sacramento, CA 12/2012-05/2016
Senior Legislative Advocate | Legislative Advocate

- Managed SCE position development, negotiation, advocacy, and coalition outreach on dozens of bills spanning the full spectrum of utility operations, including resource planning, transmission, distribution, rate design, demand-side management, and distributed resources.
- Developed lasting relationships with energy sector policymakers and stakeholders through a collaborative approach emphasizing the development of viable, sustainable policy solutions for the energy transition.

California State Assembly, Sacramento, CA 10/2010-12/2012
Legislative Director | Jesse M. Unruh Assembly Fellow

- Developed an insider's view of energy policy and politics as the advisor to a key member of the Assembly Committee on Utilities and Commerce during the formative period of California's climate policy development.
- Managed the legislative agenda and bill analysis for thousands of committee and floor votes and met with hundreds of community and stakeholder interests on legislative and community issues.

EDUCATION

M.S. Energy Systems – University of California, Davis 2018
Jesse M. Unruh Assembly Fellowship – California State Legislature 2011
B.A. Economics; Minors Writing, Latin American Studies – University of California Davis 2010