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Regulating existing power plants under the U.S. Clean Air Act: Present and future consequences of key design choices

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HIGHLIGHTS

- US EPA proposed rules to regulate CO_2 emissions from existing fossil fuel power plants.
- Modeling analysis explores the long-term consequences of several key regulatory design choices.
- The design choices can create significant legacies for the power fleet and future policy choices.
- Key choices entail one set of trade-offs if rules are permanent, another set if an interim solution.

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ABSTRACT

In June 2014, the U.S. EPA released its proposed rules to regulate carbon dioxide emissions from existing fossil fuel power plants, triggering considerable debate on the proposal's design and its environmental and economic consequences. One question *not* addressed by this debate is this: What if the EPA regulations turn out to be inadequate to address future mitigation goals? That is, what will the landscape for future policies look like if these regulations turn out to be just an interim measure? This analysis compares potential short- and long-term consequences of several key regulatory design choices, including mass-based versus rate-based standards, tradable versus non-tradable standards, and differentiated versus single standards. It finds that long-term consequences may be significant in terms of the legacy they leave for future policy revisions: tradable standards lead to lower electricity prices and become weaker over time; differentiated tradable standards lead to relatively greater investment in coal retrofits; non-tradable standards lead to relatively greater retirement of coal capacity. It may be the case that key policy choices entail one set of trade-offs if proposed EPA rules are viewed as relatively permanent and final and another set of tradeoffs if the rules are viewed as an interim solution.

1. Introduction

On June 2, 2014, the U.S. Environmental Protection Agency (EPA) released proposed rules to regulate existing fossil fuel power plants under Section 111(d) of the Clean Air Act. Referred to as the *Clean Power Plan* (CPP) by the EPA, these proposed rules' key features include state-by-state emissions rate targets and considerable flexibility to achieve them (Tarr and Adair, 2014). EPA identified a specific set of technological strategies states can follow (called "building blocks") to seek the required reductions. However, states are not bound by EPA's strategies; they can devise their own policy mechanisms, from command-and-control measures to market-based instruments, so long as they meet the target emission rate or an equivalent fixed emission limit.

Among EPA's identified technological strategies, emissions reductions could be achieved by improving the efficiency of existing coal plants or by shifting, or "redispatching," generation from existing coal plants to existing natural gas-fired plants. New natural gas plants that are already slated for construction could be built earlier than planned to reduce emissions more quickly. Reductions could also be achieved within the existing natural gas- or coal-fired fleets by shifting generation from higher-emitting to lower-emitting plants within those fleets. Moreover, states could encourage these strategies through various policies including requirements that establish maximum emission rates at each plant or that establish an overall emission cap through a tradable permit

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system. Different strategies for emissions reductions and policy design could have important near-term consequences (e.g., the cost of electricity generation and market prices) and important long-term consequences (e.g., the composition of the fleet after retirements and new investments as well as future electricity prices). These consequences can vary significantly from region to region.

These long-term consequences may be particularly important in terms of the legacy left for future policies. The latest Intergovernmental Panel on Climate Change report (IPCC, 2013) indicates that stabilization of global temperatures at less than 2° C will require very steep cuts in emissions, possibly even to net zero. A recent National Academy report (NRC, 2011) similarly calls for the US to "reduce greenhouse gas emissions substantially over the coming decades." Even less ambitious goals will likely require more than the roughly 20–25% reductions in the power sector (below current business-as-usual forecasts) that will occur under the CPP.[1] Thus, if the Clean Air Act turns out to be an insufficient tool to address future mitigation goals, it could renew debate over federal legislative options, namely, emissions trading, emissions taxes, and/or a system of tradable national standards. How will the long-term consequences of current regulation affect those choices? The answer to that question defines the legacy of today's policy choices.

This paper explores a number of near- and long-term consequences of key regulatory design choices. Although the current regulatory proposal is oriented toward 2030 targets, the paper's focus is on the post–2020 timeframe. We examine this time period because the important question is not how long the regulations might last, but how soon pressure for an alternative legislative solution might arise. From that perspective, 2020 appears to be a reasonable horizon for such a possibility.

The paper also focuses on national-level policy options, even though a key feature of implementation under section 111(d) will be considerable autonomy for state-level decisions. By looking at national-level policies, the analysis seeks to focus on effects arising solely from policy design. Future research will explore state-level variations in national-level policies.

In establishing the emissions guidelines referenced above, the EPA has given states considerable discretion over a wide range of factors that can affect the short-run and long-run costs of meeting the policy's emissions goal. The remainder of this section discusses major policy choices and our policy scenarios.[2] We then describe our methodology in Section 2, followed by results and discussion in Section 3 with a particular emphasis on policy legacy effects. Section 4 concludes the paper with some further policy implications.

1.1. Rate-based versus mass-based approach

The EPA decides how to quantitatively specify emissions requirements; states must choose how they will implement those requirements. For the proposed rule, EPA expressed emissions requirements in terms of an emissions rate: pounds of CO_2 emissions per megawatt hour (MWh) of electricity produced. This rate is a transparent metric for power plants, also called electric generating units (EGUs) , because all power plants produce the exact same product (electricity). But plants use different fuels to produce their power and the variation in their conversion efficiency leads to different emissions rates across sources.

A rate-based approach is not just easy to communicate; it also provides some flexibility to the sector, allowing for growth in output while limiting its carbon intensity. However, total emissions generated by the sector could actually rise, or at least not fall as much as expected, if increasing output counters the reductions achieved through production of less carbon-intensive power. One way to more directly target EGUs' total emissions is to set a mass-based standard.

Perhaps the most important distinction between mass- and rate-based approaches arises when they are implemented through a market-based policy: a cap and trade for the former and a tradable performance standard for the latter. Similar to a carbon tax, a cap and trade approach puts a price on each ton of reduction. However, a tradable performance standard effectively represents a tax on the emissions released *plus a subsidy on the output produced*, sometimes referred to as a "feebate" (Johnson, 2006). This standard typically leads to much smaller price impacts for electricity than a cap-and-trade or tax approach.

In its proposal, the EPA established an emissions rate target for each state and provided guidance on how to translate that target into a mass-based target if the state so chooses (U.S. EPA, 2014a). This analysis compares mass- and rate-based approaches to provide insights into that choice.

1.2. Command-based versus market-based implementation

A rate-based standard can be strictly applied on a unit-by-unit basis or can allow for trading across units to meet compliance. Strict unit-level ("command-and-control") compliance means that an EGU must operate below the specified emissions standard or retire. For an existing EGU that currently operates above the standard, the only possible options under the command-and-control approach are to switch to a lower-carbon fuel, retrofit the plant to emit lower-than-the-policy rate, or retire, each of which may be costly.

Under a more flexible system, an EGU that exceeds the emissions standard could comply by procuring pollution permits for a price – either through a carbon tax on EGU emissions or through a cap and trade program that limits emissions through allowances that can be traded across regulated sources (or purchased as "offsets" from unregulated sources, if allowed).[3]

Typically, a carbon tax and cap and trade are entirely focused on tons of emissions and are therefore viewed as mass-based approaches. However, the basic logic can be translated to a rate-based performance standard, as has been done in the case of state-based renewable portfolio standards (RPS) for electric power. In that case, the regulation establishes an overall performance rate (e.g., percent of electricity from renewable sources), but the standard can be met for the industry as a whole when individual EGUs purchase renewable energy credits (RECs) that represent units of output (a megawatt-hour of electricity) generated from renewable sources. These credits can represent a share of their total generation to compute their "percent renewable" for compliance purposes. Likewise, in the case of a tradable rate-based performance standard for EGUs, some units that operate below the GHG emissions rate can generate additional credits (denominated

[1] A study by the Energy Information Administration (U.S. EIA, 2010) of an economywide emission trading program suggests roughly 80% of the cost-effective reductions come from the power sector, even though it represents only 40% of emissions (see Fig. 3 of that study). In EIA study, power sector emissions were reduced by about 50% as national emissions were reduced by about 25% (relative to business-as-usual forecasts).

[2] Of course, EPA has discretion on how to set the level and time horizon of emission targets, which by statute is based on the best system of emissions reduction that has been adequately demonstrated (U.S. EPA, 2014b). However, for this analysis we take the emissions goal that EPA has set as given, and focus on policy implementation options below that are still open to choice.

[3] In practice, either a tradable permit system or a tax must also be backed by strong rules and institutions to ensure it achieves the cost-effectiveness that flexibility can provide, fairly and equitably for all market participants.