No. 20-1530

In The
Supreme Court of the United States

STATE OF WEST VIRGINIA, *et al.*,

Petitioners,

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, *et al.*,

Respondents.

On Writ Of Certiorari To The United States Court Of Appeals For The District Of Columbia Circuit

BRIEF OF *AMICI CURIAE* GRID EXPERTS BENJAMIN F. HOBBS, BRENDAN KIRBY, KENNETH J. LUTZ, AND JAMES D. MCCALLEY IN SUPPORT OF RESPONDENTS

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STATEMENT OF INTEREST[1]

Amici are among the nation's leading engineers with expertise in the operation, structure, economics, and reliability of the U.S. power system. They have expertise in grid structure, operations, economics, and modernization; integration of renewable energy generation; and power-system reliability and planning. *Amici* have a significant interest in the efficient functioning and regulation of the grid. To aid the Court's understanding of the technical matters at issue in this case, this brief clarifies how and why the grids are designed and operated as they are; the implications of the grids' unique features for pollution controls; and how pollution controls generally interact with grid operations and the industry.

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SUMMARY OF ARGUMENT

Effective air pollution controls for the U.S. power sector work with the interconnected design and operation of the U.S. electric grids. When regulating carbon dioxide, just as when regulating any other air pollutant in this sector, the U.S. Environmental Protection Agency ("EPA") must give appropriate consideration to grid design and operation. Fundamental characteristics of the electric grids mean that in response to any air pollution control measure, operators may shift power generation from higher-emitting to lower-emitting sources, a result known as "generation shifting." Generation shifting is an ordinary consequence of workaday pollution-control rules.

Recognizing this, regulators designing the Clean Power Plan went a step further: They calibrated that rule's emission limitations in reliance on an achievable, and significant, degree of generation shifting. A key issue in this case is whether the Clean Air Act

("Act") authorizes regulators to take that approach. However that legal question is resolved, grid engineers and operators understand that any pollution control measure may lead to generation shifts, for reasons described below. Moreover, pollution control measures for carbon dioxide ("CO_2"), as for other air pollutants, are incorporated easily into grid workings and change nothing about the fundamentals of the sector.

Engineers have declared the U.S. power system as the largest, "most complex machine ever made." Phillip F. Schewe, *The Grid: A Journey Through the Heart of Our Electrified World* 1 (2007); *see also* Mass. Inst. of Tech., *The Future of the Electric Grid* 1 (2011). Every electric generator in the continental United States is embedded within one of three regional grids and linked to other generators and consumers through transmission and distribution lines. Each grid operates as a single integrated machine. The fundamental purpose of each machine's interconnectedness is to allow grid operators to continuously balance electricity supply and demand in real time, over vast regions, thus ensuring all consumers access to affordable and reliable power. This feat is accomplished through orchestrated, second-by-second shifts among different generators, facilitated by the grids' physical structure and design and by complex dispatch software and regional spot electricity markets. The use of any individual generator is thus dependent on the performance of other components of the machine.

Amici emphasize three key points:

***First*, effective power-sector emission controls reflect grid operations, which are defined**

by fundamental characteristics of electricity and of the infrastructure and markets that connect and coordinate power generation and demand. The power sector has distinctive operational features that create both opportunities and challenges for pollution control, and EPA must account for these features in determining the Best System of Emission Reduction ("BSER") under Section 111(d) of the Act. For example, a defining feature of the three regional grids is that each operates as a single, interconnected machine. Governance frameworks for the dispatch of electricity are designed to facilitate seamless shifts among generators to ensure affordable, reliable electricity. For these reasons, the most effective and least costly CO_2 pollution control measures for the power sector allow for shifting of generation to lower-emitting generators. The approach taken in the Clean Power Plan ("CPP") accomplished this by including shifts from higher-emitting to lower-emitting generators as part of its definition of the Best System of Emission Reduction. *See* 80 Fed. Reg. 64,662, 64,717 (Oct. 23, 2015), J.A. 273–1445, *rescinded by* "Repeal of the Clean Power Plan; Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guidelines Implementing Regulations," 84 Fed. Reg. 32,520 (Jul. 8, 2019), J.A. 1725–2030 ("Rule" or "ACE Rule"). In other words, EPA relied on generation shifting in defining the BSER and in setting the Clean Power Plan's required degree of emission-reduction stringency.

***Second*, any air pollution standard applied to the power sector may induce generation-shifting effects, even if it is not designed—as the Clean Power Plan was—in reliance on such shifts.** All power-sector environmental regulation may affect operating costs or constrain operation of regulated entities. Given the interconnected nature of the power grid, this may cause dispatch to shift to units whose relative costs decrease. Regulators have long incorporated this feature of grid operations into the design of pollution controls to minimize costs of compliance. Generation shifting is an ordinary consequence of all power-sector pollution controls. Moreover, industry experts understand that the easiest, cheapest, and best way to reduce CO_2 emissions from coal-fired power plants is to shift generation away from those plants and toward cleaner sources of energy.

***Third*, pollution control measures blend seamlessly into power-sector operations and change nothing about the fundamentals of the sector.** Pollution control measures are business-as-usual for this industry and are incorporated easily into grid workings and dispatch. This is as true for CO_2 as for other air pollutants: Regulating CO_2 pollution from the power sector reduces harms to human health without significantly affecting grid operations or risking reliability. Because renewable sources of power are now cheaper than or cost-competitive with fossil fuel generation, regulation of power-sector CO_2 emissions builds on existing energy-sector trends in a way that reinforces, rather than disrupts, longstanding industry practices.

ARGUMENT

I. Effective Power-Sector Pollution Controls Work with the Distinctive Characteristics of Electricity and the Interconnectedness of the Regional Grids.

The fungible nature of electricity and the need to instantaneously and continuously balance supply and demand in real time have driven the design of the world's most "complex machine"—the U.S. power system. Schewe at 1. Every generator in the continental United States is embedded within one of three regional, interconnected electric grids. To ensure that consumers receive reliable, affordable power that meets environmental standards, each grid is designed and operated specifically to facilitate, within its respective region, shifts among different generators. Shifting among generators is both unique to the power sector and an essential, routine feature of grid operations. Regulators have long harnessed these shifts as an efficient tool to reduce power-sector air pollution.

A. Electricity Is a Uniquely Fungible and "Real-Time" Good.

Electricity has two fundamental distinguishing features. First, electricity is fungible. In the continental United States, "any electricity that enters the grid immediately becomes a part of a vast pool of energy that is constantly moving in interstate commerce." *New York v. Fed. Energy Regulatory Comm'n*, 535 U.S. 1, 7 (2002). Electricity moves across the grid according to the laws of physics, following the path of least resistance. It cannot be directed (like an e-mail or package) to a particular recipient.

Second-by-second variation in withdrawals of electricity (demand) is balanced by injections of electricity from generators connected to the grid (supply), by responding to the frequency variation that those imbalances cause. The frequency is analogous to the water level in a swimming pool fed by many spigots located around the pool's edges. When the water level (frequency) increases, the water supply (generation) decreases, and vice versa. All spigots have the same effect on maintaining a constant water level, independent of their location around the pool (grid). For example, "If [someone] in Atlanta on the Georgia system turns on a light, every generator on Florida's system almost instantly is caused to produce some quantity of additional electric energy which serves to maintain the balance in the interconnected system." *Fed. Power Comm'n v. Fla. Power & Light Co.*, 404 U.S. 453, 460 (1972) (citation omitted).

Electricity that is added to the grid energizes the entire grid. Generators do not "generate" electrons and consumers do not "consume" electrons, as is commonly believed—electric power is injected into and withdrawn from the grid. An electromagnetic wave, propagated by generators, moves at the speed of light along wires. Electrons in an alternating current network merely move back and forth at a frequency of sixty cycles per second. Because all electricity within a grid is pooled, the electric power added by any single generator becomes part of this undifferentiated supply. As with water added to a pool, consumers cannot distinguish coal-generated power from solar-generated power once it is injected into the grid.

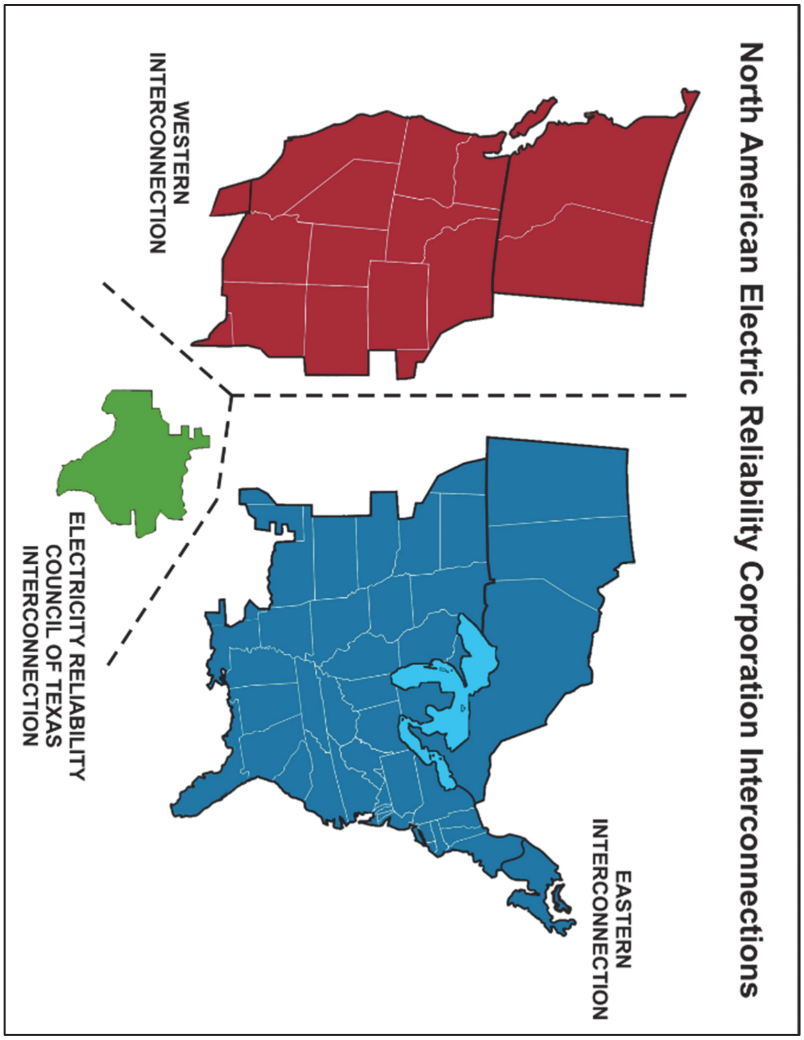
The second distinctive feature of electricity is that it is only beginning to be able to be stored economically on a large scale. The present difficulty of storing large amounts of electricity means generation (supply) and load (demand) must continuously and precisely be balanced. This makes electricity the ultimate "just-in-time" product. *See* Paul L. Joskow, *Creating a Smarter U.S. Electricity Grid*, 26 J. Econ. Persp. 29, 33 (2012); *but see* Energy Info. Admin., *U.S. Battery Storage Market Trends* 4 (2018) (noting rapid advances in energy storage technology that may someday overcome this hurdle). As battery technology advances and costs decline, utilities are gaining greater experience with energy storage, enabling higher penetrations of wind and solar generation and enhancing reliable operations with reduced fossil-fueled generation.

B. Each of the Three Regional Grids Operates as a Single Machine.

The infrastructure necessary to balance supply and demand distinguishes the power system from any other industry or supply chain. Its defining feature is interconnection. Each of the three regional grids, or "interconnections"—Eastern, Western, and Texas—operates as a single, synchronized machine.[2]

[2] Hawaii and Alaska have their own grids.

Figure 1. U.S. Power-System Interconnections[3]



[3] U.S. Dep't of Energy, *North American Electric Reliability Corporation Interconnections*, https://www.energy.gov/oe/downloads/north-american-electric-reliability-corporation-interconnections.

Each of the grids consists of three components essential to delivering reliable and cost-effective power to consumers: generation, transmission, and distribution. *First*, a diverse set of generators converts primary energy (such as coal, sunlight, or wind) into electricity. *Second*, within each grid, a giant network of high-voltage transmission lines allows power to flow where it is needed, sometimes over hundreds or even thousands of miles. The transmission network is crucial because many generators are located far from population centers. The transmission network also facilitates system reliability: If one line goes down, electricity can flow through alternate routes; when a generator fails, other generators can pick up the load smoothly without a power interruption. *Third*, local substations receive electricity from high-voltage transmission lines and lower the voltage for delivery to consumers via local distribution networks.

Grid interconnectedness is a product of history. The first power plants constructed in the late 1800s initially served only a small set of local customers. Backup generators maintained reliability. Local systems gradually consolidated to reduce costs and improve reliability. Consolidation required local systems to become interconnected through transmission lines. Networks continued to grow, ultimately giving rise to the three interconnections. 80 Fed. Reg. at 64,690–92, J.A. 401–13.

Today, each of the three interconnections is highly coordinated to maintain reliability. The balancing of generation and load must be virtually instantaneous across each interconnection, such that the amount of power dispatched to the grid is identical to the amount withdrawn for end uses in real time. Like orchestra conductors signaling entrances and cut-offs, grid operators use automated systems to signal particular generators to dispatch more or less power to the grid as needed over the course of the day, thus ensuring that power pooled on the grid rises and falls to meet changing demand.

As components of an integrated machine, each generator is interdependent with every other generator, and routine operations are coordinated by grid operators. Because the performance and usage of their units depends on the operation of other units outside their control, power companies regularly coordinate with each other to plan new investments, plan unit retirements, and balance their respective systems—for example, through joint dispatch arrangements (which pool the generation sources of multiple utilities to reduce operating costs and increase reliability), joint power-plant ownership agreements, bilateral power purchase agreements, and short-term balancing transactions. As this Court has recognized, "generating facilities cannot be maintained on the basis of a constant demand." *Gainesville Util. Dep't v. Fla. Power Corp.*, 402 U.S. 515, 518 (1971). Coordinated planning is critical to ensure there is always adequate generation to meet expected regional demand, plus additional capacity in case generators fail during times of peak demand. *Id*.

C. Dispatch Governance Frameworks Are Designed to Facilitate Shifts Among Generators and Ensure Affordable, Reliable Electricity.

Regional energy governance frameworks keep the "complex machine" operating reliably. Although governance differs within and across the three interconnections, the standard approach all grid operators use to dispatch generation is called "Security Constrained Unit Commitment and Economic Least-Cost Dispatch" (hereinafter "Constrained Least-Cost Dispatch" for brevity). As its name implies, Constrained Least-Cost Dispatch deploys generators with the lowest variable costs first, as system operational limits allow, until all demand is satisfied. Constraints that grid operators routinely consider include transmission limits, generators' physical constraints, and environmental standards.

In competitive wholesale markets, which govern about two-thirds of the power sector, federally regulated entities called Independent System Operators ("ISOs") or Regional Transmission Organizations ("RTOs") use a series of auctions to match generation and load. Generators bid into a regional market with a price at which they are willing to sell electricity during specified periods, and the ISO/RTO ranks bids according to Constrained Least-Cost Dispatch principles. In traditional cost-of-service states outside of ISOs/RTOs, utilities use generators' marginal costs, rather than bid prices, to determine dispatch order. In these ways, Constrained

Least-Cost Dispatch principles guide all dispatch planning across the country.

Dispatch and the necessary planning for it occur on multiple scales—yearly, seasonally, monthly, weekly, daily, hourly, and five-minute intervals—as grid operators respond to variable supply, demand, and operational constraints by managing shifts among different generators. In both organized markets and traditional cost-of-service regimes, renewable energy generators typically receive dispatch priority because they have lower variable costs than fossil-fuel-fired generators, which must purchase fuel. 80 Fed. Reg. at 64,693, J.A. 413–15.

Power companies recognize that their units are subject to Constrained Least-Cost Dispatch and have long planned their operations and investments accordingly. Power companies routinely execute contracts to purchase power from third-party generators; invest in demand-side energy efficiency programs; invest in battery storage facilities; and, as existing units retire, invest in more efficient and cost-competitive generation facilities, such as natural gas and renewable sources, to compete for dispatch priority.

II. Power Companies and Grid Operators Have Historically Responded to Air Pollution Controls by Shifting to Lower-Emitting Generators.

Because electricity is a unique good that requires each regional grid to operate synchronously, the power sector is designed to allow constant, real-time shifting among generators to maintain a balanced grid. These distinctive characteristics of the power grid mean that pollution controls for the power sector can easily lead to shifts to lower-emitting sources of power.

Among pollution control measures that result in such generation shifts, an important distinction exists between those that affect dispatch order only incidentally, by affecting relative costs—which nearly all pollution control measures do—and the Clean Power Plan, which determined its degree of emission limitation in reliance on generation shifting, built into its definition of the Best System of Emission Reduction.

A. Air Pollution Control Measures Ordinarily Affect Dispatch Order, Causing Generation Shifting.

All power-sector environmental regulations impact dispatch, either by increasing or decreasing the relative operating costs of affected sources or by constraining their operations. Because grid operators in both organized markets and traditional cost-of-service regimes employ Constrained Least-Cost Dispatch principles, a unit that experiences a cost increase or operational constraint will tend to operate less often, while units whose costs decrease will be dispatched more. Existing pollution regulations already affect the dispatch competitiveness of fossil-fuel-fired power plants. Under Constrained Least-Cost Dispatch, fuel costs and other costs are treated identically; the cheapest overall generation, once variable costs are accounted for, is used.

Effective air pollution controls account for and utilize this tendency toward generation shifting. Congress, EPA, and state regulators have long recognized that a systemwide approach to reducing pollution works most efficiently with grid operations. They have accordingly harnessed shifts among generators as an economical tool to reduce harmful air emissions.

One highly-regarded example of a pollution control program that resulted in generation shifting is the Clean Air Act's Acid Rain Program, which set a nationwide cap on sulfur dioxide emissions from fossil-fuel-fired generators and required affected generators to hold a tradable allowance for each ton of sulfur dioxide emitted. 42 U.S.C. §§ 7651–7651o; *see also* Emanuele Massetti et al., Oak Ridge Nat'l Lab., *Environmental Quality and the U.S. Power Sector: Air Quality, Water Quality, Land Use and Environmental Justice* 20 (2017). The allowance requirement increased the costs of regulated units, which decreased the dispatch competitiveness of those units and led some to reduce their generation. That, in turn, led grid operators to dispatch cheaper, less-polluting generators to meet consumer demand. Industry quickly recognized that incorporating allowance costs into dispatch planning was cost-effective and did not disrupt power reliability or normal grid operations. *See* Thomas M. Jackson et al., *Evaluating Soft Strategies for Clean-Air Compliance*, 6 IEEE, Computer Applications in Power 46 (1993).

Industry was thus empowered to achieve the program's emissions targets, in part, through generation shifting.

The Regional Greenhouse Gas Initiative ("RGGI") provides an example of these dynamics at work to control carbon dioxide. RGGI is a cap-and-trade program for power-sector CO_2 pollution in eleven northeast and mid-Atlantic states. The participating states span three ISOs/RTOs, all of which have been able to integrate the price of carbon allowances into their dispatch methods with ease. Affected sources simply incorporate the cost of carbon allowances into their auction bids. This generally prompts grid operators to deploy lower-cost sources, such as renewable sources, first. *See, e.g.*, Paul Hibbard et al., *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States* 6 (2018).

In these varied ways, air pollution regulators have long crafted emission programs that leverage the integrated operations of the grid to lower compliance costs, and that induce a degree of generation shifting in response to pollution control measures.

B. The Clean Power Plan Went Further by Embedding Generation Shifting in its Definition of the Best System of Emission Reduction.

While successful pollution control programs have often induced generation shifting to reduce emissions from regulated sources, the CPP took the next logical step: It identified the emissions reductions that could be achieved by regulated sources in each state based, in part, on gains from generation shifting. It did this by defining the Best System of Emission Reduction to include reductions in coal generation and increasing natural gas and renewable energy generation, relying on the interconnected workings of the grids. *See* 80 Fed. Reg. 64,662, 64,717, J.A. 273, 529–30. In other words, it built an assumption of generation-shifting into its calculation of achievable—and required—gains.

The result was a flexible, cost-effective regulation with lower emission limits than might otherwise have been set. The approach embraced by the CPP leverages the grids' interconnected, synchronous operation to allow for meaningful—and very cost-effective—cuts in emissions from the sources it regulated.[4] *See* ICF Int'l, Inc., *Assessing Effects on the Power Sector of Greenhouse Gas Emission Standards* at 3, 5, 7 (Oct. 31, 2018) (showing that a regulatory design relying on generation shifting, emissions trading, and reduced utilization would cause an additional 18–27% reduction in CO_2 emissions by 2030, at low per-ton abatement cost). By recognizing that the grid operates as a single

[4] This is not to say that the CPP mandated specific forms of compliance. On the contrary, the rule was designed to promote state flexibility in meeting its standards. Compliance options to meet state emission-reduction targets were plentiful and were well-matched to grid operations. Regulated sources could reduce emissions through a mix of generation shifting, reduced utilization, emissions trading, heat rate improvements, and other measures. *See* 80 Fed. Reg. at 64,666–67, J.A. 297–300.

integrated machine and by encouraging generation shifting rather than costly source-specific reductions, the CPP capitalized upon the unique features of the grid to reduce emissions.

By contrast, the ACE Rule excluded emission-reduction measures that take advantage of grid operations and interconnectedness, such as generation shifting. In defining the Best System of Emission Reduction in the Rule, EPA looked only to certain measures that can be "applied at and to" individual coal-fired units and settled on a definition that included only certain changes to the physical equipment and processes of generators, specifically, heat-rate improvements at coal-fired power plants. Rule at 32,532, 32,536, J.A. 1787, 1802–03. The Rule excluded many of the pollution-control measures that experts know to be the most effective at reducing emissions from coal unit operations, rejecting, for example, natural-gas co-firing, decreased utilization of the highest-emitting units, and generation shifting. *Id.* at 32,532, 32,543, J.A. 1787, 1836–37. In this way, the Rule failed to enable the emissions reductions possible by leveraging grid interconnectivity against CO_2 pollution.

Moreover, the ACE Rule adopted only those measures that reduce an individual facility's *rate* of emissions—that is, its emission of CO_2 per unit of electricity produced—and failed to credit measures that would reduce a facility's total emissions without necessarily affecting rate, such as reduced utilization. Rule at 32,555, J.A. 1890–92. Notably, a facility that improves its rate of emissions can still increase its total emissions in aggregate, simply by operating more. *Id.* at 32,542–43, J.A. 1833–36.

The consequence of the overly-narrow approach adopted in the ACE Rule—which excluded even some measures that can be accomplished on-site, like reduced utilization—was a rule that barely moved the needle on CO_2 pollution and that left health benefits worth billions of dollars unrealized. *See* EPA, *Regulatory Impact Analysis* ES-6 (2019) ("Final RIA") (projecting that the ACE Rule would result in less than a percentage point in additional CO_2 emissions reductions by 2030); *see* ICF Int'l, Inc. at 6 fig. 6 (showing that a CPP-style regulatory approach would achieve an order of magnitude greater emissions reductions than the reductions projected under the ACE rule); *see* 83 Fed. Reg. 44,746, 44,790 tbl. 14 (Aug. 31, 2018) (conceding that repealing the CPP in favor of the ACE Rule would significantly increase co-pollutants and inflict several billion dollars in health damages).

C. To Reduce Power-Sector CO_2 At Lower Cost, Regulated Entities and States Should Have The Flexibility to Employ Off-Site Measures.

Because the power sector responds to pollution controls with dispatch shifts regardless of rule design whenever those controls alter the relative costs of sources (as they almost always do), excluding generation shifting from power-sector regulation does not mean that shifting will not occur; it simply won't be captured and used by regulators to craft a cheaper, more effective rule. For these reasons, a "best" system of emission reduction for this sector will often be one that allows for measures such as generation shifting.

But even if this Court concludes that the Act does not permit EPA to rely on generation shifting in defining the BSER here—an outcome we would strongly disfavor—it should segregate that determination from questions of allowable compliance with CO_2 pollution-control measures. To reduce CO_2 from the power sector, it would be nonsensical to limit power-plant operators to using only site-constrained approaches, when grids operate as integrated machines.[5] Excluding generation shifting from CO_2 pollution control regimes would result in more expensive, less effective, and less flexible regulation.

A hypothetical illustrates why. Consider a coal-fired power plant ("Plant-A") that is subject to a CO_2 pollution control measure and that installs solar panels as part of its facility. By generating power with both

[5] Such an approach would be reminiscent of a previously rejected approach to controlling sulfur dioxide from power plants. In the debates over the 1990 Clean Air Act amendments, some had suggested that only site-specific "scrubbers" be used to control SO_2, in lieu of the Acid Rain Program's more flexible approach that allows for substituting lower-emitting units for higher-emitting units. History has since shown that the more flexible approach is a superior way to control pollution without endangering reliability. *See* Paul L. Joskow et al., *The Market for Sulfur Dioxide Emissions*, 4 Am. Econ. Rev. 669, 683 (1998). The rejected site-specific approach would have been significantly less effective and more expensive. *See id.* at 669–70.

its solar panels and coal-fired boiler, Plant-A can lower its CO_2 emissions rate (emissions per megawatt-hour). Plant-A can continue to produce the same amount of power by shifting some of its generation from coal to solar, thereby reducing the numerator of its emissions rate. Or, Plant-A can increase its annual output by adding solar to its coal generation, thereby increasing the emissions-rate denominator. In either case, Plant-A has installed a compliance mechanism that "can be applied at and to a stationary source (i.e., as opposed to off-site measures)" and "lead[s] to continuous emission reductions." Rule at 32,534, J.A. 1796.

Now, imagine that Plant-A instead installs solar panels on a field located next to its coal unit. The emissions rate result is the same. Likewise, the same emissions rate would result from solar panels instead installed several miles away. Regardless of where the solar panels are located, Plant-A would rely on the same regional network of transmission lines to pool power generated by the solar panels on the grid. From the perspective of regulators, consumers, grid operators, and EPA, it is irrelevant whether the solar panels that reduce Plant-A's emission rate are located on Plant-A's rooftop or in the next state over. From the perspective of Plant-A's owner, it is far more desirable to install solar panels in the most cost-effective location, whether or not that location is within the plant.

In promulgating the ACE Rule, EPA took account of none of these possible approaches, the consequence of which was to leave low-hanging emission reduction fruit unharvested. Furthermore, none of these approaches was allowable as a compliance method under the Rule (save perhaps the on-site panels, about which the Rule is ambiguous). Rule at 32,555, J.A. 1890–92. The effect of this was to reduce industry's flexibility in choosing low-cost emission reduction strategies.

No coal-fired unit operates by itself. Each is a piece of a power plant that, in turn, is part of the grid. It would be unreasonable and unduly costly to exclude generation shifting from CO_2 pollution-control strategies when regulated units, like all generators, are part of one big machine that delivers undifferentiated power to a unitary grid.

III. CO_2 Pollution Control Measures Are Incorporated Easily Into Power-Sector Operations.

Regulating CO_2 pollution from the power sector alleviates harms to human health without harming grid operations or reliability. Such regulation builds on existing trends and reinforces, rather than disrupts, longstanding industry practices.

A. U.S. Power Sector Is Shifting Toward Cleaner Energy Sources.

The U.S. power sector is shifting from coal-fired plants to lower- and zero-carbon sources like natural gas, wind, and solar. Successful regulation and market forces have driven large reductions in power-sector CO_2 emissions. In 2017 and 2018, the U.S. power sector emitted 30% less CO_2 compared to 2005 levels. Final RIA at 2–14.

In particular, the power sector has shifted generation away from coal and will continue to do so. By 2025, the average age of coal-fired units is projected to be 49 years old, with 20% of units older than 60—well beyond their expected operating life of 40 years. *See* 80 Fed. Reg. at 64,694, 64,872, J.A. 352, 1248; *see also* Rule at 32,548 n.215, J.A. 1859 n.215. As coal plants age, they become more expensive compared to newer units. Final RIA at 2–7. Natural gas prices, meanwhile, are low because of abundant supply, while renewable energy costs have plunged because of improving technology and government policy incentives. *Id.* at 2–11. The falling price of renewable energy has been particularly dramatic: The cost of building and operating new solar and wind projects is now cheaper than the cost of continuing to operate many coal-fired units. *Id.* These market forces are pushing coal-fired plants offline, replacing them with cleaner energy resources. *See id.* at 2–7. Increasingly, as battery costs decline, utilities are deploying batteries in combination with wind and solar generation, which can provide so-called firm power to balance the grid and replace the need for certain gas-fired plants.

Strikingly, the Clean Power Plan's goal of reducing carbon dioxide emissions to 32% below 2005 levels by 2030 had already been exceeded by the end of 2019—notwithstanding that the CPP never went into effect. *See* Environmental Integrity Project, *Greenhouse Gases from Power Plants 2005-2020: Rapid Decline Exceeded*

Goals of EPA Clean Power Plan (2021). Much of this decrease is attributable to the country's shift to renewable energy and natural gas rather than coal as a source of electricity. *See id.* at 3. That the sector has moved as quickly as it has toward low-emission and renewable energy sources, even without the CPP's implementation, shows the modest influence of CO_2 pollution control measures in comparison to other sectoral forces at play.

Yet despite progress made to date, the U.S. power sector remains a significant source of CO_2 emissions endangering public health and welfare. In 2018, it emitted more than a quarter of total annual U.S. greenhouse gas emissions. *See* EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019* ES-5 fig. ES-1, 2–3 tbl. 2–1 (2021). And progress limiting U.S. power-sector emissions may be slowing or halting: Annual emissions in 2018 increased by 1.2%. EPA, *Inventory of U.S. Greenhouse Gas Emissions* at ES-7, tbl. ES-2. It is therefore sensible and consistent with industry trends and operations for EPA to aim to reduce CO_2 pollutants from regulated sources by building on the last decade's power-sector shifts. The easiest, cheapest, and least disruptive method for reducing emissions from coal-fired power plants is to continue the shift in generation away from those plants toward cleaner sources.

B. Propping Up Coal Is Unnecessary for Grid Reliability.

In particular, generation shifting away from coal would not harm grid reliability. Despite a large number of coal retirements in recent years, grid-wide indicators for reliability have been "adequate for all interconnections and generally trending in a positive direction." N. Am. Elec. Reliability Corp., *2021 Long-Term Reliability Assessment* 36 (2021). Even in those limited areas where anticipated capacity reserves begin to fall after 2024, *see id.* at 12, the changing energy mix requires new and flexible grid operation strategies to promote reliability and meet operational needs, not artificial lifelines for coal-fired resources. *See id.* at 9–10, 22.

The Department of Energy has found that, despite coal retirements, "markets have achieved reliable wholesale electricity delivery." U.S. Dep't of Energy, *Staff Report to the Secretary on Electricity Markets and Reliability* 10 (2017) ("Staff Report"). Independent market analysis has also found that "the diverse US power supply portfolio has proven resilient to significant deviations from normal operating conditions." IHS Markit, *Ensuring Resilient and Efficient Electricity Generation* 4 (2017). Coal-fired power, furthermore, is no cure-all for reliability concerns. For example, the 2014 Polar Vortex froze coal piles solid, leaving many coal plants inoperable during a surge in energy demand. *Staff Report* at 98.

In fact, renewable sources can help *improve* reliability in some circumstances. Wind and solar can provide stability to the system by quickly detecting frequency deviations and responding to system imbalances faster than conventional generators, decreasing the need for inertia, the tendency for conventional generators and motors to continue spinning during power failure. *See, e.g.*, Nat'l Renewable Energy Lab., *Inertia and the Power Grid: A Guide Without the Spin* v-vi (2020). For instance, wind generation was key in maintaining service in the northeast and mid-Atlantic during the 2014 Polar Vortex, when demand spiked to one of the highest winter peaks in regional history. Analysis Grp., *Electric System Reliability and EPA's Clean Power Plan: The Case of PJM* 3, 12 (2015).

It is true that the availability of renewable energy is more variable than other types of generation, leading system operators to maintain generation reserves that provide back-up when renewable energy is unavailable. The U.S. power sector has successfully managed large amounts of renewable power in this manner, and technical studies have concluded the sector is capable of integrating even more without significant reliability impacts. *See, e.g.*, Nat'l Renewable Energy Lab., *Eastern Renewable Generation Integration Study* xvii (2016) (concluding that the U.S. Eastern Interconnection can accommodate upwards of 30% wind and solar photovoltaic generation); Elec. Reliability Council of Tex., *2018 State of the Grid* 2, 4 (2018) (reporting Texas's electricity grid was "operating effectively and efficiently" with about 19% energy provided by wind sources); GE Energy Consulting, *PJM Renewable Integration Study: Executive Summary Report* 6–7 (2014) (finding that the RTO PJM could operate with up to 30% of generation from wind and solar with no significant harm to reliability). By contrast, we know of no good evidence to support the idea that propping up coal generation is necessary for grid reliability.

CONCLUSION

The judgment of the U.S. Court of Appeals for the District of Columbia Circuit should be affirmed.

Respectfully submitted,

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January 25, 2022