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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, and James D. McCalley on Docket ID No. EPA-HQ-OAR-2017-0355, Proposed Affordable Clean Energy Rule

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 promulgate the Affordable Clean Energy ("ACE") Rule in place of the Clean Power Plan. We write in firm opposition to EPA's ACE proposal. In April, in response to EPA's proposed repeal of the Clean Power Plan ("CPP"), we argued that the agency's newly narrow approach to regulating greenhouse gas emissions from the power sector would, if finalized, result in costlier and less effective regulation.[1] EPA's own analysis of its ACE proposal confirms our view. We now know that replacing the CPP with the ACE Rule would increase pollution of CO_2 and other air pollutants; cost us billions of dollars in forgone benefits; and harm public health, resulting in thousands of premature deaths that the CPP would prevent. At the same time, as described below, the ACE Rule is not likely to save industry much in compliance costs.

These infirmities result, in part, from EPA's failure in its ACE proposal to account properly for the operations of the U.S. electricity grids and their responses to pollution controls. The Clean Power Plan, 80 Fed. Reg. 64,662 (Oct. 23, 2015), 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. The CPP uses these features of the grid to advantage, allowing for and encouraging the reduction of pollution by shifting generation away from the

[1] *See* Comment Letter from Electricity Grid Experts Benjamin F. Hobbs, Brendan Kirby, Kenneth J. Lutz, James D. McCalley, and Brian Parsons to EPA on Proposed Clean Power Plan Repeal (April 18, 2018).

grid's dirtiest power sources. By working with the fundamental characteristics of the grid, not against them, the CPP results in lower-cost, meaningful pollution reduction.

By contrast, the proposed ACE Rule aims to reduce pollution by drawing only from a tightly constrained set of measures that can be applied at individual facilities. Its focus is limited to a subset of measures that can be applied to sources on-site, namely, only those measures that result in heat-rate improvements ("HRI") at individual coal-fired power plants. As EPA's own analysis concedes, its proposed 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. But the end result will be fewer emission reductions, billions of dollars lost in foregone benefits, and far fewer public health benefits than what the CPP would have yielded.

Collectively and individually, we have decades of experience and significant expertise in this area.[2] In this comment letter, we support our opposition to the ACE proposal with information about (1) how the interconnected electric grids work and how effective pollution controls acknowledge their distinctive characteristics; and (2) how the ACE proposal's failure to account for grid characteristics results in costlier, less effective regulation.

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

Effect pollution control regimes work with, rather than fight against, fundamental characteristics of the power sector. It is important, therefore, to understand the operations of the electricity grids when considering any replacement rule for the CPP.

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[2] Signatories of this letter include Benjamin F. Hobbs, Brendan Kirby, Kenneth J. Lutz, and James D. McCalley. 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 and chair of the California ISO Market Surveillance Committee; his research focuses on electric power and energy market planning, risk analysis, and environmental and energy systems analysis and economics. Brendan Kirby worked at the Oak Ridge National Laboratory and is a private consultant with clients including the Hawaii Public Utilities Commission, National Renewable Energy Laboratory, and others. He has forty-three 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 Affiliated Professor in the Department of Electrical and Computer Engineering at the University of Delaware, where he does research and 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. 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 exhibit appended to this letter.

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 while maintaining reliability and minimizing costs.

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).

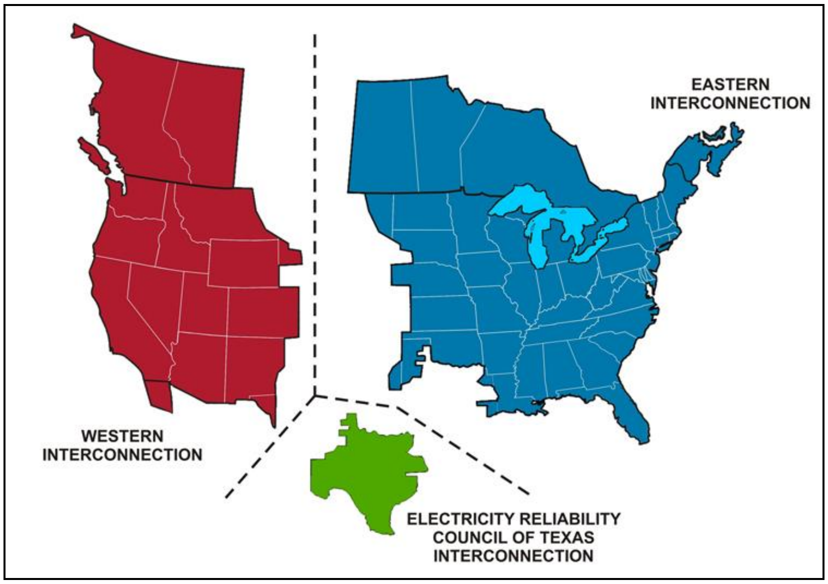
Electricity that generators add to the grid energizes the entire grid. Generators do not "generate" electrons and consumers do not "consume" electrons, as is commonly believed—electric power is injected into and withdrawn from the grid. An electromagnetic wave, propagated by generators, moves at the 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]

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.

[3] Hawaii and Alaska have their own grids.
[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).

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.

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. 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, LAND USE AND ENVIRONMENTAL JUSTICE 19 (Oak Ridge National Laboratory, Jan 4, 2017);[5] 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)[6]. 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,*

[5] *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

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

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.[7] 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 power, first. Since 2009, the RGGI states have received virtually all of the nearly $2.8 billion in proceeds from CO_2-allowance auctions and disbursed them back into the economy without sacrificing reliability. *See* PAUL HIBBARD ET AL., THE ECONOMIC IMPACTS OF THE REGIONAL GREENHOUSE GAS INITIATIVE ON NINE NORTHEAST AND MID-ATLANTIC STATES 1-2 (2018).[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. REGIONAL GREENHOUSE GAS INITIATIVE, THE INVESTMENT OF RGGI PROCEEDS IN 2015 p. 6 tbl.1 (Oct. 2017).

II. The ACE Proposal's Constrained Approach to Pollution Control Does Not Make Sense for Power-Sector CO_2.

The ACE Rule is not a sensible program for controlling future emissions from the power sector. As compared with the status quo of the CPP, the ACE Rule would increase pollution, decrease net benefits, and significantly worsen health outcomes—all while potentially *adding to* the compliance costs of industry, as explained below. These flaws result from EPA's overly constrained approach to regulating CO_2 emissions from power plants, an approach that fails to reflect and accommodate the nature of the U.S. power system.

Because of the fundamental grid characteristics discussed in Section I above, the most cost-effective CO_2 emissions reductions can be achieved over the coming decades by encouraging the displacement of generation from carbon-intensive sources. Successful CO_2-reduction policies to date have harnessed the interconnected nature of the power system to facilitate shifts away from high-emitting generators.[9] Such policies have contributed to significant cost-effective emissions

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[7] The State of New Jersey is in the process of rejoining RGGI; once it does, the number of RGGI members will be ten.

[8] *Available at* http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf.

[9] Ten states already participate in CO_2 trading programs, and 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).

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) (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 emissions reductions in ten states). The CPP recognizes these dynamics by defining BSER to include shifts to lower-carbon generation, reflecting current industry best practices to reduce a distinctive pollutant, CO_2, from the uniquely interconnected power sector.

By contrast, the ACE proposal would define the Best System of Emission Reduction to include only certain changes to the physical equipment at generating units, namely, heat-rate improvements at coal-fired power plants. "Emissions Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emissions Guideline Implementing Regulations; Revisions to New Source Review Program," 83 Fed. Reg. 44746 at 44755 (Aug. 31, 2018). It excludes from the definition of BSER other on-site measures, such as reduced utilization of the highest-emitting plants and co-firing/fuel switching, each of which can be accomplished on site but is rejected in EPA's proposal. *Id.* at 44752, 44762. In excluding these and other measures, EPA unnecessarily defines as out-of-bounds a broad set of pollution controls that industry typically uses to reduce emissions from the grid cost-effectively.

For example, decreased utilization of the highest-emitting plants strikes us as an "on-site" measure that could reduce emissions cost-effectively in line with usual grid operations, but which is needlessly excluded from this proposal. EPA rejects it as "not a valid system of emission reduction for purposes of establishing a standard of performance." 83 Fed. Reg. at 44752. To the contrary, evidence and history suggest that reducing reliance on high-emitting sources and substituting in generation from lower-emitting sources is the most usual, practical, and effective means of reducing pollution from the power sector, especially for CO_2. *See supra* Section I.d. Although EPA expresses some concern that generation-shifting would harm grid reliability (83 Fed. Reg. at 44754), this was not the case with the present sulfur dioxide and nitrogen trading systems and is not the case with the likely generation shifts that the CPP would encourage.[10]

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. 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.

[10] For example, PJM Interconnection completed a 30-day reliability study of FirstEnergy Solutions' (FES) proposed 4GW of coal and diesel plant retirements and concluded that the shutdowns can proceed without impacting reliability. Robert Walton, *PJM: FirstEnergy can shut 4 GW of fossil plants without harming reliability*, UTILITY DIVE (Oct. 2, 2018), https://www.utilitydive.com/news/pjm-firstenergy-can-shut-4-gw-of-fossil-plants-without-harming-reliability/538618/; *see also Generation Deactivation Notification Update*, PJM (May 3, 2018), available at https://www.pjm.com/-/media/committees-groups/committees/teac/20180503/20180503-teac-generation-deactivation-notification.ashx. The U.S. power sector has successfully managed large amounts of renewable power without adverse reliability effects, and technical studies have concluded the sector can integrate even more

Because of the limitations of EPA's new, proposed BSER definition, the ACE Rule would not effectively and economically reduce power-sector CO_2 emissions over the coming decades. This conclusion is supported by the ACE proposal itself and its Regulatory Impact Analysis ("RIA"), which show each of the following:

The ACE Rule Increases Pollution Compared to the CPP: In each of the scenarios reported by EPA and in every year considered, swapping out the CPP for the ACE Rule would result in significantly greater emissions of CO_2, SO_2, and NOx pollution. 83 Fed. Reg. at 44784, Table 6.[11] Much of this additional pollution would be focused in the Midwest and Mid-Atlantic regions. RIA, Figure 4-5.

The ACE Rule Harms Public Health and Results in Thousands of Deaths the CPP Would Prevent: Because it would increase particulate matter and ozone pollution, the ACE Rule would harm public health significantly, including by resulting in thousands of additional deaths as compared with the CPP. EPA estimates, for example, that in the year 2030 alone somewhere between 350 and over 1000 people will die from exposure to particulate matter and ozone whose deaths would have been avoided under the CPP. RIA, Table 4-6 (considering estimated incremental PM 2.5 and ozone-related premature deaths in 2030, looking at three ACE implementation scenarios as compared with the CPP). Those deaths will be concentrated in the Midwest and Mid-Atlantic regions. RIA, Figure 4-5.

The ACE Rule Likely Costs Industry About as Much as the CPP to Comply, Maybe More: Despite achieving far less pollution control than the CPP, the ACE Rule will likely impose similar, or perhaps even greater, compliance costs. EPA modeled compliance costs to industry for the ACE Rule as compared with the CPP base case. 83 Fed. Reg. at 44786, Table 9. Compliance costs include total power sector generating costs plus the costs of monitoring, reporting, and recordkeeping. In this modeling, EPA considered three ACE Rule implementation scenarios. In only one of those three cases did the ACE Rule result in significant savings from the CPP base case. In another, the costs of compliance between the two programs were very similar. And in the third scenario, complying with the ACE Rule actually costs industry *more than* complying with the CPP while producing significantly fewer emissions reductions. *Id*.

The ACE Rule Forgoes Billions of Dollars in Net Benefits: In six of six scenarios modeled and at all time periods reported, swapping out the CPP for the ACE Rule results in billions fewer dollars in net benefits. 83 Fed. Reg. at 44794, Table 18. This is true both in net present

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without significant reliability impacts. *See, e.g.*, GE ENERGY, PJM RENEWABLE INTEGRATION STUDY, COVER LETTER 1 (2014) (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) (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) (finding that the Western Interconnection could maintain reliability with 35% wind and solar generation).

[11] *See also* Regulatory Impact Analysis ("RIA"), Table ES-7, *available at* https://www.epa.gov/sites/production/files/2018-08/documents/utilities_ria_proposed_ace_2018-08.pdf.

value and annualized terms. *Id.* It also is hardly surprising, given the high costs of compliance but fewer environmental and public health benefits outlined above.

These comparisons between the ACE Rule and the CPP highlight how difficult it is to craft a rational regulation to reduce power sector CO_2 using only the hyper-constrained BSER measures that EPA adopts in this proposal.

Even on its own terms and compared to a baseline without the CPP in place, the ACE Rule wouldn't accomplish much. The Regulatory Impact Analysis shows that the ACE Rule would have very little impact on emissions of CO_2 and other pollutants, relative to the no-CPP baseline. 83 Fed. Reg. at 44784, Table 7. It also shows modest net societal benefits at best, and net costs in several scenarios. 83 Fed. Reg. at 44795, Table 20. This lack of overall efficacy is not surprising. Not much is accomplished for pollution control by increasing efficiency through limited measures at individual facilities. This is partly because efficiency upgrades can result in something called the "rebound effect" that limits the efficacy of those measures by increasing reliance on the dirtiest generation sources. In our April letter, we noted that use of HRI 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). In its ACE proposal, EPA concedes that "sources that adopt HRI may increase generation, due to their improved efficiency," but then asserts that this increase in generation will not result in an overall emissions increase. 83 Fed. Reg. at 44761. Whether or not the rebound effect largely or entirely negates the gains won through efficiency measures, it certainly undercuts the efficacy (and cost-effectiveness) of the rule. In contrast, the caps that states would place on emissions tonnage or overall system emissions rates under the CPP cannot, by definition, result in increased emissions due to rebound.

Moreover, the ACE Rule risks ever further significant emissions increases due to its proposed changes to the New Source Review (NSR) program. EPA would give states the option of considering only hourly rates of emissions when evaluating whether modifications to power plants result in higher emissions and trigger the need for new pollution-control equipment—rather than considering total cumulative emissions, as current law does. 83 Fed. Reg. 44780. The effect of this change could be significant and troubling. Because of the rebound effect described above, by which sources installing BSER upgrades become more attractive to the grid, sources could increase their hours of operation and thus increase their cumulative emissions without increasing their hourly *rate* of emissions. Under the proposed reforms to NSR, some sources that increase their cumulative emissions would be able to skip the environmental review that would normally require the installation of air pollution control technologies to counteract those increases. *See* Meredith Hankins, *The Clean Power Plan Replacement Comes With a Major Change to NSR*, LegalPlanet.org, Aug. 21, 2018.[12]

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[12] *Available at* http://legal-planet.org/2018/08/21/the-clean-power-plan-replacement-comes-with-a-major-change-to-nsr-part-1/.

In sum, the details of the ACE Rule affirm that it makes little sense, as EPA proposes, to consider only certain CO_2 emissions reduction measures within the ephemeral boundaries of individual facilities, when all facilities deliver undifferentiated power to unitary grids.

III. Conclusion

The ACE Rule reflects an artificially constrained approach to regulating CO_2 emissions from power plants, one that fights against the operations of the U.S. power system. The rule is markedly less effective than the CPP and reduces pollution only negligibly even from a no-CPP baseline. It is, at the same time, likely just as costly (or more) to industry and significantly more costly to society as a whole, forgoing billions of dollars in net benefits if the CPP is replaced by the ACE Rule. We oppose the proposal.

Sincerely,

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With and on behalf of:

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Exhibit: Credentials of Grid Experts

1. Grid Experts 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.

2. Benjamin Hobbs is the Theodore M. and Kay W. Schad Professor in Environmental Management in the Department of Geography and Environmental Engineering at Johns Hopkins University. He has a joint appointment in the Department of Applied Mathematics and Statistics, and directs the Johns Hopkins University Environment, Energy, Sustainability and Health Institute. His research focuses on electric power and energy market planning, risk analysis, and environmental and energy systems analysis and economics. He is Chair of the California Independent System Operator Market Surveillance Committee and a Fellow at the Institute of Electrical and Electronics Engineers ("IEEE") and the Institute of Operations Research and Management Science. He was also a consultant to the PJM Independent System Operator and developed the methodology it uses to evaluate the capacity market demand curve. From 1995 to 2002, he was consultant to the Federal Energy Regulatory Commission's Office of the Economic Advisor. He holds a Ph.D. in Civil and Environmental Engineering from Cornell University.

3. Brendan Kirby is a private consultant with clients including the Hawaii Public Utilities Commission, National Renewable Energy Laboratory, Utility Variable-Generation Integration Group, Electric Power Research Institute, American Wind Energy Association, Oak Ridge National 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 integrating renewable energy generation into the power grid. He is a member of the North American Electric Reliability Corporation's Essential Reliability Services Task Force, and previously served on its Standards Committee. He retired from the Oak Ridge National Laboratory's Power Systems Research Program. He is a Licensed Professional Engineer with an M.S. degree in Electrical Engineering (Power Option) from Carnegie-Mellon University and a B.S. in Electrical Engineering from Lehigh University.

4. Kenneth J. Lutz is an Affiliated Professor in the Department of Electrical and Computer Engineering at University of Delaware, where he does research and teaches a specially designed course on the smart grid. He has decades of experience in the regulation of utilities. He founded AMR Strategies, LLC, to help utilities modernize their grids. Previously, he served as an IEEE/American Association for the Advancement of Science Congressional Fellow for United States Senator Ron Wyden, where he played a key role in drafting federal legislation for renewable energy and energy efficiency. He has a Ph.D. in electrical engineering from the Johns Hopkins University and a B.E.E. from the University of Delaware.

5. James D. McCalley is the London Professor of Power System Engineering in the Electrical and Computer Engineering Department at Iowa State University. He has graduated twenty-eight Ph.D. students under his supervision and 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, including those encountered in operations and planning. Dr. McCalley has been an IEEE Fellow since 2004. He chaired the IEEE Power and Energy Society's

Subcommittee on Risk, Reliability, and Probability Applications from 2004 to 2006. He has been involved in the International Conference on Probabilistic Methods Applied to Power Systems (PMAPS) since PMAPS-4 in 1994 and served as General Chair of PMAPS-8. Prior to joining the Iowa State University faculty, from 1985 to 1990, he was a Transmission Planning Engineer with Pacific Gas and Electric Company in San Francisco, California, and a licensed professional engineer. He holds Ph.D., M.S., and B.S. degrees in electrical engineering from the Georgia Institute of Technology.