The Supreme Court's Stay of the Clean Power Plan: Economic Assessment and Implications for the Future

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Summary

The Clean Power Plan (CPP) is expected to play an important role in reducing U.S. greenhouse gas emissions. In February 2016, responding to appeals from some of the affected industries and states, the U.S. Supreme Court issued a stay suspending implementation of the CPP until after the judicial review process. Industry groups stated the CPP will pose large and "irreparable" costs to the coal sector during the period of judicial review. However, modeling suggests that because of prevailing market, technological, and policy trends, the CPP will result in near-zero costs beyond current trends until 2025, in part because of the plan's built-in flexibility. These factors and lessons from option theory suggest the stay is economically unjustifiable based on claims of irreparable economic harm to the coal sector. If implementation of the rule proceeds, current trends imply the stay will have little effect on industry's ability to follow the current compliance schedule.

The United States has pledged to reduce its greenhouse gas (GHG) emissions by more than one-quarter between 2005 and 2025. This pledge helped spark like-minded emissions reduction pledges from China and 195 other countries at the 2015 United Nations climate negotiations in Paris.

Emissions reductions from the electric power sector under the Clean Power Plan (CPP) constitute a key part of the U.S. effort to meet its commitment. The power sector is the largest source of U.S. GHG emissions, accounting for nearly one-third of emissions in 2013. Emissions reductions from the electricity sector are expected to account for about 47% of the economywide carbon dioxide (CO_2) emissions reductions from 2005 levels needed to meet the U.S. pledge for the year 2025. The CPP is expected to account for about one-third of the electric power sector reductions.[1]

The CPP has been the most visible of President Barack Obama's climate initiatives. Environmental groups and some businesses argue for aggressive U.S. leadership in achieving sustained global emissions reductions that would reduce the costs of climate change. These groups claim that the power sector offers some of the least expensive opportunities for reducing emissions. Meanwhile, many business groups counter with the claim that the CPP will significantly harm the U.S. economy. They argue that the CPP will raise the cost of generating electricity and cause harm to the coal industry through further closures of coal mines, bankruptcies of coal producers, and retirements of coal-fired electricity generators.

Along with these public campaigns, there has been intense legal drama over the CPP. Over one-half of the states and many business groups have sued the U.S. Environmental Protection Agency (EPA) to block the CPP, and 18 states and the District of Columbia, as well as environmental and public health groups and some electricity companies, have filed briefs in support of the CPP. In 2015, states and business groups that opposed the rule requested that the court halt EPA's implementation of the regulation while the courts resolve the legal challenges. Business groups claimed that the CPP would cause a "fundamental restructuring of the power sector" and "immediate, irreparable harm" to power plant and coal mine owners and employees, electricity consumers, and the broader public[2];

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1. U.S. Energy Info. Admin. (EIA), Annual Energy Outlook (2016); U.S. Dep't of State, 2014 United States Climate Action Report (2014).
2. U.S. Chamber of Commerce. v. EPA, Motion for Stay of EPA's Final Rule (D.C. Cir. Oct. 23, 2015), https://www.edf.org/sites/default/files/content/201.10.23_cc_111d_motion_for_stay.pdf.

states claimed that beginning to develop their compliance plans during the litigation period would be costly.[3]

On January 21, 2016, the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit denied the stay request,[4] but on February 9, the U.S. Supreme Court reversed this decision and issued the stay by a vote of 5-4, suspending implementation of the rule until after both the D.C. Circuit and the Supreme Court have decided on the merits of the regulation, a process that could continue through late 2017.[5] If the regulation is ultimately upheld, a new schedule will be set for states to develop compliance plans. A separate decision will determine whether the schedule for compliance by regulated facilities, currently starting in 2022, will be affected.[6]

The Supreme Court's action was highly unusual. It is uncommon for federal courts to block the implementation of a regulation while they decide the merits of the challenges, and it is even more unusual to grant a stay on a rule with delayed compliance deadlines. To our knowledge, the Supreme Court has never before acted to freeze implementation of a regulation after a federal appeals court has declined to do so and before the appeals court has completed its evaluation of the merits of challenges to the rule.[7]

While the rationale behind the Supreme Court decision was not made public, courts generally decide whether to grant a stay based on the likelihood that the challengers' case will ultimately prevail; on the likelihood that challengers will be harmed irreparably *while the courts deliberate*; on potential harm to others if the stay is granted; and on the assessment of whether the stay is in the public interest.[8] The burden of proof is on challengers to demonstrate that a stay is justified.[9] Among the many factors that courts consider when deciding whether to issue a stay, we focus on the claims that states and business groups made for irreparable harm to the coal sector (including coal-fired power plants and coal mines). Courts have not settled on a precise definition of irreparable harm. In this Article, we present an economic approach to considering irreparable harm. We frame the CPP in the context of current power sector trends. Our analysis of irreparable harm is based on the timing and magnitude of the costs of the CPP. Our analysis has broader implications for the CPP and we apply our economic framing to potential stays of future EPA regulations.

The litigation period is expected to be completed by 2018, and the CPP requires emissions reductions to begin in 2022. We ask whether the anticipation of the regulation imposes extraordinarily high costs on regulated businesses or related businesses, and if the costs could not be reversed if the courts overturn the regulation. From an economic perspective, we delineate two conditions that are necessary for irreparable harm to the coal sector. First, for a particular business, the costs of compliance must be large and irreversible. We use the term "irreversible" in the economic rather than legal sense to denote any cost that cannot be recovered at a later date. If the costs are small, or if a facility can generally continue operating and recover costs at a later date (meaning that the costs are reversible), then there is no basis for irreparable harm, according to our definition of the term (for expositional reasons we do not focus on the nuanced legal meaning of this term, which would be relevant to legal application of our analysis).[10]

Second, for irreparable harm to occur, these large, irreversible costs must be incurred during the courts' reviews of the cases; there is no need for a stay if costs are not incurred until after the courts have reached their decisions. Typical regulations have some combination of reversible and irreversible costs. The magnitude and irreversibility of costs incurred *after* the litigation period are not relevant to the economic justification of the stay. As such, both conditions are necessary and if either of these conditions is not satisfied, a stay cannot be supported economically on the basis of irreparable harm.

In this Article, we argue that:

- The overall costs of the CPP are likely to be low because of existing market, technological, and policy trends that would prevail even in the absence of the CPP. Despite the low overall costs, the CPP could ultimately impose substantial costs on the coal sector. Some, but not all, of these costs may be irreversible.
- Because of the electricity sector trends, flexibility, and time frame of the CPP, and economic incentives to delay decisions as much as possible, it is highly unlikely that the CPP would impose any costs—much less large or irreversible costs—during the time frame of litigation.

3. West Virginia v. EPA, State Petitioners' Motion for Stay and for Expedited Consideration of Petition for Review, No. 15A773 (D.C. Cir. Oct. 23, 2015), https://www.edf.org/sites/default/files/content/2015.10.23_states_motion_for_stay_expedited_consideration.pdf.
4. West Virginia v. Environmental Protection Agency, No. 15-1363 (D.C. Cir. Jan. 21, 2016).
5. West Virginia v. EPA, No. 15A773 (U.S. Feb. 9, 2016), https://www.supremecourt.gov/orders/courtorders/020916zr_21p3.pdf.
6. Richard L. Revesz & Alexander Walker, Understanding the Stay: Implications of the Supreme Court's Stay of the Clean Power Plan (2016); *McCabe Says "Premature" to Speculate Whether ESPS Deadlines Delayed*, Inside EPA, Mar. 18, 2016, http://insideepa.com/daily-news/mccabe-says-premature-speculate-whether-esps-deadlines-delayed (last visited Mar. 24, 2016).
7. Lisa Heinzerling, *The Supreme Court's Clean-Power Power Grab*, 28 Geo. Envtl. L. Rev. 425-40 (2016).
8. Wisconsin Gas Co. v. Federal Energy Regulatory Comm'n (FERC), 758 F.2d 669 (D.C. Cir. 1985).
9. Nken v. Holder, 556 U.S. 418 (2009).
10. We are not aware of a precise legal definition of "large" in this context, although courts have referred to harms that are "both certain and great" and "actual and not theoretical." In addition, if costs that are incurred during the litigation period could be recovered subsequently, such costs could constitute irreparable harm only if they "threaten the very existence of the movant's business." *Wisconsin Gas*, 758 F.2d at 674. As we use the term "large," it should not be taken to mean "non-negligible." The test for irreparable harm must demonstrate that there is a "clear and present" injury that must be both "certain and great." *Id.* at 674 (citing Ashland Oil, Inc. v. Federal Energy Regulatory Comm'n, 409 F. Supp. 297, 307 (D.D.C.), *aff'd*, 548 F.2d 977 (D.C. Cir. 1976). The fact that the second condition does not hold makes the ambiguity of the first condition irrelevant to the conclusion that the stay was not economically justified.

Although the first condition for a stay is met, the second is not, and the CPP does not meet the economic conditions for irreparable harm to the coal sector.

As a foundation for our analysis, we begin with an overview of the CPP and describe changes that have been occurring in the electricity sector over the last decade. These changes have already begun to fundamentally transform the power sector. Underlying this transformation are changes in fuel markets, technology, and policies that improve air quality and support the use of natural gas and renewables for electricity generation. Since 2008, coal production has fallen 15%, coal-mining employment has fallen 14%, and 20% of the coal-fired generation fleet has retired or will retire soon.[11] These changes are unrelated to the CPP and would likely continue in its absence.

These trends imply that the overall costs of the CPP will be low. Because the CPP targets power-sector CO_2 emissions, and coal-fired generation accounts for about 70% of these emissions, the CPP will further shift the power sector away from coal as a generation fuel. Our analysis suggests that the costs to the coal sector from the CPP are likely smaller than the costs of the recent changes in fuel markets, technology, and other policies. However, the first condition is satisfied because we cannot rule out the possibility of substantial costs to the coal sector during the entire duration of the CPP, and that at least some of these costs may be irreversible.

We find that the second economic condition is not satisfied. The electricity sector trends that cause low overall costs of the CPP also imply that the CPP will not reduce emissions until at least the early 2020s, if not the mid-2020s. Over the next decade, an important means of reducing carbon emissions under the CPP will be the expanded utilization of existing natural gas-fired generation facilities. Recent history demonstrates that shifts to greater utilization of natural gas can be accomplished and reversed quickly, eliminating the need to reduce coal consumption or shut down coal-fired plants until shortly before the CPP emissions targets take effect. The fact that the CPP will not affect coal-fired plant profitability or coal mine production until at least the early 2020s makes it unlikely that irreversible costs attributable to the CPP would occur during the litigation period.

Further, option theory demonstrates that any closures and retirements *caused* by the CPP will be delayed. The litigation itself is a major source of uncertainty, and virtually any coal-fired plant that would retire (only) if the CPP proceeds would delay its retirement decision until that uncertainty is resolved. The time frame during which emissions reductions must occur under the CPP is sufficiently lengthy to enable such delay. As a consequence, there is no reason to believe that the CPP will reduce coal consumption and affect coal-mining profits and employment before 2022, likely well after the courts reach their decisions.

Our analysis has five implications beyond irreparable harm to the coal sector:

- Because of the market, technological, and policy trends that are independent of the CPP, the overall costs of the CPP are likely to be substantially lower than the societal benefits of reducing emissions.[12] Our modeling suggests that the costs may be zero until 2025. The low overall cost of the CPP mitigates concerns raised by business groups about large increases in electricity prices and harms to the broader economy until at least 2022.
- The CPP will cause small increases in electricity prices and decreases in coal consumption until at least the mid-2020s. This is inconsistent with claims that the CPP will harm electricity consumers and states' economies during the litigation period. Note that we have not evaluated the claim that states would face irreparable harm from needing to begin developing compliance plans during the litigation period.
- Opponents of the CPP have claimed that the EPA standards are inappropriate under the Clean Air Act (CAA).[13] The gradual phasing of the emissions reductions and the flexibility to reduce emissions by a wide range of approaches are well within the confines of the CAA. EPA standards stem from the Agency's decision to set emissions targets based on furthering the use of technologies—natural gas and renewables, primarily—that businesses have already started using. EPA provides states the flexibility to design cost-effective implementation policies.
- The Supreme Court's stay has raised the question of whether the deadlines for implementing the CPP will be pushed back, should the courts ultimately uphold the CPP. Existing market, technology, and policy trends suggest that current deadlines provide sufficient time to comply. The stay will have little effect on the ability of the coal sector to meet these deadlines. The cost to the public of pushing back the CPP deadlines, however, would be substantial.
- Claims of irreparable harm arise frequently and a careful economic analysis of irreparable harm is timely. When considering irreparable harm in other regulatory contexts, the two economic conditions (in addition to other conditions) must hold. Even for regulations that require irreversible capital investments, such as pollution control equipment, the gradual phasing of emissions reductions and flexible performance standards can allow regulated sources

11. Since its peak in 2011, coal-mining employment has fallen by an average of 6% per year. *See* U.S. EIA, Annual Coal Report 2014 (2016). The introduction of new extraction techniques and types of mining has contributed to this evolution.

12. U.S. EPA, Regulatory Impact Analysis for the Clean Power Plan Final Rule (2015); Charles T. Driscoll et al., *U.S. Power Plant Carbon Standards and Clean Air Co-Benefits*, 5 Nature Climate Change 535-40 (2015); Dallas Burtraw et al., *The Costs and Consequences of Greenhouse Gas Regulation Under the Clean Air Act*, 104 Am. Econ. Rev. Papers & Proc. 557-62 (2014).

13. 42 U.S.C. §§7401-7671q, ELR Stat. CAA §§101-618.

to postpone irreversible decisions until after the litigation period, avoiding irreparable harm.

I. Overview of the Clean Power Plan

Before analyzing the potential economic basis for a stay, we briefly summarize the relevant features of the CPP. In August 2015, EPA released the final CPP regulation of CO_2 emissions from power plants under CAA §111(d). The regulation establishes emissions performance rates for steam (mostly coal-fired) units and natural gas-fired combined cycle units. States are responsible for developing plans that indicate how their existing generating units will achieve the standards.

States may implement a rate-based goal (in pounds of CO_2 per megawatt hour (MWh)) or a legally equivalent mass-based goal (in tons of CO_2; that is, an emissions cap) and they can average emissions rates across units or trade emissions allowances (tons) between units. With EPA approval, averaging and trading may occur across state borders. However, units in states choosing a rate-based approach may not trade with units in states choosing a mass-based approach. The standards cover existing emissions sources only; EPA regulates new sources under a different portion of the CAA. EPA lacks authority to require coverage of new sources under these provisions, but states may decide to do so.

The emissions standards are based on EPA findings of adequately demonstrated technology. Variation in emissions rates at existing coal-fired power plants provides one opportunity to reduce emissions by improving fuel efficiency. Shifting from coal- to natural gas-fired generation at existing power plants provides another opportunity. EPA also has identified opportunities for renewable energy. EPA sets state emissions standards that depend on improving efficiency at existing plants, shifting generation from coal- to gas-fired plants, and adding renewables to the power system. States can use these approaches to meet their standards, but they also can use other approaches such as expanded use of biomass and energy efficiency in households and businesses. The CPP does not impose specific technology requirements on generating units; no specific investment or operational change is required at any unit or at any time.

According to EPA's schedule, by September 6, 2016, states are required to submit a plan or request an extension. EPA expressed its "intent to place only modest requirements on states seeking extensions," including identifying the policy approaches they were considering, explaining why they need additional time, and describing the opportunity for public comment and meaningful engagement with stakeholders.[14] Most states were expected to request and receive an extension. By September 6, 2017, states were expected to commit to a plan type (rate or mass) and outline remaining steps that would lead to a final plan by September 6, 2018. EPA would implement a federal plan for generating units in states that fail to comply with this schedule.

Generating units do not face any compliance obligation until 2022, and the first measure of compliance covers a three-year period, 2022-2024. Moreover, states have some flexibility to determine the timing of the compliance obligations between 2022 and 2030, potentially allowing them to delay some emissions reductions until later in the decade as long as the states achieve the standards on average between 2022 and 2030.

II. Current Trends in the Power Sector

To evaluate the potential for the CPP to cause irreparable harm to the coal sector, we begin by discussing the technological trends and policies that have already placed tremendous pressure on the coal sector. Collectively, these developments have caused many coal-fired generation plants to retire and coal mines to close. The CPP will likely further the reduction in CO_2 emissions and the transition from coal to other generation sources.

A. *The Clean Power Plan Will Continue Recent Emissions Reductions Trends, But at a Slower Annual Rate*

After rising steadily for decades, electricity sector CO_2 emissions peaked in 2007 and decreased 15% by 2013. A number of factors explain the turnaround, including macroeconomic trends (the 2008-2009 economic recession and gradual recovery) and energy market trends (the dramatic decline in natural gas prices after 2008). In addition, during this time, environmental regulation raised the costs of coal-fired generation relative to other sources, and a wide array of policies promoted energy efficiency and provided incentives for renewables such as wind and solar.

Researchers have compared the influences of natural gas prices and previous federal emissions regulations, including the Cross State Air Pollution Rule[15] and the Mercury and Air Toxics Rule,[16] which is more expensive than the CPP or any other environmental regulation that EPA has promulgated. They find that natural gas prices and electricity demand had a substantially larger impact on electricity prices and the generation mix than did environmental regulations, which led primarily to the installation of post-combustion controls on power plants but caused little

14. Memorandum from Stephen D. Page, Director, EPA Office of Air Quality Planning and Standards (Oct. 22, 2015), *available at* https://www3.epa.gov/airquality/cpptoolbox/cpp-initial-subm-memo.pdf (last visited Mar. 22, 2016).

15. U.S. EPA, Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals, 76 Fed. Reg. 48208 (Aug. 8, 2011).

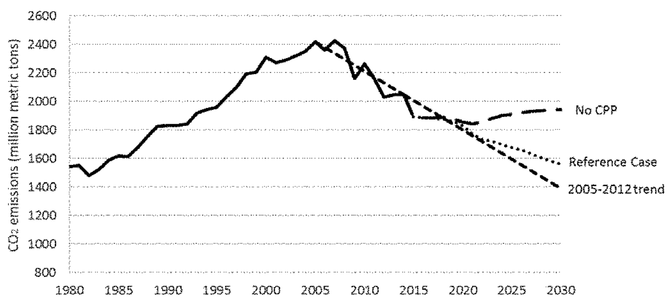
16. U.S. EPA, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 77 Fed. Reg. 9304 (Feb. 16, 2012).

change in coal consumption or retirement of coal-fired power plants.[17] In contrast, the decline in natural gas prices caused a sharp drop in coal consumption and the retirement of coal-fired plants.[18]

These trends have caused emissions to decline more quickly in recent years than the CPP will cause in coming years. Figure 1 shows that between 2007 and 2013, emissions declined at an average rate of almost 3% per year. By comparison, between 2013 and 2030, the CPP would cause emissions to fall by less than 1% per year. In that sense, the CPP continues, to a lesser extent, the emissions trajectory that the U.S. power sector is already on.

As we discuss next, expanded availability of natural gas and renewables is particularly prominent in the recent emissions trends.

Figure 1: Electricity Sector CO_2 Emissions



Notes: The figure plots historic CO_2 emissions from the U.S. Energy Information Administration Monthly Energy Review, April 2016, and projected emissions under the reference case, which includes the mass-based CPP rule, and an alternative case without the CPP. *Source:* EIA, ANNUAL ENERGY OUTLOOK (2016).

B. *The Clean Power Plan Will Continue the Shift From Coal- to Natural Gas-Fired Generation That Accelerated After 2008*

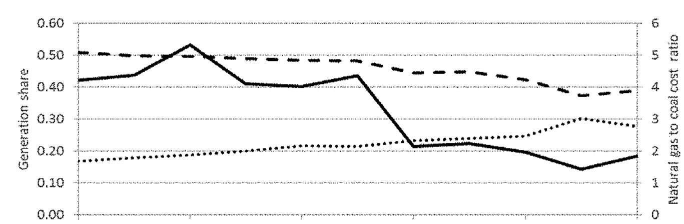
In most of the country, coal- and natural gas-fired generators compete to supply electricity. In some markets, these plants compete in short-term (for example, hourly) wholesale electricity markets. In other cases, they compete to offer long-term contracts to electric utilities, which sell electricity to consumers. Finally, in many regions, coal- and natural gas-fired plants are dispatched on the basis of their operating costs rather than in a market. In all three cases, plants with lower fuel costs generate more electricity.

Coal-fired power plants tend to be larger and older than natural gas-fired plants. Prior to 2008, most coal-fired plants had lower marginal generation costs, which are primarily fuel costs, than most natural gas-fired plants. As a result, coal-fired plants, particularly the larger and younger ones that had comprehensive environmental controls and higher efficiency, operated as much as possible. Natural gas-fired plants, even the relatively efficient ones, operated mainly during high demand periods. Between 2004 and 2008, a period of high natural gas prices, coal accounted for about one-half of total U.S. power generation and natural gas for about one-fifth. Few gas-fired plants operated at high utilization levels during this period.

Due largely to improvements in drilling and seismic imaging technology, natural gas production and estimated resources from shale formations have expanded dramatically in the past decade. The technological advances have made economical the extraction of natural gas from shale formations that were previously thought to be too costly. Between 2008 and 2012, the share of total natural gas production that came from shale formations tripled, and the estimated resources increased almost fourfold.[19] A sharp decline in natural gas prices has coincided with these technological developments. The average delivered natural gas price decreased about 60% between 2008 and 2012. Coal prices were fairly stable during this period, and the relative cost of natural gas to coal dropped by about one-half between 2008 and 2012.

The drop in natural gas prices had a profound and rapid effect on electricity generation. Figure 2 shows the shares of coal and natural gas in total power generation, as well as the relative costs of the two fuels. Through 2008, the coal generation share decreased gradually and the natural gas generation share increased gradually. The data show the expected relationship between fuel prices and generation levels after 2008: Year-to-year changes in fuel costs after 2008 are matched by changes in generation shares of coal and natural gas.[20] The shift from coal- to natural gas-fired generation implies an overall 13% decrease of CO_2 emissions, which explains most of the reduction in total emissions between 2008 and 2013.

Figure 2: National Delivered Fuel Costs and Generation Shares

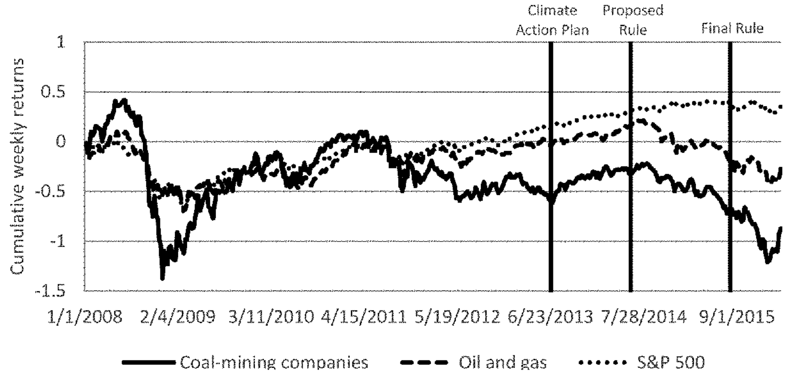


Notes: The figure plots the shares of coal and natural gas in total electricity generation, as well as the ratio of the average delivered cost (dollars per unit of fuel input) of natural gas to coal (right axis). Generation shares and fuel costs are computed from EIA data.

17. Dallas Burtraw et al., *Secular Trends, Environmental Regulations and Electricity Markets*, 25 ELECTRICITY J. 35-47 (2012).
18. Dallas Burtraw et al., *Reliability in the Electricity Industry Under New Environmental Regulations*, 62 ENERGY POL'Y 1078-91 (2013).
19. U.S. EIA, NATURAL GAS RESERVES SUMMARY (2015).
20. The extent of the recent shift from coal- to gas-fired generation has varied across the country (see Appendix for further details).

The decline in natural gas prices also reduced wholesale power prices, which are the value a generation plant receives per MWh of generation. Because the output from a natural gas combined cycle plant can be more readily adjusted than the output from a coal-fired plant, natural gas-fired generation is often the marginal technology, meaning that it responds to short-term electricity demand fluctuations. In markets where short-run variable cost determines the market price, natural gas often sends that marginal price signal. Because natural gas prices have been lower since 2008 than in prior years, for those hours when natural gas is the marginal technology, wholesale power prices have fallen. Researchers have shown that the decrease in natural gas prices after 2008 reduced national average wholesale electricity prices by roughly one-third, reducing the prices per MWh of generation received by all types of electricity generators.[21]

Figure 3: Stock Prices of Coal Companies, Oil and Gas Companies, and the S&P Index



Notes: Weekly stock price data collected from Yahoo Finance were used to create a coal index, which includes eight of the largest 15 2008 coal producers (those with public stock data from 2008 to 2015). Weekly S&P 500 stock prices were also obtained from Yahoo Finance. The oil and gas series represents the Dow Jones index for U.S. oil and gas (DJUSEN, Google Finance).

The decrease in power-sector coal consumption led to a precipitous fall in the profits of coal-mining companies. In Figure 3, we examine this change using the stock prices of coal companies, oil and gas companies, and a broad stock market index (the S&P 500). The coal index contains the coal producers that have public stock data since 2008, which includes eight of the largest 15 coal producers in 2008.[22] The weekly return is the change in the natural log of the share-weighted average stock price between consecutive weeks, and the figure plots the cumulative return since the first week of the sample. The oil and gas series represents the Dow Jones index for U.S. oil and gas (DJUSEN).

The oil and gas index tracks the S&P rather closely until mid-2014, which coincides with the sudden drop in global oil prices. Cumulative returns of coal-mining companies are fairly similar to those of the other two indexes through late 2011. After 2011, the returns of the coal-mining companies are much lower than those of the other indexes. This divergence, which reflects the mounting economic difficulties of the coal-mining sector, precedes the CPP by several years.

C. The Expansion of Wind- and Solar-Powered Generation Will Continue

In recent years, the United States has experienced unprecedented growth in wind and solar energy. Figure 4 illustrates this growth and documents the investment shift from natural gas-fired plants to wind- and solar-powered plants. In 2005, natural gas accounted for 80% of new investment, but by 2014, that share fell below 40%; wind and solar account for nearly all of this change. In 2005 and 2006, wind capacity additions accounted for about 15% of total capacity additions.[23] Although this share has been volatile, after 2006, the share has typically been about twice as large as it was before 2006. The sustained and high levels of investment have caused wind's share of total generation to increase tenfold, from 0.4 to 4.7% between 2005 and 2015.[24]

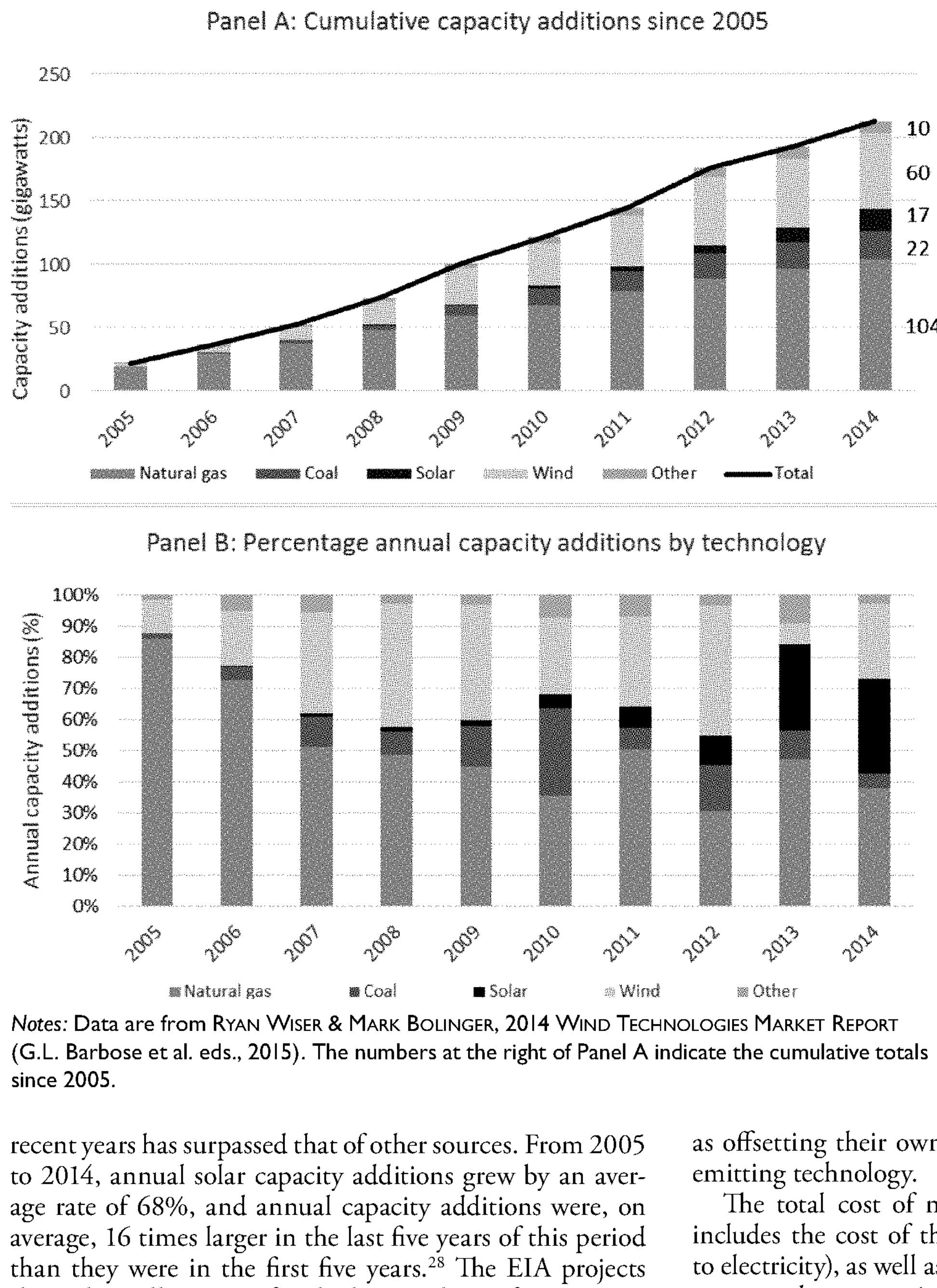
Policies and technological improvements largely explain the investment growth for renewables.[25] Policies promoting wind power include the federal production tax credit, which provides a subsidy of $23 per MWh of electricity generation and accounts for roughly one-third of the total revenue for a typical new wind-powered generator. This production tax credit has recently been extended to 2020. At various times, owners of wind power plants have opted to take a 30% subsidy for up-front investment costs rather than the production tax credit. In addition, most states have adopted some form of a renewable portfolio standard, which requires a specified level of generation from renewables and provides further support for wind investment.[26]

Technological developments over the past several decades have reduced costs and improved performance of wind facilities, particularly wind turbines (as opposed to the tower or other equipment).[27] While technological progress and policies have favored wind capacity additions, it is noteworthy that renewable energy technologies have experienced the same fall in wholesale power prices, and associated revenues, that has hurt fossil generators.

While solar power remains a relatively small source of electricity for most of the country, its rate of growth in

21. Joshua Linn et al., How Do Natural Gas Prices Affect Electricity Consumers and the Environment? (2014).
22. U.S. EIA, Annual Coal Report 2008 (2010).
23. Ryan Wiser & Mark Bolinger, 2014 Wind Technologies Market Report (G.L. Barbose et al. eds., 2015).
24. U.S. EIA, *What Is U.S. Electricity Generation by Energy Source?*, https://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3 (last visited Apr. 23, 2016).
25. *Id.*; Gregory F. Nemet et al., Characteristics of Low-Priced Solar Photovoltaic Systems in the United States (2016).
26. Database of State Incentives for Renewables and Efficiency (DSIRE), *Program Type: Renewables Portfolio Standard*, http://programs.dsireusa.org/system/program?type=38& (last visited Mar. 23, 2016).
27. Wiser & Bolinger, *supra* note 23.

Figure 4: Capacity Additions by Technology, 2005-2014



Notes: Data are from Ryan Wiser & Mark Bolinger, 2014 Wind Technologies Market Report (G.L. Barbose et al. eds., 2015). The numbers at the right of Panel A indicate the cumulative totals since 2005.

rable damages" to describe the potential effect on revenues and growth prospects for utilities stemming from the expansion of rooftop photovoltaic generation (this phrase did not refer to the CPP litigation).[30] Notwithstanding the report's focus on rooftop solar, large arrays contribute about two-and-one-half times as much generation as rooftop systems.[31]

As with wind power, federal, state, and local policies have supported investment in solar electricity systems. Federal tax credits cover 30% of the up-front investment cost of any new system, and were recently extended to 2022. State renewable portfolio standards provide additional incentive for new systems, and some states go farther by providing special provisions for solar that are not available to wind or other renewables. Many states also offer net metering, which allows the owner of a small-scale residential and commercial photovoltaic system to sell the electricity at retail rates to the electric utility. Because the retail rate usually exceeds the value of the electricity to the utility, net metering constitutes an implicit subsidy to solar, although from the photovoltaic system owners' perspective, this might be viewed as offsetting their own extra cost of investing in the low-emitting technology.

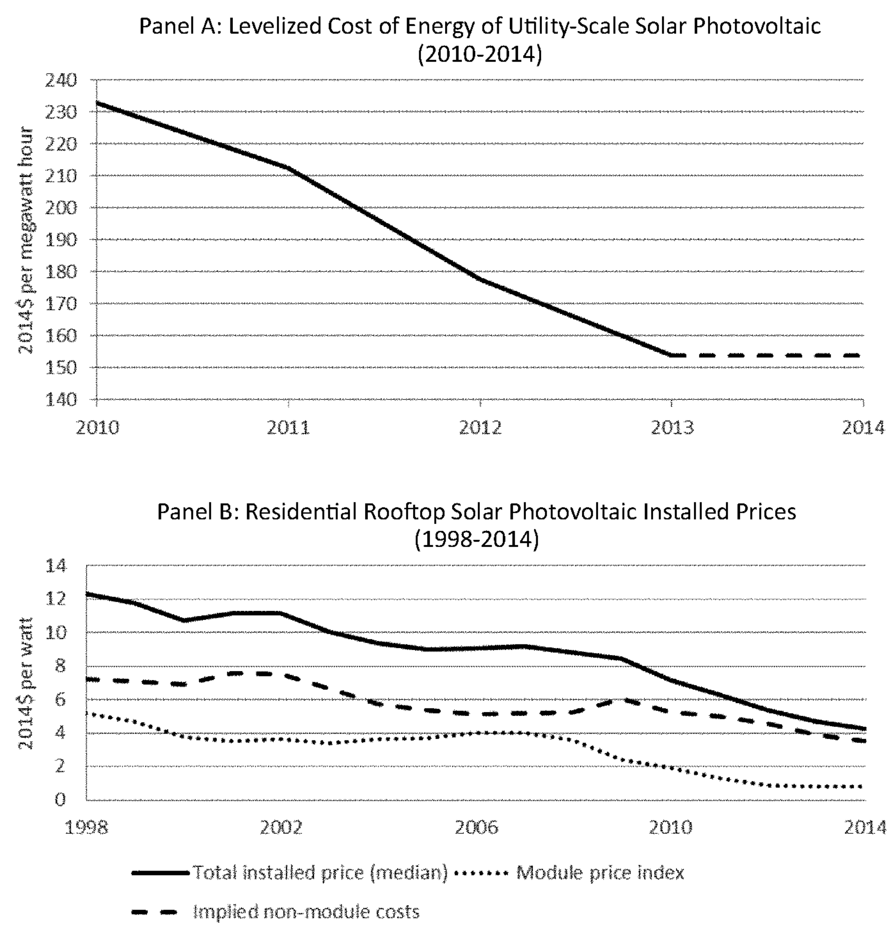
recent years has surpassed that of other sources. From 2005 to 2014, annual solar capacity additions grew by an average rate of 68%, and annual capacity additions were, on average, 16 times larger in the last five years of this period than they were in the first five years.[28] The EIA projects that solar will account for the largest share of investment in 2016 (37%).[29] During this period, coal-fired capacity additions were typically low, and most analysts project no coal additions for the foreseeable future, even in the absence of the CPP.

Most solar electricity is produced by photovoltaic modules, which can be installed in large arrays on the ground (sometimes referred to as utility-scale arrays) or on residential or commercial rooftops. Indeed, one report prepared for the Edison Electric Institute used the phrase "irrepa-

The total cost of new solar electricity systems, which includes the cost of the module (which converts sunlight to electricity), as well as the cost of labor, land, other equipment, and construction permits, has fallen relative to the cost of both wind power and natural gas-fired plants. Panel A of Figure 5 shows the levelized cost of energy for utility-scale solar, which is equal to the average cost of electricity over the life of a system constructed in the indicated year. The average cost fell by about one-third between 2010 and 2014, or 8% per year. Underlying the total cost reduction have been technological and manufacturing advances to the photovoltaic modules, as well as reductions in the other

28. *Id.*
29. U.S. EIA, *Solar, Natural Gas, Wind Make Up Most 2016 Generation Additions* (2016), http://www.eia.gov/todayinenergy/detail.cfm?id=25172&src=email (last visited Mar. 23, 2016).
30. Peter Kind, Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business 3 (2013).
31. U.S. EIA, *EIA Electricity Data Now Include Estimated Small-Scale Solar PV Capacity and Generation* (2015), https://www.eia.gov/todayinenergy/detail.cfm?id=23972 (last visited Mar. 23, 2016).

Figure 5: Average Costs of Utility-Scale Solar and Installed Prices of Residential Solar



Notes: The levelized cost of energy of utility-scale solar is calculated using the National Renewable Energy Laboratory's (NREL's) 2015 Annual Technology Baseline. Because the capacity factor in 2014 is imputed by extrapolating the trend in capacity factors between 2010 and 2013, we indicate the 2014 costs using a dashed line. While the capacity-weighted average installed price of utility-scale solar photovoltaics increased from 2013 to 2014, the median installed price decreased. The levelized cost is reported in 2014 dollars per MWh. The installed prices of rooftop solar are from researchers Galen Barbose and Naim Darghouth and are reported in 2014 dollars per watt. NREL subsequently reduced its capital cost for solar in its 2015 Annual Technology Baseline by another 20%.

Sources: National Renewable Energy Laboratory (NREL), 2015 Annual Technology Baseline (2015); Mark Bolinger & Joachim Seel, Utility-Scale Solar 2014: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States (2015). Galen Barbose & Naim Darghouth, Tracking the Sun VIII: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States (2015). NREL, Annual Technology Baseline and Standard Scenarios, http://www.nrel.gov/analysis/data_tech_baseline.html (last visited May 10, 2016)

cost components and installation costs (which are sometimes referred to as "balance of system" costs).

Costs of residential and commercial systems have also fallen. As seen in Panel B of Figure 5, between 2002 and 2005, the average installed price for residential rooftop solar photovoltaic systems declined by 7% per year.[32] Largely because of bottlenecks in the production of silicon, an important input in most photovoltaic cells, production costs of new systems leveled off between 2005 and 2009. Silicon prices fell after 2008, and between 2009 and 2014, the cost of photovoltaic systems decreased by 15% per year.[33] Although we do not present data for commercial systems, they have experienced rapid cost declines as well.

III. Does the Clean Power Plan Meet the Two Economic Conditions for Irreparable Harm to the Coal Sector?

With the structure of the CPP and technology trends as background, we now examine the two conditions that together would lend economic support to claims of irreparable harm to the coal sector during the period of judicial review.

A. *Will the Clean Power Plan Cause Large and Irreversible Costs?*

Conceptually, because coal-fired power plants emit more CO_2 than do other generation technologies, including natural gas-fired plants, the CPP will raise the cost of coal-fired electricity generation relative to other technologies. This will reduce the profitability of coal-fired plants, perhaps causing some to shut down. It will also reduce demand for coal and production from coal mines, perhaps causing some coal mines to close. The CPP introduces a cost advantage of natural gas over coal that is in the same direction as the relative cost advantage introduced by the recent decline in natural gas prices relative to coal prices.

The historic effect of the recent natural gas price declines on the coal sector provides a method for assessing the future effects that can be expected from the CPP. We estimate the magnitude of the effect of the decline of natural gas prices on the coal-fired fleet by focusing on plants existing in 2008, prior to the drop in natural gas prices. The value of such plants is equal to their future operating profits dis-

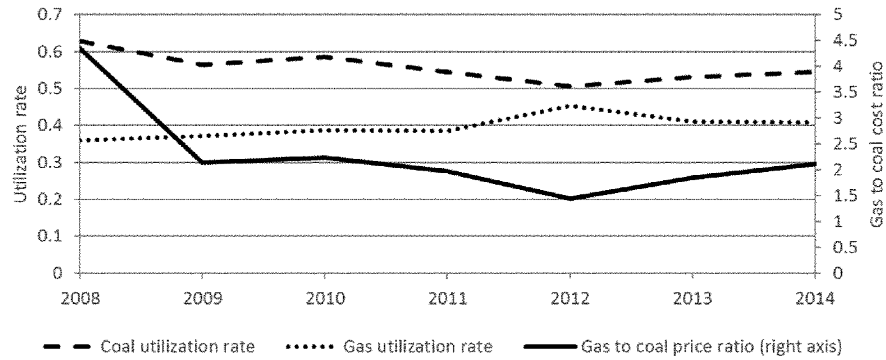
32. The installed price is the cost per unit of generation capacity, which does not depend on the amount of electricity the system generates. The levelized cost of energy is the average cost per unit of electricity generation.

33. Galen Barbose & Naim Darghouth, Tracking the Sun VIII: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States (2015).

counted back to the present. We use the analysis employed by researchers cited in this Article to estimate the effect of the decline of natural gas prices on revenues and costs of power plants, which allows us to estimate the change in value for both natural gas- and coal-fired plants stemming from the change in gas prices.

As noted previously, the reduction in natural gas prices between 2008 and 2012 reduced fuel costs of natural gas-fired plants by 60% and caused a shift from coal- to gas-fired generation. Figure 6 shows utilization rates (the ratio of actual generation to the generation level if the plant were operating at its rated capacity throughout the year) between 2008 and 2014. The average rate for coal-fired plants was about 0.6 in 2008, which accounts for planned maintenance, equipment failures, and cases in which plants were too costly to operate profitably.[34] Coinciding with the drop in natural gas prices, the coal-fired utilization rate fell to 0.5 in 2012. Utilization rates for natural gas-fired plants moved in the opposite direction, increasing from 0.36 to 0.45 between 2008 and 2012.

Figure 6: Average Utilization Rates and Fuel Costs for Coal and Gas-Fired Plants, 2008-2014



Notes: The figure plots the coal and natural gas utilization rates, which are the ratio of reported annual net generation to the maximum annual net generation if the unit operated at full capacity throughout the year. Utilization rates are capacity-weighted averages across the coal- and natural gas-fired units that were operating in 2008. The natural gas to coal cost ratio is the same as that shown in Figure 2. All data are from EIA Forms 860 and 923.

Year-to-year ups and downs in fuel costs were typically matched by changes in utilization rates. By 2015, utilization of gas-fired generators exceeded that of coal-fired generators for the first time.[35] Researchers have shown that natural gas prices explain a large share of these utilization changes and that a given drop in natural gas prices causes a smaller (that is, less than proportional) drop in the wholesale electricity prices received by all electricity generators.[36]

We can express a plant's future profits as its generation multiplied by its profits per unit of generation. Low natural gas prices raise generation levels for natural gas-fired plants. These plants experience a decrease in both the price they receive and the fuel cost they pay; because fuel prices fall by more than electricity prices, the net effect is to increase a natural gas plant's profit per unit of generation. Consequently, a drop in natural gas prices raises the value of natural gas-fired power plants. In contrast, a drop in natural gas prices decreases profits for coal-fired plants because both generation levels and profits per unit of generation decrease, and the value of these plants falls accordingly.

Accounting for all these effects, we conclude that the decline in natural gas prices has reduced profits of existing coal-fired plants and increased profits of existing natural gas-fired plants. On balance, the annual profits of existing natural gas-fired plants increased 70%, and the annual profits of existing coal-fired plants decreased by 50%, between 2008 and 2012. The large drop in coal-fired plant profits is consistent with the wave of coal-fired plant retirements that began after 2008.

We expect the CPP to have a small effect on the profits of operating coal-fired power plants. The ultimate cost will depend on the implementation approach adopted by states and the degree to which states coordinate to reduce their compliance costs. Such coordination has emerged in previous EPA and regional trading programs, including the eastern Nitrogen Oxides Budget Trading Program and the northeastern Regional Greenhouse Gas Initiative.[37] This suggests that states will coordinate for the CPP.

A variety of organizations have performed simulation modeling of the CPP on behalf of the electricity industry and environmental organizations, which they have shared in stakeholder dialogues, workshops, and private briefings. These findings are not generally available in a citable form. We depend on our own modeling results, which are consistent with the results that other groups report.

We have used Resources for the Future's Haiku electricity model[38] to simulate about 50 CPP scenarios, which differ in the compliance approach taken by states, the level of coordination among states, and the levels of future electricity demand and fuel prices. Here, we focus on a scenario in which all states are assumed to participate in a nationwide emissions trading program and choose to cover existing

34. Joshua Linn et al., *Regulating Greenhouse Gases in the Electricity Sector Under the Clean Air Act*, 1 J. Ass'n Envtl. & Resource Economists 97-134 (2014).
35. U.S. EIA, Average Utilization for Natural Gas Combined-Cycle Plants Exceeded Coal Plants in 2015 (2016), https://www.eia.gov/todayinenergy/detail.cfm?id=25652 (last visited Apr. 14, 2016).
36. Linn et al., *supra* note 21.
37. *See* U.S. EPA, NO_x Budget Trading Program, https://www.epa.gov/airmarkets/nox-budget-trading-program; Regional Greenhouse Gas Initiative, https://www.rggi.org/.
38. Anthony Paul et al., Haiku Documentation: RFF's Electricity Market Model Version 2.0 (2009), *available at* http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-Rpt-Haiku.v2.0.pdf (A simulation model of regional electricity markets and interregional electricity trade in the continental United States. The model can be used to simulate changes in electricity markets stemming from public policy associated with regulation of the industry to promote competition and environmental benefits.).

and new sources under their state caps.[39] The assumption of national emissions trading (as opposed to regional or no trading) reduces overall implementation costs, but the coverage of new sources under the cap raises implementation costs. We assume (conservatively) only one-half the level of new programmatic energy efficiency assumed by EPA in its modeling. These assumptions should yield a balanced estimate of the overall costs of the CPP and the effect of the CPP on the coal-fired fleet.

In this context, we estimate total compliance costs of \$6.3 billion per year in 2025 and \$8.4 billion in 2030 (estimated in 2011 dollars). The 2030 estimate can be compared to EPA's estimates of \$5.1 to \$8.4 billion for 2030 costs, depending on the approach states choose.[40] It is noteworthy that EPA finds the costs before 2030 to be substantially lower than in 2030. In 2022, EPA estimates costs of \$1.4 to \$2.5 billion, and in 2025 costs of \$1 to \$3 billion. These estimated costs are comparable in magnitude to the costs of existing policies, but not the most expensive among recent policies. For example, for the Mercury and Air Toxics Standards, EPA estimates annual costs of \$10.4 billion in 2016 (2011 dollars).[41] Researchers have reported annual compliance costs of \$2.5 billion in 2014 for state renewable portfolio standards (2011 dollars).[42] It is also noteworthy that EPA estimates the CPP costs to be several times lower than the societal benefits of lower emissions.

Other researchers estimate that emissions allowance prices with multistate compliance (trading) rise to only \$2 per ton of CO_2 by 2025, meaning that existing technological trends and policies will reduce emissions nearly to the levels required for the initial compliance period (2022-2024).[43] By 2030, allowance prices rise to \$17 per ton of CO_2. For comparison, EPA analyzes state-level compliance and estimates allowance prices ranging from \$0 to \$14.59 per ton in the first compliance period.[44] Multistate compliance would be expected to have an allowance cost that is much less than the maximum for any individual state-based approach.

For an average coal-fired plant, the allowance price in 2030 implies a marginal cost increase of about \$17 per MWh (47%), and for a natural gas-fired plant the allowance price in 2030 translates into an increase of about \$7 per MWh (15%). The CPP therefore provides a relative advantage to natural gas-fired plants compared with coal-fired plants. Without the CPP, generation from coal-fired plants would account for 32% of total generation in 2030; under the CPP, they would account for 27% of total generation. These shares contrast sharply with the 50% share in 2005 and even the 37% share in 2012.[45]

The CPP is expected to increase the average wholesale generation price by about 4%, raising the revenue per MWh of generation at these plants and offsetting some of the higher generation costs caused by the policy. Table 1 shows that, in annual percentage terms, the effect of the CPP on operating profits is a fraction of the effect of the recent natural gas price declines on operating profits. The reduction in generation from coal-fired power plants will be felt at coal mines that face lower demand for coal.

Table 1: Comparison of Effects of Recent Natural Gas Price Changes and CPP on Operating Profits of Coal- and Gas-Fired Plants

	Percentage change in 2012 operating profits caused by 2008-2012 natural gas price decline	Percentage change in 2030 operating profits caused by CPP
Natural gas-fired plants	70	41
Coal-fired plants	-50	-19

Notes: Operating profits are defined as the difference between revenues and the sum of fuel costs and other operating and maintenance costs.

The preceding discussion indicates that the CPP will increase pressure and likely reduce profits on coal-fired plants and coal mines. The magnitude is expected to be much less than the recent effects of natural gas prices on the profitability of coal-fired power plants.

However, irreparable harm is based not on the cost of the policy, but on the premise that irreversible costs will ensue while the courts review the cases. Therefore, in the context of discussing irreparable harm, the potential irreversibility of costs is more important than the costs themselves.

All regulations will likely have a combination of reversible and irreversible costs. Irreversible costs are an inevitable, and not necessarily unfavorable, aspect of any regulation. However, to understand the nature of costs during the judicial review period, it is important to determine which of the costs imposed by the CPP will be irreversible and whether the industry can make reversible decisions during the review period to delay irreversible decisions until after the judicial review process.

Modeling illustrates that the primary mode of compliance with the CPP will be substitution from coal to natural gas, especially in the first years of the program. This substitution can be achieved quickly and can be reversed equally quickly. Figure 6 illustrates that the utilization of power plants has shifted rapidly. This is even more evident at the local level; for example, utilization rates in Pennsylvania increased by 58% in two years in response to changes in relative fuel prices. Further, the utilization of coal could

39. Dallas Burtraw et al., Approaches to Address Potential CO_2 Emissions Leakage to New Sources Under the Clean Power Plan (2016).
40. U.S. EPA, Regulatory Impact Analysis for the Clean Power Plan Final Rule (2015).
41. U.S. EPA, Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards (2011).
42. Barbose & Darghouth, *supra* note 33.
43. Burtraw et al., *supra* note 39.
44. U.S. EPA, *supra* note 40.
45. U.S. EIA, Annual Energy Outlook (2015).

recover quickly, as occurred in early 2013 when natural gas prices and electricity demand increased.[46]

Changes in utilization of generation facilities are routine and reversible; generation facilities change their utilization regularly in the course of normal operation. More important in the discussion of irreversible costs are costs associated with plant retirements that would not be recoverable if the courts overturned the CPP. Given that the recent natural gas price-driven decline in coal-fired plant profits has caused some coal-fired plant retirements already, the change in profitability imposed by the CPP could ultimately cause some coal-fired plants to retire, constituting large and irreversible costs. In addition, the lower coal demand could reduce revenue at coal mines sufficiently for some to shut down. However, the change in profit due to the CPP is less than the change in profit due to changes in natural gas prices, and its effects are expected to be less as well.

Although the existing market and technology trends have likely imposed far greater costs on the coal sector than the CPP will, and these trends imply low aggregate costs to the electricity sector, we cannot rule out the possibility that the CPP may, at some point during its regulatory lifetime, impose significant irreversible costs to the coal-fired generation fleet and to coal mines.

B. *Will the Clean Power Plan Impose Important Costs During the Litigation Period?*

The CPP requires no specific decisions about investment or operation of specific plants. Instead, the CPP creates economic incentives to reduce emissions, and plant owners decide how to respond. We make three points in this section that follow from this context: (1) generation plant owners will delay retirement as long as possible; (2) the CPP schedule provides sufficient flexibility to delay decisions about retirement until the 2020s; and (3) the CPP should not affect coal-mining revenue until at least 2022.

Retiring a coal-fired plant is a dynamic decision that depends on expectations of future costs and revenues and, as we explain below, on the uncertainty of those costs and revenues. A retirement decision is largely irreversible: Once it has been made, the plant owner loses the ability to bring a power plant back into service and produce electricity again without paying a large restarting cost. Consequently, that decision will be delayed as long as possible. The relevant question for the second condition is not *whether* the CPP will affect retirements or coal consumption, but *when* these effects will happen. That is, there is irreparable harm only if these effects occur during judicial review. If they occur after the litigation is resolved, there is no possibility for irreparable harm to the coal sector.

Plant owners have to make decisions about the future operation of their plants in an environment of uncertainty. This environment is created not only by the legal uncertainty of regulations like the CPP, but also by uncertainty about trends in future fuel prices and technologies, which we have shown have more potent effects on coal-fired plant profitability than does the CPP. Economic theory has established that profit-maximizing decisionmakers are expected to delay irreversible decisions in the presence of uncertainty compared with a (hypothetical) certain future environment.[47]

To understand the argument, imagine a decisionmaker at a point in time when it appears that future costs are likely to be slightly greater than future revenues, but uncertainty exists about both future costs and revenues. The decisionmaker can retire the plant immediately and earn zero future profits for sure, or she can wait and learn more about uncertain factors. By waiting, the decisionmaker incurs a slight cost but preserves the option of keeping the plant in service in case fuel prices and costs turn out to be lower than expected.

Given these considerations, owners of coal-fired plants and coal mines will delay retirement as long as possible—at the very least, until after the litigation is resolved. Suppose the owner of a coal-fired plant will definitely retire the plant if the CPP proceeds but will continue operating profitably if the courts strike down the CPP. This example is relevant because it is the CPP itself, rather than other factors, that causes the retirement. If the owner retires the plant now but the courts ultimately strike down the CPP, the owner will regret having retired. The owner wants to delay retirement at least until the litigation is resolved to avoid this potential regret. This is especially true if the plant owner does not have to incur any costs associated with the CPP until after the litigation is resolved.

The nature of the judicial review period catalyzes a delay in retirement decisions until after the judicial review period is complete. The judicial review period introduces uncertainty that, unlike uncertainty about other factors such as fuel prices, has an anticipated resolution date. Such a discrete resolution of uncertainty creates a particularly strong incentive to delay irreversible decisions until the courts reach their decisions.

Some plants may be losing money now and expect to be unprofitable regardless of the CPP. We would expect those plants to retire, and perhaps to do so during the litigation period, but in that case, it is not the CPP that causes the retirement, but the other factors that make the coal-fired plant unprofitable now, before the CPP is implemented. Such retirements are therefore irrelevant to the stay and to discussion of the CPP in general.

We have focused on coal-fired plant retirements, but the CPP may also cause investments in transmission capacity or generation capacity that would not be profitable in the absence of the CPP. Particularly for transmission, completion of these projects can take many years, between the time of initial planning and the time when the investment

46. U.S. EIA, *Coal Regains Some Electric Generation Market Share From Natural Gas* (2013), http://www.eia.gov/todayinenergy/detail.cfm?id=11391 (last visited Apr. 15, 2016).

47. Avinash K. Dixit & Robert S. Pindyck, Investment Under Uncertainty (1994).

is completed. Therefore, even though no action is required until at least 2022, planning could begin for specific transmission or plant investments before then. In principle, planning could begin immediately—that is, while courts are deciding the cases—but the same principles of investment under uncertainty would apply. These decisions should be delayed as long as possible. Moreover, because the court review is likely to be resolved within one or two years, this would affect only the initial planning stages, which account for a very small share of the total costs. Such low costs would not constitute irreparable harm.

Owners of coal-fired plants and coal mines want to delay irreversible decisions, and the question is whether they can delay the decisions until after the litigation period. As discussed previously, early costs of compliance under the CPP are expected to stem from changes in utilization, which represent reversible costs. In fact, the broad flexibility that EPA provides states in implementing the CPP offers sufficient opportunity to delay *all decisions* related to the CPP until at least 2020. An important form of flexibility regards the timing of the emissions reductions. The aggregate emissions (or emissions rates) are established over the period 2022-2029. States can propose implementation schedules that differ from the schedule provided by EPA as long as they achieve the same outcome on average over these years. EPA does not actually set specific targets for 2022. The first evaluation period covers the years 2022-2024, but a state's actual emissions can exceed its target if the state obtains sufficient credits from other states that overcomply with their targets.

Previously, we noted that the CPP will impose only very low costs as late as the mid-2020s. The low costs arise from the length of time between the finalization of the rule and initial compliance, as well as from the power-sector trends that cause future emissions to be close to the levels required by the CPP. Because the CPP will not affect profits before 2022, it will not affect coal-fired plant retirements or coal-mining production before then. In other words, if a coal-fired plant is currently sufficiently profitable to have survived the recent natural gas price, technology, and policy changes, the CPP will not affect its operating profits and will not cause the plant to retire before 2022.

The costs to coal-fired plants and changes in coal consumption in the mid-2020s are expected to be small, but even if they were large, the CPP would not necessarily cause retirements. EPA does not require any particular means of reducing emissions. A state's plan can include a broad range of emissions reduction approaches, as long as the state can demonstrate their efficacy. In particular, a state could avoid retiring any coal-fired plants whatsoever if it chose to do so. This flexibility allows coal-fired plant owners to delay retirement decisions until at least 2022 if they wish—that is, no provision of the CPP specifically forces retirements.

Finally, because emissions are counted for compliance beginning in 2022, one would not expect any reduction in coal consumption, and therefore any effect on coal-mining production, until at least 2022. Earlier in the Article, we documented the rapid shift from coal- to natural gas-fired generation that occurred between 2008 and 2012. The pace of this shift implies that even if a state plans to rely heavily on coal to natural gas substitution to reduce its emissions in 2022, such changes can occur quickly. Coal consumption need not fall much before 2022, and any changes would occur after the litigation period. Absent a reduction in coal demand or consumption long before 2022, we would not expect the CPP to cause any coal mine shutdowns or coal-fired plant retirements before that year.

Because of the timing and flexibility of the rule, the coal sector is doubly protected from experiencing large and irreversible costs during the judicial review period. The option to change utilization rates before making retirement decisions, as well as the flexibility of states to design their own plans, means that if some costs needed to be incurred during the judicial review period, these costs would not need to be irreversible. Even if that were not the case and irreversible decisions could not be avoided, given the timing of the rule, the CPP is not expected to affect a coal-fired plant's profits until years after the litigation period is complete, allowing coal-fired generators to delay retirement until after the litigation is resolved.

Thus, because compliance currently begins in 2022 and because of the existing market, technology, and policy trends, the CPP is expected to have virtually no effect on emissions and to impose no direct generation costs on the sector until the mid-2020s. In principle, firms could begin reducing emissions before 2022, but history and modeling suggest that there would be no reason to do so because of the speed at which generation can shift from coal- to gas-fired plants to reduce emissions in the mid-2020s. Because the CPP does not affect a coal-fired plant's profits before 2022 and perhaps later, it will not cause any retirements during the litigation period. It is in the best interest of owners to delay costly decisions, and because the rule provides them with the flexibility to do so, the second condition needed to justify the stay based on economic harm to the coal sector is not satisfied.

IV. Conclusion

The Supreme Court recently issued a stay that halted implementation of the CPP until judicial review is completed. One of the factors considered when issuing a stay is potential irreparable harm that may be imposed on regulated parties or others during the period of judicial review. The Supreme Court action surprised many legal experts. In this Article, we have economically analyzed the claim of irreparable harm to the coal sector.

We have shown that the electricity industry has been changing because of forces that predate the CPP and likely overshadow it in importance. Technological innovation has undermined and in many cases eliminated coal-fired generation's long-held cost advantage over other forms of generation. Natural gas prices declined sharply after 2008 and are expected to remain low, which has caused a large drop in coal consumption. This in turn has driven many coal-mining companies to bankruptcy and forced the retirement of many coal-fired power plants.

In addition, costs and performance of wind- and solar-powered generation have continued to improve. As a result of these developments and a number of local, state, and federal policies, renewables now account for a large share of new power plant construction. Because of these trends, most analysts project zero new coal-fired capacity to come online for the foreseeable future, even if there were no CPP. Finally, other environmental regulations have increased the cost of burning coal, but these regulations have had a smaller effect on the coal sector than have natural gas prices.

The CPP would increase the cost of coal-fired generation. We expect higher costs to further reduce coal consumption, potentially causing further power plant retirements and coal mine closings. However, these changes and associated cost would be much smaller than in recent years.

Importantly, the *ultimate* costs of the CPP are not relevant in the decision to issue a stay. Avoiding irreparable harm by delaying the CPP is one potential justification for a stay. Requests for the stay cited potential harm to the coal sector, electricity consumers, and the broader economy, as well as to states developing their compliance plans. We considered whether coal-fired plants will retire and coal mines will shut down during the time the CPP is being litigated and whether those irreversible decisions could be avoided if a stay were granted. Whether these would happen *after* the litigation is irrelevant.

Claims of irreparable harm to the coal sector during courts' reviews are unsubstantiated. Any retirements of coal-fired plants or closures of coal mines caused by the CPP would occur well after the litigation ends. The extent of retirements is uncertain and depends on many factors, such as future natural gas prices and costs of wind- and solar-powered generation. The litigation itself creates additional uncertainty about the future profitability of any given plant. The uncertainty does not affect retirement decisions for plants that would retire regardless of the CPP. For plants and coal mines that would retire only under the CPP, plant and coal mine owners will delay decisions until the courts resolve the litigation, if not until 2022. Compliance flexibility and the fact that emissions reductions need not occur until at least 2022 make such delays possible.

EPA provided seven years for preparation by states and regulated businesses between finalizing the CPP and the first required emissions reductions. In addition, the existing trends imply that the CPP will cause modest emissions reductions before 2025, thus implying low costs to the coal sector before the mid-2020s. Even if EPA had chosen a substantially compressed time frame and deeper emissions reductions, the power sector could still seek reversible strategies for reducing emissions, such as shifting from coal- to natural gas-fired generation and delaying irreversible decisions such as retirements until after the courts resolved the litigation. Given the length of time before initial compliance and the compliance flexibility EPA has provided the states, any harm to owners of coal-fired plants or coal mines caused by the CPP should occur well after the litigation is over.

Many of the elements of the CPP that preclude the plausibility of irreparable harm are those that also enable the flexibility and limit the costs of the regulation. The benefits of the rule are substantial and outweigh the costs. The costs to coal-fired plants and coal mines in particular will be lower than the costs incurred in recent years because of other policies and technological trends. The CPP adds to the pressure on the coal sector, but it is by no means the main source of pressure. The flexibility of the compliance periods and the ability of states to participate in trading and to design their own compliance plans limit the costs of the rule. The low overall costs and gradual emissions reductions under the CPP imply modest increases in electricity prices, and therefore modest effects on most of the country, during the transition to a cleaner power sector.

Further, the increase in costs to electricity consumers will not begin until the next decade. This timing rules out the possibility that the CPP will harm consumers or the broader economy during the period of litigation or even before the mid-2020s, refuting claims that some stay petitioners have made. The only remaining claim for irreparable harm is to states developing compliance plans, which we have not considered in this Article.

Following the Supreme Court's stay of the CPP, a debate has ensued over whether the deadlines affecting state compliance plans and the emissions reductions would be pushed back if the courts ultimately uphold the CPP. The coal sector would benefit from such delays because costs would be pushed farther into the future. However, existing market, technological, and policy trends imply that the CPP will have a small effect on the coal sector until the mid-2020s, making such delays irrelevant to the coal sector for about a decade. In addition, because the CPP does not affect decisions by the coal industry, the stay likely had little effect on decisions; delaying future deadlines would not make sense economically.

On the other hand, delaying the deadlines would be costly to the public because any additional pollution emissions that result would contribute to global warming and harm local air quality. Perhaps even more important is the possible effect that delaying the CPP will have on international efforts to reduce GHG emissions. As one of the world's largest emitters, the United States has played a pivotal role in the recent international momentum, as evidenced in the 2015 United Nations climate negotiations in Paris. If the United States were to delay its emissions reduction schedule, other countries may similarly delay their reductions, magnifying the global costs of U.S. delay.

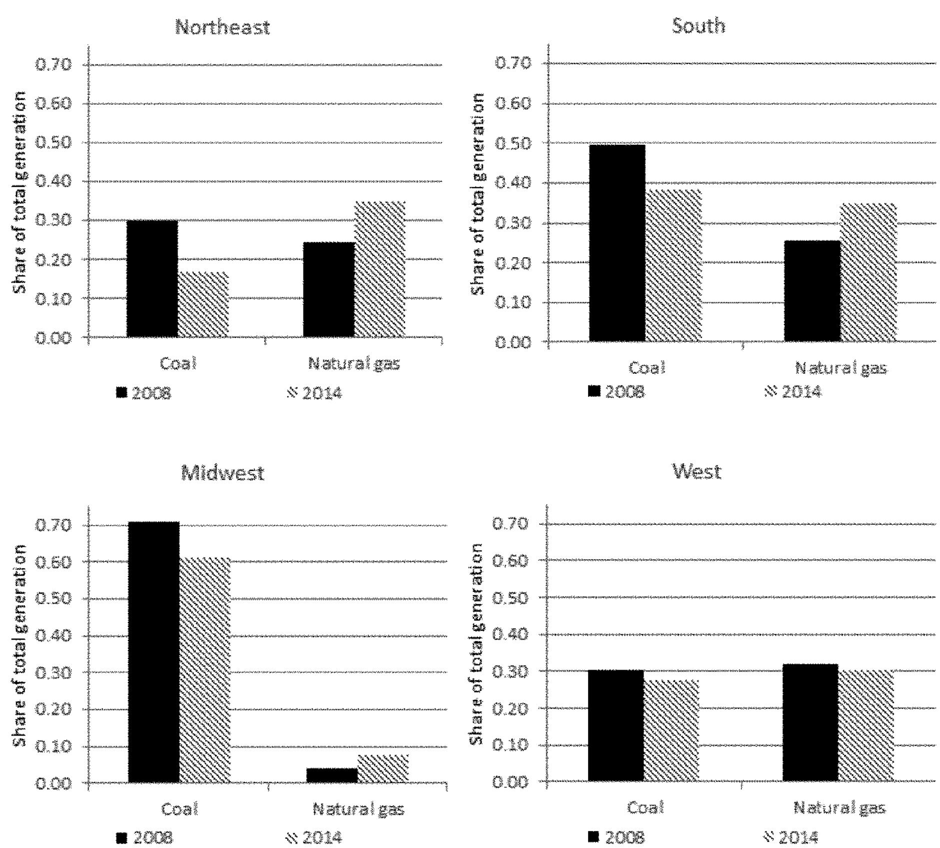
Claims of irreparable harm arise frequently in environmental litigation, and our economic framework for the potential irreparable harm under the CPP is applicable in other contexts. The forgone profits during any litigation period may not be recoverable even if a regulation is ultimately reversed. Only if the forgone profits during the litigation period force irreversible decisions such as the shutting down of a plant or mine would the possibility of future profits disappear, thereby constituting what would be irreparable harm. Therefore, for other regulations, there would have to be a direct link between forgone profits during litigation and irreversible decisions. These costs would have to be sufficient to threaten the existence of individual businesses—a condition that we did not consider because we found that the CPP would not cause irreparable harm to the entire sector, much less to individual businesses.

The nature of the irreversible costs of the CPP is different from that of other regulations, such as the Mercury and Air Toxics Standards. In the case of the CPP, reversible decisions may precede and allow for the delay of irreversible decisions, whereas other regulations ultimately require installation of pollution abatement equipment, which are irreversible investments. Despite this difference between the CPP and other regulations, irreparable harm can arise only in other situations in which it would not be possible for regulated firms to take interim measures and postpone irreversible decisions while the courts deliberate. Allowing regulated sources sufficient compliance flexibility in the early years would make such interim measures possible, preventing the possibility of irreparable harm.

Appendix

The extent of the recent shift from coal- to natural gas-fired generation has varied across the country. Figure A1 illustrates that in 2008, when natural gas prices were at their peak, some regions were much more coal-intensive than others. The Midwest, for example, generated almost three-quarters of its power from coal, whereas the West generated less than one-third of its power from coal. From 2008 to 2014, the Northeast and South experienced the largest shifts of generation shares from coal to gas, with much smaller changes in the West and Midwest. The regional differences suggest that the cost and opportunity to shift further from coal- to natural gas-fired generation in the future may vary across regions under the CPP.

Figure A1: Regional Changes in Coal- and Natural Gas-Fired Generation, 2008-2014



Notes: The figure reports the share of coal and natural gas in total generation by region, for 2008 and 2014. The data are the same as the data used for Figure 2.