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Environmental Protection Agency
EPA Docket Center (EPA/DC)
Mail Code 28221T
Attention Docket ID No. EPA-HQ-OAR-2017-0355
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Comment by Electricity Grid Experts Benjamin F. Hobbs, Brendan Kirby, Kenneth J. Lutz, James D. McCalley, and Brian Parsons on Docket ID No. EPA–HQ–OAR–2017–0355, Proposed Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units

We submit this comment letter with and on behalf of a group of nationally renowned experts on the operations of the U.S. electric grids, in response to the recent proposal by the U.S. Environmental Protection Agency ("EPA") to repeal the Clean Power Plan. We write in firm opposition to EPA's proposal to repeal the Clean Power Plan, for reasons outlined below. EPA's proposed approach to regulating greenhouse gas emissions from the power sector would, if finalized, result in costlier, less efficient, less reliable electric grids.

In its repeal proposal, EPA cites concerns about "serious economic and political implications" that might ensue from implementation of the Clean Power Plan. *Repeal of the Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units*, 82 Fed Reg. 48,035 at 48,042 (proposed Oct. 16, 2017). In particular, EPA expresses concern that the Clean Power Plan encourages shifting between different types of electricity generation and argues that any replacement rule must rely, instead, only on "measures that can be applied to or at the source." 82 Fed. Reg. at 48,039. The EPA has invited comment on the policy implications of its proposed repeal. *Id.*

It is our position that the Clean Power Plan, 80 Fed. Reg. 64,662 (Oct. 23, 2015)("CPP") respects and harnesses what grid experts recognize as the defining feature of the U.S. electric grids: their operation as a single interconnected synchronous system. We also believe that an alternative rule of the sort that EPA seems to contemplate, focused only on a subset of measures that can be applied to sources on-site, would be less cost-effective than the Clean Power Plan. Such an alternative rule would also fail to avoid many of the (in our view, unwarranted) concerns that EPA now expresses about the CPP. Any such rule would still lead to shifts in generation, as utilities work to comply with new regulations or adjust for the altered relative costs of different generating sources.

Collectively and individually, we have decades of experience and significant expertise in this area.[1] In this comment letter, we support our opposition to the proposed repeal with information about (1) how the interconnected electric grids work and how effective pollution controls acknowledge their distinctive characteristics; (2) how the CPP utilizes the physical features of the interconnected grids to ensure efficient compliance and continued reliability; and (3) why repealing the CPP and constraining future regulation to standards applied on or at individual sources would be a mistake resulting in costlier, less efficient regulation.

Limiting the CPP to a site-constrained approach in developing pollution controls would make neither technical nor economic sense for grids, which operate as integrated machines.[2] The power sector uses generation shifting to respond to changes in reliability, economics, and equipment/ facility objectives, in addition to pollution regulations. When it formulated the CPP, EPA correctly recognized that the power sector responds to pollution controls by shifting generation among sources. EPA should continue to do so.

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[1] Signatories of this letter include Benjamin F. Hobbs, Brendan Kirby, Kenneth J. Lutz, James D. McCalley, and Brian Parsons. These signatories have expertise in the structure, operation, and economics of the U.S. power system; integration of low- and zero-carbon generation sources into the power system; power-system reliability and planning; and electric grid modernization. Benjamin Hobbs is the Theodore M. and Kay W. Schad Professor in Environmental Management at Johns Hopkins University; his research focuses on electric power and energy market planning, risk analysis, and environmental and energy systems analysis and economics. Brendan Kirby is a private consultant with clients including the Hawaii Public Utilities Commission, National Renewable Energy Laboratory, and others. He has forty-one years of electric grid experience and has published over 180 papers, articles, book chapters, and reports on power system reliability and on integrating renewables into the grid. Kenneth J. Lutz is an Adjunct professor at University of Delaware, where he teaches a specially designed course on the smart grid. He has decades of experience in the regulation of utilities. James D. McCalley is the London Professor of Power System Engineering at Iowa State University. He is the author of over 230 publications in electric power systems engineering; his areas of research include: transmission planning, power-system security, power-system dynamics, wind energy, long-term investment planning for energy and transportation systems at the national level, and power-system decision problems under uncertainty. Brian Parsons worked at the National Renewable Energy Laboratory for over three decades on topics including power technology development, systems analysis, and grid integration of renewable energy. Each of these experts has an interest in the integrity and reliability of electricity infrastructure, and the efficiency of its management and regulation. Their credentials are outlined more fully in the Appendix to this letter ("App.") at Exhibit 1.

[2] History has shown that including the cost of allowances in dispatch, and substituting lower-emitting units for higher-emitting units, is an efficient way to control pollution without endangering reliability. *See Prepared Testimony on Acid Rain Special Topic Information Before the Pub. Util. Comm'n of Ohio* (Sept. 28, 1990) (testimony of Benjamin F. Hobbs on behalf of Ohio Consumers' Counsel), *available at* http://tinyurl.com/zs7q5g9.

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

The CPP was developed to work with, rather than fight against, fundamental characteristics of the power sector. The rule itself specifically recognizes and responds to the structure and operations of the regional grids. 80 Fed. Reg. at 64,665 ("The first [objective] was to establish guidelines that reflect both the unique interconnected and interdependent manner in which the power system operates and the actions, strategies, and policies states and utilities have already been undertaking that are resulting in CO2 emission reductions."). It is important, therefore, to understand these grid characteristics when considering any proposal to substantially alter the CPP. EPA's current proposal to repeal the CPP does not discuss these fundamentals, so we emphasize them here.

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. PHILLIP F. SCHEWE, THE GRID: A JOURNEY THROUGH THE HEART OF OUR ELECTRIFIED WORLD 1 (2007). 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 most of the 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). Energy must be pooled because it cannot be directed (like an e-mail or letter) to a particular recipient.

Second-by-second variation in demand is balanced by all generators in the grid, independent of the location of the generators, 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 supply 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). In other words, "[i]f [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. Florida Power & Light Co.*, 404 U.S. 453, 460 (1972) (citation omitted).

Electricity that generators add 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 60 cycles per second. Because all electricity within a grid is pooled, the electric power that any single generator adds becomes part of an undifferentiated stream. As with water added to a pool, consumers cannot distinguish coal-generated power from wind-turbine-generated power once it is injected into the grid.

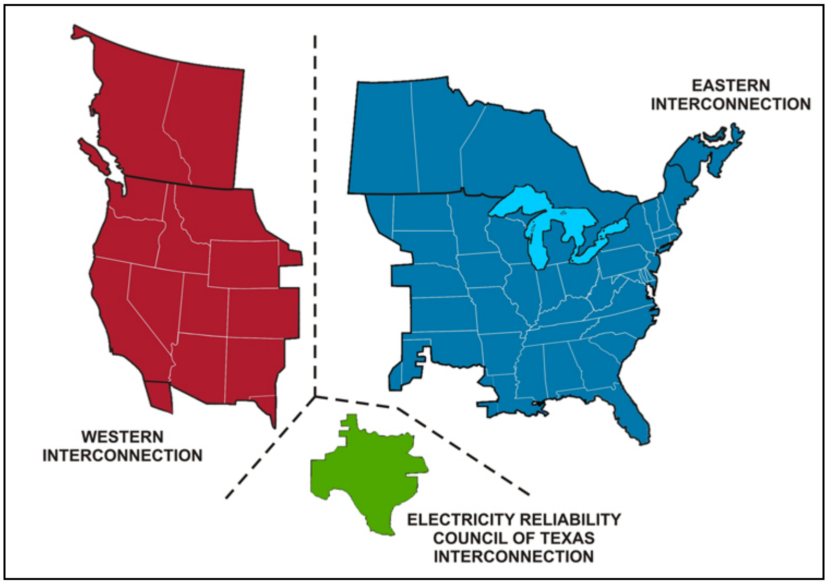
The second elemental feature of electricity is that it cannot easily or economically be stored on a large scale with current technology. The inability to store large amounts of electricity means generation (supply) and load (demand) must continuously and precisely be balanced. This makes electricity the ultimate "real-time" product. *See* Paul L. Joskow, *Creating a Smarter U.S. Electricity Grid*, 26 J. ECON. PERSP. 29, 33 (2012).

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. The central enabler to synchronized operation is interconnection. Each of the three regional grids, or "interconnections"—Eastern, Western, and Texas—operates as a single, synchronized machine.[3]

[3] Hawaii and Alaska have their own grids. They are not subject to the CPP. 80 Fed. Reg. at 64,708.

Figure 1. U.S. Power-System Interconnections[4]



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; it also enables use of the most economic resources at any given time. The transmission network 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 the development of transmission lines. Networks continued to grow, ultimately giving rise to the three interconnections. 80 Fed. Reg. at 64,690–92.

[4] *North American Electric Reliability Corporation Interconnections*, U.S. DEP'T OF ENERGY, http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/NERC_Interconnection_1A.pdf (last visited Jan. 8, 2018).

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, interdependent generators must coordinate with one another, and with grid authorities, regarding their routine operations. Because the performance and usage of their units depends on the operation of other units outside their individual control, power companies regularly coordinate 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 the Supreme Court has recognized, "generating facilities cannot be maintained on the basis of a constant demand." *Gainesville Util. Dep't v. Florida 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 Security Constrained Unit Commitment and Economic Dispatch, or "Constrained Least-Cost Dispatch." As its name implies, Constrained Least-Cost Dispatch deploys generators with the lowest variable costs first, as system operational limits allow, until the generation satisfies all demand. 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") utilize 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. While the ISOs/RTOs' use of Constrained Least-Cost Dispatch principles is more transparent, Constrained Least-Cost Dispatch principles guide all dispatch planning across the country.

Dispatch and related coordination activities 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.

Power companies recognize that their units are subject to Constrained Least-Cost Dispatch and have long planned their operations accordingly. They routinely execute contracts to purchase power from third-party generators; invest in demand-side energy efficiency programs; and, as existing units retire, invest in more efficient and cost-competitive generation facilities, such as natural gas and renewable sources, in order to compete for dispatch priority. These practices are consistent with both the fungibility of electricity (described above) and with the approaches that the CPP Best System of Emission Reduction ("BSER") recognizes.

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

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 frequently, while units whose costs are relatively lower 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 all costs are accounted for, is used.

Congress, EPA, and state regulators have long recognized that a system-wide approach to reducing pollution works most efficiently within grid operations, and previous Clean Air Act ("CAA") programs or rules have harnessed shifts among generators as an economical tool to reduce harmful air emissions. *See* Respondent EPA's Initial Brief, *West Virginia v. EPA* 32-34, No. 15-1363 (D.C. Cir. Mar. 28, 2016).[5] One example 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, e.g.* EMANUELE MASSETTI ET AL., ENVIRONMENTAL QUALITY AND THE U.S. POWER SECTOR: AIR QUALITY, WATER QUALITY,

[5] *Available at* https://ago.wv.gov/publicresources/epa/Documents/EPA%20Response%20Brief%20(consolidated)%20(M0122282xCECC6).pdf.

LAND USE AND ENVIRONMENTAL JUSTICE 19 (Oak Ridge National Laboratory, Jan 4, 2017);[6] Robert Stavins et al., *The US sulphur dioxide cap and trade programme and lessons for climate policy*, CENTRE FOR ECONOMIC POLICY RESEARCH (Aug. 12, 2012)[7]. The allowance requirement increased the costs of regulated units, which decreased the dispatch competitiveness of those units and led some to curtail 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, e.g.*, Thomas M. Jackson et al., *Evaluating Soft Strategies for Clean-Air Compliance*, 6 IEEE COMPUTER APPLICATIONS IN POWER 46 (1993).

The effect of pollution controls in organized wholesale power markets and in traditional cost-of-service regimes is similar. In traditional cost-of-service states, utility system operators and state regulators account for the additional costs of pollution control in dispatching generators, planning for and approving new investments, and setting electricity rates. In organized markets, the variable cost of pollution controls is reflected in generators' offers in ISO/RTO auctions.

The Regional Greenhouse Gas Initiative ("RGGI") provides an example of how carbon pollution controls blend seamlessly into organized markets' operations. RGGI is a cap-and-trade program for power-sector CO_2 pollution in nine northeast and mid-Atlantic states. The participating states span three ISOs/RTOs, all of which have been able to integrate 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. Since it began in 2009, RGGI has not reduced reliability. PAUL HIBBARD ET AL., THE ECONOMIC IMPACTS OF THE REGIONAL GREENHOUSE GAS INITIATIVE ON NINE NORTHEAST AND MID-ATLANTIC STATES 13 (2015).[8] RGGI calculates that its programs have led to 5.3 million tons of avoided CO_2 emissions over its lifetime, and that is has cumulatively saved consumers $2.31 billion on energy bills, with $154.5 million in savings coming in 2015. REGIONAL GREENHOUSE GAS INITIATIVE, THE INVESTMENT OF RGGI PROCEEDS IN 2015 p. 6 tbl.1 (Oct. 2017).

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[6] *Available at* https://energy.gov/sites/prod/files/2017/01/f34/Environment%20Baseline%20Vol.%202--Environmental%20Quality%20and%20the%20U.S.%20Power%20Sector--Air%20Quality%2C%20Water%20Quality%2C%20Land%20Use%2C%20and%20Environmental%20Justice.pdf

[7] *Available at* http://voxeu.org/article/lessons-climate-policy-us-sulphur-dioxide-cap-and-trade-programme.

[8] *Available at* http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_july_2015.pdf.

II. The CPP Respects and Utilizes the Physical Features of the Interconnected Electric Grids, Ensuring Efficient Compliance and Continued Reliability.

Like past successful power plant pollution control programs, the CPP respects and harnesses the routine shifting of generation among sources to cost-effectively reduce CO_2 emissions from the machine as a whole. The CPP does not change how each grid operates. Instead, like other pollution controls, rule compliance will be one of multiple inputs to the Constrained Least-Cost Dispatch process, thereby allowing operators to employ well-used tools and practices to ensure the lights do not go out. The gradual shifts that the CPP promotes are modest compared to broader changes already underway, as the power sector trends away from coal and toward cheaper, more efficient lower-carbon sources.

These points are significant because, in its proposed repeal, EPA has stated that it has "substantial concerns" that the CPP: (1) imposes massive costs on power sector entities; (2) invades traditional areas of state regulation; (3) departs radically from EPA's prior regulatory practice; and (4) does not adequately ensure affordable and reliable electricity. 82 Fed. Reg. at 48,038. In its proposed repeal, EPA also suggests that CPP could lead to "transformative" economic, policy, and political changes. *Id.* at 48,042. These concerns are unfounded. Because the CPP promotes gradual shifts that are modest in comparison to broad system trends, and because it utilizes the features of the grids themselves, it can be implemented without peril to EPA's areas of concern and without transformative change.

Furthermore, designation of a BSER is a factual question that EPA must consider in a manner that is sensitive to the context of each pollutant and each sector. EPA's proposed repeal does not reflect either an understanding of how modern grids operate or engagement with the history of effective power-sector regulation. Such realities—as discussed below—are fundamental to a well-considered interpretation of the BSER under Section 111(d).

A. The CPP Will Not Destabilize the Grids.

EPA had previously projected that the CPP will have four main effects on the power sector, as states and regulated parties adopt a flexible range of measures to comply: (1) gradually increasing utilization of the most efficient existing natural gas units; (2) adding new renewable energy generation; (3) gradually decreasing generation from higher-carbon sources; and (4) modestly decreasing overall generation due to deployment of consumer-side energy efficiency measures. EPA, REGULATORY IMPACT ANALYSIS FOR THE CLEAN POWER PLAN FINAL RULE ("RIA 2015") 3-14, tbl. 3-2, 3-27, tbl. 3-11, EPA-HQ-OAR-2013-0602-37105 (Aug. 2015). None of these effects would impose significant—let alone "massive"— costs on power sector entities or threaten the reliable delivery of electricity, as EPA seems to fear. 82 Fed. Reg. at 48,039.

Historical grid performance and technical assessments demonstrate that these gradual shifts fit easily within the capabilities and structure of the grids. *Accord* M. AHLSTROM, ET AL., RELEVANT STUDIES FOR NERC'S ANALYSIS OF EPA'S CLEAN POWER PLAN 111(D) COMPLIANCE iv (2015),[9] (reviewing an "extensive" suite of studies showing that "reliable and cost-effective compliance [with the CPP] is possible"). The power sector is able to support a diverse and evolving portfolio of generation while maintaining reliability and affordability; current trends show that it is already doing so at a rapid rate. In the 2015 Regulatory Impact Analysis, EPA expected the CPP to reduce emissions to 32% below 2005 levels by 2030. RIA 2015, ES-8, tbl. ES-4. In 2016, power sector emissions were already 25% below 2005 levels, 78% of the way to the 2030 goal. INST. FOR POLICY INTEGRITY, THE FALLING COST OF CLEAN POWER PLAN COMPLIANCE ("IPI 2017") 6, (Oct. 2017)[10].

The grid has also shown it is capable of incorporating high levels of renewable energy generation. Under the CPP, EPA projected renewable energy to account for 20% of U.S. electricity generation by 2030. The majority of this growth was expected under business-as-usual trends, regardless of the CPP. RIA 2015 at 3-27, tbl. 3-11. More recent analysis found that renewable energy generation would account for 24.3% of power sector production under the CPP,[11] and would still reach 22.2% of electric sector power without the rule.[12] ENERGY INFORMATION ADMINISTRATION, ANNUAL ENERGY OUTLOOK 2018 Table: Electricity Supply, Disposition, Prices, and Emissions.[13] The RIA for the proposed repeal is in agreement on this point, finding that a majority of the renewable energy growth that EPA projects under the CPP will occur in the absence of the rule. EPA, REGULATORY IMPACT ANALYSIS FOR THE REVIEW OF THE CLEAN POWER PLAN: PROPOSAL, EPA–HQ–OAR–2017–0355 116-17, fig. 7-17 (Sept. 2017).

The grids can integrate renewable energy even above the levels expected under the CPP without adverse reliability impacts. For example, in March of 2017, wind met 52.22% of the Southwest Power Pool's demand, and in October it met 54.22 % of the Texas Interconnection's demand. Southwest Power Pool (@SPPorg), TWITTER (Mar. 20, 2017, 8:14 AM); [14] ELEC. RELIABILITY COUNCIL OF TEXAS, WIND INTEGRATION REPORT (Mar. 31, 2017).[15] Wind met 25% of demand in the Midcontinent ISO on November 23, 2012. Hannah Hunt, *Strong winds blow away records across the U.S.*, INTO THE WIND: THE AM. WIND ENERGY ASSOC. BLOG (Nov. 7, 2017).[16] And the main grid operator in Colorado regularly

[9] *See* App. at Exhibit 2.
[10] *See* App. at Exhibit 3.
[11] Under the EIA's Reference Case with Clean Power Plan, assuming compliance with the CPP.
[12] Under the EIA Reference Case, assuming the CPP is not implemented.
[13] *Available at* https://www.eia.gov/outlooks/aeo/data/browser/#/?id=8-AEO2018&region=0-0&cases=ref2018~ref_cpp&start=2016&end=2050&f=A&linechart=ref2018-d121317a.6-8-AEO2018~ref_cpp-d121317a.6-8-AEO2018&chartindexed=1&sourcekey=0.
[14] https://twitter.com/SPPorg/status/843843253346668544
[15] App. at Exhibit 4, http://www.aweablog.org/strong-winds-blow-away-records-across-u-s/.
[16] App. at Exhibit 5.

meets demand with large percentages of wind, including 20 hours during which wind met over 60% of demand. Michael Goggin, *Output Records and NERC Report Show Increasing Reliability Contributions of Wind*, INTO THE WIND: THE AM. WIND ENERGY ASSOC. BLOG (Dec. 22, 2015).[17]

In fact, renewable sources can help *improve* reliability. 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 GROUP, ELECTRIC SYSTEM RELIABILITY AND EPA'S CLEAN POWER PLAN: THE CASE OF PJM 3, 12 (2015).[18] It is true that the renewable energy varies more in availability than other types of generation, leading system operators to maintain generation reserves that provide back-up when renewable energy is unavailable. But the U.S. power sector has successfully managed large amounts of renewable power in this manner, and technical studies have concluded the sector can integrate even more without significant reliability impacts. *See, e.g.*, GE ENERGY, PJM RENEWABLE INTEGRATION STUDY, COVER LETTER 1 (2014),[19] (finding that the RTO PJM could operate with up to 30% of generation from wind and solar with no significant reliability impacts); ENERNEX CORP., EASTERN WIND INTEGRATION AND TRANSMISSION STUDY 27 (2011),[20] (finding that wind generation could feasibly supply 20% to 30% of electricity on the Eastern Interconnection); GE ENERGY, WESTERN WIND AND SOLAR INTEGRATION STUDY (2010),[21] (finding that the Western Interconnection could maintain reliability with 35% wind and solar generation).

Importantly, the existing tools and procedures that industry and regulators use to ensure grid stability would continue to function effectively under the CPP. For example, the North American Electric Reliability Corporation develops and enforces reliability standards. The Federal Energy Regulatory Commission ("FERC") and state public utility commissions are also closely involved in overseeing reliability. Additionally, balancing authorities, such as ISOs/RTOs, maintain reliability on particular areas of the grid, operating to limit the impact of outages. All of these entities continuously incorporate changing economics and operational conditions into their planning processes. The CPP changes nothing about how they function. In fact, the rule's regional approach reflects the regional perspective of reliability coordinators.

EPA now cites concerns that the CPP does not "adequately ensure the national interest in affordable, *reliable* electricity." 82 Fed. Reg. at 48,038 (emphasis added). To the contrary, the rule includes redundant reliability protections. For instance, compliance does not begin until 2022, with emissions reductions then phased in gradually over the next eight years. *See* 80

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[17] App. at Exhibit 6, http://www.aweablog.org/output-records-and-nerc-report-show-increasing-reliability-contributions-of-wind/.
[18] App. at Exhibit 7.
[19] App. at Exhibit 8.
[20] App. at Exhibit 9.
[21] App. at Exhibit 10.

Fed. Reg. at 64,665, 64,743, 64,875. As EPA correctly noted when it published the CPP, "[t]hese periods of time are consistent with current industry practice in changing generation or adding new generation." *Id.* at 64,744. Additionally, in an emergency situation, a unit can temporarily operate under less-stringent emissions standards. *Id*. at 64,878–79. We also note that while reliability concerns have been raised in past EPA rulemakings, we know of no instance where an environmental regulation caused a reliability event.

FERC has also recently addressed, and rejected, the claim that foreseeable levels of generation shifting will harm reliability. In denying a DOE request that FERC provide special compensation for coal plants in the interest of resilience and reliability, FERC noted that "the extensive comments submitted by the RTOs/ISOs do not point to any past or planned generator retirements that may be a threat to grid resilience." *Grid Resiliency Pricing Rule: Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures, Grid Resiliency Pricing Rule*, 162 FERC ¶ 61,012 at P. 15 (Jan. 8, 2018). FERC found that the current trend toward cleaner energy generation is not currently threatening reliability, and is not expected to do so. *Id.*

These and other design elements, such as the option to adopt emissions trading programs, provide states and utilities substantial flexibility to plan optimal emissions reductions and adjust compliance strategies if necessary. Reliability entities that initially raised concerns about the proposed rule have since praised EPA for its responsiveness on this issue. *See, e.g.*, Press Release, NORTH AM. ELEC. RELIABILITY CORP., *Statement on Clean Power Plan Finalization* (Aug. 3, 2015).[22]

B. The CPP is Consistent with Broader Power-Sector Investment Trends and Will Not Be Unduly Costly.

In promoting lower-carbon generation, the CPP builds on and locks in ongoing market trends, while ensuring those trends continue into the future. With or without the rule, the U.S. power sector is in the midst of a transition. Many coal-fired generators are headed toward retirement. By 2025, coal-fired units will have an average age of 49 years, and 20% of units will be over 60 years old—well beyond their typical expected operating life of 40 years. *See* 80 Fed. Reg. at 64,694, 64,872. As aging infrastructure is replaced, utilities are upgrading to renewable energy and other modern technologies that allow them to meet demand more cost-effectively and with fewer emissions.[23] From 1990 to 2016, natural gas, wind, solar and other renewable

[22] *Available at* http://www.nerc.com/news/Pages/Statement-on-Clean-Power-Plan-Finalization.aspx.
[23] Natural gas and renewable energy sources generate electricity at the source with approximately 40 to 100% fewer CO_2 emissions than coal. Between 2005 and 2013, power-sector CO_2 emissions fell approximately 15%, mostly due to increased natural gas and renewable energy generation. *See* 80 Fed. Reg. 64,689. In addition to reduced emissions compared to coal, natural-gas provides a flexible, baseload generation system that can be more responsive than other baseload generators—such as coal—for rapidly responding to changing needs, such as when solar generation falls at night.

sources accounted for approximately 93% of new utility-scale generating capacity. *U.S. electric generating capacity increase in 2016 was largest net change since 2011*. U.S. ENERGY INFORMATION ADMINISTRATION (Feb. 27, 2017). Fifty-four percent of installed new generating capacity over the past ten years has come from renewables, and in 2016 solar alone accounted for more than half of new generating capacity. BLOOMBERG NEW ENERGY FINANCE AND BUSINESS COUNCIL FOR SUSTAINABLE ENERGY, SUSTAINABLE ENERGY IN AMERICA FACTBOOK 3 (2017).[24]

Renewable energy is already cost-effective, and costs are rapidly falling. In terms of the total unsubsidized cost of producing power over the life of a unit ("levelized cost"), wind is the cheapest generation source, followed by natural gas combined-cycle and utility-scale solar. *See* LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS, VERSION 11 p.2 (Nov. 2017).[25] This is projected to remain the case over the course of Rule compliance. The levelized cost of onshore wind capacity that comes on line in 2022 is projected to be $52.2 per megawatt-hour,[26] compared to $57.3 per megawatt-hour for conventional combined-cycle natural gas and $123.2 per megawatt-hour for conventional coal (with 90% carbon capture and storage). *See* EIA, LEVELIZED COST AND LEVELIZED AVOIDED COST OF NEW GENERATION RESOURCES IN THE ANNUAL ENERGY OUTLOOK 2017 8, tbl.1b (2017).[27] Although levelized costs are not the only consideration in supply investment decisions, since dispatchability and correlation with demands also matter strongly, they are very important and are expected to continue to decrease for renewable sources. A 2016 survey by Lawrence Berkeley National Laboratory and the National Renewable Energy Laboratory found that a group of wind experts projected a further decrease in wind energy's price in 2030, of 24 to 30% when compared to today's prices. Ryan Wiser et al., *Expert Elicitation survey on future wind energy costs*, 1 NATURE ENERGY 1 (Sept. 12, 2016).[28] Solar prices fell by more than 80% between 2007 and 2015. BLOOMBERG NEW ENERGY FINANCE AND BUSINESS COUNCIL FOR SUSTAINABLE ENERGY, SUSTAINABLE ENERGY IN AMERICA, 2015 FACTBOOK 50, (Feb. 2015);[29] David Feldman et al., NATIONAL RENEWABLE ENERGY LABORATORY, PHOTOVOLTAIC SYSTEM PRICING TRENDS,

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[24] App. at Exhibit 11, http://www.bcse.org/sustainableenergyfactbook.
[25] App. at Exhibit 12, https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf. However, due to the Trump administration's January announcement of a 30% tariff on solar panels, the cost of solar energy per watt would likely increase 10 to 15 cents, while "soft costs" of solar could continue to decrease. Krysti Shallenberger, *ITC proposes 3 solar trade case remedies with tariffs, quotas and capped imports*, UTILITY DIVE (Oct. 31, 2017), https://www.utilitydive.com/news/itc-proposes-3-solar-trade-case-remedies-with-tariffs-quotas-and-capped-im/508596/; *see, e.g.* DOE Office of Energy Efficiency & Renewable Energy, *Soft Costs 101: The Key to Achieving Cheaper Solar Energy*, ENERGY.GOV (Feb 26, 2016), https://www.energy.gov/eere/articles/soft-costs-101-key-achieving-cheaper-solar-energy.
[26] After tax credits.
[27] App. at Exhibit 13, *available at* https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.
[28] App. at Exhibit 14.
[29] App. at Exhibit 15.

(Sept. 22, 2014). EIA has projected that renewable sources will account for the vast majority of capacity additions between 2018 and 2022. EIA, ANNUAL ENERGY OUTLOOK 2017 85, (2017).[30]

Natural gas generation is growing, too. *See id.* at 14 (projecting that natural gas will account for almost 40% of production by 2040). Natural gas combined-cycle technologies produce more electricity per unit of fuel energy than do coal-fired units, and often do so more cheaply because of the recent fall in gas prices. Accordingly, decreasing coal generation has corresponded with increasing natural gas and renewable energy generation, as highlighted by Table 1 below. In 2004, coal represented nearly half of total U.S. generation; but, in less than a decade, the combination of natural gas and renewable energy surpassed coal. In 2016, monthly generation from natural gas alone surpassed generation from coal; gas provided 34% of total electricity generation that year, surpassing coal generation at 30%. Sara Hoff, *Competition between coal and natural gas affects power markets*, TODAY IN ENERGY (JUNE 16, 2017).[31] In October of 2017, coal generation was down 9.2% compared to one year before; wind generation increased 21.9%, and solar 43.6%, over that same time period. EIA, ELECTRIC POWER MONTHLY tab. ES.1.A (Nov. 2017).[32]

Table 1. U.S. Electricity Generation: Selected Sources[33]

Year	Coal	Natural Gas	Renewables
2004	49.7%	17.8%	8.8%
2005	49.5%	18.7%	8.8%
2006	48.9%	20.0%	9.5%
2007	48.4%	21.5%	8.5%
2008	48.1%	21.4%	9.3%
2009	44.4%	23.3%	10.6%
2010	44.7%	23.9%	10.4%
2011	42.2%	24.7%	12.6%
2012	37.3%	30.2%	12.4%
2013	38.7%	27.6%	13.1%
2014	38.4%	27.4%	13.5%
2015	33.0%	32.5%	13.8%

[30] App. at Exhibit 16.

[31] App. at Exhibit 17, *available at* https://www.eia.gov/todayinenergy/detail.php?id=31672. *See also Electricity in the United States*, ENERGY INFORMATION ADMINISTRATION, eia.gov /energyexplained/index.cfm?page=electricity_in_the_united_states (May 10, 2017).

[32] App. at Exhibit 18, *available at* https://www.eia.gov/electricity/monthly/current_month/epm.pdf.

[33] NAT'L RENEWABLE ENERGY LAB., 2015 RENEWABLE ENERGY DATA BOOK 12 (2016), App. at Exhibit 19, *available at* https://www.nrel.gov/docs/fy17osti/66591.pdf.

Investment trends will likely continue to favor decarbonization. Over the coming decade, state policies will drive substantial growth in energy efficiency investments, with or without the CPP. *See* GALEN L. BARBOSE ET AL., THE FUTURE OF UTILITY CUSTOMER-FUNDED ENERGY EFFICIENCY PROGRAMS IN THE UNITED STATES: PROJECTED SPENDING AND SAVINGS TO 2025 30 (Lawrence Berkeley National Laboratory, 2013),[34] (projecting utility customer-funded spending of $9.5 billion annually by 2025). The rule is likely to result in additional investments, as energy efficiency is frequently a cost-effective alternative to fossil-fuel-fired generation. *See* RIA 2015 at 3-12–3-16.

Although business as usual will result in significant carbon dioxide emission reductions from electricity sources, the CPP nevertheless plays a critical role. Changing market conditions could alter the business-as-usual utilization of low- and no-carbon energy sources, and the rule will serve as an important regulatory backstop to ensure expected progress in the power sector. It also sends a signal to utilities of the government's consistent intent to regulate carbon dioxide in a cost-effective manner. Finally, the rule creates a flexible, unified regulatory framework upon which to base future efforts to increase standards and reduce emissions.

In its proposed repeal, EPA now expresses concern that the CPP will not "ensure the national interest in affordable, reliable electricity, including from coal generation," forcing a "grid-wide shift" from fossil fuel-fired generation to renewable generation. 82 Fed. Reg. 48,037-38. First, we do not accept the premise that maintaining high percentages of fossil fuel generation is in the national interest or necessary to ensure reliability. For reasons described above, trends toward cleaner generation and retirement or displacement of coal do not threaten reliability, and are not projected to do so. *See supra* Part II.A. Second, utilities will still consume large amounts of fossil fuels under the CPP. Coal and natural gas will remain the country's two leading sources of electricity. Projections to 2030 show that coal will continue to provide more than one-quarter of all U.S. electricity generation—only 5.4% less than projected without the CPP—and natural gas will provide about one-third. *See* 80 Fed. Reg. at 64,665. EIA has also projected that, in 2030, electricity generation from coal will be 25% of total generation. ENERGY INFORMATION ADMINISTRATION, ANNUAL ENERGY OUTLOOK 2017, Table: Electricity Supply, Disposition, Prices, and Emissions. The changes in generation mix anticipated because of the CPP are of degree and not kind, and power engineers will continue to use tried-and-true systems operations software (as described in the next subsection) to maintain reliable and economic operation.

The CPP is projected to be affordable. A study by MJ Bradley and Associates ("MJB") examining state investments in electric power found that 21 of 27 states that had opposed the CPP would be in compliance through 2024 when considering only existing and planned investments. MJ BRADLEY & ASSOC., STATE SCENARIOS, EPA'S CLEAN POWER PLAN:

[34] App. at Exhibit 20, *available at* https://emp.lbl.gov/sites/all/files/lbnl-5803e.pdf.

COMPLIANCE PATHWAYS 4 (Dec. 8, 2015).[35] EPA, in its January 2017 Basis for Denial of Petitions to Reconsider and Petitions to Stay the CAA section 111(d) Emission Guidelines for Greenhouse Gas Emissions and Compliance Times for Electric Generating Units ("Basis for Denial"), interpreted an updated MJB result—finding that CPP compliance costs are negative for almost every policy scenario they used—to mean that total system costs would be lower with the CPP than they would be without it. Basis for Denial, App. at Exhibit 2—Power Sector Trends 69 (*citing* MJ BRADLEY & ASSOC., System Costs, Average Bills and Emissions (June 2016). More recently, the Rhodium Group found that, depending on market trends, between 12 and 21 states would require additional efforts to comply with the CPP; all other states would meet their targets through existing efforts. John Larsen and Whitney Herndon, *What the CPP Would Have Done*, RHODIUM GROUP (Oct. 9, 2017).[36] Overall, the EPA Basis for Denial utilized a host of new data published after the release of the final CPP to find that trends toward low- and zero-emitting energy "continue unabated" and that many of the CPP's targeted reductions will occur under business-as-usual scenarios. *Id.* at 4. Therefore, the Basis for Denial found that the CPP will be "considerably less costly to implement now" than EPA had originally calculated at the time of rule promulgation. *Id.* Multiple reports, including those by the Institute of Policy Integrity and MJB, confirm this expectation of lower compliance costs. *See* IPI 2017;[37] MJ BRADLEY & ASSOCS., SUPPLEMENTAL DATA: SYSTEM COSTS, AVERAGE BILLS, AND EMISSIONS (June 2016) (*hereinafter* MJB 2016).

Even considering the investments necessary to reach a high penetration of renewables, transmission costs will continue to be a modest percentage of the overall capital and operating costs of the grids. *See* Alexander E. MacDonald et al., *Future Cost-Competitive Electricity Systems and Their Impact on US CO_2 Emissions*, 6 NATURE CLIMATE CHANGE 526 (2016) (finding that the investments necessary to reduce power-sector CO_2 emissions up to 78% would have minimal impact on electricity costs).[38] Furthermore, utilities are already planning significant infrastructure investments. *See, e.g.*, EPA, GREENHOUSE GAS MITIGATION MEASURES TECHNICAL SUPPORT DOCUMENT ("MITIGATION TSD") 4-24, EPA-HQ-OAR-2013-0602-37114 (Aug. 3, 2015), (stating that members of the Edison Electric Institute, which represents all investor-owned utilities, are planning to invest approximately $20 billion annually in transmission upgrades over the next five years).

For these and other reasons, complying with the CPP will not be unduly costly. Estimates of the cost of compliance with CPP have been declining over time. EPA's analysis in its 2015 RIA estimated that the rule would result in $32 to $54 billion in annual benefits, with $5.1 to $8.4 billion in yearly costs in 2030. *See* EPA, RIA 2015 tbl.ES-9 & tbl.ES-10 (2015) (using 3% discount rate). Other, more recent research efforts have calculated even lower compl

[35] App. at Exhibit 21, *available at* http://blogs.edf.org/climate411/files/2016/09/MJB-study-on-CPP-compliance.pdf

[36] App. at Exhibit 22, *available at* http://rhg.com/notes/what-the-cpp-would-have-done.

[37] App. at Exhibit 3.

[38] App. at Exhibit 23, http://www.nature.com/nclimate/journal/vaop/ncurrent/pdf/nclimate2921.pdf.

iance costs than EPA did in 2015, with one June 2016 analysis estimating costs ranging from $0.8 to $3.7 billion for annual incremental compliance costs in 2030. IPI 2017, (*citing* MJB 2016). When compared to total projected generating costs of $180 billion for 2030, *see* RIA 2015, tbl.ES-9 & tbl.ES-10, it becomes obvious that the incremental costs of the CPP account for a small share of total costs and can be accommodated.

C. States and Power Companies Have a Range of Familiar Options to Comply with the CPP.

Although the CPP will bring shifts in generation sources, it does not pose a danger to the grid or otherwise drastically change grid operations. Rather, the rule respects and follows the Constrained Least-Cost Dispatch principles that govern the grids and provides states with extensive flexibility for compliance.

Compliance options are plentiful. They include:

- making technological or operational adjustments to improve the "heat rate" (generation efficiency) of coal-fired units;
- increasing generation from existing and new natural gas units;
- co-firing or fuel-switching at coal-fired units;
- investing in new renewable energy generation;
- investing in programs to lower demand by increasing consumer-side energy efficiency or by employing demand response;
- installing carbon capture and sequestration technologies;
- purchasing lower-emitting power via a power purchase agreement;
- establishing operational limitations on carbon-intensive sources through permits or run-time restrictions; and
- purchasing credits or allowances through a trading program.

All of these are actions that states and utilities regularly take to supply consumers with reliable and affordable power that meets regulatory standards.

The power sector can implement these familiar strategies without changing dispatch methodology. Constrained Least-Cost Dispatch principles will continue to guide grid operations under the CPP. Dispatch algorithms and ISO/RTO market software easily accommodate emissions constraints. The competitive postures of generators normally change over time, as fuel prices fluctuate, aging units retire, generation technologies evolve, and new pollution controls are implemented. The CPP creates a flexible regulatory mechanism to increase standards and reduce pollution as technological progress is made. It may affect the operating costs of various units (*e.g.*, if an affected unit needs to purchase an emissions allowance), or lead to new permit restrictions that limit a unit's operating hours, but grid operators routinely account for such costs and operational limitations.

Most of the above-listed compliance actions do not involve procuring renewable energy generation; however, we note that owners and operators of affected units have already done so for some time and retain ample opportunity to do so under the CPP. EPA raises concerns about a "shift" from fossil fuel-fired generation to renewable generation. In fact, both fossil fuel-fired generation and renewable generation are often part of a utility's integrated generation portfolio. Utilities own many affected generators; the utilities can largely control their generation mix or acquire new renewable sources. Renewable energy plays a valuable role in a utility's resource portfolio because Constrained Least-Cost Dispatch typically favors it. Hence, virtually all major utilities are already planning investments in renewable energy. For example, Duke Energy is planning on reducing its carbon dioxide emissions 40% below 2005 levels by 2030. Duke Energy's latest Sustainability Report details cleaner energy investments and an aggressive goal to reduce carbon emissions 40 percent by 2030, DUKE ENERGY NEWS CENTER (Apr. 27, 2017).[39] Xcel Energy's CEO pledged to reduce the company's emissions 60% below 2005 levels by 2030. Ben Fowke, (Xcel Energy CEO), *At Xcel, we'll stay on a clean energy path*, STAR TRIBUNE (JUNE 14, 2017). And American Electric Power plans to add 5,500 MW of wind and 3,000 MW of solar capacity in the coming years, and to cut carbon emissions by 60% from 2000 levels by 2030 and 80% from 2000 levels by 2050. Robert Walton, *AEP CEO: Clean Power Plan could be the 'catalyst' to transform utility industry*, UTILITY DIVE (Nov. 13, 2015); *AEP's Clean Energy Strategy Will Achieve Significant Future Carbon Dioxide Reductions*, SEEKINGALPHA.COM (Feb. 6, 2018). MidAmerican Energy has pledged to use renewables to provide 100% of its energy. MIDAMERICAN ENERGY, *Our 100% Renewable Vision*;[40] *see also* EPA, Supplement to the Review of Electric Utility Integrated Resource Plans, EPA-HQ-OAR-2013-0602-36303 (Oct. 23, 2015.) (describing numerous utilities' plans to convert coal units to natural gas generation). In 2016, EIA stated that power companies installed more than 7600 megawatts of utility-scale solar, growing faster than any other generating technology. EIA, *Utility-scale solar has grown rapidly over the past five years*, TODAY IN ENERGY (May. 1, 2017).[41]

Additionally, all states can adopt compliance plans that allow affected units to invest indirectly in renewable energy through purchase of tradable credits or allowances. Market-based programs are well suited to the interconnected, transactional, and regionally coordinated operations of the power sector. Recognizing this, Congress and EPA have developed successful trading programs for power-sector pollutants such as sulfur dioxide, ozone, and particulate matter. *See* Respondent EPA's Initial Brief, *West Virginia v. EPA* 32-34, No. 15-1363 (D.C. Cir. 2016). Many states are currently implementing these programs. Additionally, ten states already participate in trading programs for power-sector CO_2 emissions. In all cases,

[39] *Available at* https://news.duke-energy.com/releases/duke-energy-s-latest-sustainability-report-details-cleaner-energy-investments-and-an-aggressive-goal-to-reduce-carbon-emissions-40-percent-by-2030
[40] *Available at* https://www.midamericanenergy.com/our-renewable-energy-vision.aspx.
[41] App. at Exhibit 24, *available at* https://www.eia.gov/todayinenergy/detail.php?id=31072#tab2.

grid operators have been able to smoothly integrate emissions trading into the routine operation of the "complex machine."

III. A Site-Constrained Approach to Developing Pollution Controls Does Not Make Sense for Power-Sector CO_2.

a. EPA's Approach Under the CPP Reflects the Grids' Machine-Like Operations and the Distinctive Characteristics of CO_2.

In formulating the CPP, EPA appropriately concluded that the potential to shift from higher-emitting to lower-emitting generators should be considered in developing a "best system of emission reduction" for power-sector CO_2. This is not necessarily true for other pollutants or industries. *Cf.* 80 Fed. Reg. at 64,782 ("No other industry is both physically interconnected in this manner and manufactures such a highly substitutable product."). Carbon pollution is globalized, meaning the location of particular reductions is irrelevant to mitigating the associated harm. Additionally, end-of-smokestack technologies are more costly for controlling CO_2, because CO_2 is chemically unreactive relative to other power-sector pollutants. *Id.* at 64,725. Over the coming decades, the most cost-effective CO_2 emissions reductions can be achieved primarily by displacing generation from carbon-intensive sources.

The most successful CO_2-reduction policies to date have harnessed the interconnected nature of the power system to facilitate shifts away from high-emitting generators. In addition to the ten states that already participate in CO_2 trading programs, three more are likely to join. Chris Martin and Joe Ryan, *Cap-and-Trade Is Catching On in the Trump Era*, BLOOMBERG.COM (Sept. 21 2017).[42] Twenty-nine states plus the District of Columbia have enforceable Renewable Portfolio Standards requiring utilities to meet a certain percentage of electricity demand with renewable energy. Jocelyn Durkay, *State Renewable Portfolio Standards and Goals*, NATIONAL CONFERENCE OF STATE LEGISLATURES;[43] *see also, e.g.*, 2015 Cal. Legis. Serv. ch. 547 (West) (requiring 50% of utility retail sales in California to come from renewable energy by 2030). And at least half of the states have adopted a long-term target to reduce energy demand by increasing consumer-side energy efficiency. 80 Fed. Reg. at 64,695. Such policies have contributed to significant cost-effective emissions reductions by promoting shifts among generators. *See* RYAN WISER ET AL., A RETROSPECTIVE ANALYSIS OF THE BENEFITS AND IMPACTS OF U.S. RENEWABLE PORTFOLIO STANDARDS 17 (2016),[44] (finding that new renewable energy generation used to meet Renewable Portfolio Standard obligations in 2013 reduced power-sector CO_2 emissions by about 3%); EPA, Demand-Side Energy Efficiency Technical Support Document 6, EPA-HQ-OAR-2013-0602-36842 (Aug. 2015) (reporting that energy efficiency policies accounted for 35% to 70% of power-sector CO_2

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[42] *Available at* https://www.bloomberg.com/news/articles/2017-09-20/state-efforts-boost-cap-and-trade-as-trump-pushes-for-more-coal.

[43] *Available at* http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

[44] App. at Exhibit 14.

emissions reductions in ten states). Using a Best System that includes shifts to lower-carbon generation, as the CPP currently does, recognizes current industry best practices to reduce a distinctive pollutant, CO_2, from the uniquely interconnected power sector.

EPA sensibly used the Eastern, Western, and Texas Interconnections as the units for quantifying the level of CO_2 emissions reductions achievable through shifts to lower-carbon generation. Grid operators (known as "balancing authorities") use constrained cost-minimization software to shift generation among sources within the three regional interconnections of energy to meet demand in real time. Balancing authorities within a given interconnection cooperate closely to facilitate energy trade and reliable operation. It is also at the interconnection level that reliability standards are applied. Alternative approaches would not make sense. The "machines" pay no heed to state or facility boundaries as they shift dispatch among generators according to Constrained Least-Cost Dispatch principles.

b. It Would Not Make Sense to Disregard Shifts Among Generators in Developing Pollution Controls for Power-Sector CO_2.

If it proceeds with the proposed repeal using the rationale suggested in its notice, it appears EPA will limit itself to considering only certain on-site measures for achieving pollution reduction. 82 Fed. Reg. at 48,037.[45] EPA appears to be considering only changes to the physical equipment at generating units, such as heat-rate improvements at coal-fired power plants, in defining BSER. 82 Fed. Reg 48,037. This would exclude from discussion other on-site measures, such as reduced utilization of the dirtiest plants and co-firing/fuel switching, each of which can be accomplished on site but gets little attention in EPA's proposal.

The limited on-site measures that EPA focuses on would not sensibly and economically reduce power-sector CO_2 emissions over the coming decades. Alone, they would influence the emissions intensity of individual units by only a few percentage points, and the precise amount of reduction would depend on the generators' marginal cost and resulting redispatch relative to other supply sources. In fact, use of heat-rate improvements alone could create an emissions "rebound effect," during which coal facilities implement emissions improvements but operate more frequently and for longer stretches, undermining pollution control efforts. Charles Driscoll et al., *US power plant carbon standards and clean air and health co-benefits*, 5 NATURE CLIMATE CHANGE 535, 537 (May 4, 2015). Combining heat-rate improvements with incentives to reduce coal generation, as EPA did in the CPP, ensures more meaningful and cost-effective emissions reductions. *See* 80 Fed. Reg. at 64,745, 64,748.

[45] "EPA is reconsidering the legal interpretation underlying the CPP and is proposing to interpret the phrase 'best system of emission reduction' in a way that is consistent with the Agency's historical practice of determining a BSER by considering only measures that can be applied to or at the source."

If EPA were to consider a more full range of site-constrained measures in designing the BSER, such as carbon capture and sequestration, co-firing, fuel switching, heat rate improvements, and reduced utilization, the resulting rule could cause the same shifts among generation sources that EPA appears to be concerned about, but at potentially greater total cost than the CPP would impose. The CPP itself notes the feasibility of reduced utilization and reduced generation several times. *See, e.g.* 80 Fed. Reg. 64,732. A feasible site-constrained approach could in fact rely on reduced utilization as a key component of the BSER. If the BSER then measured required reductions in utilization by reference to cost and the availability of cleaner substitute electricity, the resulting rule would be functionally very similar to the CPP. Many units would comply with the resulting emissions standards by reducing or shifting generation. Lower-carbon generation would be more cost-competitive and therefore favored in dispatch and utility investments—just as it is under the CPP. *Id.* at 64,728, 64,784. It would be far better simply to maintain the CPP in place, which includes system-focused features—such as provisions facilitating emissions trading—that are compatible with present utility operational practice and further increase compliance flexibility and lower costs.

As discussed above, companies that own fossil-fuel-fired units routinely invest in, and coordinate with, renewable energy generation—even to the point of co-locating natural gas or renewable energy generation with a coal-fired unit at the same site. *See* Mitigation TSD at 4-24–4-25, (discussing numerous examples of renewable generation sited within an affected generator's power control area). For instance, to reduce emissions, Iowa State University Utilities installed a wind turbine and solar panels next-door to its coal-fired power plant and partially converted the plant to natural gas. *See Environmental Performance*, IOWA STATE UNIV. UTIL. SERV.[46] Louisville Gas and Electric and Kentucky Utilities jointly installed Kentucky's largest array of solar panels at a coal facility owned by the utilities. EPA, Supplemental Memorandum to Mitigation TSD, EPA-HQ-OAR-2013-0602-37117 (Oct. 23, 2015); Press Release, LG&E and KU unveil Kentucky's largest universal solar facility, LG&E AND KU SOLAR (Apr. 19, 2016).[47] Co-located generation underscores the point that shifting among generation sources is routine in the integrated power sector.

A simple hypothetical illustrates why EPA would be mistaken in relying only on "technological or operational measures that can be applied to or at a single source." 82 Fed. Reg. at 48,037. Consider coal-fired Power Plant A ("Plant A"), which installs rooftop solar panels. By generating power with both 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

[46] https://www.fpm.iastate.edu/utilities/environmental_performance.asp.

[47] https://lge-ku.com/newsroom/press-releases/2016/04/19/lge-and-ku-unveil-kentuckys-largest-universal-solar-facility

A has installed what EPA characterizes as the only reasonable emissions reduction measures, those that must "be applied to or at those same individual sources." 82 Fed. Reg. at 49,039.

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 the EPA under the prior administration, 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's existing (or expanded) fenceline. The CPP allows for flexibility and choice on locating the panels. By contrast, the option for the plant owner to install solar panels off-site would not be present if the EPA were to take a site-constrained approach.

It would make little sense for EPA to consider only CO_2 emissions reductions within the ephemeral boundaries of individual facilities when all facilities deliver undifferentiated power to unitary grids. The CPP is a superior alternative to measures that are limited to individual sites because the CPP works with the grid structure, rather than against it, to achieve significant low-cost emission reductions.

IV. Conclusion: Repealing the CPP Would be Costly and Would Inhibit Cost-Effective Future Emissions Reductions.

In its January 2017 Basis for Denial, EPA affirmed that relying only on site-constrained pollution reductions would be costly. EPA noted then that the industry had been experiencing a shift away from coal-fired generation and towards increased natural gas and renewable generation. Basis for Denial at 54. Additionally, EPA evaluated newer data to find that costs of implementing the CPP would be lower and that, because large shifts in generation are already occurring, the economic impact of the CPP would be less than originally thought. *Id.*[48] Until recently, it has been the EPA's position that "no other technology or method for reducing emissions has emerged that achieves reasonable amounts of emission reductions more cost-effectively than generation-shifting." *Id.* at 54. In its Basis for Denial, it cited ample data to support that conclusion.[49]

The CPP, which recognizes and leverages the characteristics of the grid itself, is the most reasonable way to pursue carbon dioxide regulation from existing power plants. The CPP harnesses the unique "interconnectedness" that "is a fundamental aspect of the nation's electricity system" to drive significant, cost-effective emissions reductions. 80 Fed. Reg. at

[48] *See also* Denial of Petition Appendix 2—Power Sector Trends.
[49] *See* Denial of Petition Appendix 2—Power Sector Trends.

64,780. The CPP's design is eminently sensible: it reflects the regional nature of the power system, facilitates familiar compliance approaches such as emissions trading, and gradually accelerates industry trends already underway, as aging coal-fired units are replaced with cheaper, cleaner natural gas and renewable energy generation. The CPP is consistent with the grids' twin aims: power reliability and affordability for all consumers. Repeal of the CPP would impede, not advance, power reliability and affordability.

Sincerely,

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Encl. (exhibits have been submitted via email and U.S. mail)

List of Appended Exhibits

1. CREDENTIALS OF GRID EXPERTS
2. M. AHLSTROM, ET AL., RELEVANT STUDIES FOR NERC'S ANALYSIS OF EPA'S CLEAN POWER PLAN 111(d) COMPLIANCE (Nat'l Renewable Energy Lab., 2015).
3. INSTITUTE FOR POLICY INTEGRITY, THE FALLING COST OF CLEAN POWER PLAN COMPLIANCE (Oct. 2017).
4. ELECTRIC RELIABILITY COUNCIL OF TEXAS, WIND INTEGRATION REPORT (Mar. 31, 2017).
5. Hannah Hunt, *Strong winds blow away records across the U.S.*, INTO THE WIND: THE AMERICAN WIND ENERGY ASSOC. BLOG (Nov. 7, 2017).
6. Michael Goggin, *Output Records and NERC Report Show Increasing Reliability Contributions of Wind*, INTO THE WIND: THE AMERICAN WIND ENERGY ASSOCIATION BLOG (Dec. 22, 2015).
7. SUSAN TIERNEY, PAUL HIBBARD, AND CRAIG AUBUCHON, ELECTRIC SYSTEM RELIABILITY AND EPA'S CLEAN POWER PLAN: THE CASE OF PJM, pp. 1-13 (Analysis Group, 2015).
8. GE ENERGY, PJM RENEWABLE INTEGRATION STUDY, COVER LETTER (2014).
9. ENERNEX CORP., EASTERN WIND INTEGRATION AND TRANSMISSION STUDY, EXECUTIVE SUMMARY (2011).
10. GE ENERGY, WESTERN WIND AND SOLAR INTEGRATION STUDY (2010).
11. BLOOMBERG NEW ENERGY FINANCE AND BUSINESS COUNCIL FOR SUSTAINABLE ENERGY, SUSTAINABLE ENERGY IN AMERICA FACTBOOK EXECUTIVE SUMMARY (2017).
12. LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS, VERSION 11 (Nov. 2017).
13. EIA, LEVELIZED COST AND LEVELIZED AVOIDED COST OF NEW GENERATION RESOURCES IN THE ANNUAL ENERGY OUTLOOK 2017 (2017).
14. Ryan Wiser, Karen Jenni, Joachim Seel, Erin Baker, Maureen Hand, Eric Lantz, and Aaron Smith, *Expert Elicitation survey on future wind energy costs*, 1 NATURE ENERGY 1 (Sept. 12, 2016).
15. BLOOMBERG NEW ENERGY FINANCE AND BUSINESS COUNCIL FOR SUSTAINABLE ENERGY, SUSTAINABLE ENERGY IN AMERICA, 2015 FACTBOOK EXECUTIVE SUMMARY and pp. 47-53 (Feb. 2015).
16. EIA, ANNUAL ENERGY OUTLOOK 2017 pp. 69-87 (2017).
17. Sara Hoff, *Competition between coal and natural gas affects power markets*, TODAY IN ENERGY (EIA, JUNE 16, 2017).
18. EIA, ELECTRIC POWER MONTHLY EXECUTIVE SUMMARY (Nov. 2017).
19. NAT'L RENEWABLE ENERGY LAB., 2015 RENEWABLE ENERGY DATA BOOK pp. 1-16 (2016).

20. GALEN L. BARBOSE ET AL., THE FUTURE OF UTILITY CUSTOMER-FUNDED ENERGY EFFICIENCY PROGRAMS IN THE UNITED STATES: PROJECTED SPENDING AND SAVINGS TO 2025 pp. 1-32 (Lawrence Berkeley Nat'l Lab., 2013).
21. MJ BRADLEY & ASSOC., STATE SCENARIOS, EPA'S CLEAN POWER PLAN: COMPLIANCE PATHWAYS pp. 1-20 (Dec. 8, 2015).
22. John Larsen and Whitney Herndon, *What the CPP Would Have Done,* RHODIUM GROUP (Oct. 9, 2017)
23. Alexander E. MacDonald et al., *Future Cost-Competitive Electricity Systems and Their Impact on US CO_2 Emissions*, 6 NATURE CLIMATE CHANGE 526 (2016).
24. Manussawee Sukunta, *Utility-scale solar has grown rapidly over the past five years,* TODAY IN ENERGY (EIA, May 1, 2017).