THE KEY TO ELECTRIC GRID RELIABILITY: MODERNIZING GOVERNANCE

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EXECUTIVE SUMMARY

The U.S. electric grid is under strain, with blackouts on the rise and the system's reliability more frequently tested than ever before in the face of more frequent storms, heat waves, hurricanes, and the like. In diagnosing the causes of diminishing grid reliability, policymakers and experts have pointed to aging grid infrastructure, growing cyber threats, more natural disasters and weather extremes, and overreliance on renewable energy—such as solar and wind.

This white paper argues that the primary cause of our unreliable grid is not the changing energy mix but rather a failure of grid governance. The grid governance system consists of the institutions and rules that control how the grid is planned, built, and operated, and it has three central flaws: (1) jurisdictional silos and inadequate coordination; (2) too little public oversight; and (3) misconceptions of the nature of modern reliability problems, leading to a cabined solution set. We briefly summarize solutions to these challenges.

Break down silos and enhance reliability coordination. The design of our grid governance institutions renders authority over the grid's reliability jurisdictionally and functionally siloed. Governmental and self-regulatory organizations at different levels (federal and state) control different portions of the grid. Different agencies control different functions of grid reliability, such as planning for new generation versus writing reliability rules that ensure safe grid operations. In some cases, such as ensuring the reliability of the transportation of natural gas through pipelines to powerplants, *no entity* has jurisdiction. Several reforms could lessen these silos and improve the institutions overseeing reliability:

- Most ambitiously, Congress should vest more authority in the Federal Energy Regulatory Commission (FERC) to write and enforce reliability standards. In this role, FERC could move beyond the narrow, technical focus of the standard-setting currently performed by the North American Electric Reliability Corporation (NERC). For instance, FERC should be empowered to write more performance-based, forward-looking standards, with NERC remaining a technical advisory body to the commission.
- In addition, FERC and NERC should more formally and regularly convene meetings between entities that govern the gas system and those with control over electricity reliability. FERC should be given more formal regulatory authority over natural gas system reliability.

- At a minimum, Congress should reform the statutory regime for electric grid reliability that currently requires FERC to defer to NERC and regional entities and instead allow FERC to modify proposed standards rather than sending them back to NERC for any changes.

Reform overly privatized governance systems. Grid reliability governance suffers from excessive privatization. The authority responsible for writing and enforcing grid reliability standards, NERC, is a private membership organization. Regional Transmission Organizations (RTOs)—responsible for planning for the electric grid and designing and operating the markets that ensure resource adequacy in many regions—are also private membership organizations.

In both cases, voting members select each organization's governing board and vote on the standards to be approved by the board. And both NERC and RTOs are dominated by entrenched, large industry players. This structure produces decision-making processes and rules that favor incumbents and lack adequate input from numerous public stakeholders, who have much to gain or lose from reliability-related decisions. To strengthen *public* control of grid reliability, we recommend the following:

- Enhance FERC's oversight of RTOs and NERC so that the agency responsible for grid reliability has the tools necessary to accomplish reforms systematically and expeditiously.
- Create a public office of grid reliability in lieu of NERC, which might also function as the central locus of planning for new transmission lines—a process that will be critical to ensure reliability in coming decades. This change would convert transmission grid planning into a public, more stakeholder-driven enterprise.
- More modestly, require NERC and RTOs to change the compositions of their voting sectors and boards to include more public representatives and better balanced authority across stakeholders. Create more transparent and participatory processes in these institutions.

This white paper argues that the primary cause of our unreliable grid is not the changing energy mix but rather a failure of grid governance.

Broaden the scope of reliability fixes. One common solution to reliability challenges plaguing the grid has been to build new fossil-fuel-fired resources and financially prop up aging fossil-based resources. But these short-sighted fixes misapprehend the nature of the modern reliability challenges. The correlated failures of gas and electricity supply make clear that it is no longer enough to ensure that new generation is constructed; grid regulators must assure that resources that *perform during extreme weather events* are available in the future.

Many resources beyond fossil fuels are available to serve this role, including a panoply of distributed energy resources (DERs)—small-scale resources that include battery storage; small renewables such as rooftop solar panels or mid-sized microgrids that power a campus or critical infrastructure within a neighborhood; and demand response, which is customers' reduction of electricity use during periods of low supply or high demand. To broaden the range of reliability solutions available, policymakers should focus more attention on underappreciated substantive reform possibilities:

- Revise penalties for non-performance that make generators accountable for failing to perform (provide electricity) when called upon—particularly during correlated failures. Allow higher prices in *energy* markets—the markets for actual electricity provided with adequate consumer safeguards.
- Place more emphasis on DERs as resources capable of contributing to grid reliability and managing resource variability. Eliminate states' ability to veto demand response providers' participation in wholesale markets. Speed up and enhance regional rules for DERs' market participation.
- Create a new committee within NERC (or FERC, if FERC becomes the reliability regulator) to propose reliability standards that address DERs and enhance their ability to serve as reliability solutions.

INTRODUCTION

A reliable electric grid is essential to a thriving modern economy and society. For more than a century, the United States has built and maintained a bulk power system that delivers homes and businesses power whenever they need it. But this system is under increasing stress. Frequent headlines suggest that many parts of the grid are on the precipice of blackouts during periods of extreme heat and cold. In the past few years, multiple winter storms have led to rolling blackouts, with devastating effects.[1] And the aging U.S. electric grid is set to come under additional reliability threats as climate change fuels ever more severe weather disasters. Indeed, the number of "major disruptions" on the grid increased from fewer than two dozen in 2000 to over 180 in 2020.[2]

Policymakers and stakeholders are therefore right to prioritize grid reliability as a pressing concern.[3] But many are misdiagnosing the nature of the reliability challenge—or worse, using it to pursue separate agendas that are likely to hinder grid reliability over the long haul. One common refrain is that our reliability challenges are due to a too-rapid transition to clean energy—the same transition that is desperately needed to stave off worsening climate disasters. Even the country's main reliability regulator, NERC, has raised concerns about the rise of renewable energy contributing to our country's growing grid reliability woes.[4]

Blame has also been directed at the Environmental Protection Agency (EPA) as it works to fulfill its mandate to protect Americans from the health and welfare impacts of climate change. After the EPA proposed a new rule to regulate carbon dioxide pollution from power plants—one that would place new emission reduction requirements on natural gas generators[5]—a *Wall Street Journal* op-ed proclaimed, "The EPA Threatens to Turn Out the Lights."[6]

Yet agency decarbonization efforts and the growth of renewable energy have *not* been the primary culprits of recent major reliability failures. Instead, the natural gas system—while still critical as the grid transitions to zero-carbon sources—has repeatedly failed to meet its reliability obligations.[7] In fact, during many extreme weather events, solar and wind energy have helped contribute to *stabilizing* the grid.[8] Shoring up and building more fossil fuel-fired resources in the name of reliability—the current mainstream approach—will only worsen climate change and the pummeling of the electric grid that occurs with ever more extreme weather.

How can all of this be reconciled? And, if renewable energy is not the core challenge to grid reliability, what is? These are the questions this white paper seeks to answer.

In brief, our contention is that grid reliability faces not a resource challenge but a **governance challenge**. Our institutions for managing this system and its transformation are out of date and out of synch with each other. In many instances, they are comprised of entities with vested interests in promoting a myth that equates a clean grid with a less reliable one. This is particularly problematic because, while grid reliability institutions continue to cling to and expand rules designed for a fossil fuel-based grid,[9] energy generation developers have already shifted to a low-carbon generation portfolio because of declining costs, corporate and individual retail customer demand, and state and federal mandates and tax incentives.[10] Indeed, over ninety percent of energy generation projects waiting in U.S. grid interconnection queues are zero-carbon and exceed the capacity of all existing power plants.[11]

In other words, the train has already left the station. The economics of clean energy have shifted, the private sector is already building out a carbon-free generation portfolio, and our grid reliability institutions are, perversely, now some of the primary barriers to a reliable grid.

Fortunately, these governance challenges are fixable. This white paper focuses on three major governance changes needed to ensure the reliability of an outdated, climate-threatened, and transforming U.S. electric grid. These include broader federal jurisdiction and increased coordination among all reliability actors; the infusion of more public oversight in grid governance; and substantive changes to the rules that govern transmission planning, electricity markets, and demand-side solutions.

Part I of the paper introduces the electricity grid and its current challenges, while Part II describes the current governance regime for the grid. Part III analyzes jurisdictional issues and proposes ways to de-silo grid reliability oversight. Part IV critiques the marginalization of public values in grid governance processes, highlighting several reforms that could better align grid reliability institutions with public objectives. Finally, Part V examines two areas in need of more attention for their relationship to grid reliability: electricity market design and distributed energy resources policy.

If renewable energy is not core challenge to grid reliability, what is?....Our contention is that grid reliability faces not a resource challenge but a governance challenge.

I. THE U.S. ELECTRICITY GRID IN TRANSITION

The U.S. electric grid—comprised of electric generation plants, high-voltage long-distance transmission lines, low-voltage distribution lines, and associated components—is at a precarious point. The U.S. grid is outdated and less reliable than that of any other developed country—a fact that suggests that our approach to grid reliability needs to change, even if the grid were facing no new pressures.[12]

We focus here on the "bulk" electric grid, comprised of generators and transmission lines that connect generation to areas of demand. Significant new challenges now confront this bulk electricity system.

Federal and state policies driving the electrification of transportation and other sectors are causing recently flat electricity use ("load") to increase, demanding more rapid expansion of electricity generation.[13] The most cost-effective new resources, solar and wind, are largely weather-dependent and require balancing to preserve reliability. Load growth and an expansion in variable generation resources, in turn, necessitate a *significant* expansion of the U.S. grid.

In the coming decades, experts project that current transmission line mileage will need to double or triple, as well as become far more interconnected across long distances. Indeed, modeling shows that the most efficient grid would involve one nationally interconnected web of wires.[14] This "macrogrid" would cost-effectively enhance grid reliability for consumers across the country—but has proven exceedingly difficult to plan, site, and construct.

Climate-induced temperature swings, drought, and wildfires also create more grid emergencies. These emergencies have highlighted the ways in which even traditional fossil-fueled electricity generation is less reliable than is often presumed.

For example, during 2021 Winter Storm Uri and again during 2022 Winter Storm Elliott, natural gas plant failures were a primary cause of grid blackouts.[15] These failures can be traced back, in turn, to the ways in which these plants are centrally tied to the natural gas production and transport system—even though governance of the electric grid and natural gas system is separate. Regulators continue to struggle with managing correlated risks across these two systems.

A grid facing these conditions—increasing renewable generation, worsening extreme weather events, and accelerating load growth—needs a modified approach to reliability. Specifically, there needs to be less attention to reserve capacity (the physical generation equipment that can produce power during peak demand or other plant outages) and more focus on "flexible" and "reactive" resources that can quickly ramp up generation or reduce demand as needed, as well as the transmission capacity necessary to shift power across regions.[16]

Yet our regimes to manage the electricity grid and electricity markets are stuck in a paradigm developed for fossil fuel resources that no longer matches the conditions facing the grid in the present or the future. There is growing attention to technical approaches to enhancing the reliability of an evolving, expanding U.S. electric grid.[17] But these technical approaches, which already exist, will only be implemented with a major overhaul of grid governance—the system that dictates how the grid changes, how quickly it changes, and how reliably it operates.

Our regimes to manage the electricity grid and electricity markets are stuck in a paradigm developed for fossil fuel resources that no longer matches the conditions facing the grid in the present or the future.

II. AN INTRODUCTION TO GRID GOVERNANCE

Ensuring the reliability of the sprawling U.S. electricity system involves coordinating infrastructure and operations among generation, transmission, and distribution to ensure that the full quantity of electricity needed by customers is provided at all times. This endeavor is exceedingly complex, because there is not yet a large amount of electricity storage to help smooth periods of supply and demand imbalance.

Accordingly, the electric grid requires careful management. The entities that control the flow of electricity through the grid must ensure that the quantity of electricity used nearly exactly matches the quantity of electricity generated and dispatched into the grid. This helps to maintain a frequency in the grid close to 60 hertz—the magic number that allows the grid to operate properly. If the frequency within the wires deviates too far from 60 hertz, generation equipment can shut down or inverters that connect solar photovoltaic panels to the grid can trip—with too large of deviations ultimately causing blackouts.[18]

To accomplish this delicate balancing act of dispatch and load, grid governing entities regulate two primary activities: (1) planning for, constructing, and maintaining the physical infrastructure necessary to provide adequate generation, storage, transmission, and distribution; and (2) properly operating this infrastructure by balancing electricity dispatch and load and rerouting power flows in transmission or distribution lines when needed.

A complex array of actors is responsible for this difficult task. Given its legal control over interstate transmission and interstate sales of electricity, and its mandate to oversee the reliability of the system, **FERC** in many ways stands at the helm.[19] However, it must coordinate with and oversee numerous entities that each have a role in ensuring a reliable electricity system.

Most centrally, **NERC** serves as the country's designated electric reliability organization, responsible for overseeing the reliability of the bulk power system. NERC is a private 501(c)(6) corporation that writes electric reliability standards, which are mandatory rules for bulk power system facilities.

In 2006, FERC began to provide oversight authority over NERC per congressional mandate.[20] That means FERC must approve all reliability standards proposed by NERC or else reject them and send them back for revision; FERC may not independently amend the standards.[21] In addition, FERC must approve or reject NERC's actions enforcing reliability standards on utilities and other grid actors.[22]

Although NERC is nominally the central organization responsible for reliability, many other actors play exceedingly important roles. Specifically, NERC's sub-organizations, called **regional entities**, propose reliability standards specific to their region, influence the content of nationally applicable reliability standards, do much of NERC's enforcement work, and contribute extensively to NERC's annual "reliability assessments" by providing data and summaries about annual reliability within their regions.[23]

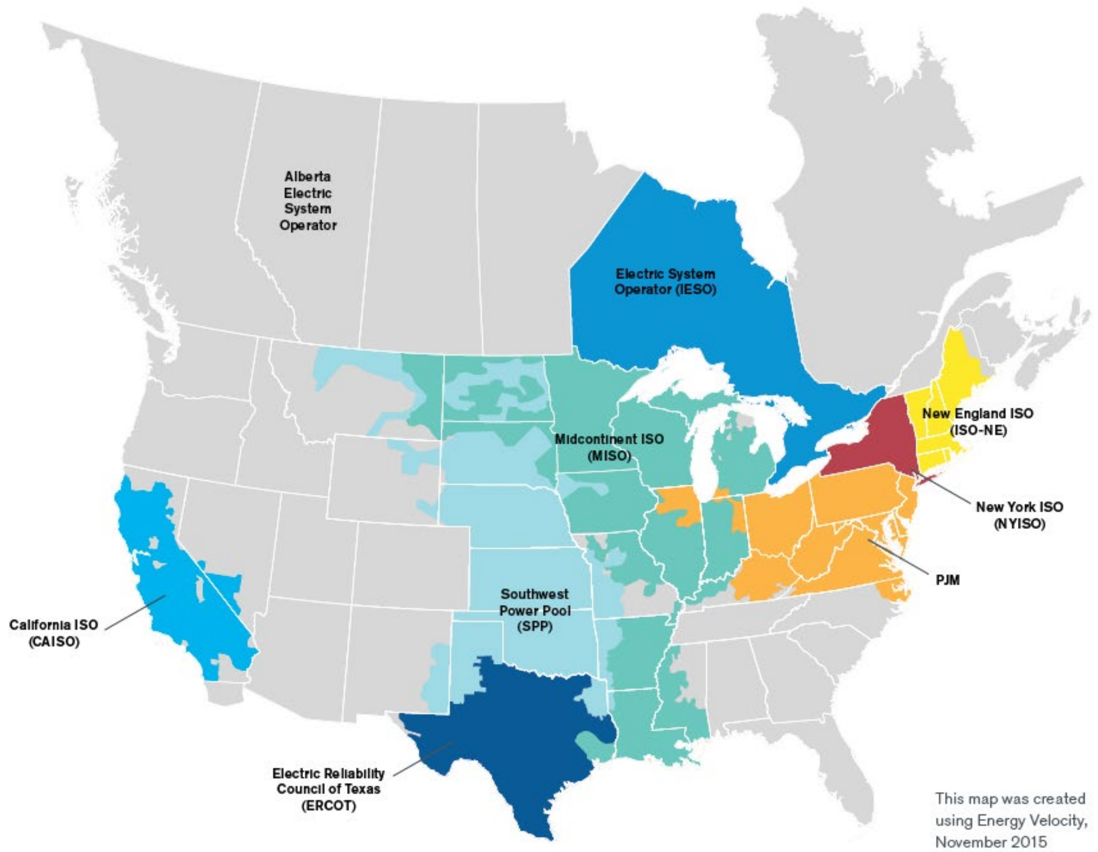
Like NERC, regional entities are private, nonprofit corporations, comprised of utilities and other bulk system actors operating within a region. Reliability assessments, influenced by regional entities and ultimately written and published by NERC, play an important role in grid reliability despite not being formal standards. Utilities and other actors in the bulk power system sometimes cite these assessments in justifying the construction of new infrastructure, including fossil fuel-fired generation capacity.[24]

Underneath all of these entities, the actors responsible for the more granular implementation of NERC's reliability standards include **"reliability coordinators,"** which work to "prevent or mitigate emergency operating situations."[25]

Operating within this layered authority are the entities in charge of managing the day-to-day dispatch of electricity and controlling the flow of electricity through the wires. In regions of the country with states that have not "restructured" to create electricity markets and separated transmission and distribution ownership from generation ownership, vertically integrated utilities often serve as their own system managers.

But in two-thirds of the country, utilities in both traditionally regulated and restructured states have opted to join a regional dispatch model. In these areas, transmission operators called **"regional transmission organizations" (RTOs) or "independent system operators" (ISOs)** have operational control of the transmission grid, although individual utilities maintain physical ownership of the wires.

FIGURE 1: REGIONAL TRANSMISSION ORGANIZATIONS[26]



In regions where they operate, RTOs and ISOs are also in charge of longer-term transmission planning to maintain reliability, under FERC-issued rules. Likewise, FERC has required utilities in non-restructured regions to nominally engage in regional transmission planning, but in practice this usually just amounts to "adding up" individual utilities' plans.[27]

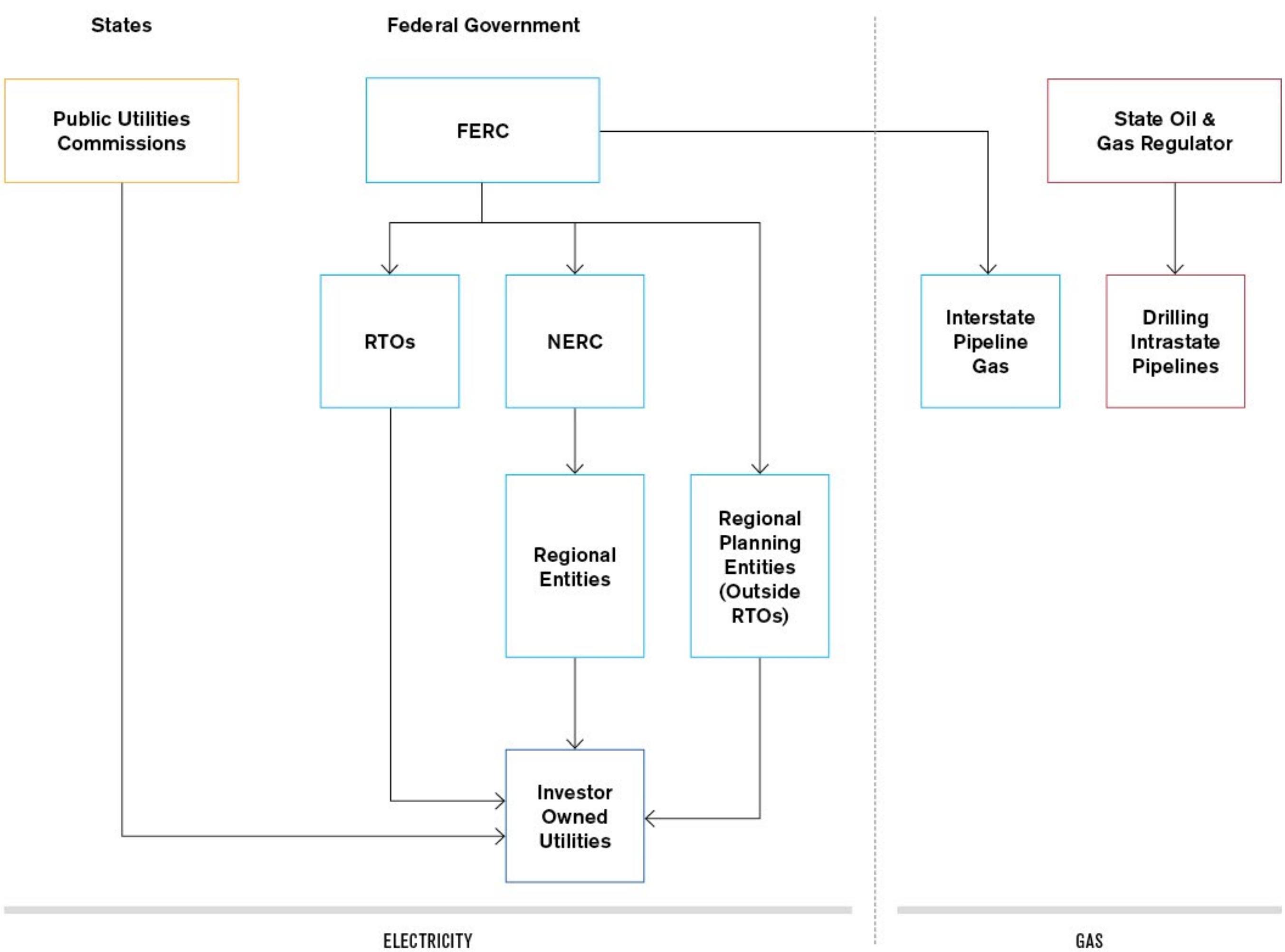
Alongside this web of federal actors, **states** continue to play a vital role in managing the electricity system. Federal law gives states control over electricity generation and the distribution system (the smaller poles and wires that connect the bulk power grid to our homes, industries, and businesses).[28] State utility commissions—called **public utility commissions, public service commissions, corporation commissions**, or the like—govern electric utilities' construction of power plants, distribution lines, and associated infrastructure, as well as the siting of transmission lines.

However, FERC and NERC do not control the reliability of the electricity distribution system or decisions about what power plants to build. In many states, these commissions plan for future expansion of generation capacity within their borders through a process known as "Integrated Resource Planning."[29] This divided authority between planning for generation at the state level and the transmission necessary to transport electricity at the federal level creates predictable complications—a topic that we take up in the next part.

Beyond the electric grid itself, other energy systems are critical to electricity reliability. These include, for example, fuel production facilities (such as natural gas wells) and non-transmission line energy transport infrastructure (primarily railroads for coal and natural gas pipelines for gas). Due to jurisdictional directives from Congress, different entities control the reliability of these separate systems.

States primarily govern natural gas production, meaning that they are responsible, for example, for ensuring that gas wells and associated equipment do not freeze during cold snaps. Meanwhile, FERC regulates the siting and operation of interstate natural gas pipelines (with the Department of Transportation regulating pipeline safety), and states regulate intrastate pipelines. Altogether, this governance system—the product of accretive statutes, court decisions, and regulatory rulemakings over more than 100 years—has historically been largely successful in keeping the lights on. But under conditions of rapid grid transformation and increasingly severe weather events due to climate change, its structures are being put to the test, as mounting pressures create a *massive* coordination challenge for this sprawling governance regime.

FIGURE 2: RELIABILITY GOVERNANCE INSTITUTIONS



III. INSTITUTIONAL SILOS AS A CORE RELIABILITY CHALLENGE

As suggested in the introduction to grid governance, regulatory jurisdiction over the construction, operation, and pricing of the electric grid is significantly fractured—far more so than for other types of energy infrastructure. Beyond inadequate jurisdictional authority, the many federal and state actors responsible for reliability are housed within distinct silos, both horizontally (at the same level of government), and vertically (at different levels, such as state and federal authority). Governance challenges in the form of silos and inadequate federal jurisdictional authority reach all areas that are critical to modern reliability. This part introduces several critical problems with siloing in grid reliability governance before suggesting several potential reforms.

A. UNDERSTANDING THE SILOS

There are at least four ways in which reliability governance is splintered that are particularly detrimental to the ability of our web of related institutions to manage the grid under changing conditions: the state–federal jurisdictional silo; unclear federal authority over transmission planning; divided control over reliability standards; and the gas–electric divide.

1. **State–federal jurisdictional silos.** The electric grid is distinctly siloed with respect to federal and state control over different portions of the grid. States control the construction of most generation resources and dictate whether intra- or interstate transmission lines may be built by controlling the siting (location) of those lines.[30] Yet FERC—working through RTOs—controls transmission planning and, in many regions, administers markets to incentivize generation capacity additions.

   This creates a mismatch: although FERC nominally has responsibility for grid expansion, it has very little authority to override any state decisions to grant or deny permits for new transmission lines or new energy generation plants. As a result, it can take decades to finance, plan, and obtain permits for interstate electric transmission lines since companies must obtain regulatory approval from multiple states applying different regulatory standards and which have varying interests in favor of or against the project in question.

Congress made incremental progress in the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) in addressing these challenges by granting FERC enhanced "backstop siting authority" to issue siting permits and grant eminent domain authority for needed lines in certain DOE-designated national interest transmission corridors, even over the objections of affected states. And there has been some progress under the Biden administration toward rationalizing and expanding transmission.[31] But more needs to be done to overcome federal–state tensions in this critical policy space.[32]

By contrast, the regulatory regime governing the construction (as opposed to reliability) of interstate natural gas pipelines and related natural gas infrastructure is far more streamlined from a federalism perspective. Under the Natural Gas Act, FERC, for nearly a century, has had the regulatory authority to plan and authorize building the interstate natural gas pipeline network required to move natural gas resources from places of production to end users. The lack of similar federal approval and siting authority over the interstate electric grid has resulted in a patchwork of siloed private, public, and hybrid government actors at federal and state levels that occasionally work together collaboratively but often do not, making necessary grid modernization difficult.

2. **Lack of adequate federal control over transmission planning.** *In general,* FERC has long taken a flexible, light-touch approach to how it induces regions to plan and pay for grid expansions. It has interpreted its authority to ensure "just and reasonable" rates for transmission to allow it to impose certain requirements on utilities' transmission planning. Yet FERC's requirements for interregional planning have largely caused grid operators to merely "check the boxes" and have not, for the most part, led to connections across the seams between regions.

   Utilities have tended to continue building out local lines, which, while improving reliability within a utility's territory, do not provide the broader reliability or economic benefits of a nationally interconnected grid.[33] Rationalizing these planning processes will be critical to ensuring a reliable, cost-effective clean energy transition.

   Although FERC likely has not reached the outer parameters of its jurisdiction to require better planning from its regions,[34] part of what holds the agency back is a lack of legal clarity regarding how prescriptive it can be in its planning oversight.

3. **Piecemeal and cabined approaches to reliability standard-setting.** There is also a lack of coordinated authority in the arena of reliability standards—the rules that directly require bulk-power-system actors to ensure reliability through infrastructure and operations. Here, both NERC and FERC are unduly constrained, or they read their authority in a manner that curbs their effective governance of modern grid reliability problems.

   Centrally a *technical* body, NERC is constrained by law to regulating facility design and operation specifications—and explicitly forbidden from requiring system expansions.[35] Indeed, NERC's interpretation of its charge has precluded it from becoming a visionary entity that identifies new challenges arising from a rapidly transitioning grid and crafts *results*-based standards to address those challenges.

However, NERC is aware of new challenges and regularly highlights intermittent renewables and climate-induced events such as wildfires, drought, and extreme weather in its reports.[36] Yet when NERC goes to address these challenges, it tends to focus on traditional solutions squarely within its wheelhouse, rather than think systemically or dynamically.

To give an example, take NERC's response to the challenge of solar inverters. In several instances, and in compliance with NERC standards, solar inverters have tripped (gone offline) in response to minor voltage fluctuations even when this was not necessary for grid stability—in some cases, contributing to blackouts.[37] But despite knowing of the problem, NERC failed to require smart inverters that could ride through voltage and frequency fluctuations until FERC put pressure on NERC to do so.

Similar to NERC's slow response to inverter problems, FERC has had to issue orders to NERC to address climate-related transmission line issues, including, for example, "transmission system planning for extreme heat and cold weather conditions over wide geographical areas," which necessitates even broader geographical transmission connections to allow electricity imports from less-affected areas.[38] Additionally, FERC and NERC repeatedly dragged their feet on mandating the winterization of grid infrastructure, despite several lengthy FERC and NERC reports concluding that winterization was necessary to address growing and unpredictable weather extremes.

Part of the problem underlying FERC's foot-dragging is political pressure from utilities and states pushing back against perceived jurisdictional overreach. But FERC also lacks the necessary jurisdictional authority to push NERC to more directly identify and address modern grid reliability challenges. The Energy Policy Act of 2005 requires FERC to defer to NERC's technical standards, and NERC, in turn, must defer to the reliability judgments of NERC's regional entities.

This triple deference, while largely untested in court to date, unduly constrains FERC—an agency that already has broad jurisdiction over grid planning and operations and is the best positioned to identify the extensive changes that must occur to make a modern, changing grid more reliable. Moreover, NERC has also historically been reluctant to share key reliability information with FERC, such as NERC's database of the generation failures and their causes—a database that centrally influences reliability assessments and utilities' expenditures on new reliability measures.

4. **Gas–electric disconnect.** In the interim period between a natural gas-dominated and zero-carbon grid, another key jurisdictional gap must be filled. There is *no* reliability authority for natural gas pipelines, including intra- and inter-state pipelines. States have begun to address this problem in fits and spurts, but not in a comprehensive manner, and not in all states.

   For example, Texas now requires electric-driven natural gas pipeline compressors to identify themselves as critical resources that should be last in line for involuntary curtailment when electricity is scarce. A broader reliability authority, however, is necessary to address the many potential failures of natural gas pipelines that can reduce gas supply to power plants, including, for example, freezing equipment on pipelines.

B. MATCHING JURISDICTIONAL AUTHORITY WITH THE PHYSICAL GRID

A recognition that silos among our reliability institutions present the core threat to reliability—rather than any particular regulation or set of resources—sets the stage for different approaches to ensuring grid reliability in the coming decades. Numerous reforms—both ambitious and more moderate—could help break down these silos and forge a more coherent model of grid reliability governance.

DEEP TRANSFORMATIONS TO COHERE RELIABILITY GOVERNANCE

1. **Expand FERC's authority over grid reliability.** To produce more visionary and results-oriented reliability standards that address pressing modern reliability challenges in a comprehensive, system-wide manner, FERC needs clear legal authority. In addition, NERC's central command over reliability standards requires re-visitation. While NERC possesses critical technical expertise, it does not have legal authority to write standards beyond requirements for existing bulk-power system facilities.

   A legal overhaul that gave FERC central authority to broadly remediate reliability challenges across supply, transmission, markets, and beyond would allow for a more flexible, adaptive approach to managing grid reliability. In this scenario, NERC might still be positioned as an expert adviser to FERC, but FERC would be the central entity—the "reliability Fed"—responsible for all aspects of system reliability.

2. **Form a natural gas reliability authority.** As FERC has noted, a major jurisdictional gap needs to be filled between the electricity and natural gas systems.[39] Congress should create an authority specifically for the reliability of the natural gas system, including, for example, the continued functioning of compressors that help to "push" natural gas through pipelines to power plants and pipeline components that can withstand freezing weather. There should be *one* entity responsible for ensuring continuity across this system—ideally FERC, which already controls the siting and market operations of interstate pipelines.

   However, natural gas is not a long-term solution to the climate problem; the industry itself has described natural gas as a "bridge" fuel to a zero-carbon future. It is essential, then, that reliability policies for natural gas avoid expanding natural gas infrastructure where reliable zero-carbon energy would otherwise have been built.

   For example, efforts to expand natural gas pipelines solely for reliability should be viewed skeptically, as batteries, microgrids, or other resources, rather than gas, can often fill reliability gaps. A newly-formed natural gas reliability entity should operate under a "non-gas alternatives" standard similar to New York's "non-wires alternatives." Under the "non-wires alternatives" policy, the state scrutinizes utilities' proposals to expand transmission, distribution lines, and transformers to ensure there is no less expensive and equally reliable substitute.

3. **Clarify and expand federal jurisdiction over transmission planning.** Other literature has thoroughly explored the many ways in which Congress has begun to expand federal transmission *siting* authority and how it could further expand such authority.[40] Equal work needs to be done on the transmission *planning* front.

   Although FERC has asserted relatively moderate authority over transmission planning under its authority for ensuring "just and reasonable" transmission rates, more direct authority from Congress to prescribe transmission planning procedures and criteria could help further counteract the outsized influence of states and utilities opposing such planning.

MODEST REFORMS TO AMELIORATE COORDINATION AMONG SILOS

1. **Continue to pursue better regional and interregional transmission planning.** Under its existing legal authority, FERC has already announced plans to reform regional and interregional transmission planning.[41] It is worth emphasizing that these plans are *critical* to the reliability of the grid under changing conditions–and should remain priorities that the agency expedites in the coming months and years.
2. **Enhance coordination among gas and electric grid authorities.** Both FERC and NERC should more consistently coordinate with state entities that control the natural gas system, as they have already begun to do. FERC should set a schedule requiring regular meetings of FERC, NERC, and state entities that control natural gas production and pipelines.
3. **Fully deploy federal authority at the supply–demand interface.** As we discuss further in Part V, FERC has more authority than it has yet used to control how distributed energy resources—including storage, microgrids, demand response, and small-scale renewables—interface with wholesale markets and interstate transmission. It is time FERC uses the fullest extent of its authority to integrate supply- and demand-side solutions to reliability.

IV. DE-PRIVATIZING GRID GOVERNANCE

The previous section focused on jurisdictional and institutional silos—that is, fractured coordination of grid reliability—as one core governance challenge. In this part, we turn to examine governance failures from a different angle, focusing on public–private tensions in reliability governance.

As we have described, the entities with front-line responsibility for managing the reliability of our electricity grid—and ensuring the grid grows in line with the changing nature of the system—are RTOs and NERC. While FERC supervises these entities, it does so under relatively deferential standards of review.[42] This largely privatized model of grid governance presents particular challenges for managing reliability under changing circumstances. Fortunately, several avenues of de-privatizing reforms are available.

A. UNDERSTANDING THE PUBLIC–PRIVATE TENSION

Those outside the energy industry are often surprised to learn that core decisions about the U.S. electricity grid are made by functionally private entities.[43] Both RTOs and NERC operate as not-for-profits, with dedicated, expert staffs. However, both are also *membership* organizations, meaning that the core decisions for each are strongly guided, and in some cases determined, by a sort of "membership club democracy."[44]

These membership bodies are responsible for electing the boards of the organizations—which wield substantial decision-making authority—and for voting on proposed rules or standard changes. Membership, in turn, is largely comprised of industry insiders, most of whom have strong financial interests in the outcomes of changes in RTO tariffs and operating agreements and NERC standards.

To give a sense of the membership composition of these organizations, we reproduce below the voting membership breakdown for the largest U.S. RTO, PJM, and NERC (see Figures 2 and 3). It is worth noting, however, that RTOs and NERC use a "weighted sectoral voting" procedure that generally gives each sector equal voting power—such that sectors with large numbers of members have their votes diluted, while entities that participate in small, homogeneous sectors or that can vote across sectors wield outsized power in these processes.[45]

Within NERC, responsibilities are delegated further yet: NERC relies on regional entities to develop and propose region-specific standards and reports. Often, utilities play outsized roles in these regional processes as well—including by reporting reliability conditions that justify their own preferred grid outcomes.[46]

FIGURE 3: PJM VOTING MEMBERSHIP COMPOSITION[47]

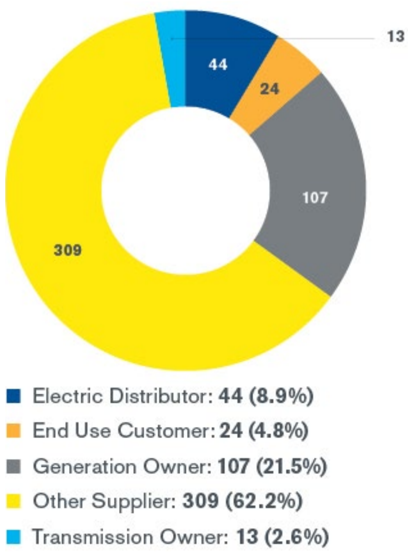
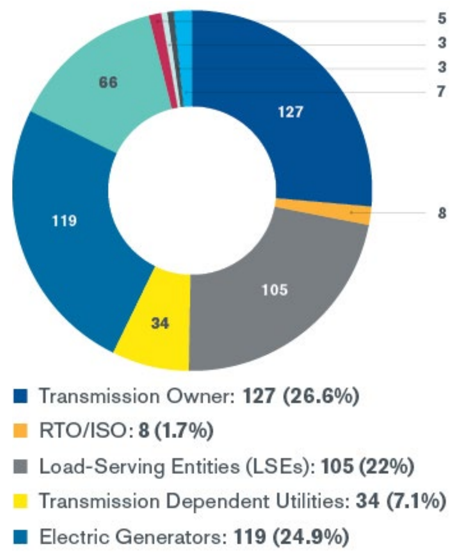


FIGURE 4: NERC BALLOT BODY SEGMENTS[48]



There are some good reasons for giving industry members such ingrained stakes in the rules that shape the electricity grid and its reliability. The entities that make up RTOs and NERC—which, notably, are largely comprised of *the same* players—bring considerable expertise about the electric grid and its regional operation to the table.[49] Similarly, regional differences in weather, resource availability, and utility footprints may sometimes justify variances from national norms and practices.

However, there are also mounting reasons to doubt that these functionally private entities will produce outcomes well aligned with public goals for the sector. For example, NERC struggles to produce sufficiently stringent standards in instances where these standards would impose substantial costs on generators.[50] Similarly, the organization has been largely focused on responding to reliability crises with solutions that prioritize baseload and fossil fuel resources while ignoring or even impeding the many reliability benefits that renewable energy can offer to the grid.[51]

For their part, RTOs have mounted an overall disappointing performance in planning and constructing a transmission grid capable of supporting change in the energy system. In fact, FERC recently gave a detailed accounting of these failures in a new proposed order on transmission planning, expected to be finalized in 2024.[52] Similarly, RTOs have been slow to amend the rules governing how new resources connect to the grid—resulting in backlogged interconnection queues full of new renewable energy and storage projects ready and waiting to provide much-needed injections of grid-stabilizing resources.[53] While FERC has recently tried to force improvements in these processes,[54] many doubt that the relatively conventional set of reforms the agency pursued will prove adequately transformative.

Even so, RTOs are an improvement on the institutional design of those regions without organized markets or central dispatch. In these areas, utilities essentially continue to run their own fiefdoms to manage grid planning and transmission and generation infrastructure. These non-interconnected regions are increasingly proving themselves to be substantial impediments to a reliable, low-carbon grid.[55]

There is an obvious reason that RTOs and other regional planning entities might prove inapt institutional constructs for managing the type of transformation necessary to maintain reliability in a changing grid: they are comprised of numerous powerful utilities that have a limited interest in advancing such a transformation. Utilities have financial incentives to build transmission infrastructure within their own service territories, but often resist helping to fund longer-distance lines that they themselves do not control or earn revenue on.

Moreover, those utilities that own generation may have incentives *not* to construct transmission lines that would lower the power prices the utility receives in constrained areas. And all incumbent generators have incentives not to make it too easy for new competitors to enter electricity markets, creating a bias against dramatic changes to interconnection processes or the easing of rules on electricity market participation.[56]

All to say, private companies with vested financial interests have an outsized role in setting the rules that determine grid reliability. These entities naturally seek to protect and advance the interests of their companies within these processes. But under conditions that demand rapid change to respond to a shifting sector, private and public interests are increasingly misaligned.

Amalgamated member preferences are a bad way to design and implement the kinds of forward-looking reforms that could ensure the reliability of a transformed, clean energy grid. This fact calls into question not just the contents of particular rules here and there but the entire structure of *how* the U.S. makes rules to govern the grid in the first place.

. . .under conditions that demand rapid change to respond to a shifting sector, private and public interests are increasingly misaligned. Amalgamated member preferences are a bad way to design and implement the kinds of forward-looking reforms that could ensure the reliability of a transformed, clean energy grid.

B. BRIDGING THE PUBLIC–PRIVATE DIVIDE

Potential reforms in this area range from modest to deeply transformative. At the far end of the spectrum, some have called for the nationalization of the transmission system as a maximalist response to privatized grid governance.[57] We do not go so far as to suggest a complete publicization of the grid, as we think there is a more balanced and realistic set of intermediate responses worth pursuing.

DEEP TRANSFORMATIONS TO RE-PUBLICIZE GRID GOVERNANCE

1. **Strengthen FERC's control over RTOs and NERC.** At present, the statutory provisions establishing FERC's control over RTOs and NERC require the agency to largely defer to proposals created via regional processes. If FERC disapproves of these proposals, its only remedy is to remand for a lengthy re-do in these same processes. This is a sclerotic way to implement reforms in the face of pressing grid reliability challenges. Congress should amend FERC's statutory authority to allow the agency to accept portions of regional filings while rejecting others.[58] More generally, Congress might more directly authorize FERC to mandate concrete solutions when it finds regional attempts unsatisfactory.[59]

2. **Create a public office of grid reliability.** Because managing grid reliability through the clean energy transition is such a critical public challenge, it makes sense to charge a *public* entity with responsibility for carefully evaluating how to manage it. The public/private divide creates further reasons to establish FERC as the reliability "Fed" to oversee all grid reliability issues comprehensively, as proposed above.

   Less dramatically, Congress might draw from existing strengths and give FERC's Office of Electric Reliability (OER), which currently serves an oversight and collaborative role with NERC and states, primary authority to propose reliability standards to FERC. This change would shift reliability standard-setting from a private-club model to a public, notice-and-comment model in which industry could and certainly would participate but without agenda-blocking powers.

3. **Make grid planning a public exercise.** Well-executed planning for the future of the grid will be *central* to maintaining reliability through a successful clean energy transition. As traced above, there are strong intuitive reasons to distrust private groups of utilities to act as the core planners of a transformed grid—and there is a 25-year track-record of failures to plan the grid rationally, efficiently, and collectively to now back up these intuitions.

   Given these well-documented limitations, it is arguably time to move authority for grid planning to a public entity, drawing from already extensive public expertise in modeling the ideal shape of a more interconnected grid.[60] There are different ways that grid planning could be federalized, and we do not offer a particular detailed proposal here.

   Whether done through an existing agency or the creation of a new one, a federal grid planning effort should design and execute a *national* plan for grid expansion, which could be mandatorily imposed as regions' baseline plans in FERC-overseen regional transmission planning.

MODEST CHANGES TOWARD MORE PUBLICLY-ORIENTED GRID RELIABILITY OVERSIGHT

1. **Reform the boundaries and composition of membership sectors and voting segments.** Neither RTO nor NERC membership and voting practices have kept pace with the degree of change in the composition of the industry. Thus, FERC might revisit both whether the existing division among industry segments and the existing weighting of votes by segment are capable of producing just and reasonable outcomes. In addition, FERC might also consider re-weighting voting to give a stronger voice to representatives of the public, including states and consumer advocates.

2. **Reform board composition requirements.** At present, the boards of both NERC and RTOs are dominated by industry insiders, elected either directly or indirectly by organizational members. Because these boards wield significant power, adding public representatives could help shape organizational culture and outputs in more public-oriented directions. Regional organizations of states might prove one logical place to ground nominating authority for public board representatives.

3. **Enhance transparency and participation.** Participation in NERC and RTO procedures is described by outsiders as byzantine and resource intensive, with inordinate amounts of subcommittee meetings and separate proceedings. Certain information channels and proceedings are also closed to the broader public in ways that create a veneer of secrecy and backroom dealing.[61]

   While FERC has previously disclaimed authority to regulate these aspects of RTO governance,[62] we believe its authority is broader than this decision suggests and bears revisiting at a nationwide level. At the very least, FERC's Office of Public Participation might launch an inquiry into how to best enhance the public's ability to participate meaningfully in RTO and NERC governance processes, given their increasing centrality to accomplishing pressing public priorities.

4. **Enhance uptake of best practices through mandates.** Certain RTOs have proven themselves willing to experiment with forward-looking best practices far more than their counterparts. The most cited example is the multi-value projects (MVP) planning initiative in the Midcontinent Independent System Operator (MISO), which collectively builds and pays for a group of transmission lines that bring economic value to the region and facilitate states' clean energy goals.[63] FERC should draw from such positive examples in designing new mandatory transmission planning and cost allocation criteria that all regions must follow.

V. SUBSTANTIVE REFORMS: RETHINKING MARKET DESIGN AND DEMAND-SIDE SOLUTIONS

This white paper has made the case that we should understand the crisis of grid reliability as a crisis of *governance*. More specifically, we have diagnosed the challenges as ones of (1) severed jurisdiction and authority, vertically among levels of government and horizontally among overlapping institutions; and (2) over-reliance on private institutions to accomplish the core public good of ensuring a reliable grid under changing imperatives. Following these diagnoses, we have suggested fixes that might better align our reliability governance constructs with the aims we have for the grid.

Better governance constructs are the first piece of the puzzle. But in this section, we emphasize a second piece: expanded horizons for conceptualizing what the reliability problem *is*, and what must be addressed in order to achieve the potential of a durably clean, reliable, and affordable electricity grid. We therefore highlight two critical dimensions of ensuring grid reliability that are often overlooked: electricity market design and demand-side solutions. Each of these substantive areas of reform is neglected in no small part *because* of the silos and tensions discussed above—and each bears emphasizing as an area ripe for attention by revamped grid reliability institutions.

A. OUTDATED MODELS FOR MANAGING ELECTRICITY MARKETS

The U.S. electricity system has regionally disparate means of managing reliability markets. Different parts of the United States rely on different market designs to ensure that they procure enough resources to meet peak demand. We and others have previously written at length about why resource adequacy markets are struggling to ensure that generation resources will be available during extreme weather events.[64]

One recurring theme is that the wholesale market rules prevent resources from taking economic losses when they fail to meet their resource adequacy obligations. In response, rather than fix the rules that create insufficient performance incentives, grid operators and regulators often opt to provide side payments to a predefined set of resources that are thought to be needed to keep the lights on. In doing so, wholesale markets shield fossil resources from clean energy policies, render them indifferent to the price signals sent by competitive energy markets, and prevent new entrants, especially carbon-free resources, from being compensated even when they provide significant reliability benefits.

One example of this phenomenon is capacity market rules that limit the penalties resources face for failing to meet their performance obligations. Capacity markets are resource adequacy markets that compensate resources for being *available* to sell energy, whereas energy markets compensate resources for selling energy. Capacity markets aim to ensure enough backup supply to provide consumers with an uninterrupted supply of energy—even during heat waves and winter storms. In the past few years, regions with capacity markets have struggled to keep the lights on during winter storms.

For example, during Winter Storm Elliott, PJM experienced 46,000 megawatts (MW) of forced outages,[65] seventy percent of which was due to gas being unavailable.[66] Many of these resources were compensated in capacity markets on the idea that they would be able to operate during scarcity events. Yet when the region needed them most, PJM found itself unable to call on nearly a quarter of its capacity resources.[67]

This is perhaps unsurprising, however, since PJM and other regions that use capacity markets have failed to impose penalties stringent enough to give capacity resources a sufficiently strong incentive to meet their performance obligations.[68] Because capacity markets pay resources in advance, they rely on a system of penalties to make sure that resources actually meet their performance obligations. Without sufficient penalties, resources have an incentive to promise that they will be able to perform when needed, and then to underinvest in reliability solutions that would make sure resources can operate during extreme weather events.[69]

The broad pattern that has emerged from recent cold snaps is that, rather than improve market design, regulators and grid operators silo and fragment resource adequacy markets in a manner that (a) may not address reliability needs, (b) shields fossil resources from competitive pressures, and (c) makes it difficult for carbon-free resources to be compensated even when they can provide reliability services.

Perhaps the most significant problem with resource adequacy markets across the United States is that they often fail to properly incentivize performance when it really matters. First, the size of nonperformance penalties is too low.[70] Second, capacity market rules typically include stop-loss provisions, which set an upward limit on the maximum penalty resources can incur in any month or year.[71] As a result, even as penalties have gotten stronger over the past few years, individual resources know that they will not become overly onerous. Third, margin requirements are too low.[72] Margin requirements force resources to post collateral or procure a bond to guarantee that they will be able to meet nonperformance obligations. However, if regional rules do not impose strict margin requirements, resources can file for bankruptcy if they cannot afford to pay their nonperformance penalties.[73]

Another problem with nonperformance penalties is that they sometimes reduce the size of penalties when failures are correlated. In PJM, one of the inputs in calculating nonperformance penalties is expected performance. However, if the entire fleet performs poorly, the size of the penalty is reduced. As a result, resources face a lower penalty if resource failures are correlated.

Recent extreme weather events have highlighted that failures, especially of gas-fired power plants, are highly correlated.[74] Reducing the size of generator penalties when failures are correlated reduces generators' incentives to make investments that enhance their performance during scarcity events. This accountability gap thus exacerbates the lack of electric–gas system coordination discussed earlier in this paper.

Yet rather than improve wholesale market rules, regulators and grid operators seem increasingly inclined to pick and choose the resources that are needed to keep the lights on and then ensure that those resources are able to recover their costs. Regulators continue to silo markets to the detriment of new entrants in the name of resource adequacy.

For example, in the past few years, the east coast markets have experimented with Minimum Offer Price Rules (MOPRs), which would have set a minimum bid amount that capacity resources can submit in capacity markets.[75] These MOPRs have been hotly debated and recently rolled back.[76] Had they gone into effect, however, they would likely have prevented many carbon-free resources from clearing capacity auctions, thus depriving clean energy resources of approximately thirty percent of wholesale market revenues.[77]

Controversial MOPRs are just one intervention that follows this pattern. Grid operators also often enter into reliability-must-run (RMR) agreements with generators that are slated to retire but are needed for reliability.[78] This means RMRs take a generator out of the market and authorize it to cover its costs and earn a profit if it does not retire. Similarly, New England's grid operator (ISO-NE) has repeatedly tried to provide additional payments to generators that can store fuel onsite, effectively guaranteeing they remain in the market.[79] ISO-NE has justified these payments on the ground that they prevent the retirement of resources that are able to deliver power when needed.[80] Yet many of these resources continue to struggle to perform during extreme weather events.[81]

These interventions are problematic from both a climate and a reliability perspective. Without proper price signals, resources have an incentive to overpromise and underdeliver. The result is that we are not receiving the reliability services we are paying for. Moreover, given how poorly certain resources have performed in recent years, it seems that grid operators are not in a position to identify prospectively which resources will be available during extreme events.

Without proper price signals, resources have an incentive to overpromise and underdeliver. The result is that we are not receiving the reliability services we are paying for.

Equally problematic is that regulators and grid operators respond to problems in resource adequacy markets by further siloing energy markets. By offering special compensation to fossil resources that are thought to be needed for reliability, grid operators guarantee the continued operation of certain fossil resources, and, in doing so, undermine state and federal climate policies.

In our view, there are a number of plausible ways to design wholesale energy markets, but a few basic guidelines should apply no matter what approach grid operators take to addressing resource adequacy. Put simply, grid operators should not pick and choose and should make sure that resources are paid for providing essential services. They should not protect fossil resources in markets that are unavailable to other resources and should instead compensate whatever resources contribute to grid reliability.

1. **Do not set offer caps in energy markets too low.** Energy markets compensate resources for providing electricity when it is needed. Unlike resource adequacy markets, energy markets do not rely on administrative judgments.

   We think there are compelling reasons to rely on resource adequacy markets to ensure a sufficient amount of generation enters the market, but we are skeptical that grid operators are in a position to predict years in advance what generation will be able to make itself available during scarcity events. Generators that actually support resource adequacy in real time should be compensated accordingly.

2. **Ensure that resources face meaningful performance incentives.** Again, our guiding principle is that regulators should eliminate arbitrary barriers that prevent resources from being compensated when they contribute to system reliability. In energy-only markets, that means raising the price cap to a high enough level to induce needed suppliers to enter the market and make investments that will allow them to perform during extreme weather events.

   In capacity markets, it means ensuring that generators that do not meet their performance obligations face meaningful penalties. Generators that earn revenues from capacity markets should not be able to profit if they do not in fact contribute to resource adequacy and reliability. Equally important is that grid operators address counterparty credit risk. If energy market prices are allowed to reach high levels, retailers may file for bankruptcy instead of paying their wholesale market obligations.

If capacity market nonperformance penalties increase, generators may also default instead of paying penalties. In both situations, regulators need to require resources to post margin ahead of time to ensure that resources are able to meet their resource adequacy obligations.

3. **Eliminate barriers to entry.** While regulators must make sure that resources comply with environmental laws and do not possess market power, they should not arbitrarily prevent certain resources from participating in resource adequacy markets.

   Of course, a resource should not be compensated for contributing to reliability if it does not actually contribute to reliability, but there is no need to stipulate that reliability payments can only go to certain resources. If the market is well-designed, and if a resource is needed, then it will receive sufficient revenues from the resource adequacy market to cover its costs.

B. REALIZE THE RELIABILITY VALUE OF DISTRIBUTED ENERGY RESOURCES

The distribution system, which feeds electricity from a transformer at the edge of the bulk power system to industry, businesses, and residences, is also a core component of grid reliability. It is where the vast majority of reliability incidents occur (from trees downing distribution wires, for example), and it is the point at which bulk system failures can be mitigated.

Resources that function as part of the distribution system are often called “distributed energy resources,” or DERs, and include, among others, rooftop solar-photovoltaic (PV) panels or backyard wind turbines; microgrids; storage; and demand response (each described in more detail below).

DERs have numerous reliability advantages. Even with widespread power outages, distributed energy resources can provide power for life-saving medical equipment, limited heating and cooling, refrigeration, and other essentials. And particularly when they include batteries, DERs can provide the very type of flexible and reactive power necessary to respond to rapid fluctuations in output from large-scale renewable energy generation.

For most of the system’s history, the “bulk power system” and the distribution system have remained largely cordoned off from one another, with FERC and NERC attending to the former but with states retaining primary control over their distribution grids. But the introduction of large quantities of weather-dependent resources makes it ever more important to enhance the cross-visibility and integration of these two systems, because promoting demand-side resources is one key way to produce the flexibility needed for a renewables-heavy grid.

Recognizing these interdependencies, FERC has endeavored to enable these resources by easing their entry into areas of federal jurisdiction—most notably, wholesale markets—with mixed success.[82] Below, we catalog the regulatory state of affairs with respect to core DER technologies and suggest means of better incorporating these resources into grid reliability governance and operations.

Demand response manages grid fluctuations by asking electricity customers to pre-commit to reduce their electricity use during periods of peak demand. Reducing electricity use during periods of peak demand can avoid the use of expensive, often dirty peaker resources and can prevent blackouts by reducing total demand during extreme events when supply might be strained. As with other DERs, FERC has encouraged demand response by allowing aggregators to bid demand response commitments from retail customers into wholesale markets. Its jurisdiction over practices "directly affecting" wholesale electricity prices enables FERC to govern this seemingly off-limits jurisdictional area.[83]

Aggregation of demand response resources has lowered energy costs and enhanced grid reliability throughout the regions where it is allowed. However, states in the RTOs called MISO and Southwest Power Pool (SPP), which still are home to regulated, vertically integrated (monopoly) utilities, have generally responded to utility pressure by opposing third-party aggregator participation in energy markets.

Utilities oppose third-party demand response aggregation because of aggregators' ability to compete against incumbent generation resources by lowering demand. Indeed, FERC acquiesced to that opposition in Order 719 in 2008, allowing states to wholly "opt out" of third-party aggregator demand response participation. Nearly all the midwestern states opted out, preventing large-scale demand response from enhancing grid reliability throughout large parts of the country.[84]

Distributed generation and microgrids. Distributed generation resources such as rooftop solar can enhance reliability by providing electricity during peak demand. If they have the capacity to "island" from the grid—as is technically possible—they can continue to provide power even during a blackout. Microgrids, such as mid-scale solar arrays located in a community area and paired with a battery, can also provide critical peaker power and electricity during a blackout. In fact, FERC has already supported the expansion of these critical reliability resources through Order 2222, which enables "aggregators" of DERs to participate in federally regulated wholesale markets.

Aggregators pool together numerous sources of distributed generation and bid these sources into markets as one larger "product." However, RTOs' implementation of Order 2222 has resulted in varied rules, some of which impede market entry by DERs, such as minimum size requirements for individual DERs participating as part of an aggregated unit and expensive metering mandates.[85] Some RTOs' rules implementing the order also do not allow aggregators to begin participating in wholesale markets until 2026.[86]

Battery storage and other storage. Large (transmission-scale) and small (distribution-scale) energy storage—primarily through batteries—is a critical component of grid reliability as resource variability increases and the grid experiences more threats from weather extremes and other natural disasters. In 2018, FERC encouraged the expansion of batteries by ordering that grid operators allow storage resources to participate in all wholesale markets. This order contained no state veto provision.[87]

ENHANCING THE ROLE OF DERS IN GRID RELIABILITY

As federalism theory would project, some states have exercised their jurisdiction to promote the expansion of reliable, clean DERs through subsidies, mandates, and procurement policies. Other states have lagged. It is beyond the scope of our remit to make recommendations concerning state DER deployment more generally. Instead, we are centrally interested in the interrelationship of DERs and the bulk power grid. Accordingly, we focus our recommendations on how federal authorities might better harness DERs' bulk-power-system-related capabilities. Priority areas for reform include:

1. **Optimize demand response across the country.** We believe FERC should reverse its opt-out policy for demand response aggregation, following the precedent it set for a similar broad prohibition on opt-out for DERs in Order 2222.[88] More ambitiously, FERC might also consider crafting a new best-practices-based rule for demand-side resource participation in wholesale markets, drawing from PJM's superior experience in integrating demand response resources.
2. **Eliminate carve-out vetoes for DER.** Order 2222 is important in enabling DERs, but it contains a limited state "veto" provision. Specifically, it allows states to block DERs attached to small utilities' distribution systems from participating in wholesale markets.[89] FERC should issue a new order to remove this state veto provision.
3. **Speed up compliance.** Additionally, FERC should step in to speed up RTO compliance with Order 2222, as several RTOs have missed compliance deadlines for redesigning markets as required by Order 2222.[90]
4. **Focus on the contributions of DERs.** In our ideally reshuffled governance vision, a relevant FERC office—or, barring this, NERC—should form a committee that focuses on the contributions of DERs to reliability and drafts reliability standards and other policies that support the expanded use of DERs.

CONCLUSION

A clean *and* reliable electricity grid is well within our grasp. Market forces are rapidly driving a transformation of the energy mix toward lower-carbon resources, which ultimately will help temper the extremes of climate change. Technologies that bolster reliability, such as batteries and microgrids, are rapidly growing.

Despite this promise, the governance apparatus that the United States has erected to ensure grid reliability has not proven itself up to the task of reshaping rules and processes to match changing physical infrastructure, market conditions, and public goals for the sector. Consequently, those interested in shoring up grid reliability should focus on these institutions and their pathologies as the first step to real and durable grid reliability in the coming decades.

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17 *See, e.g.,* Goldman Sch. of Pub. Pol'y, Univ. of Cal. Berkeley , Plummeting Solar, Wind, And Battery Costs Can Accelerate Our Clean Electricity Future (2020), http://www.2035report.com/wp-content/uploads/2020/06/2035-Report.pdf?hsCtaTracking=8a85e9ea-4ed3-4ec0-b4c6-906934306ddb%7Cc68c2ac2-1db0-4d1c-82a1-65ef4daaf6c1; Trieu Mai et. al., Pr Renewable Electricity Futures Study, Nat'l. Renew. Elec. Lab'y (2012), https://www.nrel.gov/docs/fy13osti/52409-ES.pdf; Eric Larson et al., Princeton Univ., Net-Zero America: Potential Pathways, Infrastructure, and Impacts 88 (2021), https://netzeroamerica.princeton.edu/img/Princeton%20NZA%20FINAL%20REPORT%20SUMMARY%20(29Oct2021).pdf.

18 "Smart" inverters allow solar panels to "ride through" slight deviations, but larger deviations interfere with all generating equipment. U.S. Dept. of Energy, *Solar Integration: Inverters and Grid Services Basics*, https://www.energy.gov/eere/solar/solar-integration-inverters-and-grid-services-basics#:~:text=In%20general%2C%20the%20standard%20for,the%20grid%20and%20shut%20down.

19 *See* 16 U.S.C. §§ 824, 824o.

20 *See* 16 U.S.C. § 842o.

21 *See* 16 U.S.C. § 842o (d)(2), (d)(5).

22 16 U.S.C. § 842o(e)(2).

23 *See* Macey at al., *supra* note 9, at 225–30.24

24 *Id.* at 213–30.

25 *Glossary of Terms Used in NERC Reliability Standards*, N. Am. Elec. Reliability Corp. (Dec. 1, 2023), https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf.

26 Fed. Ener. Regul. Comm'n, Regional Transmission Organizations (2015), https://www.ferc.gov/sites/default/files/2020-05/elec-ovr-rto-map.pdf.

27 Fed. Ener. Regul. Comm'n, Proposed Rule, Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection, 179 FERC ¶ 61,028, at 35–26 (Apr. 21, 2022).

28 *See* 16 U.S.C. § 824.

29 EPRI, State of Electric Company Resource Planning 2023 (2023), https://www.epri.com/research/products/3002026243.

30 *See* 16 U.S.C. § 824(b).

31 For instance, DOE has used its authority under BIL, IRA, and the Energy Policy Act of 2005 (EPAct 2005) to promote grid reliability through a range of permitting reform, funding, and financing mechanisms. These include proposing a new rule using never-used authority in EPAct 2005 for DOE to act as the lead agency for coordinating all federal permits, other authorizations, and environmental review required for new, interstate transmission lines, with a two-year deadline for agency action; proposing a revised categorical exclusion (CE) under NEPA for upgrading and rebuilding transmission lines that would eliminate the need for an Environmental Assessment or Environmental Impact Statement for such projects and that could be used by DOE or any other federal agency without further notice and comment rulemaking; entering into capacity contracts worth $1.3 billion with three interregional transmission lines to overcome some of the financial hurdles faced by these lines and seeking applications for providing a similar amount of financing for additional lines; and issuing billions of dollars of grants under its BIL and IRA authority to states, utilities, and other transmission providers and stakeholders to support grid reliability projects, including transmission buildout. *See* U.S. Dep't of Ener., Grid Dev.Off., *National Transmission Needs Study*, https://www.energy.gov/gdo/national-transmission-needs-study; Dev Millstein et al., The Latest Market Data Show that the Potential Savings of New Electric Transmission was Higher Last Year than at Any Point in the Last Decade, Berkeley Lab (Feb. 2023), https://eta-publications.lbl.gov/sites/default/files/lbnl-transmissionvalue-fact_sheet-2022update-20230203.pdf; *See* also American Council on Renewable Energy and Grid Strategies, Billions in Benefits: A Path for Expanding Transmission Between MISO and PJM (Nov. 2023), https://acore.org/wp-content/uploads/2023/11/ACORE-Billions-in-Benefits-A-Path-for-Expanding-Transmission-Between-MISO-and-PJM.pdf (evaluating cost savings and increased grid reliability associated with interregional transmission between MISO and PJM); John D. Wilson & Zach Zimmerman, The Era of Flat Power is Over (2023), https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-

Growth-Report-2023.pdf; Fed. Ener. Regul. Comm'n, *E-1: Commissioner Clements Concurrence on Order No.2023: Improvements to Generator Interconnection Procedures and Agreements* (July 28, 2023), https://www.ferc.gov/news-events/news/e-1-commissioner-clements-concurrence-order-no-2023-improvements-generator.

32 Kelsey Brugger, *Democrats Work to Align Proposals on Permitting, Grid*, E&E Daily (Dec. 12, 2023), https://subscriber.politicopro.com/article/eenews/2023/12/12/democrats-work-to-align-proposals-on-permitting-grid-00130393?source=email; Cong. Res. Serv., Electricity Transmission Permitting Reform Proposals (Oct. 11, 2023), https://crsreports.congress.gov/product/pdf/R/R47627 (detailing recent bills and draft bills); Miranda Willson, *"Latest Battleground": How Politics Seized the Electric Grid*, Energywire (Dec. 19, 2023), https://subscriber.politicopro.com/article/eenews/2023/12/19/latest-battleground-how-politics-seized-the-electric-grid-00132295?source=email.

33 *Cf.* Aaron Bloom et al., *supra* note 14.

34 179 FERC ¶ 61,028, *supra* note 27.

35 *See* 16 U.S.C. § 824o(a)(3).

36 Macey et al., *supra* note 9, at 210–13.

37 *See* Macey et al., *supra* note 9, at 210, 231–32, 308; IEEE PES Indus. Tech. Support Lead. Comm., Impact of IEEE 1547 Standard on Smart Inverters and the Applications in Power Systems 1–2 (2020), https://www.nrel.gov/grid/ieee-standard-1547/assets/pdfs/smart-inverters-applications-in-power-systems.pdf.

38 Fed. Energy Reg. Comm'n, *FERC Finalizes Plans to Boost Grid Reliability in Extreme Weather Conditions* (June 15, 2023), https://www.ferc.gov/news-events/news/ferc-finalizes-plans-boost-grid-reliability-extreme-weather-conditions.

39 FERC, NERC And Region. Entity Staff Rep. (2021), *supra* note 15, at 138 ("Congress could consider whether additional or exclusive authority for natural gas infrastructure reliability should be placed within a single federal agency…").

40 *See, e.g.*, Alexandra B. Klass, *The Transmission Grid at a Crossroads: A Regional Approach to Siting Transmission Lines*, 48 U.C. Davis L. Rev. 1895 (2015); Macey et al., *Grid Reliability, supra* note 9; Congr. Res. Svc., Electricity Transmission Permitting Reform Proposals (2023), https://crsreports.congress.gov/product/pdf/R/R47627/3; Charles Harper & Daniela Schulman, Evergreen Collaborative, Warp Speed Clean Energy: Expediting Permitting and Equitable Grid Deployment Without Congress (2023), https://collaborative.evergreenaction.com/policy-hub/Warp-Speed-Clean-Energy-December-2023.pdf.

41 179 FERC ¶ 61,028, *supra* note 29; Fed. Ener. Regul. Comm'n, *supra* note 31.

42 RTOs can file with FERC any change in their governing rules that is "just and reasonable." 16 U.S.C. § 824d. In contrast, FERC can only force changes in RTO practices and procedures if it finds that the rules in place are "unjust and unreasonable." 16 U.S.C. § 824e. In practice, this creates a higher burden of proof for FERC to force changes than it does for RTOs to have their preferred changes approved. *See* Morgan Stanley Capital Grp. Inc. v. Pub. Util. Dist. No. 1, 554 U.S. 527, 530 (2008); NRG Power Mktg. v. FERC, 862 F.3d 108, 114 (D.C. Cir. 2017) (observing that "Section 205 puts FERC in a passive and reactive role"). Similarly, the Federal Power Act explicitly instructs FERC to defer to NERC in reliability standard setting by "giv[ing] due weight to the technical expertise" of NERC. § 824o(d)(2).

43 For more on the history of RTOs, *see* Shelley Welton, *Rethinking Grid Governance for the Climate Change Era*, Calif. L. Rev. 209 (2021); Daniel Walters & Andrew N. Kleit, *Grid Governance in the Energy Trilemma Era: Remedying the Democracy Deficit*, 74 Ala. L. Rev. 1033, 1037 (2022). For more on the history of NERC, *see* Macey et al., *supra* note 9.

44 Welton, *supra* note 43 at 253.

45 For example, PJM uses an equal weighted sectoral voting approach, such that each sector receives 20 percent voting power, with a supermajority requirement of two-thirds for passage. *See* https://learn.pjm.com/pjm-structure/member-org/committees-groups-faqs/sector-weighted-voting.aspx. NERC uses a formula that allocates each industry segment equal weight in voting on proposed standards (except those segments with fewer than 10 voters), with approval also requiring a two-thirds majority of the weighted segment votes. If a segment has fewer than ten voters, its weight is adjusted downward. *Standard Processes Manual Version 4*, NERC 19 (Mar. 1, 2019), https://www.nerc.com/FilingsOrders/us/RuleOfProcedureDL/SPM_Clean_Mar2019.pdf.

46 *See* Macey et al., *supra* note 9, at 202–03, 225–27.

47 Chart created with data from *Member List*, PJM, https://www.pjm.com/about-pjm/member-services/member-list. Current as of December 11, 2023.

48 Data from *Ballot Body*, NERC, https://sbs.nerc.net/Users/VotersBallotBody. Current as of Dec. 11, 2023.

49 *See* Macey et al., *supra* note 9, at 234.

50 *See* Klass et al., *supra* note 9, at 1048 (explaining that "regional entities and states did not consistently implement" NERC recommendations regarding mandatory weatherization standards for cold weather, with the result that "the same shortcomings were some of the primary causes of the extensive outages in Texas in 2021").

51 *See* Macey et al., *supra* note 9, at 210–11, 231–32.

52 *See* 179 FERC ¶ 61,028, *supra* note 27.

53 *See* Joseph Rand et al, *supra* note 11.

54 *See* FERC Order 2023, Improvements to Generator Interconnection Procedures and Agreements, 184 FERC ¶ 61,054 (issued July 28, 2023).

55 To be sure, some states in these regions, for example Colorado, are pursuing robust state integrated resource planning and decarbonization policies. Nevertheless, numerous studies have confirmed that larger regional and interregional interconnections are critical for managing reliability and resource variability—such that leading states in these regions are now pushing for more integrated planning and dispatch. *See, e.g.*, Bloom et al., *supra* note 14, at 1764–68.

56 *See* Ari Peskoe, *Is the Transmission Utility Syndicate Forever?*, 42 Energy L.J. 1 (2021), https://www.eba-net.org/wp-content/uploads/2023/02/5-Peskoe1-66.pdf.

57 *See*, e.g., Comments of Public Citizen at 3–4, Reg'l Transmission Orgs., FERC Docket No. RM99-2-000 (Aug. 16, 1999).

58 In other words, Congress should explicitly reverse the presumption established in *NRG Power Mktg. v. FERC*, 862 F.3d 108, 114 (D.C. Cir. 2017).

59 Changes in this vein would likely revolve around specifying FERC's authorities vis-à-vis RTOs under 16 U.S.C. § 824d, and vis-à-vis NERC under § 824o.

60 *See, e.g.*, Bloom et al., *supra* note 14; U.S. Dep't of Energy, Nat'l Transmission Needs Study (Oct. 2023).

61 *See, e.g.*, Ari Peskoe, *Replacing the Transmission Utility Syndicate's Control*, 44.2 Energy L.J. 1, 59–64 (2023).

62 Order Dismissing Complaint, RTO Insider LLC v. New England Power Pool Participants Comm., 167 FERC ¶ 61,021 (2019).

63 *See* Hannah Wiseman, *Regional Cooperative Federalism and the U.S. Electric Grid*, 90 Geo. Wash. L. Rev. 181–83 (2022).

64 *See* Jacob Mays et al., *Private risk and social resilience in liberalized electricity markets*, 6:2 Joule 369 (Feb. 2022); Jacob Mays & Joshua C. Macey, *Accreditation, Performance, and Credit Risk in Electricity Capacity Markets*, (Energy Pol'y. Ctr. at the Univ. of Chicago, Working Paper, 2023), https://epic.uchicago.edu/research/accreditation-performance-and-credit-risk-in-electricity-capacity-markets/; Jacob Mays, David P. Morton & Richard P. O'Neill, *Asymmetric risk and fuel neutrality in electricity capacity markets*, 4 Nature Energy 948 (2019).

65 *See* PJM, *Winter Storm Elliott Frequently Asked Questions* 3 (Apr. 12, 2023), https://www.pjm.com/-/media/markets-ops/winter-storm-elliott/faq-winter-storm-elliott.ashx#:~:text=PJM%20had%20as%20many%20as,up%20the%20majority%20of%20outages.

66 *See* PJM, Winter Storm Elliott Event Analysis and Recommendation Report 49 (Jul. 17, 2023), https://pjm.com/-/media/library/reports-notices/special-reports/2023/20230717-winter-storm-elliott-event-analysis-and-recommendation-report.ashx.

67 *See id.* at 49.

68 *See* Mays & Macey, *supra* note 64.

69 *See id.*

70 *See id.* Relatedly, compensation policies can also cause resources that do not meet their reliability commitments to be overpaid. Resources that do not meet their performance obligation are charged a penalty. Those that overperform receive additional payment. PJM measures a resource's capacity performance by seeing how the resource performed during Performance Assessment Hours (PAH). PAH occur when PJM declares an Emergency Action, which are situations in which there are locational or system-wide shortages. To calculate non-performance penalties, PJM takes the net cost of new entry (net CONE) and divides by the number of expected performance hours. The problem is that PJM designates too many non-performance hours. As a result, resources that are not available during extreme weather events are still treated as though they meaningfully contribute to resource adequacy. The larger number of PAH that do not reflect genuine scarcity, the more PJM pays resources that have not assured that they will be available during scarcity events. These challenges are not unique to PJM. In the wake of recent winter storms, evidence has emerged that generators in restructured and non-restructured markets do not face sufficiently strong incentives to perform during extreme weather events. *See id.*

71 *See id.* at 9.

72 *See id.*

73 *See id.*

74 *See* PJM, *supra* note 66.

75 *See* Joshua C. Macey & Robert Ward, *MOPR Madness*, 42 Energy L.J. 67, 72–73 (2021).

76 *See* Ethan Howland, *Federal Appeals Court Upholds FERC Action on PJM Capacity Market Rule, Sets Precedent*, Utility Dive (Dec. 4, 2023), *https://www.utilitydive.com/news/appeals-court-ferc-pjm-mopr-p3-epsa/701407/*.

77 *See* Macey & Ward, *supra* note 75, at 72.

78 *See* ERCOT, Reliability-Must-Run Procedures 1 (2016); *See* N.Y. Ind. Sys. Operator, 150 FERC ¶ 61,116, at 1–3 (Feb. 19, 2015), *https://www.ercot.com/files/docs/2016/06/03/OnePager_RMR_May2016_FINAL.pdf*.

79 *See* ISO New England Inc., 180 FERC ¶ 61,181 (2022).

80 *See id.*

81 *See* Letter from Gordon van Welie President & Chief Executive Officer of ISO-NE to New England Senators 2 (Feb. 10, 2023), *in* ISO New England Operating Procedure No. 4 (OP-4), *https://www.iso-ne.com/static-assets/documents/2023/02/combined_storm_elliott_op4_letters.pdf* ("Two primary factors led to the implementation of OP-4 and the capacity scarcity condition that triggered scarcity pricing on December 24. First, generator outages and reductions totaling approximately 2,275 megawatts (MW) occurred across the operating day. Second, net imports to New England were less than the quantity that cleared the Day-Ahead Energy Market (approximately 1,100 MW less at the time OP-4 actions were implemented).").

82 FERC Order No. 719, 125 FERC ¶ 61,071 (2008); FERC Order No. 745, 134 FERC ¶ 61,187 (2011); FERC v. Elec. Power Supply Ass'n, 577 U.S. 260 (2016); FERC Order No. 2222, 172 FERC ¶ 61,247 (2020); FERC Order No. 841, 162 FERC ¶ 61,127 (2018).

83 FERC v. Elec. Power Supply Ass'n, 577 U.S. 260, 279 (2016).

84 Sydney P. Forrester et al., Lawrence Berkeley Nat'l Lab., Regulation of Third Party Aggregation in the MISO and SPP Footprints (Sept. 2023), *https://eta-publications.lbl.gov/sites/default/files/aggregation_in_spp_and_miso_-_lbnl_report_09.27.23.pdf.*

85 Guidehouse Insights, Alternative Aggregated DER Participation Methods for U.S. Grids Are Still Needed 12 (2023).

86 *Id.*

87 FERC Order No. 841, 162 FERC ¶ 61,127 (2018).

88 *See* cites in *supra* note 85. This problem also exists in parts of the country not served by RTOs, where incumbent utility opposition to aggregated demand response is equally strong. *See, e.g.*, Shelley Hudson Robbins, *Commentary: Demand Response Could Have Prevented Blackouts in North Carolina*, Energy News Network (Jan. 3, 2024), *https://energynews.us/2024/01/03/commentary-demand-response-could-have-prevented-blackouts-in-north-carolina/* (discussing lack of demand response resources in North Carolina that resulted in excessive blackouts during Winter Storm Elliott in December 2022 and comparing the amount of demand response in Duke Energy territory with that of PJM).

89 This is called an "opt-in" provision, requiring state utility regulators to choose to allow DERs connected to utilities with annual electric output of 4 million MWh or less to opt into federal wholesale markets. Fact Sheet, *FERC Order No. 2222: A New Day for Distributed Energy Resources*, *https://www.ferc.gov/sites/default/files/2020-09/E-1-facts.pdf*.

90 Order on Compliance Filing, 185 FERC ¶ 61,011 at 151–157 (Oct. 10, 2023), *https://elibrary.ferc.gov/eLibrary/filelist?accession_num=20231010-3046*.

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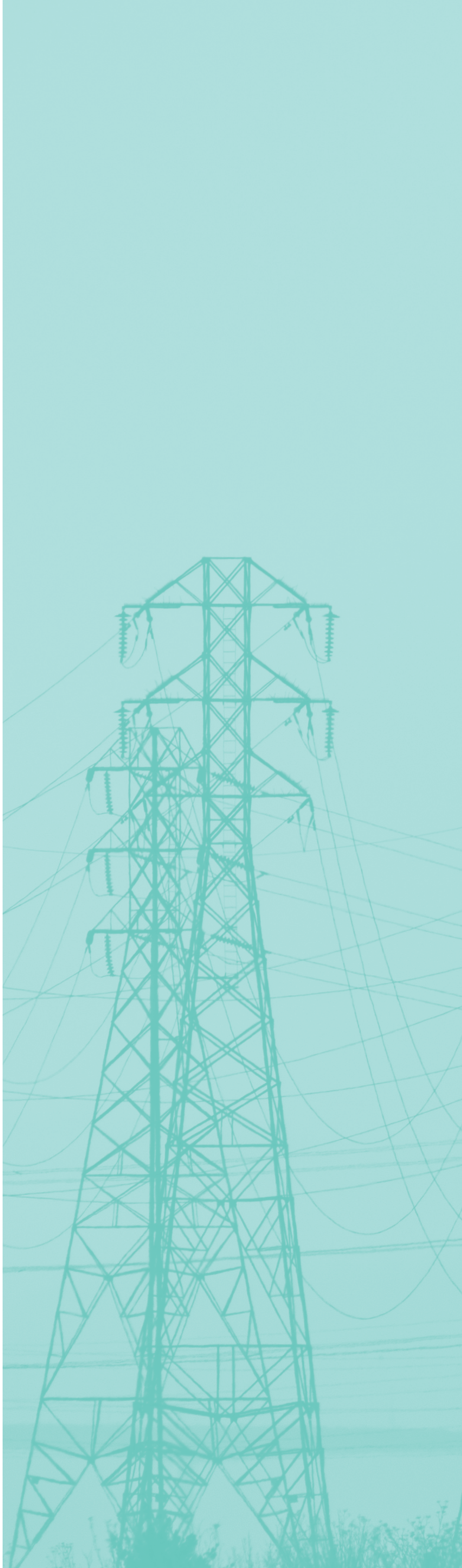

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