Energy Policy 123 (2018) 558–568

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Coal-fired power plant regulatory rollback in the United States: Implications for local and regional public health☆

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ARTICLE INFO

Keywords:
Clean Air Act
$PM_{2.5}$
Power plants
Coal
Transport rule
Mercury rule

ABSTRACT

President Trump wants to promote coal and weaken Clean Air Act regulations that affect coal-fired power plants. We analyze which US regions have benefited from air quality improvements realized since adoption of two Clean Air Act power plant rules, the transport and mercury rules, which have been targeted by lobbyists and national officials. For 20 coal states, we create a pre-regulatory emissions scenario for the current (2016) fleet of power plants. Using the US Environmental Protection Agency's CO-Benefits Risk Assessment screening model, we estimate the differences between the impacts of pre-regulatory emissions and current emissions on fine particulate matter ($PM_{2.5}$) concentrations and on public health. We compare those impacts with voting patterns in the 2016 presidential election and with demographic data. Among the air quality and public health gains of the current situation relative to the pre-regulatory scenario are that: annual average $PM_{2.5}$ concentrations are lower by 1–5 µg/m3; 17,176–39,291 premature mortalities are avoided for each year of lower emissions; coal mining counties and White, rural counties experience some of the best improvements in air quality; and, in several states, Trump counties benefit more than Clinton counties. We suggest refining these results with atmospheric dispersion models.

1. Introduction

Coal advocates have a powerful ear in the Trump Administration (Anonymous, 2018; Puko, 2018). As a result, EPA officials are closely scrutinizing important Clean Air Act regulations for coal-fired power plants (Cutler and Dominici, 2018). The questions examined here are: Which communities have benefited from the public health gains of two central rules limiting power plant pollution from coal-fired power plants and, by extension, who stands to lose if those rules are undercut?

Coal company executives, the EPA's current and former leadership, and members of Congress have indicated that specific Clean Air Act power plant rules should be weakened or eliminated. The US Environmental Protection Agency's former Administrator Scott Pruitt, while Oklahoma Attorney General, challenged many Clean Air Act rules for coal-fired power plants, including the Cross-State Air Pollution Rule (the CSAPR, "the transport rule") and the Mercury and Air Toxics Standards (the MATS, "the mercury rule") (Lipton, 2017). Pruitt resigned in July 2018. In August 2018 EPA officials announced plans to modify the mercury rule (Knickmeyer, 2018). Robert Murray, CEO of Murray Energy, included in his 2017 "wish list" memo to President Trump the elimination of the mercury and transport rules (Friedman, 2018). In August 2018, EPA formally proposed to modify the Clean Power Plan, whose regulatory target is carbon dioxide emissions, in a fashion that would allow higher emissions not only of carbon dioxide but also sulfur dioxide and nitrogen oxides (US Environmental Protection Agency, 2018e, ES-9). Even as some electric utility representatives have asked that the mercury rule remain intact (Reilly, 2018), members of the US House of Representatives have introduced bills to weaken Clean Air Act rules, including the transport and mercury rules (Sobczyk and Reilly, 2017). State air pollution officials implement and may increase the stringency of Clean Air Act rules for power plants, but they would be hard pressed to hold back a flood of federal regulatory reversals (Thomson, 2017).

Emissions from coal-fired power plants, while dramatically lower than before the 1990 Clean Air Act Amendments were adopted, have posed widespread public health and environmental threats in the United States because they contribute to fine particulate matter pollution, acid deposition, ambient ozone, and mercury deposition (US

☆ This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
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https://doi.org/10.1016/j.enpol.2018.09.022
Received 29 May 2018; Received in revised form 14 September 2018; Accepted 16 September 2018
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Environmental Protection Agency, 2011a, b, c, d). Fine particulate matter ($PM_{2.5}$) exposures have been linked causally to an enhanced risk of premature death (Fann et al., 2017). Estimates of premature mortalities in the United States caused by fine particulate matter pollution from one year's worth of power plant emissions in 2005 range from 21,000 to 52,000 (Caiazzo et al., 2013; Fann et al., 2013; Penn et al., 2017). Sulfur dioxide emissions from power plants are thought to have a much greater adverse impact on public health than nitrogen oxides emissions (Caiazzo et al., 2013, 207; US Environmental Protection Agency, 2015, 4A-12; Penn et al., 2017, 324).

The many coal-fired power plants that stretch along the Ohio River Valley in Ohio, Illinois, Indiana, Kentucky, West Virginia, and Pennsylvania have been of special concern for some time because they have burned high-sulfur coal, earning them the moniker “the dirties” (CQ Almanac, 1990; Lynch et al., 2000). During the 1970s, power plant owners erected tall (over 200 feet) stacks on over 400 midwestern and southeastern power plants, thereby reducing local levels of sulfur dioxide but increasing regional transport of sulfate and fine particulate matter (Likens et al., 1979; Lee, 1981; Regens and Rycroft, 1988, 47).

Undercutting the mercury and transport rules could have serious public health consequences and could interfere with ongoing ecosystem recovery (Driscoll et al., 2016). Those rules, including the transport rule's predecessor, the Clean Air Interstate Rule (CAIR), and the Acid Rain Program, have reduced health- and environment-impairing emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and trace pollutants like mercury from fossil fuel fired power plants. According to EPA's 2011 estimates, fine particulate matter and ozone reductions achieved in one year by the mercury and transport rules combined would avoid 17,200–43,000 premature deaths, 19,700 heart attacks, thousands of hospitalizations for respiratory and cardiovascular disease, and over a million lost workdays (US Environmental Protection Agency, 2011a, ES-3; US Environmental Protection Agency, 2011b, 4). In these calculations, most health impacts occur in the year of the emissions, but premature mortalities are spread over 20 years.[2] For both rules, estimated social benefits far outweighed social costs, by ratios of 3/1–9/1 (for the mercury rule) and by ratios of 150/1–350/1 (for the transport rule) (US Environmental Protection Agency, 2011a, ES-1; US Environmental Protection Agency, 2011b, 1).

Here we contribute new, regionally focused analyses of the public health gains achieved since the transport rule–taken to include the CSAPR and its predecessor, the CAIR–and the mercury rule were finalized. We compare those impacts with demographic and voting patterns. Previously published estimates of the public health impacts of power plant pollution have presented results at the national or state levels (US Environmental Protection Agency, 2011a, b; Caiazzo et al., 2013; Fann et al., 2017; Penn et al., 2017; Cutler and Dominici, 2018). Further, the EPA's regulatory estimates of the mercury and transport rules' impacts, which were published in 2011, could not account for unanticipated changes in the US fuel mix for electricity, which now includes more renewables and natural gas (Storrow, 2017). We account for those shifts in the analysis presented here. Finally, as Di et al. (2017) note, those analyzing the public health effects of air pollution policy have often focused on urban areas, not only because of the greater populations in those areas but because particulate matter and ozone levels are often higher in cities. Fine particulate matter monitors tend to be clustered near major urban areas (US Environmental Protection Agency, 2018h). So, analyzing air quality improvements for people who reside in less densely populated areas addresses an area that has received less regulatory and scholarly attention.

[2] The EPA assumes that avoided or additional premature mortalities are spread over a “lag structure,” relative to the year of increased or reduced emissions, as follows: 30% in the first year, 50% over years 2–5, and 20% over the years 6–20 after the reduction in $PM_{2.5}$ (US Environmental Protection Agency, 2011, 5–40; US Environmental Protection Agency, 2015, 4–20).

2. Background

2.1. Trends in US power plant emissions

Air pollution from electric utilities in the United States has dropped to levels that would have been deemed unimaginable at the start of the 21st century. In 2017, US power plant emissions were 92% (for sulfur dioxide) and 83% (for oxides of nitrogen) lower than their 1990 levels (US Environmental Protection Agency, 2018b). This record rivals Germany's percentage decrease in SO_2 emissions from power plants, and far exceeds the German power plant record for NO_x emissions, over the same interval of time (Germany, 2018). Power plant emissions reductions in the United States stem from regulatory forces and market trends, which together have pushed power generation away from coal (US Energy Information Administration, 2018a).

The situation with carbon dioxide emissions from US power plants is another, ongoing story. Carbon dioxide emissions from US electric utilities rose between 1990 and the mid-2000s and then fell, approximately equaling 1990 levels in 2016 (US Environmental Protection Agency, 2017, ES-6). Regulatory actions or enforcement decisions that incentivize the use of coal could cause power plant carbon dioxide emissions to rise once again. The EPA's proposed changes to the Clean Power Plan would increase carbon dioxide, sulfur dioxide, and nitrogen oxides emissions, illustrating the fact that emissions of all three pollutants from coal fired power plants often rise and fall in tandem (US Environmental Protection Agency, 2018e).

2.2. The transport and mercury rules

The Clean Air Interstate Rule (CAIR) was adopted in 2005, with the goal of ameliorating interstate transport of fine particulate and ozone pollution and their precursors (US Environmental Protection Agency, 2011b). The CAIR took effect in 2009, but a court judgment ordered the EPA to modify the CAIR, and the Cross-State Air Pollution Rule (CSAPR) resulted (US Environmental Protection Agency, 2008a; Adair et al., 2014). The CAIR remained in effect until the CSAPR's implementation in 2015 (US Environmental Protection Agency, undated). Both transport rules take the form of cap-and-trade regulations in which state authorities can decide how to allocate sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) emissions budgets to affected electric utility units. The EPA estimated that the CSAPR would avoid 13,000–34,000 premature mortalities for each year of reduced emissions (US Environmental Protection Agency, 2011b, see footnote 2 for the lag structure used).

Electrical generating units (EGUs) in states affected by the transport rule may be required to comply with one or more of the following programs: annual SO_2 reductions, ozone season NO_X reductions, or annual NO_X reductions. EGUs can use a variety of means to comply, including fuel switching, fuel blending, adding pollution control equipment, moving electric generation to cleaner units, or purchasing emissions allowances (US Environmental Protection Agency, 2011b).

The Mercury and Air Toxics Standards (the mercury rule) took effect in 2012, and the rule's goal is to reduce emissions of trace toxic pollutants like mercury and arsenic from coal- and oil-fired power plants (US Environmental Protection Agency, 2011a, 2012). Among the mercury rule's estimated co-benefits are substantial health improvements from reducing $PM_{2.5}$ levels, a result of the rule's effect on sulfur dioxide and nitrogen oxides emissions. In total, the EPA estimated that the mercury rule would avoid 4200 to 11,000 premature mortalities from each year's worth of emissions reductions (US Environmental Protection Agency, 2011a, ES-1, 3–10 to 3–13, see footnote 2 for a description of the EPA's lag structure). Compliance can be achieved through fuel switching, efficiency improvements, fuel blending, moving generation to other fuels (e.g., natural gas), or adding pollution control equipment (US Environmental Protection Agency, 2011a, 3–14).

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