

Cost-Benefit Politics in U.S. Energy Policy

David E. Adelman* and David B. Spence⁺

The political economy of energy policy in the United States is dominated by partisanship and industry lobbying. Both are reflected in the widespread belief that the Environmental Protection Agency (EPA) is engaged in a misguided “war on coal”—despite decades of regulatory delays, the coal industry’s status as the leading industrial source of air pollution, and compelling evidence that the benefits of EPA’s regulations vastly exceed their costs. The politics are compounded by tensions between electricity managers and environmental regulators. Much of this is driven by competing perspectives: EPA tends to have a national focus, whereas grid managers operate regionally. This Article resolves the apparent conflicts by downscaling the regulatory analyses of three high-profile EPA rules that cover conventional pollutants, air toxics, and greenhouse gases associated with climate change. We utilize complementary EPA databases and draw on several model estimates to examine the regional impacts, both costs and benefits, of regulations targeting coal-fired power plants.

Overall we find little evidence of significant regional disparities, as the distribution of compliance costs and benefits is roughly commensurate with each regions’ reliance on coal-fired power, and particularly older facilities. This result follows naturally from the benefits of reducing emissions under these rules being predominantly local; as a consequence, regulatory benefits exceed costs at the regional level and typically by large margins. Further, with a few important caveats, we find that while the EPA rules will encourage many power-plant closures, most will occur in electricity markets that have sufficient excess capacity to mitigate potential threats to electricity supplies and reliability. We conclude that while interest group opposition and political partisanship are clearly both important in this context, the latter appears to hold greater sway based on varying levels of political opposition regionally and may—incrementally—be shifting in EPA’s favor.

* Harry Reasoner Regents Chair in Law, University of Texas at Austin School of Law.

⁺ Professor of Law, University of Texas at Austin McCombs School of Business and School of Law. Professor Spence would like to thank Kelly Cavnar-Johnson for her research assistance in the preparation of this article.

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Energy policy in the United States is shaped by ideological conflicts between the political parties and powerful corporate interests with large assets at stake. While the increasing polarization of American politics is well recognized,¹ conflicts over regulation of the energy sector are especially sharp. The Environmental Protection Agency’s (EPA) regulation of electric utilities has become a focal point of this partisan divide and an ideological litmus test for congressional campaigns.² It is also emblematic of the broader trends in congressional politics, characterized by a shift from norms of cooperation among centrists of both parties in the 1970s

¹ For a good overview of the various theories of congressional polarization, see SEAN M. THERIAULT, PARTY POLARIZATION IN CONGRESS (2008); JOHN H. ALDRICH, WHY PARTIES? THE ORIGINS AND TRANSFORMATION OF POLITICAL PARTIES IN AMERICA (1995); KEITH T. POOLE & HOWARD ROSENTHAL, CONGRESS: A POLITICAL ECONOMIC HISTORY OF ROLL CALL VOTING (1997); Morris P. Fiorina & Samuel J. Abrams, *Political Polarization in the American Public*, 11 ANN. REV. POL. SCI. (2008); Morris P. Fiorina, *Paper presented at the Midwest Political Science Association Annual Meeting at Chicago, Illinois, Whatever Happened to the Median Voter?* (Apr. 15–17, 1999).

² Bloomberg reports more than 12,000 anti-EPA ads and more than 25,000 pro-coal ads aired in 2014 Senate campaigns, as against about 5,000 pro-EPA ads and another 12,000 pro-clean energy ads. See *722,023 Ads—And Counting*, BLOOMBERG POLITICS, 2014, available at: <http://www.bloomberg.com/politics/graphics/2014-senate-ads-and-issues/>.

and 80s to the dominance of bitter partisanship today.³ In the 1970s, for example, a Republican president created the EPA⁴ and a Democratic president oversaw the deregulation of natural gas prices.⁵ Similarly in the 1980s and early 90s, a bipartisan Congress addressed the problems of acid rain and the global threat of ozone losses in the stratosphere,⁶ and a Republican president ran for reelection as the “environmental president.”⁷ Today, the parties are more ideologically homogenous than at any time in the post-war era, and further apart on issues that concern the regulation of the energy industry, most notably climate change.⁸

Growing partisanship is central to the political stalemate that exists over national policies at the intersection of energy and the environment, and regulation of coal-fired power plants is its focal point. Congressional gridlock has caused the locus of policymaking to revert to the executive branch and the courts.⁹ This movement has incited a backlash in Congress, where EPA’s efforts to regulate emissions from coal plants are commonly portrayed as a “war on coal” and a regulatory “train wreck.”¹⁰ In substance, the debate reflects the contrasting visions of energy policy that growing partisanship has cultivated between the political parties: One vision, more associated with Democrats and the ideological left, is premised on transitioning away from fossil fuels and toward cleaner modes of generating electricity; another vision, more associated with Republicans and the ideological right, is that alternative sources of energy are antithetical to energy security and economic prosperity. These opposing visions are infused with deeper partisan conflicts over the role of government in the economy.¹¹

³ The most widely-cited data on the ideological polarization in Congress are those assembled originally in Keith Poole and Howard Rosenthal’s DW-NOMINATE dataset, which places members of Congress on an ideological spectrum based upon members’ voting behavior. See NOLAN MCCARTHY, KEITH T. POOLE, AND HOWARD ROSENTHAL, *POLARIZED AMERICA: THE DANCE OF IDEOLOGY AND UNEQUAL RICHES* (2006). For a striking visual illustration of polarization in Congress, see Nolan McCarty, Keith T. Poole, and Howard Rosenthal, Voteview.com, <http://voteview.com/polarizedamerica.asp>.

⁴ Richard Nixon established the EPA from parts of other agencies, by executive action in 1970. See U.S. EPA, *The Guardian: Origins of the EPA* (1992), available at: <http://www2.epa.gov/aboutepa/guardian-origins-epa#agency>.

⁵ Jimmy Carter signed into law the Natural Gas Policy Act of 1978, 15 U.S.C. 3301 et seq., which deregulated wellhead prices in the hopes of stimulating more exploration for natural gas. For a description of the early effects of the Natural Gas Policy Act, see Richard J. Pierce, Jr., *Reconsidering the Rules of Regulation and Competition in the Natural Gas Industry*, 97 HARV. L. REV. 345 (1983).

⁶ Pub. L. 101-549, Nov. 15, 1990, Clean Air Act, Title IV, 42 U.S.C. Sec. 7651 et seq.

⁷ This was George H.W. Bush in 1992. See LESLIE DALE FELDMAN, ROSANNA PEROTTI, HONOR AND LOYALTY: INSIDE THE POLITICS OF THE GEORGE H.W. BUSH WHITE HOUSE (2002).

⁸ For example, Republican leaders in Congress continue to express skepticism about climate science, and oppose GHG regulation on that basis, despite an overwhelming scientific consensus that the climate is warming largely as result of human energy consumption. Ned Resnikoff, *Senate committee again debates existence of climate change*, MSNBC, January 17, 2014, <http://www.msnbc.com/all/senate-republicans-what-climate-change> (in which Senator Jim Inhofe repeated his views that climate change science is a hoax). See, e.g., Nat’l Climate Assessment and Dev. Advisory Comm., *Introduction to Federal Advisory Committee Draft Climate Assessment*, 1 (Jan. 14, 2013), available at <http://ncadac.globalchange.gov/>; Intergovernmental Panel on Climate Change, *Climate Change 2013: The Physical Science Basis – Summary for Policymakers* (2013) at 15, 23.

⁹ For a detailed examination of this phenomenon, see Jody Freeman and David B. Spence, *Old Statutes, New Problems*, 163 U. PENN. L. REV. 1 (2014).

¹⁰ See e.g., James E. McCarthy and Claudia Copeland, *EPA’s Regulation of Coal-Fired Power: Is a ‘Train Wreck’ Coming?*, Congressional Research Service, Aug. 8, 2011, available at: <http://www.lawandenvironment.com/uploads/file/CRS-EPA.pdf>.

¹¹ Poole and Rosenthal describe the ideological divide captured by their data as one centered on the role of government intervention in the economy. See, e.g., McCarty et al., *supra*, at *Party Polarization 1879-2013*.

The ideological barriers to constructive policymaking are compounded by severe interest-group politics in the electric utility sector. The power of private opposition to EPA's rules is driven in part by the disparities between the concentration of regulatory costs in a single industry and diffuse benefits that are shared by the wider public. The rules at the center of this debate require fossil-fueled power plants to reduce emissions of pollutants associated with a long list of adverse health and environmental impacts. The addition of new controls will lower the incidence of asthma, birth defects, and thousands of premature deaths annually;¹² it will also reduce power plant emissions of greenhouse gases (GHGs) that contribute to climate change. The political economy of EPA's rules is made more challenging by the high stakes. Power plants are the largest industrial sources of major air pollutants (including GHGs) in the U.S.,¹³ and EPA's rules represent a genuine threat to the economics of the coal industry. The new rules, along with rising competition from natural gas-fired power, put coal-industry and electric utility jobs at risk, and are projected to prompt the closure of many coal plants. Moreover, the potential impacts are not limited to the coal sector; several recent studies suggest that retirements of coal plants could undermine the reliability of the electric grid as well.¹⁴

The EPA has defended its rules on the ground that their benefits exceed the respective costs by a wide margin.¹⁵ However, the agency's arguments are based on national averages and therefore ignore disparities in the geographic distribution of the costs and benefits for each rule. This is problematic because the costs will not be evenly spread. In particular, coal-fired power plants at risk of closure are concentrated in the Midwest and southeast, and coal-producing regions are located in just a few eastern and western states. The perceived salience of such geographic disparities is enhanced by the temporal lags that exist between the costs and benefits of EPA's rules. The economic costs (including job losses) are near-term and fall on identifiable individuals, whereas the benefits will accrue in the future to people whom we can count but cannot identify—those who will *avoid* an illness or premature death. EPA is therefore advancing the very kind of “concentrated costs/diffuse benefits” policies that political scientists have long recognized as posing the greatest challenges politically.¹⁶ As a consequence, opposition to EPA's rules¹⁷ has two distinct sources—ideologically opposed Republicans *and* interest-group driven coal-state Democrats.¹⁸

¹² For a fuller description of these effects, *see infra* section I.A.

¹³ David E. Adelman, *Environmental Federalism when Numbers Matter More than Size*, 32 U.C.L.A. ENVTL. L. REV. 238, 287-88 (2014) (noting that in 2005 electric utilities accounted for 90 percent of the SO₂ emissions from industrial sources, 82 percent of the NO_x emissions, and 63 percent of the PM_{2.5} emissions).

¹⁴ For a fuller description of these economic impacts, *see infra* section III.

¹⁵ *See* the discussion of EPA's cost-benefit estimates, *infra*, at section I.

¹⁶ Political scientist James Q. Wilson is often credited with explaining the political difficulty of enacting these kinds of regulatory policies. *See* James Q. Wilson, *The Politics of Regulation* 85-87, IN THE POLITICAL ECONOMY: READINGS IN THE POLITICS AND ECONOMICS OF AMERICAN PUBLIC POLICY (THOS. FERGUSON, ED. 1984).

¹⁷ *See* Nick Wing, *Joe Manchin Shoots Cap and Trade Bill With Rifle in New Ad*, HuffPost Politics, October 11, 2010, available at: http://www.huffingtonpost.com/2010/10/11/joe-manchin-ad-dead-aim_n_758457.html; and Jean Chemnick, *The Evolution of a Coal State Senator*, The New York Times, January 18, 2011, available at: <http://www.nytimes.com/gwire/2011/01/18/18greenwire-jay-rockefeller-the-evolution-of-a-coal-state-s-4772.html?pagewanted=all>.

¹⁸ *See* Carolina May, *Obama on EPA Rule: Obama Administration 'Deniers'*, Breitbart, June 3, 2014, available at: <http://www.breitbart.com/Big-Government/2014/06/03/Manchin-on-EPA-Rule-Obama-Administration-Deniers> (describing Senator Manchin's opposition to the EPA rule).

Our purpose here is to examine the relationship between the projected costs and benefits of the EPA rules, on the one hand, and the politics surrounding their adoption, on the other. This analysis uses publicly available data from several EPA data sets¹⁹ to explore the geographic distribution of the costs and benefits of the EPA rules. We begin in Part I by examining the factual and historical basis of EPA’s complex suite of regulations. After briefly describing the virtues of coal-fired power in American electricity markets and the externalities associated with its air emissions, we review the Clean Air Act (CAA) rules that comprise the bulk of EPA’s alleged “war” on coal-fired electricity generation.

In Part II we discuss a recent series of reports analyzing the potential effects of EPA’s rules on management of the electric grid and the reactions of electricity regulators and other stakeholders to these rules. The discussion focuses on the perspectives of regulators whose mission is guided by the broader public interest, as opposed to nongovernmental actors with an economic or organizational interest that predisposes them to either favor or disfavor the EPA rules. We find that most of this commentary raises significant technical questions and is strongly or cautiously negative, but not all of it—substantial variation exists in the degree of concern expressed by federal, regional, and state officials. What is unmistakable in the comments is a widespread concern about the potential threats to reliable electricity supplies and the importance of regulatory flexibility to maintaining grid stability.

In Part III we utilize several complementary EPA datasets to provide a detailed picture of coal-fired power generation in the American electric utility sector. Drawing on existing studies and our own work, we examine the types and geographic distribution of coal plants at risk of closure under the new EPA rules. Our analysis shows that (i) while the impacts of the EPA rules are not uniform across wholesale power markets, they are typically proportional to each region’s reliance on coal-fired power; (ii) in the few instances where a region’s share of the costs of a rule is greater than its share of coal-fired generation capacity nationally, the region’s fleet is older, smaller, and higher-polluting; (iii) regions that bear the highest costs receive the greatest benefits because the health benefits of the EPA rules are predominantly local; and (iv) the net benefits of EPA’s rules are positive—and typically by large margins—not just nationally, but in every regional power market. With regard to grid stability, the data reveal that with the exception of the Texas wholesale market, the regions projected to have the greatest numbers of coal plant closures have significant excess generation capacity to mitigate these losses. In short, we find little evidence to oppose EPA’s rules on either economic or distributional grounds.

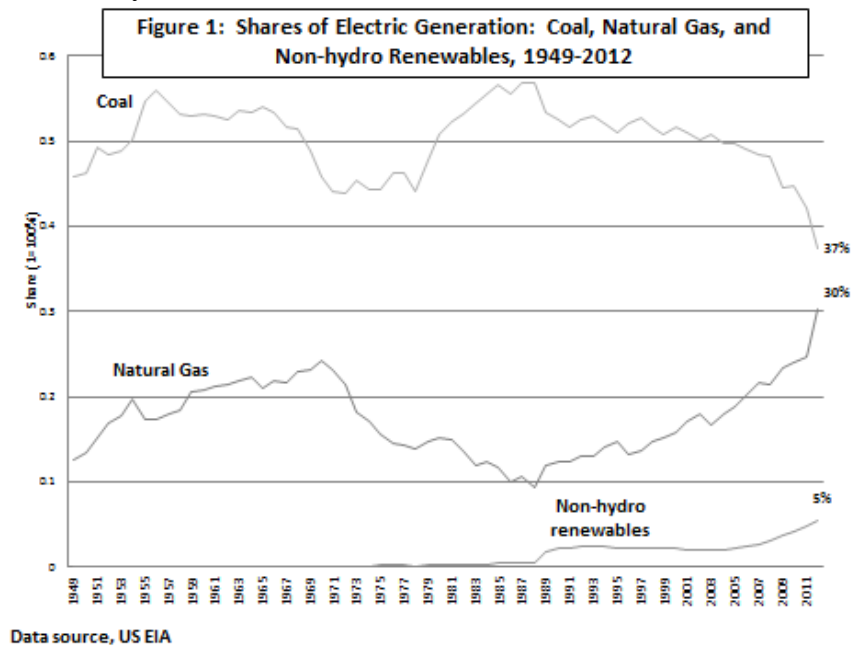
Finally in Part IV we explore the political economy of EPA’s rules in greater detail to answer the following question: Why are the highly favorable net benefits of EPA’s rules at the national and regional levels failing to foster a more constructive public debate and to mitigate the influence of ideological and interest-group politics? To answer this question, we explore the variation in state and regional positions on the EPA rules. We note that some state and regional opposition to the rules is consistent with interest group politics, and the notion that concentrated economic costs (or the risk of such costs in the form of reliability risks) loom larger in the policy process than diffuse environmental benefits. However, some of the regions and states hit hardest by the risk of plant closures have raised far stronger objections than others, and much of the

¹⁹ The data analyses presented below utilize data drawn from EPA’s Integrated Planning Model (IPM) datasets for the MATS and CSAPR rules, IPM 4.10, and the more recent dataset for the CPP, IPM 5.13. We analyze data from the IPM 4.10 and 5.13 Base Cases, as well as the datasets EPA generates for each rule assuming it is implemented. The details of the analysis are described further in Section III.

variation in state and regional position-taking on the rules seems more consistent with state and regional ideological differences than with interest group pressure.

I. The Evolution of Regulations Governing Coal-Fired Generation

Coal has traditionally claimed the lion’s share of the American electric generation supply because of its low cost, large domestic reserves, and reliability.²⁰ These characteristics make it exceptionally attractive to grid managers as source of electricity—none of the other generation technologies has had such a powerful combination of stabilizing attributes. However, coal has lost market share to natural gas and renewables in recent years, as Figure 1 indicates. Historically coal-fired and nuclear power plants have had high capacity factors,²¹ while other technologies have been used to serve daily or seasonal peaks in demand. For this reason, we characterize coal-fired and nuclear power as “base load technologies” that run most of the time and thus have high “capacity factors.”²² Generation sources are distinguished on these bases because power is dispatched to the grid on an as needed basis to serve load; accordingly, plants with the lowest marginal costs are dispatched first, subject to the need to avoid grid congestion and to maintain reliability.²³



²⁰ The U.S. has the largest coal reserves in the world, amounting to more than one fourth of economically proven reserves globally. The technologies underlying coal generation are very well established and robust, and coal has the substantial virtues of being easy to transport and stockpile at generation plants, which further enhances its reliability as a fuel for electricity generation. International Energy Agency, International Energy Statistics, Total Recoverable Coal, available at: <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=1&pid=7&aid=6>.

²¹ A plant’s “capacity factor” is the percentage of time it is dispatching power to the grid. For example, if a plant is dispatching power to the grid during 7888 of the 8765 hours in a year, its capacity factor is 0.90.

²² A base load plant may have a capacity factor of 75%, meaning that it is operating and dispatching power to the grid 75% of the time during the year. A peaking plant may have a capacity factor as low as 5%.

²³ This rule of operation is referred to as “security-constrained economic dispatch” (SCED). See FERC, SECURITY CONSTRAINED ECONOMIC DISPATCH: DEFINITION, PRACTICES, ISSUES AND RECOMMENDATIONS 5 (2006), available at <http://www.ferc.gov/industries/electric/indus-act/joint-boards/final-cong-rpt.pdf>.

A. Widespread Health and Environmental Impacts

A growing number of studies is revealing that the technical and economic virtues of coal-fired power are overshadowed by their singularly large pollution externalities. Coal combustion produces a variety of air pollutants, including: (1) carbon dioxide (CO₂), the most common greenhouse gas (GHG); (2) sulfur dioxide (SO₂), a precursor of acid rain and particulate matter; (3) nitrogen oxides (NO_x), precursors of both acid rain and ground-level ozone (smog); (4) other forms of particulate matter (PM), a major contributor to premature human mortality; and (5) mercury (Hg), a neurological toxin. Coal-fired power plants are the largest industrial sources of each of these pollutants, and the largest source period of SO₂ and mercury in the United States.²⁴ As Table 1 indicates, coal plants emit nearly twice the CO₂ and many times the NO_x, PM, and SO₂ as power plants that use other fossil fuels to generate electricity.²⁵

Table 1: Air Emissions from Combustion of Different Fossil Fuels

Pollutant	Source (lbs/Billion Btu)		
	Natural Gas	Oil	Coal
Carbon Dioxide	117,000	164,000	208,000
Nitrogen Oxides	92	448	457
Sulfur Dioxides	0.6	1122	2591
Particulates	7	84	2744

Source: EIA 1998

Coal combustion produces more harm to human health and the environment than any other industrial source. A 2009 National Academy of Sciences study estimated the annual non-climate related external damages from coal-fired power plants to be \$62 billion, representing about 30 percent of the average retail price of electricity.²⁶ A more comprehensive 2011 study, reported in the *American Economic Review*, quantified the damages from conventional air pollutants for 820 industries.²⁷ The authors found that the net benefits²⁸ of 7 industries (including coal-fired power) were negative,²⁹ and that coal-fired power plants produced by far

²⁴ According to EPA's 2009 National Emissions Inventory, coal combustion accounts for about 50% of mercury emissions, and 60% of sulfur dioxide emissions in the United States.

²⁵ U.S. EPA, Clean Energy: Air Emissions, available at: <http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html>. Of course, nuclear power and renewable generation produce none of these emissions, though all forms of generation produce emissions when we consider the full life cycle of the technology.

²⁶ National Academy Of Sciences, Press Release: Report Examines The Health and Environmental Costs of Energy Production and Consumption in U. S. (October 19, 2009), URL: <http://www.usclimatenetwork.org/resource-database/NAS%20study%20on%20costs%20of%20energy.pdf>. In Clean Air Act parlance, "conventional" pollutants are distinguished from toxic pollutants like mercury, and from GHGs.

²⁷ Nicholas Z. Muller, Robert Mendelsohn, and William Nordhaus, *Environmental Accounting for Pollution in the United States Economy*, 101 AM. ECON. REV. 1649 (2011).

²⁸ More precisely, the authors expressed the results in terms of net costs – the ratio of environmental damages to value added for each industry.

²⁹ Muller, *et. al*, *supra* note 27, at 1665 (Table 2). The ratio of environmental damage to value added was higher for oil fired generation (5.13) and from coal-fired generation (2.20), and higher still for solid waste combustion and

the largest environmental damages (estimated at \$53 billion per year).³⁰ Similarly, a second 2011 study conducted by public health experts calculated that the annual lifecycle health and environmental costs of coal to the American public were as high as half a *trillion* dollars,³¹ and “conservatively” estimated that internalizing them would “double or triple” the price of electricity generated from coal.³² These harms are orders of magnitude greater than those produced by other electric generation sources.³³ In terms of the overall U.S. economy, “[c]oal plants are responsible for more than one-fourth of [gross environmental damage] (GED)” and the coal sector causes harms that are “larger than the combined GED due to the three next most polluting industries.”³⁴

Emissions from the American coal plants also represent significant contribution to the harms from coal-fired generation globally. According to the World Bank, just three countries—the U.S., China, and India—accounted for almost 70 percent of the electricity generated globally from coal in 2010, while the countries outside the top ten collectively accounted for just 13 percent of the global total.³⁵ Per capita the U.S. is more reliant on coal than any of the other leading countries; even China’s per capita coal generation is only about 40 percent of that in the U.S.³⁶ Moreover, China, India, and the United States are projected to dominate the global market for coal and coal-fired generation for the foreseeable future,³⁷ with U.S. per capita generation continuing to exceed the levels in China and India by a substantial margin.³⁸ It is against this backdrop that we consider recent efforts to address emissions from coal combustion in the U.S., the wealthiest of the big three coal-fired power producers.

The widespread harms associated with coal-fired power reflect major gaps in the Clean Air Act (CAA) regulatory regime. Although Congress and the EPA have enacted regulations to cover most of the major air pollutants emitted by coal plants, the regulations exempt many plants—often through lax grandfathering provisions—and emissions levels still vary greatly between plants. The 45-year history of CAA is replete with battles in Congress, the executive

incineration (6.72). However, the ratio for natural gas-fired generation was less than .10, denoting a positive and if the cost ratio for that industry. *Id.*, at 1664.

³⁰ *Id.* The next largest amount of environmental damage was associated with the livestock production industry, at \$14.8 billion. By contrast, the authors estimated environmental damages from natural gas-fired production to be less than \$1 billion per year. *Id.*, at 1669.

³¹ Paul R. Epstein, et al., *Full Cost Accounting for the Life Cycle of Coal in “Ecological Economics Reviews,”* 1219 ANN. N.Y. ACAD. SCI. 73 (2011).

³² *Id.*

³³ Epstein *et al.* put the number of annual deaths from coal at 13,200. *Id.* at 91. Researchers at NASA and Columbia University estimate that nuclear power has averted 1.84 million air pollution related deaths worldwide that would have resulted from fossil fuel combustion but for reliance on nuclear energy. See Pushker A. Kharecha and James E. Hansen, *Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power*, 47 ENVTL. SCI. & TECHNOL. 4889 (2013).

³⁴ Muller, *et. al.*, *supra* note 27, at 1667.

³⁵ World Bank Database <<http://data.worldbank.org/indicator>>.

³⁶ India is an outlier here with just 0.53 MWh/person generated from coal in contrast to the 6.45 MWh/person in the United States, making per capita generation from coal twelve times greater than in India. Further, in terms of per capita reliance on coal-based electricity, only Australia generated more from coal per capita than the United States, but it generates less than one-tenth the quantity of electricity annually.

³⁷ Matthias Finkenrath, *et al.*, *CCS Retrofit: Analysis of the Globally Installed Coal-Fired Power Plant Fleet 35-36* (2012) (noting that these three countries will account for eighty-six percent of the new coal-fired power plants constructed globally through 2035).

³⁸ *Id.*

branch, and the courts over attempts to bring *all* coal plants up to modern pollution-control standards. The struggle to control emissions from the oldest and dirtiest coal plants dates back to the 1980s and includes both innovative initiatives, such as the acid rain pollution-trading program,³⁹ and long-running battles over so-called “new source review.”⁴⁰ Indeed, two of the EPA rules examined here—the rules on interstate transport of criteria air pollutants and emissions of toxic pollutants from coal-fired plants—are just the latest rounds of regulatory battles that date back to the 1990s.⁴¹ Among the CAA rules that comprise EPA’s alleged war on coal, only the rules governing GHG emissions are of relatively recent vintage. We turn to those rules in the next section.

B. The Protracted History of EPA’s Air Pollution Rules

Critics of the EPA’s regulatory agenda point to a long list of agency initiatives aimed at fossil-fueled power plants, including new rules addressing water pollution discharges,⁴² the handling of coal ash as a solid waste,⁴³ and the use of cooling water.⁴⁴ However, critics view the agency’s Clean Air Act rules as the heart of the war on coal,⁴⁵ particularly the Cross-State Air Pollution Rule (CSAPR), the Mercury and Air Toxics (MATS) rule, and the Clean Power Plan (CPP) targeting GHG emissions from existing power plants.⁴⁶ In this section we briefly

³⁹ See *supra* note 6.

⁴⁰ This was a decades long conflict over agency and environmental group attempts to extend CAA requirements to older power plants. For a description of this issue, see *Environmental Defense v. Duke Energy Corporation*, 549 U.S. 561 (2007).

⁴¹ These rules, and their ancestry, are explained *infra* at notes 43-75 and accompanying text.

⁴² On June 7, 2013, EPA proposed a rule under the Clean Water Act (CWA)⁴² that would set the first federal limits on toxic metals in wastewater that can be discharged from steam electric power plants. *Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, 78 Fed. Reg. 34,432 (proposed June 7, 2013). The EPA estimates that fewer than half of all coal-fired plants would incur costs to comply with the proposed rule because most have technology in place that would be compliant.

⁴³ In 2010, EPA proposed to regulate the disposal of fly ash and bottom ash—known in an EPA proposed rule as “coal combustion residuals,” or “CCRs”—in surface impoundments or landfills under RCRA. 75 Fed. Reg. 35,128. Other methods of coal ash disposal remain exempt from RCRA regulation under the Bevill determination. *Id.* at 35,148.

⁴⁴ In 2011, however, EPA proposed new requirements aimed at reducing fish entrainment at cooling water intake structures associated with new or existing power plants and industrial facilities. *National Pollutant Discharge Elimination System—Cooling Water Intake Structures at Existing Facilities and Phase I Facilities*, 76 Fed. Reg. 22,174, 22,176 (proposed Apr. 20, 2011). EPA estimates that all steam electric generating facilities will be affected by this rule, and estimates that total annualized compliance costs for facilities covered by this rule to be \$384 million, of which approximately \$318 million will fall on steam electric generators. EPA and industry disagree over the likely economic effects of these costs on electric generating units. EPA projects compliance cost to average only a few hundredths of a cent per kilowatt hour of electricity generated. *Id.* at 22,228 (Exh. VII).

⁴⁵ McCarthy & Copeland, *supra* note 10, at 13.

⁴⁶ The EPA has also proposed revisions to its National Ambient Air Quality Standards (NAAQS) for PM, ozone and NOx, which in turn impact coal-fired power plants indirectly. The Obama EPA has initiated, completed, or is considering three important NAAQS revisions that may have important effects on fossil-fired power plants. In 2010, EPA revised the NAAQS for SO₂. *Primary National Ambient Air Quality Standard for Sulfur Dioxide*; Final Rule, 75 Fed. Reg. 35,520 (June 10, 2010). EPA proposed revisions of the NAAQS for ozone in 2014. *National Ambient Air Quality Standards for Ozone*; Proposed Rule, _ Fed. Reg. _ (November 25, 2014). EPA is considering revising the current annual NAAQS for fine particles (PM), but has not yet proposed a revision. Its internal review documents indicate it is considering making the standards more stringent. *Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards* (Apr. 2011), available at

describe the key provisions of the EPA rules and the legal battles over them. Two seemingly contradictory patterns emerge from the descriptions: (1) the highly protracted and intensely litigated nature of the rulemaking processes; and (2) the strength of the environmental, human health, economic grounds for promulgating them.

1. *The CSAPR*

The foundation of the CAA's regulation of conventional pollutants (including SO₂, PM, and ozone) is the establishment of National Ambient Air Quality Standards (NAAQS) for each such pollutant.⁴⁷ The statute directs the EPA to set the NAAQS at a level that will "protect public health" with "an adequate margin of safety."⁴⁸ States with air quality control regions that do not comply with NAAQS (so-called nonattainment areas) are required to develop plans for coming into compliance with the NAAQS, and to ensure that other regions in attainment with the standards remain in compliance.⁴⁹ Fossil-fueled power plants built or modified after passage of the CAA must obtain permits covering their emissions of conventional pollutants,⁵⁰ and whether the plant is located in an attainment or nonattainment area determines the stringency of the plant's permitted emissions limits.⁵¹

The EPA has struggled for two decades to issue regulations governing the interstate transport of ozone precursors from the Midwest and south that cause NAAQS violations in downwind states along the eastern seaboard. Violations of the ozone NAAQS are largely attributable to local vehicle emissions, but the problem is exacerbated by the interstate transport of ozone and its precursors, particularly NO_x, emitted by fossil-fueled power plants. After years of pressure from Northeastern states⁵² and Congress, EPA concluded that state programs alone could not resolve the regional contribution to elevated ozone levels. In addition to setting a more stringent ozone standard in 1997,⁵³ the Clinton Administration responded to the crisis by promulgating a rule in 1998 designed to control ozone emissions regionally. It placed additional restrictions on emissions of ozone precursors from 22 states in the eastern half of the country, specifically mandating that power plants account for a significant portion of the reductions. The Clinton-era rule also established a voluntary cap-and-trade program to minimize the costs of the

<http://www.epa.gov/ttn/naaqs/standards/pm/data/20110419pmpafinal.pdf>. However, because the effect of NAAQS revisions on coal-fired power plants is dwarfed by the effects of these other rules that regulated the sector more directly, this analysis does not address NAAQS revisions.

⁴⁷ Clean Air Act § 109, 42 U.S.C. § 7409.

⁴⁸ *Id.*, § 109(b), 42 U.S.C. § 7419(b).

⁴⁹ *Id.*, § 110, 42 U.S.C. § 7410, 42 U.S.C. § 7410.

⁵⁰ *Id.*, § 111, 42 U.S.C. § 7411(a) applying the CAA permitting provisions to new and modified sources.

⁵¹ New sources located in non-attainment areas face more stringent requirements, including the requirement that their permit reflect the "lowest achievable emission rate" for the pollutant in question, and the requirement to obtain "offsets" (reductions in emissions from existing sources) to make room for their emissions. *See* 42 U.S.C. § 7503.

⁵² The Clean Air Act's so-called "good neighbor provision" addresses the interstate transport of air emissions by requiring states to include provisions in their State Implementation Plans (SIPs) to regulate emissions "which will . . . contribute significantly to nonattainment [with a NAAQS in a downwind state]." CAA § 110(a)(2), 42 U.S.C. § 7410(a)(2)(D). After Congress added the good neighbor provision to the statute in 1990, EPA and several states formed the Ozone Transport Assessment Group (OTAG). *See* 63 Fed. Reg. 57,356 (Oct. 27, 1998).

⁵³ The existing standard was expressed in terms of a one-hour average limit. That standard was replaced by an 8-hour standard at a level of 0.08 parts per million (ppm), which was generally considered to be a more stringent standard. *See* National Ambient Air Quality Standards for Ozone; Final Rule, 62 Fed. Reg. 2 (July 18, 1997).

reductions,⁵⁴ which the Bush Administration EPA replaced in 2005 with its own, less stringent, “Clean Air Interstate Rule” (CAIR).⁵⁵ Progress was interrupted, however, in July 2008 when the D.C. Circuit Court of Appeals overturned CAIR for, among other things, failing to ensure that upwind contributions to NAAQS violations would be reduced.⁵⁶ Fortunately this was short lived; after initially vacating the rule, the court granted EPA’s petition to leave it in place pending amendments conforming to the court’s decision.

The Obama Administration was left with the CAIR program in limbo. It responded to the D.C. Circuit decision with a new rule of its own, the CSAPR, that was promulgated in July 2011.⁵⁷ The saga continued in the courts with a successful industry challenge in the D.C. Circuit, which struck CSAPR down in August 2012,⁵⁸ followed by a June 2014 Supreme Court verdict in *EPA v. EME Homer Generation, L.P.*, that overturned the D.C. Circuit decision and upheld the rule.⁵⁹ The CSAPR requires 27 states to reduce power plant emissions of SO₂ and NO_x that contribute to ozone or fine particle pollution in other states. The SO₂ emissions reductions mandated by the rule are dramatic: emissions would decline to 73 percent below 2005 levels in the covered states by 2014.⁶⁰ EPA estimates that the rule will impose compliance costs on the power sector of about \$2.4 billion annually when fully implemented,⁶¹ and render about 4.8 GW of coal-fired generation (U.S. total capacity of coal plants is about 321 GW) uneconomic.⁶² The EPA estimates that the monetized benefit will be \$110-250 billion per year.⁶³

2. *The MATS Rule*

Similar to ozone, the fight over whether (and how stringently) to regulate mercury emissions from power plants spans decades. Despite strong evidence by the 1990s that the accumulation of mercury in the food chain was associated with increased incidences of birth defects and neurological damage in humans, the EPA continued to defer regulating mercury emissions from coal-fired power plants. Spurred by a congressional directive in the 1990 amendments to the CAA, the Clinton EPA prepared a study of mercury emissions and concluded

⁵⁴ This rule is known as the “NO_x SIP Call,” because it required states to submit revised “state implementation plans” (SIPs) to describe how they planned to implement these additional restrictions on emissions of ozone precursors. Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone, 63 Fed. Reg. 57,356 (Oct. 27, 1998).

⁵⁵ Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule), 70 Fed. Reg. 25,165 (Mar. 25, 2005) (CAIR imposed NO_x emission limits (“budgets”) on 28 eastern states and the District of Columbia).

⁵⁶ *North Carolina v. EPA*, 531 F.3d 896, 907 (D.C. Cir. 2008).

⁵⁷ Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals, 76 Fed. Reg. 48,208 (Aug. 8, 2011).

⁵⁸ *EME Homer City Generation, L.P. v. EPA*, 696 F.3d 7 (D.C. Cir. 2012).

⁵⁹ *EPA v. EME Homer Generation, L.P.*, 134 S. Ct. 1584 (2014).

⁶⁰ *Id.* at 48,311 (noting that the CSAPR is projected to reduce emissions of SO₂ from electrical generating units by about 25 million metric tons annually).

⁶¹ EPA estimates the benefits of the rule, primarily in the form of tens of thousands of premature deaths avoided, to be significantly greater than this number.

⁶² 76 Fed. Reg. at 48,346.

⁶³ EPA, Regulatory Impact Analysis (RIA) for the Final Transport Rule 1 (EPA-HQ-OAR-2009-0491, 2011) available at < <http://www.epa.gov/airtransport/pdfs/FinalRIA.pdf>>.

that regulating them as an air toxic was “appropriate and necessary.”⁶⁴ This finding led the Clinton EPA to propose stringent technology-based mercury standards for new and existing power plants.⁶⁵ The proposed rule went too far for the Bush Administration, however, which reversed the Clinton EPA’s finding on the mode of regulation—treating mercury as a conventional pollutant rather than an air toxic. The alternate legal framework adopted a less stringent “cap and trade” system for mercury emissions that was limited to new power plants.⁶⁶

The courts figure prominently here as well. By 2008, the D.C. Circuit had struck down the Bush EPA mercury rule,⁶⁷ setting the stage for the Obama EPA to promulgate its MATS rule in February of 2012.⁶⁸ The new rule, unsurprisingly, prompted a broad array of industry and environmental petitioners to challenge it in court. The D.C. Circuit rejected those challenges in 2014,⁶⁹ but this success was short-lived, as the Supreme Court struck down the MATS rule in the spring 2015 case *Michigan v. EPA*.⁷⁰ The Court found that the EPA’s conclusion that it need not consider costs in determining whether regulating mercury emissions from coal-fired power plants was reasonable.⁷¹ The EPA later performed a cost-benefit analysis for the MATS rule, and estimated that annual compliance costs for the electric power industry would be about \$9.6 billion and that the rule would have negligible net impacts on jobs.⁷² The agency estimated that the benefits of the new rule would be \$30-80 billion, and that most of them would derive from avoided human illnesses and premature deaths.⁷³ Crucially, these benefits include the effects of the MATS rule on reductions of non-mercury as well as mercury emissions, and in *dicta* the Court questioned the EPA’s practice of including these “co-benefits” in its cost-benefit analysis. Industry and several states have further countered that the estimated costs of the MATS rule do not adequately assess its potential to undermine electric power reliability when coal-fired power plants are taken off-line faster than they can be replaced.⁷⁴ As discussed further below, the EPA rejects this contention and maintains that industry compliance with the MATS rule would not adversely affect the reliability of electricity generation or transmission systems.⁷⁵

⁶⁴ See U.S. EPA, Mercury Study: Report to Congress, (EPA-452/R-97-003, December 1997); U.S. EPA, Study of Hazardous Air Pollutant Emissions from Electric Steam Generating Units: Final Report to Congress (EPA-453/R-98-004a, February, 1998).

⁶⁵ CAA § 112 specifies that permits for toxic pollutants must reflect “maximum achievable control technology” (MACT). CAA § 112(d)(3), 42 U.S.C. § 7412(d)(3).

⁶⁶ Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List, 70 Fed. Reg. 15,994 (Mar. 29, 2005).

⁶⁷ *New Jersey v. EPA*, 517 F.3d 574 (D.C. Cir. 2008).

⁶⁸ National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 77 Fed. Reg. 9,304 (Feb. 16, 2012).

⁶⁹ *White Stallion Energy Center, LLC v. EPA*, 748 F.3d 1222 (2014), *cert. granted sub nom. Michigan v. EPA*, 135 S.Ct. 2699 (2015).

⁷⁰ *Michigan v. EPA*, _ U.S. _ (2015).

⁷¹ *Id.* at _.

⁷² 77 Fed. Reg. at 9425-26. Industry assessments, however, project much greater job losses and slightly higher costs. See Anne E. Smith et al., An Economic Impact Analysis of EPA’s Mercury and Air Toxics Standards Rule, NERA Economic Consulting (Mar. 1, 2012), http://www.nera.com/67_7631.htm.

⁷³ EPA, Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards ES-1 (EPA-452/R-11-011, 2011) available at <<http://www.epa.gov/ttnecas1/regdata/RIAs/matsriafinal.pdf>>.

⁷⁴ For a full discussion of industry’s reliability-based challenge to this and other EPA rules, see *infra* section II.

⁷⁵ 77 Fed. Reg. at 9407.

3. *The CPP: Controlling GHGs from Existing Power Plants*

The Supreme Court's 2007 decision in *Massachusetts v. EPA*⁷⁶ established the legal basis for EPA to regulate GHG emissions from any source covered by the CAA.⁷⁷ In September 2013, the EPA initiated the process of regulating GHG emissions from power plants under the New Source Performance Standard (NSPS) program, which covered only new or modified fossil-fueled power plants,⁷⁸ and finalized the NSPS in August 2015.⁷⁹ While the rule exempted existing power plants, once EPA sets a standard for *new* sources of GHGs, CAA Section 111(d) requires states to set "standards of performance" for *existing* sources under their jurisdiction, and these standards must conform with EPA "guidelines." In June 2014 the EPA proposed the CPP,⁸⁰ and recently finalized it in August 2015.⁸¹ The rule encompasses a set of state-level goals and guidelines for regulation of CO₂ emissions from existing power plants, which pursuant to CAA Section 111(d) must reflect the "best system of emission reduction [that has been] adequately demonstrated" (BSER), considering (among other things) compliance costs.⁸²

The CPP guidelines address CO₂ emissions from fossil-fueled power plants, offering states the option of applying EPA-specified GHG emissions limitations directly to existing coal- and gas-fired generators, or achieving similar reductions indirectly by substituting lower-emitting generators for coal-fired plants. Specifically, states choosing these indirect approaches must meet the EPA's emissions reduction goal for the state, which in turn is based upon a combination of three "building blocks": (i) enhancing the efficiency of coal-fired generation; (ii) increasing the dispatch of natural gas-fired generators in place of coal-fired generators; and (iii) expanding the use of renewables or nuclear power.⁸³ The guidelines also contemplate compliance by way of participation in multistate GHG permit trading programs.⁸⁴ If the EPA guidelines survive the anticipated legal challenges they will further erode the competitiveness of coal-fired power plants. The EPA estimates that the annual costs of the CPP will rise to approximately \$8.4 billion in 2030, but that they will remain far lower than the estimated

⁷⁶ *Massachusetts v. EPA*, 415 F.3d 50 (2007).

⁷⁷ After *Massachusetts v. EPA*, the EPA initiated a number of other GHG regulatory initiatives, one of which (its so-called "tailoring rule") was subsequently struck down by the Supreme Court. That decision, *Utility Air Regulatory Group v. EPA*, ___ U.S. ___ (2014), contains a good description of the EPA's post-*Massachusetts* GHG initiatives.

⁷⁸ *Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units*, 77 Fed. Reg. 22,397 (proposed Apr. 13, 2012) (to be codified at 40 C.F.R. pt. 60), available at: <http://www2.epa.gov/sites/production/files/2013-09/documents/20130920proposal.pdf>.

⁷⁹ *Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units*, ___ Fed. Reg. ___ (proposed Aug. 3, 2015) (to be codified at 40 C.F.R. pt. 60), available at: <http://www.epa.gov/airquality/cpp/cps-final-rule.pdf>.

⁸⁰ *Proposed Rule: Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units*, 79 Fed. Reg. 34830 (June 2, 2014).

⁸¹ *Final Rule: Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units*, 79 Fed. Reg. 34830 (June 2, 2014) ("Clean Power Plan")

⁸² 42 U.S.C. § 7411(a)(1)(a).

⁸³ Clean Power Plan, *supra* note 81.

⁸⁴ *Id.*

benefits of \$26-45 billion per year.⁸⁵ Similar to the other rules, the projected benefits of the CPP far exceed its projected costs, but similar to the MATS rule the benefit estimates for the CPP are also dominated by non-GHG co-benefits.⁸⁶

II. EPA's Regulations Viewed from the Perspective of Grid Regulators

Opposition to EPA's rules has produced a blizzard of commentary on potential threats to stable supplies of electricity and grid management. The most prevalent concern is that EPA's rules will prompt closure of too many coal-fired power plants too quickly. This could arise if the rules require power plants to install pollution controls that render them uneconomic in wholesale power markets. If too many plants retire, or if they cannot be replaced with new capacity in a timely manner, the resulting shortfall in generating capacity could endanger system reliability. Proponents of EPA's rules believe these concerns are misplaced. They claim that coal plants are being driven out of the market by competition from natural gas-fired power plants and renewables,⁸⁷ and that EPA's rules hasten that process only at the margins. The opposing camp views EPA's rules as the primary driver of this decline.⁸⁸ Most of the critical commentary has focused on the MATS rule and CPP, which are also the most costly.⁸⁹ This has produced two waves of technical reports: one following the proposal of the MATS rule in 2010, and a second following the proposal of the CPP in 2014.

Collectively the reports encompass views across the political spectrum, and the perspectives of organizations with public and private interests. Among private business interests, the views of the Edison Electric Institute (EEI), an electric utility trade association, are representative. Although hedged in significant respects, its 2011 report invited the inference that EPA's rules would jeopardize grid reliability based on projections that plant closures would greatly exceed EPA's estimates.⁹⁰ More recently American Electric Power, a leading owner of

⁸⁵ EPA, Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants ES-8 (EPA-452/R-14-002, 2014) available at <<http://www2.epa.gov/sites/production/files/2014-06/documents/20140602ria-clean-power-plan.pdf>>.

⁸⁶ Clean Power Plan, *supra* note 81.

⁸⁷ For an up-to-date list of state renewable portfolio standards and other state policies favoring renewables, *see* DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY, www.dsireusa.org (last visited Mar. 5, 2015).

⁸⁸ Even before the EPA's proposed GHG rules, analyses of the effects of the preceding rules were numerous enough to prompt Susan Tierney of World Resources Institute to describe keeping track of the studies as "a full time job" and to prepare "a field guide" to the studies. Susan Tierney, Electric Reliability Under New EPA Power Plant Regulations: A Field Guide, January 18, 2011, available at: <http://www.wri.org/blog/2011/01/electric-reliability-under-new-epa-power-plant-regulations-field-guide>.

⁸⁹ EPA's estimated compliance costs for each of these rules ran into the billions of dollars. *See supra* note _ and _ and accompanying text. Critics have also charged that EPA's non-air rules, especially the coal combustion residuals rule and the cooling water rule, *supra* notes _ and __, will drive coal-fired plants out of business. *See* National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 76 Fed. Reg. 24,976 (proposed May 3, 2011); 79 Fed. Reg. at 34,830.

⁹⁰ STEVEN FINE, SHANYN FITZGERALD, AND JESSE INGRAM, POTENTIAL IMPACTS OF ENVIRONMENTAL REGULATION ON THE U.S. GENERATION FLEET: FINAL REPORT, EDISON ELECTRIC INSTITUTE/ ICF INTERNATIONAL (January 2011), available at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2011IRP/EEIModelingReportFinal-28January2011.pdf. For criticism of the methods used in the EEI/ICF report, *see* Susan F. Tierney and Charles Cicchetti, The Results in Context: A Peer Review of EEI's "Potential Impacts of Environmental

coal plants nationally, has claimed that the CPP will jeopardize system reliability based on EPA's own projections of the number and rate of plant closures.⁹¹ Other industry commentary has been more targeted regionally but no less critical. For example, Southwest Electric Power Co. (SWEPCO) has argued that the CPP "assumes the retirement or reduced use of all coal- or lignite-fueled power plants serving SWEPCO's 24/7 base load" in Texas, Louisiana and Arkansas and consequently poses a critical threat to system reliability.⁹²

At the other end of the spectrum, public interest organizations and other private entities have actively supported EPA's analyses or conducted their own favorable assessments. For example, a 2012 report issued by the Union of Concerned Scientists concluded that coal plant retirements were driven predominantly by market forces and that EPA rules would not jeopardize reliability given the excess generation capacity in the system.⁹³ Likewise, a 2010 analysis of the CSAPR and MATS rules prepared for Exelon Corp, the largest merchant seller of electricity from nuclear power plants, concluded that coal plant retirements would lag planned capacity additions and that electricity grids were protected regionally by excess capacity that was more than sufficient to safeguard reliability.⁹⁴

Comments from organizations with direct responsibility for ensuring the reliability of the electric system are more varied and difficult to summarize, in part because the regulatory landscape itself is complex. The law divides responsibility for grid management among three types of entities: (1) electric reliability organizations, which are charged with ensuring system reliability and security pursuant to the Energy Policy Act of 2005;⁹⁵ (2) Independent System Operators (ISOs)⁹⁶ and Regional Transmission Organizations (RTOs),⁹⁷ which are nonprofit

Regulation on the U.S. Generation Fleet" (The Analysis Group, May 2011), available at: http://www.analysisgroup.com/uploadedFiles/News_and_Events/News/EEI_PeerReview_Tierney_Cicchetti%20_May2011.pdf

⁹¹ Press Release: *AEP's View of the EPA's Clean Power Plan Proposed Rule*, AEP Action Network (undated), available at: <https://www.aepadvocacy.com/issues.aspx?ArticleID=Article1>.

⁹² Press Release: *Potential Impact of EPA's Proposed CO2 Rule*, SWEPCO, December 2, 2014, available at: https://www.swepco.com/global/utilities/lib/docs/info/news/swepco/111-d_Issue_Summary_12-2-14.pdf.

⁹³ UNION OF CONCERNED SCIENTISTS, *RIPE FOR RETIREMENT: THE CASE FOR CLOSING AMERICA'S COSTLIEST COAL PLANTS* 3 (2012), available at: http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/Ripe-for-Retirement-Full-Report.pdf. The Bipartisan Policy Center reached similar conclusions in a 2011 report. JENNIFER MACEDONIA, ET AL., *ENVIRONMENTAL REGULATION AND ELECTRIC SYSTEM RELIABILITY* (2011) at 3 (concluding little risk to reliability because of market adaptations and the fact that retiring plants have low capacity factors).

⁹⁴ Ira Shavel and Barclay Gibbs, *A Reliability Assessment of EPA's Proposed Transport Rule and Forthcoming Utility MACT*, Charles River Associates (December 16, 2010) at 3-4. The Bipartisan Policy Center reached similar conclusions

⁹⁵ The Energy Policy Act of 2005, Pub. L. 109-58 (2005).

⁹⁶ FERC Order 888 encouraged utilities to join together to form ISOs to manage the grid and the geographically broader markets that accompanied the move to competition in wholesale electricity markets. *See* Order No. 888, *Promoting Wholesale Competition Through Open Access, Nondiscriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, 61 Fed. Reg. at 21,591-21,597. Transmission owners retain ownership of their lines when they joined the ISO, but relinquish control over their use (including pricing and scheduling of transmission services) to the ISO.

⁹⁷ FERC's Order 2000 established the parameters for creating regional transmission organizations. *See* Order No. 2000, *Regional Transmission Organizations*, 89 FERC ¶ 61,285 (Dec. 20, 1999). RTOs operate similarly to ISOs. FERC originally hoped that RTOs would be much broader geographically such that the entire country might be covered by as few as four RTOs. However, we now use the terms RTO and ISO interchangeably.

associations of electric utilities that manage wholesale power and transmission markets;⁹⁸ and (3) state public utility commissions, which oversee retail electricity service and manage the siting of generation and transmission facilities within their states, among other things.⁹⁹ In addition, the Federal Energy Regulatory Commission (FERC) oversees wholesale power and interstate transmission markets by working with grid operators and other entities to promote reliability.¹⁰⁰ We describe these organizations' analyses of the EPA rules in this part, before turning to a broader evaluation of their effects in Part III.

A. Federal Regulators: NERC and FERC

FERC has primary responsibility for setting standards and ensuring grid reliability at the federal level, but it exercises this authority indirectly through other entities. Under the Energy Policy Act of 2005, FERC is required to designate one or more electric reliability organizations to enforce electric reliability standards.¹⁰¹ In 2007, FERC designated the North American Electric Reliability Council (NERC),¹⁰² a nonprofit organization created in 1968 following the massive blackout of the eastern seaboard earlier in the decade.¹⁰³ While the U.S. electric grid has been described as the world's largest machine,¹⁰⁴ it is in fact three grids: the Eastern Interconnection, the Western Interconnection, and the ERCOT grid in Texas.¹⁰⁵ For electric reliability planning purposes, NERC has divided these grids into subregions.¹⁰⁶ Conditional on FERC approval,¹⁰⁷ NERC establishes a "reference" target level of generating capacity reserves

⁹⁸ In most (but not all) places where there is no RTO to manage wholesale markets, IOUs remain vertically integrated and traditionally regulated such that the volume and geographic reach of third-party wholesale transactions is smaller; in these settings, IOUs manage reliability collectively through informal power pools. During the 1990s a sizable minority of states also opted to restructure their retail electricity markets, mandating the unbundling of electricity sales from distribution services, opening up retail sales to competition, and authorizing market pricing. As a consequence of these changes, RTOs now manage organized, robust regional wholesale electricity markets in the Northeast and Midwestern United States, as well as Texas and California, with FERC oversight.

⁹⁹ Section 201(a) of the Federal Power Act recognizes state authority over retail rates and the siting of generation facilities. 16 U.S.C. § 824(a).

¹⁰⁰ FERC has jurisdiction over the rates charged for wholesale power, and transmission services, 16 U.S.C. § 824(b)(a)(1)(D)(ii), and to ensure that rates are just, reasonable, and nondiscriminatory, 16 U.S.C. § 824(d)(a)-(b). FERC sometimes uses its power over "practices affecting" rates to encourage investment in generating and transmission capacity. *See e.g., Conn. Dep't of Pub. Util. Control v. FERC*, 569 F.3d 477 (D.C. Cir. 2009) (FPA authorizes ERC to regulate pricing of capacity markets as practices affecting wholesale rates).

¹⁰¹ The Energy Policy Act of 2005 § 1211, 16 U.S.C. § 824(o).

¹⁰² *North American Electric Reliability Corp.*, 116 FERC ¶ 61,062 (*Certification Order*), *order on reh'g and compliance*, 117 FERC ¶ 61,126 (2006).

¹⁰³ North American Electric Reliability Council, History of NERC, December 2012, available at: http://www.nerc.com/AboutNERC/Documents/History_Dec12.pdf.

¹⁰⁴ PHILIP SCHEWE, THE GRID: A JOURNEY THROUGH THE HEART OF OUR ELECTRIFIED WORLD 1 (2007) ("Taken in its entirety, the grid is a machine, the most complex machine ever made.")

¹⁰⁵ ERCOT stands for the Electric Reliability Council of Texas.

¹⁰⁶ These regions correspond (roughly, if not precisely) with ISO/RTO regions described *infra* at section B, except in regions not covered by an ISO or RTO. For a map and descriptions of NERC regions, *see* North American Reliability Council, Regional Entities, available at: <http://www.nerc.com/AboutNERC/keyplayers/Pages/Regional-Entities.aspx>.

¹⁰⁷ 16 U.S.C. § 824(o)(b)(1).

referred to as a “reserve margin”,¹⁰⁸ but due to heterogeneity in generation sources and other grid characteristics, each NERC subregion has discretion to refine their reserve margins consistent with local conditions.¹⁰⁹

As the lead regulators nationally, NERC and FERC have been measured in their critiques of the EPA rules. In 2011, NERC analyzed the effects on system reliability of several rules, including the CSAPR and MATS. The resulting report concluded that “bulk power system reliability could be affected” in certain subregions if EPA did not allow sufficient time for construction of new capacity to replace retiring coal plants.¹¹⁰ NERC qualified its conclusions, however, noting that it was too early to project accurately the “exact impacts” of the regulations, and acknowledging that EPA could mitigate potential threats to reliability by allowing deadlines to be adjusted.¹¹¹ When state regulators, ISOs/RTOs,¹¹² and other entities expressed concerns about the effects of the MATS rule (and to a lesser extent CSAPR) on system reliability, NERC responded by identifying measures for mitigating potential problems. NERC also went out of its way to explain how it would advise EPA regarding waivers from MATS rule deadlines for coal plants it deemed necessary to maintaining grid reliability.¹¹³

More recently, NERC released an “initial review” of the CPP that adopts a similarly qualified tone, noting at the outset that “detailed and thorough analysis will be required” to assess the feasibility of the Plan accurately.¹¹⁴ This did not prevent NERC from raising substantial concerns. Among other questions, NERC suggests that EPA’s estimates of the generation capacity lost to plant retirements “may be conservative,” and that replacing it without jeopardizing reliability “may” be challenging.¹¹⁵ NERC also takes issue with the first and second building blocks identified in the CPP, raising particular concerns about the viability of

¹⁰⁸ For a description of NERC reserve margins, *see* North American Electric Reliability Council, Planning Reserve Margin, available at: <http://www.nerc.com/pa/RAPA/ri/Pages/PlanningReserveMargin.aspx>.

¹⁰⁹ NERC’s Reference Reserve Margin is equivalent to the Target Reserve Margin Level provided by each region/subregions own specific margin based on load, generation, and transmission characteristics as well as regulatory requirements. If not provided, NERC assigned 15 percent Reserve Margin for predominately thermal systems and 10 percent for predominately hydro systems. North American Electric Reliability Council, NERC, Summer 2014 Reliability Assessment, 34, (May 2014), available at: <http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2014SRA.pdf>.

¹¹⁰ North American Electric Reliability Council, Potential Impacts of Future Environmental Regulations Extracted from the 2011 Long-term Reliability Assessment, 116-119 (November, 2011), available at: <http://www.nerc.com/files/epa%20section.pdf>.

¹¹¹ *Id.*, at 116 and 120.

¹¹² *See e.g.*, FERC, Midwest Independent Transmission System Operator, Inc. Responses To Request For Evidence Of Commissioner Phillip D. Moeller On EPA Issues For The November 2011 Reliability Conference, at 2 (alleging a reliability problem caused by the MATS rule), available at: https://www.misoenergy.org/Library/Repository/Tariff/FERC%20Filings/Resp.%20Evidentiary%20Requests_AD12-1-000.pdf.

¹¹³ FERC, Policy Statement on the Commission’s Role Regarding the Environmental Protection Agency’s Mercury and Air Toxics Standards, 139 FERC ¶ 61,131 (May 17, 2012), available at: <http://www.ferc.gov/whats-new/comm-meet/2012/051712/E-5.pdf>.

¹¹⁴ North American Electric Reliability Council, Potential Reliability Impacts of EPA’s Proposed Clean Power Plan: Initial Reliability Review (November 2014), at 1, available at: http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/Potential_Reliability_Impacts_of_EPA_Proposed_CPP_Final.pdf.

¹¹⁵ *Id.* at 2.

significant efficiency gains in the power sector¹¹⁶ and relying on increased operation of natural gas-fired units to offset the lost capacity from coal plant retirements.¹¹⁷ While NERC’s analysis stops short of declaring that the CPP will impair reliability, it urges EPA to include a provision for regulatory waivers much like it did for the MATS rule.¹¹⁸

The responses of the FERC commissioner’s to the CPP roughly track their respective political affiliations. All five FERC commissioners addressed the effects of the CPP in 2014 testimony before Congress. Then-Acting Chairman LaFleur was circumspect, urging a greater role for FERC and state energy regulators in the development and implementation of the Plan, but he declined to comment about whether the rule would jeopardize grid reliability.¹¹⁹ Commissioner Norris, who left FERC in August of 2014, was supportive of the EPA rule and expressed optimism that FERC could work with EPA to manage the “challenging” transition to a lower-carbon fuel mix.¹²⁰ Commissioner Bay’s testimony¹²¹ was perfunctory but indicated a willingness to work with EPA and other regulators to implement the CPP. By contrast, the two Republican commissioners expressed much more skepticism.¹²² Commissioner Moeller asserted that “EPA is creating national electricity policy” that reorients grid management from its traditional focus on economic dispatching to one based on “environmental dispatch,”¹²³ and

¹¹⁶ The first building block on which EPA established state emission budgets, and on which EPA will judge state compliance plans, calls for improving the heat rate at existing coal-fired units by 6 percent. EPA, Clean Power Plan, *supra* note 81, 79 Fed. Reg. 34855-34862. “Heat rate” refers to the amount of energy required to produce a unit of electricity (e.g., btus per kilowatt-hours, or kwh). Lowering the heat rate represents improved efficiency.

¹¹⁷ The second building block contemplates “redispatch” of cleaner, combined cycle natural gas-fired plants in lieu of coal-fired plants. See *Id.* at 34862-34866. NERC expresses doubt that coal-fired plants can improve their combustion efficiency to the degree that EPA does, and it contends that natural gas-fired plants are ill-suited to operating at the levels EPA contemplates in the rule. NERC, Potential Reliability Impacts of EPA’s Clean Power Plan, *supra* note 110, at 8-9.

¹¹⁸ *Id.*, at 22 (suggesting “a set of reliability assurance provisions that may include a reliability backstop”).

¹¹⁹ See Written Testimony of Cheryl A. LaFleur Acting Chairman Federal Energy Regulatory Commission Before the Committee on Energy and Commerce Subcommittee on Energy and Power United States House of Representatives Hearing on FERC Perspective: Questions Concerning EPA’s Proposed Clean Power Plan and other Grid Reliability Challenges, July 29, 2014, available at: <http://www.ferc.gov/CalendarFiles/20140729091732-LaFleur-07-29-2014.pdf>.

¹²⁰ See Written Testimony of FERC Commissioner John Norris Before the Committee on Energy and Commerce Subcommittee on Energy and Power United States House of Representatives Hearing on FERC Perspective: Questions Concerning EPA’s Proposed Clean Power Plan and other Grid Reliability Challenges, July 29, 2014, available at: <http://www.ferc.gov/CalendarFiles/20140729091817-Norris-07-29-2014.pdf>.

¹²¹ At the time of his testimony Norman Bay had not yet been sworn in as FERC commissioner, but had been confirmed by the Senate.

I. ¹²² The Federal Power Act requires that no more than three of the five commissioners be from the same political party. 16 U.S. Code § 792. Phillip Moeller was originally appointed to the FERC by President George W. Bush, and was subsequently reappointed by President Obama. Commissioner Tony Clark is a Republican appointed by President Obama.

¹²³ See Written Testimony of FERC Commissioner Philip D. Moeller Before the Committee on Energy and Commerce Subcommittee on Energy and Power United States House of Representatives Hearing on FERC Perspective: Questions Concerning EPA’s Proposed Clean Power Plan and other Grid Reliability Challenges, July 29, 2014, available at: <http://www.ferc.gov/CalendarFiles/20140729091755-Moeller-07-29-2014.pdf>. Since their testimony before Congress, Commissioner Moeller has become more outspoken about his reliability concerns. In a letter to EPA Administrator Gina McCarthy, Moeller expressed concern about (i) the impacts of state-level pollution budgets and planning on national grid management, (ii) the high costs of compliance with the Plan, and (iii) the technical barriers to complying with the “frontloaded timeline” of the Clean Power Plan. Letter from FERC

expressed concerns about reliability that mirrored those highlighted in the NERC report. Commissioner Clark’s testimony amplified Moeller’s views by accusing EPA of seeking to “reorder the jurisdictional relationship” between federal energy and environmental regulators.¹²⁴

Thus, although neither FERC nor NERC has directly opposed the EPA rules, officials in both entities raise significant concerns about potential threats to grid reliability and express substantial reservations about the proposed regulations.

B. Regional Regulators: ISOs and RTOs

ISOs and RTOs are the independent entities NERC established to manage grid stability in seven planning regions that cover most of the United States. Table 2 summarizes the geographic reach of the existing ISOs/RTOs as well as two large regional grids, both dominated by traditionally regulated, vertically integrated utilities, that are not managed by ISOs/RTOs. As indicated below, the two unincorporated areas encompass the mountain west, which is overseen by the Western Electric Coordinating Council (WECC),¹²⁵ and much of the southeast, which is overseen by the Southeastern Electric Reliability Council (SERC).¹²⁶

Table 2: ISOs/RTOs operating in the United States, 2014

Name	Acronym	Coverage (all or parts of states)
ISO New England	ISO-NE	ME, VT, NH, MA, RI, CT
New York ISO	NYISO	NY
PJM Interconnection	PJM	PA, NJ, MD, DE, VA, NC (part), OH, WV, KY, MI, IN, IL
Midcontinent ISO	MISO	MN, MI, WI, MT, ND, SD, IA, MO, AR, LA, MS, IL, IN, TX
Southwest Power Pool	SPP	NE, KS, MO, OK, TX
Electric Reliability Council of Texas	ERCOT	TX
California ISO	CAISO	CA

The regulatory authority of ISOs/RTOs is derivative of FERC’s statutory authority, and like FERC their principal mandates are ensuring that wholesale power and transmission prices are just and reasonable¹²⁷ and that the grid remains in balance.¹²⁸ Among other responsibilities,

Commissioner Phillip D. Moeller to EPA Administrator Gina McCarthy, December 1, 2014, available at: <http://www.ferc.gov/about/com-mem/moeller/moeller-12-02-14.pdf>.

¹²⁴ See Written Testimony of FERC Commissioner Tony Clark Before the Committee on Energy and Commerce Subcommittee on Energy and Power United States House of Representatives Hearing on FERC Perspective: Questions Concerning EPA’s Proposed Clean Power Plan and other Grid Reliability Challenges, July 29, 2014, available at:

¹²⁵ WECC comprises all or parts of Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Idaho, Washington, Oregon, Nevada and California.

¹²⁶ SERC covers some states that exist entirely outside of ISOs/RTOs (Florida, Georgia, Alabama, Mississippi, South Carolina and Tennessee) as well as portions of other states that are within ISOs/RTOs (Virginia, North Carolina, Kentucky, Illinois, Missouri, Arkansas, Louisiana and Texas).

¹²⁷ See Federal Power Act § 205. Indeed, it is this requirement that justifies the SCED rule, described *supra* at note 23 and accompanying text.

ISO/RTO oversight centers on facilitating investment in the maintenance and expansion of the grid to meet changing market conditions. They achieve this using either or both of two mechanisms: (1) allowing wholesale electricity prices to float freely to encourage investment when prices are very high, which is the approach taken in the restructured ERCOT market¹²⁹; or (2) creating a separate capacity market through which electric utilities are paid to construct new capacity, as is done in PJM, NE-ISO and NYISO.¹³⁰ This responsibility is of particular relevance here because it gives ISOs and RTOs a large stake in maintaining grid stability and a critical perspective on system management at the regional level.

Among regional grid managers, PJM and MISO have a heightened interest in the EPA rules because together they are home to about 53 percent of the nation's coal-fired power plants. Both have submitted detailed and carefully considered comments on the EPA rules. In 2011 PJM analyzed the impact of the CSAPR and MATS rules within its region, and concluded that while the rules would hasten coal plant retirements, they would not jeopardize generation resource adequacy.¹³¹ Similar to NERC, PJM also stopped short of opposing the CPP by instead proposing changes it views as essential to ensuring the reliability of the grid. The most important of these was inclusion of a "reliability safety valve" that would release a state from its compliance obligations in the event that grid reliability is seriously threatened.¹³²

MISO's 2011 analysis of four EPA rules, including CSAPR and MATS, also raises substantial questions. Among other findings, it projects that retirements of coal plants would necessitate extensive investment in transmission capacity that could increase electricity rates by as much as 7.6 percent.¹³³ In support of its comments on the CPP, MISO prepared a "preliminary analysis" of the Plan. It concludes that replacement of coal plants with gas-fired

¹²⁸ The electric grid must be maintained at a frequency of 60Hz; if it strays to far from that frequency, the grid can fail, resulting in outages. Since electricity cannot be economically stored, grid operators must ensure that the amount of electricity being dispatched to the grid is roughly equal to the amount being taken off of the grid by consumers at any given moment. In the jargon of grid management, they must "balance loads." Keeping the grid in balance requires scheduling so-called ancillary services: reserves, spinning reserves, and regulation. The term "reserves" refers to generating capacity that is currently unused but which is available to serve load; if that capacity is already running, so that operator may dispatch its electricity to the grid on very short notice, it qualifies as "spinning reserves." "Regulation" services are the very short term grid management activities that maintain voltages at their proper level, to ensure grid reliability.

¹²⁹ This system attempts to address the inadequate incentives to invest in infrastructure resources such as generation capacity by addressing the imperfections in the market's design. The resulting "energy only" market does not remove the need for regulatory interventions, but substantially changes the nature of those interventions. See William W. Hogan, On an "Energy Only" Electricity Market Design for Resource Adequacy, Center for Business and Government John F. Kennedy School of Government 1, 34 (2005). (Accessed at http://www.ercot.com/content/meetings/ltstf/keydocs/2007/0423/Hogan_Energy_Only1.pdf).

¹³⁰ For an overview of each capacity market, see Federal Energy Regulatory Commission, Electric Power Markets: National Overview, available at: <http://www.ferc.gov/market-oversight/mkt-electric/overview.asp>.

¹³¹ PJM Interconnection, Coal Capacity at Risk for Retirement in PJM: Potential Impacts of the Finalized EPA Cross State Air Pollution Rule and Proposed National Emissions Standards for Hazardous Air Pollutants (August 26, 2011) at 32-33, available at: <http://pjm.com/~media/documents/reports/20110826-coal-capacity-at-risk-for-retirement.ashx>.

¹³² Comments of PJM Interconnection, L.L.C. to the EPA, RE: Carbon Pollution Emission Guidelines For Existing Stationary Sources, Electric Utility Generation Units, Docket No. EPA-HQ-OAR-2013-0602, December 1, 2014, available at: <http://www.pjm.com/~media/documents/other-fed-state/20141201-epa-hq-oar-20130602-pjm-comments-epa-rule-111d.ashx>.

¹³³ Midcontinent ISO, EPA Impact Analysis: Impacts from the EPA Regulations on MISO, October 2011, available at: <https://www.misoenergy.org/Library/Repository/Study/MISO%20EPA%20Impact%20Analysis.pdf>.

units would be the most cost-effective method of meeting the CPP's emissions goals, but warns that building new gas-fired capacity within the proposed timetable would be difficult.¹³⁴ Consistent with this finding, MISO's comments to EPA are silent on the framework and goals of the proposed rule, but urge a slower timetable for compliance to ensure system reliability.¹³⁵

In addition to their individual comments, regional managers submitted joint comments on the CPP through the ISO/RTO Council.¹³⁶ The comments express optimism about grid management that is conditional on EPA making certain changes in the rule to facilitate interstate and regional coordination. The Council proposes revisions that it claims "will give EPA and the states the tools needed to avoid negative reliability impacts ... by ensuring that appropriate state, multi-state, and/or regional reliability reviews occur at all relevant stages."¹³⁷ Specific recommendations include the provision for a "reliability safety valve" featured in the comments of its members. Thus, similar to the comments from national regulators, the ISO/RTO Council strikes a balance between caution about ensuring grid reliability and optimism about the options available to mitigate such risks within the CPP framework.

This optimism is not universal, however, and skepticism is particularly strong with respect to the CPP. For example, SPP issued an analysis in 2011 of several EPA rules, including MATS, finding that while unlikely, EPA's rules could significantly impact reliability "if larger generators are shut down or have significantly curtailed generation."¹³⁸ ERCOT has expressed fewer reservations about the MATS rule,¹³⁹ but projected significant rate increases from complying with CSAPR.¹⁴⁰ Both organizations raise much graver concerns about the CPP. In a recent analysis, SPP warns that the CPP could cause "extreme" electricity shortages and violations of NERC reliability standards if coal plant retirements in its region occur prior to deployment of necessary infrastructure improvements.¹⁴¹ ERCOT's analysis goes even further, arguing that more coal plants will retire than EPA projects and that the CPP will threaten

¹³⁴ Midcontinent ISO, Analysis of EPA's Proposal to Reduce CO₂ Emissions from Existing Electric Generating Units, November 2014, available at: <https://www.misoenergy.org/Library/Repository/Communication%20Material/EPA%20Regulations/AnalysisofEPAsProposaltoReduceCO2EmissionsfromExistingElectricGeneratingUnits.pdf>.

¹³⁵ Comments of the ISO/RTO Council to the EPA, RE: Carbon Pollution Emission Guidelines For Existing Stationary Sources, Electric Utility Generation Units, Docket No. EPA-HQ-OAR-2013-0602, December 1, 2014, available at: <https://www.misoenergy.org/Library/Repository/Communication%20Material/EPA%20Regulations/MISO%20Comments%20to%20EPA%20on%20Proposed%20CPP%2011-25-14.pdf>.

¹³⁶ The Council includes all seven American ISOs/RTOs, as well as two Canadian members that did not sign on to the Council's comments on the Clean Power Plan.

¹³⁷ Comments of the ISO/RTO Council to the EPA, RE: Carbon Pollution Emission Guidelines For Existing Stationary Sources, Electric Utility Generation Units, Docket No. EPA-HQ-OAR-2013-0602, December 1, 2014, available at: <http://www.pjm.com/~media/documents/other-fed-state/20141201-epa-hq-oar-20130602-irc-comments.ashx>.

¹³⁸ Southwest Power Pool, Concerns in Light of Expected EPA Regulations (Nov. 8, 2011), available at:

¹³⁹ ERCOT projects that compliance costs for the MATS rule will represent about \$0.75/MWh, or less than one-tenth of one cent per kwh.

¹⁴⁰ ERCOT projects compliance costs with CSAPR to represent about \$2.75/MWh. *Id.*, at ii. Regional haze rules are also projected to have significant impacts within ERCOT. *Id.*

¹⁴¹ SPP comments on CPP, Letter to Gina McCarthy, EPA Administrator, October 9, 2014, available at: http://www.spp.org/publications/2014-10-09_SPP%20Comments_EPA-HQ-OAR-2013-0602.pdf

reliability “in and around major urban centers, and will strain ERCOT’s ability to integrate new intermittent renewable generation resources.”¹⁴²

C. State Regulators

The MATS rule and the CPP also generated many comments from state public utilities commissions. Consistent with the intuition that those who object to proposed rules are more likely to comment than those who support them,¹⁴³ most of the PUC comments were critical. Eight state commissions commented on the MATS rule, and six of them were unequivocally negative. The Texas Public Utility Commission, for example, contends that EPA’s MATS rule “fails to address” the impacts on grid reliability,¹⁴⁴ while the Indiana Utility Regulatory Commission warns that the rule would cause “massive rate increases.”¹⁴⁵ By comparison, the comments from the commissions in Michigan and Oregon were relatively benign: Oregon sought only a special exemption for a particular plant,¹⁴⁶ while Michigan requested extension of the compliance period.¹⁴⁷ The comments on the CPP are more numerous and critical: 34 state commissions submitted comments and 26 were modestly or strongly negative. Some, like the Florida Public Service Commission, questioned the legality of the EPA’s proposal.¹⁴⁸ Others, like the Georgia and Michigan commissions, challenged the fairness of the methods EPA used to derive the emissions budgets for each state.¹⁴⁹ And most of the state commissions alleged that the CPP would impair electricity supplies and reliability. The Texas¹⁵⁰ and North Dakota¹⁵¹

¹⁴² ERCOT, ERCOT Analysis of the Impacts of the Clean Power Plan 1 (Nov. 17, 2014), *available at*: <http://www.ercot.com/content/news/presentations/2014/ERCOTAnalysis-ImpactsCleanPowerPlan.pdf>.

¹⁴³ ERCOT, Impacts of Environmental Regulation in the ERCOT Region i (Dec. 2014), *available at*: <http://www.ercot.com/content/news/presentations/2014/Impacts%20of%20Environmental%20Regulations%20in%20the%20ERCOT%20Region.pdf>.

¹⁴⁴ Comments by the Public Utility Commission of Texas regarding the Carbon Pollution Emission Guidelines for Existing Stationary Sources: Emissions from Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule; EPA Docket ID No. EPA-HQ-OAR-2013-0602, December 1, 2014, *available at*: http://www.puc.texas.gov/agency/topic_files/PUCT_Comments.pdf.

¹⁴⁵ Comment: EPA-HQ-OAR-2013-0602, December 1, 2014, *available at*: <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0602-24292>.

¹⁴⁶ Comment letter dated April 2, 2011 from Oregon PUC Commissioners Susan Ackerman and John Savage, EPA Docket ID No. EPA-HQ-OAR-2009-0234-18019, *available at*: <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2009-0234-18019>.

¹⁴⁷ USEPA DOCKET COMMENTS ID No. EPA-HQ-OAR-2013-0602, December 1, 2014, *available at*: http://www.michigan.gov/documents/deq/AQD-Docket_ID_No._EPA-HQ-OAR-2013-0602_Comments120114_475431_7.pdf.

¹⁴⁸ Re: Carbon Pollution Emission Guidelines for Existing Sources: Electric Utility Generating Units; Docket ID No. EPA-HQ-OAR-2013-0602, December 1, 2014, *available at*: <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0602-23650>.

¹⁴⁹ Comments of the Georgia Public Service Commission Regarding Docket No. EPA-HQ-OAR 2013-0602 Re: Proposed Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; 79 Federal Register 34830 (Filed, June 18, 2014), December 1, 2014, *available at*: <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0602-23535>.

¹⁵⁰ Comments by the Public Utility Commission of Texas regarding the Carbon Pollution Emission Guidelines for Existing Stationary Sources: Emissions from Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule; EPA Docket ID No. EPA-HQ-OAR-2013-0602, December 1, 2014, *available at*: http://www.puc.texas.gov/agency/topic_files/PUCT_Comments.pdf.

commissions were especially critical on this point, asserting that the CPP posed a major threat to the reliability of the electric grids in their regions.

In sum, many (but not all) of the federal, regional and state regulators responsible for maintaining the reliability of electricity markets have objected to one or more of the EPA's rules aimed at controlling emissions from coal-fired power plants. Among their objections are claims that the rules would force the closure of existing coal-fired plants, thereby jeopardizing the reliability of the electric system. Although their comments vary substantially in tone, the overarching message that emerges is of significant, technically grounded anxiety about the potential impacts of EPA's rules on the adequacy of electricity supplies and grid stability. Further, while a number of the comments identify straightforward measures to mitigate if not eliminate such risks, virtually all of them conclude that grid stability is a significant issue that is not satisfactorily addressed in the proposed rules.

III. The Costs, Benefits and Distributional Equity of EPA's Regulations

Assessing the impacts of EPA rules is challenging, in part, because the intersection of electric utility and environmental regulation is unusually complex. Some ISOs/RTOs oversee wholesale markets covering multiple states, whereas others cover just a single state; at the same time, regulation of retail markets by public utility commissions is entirely intrastate. State regulation, in turn, falls into either of two distinct categories—regulated retail markets with vertically integrated utilities, and restructured markets based on competitive retail pricing of electricity generation. Environmental regulations, which are set mostly at the federal level but implemented largely at the state level, are superimposed over these blended layers of electricity regulation, and incorporate a wide range of policy instruments. Further, the environmental impacts of air emissions from electric utilities can span local, regional, and global scales: GHGs responsible for climate change and the major conventional pollutants emitted by power plants are each part of global cycles, but also have local and regional impacts to varying degrees.

This complex intermeshing of regulations has allowed mismatches to persist between competing claims about regulatory impacts. When assessing the impacts of EPA regulations on grid management and reliability, commentators tend to focus on the regional level.¹⁵² As described in Section II, much of this work has focused on the potential for EPA regulations to impede ISO/RTO operators from reliably managing sub-grid regions due to projected losses of generation capacity and declines in reserve margins. While EPA considers these issues, its regulatory impact analyses (RIAs) for the CSAPR, MATS, and CPP regulations center on national costs and benefits. The resulting failure to engage in a debate at a common spatial scale has led to confusion and allowed the opposing camps to talk past each other. We hope to bridge these gaps and, in doing so, to highlight the value of examining regulatory impacts at multiple scales when environment harms and regulation do not center on a single spatial scale.

In this section we examine the variation in costs and benefits that is inherent in applying national environmental standards across a country as large and diverse as the United States. This analysis allows us to consider regional distributions of impacts that are obfuscated by regulatory

¹⁵¹ Letter from Public Service Commission, State of North Dakota to Gina McCarthy, Administrator, Re: Docket ID No. EPA-HQ-OAR-2013-0602, November 25, 2014, available at: <http://www.psc.nd.gov/public/newsroom/2014/docs/11-25-14NR-EPACarbonEmissionsComments.pdf>.

¹⁵² See Section II.

analyses based on national averages. It also provides an antidote to the prevailing focus on national social welfare in RIAs, which is striking given the prominence of environmental justice concerns at the local level and the importance of debates about equity and fairness in global negotiations over national commitments to mitigate GHG emissions.¹⁵³ Distributional concerns are salient at the local and global levels but, as we will show, they are marginalized at spatial scales in between. A virtue of EPA’s clean air regulations for electric utilities is that their impacts are felt from the local to the global level; they thus provide an opportunity to bring together the divergent scales of distributional debates over environmental regulation.

The discussion that follows will draw on a range of EPA and other data. Most of the data originate from EPA’s Integrated Planning Model (IPM) datasets for the MATS and CSAPR rules, “IPM 4.11,” and the more recent IPM dataset for the CPP, “IPM 5.13.”¹⁵⁴ We analyze data from the IPM 4.11 and 5.13 Base Cases, which estimate baseline emissions levels in the absence of the regulation under review, as well as the datasets derived from EPA’s modeled emissions projections for each rule after it is implemented. In subsection A we examine the geographic distribution of coal-fired power plants throughout the country, while subsection B explores the compliance costs and human-health benefits of the EPA regulations at the regional level. We find that (1) most of the generating plants projected to retire in response to these rules are old plants, at or near the end of their useful lives, that pollute at higher rates; and (2) the plants projected to retire are typically spread across the country in rough proportion to each region’s reliance on coal-fired power. In subsection C, we focus on the distribution of pollution reduction benefits; the EPA data reveal that the benefits of these rules tend to be concentrated in the regions experiencing the most plant retirements.

A. The Geographic Distribution of U.S. Coal-Fired Electricity Generation

As of 2012, the U.S. had 460 operational coal-fired power plants with a total generation capacity of 321 GW,¹⁵⁵ but they are not evenly distributed around the country. Western and northeastern states each accounted for less than 10 percent of the electricity generated from coal despite together accounting for about 30 percent of the electricity generated nationally from all sources. Twenty states collectively accounted for 80 percent of the coal generation in 2010, but just nine of them (Texas, Indiana, Ohio, West Virginia, Pennsylvania, Missouri, Illinois, Kentucky) accounted for 50 percent of total coal generation. As this list suggests, most of the coal-fired generation capacity is located in the Midwest and south, with just three regions—two

¹⁵³ See, e.g., David E. Adelman, *The Collective Origins of Toxic Air Pollution: Implications for Greenhouse Gas Trading and Toxic Hotspots*, 88 INDIANA L. REV. 273, 279 (2014) (outlining the origins and types of distributional concerns raised by environmental justice advocates); Nicholas Stern, *What is the Economics of Climate Change?*, 7 WORLD ECON. 1, 6, 8 (April-June 2006) (highlighting the importance of addressing distributional issues associated with the impacts of climate change and the costs of mitigating it).

¹⁵⁴ The EPA datasets are available at the following websites: the EPA IPM 4.10 datasets are available at <http://www.epa.gov/airmarkets/programs/ipm/BaseCasev410.html>; the EPA IPM 5.13 datasets are available at <http://www.epa.gov/airmarkets/programs/ipm/psmodel.html>.

¹⁵⁵ EPA IPM 4.10 Base Case Data. In terms of individual units, collectively the U.S. fleet has 1,121 operational coal-fired boilers. This number drops somewhat with the new EPA IPM 5.13 to 1033 plants, and the total capacity drops to about 290 GW.

managed by RTO/ISOs (MISO and PJM) and the southeastern SERC grid—accounting for two-thirds of coal generation nationally.¹⁵⁶

The geographic concentration of coal generation raises the specter that EPA regulations will disproportionately impact certain regions and states, and that this could be compounded by plant characteristics, such as age and size, in the areas most reliant on coal. Table 3 below summarizes the percentage of national coal-fired power emissions for key pollutants from each of the six regions with the largest fleets of coal plants.¹⁵⁷

Table 3: Regional Coal Generation Capacity & Emissions in 2012¹⁵⁸

ISO/RTO Regions	Capacity (%)	Percent Emissions Nationally			
		SO ₂	NO _x	Mercury	CO ₂
ERCOT (n=42)	7.2	3.4	5.4	9.2	8.2
MISO (n=399)	31.0	37.1	29.5	35.3	30.8
PJM (n=253)	21.5	25.8	18.7	19.1	19.6
SERC (n=207)	20.1	23.9	17.9	18.5	19.6
SPP (n=44)	4.5	3.3	6.5	6.7	5
WECC (n=111)	10.6	3	17.3	8.8	12.4
Total (n=1,121)	95.0	96.5	95.3	97.6	95.6

While the percentages of emissions are comparable to the relative generating capacities within each region, there are several examples of significant divergence. The most glaring one is mercury emissions in ERCOT, which are about 30 percent greater than the region's share of generation capacity.¹⁵⁹ Lesser, but still significant, divergences are observed for SO₂ (MISO emissions are about 20 percent higher than its share of generation capacity) and NO_x (emissions in SPP and WECC are about 40 and 60 percent higher, respectively). These results indicate that apart from the exceptions noted above, *regional emissions rates roughly track regional reliance on coal-fired generation.*

Of course, the degree to which new regulations will impose additional costs on individual plants will depend in large part on their preexisting pollution control equipment.¹⁶⁰ Table 4

¹⁵⁶ These calculations are based on EPA's IPM 5.13 Base Case dataset, which among other assumptions is premised on mercury rules being implemented and grid conditions projected for 2016. Coal plants also generate a substantial portion of the power in these regions—72 percent in MISO, 46 percent in PJM, and 38 percent in SERC.

¹⁵⁷ When interpreting the data, it is important to recognize that if emissions levels were the same throughout the six regions, the percentage of total generation or (roughly) capacity in each region would be comparable to the corresponding percentages for each of the pollutants. The data are based on unit/boiler-level information for each coal-fired power plant; this additional level of data is needed because units within a power plant can have widely divergent operating characteristics.

¹⁵⁸ Based on EPA IPM 4.10 Base Case data for 2012.

¹⁵⁹ The divergence is even greater relative to the amount of coal generation in ERCOT. Reliable generation data are only available under the EPA's IPM 5.13 database, but the earliest estimates from those data are for 2016, which is after several of the key environmental regulations are already in effect. Despite this, the IPM 5.13 base case data indicate that mercury emissions in ERCOT will be 60% greater than its share of electricity generation in 2016.

¹⁶⁰ The control technologies for emissions of SO₂ and NO_x are relatively straightforward, with two primary options available for each pollutant. In the case of SO₂, the two most common technologies are wet and dry scrubbers, which remove 96 and 92 percent, respectively, of the SO₂ emitted by a coal generation plant. EPA, *CSAPR RIA*, *supra* note 63, at 230. Dry Sorbent Injection is a less-common third alternative that is much less expensive, but it

displays the adoption rates of pollution controls for SO₂, mercury and NO_x based on the generation capacity within each region.¹⁶¹ Adoption rates of SO₂ controls are similar across the regions with two notable exceptions: (i) WECC, where state and regional haze regulations¹⁶² have driven up adoption rates; and (ii) SPP, where adoption rates are substantially lower. The prevalence of pollution controls in WECC illustrates the influence of overlapping regulatory standards, while experience in SPP highlights the effectiveness of fuel-switching.¹⁶³ Adoption rates of mercury controls are lowest in ERCOT, SERC, and SPP; however, the absence of federal regulation has permitted adoption rates for strict controls to remain low in every region. Finally, the eastern focus of prior EPA NO_x regulations is evident in adoption rates of NO_x controls, which decline as one moves from PJM in the east to SPP and WECC in the west. Thus, regional patterns of existing pollution controls suggest that (i) grid management regions in the *east are less likely to be negatively impacted by CSAPR rule than those in the Midwest, and that (ii) the MATS rule is likely to have greater impacts in ERCOT and SERC.*

must be combined with either a fabric filter (FF) or electrostatic precipitator (ESP) that is typically used to remove particulate emissions. *Id.* For NO_x emissions, two technologies exist with substantially different levels of effectiveness: (1) Selective Non-Catalytic Reduction (SNCR), which removes up to 40 percent the NO_x emissions, and (2) Selective Catalytic Reduction (SCR), which removes about 90 percent the NO_x emissions. *Id.* at 231. Control of mercury emissions is substantially more complicated because it involves a mix of control technologies and the effectiveness of a given control technology varies with different types of coal (bituminous, subbituminous, lignite). The principal control technology for mercury is Activated Carbon Injection (ACI), which must be used in conjunction with some kind of particulate matter controls (either FF or ESP) and may be further enhanced when used with an SCR system. EPA, *MATS RIA*, *supra* note 73, at 2-9. The “High Controls” referred to in Table 4 below utilize this type of system and achieve at a 90 percent reduction in mercury emissions. *Id.* The “Medium Controls” referred to in Table 4 involve systems limited to either an ESP or FF, which achieve reductions that are highly variable and typically substantially lower than 90 percent. *See, e.g.*, Energy Information Agency, Electricity Market Module 105-06 (2014) available at <http://www.eia.gov/forecasts/aeo/assumptions/pdf/electricity.pdf>.

¹⁶¹ Data on pollution controls do not exist for the CPP because the relevant CO₂ control technology at the stack—carbon capture and sequestration—is only just beginning to be deployed. Further, although not strictly a form of pollution control, coal plant efficiencies impacts CO₂ emissions but vary only modestly (typically around ten-fifteen percent) across plants and even less on average between regions.

¹⁶² EPA’s regional haze rule aims to improve visibility in national parks and wilderness areas, and is part of EPA’s regulation of particulate matter under the Clean Air Act. EPA revised its regional haze rules in 2012. *See* EPA, *Regional Haze: Revisions to Provisions Governing Alternatives to Source-Specific Best Available Retrofit Technology (BART) Determinations, Limited SIP Disapprovals, and Federal Implementation Plans*, __ Fed. Reg. __ (DATE, 2012).

¹⁶³ Despite relatively low adoption rates, SO₂ emissions in SPP are below the national average, which is likely attributable to greater reliance regionally on low-sulfur coal. Fuel choice has the opposite effect in ERCOT, which despite having relatively high rates of adoption for mercury controls has high emissions rates. This seeming inconsistency is driven by reliance on lignite coal, for which emissions controls are less effective.

Table 4: Percentage of Generation Capacity with Pollution Controls by Region¹⁶⁴

	ERCOT	MISO	PJM	SERC	SPP	WECC	Nationally
Percent Generation Capacity							
SO₂ Controls							
None (n=396)	28.22	33	18.88	28.57	53.06	5.82	26.46
Dry Scrubber (n=172)	8.99	19.92	12	3.92	15.92	25.35	14.14
Wet Scrubber (n=343)	62.79	47.08	69.13	67.51	31.02	68.83	59.40
Mercury Controls							
Low (n=415)	39.32	50.63	49.11	59.22	44.96	33.49	49.49
Medium (n=410)	57.85	35.85	29.72	34.79	48.95	52.64	38.52
High (n=86)	2.83	13.53	21.17	5.98	6.09	13.87	11.99
NO_x Post-Combustion Controls							
None (n=521)	47.67	46.27	19.14	25.78	64.31	87.18	40.58
SNCR (n=132)	19.56	8.02	13.53	7.7	6.41	0.85	9.70
SCR (n=258)	32.78	45.71	67.32	66.52	29.28	11.98	49.72
Number of Boilers	36	261	220	199	88	107	911

To the extent that new pollution controls or other measures are required, the average age and size of a power plant will place limits on the costs that it can economically bear. By virtue of their shorter remaining lifetime, older plants have less time to amortize the costs of new pollution controls. Similarly, smaller plants are reliant on relatively low levels of generation to recoup the costs of pollution controls, and they do not benefit from potential economies of scale. Thus, older and smaller coal plants are at greater risk of being shut down because the range of regulatory costs that they can incur and still remain economically viable is smaller.

The U.S. has among oldest fleets of coal-fired power plants globally; its age distribution lags that of Russia and Poland, and is much older than those in either India or China.¹⁶⁵ The EPA data reveal that older (and smaller) coal generation plants are geographically concentrated in just a few regions. As shown in Table 5, MISO, PJM, and SERC together account for about 72 percent of the nation's pre-1980 coal generation capacity.¹⁶⁶ Further, roughly two-thirds to three-quarters of the coal generation capacity in each region is derived from plants more than 35 years old. These statistics suggest that a significant potential exists for regional disparities in the number of plant closures associated with the EPA rules. The seriousness of the risks to grid stability will hinge, however, on the contribution of older plants to actual electricity *generation*, as opposed to the levels of generating *capacity* displayed in Table 5.

¹⁶⁴ Data taken from EPA IPM 5.13 NEEDs database for the year 2010; excludes units that were not generating electricity in 2010 as well as several of classes of plants. See EPA IPM 5.13 Ch 4, 4-1 to 4-2.

¹⁶⁵ Matthias Finkenrath, *et al.*, *CCS Retrofit: Analysis of the Globally Installed Coal-Fired Power Plant Fleet 34* (2012) (detailing that in India and China almost 40 and 70 percent, respectively, of coal plants were less than 10 years old in 2012).

¹⁶⁶ The numbers of pre-1980 plants in MISO and PJM are striking on their own—186 and 126, respectively.

The geographic distribution of smaller coal-fired plants overlaps substantially with the older plants. More than three-quarters of the smallest units (0-50 MW) were located in the MISO and PJM regions in 2012;¹⁶⁷ however, collectively these units account for only a few percent of the coal-based electricity generated in either region.¹⁶⁸ Among the next tier (50-100 MW), the MISO and PJM regions are home to 70 percent of the coal-fired units,¹⁶⁹ but once again these units account for a small share of coal generation. Thus, because their generation capacities and levels are low, it is unlikely that retirements of smaller coal generation units alone could pose a threat to grid stability in either MISO or PJM.¹⁷⁰

It is nevertheless important to recognize that older and smaller coal generation plants typically emit air pollutants at relatively high rates. Coal plants that went online prior to 1960 have dramatically higher SO₂ and NO_x emissions, about 100 and 50 percent higher, respectively, than newer plants and substantially higher mercury emissions, about 25 percent. Coal plants constructed post-2000, by contrast, emit on average 50 percent lower quantities of SO₂ and about 60 percent less NO_x than the fleet averages. The higher annual emissions from the oldest coal units follows from their low adoption rates of emissions control technologies. Approximately 70 to 85 percent of the plants that went online prior to 1970 have no or weak controls for SO₂, NO_x, and mercury, compared with about 25 percent of plants brought online during the 1960-70 and 1980-90 decades and less than 15 percent otherwise.¹⁷¹ The low adoption rates of pollution controls are clearly evident in the statistics displayed in Table 5. Older and particularly smaller plants have dramatically higher emission levels than newer and larger facilities.

¹⁶⁷ MISO and PJM account for 112 out of 145 units nationally. Within MISO, 69 coal boilers, with a mean size of just 19 MW, had a combined capacity of 1.37 GW in 2012; similarly, within PJM 43 boilers had a mean size of 38 MW and a combined capacity of 1.64 GW.

¹⁶⁸ In 2016, 1.4 percent in MISO and 1.6 percent in PJM [need the 2012 numbers here].

¹⁶⁹ In MISO there were 73 boilers and in PJM 41, each with aggregate capacities of 5.4 GW and 3.03 GW, respectively; collectively they accounted for about 68 percent of the aggregate capacity of boilers in the range of 50 to 100 MW. SERC was a distant third with 18 plants and an aggregate capacity that accounted for about 11 percent of the national total.

¹⁷⁰ Our analysis is conducted at the regional level and thus cannot foreclose smaller-scale impacts on grid stability at the subregional level. We are not alone in this respect, however, as other leading reports acknowledge the same types of limits in their analyses. *See, e.g.*, Metin Celebi, et al., Potential Coal Plant Retirements: 2012 Update 7 (Oct. 2012) (acknowledging that retirements could cause problems for subregions heavily reliant on specific units) available at http://brattle.com/system/news/pdfs/000/000/095/original/Potential_Coal_Plant_Retirements_-_2012_Update_-_Executive_Summary.pdf?1377791286; Metin Celebi, et al., EPA's Proposed Clean Power Plan: Implications for States and the Electric Industry 29 (June 2014) (noting similar potential problems) available at http://www.brattle.com/system/publications/pdfs/000/005/121/original/EPAs_Clean_Power_Plan_and_Reliability_-_Assessing_NERC%27s_Initial_Reliability_Review.pdf?1427375637.

¹⁷¹ Highest percentages of weak pollution controls in 1940-60 (45%-cap; 38%--gen), 1960-70 (23%/20%), and 1980-90 (25%/23%); less than 15% for other year categories.

Table 5: Generation Capacity & Emissions Levels by Plant Age & Capacity¹⁷²

	Percent Emissions Nationally				
	Total Capacity (MW)	SO ₂	NO _x	Mercury	CO ₂
Plant Age					
1940-1960 (n=329)	40,883	22.4	14.7	14.5	11.5
1960-1970 (n=230)	60,140	26.8	21	19.2	17.5
1970-1980 (n=226)	111,951	35.5	34.5	36.2	35.7
1980-1990 (n=154)	73,593	12.3	25.5	25	24.6
1990-2000 (n=74)	11,139	0.6	1.9	1.5	3.6
2000-2015 (n=29)	10,352	0.5	1	1.4	3.1
Total (n=1,042)	308,058	98.2	98.5	97.9	96.1
Plant Capacity (MW)					
0-50 (n=145)	4,251	1.4	1.7	1.3	1.2
50-100 (n=164)	12,262	5	4.7	3.7	3.4
100-500 (n=559)	130,888	46.6	44.4	39.1	38.8
500-1000 (n=240)	157,346	40.4	45.8	51.7	51.2
1000-1650 (n=13)	16,554	6.6	3.4	4.1	5.4
Total (n=1,121)	321,301	100	100	100	100

One association we expected but observed only weakly was the inverse correlation between *age and efficiency of coal-fired power plants*. Significant improvements in efficiency are evident in the units constructed after 1960, as well as the most recent post-2000 generation of coal plants. Further, the variation in efficiency for the oldest units is much larger and extends to much lower levels of efficiency than those of plants constructed after 1960. However, incremental gains were made in power plant efficiency during the intervening years, and average efficiency gains for coal-fired power plants were in the range of about 10 to 15 percent over the fifty-year period covered by the data.¹⁷³ Perhaps in part because of this, there was relatively little variation in the annual operation rates (capacity factors) for coal plants irrespective of their age or size: slightly lower for 1990-2000; slightly higher for 1940-60, 2000-2015.¹⁷⁴

The overall impression these statistics leave of U.S. coal-fired power plants is quite mixed. The most consistent attribute of the U.S. fleet is its age—less than 10 percent of the generation capacity in 2012 was constructed in the prior two decades and almost 70 percent of the units were more than 30 years old. There are also a large number of coal-fired units (almost 209 in 2012) with capacities below 100 MW and disproportionately large emissions rates—although collectively their emissions are small relative to those from much larger, higher-

¹⁷² These results are based on the EPA IPM 4.10 base-case data for 2012.

¹⁷³ The median capacity factor for plants of widely varying ages is roughly 75-85 percent, with somewhat larger variances in capacity factors for plants that went online between 1980 and 2000.

¹⁷⁴ The one notable exception was the low capacity factors for small plants in certain regions, particularly 50-100 MW plants in PJM and 0-50 MW plants in SERC, and to a lesser extent 0-50 MW plants in MISO. These differences are also reflected in the generation data by size of plant. For older plants with None/SNCR/DSI controls, capacity factors substantially lower for 1960-1980. If a plant has scrubber, which many do, capacity factors are consistently above 80%.

generating units. Yet, it is also true that from a global perspective the generation capacity of these smaller units, about 17 GW in 2012, is significant in comparison to grid capacities in many midsize countries—Chile has a total grid capacity of about 18 GW, and even larger developed countries such as Australia have total capacities of about 45 GW.¹⁷⁵

Another major pattern that emerges from the data is the geographic concentration of coal-fired power generation in Midwestern and southeastern states, while many states in the west and northeast have very little coal generation. Regions in the Midwest and southeast have benefitted from inexpensive coal generation, and have leveraged these assets by maximizing their operational life. Thus, while regions with the highest coal generation capacity may experience more plant closures than other regions, their losses will be mitigated by the fact that the plants most likely to be shut down typically will be less valuable and, in any event, fully amortized given their age and size.

Finally, the preceding analysis shows that while the regions with the largest numbers of coal plants will have the greatest number threatened by EPA regulations, as a proportion of overall generation regionally the percentages will not differ greatly. In short, while the numbers may appear large in absolute terms, they are modest when considered relative to regional generation capacity. This means that regional grid management can mitigate the potential impacts of EPA regulations by spreading the costs and risks over larger areas.

B. Economic and Technical Drivers of Vulnerable Coal-Fired Power Plants

The characteristics of a power plant and of its regional electricity market will ultimately determine whether a plant is shut down, or substantially reduces its annual output. We have already provided information on two important characteristics—plant emissions levels and the presence or absence of emissions controls. In addition to the plant-level data on heat rates and pollution control equipment discussed above,¹⁷⁶ the EPA database contains information on the costs of pollution control equipment, variable and fixed operations and maintenance, fuel, and capital investments.¹⁷⁷ This information is essential to evaluating the impacts of the EPA's rules, and is an integral part of the Regulatory Impact Analyses the agency conducts. Thus, for the CSAPR and MATS rules we have direct EPA projections of retirements at the unit level.¹⁷⁸ Table 6 displays the number, regional capacity, and median size and age of the plants that are projected to retire as a result of the CSAPR and MATS rules. As expected, the units projected to retire in response to the CSAPR rule are overwhelmingly older and smaller, with median ages typically of more than 50 years and sizes well under 100 MW. The MISO and SPP regions, which host many smaller, older plants lacking the relevant control technologies, are projected to have substantial numbers of retirements. In the EPA projections it appears that the age of a unit is the single most important factor driving retirements, presumably because the costs of emissions control upgrades cannot be fully amortized over its remaining life. This pattern is also

¹⁷⁵ See <https://www.aer.gov.au/node/9772>.

¹⁷⁶ The EPA IPM 4.10 & 5.13 datasets both contain this information. See *supra* note .

¹⁷⁷ Only the EPA IPM 5.13 datasets contains a complete set of plant-level cost information. See *supra* note .

¹⁷⁸ The CSAPR data are based on the "retrofits SO2/NOx controls" variable in the CSAPR Remedy database. For the MATS estimate, we used the IPM 5.13 Base Case data but removed the plants that were attributable to the CSAPR rule; the IPM 5.13 Base Case data start with the assumption that the MATS rule has been implemented, and since the MATS rule is very costly, it is reasonable to assume that most retirements will be attributable to it. These estimates are likely over inclusive and will thus err conservatively on the side of being too high.

evident for the retirements in the PJM and SERC regions, where the median online year of retired units is 1952 and 1953, respectively. In terms of grid reliability concerns, it is hard to see much threat from the CSAPR rule, since the total capacity at risk is just 6.6 GW and the highest relative loss in any of the regions is only about four percent of coal generation capacity and two percent of total regional generation capacity.¹⁷⁹

Table 6: Projected Coal-Fired Unit Retirements for the CSAPR and MATS Rules

Region	No. of Units	Retirements (MW)	Median Size (MW)	Median On-Line Year	No. Post-1980 Units	Percent Retirements	Percent U.S. Capacity
CSAPR Retirements							
MISO	13	904	70	1969	2	13.79	31.02
PJM	26	3,087	94	1952	4	47.11	21.54
SERC	23	2,214	106	1953	0	33.79	20.13
SPP	6	348	54	1961	0	5.31	4.52
All Regions	68	6,553	82	1957	6	100.00	77.21
MATS Retirements							
ERCOT	3	1,262	435	1978	1	2.92	7.21
FRCC	4	1,236	304	1975	2	2.86	3.37
ISO-NE	10	2,128	178	1966	2	4.92	0.84
MISO	80	10,071	86	1961	4	23.30	31.02
NYISO	15	1,561	84	1958	3	3.61	0.79
PJM	32	5,627	145	1963	7	13.02	21.54
SERC	82	15,629	135	1958	9	36.16	20.13
SPP	8	1,948	140	1971	3	4.51	4.52
WECC	17	3,759	51	1979	8	8.70	10.57
All Regions	251	43,221	140	1966	39	100.00	100.00

The data suggest that the MATS rule has the potential to have a much greater impact on coal generation, and thus on grid stability; yet, here too there are mitigating factors and considerations. First, similar to the CSAPR rule, the coal-fired units projected to retire in response to the MATS rule are older and smaller, except in ERCOT and Florida,¹⁸⁰ where the median size is larger and the median age younger. However, even in those two regions the numbers of units projected to retire are small, representing a capacity of about one GW in each region. A large number of units projected to retire date back to the 1960s or earlier—the data for MISO and SERC illustrate this correlation vividly. Furthermore, the total capacity lost in any

¹⁷⁹ As noted above, this analysis is conducted at the regional level and thus cannot foreclose smaller-scale impacts on grid stability at the subregional level.

¹⁸⁰ In Table

6, “FRCC” is the Florida Reliability Coordinating Council, the subregional reliability organization covering most of Florida.

given region, whether in absolute or relative terms, is modest.¹⁸¹ Finally SERC, the only region disproportionately impacted by the MATS rule, is in a strong position to absorb capacity lost due to retirements.¹⁸² In addition to having a fleet of coal plants nearing the end of their lifetimes (including the oldest one in the country), SERC has a reserve margin that amounts to an excess capacity above 25 percent.¹⁸³

As noted previously, estimating the number of retirements and their geographic distribution is much more challenging for the Clean Power Plan (CPP) because of the flexibility it gives states to employ measures other than reducing CO₂ emissions from coal and gas plants. EPA and other commentators are limited to using “illustrative examples” to estimate the impacts on generation sources and grid reliability, as no one can be sure of the specific mix of policies that states will ultimately adopt.¹⁸⁴ These uncertainties have not stopped independent analysts from projecting likely retirements at the regional level, and we too will draw on the EPA data to make rough estimates ourselves. One must be especially careful, however, any such estimates are necessarily imprecise given the myriad options states have in complying with the CPP.¹⁸⁵

Table 7: Projected Generation Losses (All Sources) From the CPP¹⁸⁶

Region	Generation U.S. 2018 (%)	Retirements 2020 (MW)	Retirements 2020 (%)	Retirements 2030 (MW)	Retirements 2030 (%)
ERCOT	7.80	8,358	11.47	8,623	11.66
FRCC	2.90	9,239	12.68	9,239	12.50
ISO_NE	0.04	3,687	5.06	4,581	6.20
MISO	21.84	5,152	7.07	5,661	7.66
NYISO	0.24	1,700	2.33	1,944	2.63
PJM	22.89	4,717	6.47	5,659	7.65
SERC	20.57	18,241	25.04	17,250	23.33
SPP	10.24	7,737	10.62	7,198	9.74
WECC	12.02	12,006	16.48	11,754	15.90
U.S. Total ¹⁸⁷	99.5	72,857	97.23	73,938	97.25

¹⁸¹ For example, while ISO-NE and NYISO experience large drops in coal generation, the losses represent only about five percent of total capacity because coal is a minor generation source in those regions. Conversely, the regions with the largest capacity losses in absolute terms (MISO, SERC) have the highest generation capacities, resulting in relative losses of about eight percent.

¹⁸² Disproportionately impacted in this context mean that a region’s share of projected retirements (based on capacity) significantly exceeds its share of total generation. NERC, Summer 2014 Reliability Assessment 2 (May 2014) available at <<http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2014SRA.pdf>>. Note that the reserve margins in MISO are low relative to other regions (about 15%), but still above the NERC reference margin level. Similar to SERC, the region with the third-highest capacity losses from retirements, PJM, has high reserve margins in the range of 25 percent. *Id.*

¹⁸³ SERC also has relatively low electricity prices, and is dominated by the traditional model of vertically integrated utilities earning a guaranteed return on their capital investments.

¹⁸⁴ EPA, CPP RIA, *supra* note 85, at ES-3.

¹⁸⁵ The other point to keep in mind is that while the MATS rule primarily impacted coal plants, the CPP is projected to have significant impacts on gas plants, particularly older less-efficient gas plants (so-called “oil/gas steamers”). According to EPA estimates, O/G steamers will account for about twenty percent of the retirements associated with implementation of the CPP. EPA CPP Data File: Proposed Clean Power Plan_Option 1 State_ssr.xlsx.

¹⁸⁶ EPA CPP Data File: Proposed Clean Power Plan_Option 1 State_overview file.xlsx.

EPA projections for retirements of both natural gas and coal plants are displayed in Table 7 above.¹⁸⁷ The most striking feature of the data, to our minds, is the degree to which they are proportional to regional generation levels. While the share of retirements in ERCOT, FRCC, ISO NE, and NYISO is higher than those regions' percentages of U.S. generation in 2018, and the losses in PJM and MISO are lower, these differences are relatively small.¹⁸⁹ Moreover, except for ERCOT, each of the regions experiencing retirements that exceed their share of annual generation has robust reserve margins in the range of 25 percent or higher, and the losses amount to 10 to 15 percent of their total generation capacity.¹⁹⁰ Particularly given the complexity of the CPP and the range of factors EPA is balancing, the geographic distribution of retirements effectively mitigates potential problems with grid reliability. The outlier is ERCOT, which has struggled to sustain a sufficient reserve margin given growth in the state and could be significantly impacted by what would amount to a 9.5 percent loss in generation capacity from the CPP by 2020.¹⁹¹

To gain a rough sense of the coal plants that are most likely to retire as a result of the CPP, we modified unit-level data from EPA's 5.13 IPM database to incorporate the costs of all anticipated emissions controls.¹⁹² Similar to other studies, such as those of the Brattle Group,¹⁹³ we evaluated a series of cutoffs for electricity prices above which coal plants were presumed to be uneconomic. The cutoffs were set regionally and then adjusted to generate an aggregate capacity of coal plant retirements that was comparable to the lower end of the range derived by EPA.¹⁹⁴ Table 8 displays the regional distribution and key characteristics of the coal plants

¹⁸⁷ The percentages do not add up to 100 because a small number of the coal-fired power plants that are projected to retire are not located within the regions listed in Table 7.

¹⁸⁸ EPA does not provide separate estimates for retirements of coal and natural gas power plants at the regional level. However, nationally EPA does not predict any net losses of generation capacity from either combined-cycle or combustion turbines fueled by natural gas. EPA, Proposed Clean Power Plan_Option 1 State_overview file.xlsx. Oil/Gas steamers are the only power plants with significant retirements of generation capacity other than coal-fired power plants through 2030 under the CPP Option 1 scenario. *Id.*

¹⁸⁹ Florida or the FRCC region is a potential exception: It represents less than 3 percent of U.S. generation, but is projected to experience more than 12 percent of retirements by capacity.

¹⁹⁰ NERC, Reliability Assessment, *supra* note 182, at 2.

¹⁹¹ Recent projections show ERCOT maintaining its reserve margins, thanks to lower projected peaks in demand. THE BRATTLE GROUP, ESTIMATING THE ECONOMICALLY OPTIMAL RESERVE MARGIN IN ERCOT 1 (2014); *see also infra* Part III.B.3. (describing ERCOT's approach to capacity). ERCOT's is the only wholesale market characterized by both retail competition and the absence of a capacity market, which means that prospective investors in new plants lack any sort of revenue guarantee.

¹⁹² We identified plants requiring emissions control equipment to meet the CSAPR and MATS that remained uncontrolled under EPA's IPM 5.13 Base Case; in effect, this ensured that the cost of emissions controls were integrated into the generation costs of all coal-fired units in the data base. The costs factored into the analysis included fixed O&M, variable O&M, capital costs, and fuel costs.

¹⁹³ Metin Celebi, et al., 2012 Update, *supra* note 170, at 5-6 (using the cost of different pollution control retrofits to calculate the cost implications of proposed EPA rules and then setting aggregate cutoffs for costs to estimate the total generation capacity of coal plants that are likely to retire). The Brattle Group used a more complex methodology to assess the CPP in a more recent study that we do not attempt to replicate here. Metin Celebi, et al., EPA's Proposed CPP, *supra* note 170, at 4-5.

¹⁹⁴ EPA estimates that the CPP will cause 30-49 GW of coal-fired generation to retire by 2020. EPA, CPP RIA, *supra* note 85, at 3-32. The regional cutoffs varied between \$0.045/kWh for the WECC region and \$0.065/kWh for the FRCC region. If we had attempted to lower the cutoffs further, the estimates would begin to overlap substantially with the middle of the cost distribution, making the projections subject to far greater variances.

projected to retire. While there is substantial inter-regional variation, much of this is associated with a small number of plants in a few regions.¹⁹⁵ Once again, most of the projected retirements involve older and smaller coal-fired units, with almost 60 percent of the units having capacities below 100 MW and 65 percent more than 35 years old. The results broadly follow the pattern observed in the EPA projections for retirements of both natural gas and coal units, with the regions having the largest capacities experiencing the greatest losses.¹⁹⁶ They are also generally consistent with the results of other independent analyses.¹⁹⁷

Table 8: Projected Coal-Fired Unit Retirements by 2020 for the CPP

Region	No. of Units	Capacity Lost (MW)	Median Unit Size (MW)	Median On-Line Year	No. Post-1980 Units	Capacity Lost (%)	Generation U.S. 2018 (%)
ERCOT	7	2,906	575	1980	5	7.14	7.80
FRCC	5	1,210	275	1996	5	2.97	2.90
MAPP	2	105	53	1959	0	0.26	1.48
MISO	81	9665	25	1960	9	23.75	21.84
PJM	66	9901	42	1966	27	24.33	22.89
SERC	39	10,927	252	1980	20	26.85	20.57
SPP	26	4,332	80	1978	12	10.65	10.24
WECC	22	1,647	33	1976	4	4.05	12.02
All Regions	248	40,693	56	1967	82	100	99.74

Overall from the standpoint of grid stability and the distribution of the regulatory burdens, the preceding analysis shows that the projected scale of the retirements from the CSAPR, MATS, and CPP rules are modest compared with regional generation capacities, and

¹⁹⁵ Our simple model for projected retirements reveals that in ERCOT and FRCC only a handful of larger coal-fired power plants are at risk (this is in part because the regions themselves are relatively small and only modestly reliant on coal), which accounts for the larger average size of the at-risk plants for these regions displayed in Table 8. The patterns of projected retirements in SERC is more complicated; it turns largely on relatively higher operational costs and the large installed capacity of coal-fired power plants in the region.

¹⁹⁶ Our analysis shows MISO bearing a larger burden of retirements than EPA projects; and we project WECC bearing a smaller share, particularly given that the EPA estimates include natural gas plants. These differences are undoubtedly reflective of the very simple framework that we are using, as well as the difficulty EPA acknowledges in making projections below the national level. We don't expect our estimates to be precise, but instead to provide an indication of the general patterns with respect to unit size and age that are illustrative of the facilities likely to be a greatest risk of retirement.

¹⁹⁷ The EPA's and our estimates of the net loss coal generation capacity are consistent with those found in several recent reports. See, e.g., EIA, ANALYSIS OF THE IMPACTS OF THE CLEAN POWER PLAN 17 (May 2015) (estimating that the CPP will cause 50 GW coal generation capacity to be shut down nationally) available at <http://www.eia.gov/analysis/requests/powerplants/cleanplan/>; Jurgen Weiss, et al., EPA's Clean Power Plan: Assessing NERC's Initial Reliability Review 13 (Feb. 2015) (describing SPP estimate that the CPP will cause about 6 GW of coal plant retirements in the SPP, which is about 30 percent higher than our estimate) available at http://www.brattle.com/system/news/pdf2s/000/000/790/original/EPA%E2%80%99s_Clean_Power_Plan_and_Reliability_-_Assessing_NERC%27s_Initial_Reliability_Review_%28Executive_Summary%29.pdf?1424391658; ERCOT, Analysis of the Impacts of the Clean Power Plan 6 (Nov. 2014) (projecting 4.1 GW of coal plant retirements in ERCOT from the CPP, which is about 35 percent higher than our crude projection for ERCOT) available at <http://www.ercot.com/content/news/presentations/2014/ERCOTAnalysis-ImpactsCleanPowerPlan.pdf>.

that large reserve margins exist in most regions to offset the anticipated losses.¹⁹⁸ Projected retirement rates are largely proportional across regions, relative to either coal generation capacity or annual generation, and few regions bear a disproportionate share of the regulatory burdens. Moreover, the characteristics of the at-risk coal units suggest that the great majority of the plants that are likely to retire are close to the end of their lifecycle and long ago recouped their capital costs.

Finally, we note that compliance with these rules, while costly in absolute terms, is low relative to the annual operating expenses and revenue of the electric utility sector. The compliance costs of the MATS rule and the CPP have been projected to be \$9.6 billion and \$8.8 billion, respectively. Yet these costs represent less than five percent of the industry's expenses and revenue, which in 2012 were \$235.7 billion and \$270.7 billion, respectively.¹⁹⁹ For the MATS rule, which is the most costly of the three, the projected price increases for electricity peak in 2015 at 3.1 percent above the base case nationally according to EPA.²⁰⁰ The projected rate increases for the CPP are slightly higher, with the national average peaking in 2020 at 6.7 percent above the base case and regional increases in NYISO, and ISONE running as high as 10 to 12 percent.²⁰¹ However, the projected increases in the average annual cost of electricity are substantially lower—below 5 percent and often much lower—because of reductions in demand associated with energy efficiency.²⁰² In short, overall the projected impacts on retail electricity prices and annual expenditures are very modest, particularly in comparison to their benefits – a subject to which we turn next.²⁰³

C. Distribution of Compliance Benefits

The analysis thus far has focused exclusively on the costs of EPA's rules; this subsection evaluates the environmental and health benefits. One of the defining characteristics of

¹⁹⁸ The highest-impacted regions all also have large numbers and capacities (about 75 GW) of combustion turbines and combination Oil/Gas steamers that are either in reserve or operating at very low capacity factors, and thus could further offset lost capacity from retirements of coal-fired power plants.

¹⁹⁹ EPA, CPP RIA, *supra* note , at 2-21.

²⁰⁰ EPA, MATS RIA, *supra* note 73, at 3-24 (this amounts to less than a third of a cent per kWh). The highest increase regionally is projected to occur in SERC, at 6.3 percent or about half a cent per kWh, but electricity prices in the region would still be below the national average even in the absence of the MATS rule. *Id.* at Table 3-12, at 3-24. The estimates for the CSAPR predict increases of less than two percent nationally in 2012 and dropping below one percent by 2014; the highest region increase is roughly three percent or about a third of a cent per kWh. EPA, CSAPR RIA, *supra* note 63, at 266.

²⁰¹ EPA, CPP RIA, *supra* note 85, at 3-40 to 3-43 (this amounts to about 1.5 cents per kWh). The U.S. EIA estimates that electricity prices will peak at 3-7 percent above business as usual and in many regions return to baseline levels by 2030. EIA, *supra* note 197, at 21, 40-41. In some regions, such as the southwest and southeast, prices are projected to increase to 10-11 percent by 2030, but even those areas electricity prices typically drop below 5 percent above baseline by 2040. *Id.*

²⁰² For residential customers, expenditures on electricity peak at 3.4 percent in 2020 and fall to 0.03 percent by 2040; for commercial customers, they peak at 3.9 percent in 2020 and fall to -1.3 percent by 2040; and for industrial customers, they peak at 4.6 percent in 2020 and fall to 0.2% by 2040. EIA, *supra* note 197, at 44.

²⁰³ The more plausible claim is that these rules threaten the coal industry, but this perspective gets things backwards. The coal industry has benefitted for years from to shift its enormous environmental externalities to society. If what matters is social welfare, protecting the coal industry in its current state is not in the national interest. However, recognition of the impact of these rules on the coal industry may explain some of the political opposition to the rules. *See infra* Part IV.

regulations under the Clean Air Act (CAA) is their favorable benefit-to-cost ratios,²⁰⁴ and these rules are no exception.²⁰⁵ The MATS, CSAPR, and the CPP all boast benefits greatly exceeding their costs, despite EPA's omission of numerous difficult-to-monetize benefits.²⁰⁶ However, EPA's primary focus is on national-level costs and benefits—state and regional numbers are only of secondary concern.²⁰⁷ In this section, we examine the distribution of the regulatory benefits regionally.²⁰⁸ We find that the benefits tend to be concentrated in the regions where electric utilities will be most impacted by EPA rules. This really should not be surprising, as regulatory costs naturally track reductions in emissions of air pollutants regionally. We continue to focus on regional data because it is more tractable to evaluate regional than state data,²⁰⁹ and it is consistent with the scale at which electric grids are actually managed.

1. Benefits of the MATS Rule

The MATS rule is widely criticized for requiring installation of the most expensive pollution controls on coal-fired plants. As noted above, its benefits nevertheless exceed its costs by a factor of 3 to 8.²¹⁰ Table 9 below disaggregates the national statistics into regional data, but

²⁰⁴ Environmental Protection Agency, The Benefits and Costs of the Clean Air Act from 1990 to 2020 (March 2011) available at < <http://www.epa.gov/cleanairactbenefits/prospective2.html>>. See also Michael A. Livermore and Richard L. Revesz, *Rethinking Health-based Environmental Standards*, 89 N.Y.U. L. REV. 1184, 1236-47 (2014)(illustrating that the benefits of rules establishing NAAQS standards almost always exceed costs, and establish standards that fall short of the standard that maximizes net benefits).

²⁰⁵ This has been demonstrated in a broad range of analyses, ranging from long-term cost-benefit assessments of the CAA, to examinations of specific market sectors, to regional and state-level assessments using a mix of economic indicators. See Muller, *et. al*, *supra* note 27 ; Ben Machol & Sarah Rizk, *The Economic Value of U.S. Fossil Fuel Health Impacts*, 52 ENV'T. INT'L 75, 78 (2013); Tammy Thompson *et al.*, *A Systems Approach to Evaluating the Air Quality Co-Benefits of U.S. Carbon Policies*, 4 NATURE CLIMATE CHANGE 917 (2014); and Nicholas Z. Muller, *Boosting GDP Growth By Accounting for the Environment*, 345 SCIENCE 873 (2014). About 87 percent of the GED associated with coal-fired power plants is attributable to SO₂ emissions, with PM_{2.5} and NO_x each accounting for about 6.5 percent of the total GED; about 94 percent of the GED is attributable to increased mortality. Muller, *et. al*, *supra* note 27, at 1669.

²⁰⁶ See, e.g., CPP Regulatory Impact Assessment, at ES10-ES13. For MATS net benefits are \$31-81 billion per year, compared to total annual costs of \$9.6 billion. EPA MATS RIA, *supra* note 73, at ES-1. For CSAPR net benefits are \$110-250 billion per year compared to total annual costs of \$0.81 billion. EPA CSAPR RIA, *supra* note 63, at 1. And for CPP the net benefits are \$20-46 billion per year by 2020 (and that rises to \$46-79 billion per year by 20300, while total annual costs are \$4.3 to \$8.8 billion. EPA CPP RIA, *supra* note 85, at ES20-ES23.

²⁰⁷ Simply finding the state-level data in the RIAs takes time and persistence, as they are buried hundreds of pages into the analyses and are not mentioned or discussed in the executive summaries for the rules. Nor are they made available as separate data files along with the detailed emissions data and modeling that EPA very effectively (and transparently) posts on its website. Instead, the data must be extracted from the PDF versions of the RIAs and then imported into spreadsheet or statistical programs.

²⁰⁸ The regional numbers we calculate are based on state-level estimates EPA derived for the CSAPR and MATS rules, See EPA, Combined National and State-level Health Benefits for the Cross-State Air Pollution Rule and Mercury and Air Toxics Standards 8 (2011) available at <http://www.epa.gov/ttnecas1/regdata/Benefits/casprmat.pdf> . As discussed further below, state-level estimates are not available for the CPP. It is important to note that all of the state and regional estimates are based on the distribution of benefits overall from the EPA rules—none of the estimates distinguishes between benefits from emissions reductions that occur within a state or region versus those that occur outside a state or region.

²⁰⁹ That is, comparing six or eight regions is easier than comparing data for 48 states.

²¹⁰ After the Supreme Court's decision in *Michigan v. EPA*, *supra* note 70, EPA will need to justify imposing such significant compliance costs on industry when it revisits mercury regulation. As noted in Section I, *supra*, the

focuses on the regions with the largest fleets of coal-fired power plants. The percentage of coal-fired generation capacity regionally is provided as a benchmark for a distribution of the emissions reductions and benefits that is proportional to the size of the coal fleets regionally.²¹¹ The benefits of the MATS rule are given in terms of lives saved (the overriding driver of benefits) and total monetized benefits of the rule within each region.

Table 9: Regional Benefits of MATS Regulations: Emissions, Lives Saved, Value

Region	Capacity Coal (%)	Percentage Drop in Emissions			Number of Lives Saved	Valuation (\$Millions 2007)
		NO _x Total	SO ₂ Total	PM _{2.5} Summer		
ERCOT	7.21	5.04	10.16	7.68	460-1200	\$4,000-9,700
MISO	31.02	11.79	25.93	16.22	642-1649	\$5,583-13,650
PJM	21.54	31.93	9.65	19.71	1,025-2,618	\$8,850-21,660
SERC	20.13	31.99	30.65	36.78	1,452-3,750	\$12,500-30,900
SPP	4.52	4.59	11.03	5.54	208-522	\$1,760-4,400
WECC	10.57	13.58	10.33	13.04	119-309	\$1,020-2,484
Total	94.99	98.92	97.75	98.97	4,207-10,819	\$36,337-89,277

Two broad patterns emerge from the data: First, we note again that emissions reductions in most cases are roughly proportional to the regional generation capacity. For example, ERCOT has about seven percent of the coal-based generation capacity and its share of emissions reductions for the three pollutants ranges from five to ten percent. This accord indicates that only minor disparities exist with respect to the application of the MATS regulations regionally. The southeast (SERC) is arguably an exception, but this reflects the fact that SERC coal plants substantially lag other regions in their adoption of mercury controls (*see* Table 4 above).²¹² Second, benefits closely track local emissions reductions (and thus costs) because, as the EPA data show, most of the harms associated with air pollution from coal plants occur regionally.

Thus, the case for regulation based on economic efficiency therefore does not break down at the regional level—benefits substantially exceed costs at both the national and regional levels. Importantly, this is true even when a region bears a higher share of the costs precisely because regional benefits rise with regional costs. This correlation is evident in the starkest example from the data: the relatively larger emissions reductions in SERC (30-37 percent versus its 20 percent of generation capacity) results in greater benefits that account for roughly 35 percent of

benefits of mercury regulation include co-benefits associated with reduced emissions of pollutants other than mercury. The Court's *Michigan* decision has created some uncertainty about whether EPA may reasonably base its decision to regulate on an analysis that credits these co-benefits, real though they may be.

²¹¹ As we have elsewhere, this statement assumes that an equitable sharing of the regulatory burdens would require each region to reduce its emissions to a level that is proportional to its contribution to the air pollution externalities. Here we use generation capacity as a proxy for each region's relative contribution, which as Table 3 shows tracks the emissions of the major pollutants at the regional level. This is not the only basis upon which to assess the equity of EPA's regulations (emissions reductions could be proportional to the difference between a region's average emissions rate and the national average), but by erring conservatively on the side of regions more reliant on coal, our findings below that EPA's rules are generally fair at the regional level are less vulnerable to challenges of bias.

²¹² Fifty-nine percent of the coal-fired units in SERC have low or no emissions controls for mercury, whereas the national average is 42 percent. The reduction of SO₂ emissions in SPP was also disproportionate to its generation capacity, but this is a byproduct of the mercury controls, which also impact SO₂ emissions, and the low rate of adoption for SO₂ controls in SPP (43 percent versus the national average 72 percent).

the aggregate benefits nationally. In sum, while mercury and co-pollutants such as PM_{2.5} have national and even global impacts, the *regional* health benefits of the MATS rule offset by a substantial margin the *regional* costs of complying with it.

2. Benefits of the Cross-State Air Pollution Rule

Because the CSAPR is designed to mitigate interstate air pollution (specifically, to remedy the problem of Midwest and southern plants sending pollution to downwind states to the east), regional disparities are more likely between the respective distributions of its costs and benefits. Table 10 confirms that this is true for certain regions: SPP receives about 2 percent of the monetized benefits but accounts for 25 percent of the reduction in NO_x emissions; and MISO receives 15 percent of the monetized benefits but accounts for 26 and 21 percent of the reductions in NO_x and SO₂ emissions respectively. By contrast SERC comes out ahead, with SERC responsible for about 15 percent of the emissions reductions while receiving approximately 23 percent of the monetized benefits. In the case of MISO, although the region receives a lower share of the benefits, its emission reduction burden is very close to its share of generation capacity. Similarly, while SPP bears a disproportionately large burden of reducing NO_x emissions (about five time greater than its share of capacity), this disparity is driven largely by the region's low rates of adoption for NO_x control technologies.²¹³

Table 10: Regional Benefits of CSAPR Regulations: Emissions, Lives Save, Value

Region	Capacity Coal (%)	Percentage Drop in Emissions			Number of Lives Saved	Valuation (\$Millions 2007)
		NO _x Total	SO ₂ Total	NO _x Summer		
ERCOT	7.21	2.7	7.3	4.4	700-1,800	6,100-15,000
FRCC		7	0	13.9	630-1,600	5,400-13,000
MISO	31.02	25.9	37.4	21.1	2,397-6,168	20,628-50,668
PJM	21.54	25.8	33	20.7	4,917-12,470	41,800-104,000
SERC	20.13	13.6	17.9	14.4	3,110-7,950	26,800-64,900
SPP	4.52	25.3	4.1	26	275-711	2,400-5,870
Total	94.99	99.8	99	99.9	13,234-33,736	113,523-278,988

Equally important, the compliance costs for the CSAPR rule nationally are relatively low, less than \$1 billion annually, while the benefits are enormous—more than a hundred times greater than its costs. Accordingly, although the benefits are not equally shared across different regions of the country, the large magnitude of the benefits ensures that costs will be more than offset even in the regions receiving a smaller share of the national total. For example, even if electric utilities in SPP bear 26 percent of the annual costs (i.e., costs are roughly proportional to emissions reductions), the regional costs would amount to \$211 million annually, which is less than 10 percent of the lower bound for the benefits SPP would receive.

The CSAPR illustrates powerfully how the enormous benefits of Clean Air Act rules promote Pareto improvements (on a region by region basis), even when the costs of a rule are

²¹³ In SPP, just 36 percent of coal-units have some kind of NO_x controls versus 52 percent nationally.

unevenly spread.²¹⁴ In each wholesale market, the monetized benefits of CSAPR dwarf the costs (despite the few regional cost disparities), even using quite conservative assumptions. Thus, these rules go far beyond the Pareto condition—the net benefits in each region are large and effectively nullify any unevenness in the distribution of costs. Moreover, the CSAPR is forcing upwind utilities to internalize costs they had previously shifted to downwind communities. Indeed, before the rule people in the upwind states enjoyed inexpensive electricity partly *because* they could shift those costs to people in the downwind states.

3. *Benefits of the Clean Power Plan*

Each of these rules is complex legally and technically, but the CPP is especially complex even by Clean Air Act standards. Although styled as a “standard,” it has many attributes of a broad-sector pollution trading program and has been designed by EPA to promote flexibility and cost-effectiveness because the options for reducing GHG emissions at the source are limited or very costly. However, the flexibility that is a defining feature of the rule complicates the measurement of its costs and benefits, as it is far less clear what mix of mitigation measures will ultimately be adopted.

Recall that pursuant to CAA Section 111(d), EPA has proposed guidelines according to which *states* will set standards reflecting the “best system of emissions reduction” (BSER) that take into account costs and any non-air quality health, environmental, and energy impacts.²¹⁵ In particular, EPA’s approval guidelines establish state-by-state emission reduction goals based on “the emissions reductions opportunities and state programs and measures, and characteristics of the electricity system.”²¹⁶ Thus, EPA assigns more aggressive goals to those states that have a broader range of cost-effective options for reducing GHG emissions; conversely, it assigns less aggressive goals to those states that have fewer options. These differential goals reflect EPA’s attempt to equalize compliance costs across states, thereby mitigating potential inequities between states with respect to the economic burdens of the CPP.²¹⁷

One of the challenges for our analysis is that, as EPA acknowledges, “[g]iven the flexibilities afforded states in complying with the emission guidelines, the benefits, costs, and economic impacts reported in [its] RIA are not definitive estimates, but are instead illustrative of compliance actions states may take.”²¹⁸ One consequence of this uncertainty is that the most granular level of EPA’s cost-benefit analysis is conducted at a broad super-regional level, which divides the country into “East” and “West,” as well as singling out California for analysis on its own. EPA’s super-regional East-West analysis exposes one unmistakable geographic pattern of the rule’s benefits—roughly 95 percent of the benefits associated with reducing the emissions of

²¹⁴ As noted *infra* at note 170, this is not to say that these rules produce Pareto improvements on an individual-by-individual basis, since coal mining jobs will be lost because of these rules. But their huge benefit-cost ratios do mean that these rules yield Kaldor-Hicks improvements nationally and, as we have shown, regionally as well.

²¹⁵ EPA, CPP RIA, *supra* note 85, at ES-1 to ES-2.

²¹⁶ *Id.* at ES-2.

²¹⁷ The CPP offers states additional flexibility to achieve emissions reductions through a variety of methods. *Id.*

²¹⁸ *Id.* at ES-3. The state-level BSER standards are presented in “Option 1,” the presumptive approach, but EPA is also requesting comment on a second approach, “Option 2,” which differs from the first in two primary respects—it is premised on lower deployment levels of mitigation measures and sets a shorter time period for compliance. *Id.* Each of the two options is premised on states employing mitigations measures drawn from four classes or “building blocks,” but the specific mix is left up to the states and the regulations allow them to develop plans with other states regionally. *Id.*

conventional co-pollutants occur in the East. And as with the MATS rule, a majority of those benefits are co-benefits attributable to reductions in SO₂ emissions from coal-fired power plants.²¹⁹ Indeed, co-benefits account for 48 to 69 percent of the CPP's monetized benefits, which suggests the rule's benefits will be distributed unevenly around the country.²²⁰

To try to estimate the regional distribution of CPP benefits, we used a mix of proxies, estimates of emissions reductions by state for conventional pollutants, and independent analyses of the health benefits by state for an analogous regulatory program conducted by an independent group of researchers from Harvard University, Boston University, and Syracuse University (hereinafter "Health Co-Benefits Study").²²¹ The picture that emerges from this analysis is mixed. As indicated by EPA's super-regional data, there are clear interstate and regional disparities evident in the emissions reductions projections. The ERCOT, FRCC, and SPP regions each are responsible for a disproportionate share of GHG emissions reductions when measured against their projected annual generation in 2018, whereas the standards for PJM and WECC are relatively relaxed (see Table 11 below).²²² However, similar to the other rules, the correlation between emissions of CO₂ and conventional pollutants implies that those states with more stringent emissions goals will also reap greater co-benefits. And because EPA has a legal mandate to equalize the cost burden across states, these greater reductions should be achievable at a cost that is not markedly higher than costs incurred by states subject to weaker goals.

Table 11: Regional Emissions Reductions from the CPP Using State Plans

Region	Generation ¹ (%)	Percent Reductions Nationally by 2020			Percent Reductions Nationally by 2030		
		CO ₂	NO _x	SO ₂	CO ₂	NO _x	SO ₂
ERCOT	7.8	17.8	15.2	20.1	17	14.7	17.5
FRCC	2.9	9.4	9.5	16.5	7.9	7.4	10.4
MISO	21.8	17.8	15.4	7	16.2	16.4	14.1
PJM	22.9	9.3	10.3	9.2	15	15.1	17.4
SERC	20.6	22.2	24.5	34.3	22.1	23.5	29.1
SPP	10.2	10.5	10.3	7.4	8	10.5	6.3
WECC	12.0	10.7	12.2	4.3	11	9.9	4.4
Total	98.2	97.7	97.4	98.8	97.2	97.5	99.2

1. Percent of generation nationally from all sources based on IPM 5.13 Base Case for 2018.

The Health Co-Benefits Study complicates this picture insofar as it suggests that co-benefits of the CPP may not be so localized. As summarized in Table 12, their results suggest that the FRCC and SPP regions are likely to bear a disproportionate share of the burden for

²¹⁹ *Id.* at 4-38, 4-39.

²²⁰ By contrast, one would expect the climate benefits from the rule to be distributed relatively evenly, or to be subject to such large uncertainties at the subcontinental level that estimates of benefits will only be possible at large scales, thereby effectively precluding reliable assessment of interstate disparities.

²²¹ Driscoll, C.T., *et al.* Co-benefits of Carbon Standards. Part 1: Air Pollution Changes under Different 111d Options for Existing Power Plants (2014) *available at* < <http://www.chgeharvard.org/resource/health-co-benefits-carbon-standards-existing-power-plants>>. The Health Co-Benefits Study includes a scenario, Scenario 2, that was designed to resemble the regulatory framework for the CPP. *Id.* at 1-2.

²²² The estimates in Table are limited to the years 2020 and 2030 because these are the compliances dates for the interim and final BSER standards under Option 1 for the CPP.

reducing CO₂ emissions, *and* are unlikely to receive much in the way of countervailing health co-benefits. Conversely, the states in the PJM region are subject to relatively weak emissions reduction goals, and yet they receive a disproportionate share of the benefits—30 percent of the total, which is almost triple their relative contribution to reducing emissions of CO₂ and 50 percent greater than their share of annual generation nationally. These results suggest that the distribution of health co-benefits has the potential to exacerbate, rather than offset, regional or interstate disparities in compliance costs.

Table 12: Harvard Study of Health Co-Benefits from CPP²²³

Region	Lives Saved (Avg)	Percent Lives Saved (Avg)	Lives Saved CI	Hospital Visits Avoided (Avg)	Hospital Visits Avoided CI
ERCOT	230	6.4	52-410	79	38-120
FRCC	110	3.1	24-190	38	18-58
MISO	873	24.5	195-1,538	273	137-401
PJM	1,092	30.6	242-1,916	292	154-424
SERC	660	18.5	150-1,178	215	105-326
SPP	122	3.4	28-217	43	21-65
WECC	185	5.2	43-323	59	27-91
Total	3,568	91.7	799-6,288	1073	540-1,593

A few caveats are in order here. First, as noted earlier, since EPA designed the CPP rule to spread costs evenly across states and regions, the magnitude of emissions reductions is a poor proxy for compliance costs. Second, the CPP may still represent a Pareto improvement (on a region-by-region basis) even if costs and benefits are distributed unevenly, so long as benefits exceed costs within each region. Although not as dramatic as those under the CSAPR, EPA estimates for the monetized benefits of the CPP are significantly higher than the regulatory costs—at least a factor of four greater.²²⁴ Accordingly, even for regions such as SPP, if we were to assume (conservatively and incorrectly) that costs are directly proportional to emissions reductions, the benefits would still out-weigh the costs—for SPP the benefits would be 0.5 to 3.4 times greater than the costs.²²⁵

Thus, each of the EPA rules enhances welfare nationally and within each regional wholesale electricity market. In most regions, the geographic distribution of the benefits from emissions reductions is roughly commensurate with the distribution of compliance costs.

²²³ The data are taken from Scenario 2 of the Harvard study, which is the closest analogue to the CPP. *Id.*

²²⁴ EPA, CPP RIA, *supra* note 85, at 2-12 to 2-23. For Option 1 under state implementation (3 percent discount rate), EPA estimates are as follows: (1) 2020: climate benefits -- \$18 billion, health benefits -- \$17-40 billion, compliance costs -- \$7.5 billion (ratio 4.7-7.7); (2) 2030: climate benefits -- \$31 billion, health benefits -- \$27-62 billion, compliance costs -- \$8.8 billion (ratio 6.6-10.6). *Id.*

²²⁵ This calculation is based on multiplying total costs by the region's percent share of CO₂ emissions reductions to obtain the regional share of costs, and by multiplying the climate and health co-benefits by the region's share of health co-benefits from the Health Co-Benefits Study. This estimate is conservative both on the cost side, as costs will not be directly proportional to emissions reductions, and the benefits side, as the distribution of climate benefits will not track the health co-benefits and will in all likelihood be higher for regions such as SPP and FRCC. In 2020, the calculation for SPP is as follows: regional costs = 0.105*7.5= \$788 million; regional benefits = 0.034*35/58 = \$1.19-1.97 billion. In 2030, the calculation for SPP is as follows: regional costs = 0.105*8.8= \$924 million; regional benefits = 0.034*58/93 = \$1.97-3.16 billion.

Depending on the EPA rule, some regions capture more of the benefits than others, and some regions bear more of the costs than others. However, each rule produces positive net benefits within each region, and in most cases where cost disparities exist they are projected to be small relative to the total benefits at the regional level. While our analysis stops short of state-by-state comparisons, it suggests that for most states (coal-producing regions may be excepted²²⁶) the net benefits of these rules will be positive—and often by large margins—as well.

IV. Reassessing the Political Economy of the Energy Policy Debate

The preceding analyses in Sections II and III highlight the contrasting ways in which the impacts of the EPA rules are being framed. Regulatory entities responsible for managing the electricity grid focus narrowly on potential impacts to grid stability at the regional and sub-regional levels to the exclusion of other costs, and particularly the benefits of regulation. EPA and its supporters focus on comprehensive assessments of costs and benefits nationally, which obscures potential disparities at the regional and sub-regional levels—including localized impacts on grid stability. The two perspectives are complements of each other insofar as the narrow focus of energy regulators highlights impacts of the rules that are not captured by the comprehensive, national-scale cost-benefit analyses conducted by EPA. We find that both perspectives provide important, technically grounded insights; however, their divergent scales and scope make it difficult to assess the significance of the conflicting projections they make. Moreover, these analytical differences are often misread or magnified in political debates over energy policy.

A central objective of Section III is to bridge the gap between the perspectives of grid managers and environmental regulators. While the limited scope of grid stability assessments precludes scaling them up to an analysis comparable to EPA's regulatory impact analyses, the EPA data in combination with other studies enable us to scale-down the cost-benefit information to the regional level. This midlevel analysis provides a strong basis for concluding that the distributional objections to EPA rules are unfounded—regional disparities are almost always modest to the extent they exist and, more importantly, are vastly offset in most cases by the regional benefits of each rule. These findings do not, however, negate the concerns raised by many energy regulators about the potential for significant sub-regional threats to electricity supplies and reliability. To the contrary, energy regulators from the state, to the regional, to the federal level raise significant, though widely varying in degree, concerns about threats to grid stability based on regional-scale models and experience. Our findings instead put regional reliability concerns into their larger context, one that compares reliability risks to the larger cost context and to the benefits of regulation.

Both perspectives—those of regional grid regulators and national environmental regulators—should be factored into policy development and implementation. This nevertheless presents a basic epistemic challenge: a simple algorithm does not exist for striking a balance

²²⁶ We have not examined the net benefits of these rules in coal-producing states, nor have we attempted a broader analysis of costs and benefits beyond those associated with power sector changes effected by these rules. Rather, one might speculate that in such an analysis, costs associated with job losses in the power and coal sectors in coal producing states might outweigh the benefits of emissions reductions. Similarly, a broader analysis might also suggest that the benefits to natural gas producing states (like Texas) might be significant, as gas-fired generation replaces coal-fired generation.

between them; the content and scale of the models simply provide distinct perspectives on the potential impacts of the EPA rules. The two perspectives can, however, be analyzed at spatial scales that are more closely matched to mitigate the analytical incommensurability created by their qualitative differences. This is in essence what we have done by undertaking a close examination of the cost-benefit data at the regional level. By rescaling the data, we can show that, in most cases, regional wholesale markets are not disproportionately impacted by the EPA rules. Importantly, this finding goes beyond global quantitative assessments of the costs and benefits of the rules. The data on regional excess generation capacities indicate that, while sub-regional disruptions cannot be ruled out, very few regions (ERCOT being the principal exception) are likely to be disparately vulnerable to the unquantified risk of disruptive grid instabilities at the local level.

The common spatial scale of regional data thus resolves the apparent inconsistencies between concerns raised by grid managers about stable electricity supplies and EPA's highly favorable cost-benefit analyses. They are not so much inconsistent with each other as they are operating on distinct sets of starting assumptions that are dictated by the differences in their respective spatial scales and criteria. This is an important distinction because it shows that the perspectives of grid managers should not be read as a challenge to EPA's analyses, but instead as augmenting them—the debate cannot and should not be reduced to a dichotomy with EPA on one side and grid managers on the other. Neither the substance of grid manager's concerns discussed above nor, in most cases, the concerns they raise about EPA's rules are consistent with such a view. While we have no illusions that more detailed and nuanced cost-benefit analyses will neutralize the ideological battles between the political parties and the powerful interest-group influence on regulatory policymaking, this information can help reduce the polarizing influence of such political forces. Of equal importance, careful consideration of the regional data allows one to disentangle the valid technical concerns from the political demagoguery.

Indeed, the contrast between the data on regional impacts of the EPA rules presented in Part III and the regional and state positions on the rules presented in Part II suggests two questions. First, if our analysis shows that the EPA rules represent Pareto improvements nationally and regionally,²²⁷ what accounts for the preponderance of opposition to the rules, and the litigation that they have generated? Second, putting aside the benefits of the rules and focusing only on costs, what explains the weak correlation between the regional impacts of the rules and the positions taken by market regulators (and particularly the state PUCs within them). These inconsistencies highlight not only the divergence between valid technical concerns and politics but also the variability of political forces at play in different regional energy markets.

²²⁷ Putting our analysis and the EPA analysis aside, many other studies support the notion that the net benefits of the rules are positive. See Larsen, John, et al., *Remaking American Power: Potential Energy Market Impacts of EPA's Proposed GHG Emission Performance Standards for Existing Electric Power Plants* (2014), available at: http://csis.org/files/publication/141107_Ladislav_RemakingAmerPower_Web.pdf; Schneider, Conrad, *Power Switch: An Effective, Affordable Approach to Reducing Carbon Pollution from Existing Fossil-Fueled Power Plants* (2014), available at: <http://www.catf.us/resources/publications/view/194>. Because the rules trigger emissions reductions that avert thousands of premature deaths, the dollar value of the benefits of the rules is very large. See discussion, *supra*, at ___. Moving beyond the air impacts, even Texas, the regional market that combines relatively low reserve margins with significant numbers of plant retirements, benefits not only from pollution reduction, but also from the projected increased sales of natural gas to generators in other markets as more gas-fired plants operate more often as a result of these rules. See Larsen, et. al, *supra* note 227, at 42

As to the first question, there are several possible answers. The first and most obvious answer is that at the individual (industry) level, these rules do not produce Pareto improvements. To the contrary, the EPA rules are archetypes of policies for which costs are borne by a few industries while the benefits are diffusely shared by the general public—conditions in which the bearers of the costs are much more likely than the beneficiaries to participate in the policymaking process. EPA rules threaten the profitability of coal mining companies and coal-fired power plants. Those companies and their employees are identifiably at risk, can easily coordinate their lobbying efforts,²²⁸ and have compelling economic reasons to oppose these rules. The beneficiaries of these rules, by contrast, are the tens of thousands of Americans who will be protected against the illnesses and premature deaths associated with uncontrolled air emissions, or who will (decades from now) avoid harms resulting from climate change. Not only are these beneficiaries far flung and difficult to organize, most of them cannot yet be identified²²⁹ and thus are not directly represented in the policy process.²³⁰ Therefore, politicians (including governors, attorneys general, and public utility commissioners in some states) have an electoral incentive to represent these economic interests on whom costs are concentrated, and less incentive to represent the broader public. Politicians can influence unelected public utility commissioners through the power of appointment, and state actors can influence regional organizations (like ISOs/RTOs and NERC regions) of which they are members. This bias can influence politicians and decision makers in either (or both) of two ways—one cynical, and one innocent. The innocent way is that politicians and decision-makers, hearing from one side and not the other, sincerely conclude that the net benefits of the rules are negative, and so oppose them; the cynical way is that politicians and decision makers are aware of the highly favorable cost-benefit ratios, but ignore them because doing so enhances the likelihood of their reelection or reappointment. Given the overwhelming support for the notion that the net benefits of these rules are positive, developing a sincere belief to the contrary strains credulity or requires turning a blind eye to the clear balance of the evidence.²³¹

Second, many of the organizations registering objections to these rules are charged with ensuring the reliable and efficient operation of electricity markets. While general principles of administrative law may require them to consider all elements of the public interest,²³² their core missions do not include environmental protection, or even the broad maximization of net

²²⁸ Interest group theorists have long posited this basis for outsized influence of business groups in the political process. See E.E. Schattschneider, *THE SEMISOVEREIGN PEOPLE: A REALIST'S VIEW OF DEMOCRACY IN AMERICA* 35 (1960) (“The flaw in the pluralist heaven is that the heavenly chorus sings with a strong upper class accent”); and Mancur Olson, Jr., *THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS* (1968) (1965), at 33-4. More recent analyses have challenged this hypothesis.

²²⁹ That is, most who get sick and die prematurely from ingesting pollutants from coal-fired power plants do not know that it is coal-fired power that killed them or hastened their death.

²³⁰ To the extent they are represented, they are represented by proxies – NGOs and other groups standing in their stead. Some scholars argue that groundswells of public interest can and have overcome this interest group bias in the policy process. See e.g. James Gray Pope, *Republican Moments: The Role of Direct Popular Power in the American Constitutional Order*, 139 U. PA. L. REV. 287 (1990); Daniel A. Farber, *Politics and Procedure in Environmental Law*, 8 J.L. ECON. & ORG. 59, 60 (1992).

²³¹ The psychological processes that lead to climate denial and science denial in environmental policy debates are beyond the scope of this article. For a discussion of these issues, see e.g., Jeffrey J. Rachlinski, *The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299 (2000).

²³² See *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402 (1971); *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29 (1983).

benefits; rather, their job is to keep the lights on. Therefore, they have an institutional incentive to object to policies that might introduce reliability risks, even if a comprehensive cost-benefit analysis shows that these risks are small compared to the rules' environmental benefits. NERC, regional reliability organizations, FERC, ISOs/RTOs, and state PUCs all fall into this category and thus may be biased towards safeguard their institutional mandates. This bias may be exacerbated by the phenomenon of loss-aversion,²³³ which reveals that people and institutions are more likely to comment on regulatory proposals they oppose than those they support.²³⁴

A third explanation is grounded not in interest-group politics, but in the broader ideological conflicts that have come to dominate 21st century policymaking at the state and federal levels. The ideological homogeneity of the two major parties, and their increasing ideological distance from one another, have gridlocked Congress and placed states at the center of regulatory policy conflict.²³⁵ In such an environment, federal policy initiatives tend to come from the executive branch (because Congress cannot act), and states dominated by the party opposing the president actively resist those initiatives. Some politicians and decision-makers may oppose the EPA rules because they do not believe that government should intervene in markets to address pollution externalities, or because they distrust the science behind the rules. (We describe these forces in Part I.) Thus, the GOP and coal-state Democrats' anti-EPA rhetoric may reflect the sincere belief that electricity producers *ought* to be able to shift the pollution externalities of coal-fired power to society, or that those externalities pose a much smaller risk than commonly thought. This seems unlikely, however. Even the most virulent EPA opponents in Congress stop short of calling for the repeal of most environmental protection laws. In 2011, Senate Republicans sponsored a bill to fold the EPA into the Department of Energy; however, those Republican senators based their case not on the absence of a need for environmental protection, but on efficiency grounds.²³⁶

Partisan or ideological differences can also work simultaneously with interest group politics to motivate policymakers. They can work in tandem, as in solidly Republican coal states like Wyoming; or they can work at cross purposes, as in traditionally Democratic coal states like Illinois. These dynamics may help us understand the variation among market regions and states in the positions they have taken on the EPA rules, and suggest that in some states and regions ideology is driving position-taking to these rules. Just as Republican appointees to the FERC were more critical of the Clean Power Plan than Democratic appointees, regional and state institutions in more conservative or Republican parts of the country seem more likely to be critical than their counterparts in more liberal or Democratic parts of the country. As we note in Section II, two of the market regions facing the largest numbers of projected plant retirements

²³³ For a discussion of the phenomena of loss aversion and risk aversion in the behavioral sciences, see Antoine Bechara, et al., *The role of the amygdala in decision-making*, 985 ANN. N.Y. ACAD. SCI. 356 (2003); Antoine Bechara et al., *Deciding advantageously before knowing the advantageous strategy*, 275 SCI. 1293 (1997); and James Montier, BEHAVIOURAL INVESTING: A PRACTITIONERS GUIDE TO APPLYING BEHAVIOURAL FINANCE 447-52 (2007).

²³⁴ See e.g., Dorit Rubinstein Reiss, *Tailored Participation: Modernizing the APA Rulemaking Procedures*, 12 LEG'N & POL'Y 321, 330 (2009) (“[m]ost empirical studies of rulemaking, as well as articles that draw on them, demonstrate limited participation in rulemaking and rare participation beyond involved interest groups (and especially business interest groups)”).

²³⁵ See Jessica Buhlman-Pozen and Heather Gerken, *Uncooperative Federalism*, 118 YALE L.J. 1256 (2009)(documenting this trend); and Freeman & Spence, *supra* note 000.

²³⁶ Brad Johnson, *Richard Burr Introduces Bill to Abolish EPA*, HillHeat.com (May 6, 2011), available at: <http://www.hillheat.com/articles/2011/05/06/richard-burr-introduces-bill-to-abolish-the-epa>.

(MISO, PJM) have been more circumspect and qualified in their comments on the rules than other regions facing similar losses (SPP, ERCOT).²³⁷ MISO and PJM expressed concerns about the reliability impacts of the EPA rules, but did so in specific ways that suggested solutions. For example, MISO's reaction to the CSAPR and MATS rules noted the need for transmission investment to adjust to probable losses of capacity; it then embarked on a plan for additional transmission investment.²³⁸ Likewise, both MISO and PJM emphasized the need for longer compliance periods in their comments on EPA's Clean Power Plan.²³⁹ By contrast, the comments of SPP and ERCOT were far more antagonistic of the proposed rule.²⁴⁰

Gallup reports state-by-state percentages of people who identify as conservative or liberal. Figure 2 depicts average ideology (specifically, average percentages of people identifying as conservative) in wholesale market regions.²⁴¹ These data offer only weak support for the idea that ideology drives position-taking by market regions on EPA rules. Interestingly, ERCOT, SPP, SERC and MISO all score above the national average on the "percent conservative" measure, and PJM scores at the national average. PJM and MISO North²⁴² are less conservative than ERCOT, SPP and SERC, but not strikingly so. The other regions depicted on Figure 2, CA ISO, ISO NE, and NY ISO, are strikingly less conservative than the others, which may explain the more conciliatory tone of the ISO/RTO Council's comments on the Clean Power Plan (in which they all participated),²⁴³ and why the remaining ISOs/RTOs felt the need to submit separate comments on the proposal.

²³⁷ See *supra* notes 132-134, 138-140.

²³⁸ For a description of the MISO "multivalued" transmission project program, see Alexandra B. Klass & Elizabeth J. Wilson, *Interstate Transmission Challenges for Renewable Energy: A Federalism Mismatch*, 65 VAND. L. REV. 1801 (2012).

²³⁹ See *supra* notes 132-134.

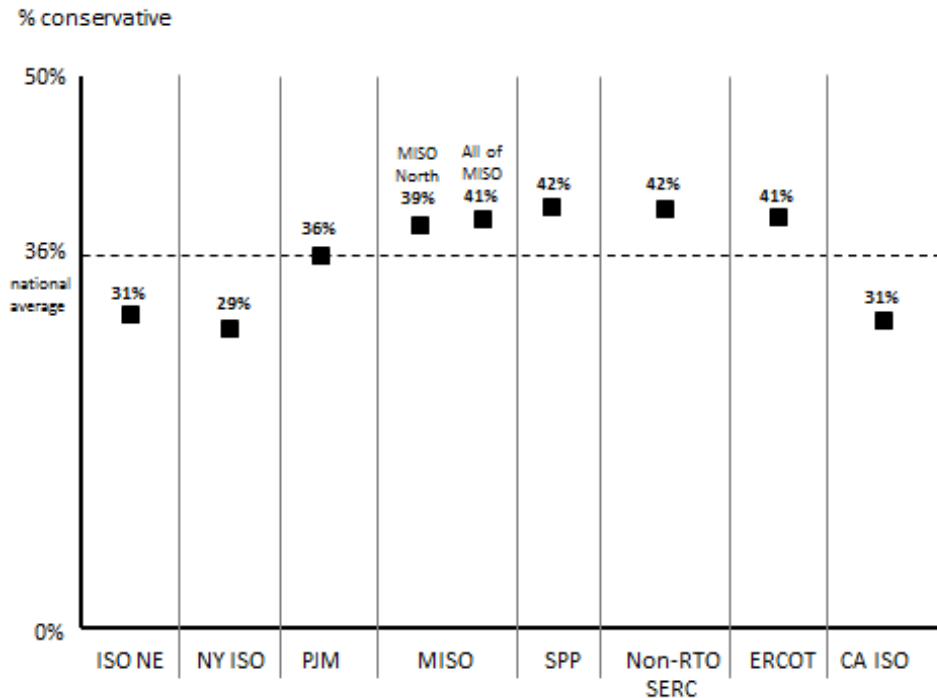
²⁴⁰ See *supra* notes 138-140.

²⁴¹ The data come from Gallup's "state of the states" polling series, available at: http://www.gallup.com/opinion/queue/181457/week-gallup-com-state-states.aspx?utm_source=WWWV7HP&utm_medium=topic&utm_campaign=tiles. Specifically, the numbers in the figure average state ideologies for the states in each market region. We chose not to weight the state ideology scores by state population because states qua states are part of the client base (and membership) of ISOs/RTOs.

²⁴² The southern zone of MISO was added only within the last 18 months, and so MISO ideology prior to 2014 is best reflected by the "MISO North" score depicted on Figure 2.

²⁴³ See *supra* note 137.

FIGURE 2: Average of State Ideology Scores – Market Regions
(Pct. Conservative, Gallup data, 2015)



Partisanship and ideology loom larger, however, in state position-taking on EPA rules. As noted in Section II, state PUC comments on the MATS rule and the Clean Power Plan²⁴⁴ were mostly critical, but tended to be less critical coming from PUCs dominated by Democratic members. Of the eight sets of PUC comments on the MATS rule, six were unambiguously critical, and two were relatively neutral: all of the critical comments came from Republican-dominated PUCs, while one of the two neutral comments came from the only Democrat-dominated PUC in the sample (Oregon).²⁴⁵ Similarly, of the 26 unambiguously negative comments submitted by PUCs in response to the Clean Power Plan, only one (from the New Mexico commission) came from a Democrat-dominated PUC; of the eight neutral or positive comments, five came from PUCs dominated by Democrats.²⁴⁶ Interestingly, two of the three Republican-dominated PUCs submitting neutral or positive comments were within MISO (the Indiana and Illinois commissions).²⁴⁷

Partisan influence shows up even more strongly when we look at states' participation in court cases challenging these EPA actions addressing coal-fired power plant pollution under the Clean Air Act. This is perhaps because those decisions are made by state attorneys general (most of whom are elected) or governors. As noted in Part II, when EPA rules have been challenged in court, some states have intervened in support of the rules, and some have intervened in opposition to the rules. Table 13 summarizes the party affiliations of state attorneys general and

²⁴⁴ Again, we focus on these rules because they entail the highest compliance costs – i.e., the most salient losses.

²⁴⁵ See Appendix B for data.

²⁴⁶ *Id.*

²⁴⁷ *Id.*

governors of states intervening in recent cases challenging EPA Clean Air Act rules that (a) reached the Supreme Court, and (b) impact coal-fired power plants. The data show that states with Democratic governors and attorneys general are overwhelmingly more likely to intervene in support of (and less likely to intervene in opposition to) EPA rules being challenged in court. This is true for each of the four court cases examined, and the differences are fairly striking.

TABLE 13: Party Affiliations of Attorneys General and Governors in States Litigating EPA Rules Addressing Emissions from Coal-fired Power Plants

Regulatory Action (Case name before the U.S. Supreme Court)	FOR Regulation		AGAINST Regulation	
	GOP AG(Gov)	DEM AG(Gov)	GOP AG(Gov)	DEM AG(Gov)
Endangerment Finding (GHGs) (<i>Massachusetts v. EPA</i> (2009))	1(8)	19 ^a (11)	10(8)	0(2)
CSAPR (ozone transport) (<i>EPA v. EME Homer Generation</i> (2014))	0(1)	10(9 ^b)	20(19)	3(4)
Tailoring Rule (GHGs) (<i>Utility Air Reg. Grp. v. EPA</i> (2014))	0(3)	15(12)	12(12)	0(0)
MATS rule (mercury) (<i>Michigan v. EPA</i> (2015) ^e)	0(7)	16(9)	17 ^c (18 ^d)	4(3)

^aIncludes data from District of Columbia, whose attorney general was appointed by the mayor at the time the litigation was initiated.

^bIncludes Rhode Island's governor, who was elected as an independent but subsequently changed his party affiliation to Democrat.

^cIncludes two attorneys general appointed by Republican governors.

^dIncludes Alaska, which had an elected independent (formerly Republican) governor at the time the case was initiated.

^eIowa's attorney general and governor each intervened on opposite sides of this case.

States with Democratic attorneys general are overwhelmingly more likely to intervene in support of EPA regulation, and overwhelmingly less likely to intervene in opposition to regulation. These trends are only slightly less striking when we focus on the party affiliation of governors. These data seem to support the notion that partisanship and ideology play a role in debates over the EPA's regulation of coal-fired power plants. They echo anecdotal evidence of state pledges not to comply with the Clean Power Plan once it is in effect,²⁴⁸ and offer further support for arguments in legal scholarship that states have become the locus of partisan conflict in the face of congressional gridlock.²⁴⁹

²⁴⁸ Senate majority leader Mitch McConnell has urged states not to comply with the EPA guidelines once they go final, and state legislatures have expressed their opposition to the rule in a variety of ways. See Niels Lesniewski, *McConnell Discourages States From Crafting Clean Power Plans*, ROLL CALL (March 4, 2015); and National Conference of State Legislatures, *States' Reactions to Proposed EPA Greenhouse Gas Standards*, May 18, 2015 (summarizing state legislation), available at: <http://www.ncsl.org/research/energy/states-reactions-to-proposed-epa-greenhouse-gas-emissions-standards635333237.aspx>.

²⁴⁹ See e.g., Jessica Bulman-Pozen, *Partisan Federalism*, 127 HARV. L. REV. 1077 (2014); Heather Gerkin, *Dissenting by Deciding*, 57 STAN. L. REV. 1745 (2005); Jessica Bulman-Pozen, *Partisan Federalism*, 127 HARV. L. REV. 1077 (2014);

Thus, it appears that ideology and interest-group politics are combining to magnify political opposition to EPA rules, even though those rules bring large increase net benefits across the country. However, public attitudes can change, sometimes quickly, thereby disrupting the political calculus for politicians.²⁵⁰ As we read the responses to EPA's rules, they suggest that interest-group politics are of secondary, and perhaps of diminishing, importance as the public becomes more familiar with alternative forms of energy and their costs continue to decline. The major industry players will undoubtedly continue to fight aggressively against EPA regulations, but the broader political context shows some signs of shifting around them.²⁵¹

The evolving political landscape and the promising trend away from coal-fired generation make it all the more important that politicians and the general public have a clear understanding of the salient technical issues. We hope that this paper provides a valuable corrective to misperceptions about the alleged conflicts between grid security, regional impacts, and EPA regulations. The technical insights complement and reinforce our findings regarding the evolving political economy of EPA regulations, and particularly those related to climate change. Despite the negative tenor of the responses from energy managers, the variation in the degree of their concerns and, in many cases, their constructive engagement with the EPA rules suggests that there is room for adjustment on both sides. More broadly, we expect that as these rules are implemented and the utility sector continues to adapt to changing market and regulatory pressures, the politics will change—albeit incrementally—as well. Recognizing the valid technical concerns and separating them from the prevailing political debates is, we believe, critically important to appreciating and taking advantage of the opportunities for facilitating change in energy systems today and going forward.

²⁵⁰ Indeed, there is growing evidence that public attitudes, even among conservative voters, is shifting in favor of EPA's regulations. See, e.g., Davis Burroughs, *Republic Voters Generally Support Clean Power Plan Fundamentals*, Morning Consult, Aug. 7, 2015, available at <http://morningconsult.com/2015/08/republican-voters-generally-support-clean-power-plan-fundamentals/>.

²⁵¹ See the discussion of how groundswells of public opinion can overcome interest group opposition to regulation, supra note 230; see also, MARK A. SMITH, *AMERICAN BUSINESS AND POLITICAL POWER: PUBLIC OPINION, ELECTIONS, AND DEMOCRACY* (2000)(concluding that business does not prevail over an interested public).