Comments on the Proposed Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 FR 34830 (June 18, 2014)

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1. Introduction

In June of 2014 the U.S. Environmental Protection Agency (EPA) issued its Clean Power Plan, a proposed rule under the Clean Air Act Section 111 (d) entitled, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units." The EPA estimates that the Plan would reduce carbon dioxide (CO_2) emissions from existing U.S. power plants 30 percent below 2005 levels by 2030. Power plant emissions have already declined by more than 15 percent since 2005, so the Plan is seeking further reductions of about 18 percent from current emission levels.

We see an urgent need for federal action to reduce greenhouse gas (GHG) emissions, and we support taking steps to limit emissions from the domestic power sector, which currently accounts for about 40 percent of domestic CO_2 emissions from all sources. We therefore regard the proposed Plan as a critical component of federal climate change policy.

In this comment we point out, from an economics perspective, some strengths of the proposed Plan along with weaknesses that could use improvement as the EPA undertakes revisions to the initial proposal. A laudable feature of the Plan is that it offers states considerable flexibility in the form of compliance. To reduce emissions cost effectively, it is critical to have a flexible structure that allows lower-cost options to be favored over higher-cost ones. While several features of the Plan are consistent with this flexibility principle, effective implementation will require greater attention to some key design issues.

Specifically, our comments center on the following issues:

- *The advantages of a mass-based compliance approach relative to the rate-based approach that currently constitutes the default option for states under the Plan.* We describe how rate-based standards can generate perverse incentives that compromise cost-effectiveness and make it more difficult for the Plan to achieve intended emissions reductions.

- *The importance of treating existing plants and investment in new plants in an integrated fashion.* We describe some important distortions that result when existing and new power plants are treated asymmetrically under the Plan.

- *The critical significance of cross-state and regional coordination to the cost-effectiveness of the Plan.* We argue that this will be particularly important if the Plan continues to give states the option of choosing between rate- and mass-based approaches, especially for states within the same regional electricity market. Absent coordination across states within a common regional electricity market, compliance with the Plan has the potential to interfere with the efficient allocation of production and investment.

In addition to pointing out these issues, we indicate what can be done to address concerns and improve the Plan. Key recommendations include:

- To mitigate concerns about the crediting of energy efficiency measures under a rate-based standard, the EPA should establish detailed protocols and guidance for evaluation, monitoring, and verification of efficiency programs. Moreover, in quantifying the savings from these interventions, the EPA should favor field-based measures.

- The EPA should facilitate the ability of states to employ a mass-based approach as a way of complying with the Plan. In addition, the EPA should allow for a *dynamically flexible* mass-based cap under the Plan. This will help lower costs of the program and add to the attractiveness of mass-based standards.

- The EPA should encourage states to integrate new emitting sources into their plans. This is particularly important in the case of mass-based standards, which can create a strong bias towards replacing existing facilities with new investment if new power plants are exempt from existing source standards.

- The EPA should take steps to lower the barriers to regional cooperation by states that adopt mass-based compliance approaches. We suggest ways to lower barriers stemming from legal uncertainty, administrative complexity, or both.

We believe that the Plan in its current form already represents an important and positive step toward cost-effective mitigation of CO_2 emissions. Our comments aim to improve what already offers a significant advance in U.S. climate change policy.

2. Rate-based emissions standards

Under the proposed Plan, each state faces a state-specific, rate-based standard. The numerator is pounds of CO_2 emitted by existing plants covered under the Plan. The denominator is a measure of electricity at most existing sources, with an adjustment for avoided generation due to efficiency improvements.[1] Although states have the option of converting to a mass-based standard, the rate-based standard is the default under the proposed Plan. In this section, we raise three concerns with the rate-based standards, leaving for the next section a comparison to the mass-based approach.

a. Production incentives under a rate-based standard

When it comes to production incentives under a rate-based standard, states have two ways to reduce their emissions ratio. They can reduce emissions, thereby decreasing the numerator. Or they can *increase* the total level of electricity generation from power plants with emissions rates less than the standard. Both changes reduce the emissions ratio, but only the first reduces CO_2 emissions. Since, under a rate-based standard, an increase in electricity generation can lower the emissions ratio, the standard introduces incentives to increase production.

Research has shown that this incentive to increase production can matter a great deal, both in theory and practice.[2] Focusing on a similar rate-based standard for the CO_2 content of transportation fuels, Holland *et al*. show that, in the extreme, a rate-based standard can actually cause total CO_2 emissions to increase. They show that while the rate-based standard discourages the use of fuels with a carbon intensity higher than the standard, it acts as an implicit *subsidy* to fuels with a carbon intensity lower than the standard. A related result from their analysis is that emissions reductions under the rate-based standard can be significantly more costly than under the alternative policy instrument of a mass-based standard.

While the results of Holland *et al*. apply to the transportation sector, the same underlying incentives arise with a rate-based standard for CO_2 emissions in the electricity sector. These should be recognized, as they represent an unintended consequence. However, there are reasons to question whether the magnitude of the effect would be important for electricity. A key parameter in the analysis is the elasticity of demand, and because electricity demand is relatively inelastic, it is unlikely that electricity production and therefore CO_2 emissions would increase significantly as a result of the rate-based standard.

b. Investment incentives under a rate-based standard

There is some ambiguity under the proposed Plan with respect to the role of new conventional (e.g., natural gas) generation and its potential role as part of the Plan's "Building Block 2." In its June 2014 proposal, the EPA stated that replacing fossil steam generation with new NGCC units and natural gas co-firing at existing fossil steam units may be considered part of the BSER. The more recent Notice of Data Availability notes that "New NGCC units and natural gas co-firing at existing fossil steam units may be considered part of a "system of emission reduction," in light of the broad definition of that phrase." If new NGCC units are incorporated into the BSER, it is unclear whether emissions from these new units could be included in measures of emissions or emissions ratios when determining states' compliance status.

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[1] We refer to the standards as "rate-based," following the convention established by the EPA and other comments about the Plan. However, it should be noted that the required rates defined by the EPA as part of the Plan are distinct from the simpler emissions-rate concept that engineers often refer to as an indicator of performance by a particular facility. The engineering concept includes no adjustment for reductions in demand stemming from policies to promote energy-efficiency.

[2] See, for example: Stephen Holland, Jonathan Hughes, and Christopher Knittel, 2009, "Greenhouse Gas Reductions under Low Carbon Fuel Standards?" *American Economic Journal: Economic Policy*, 1(1); Gloria Helfand, 1991, "Standards Versus Standards: The Effects of Different Pollution Restrictions," *American Economic Review*, 81(3): 622–34.

Nevertheless, how this question is resolved will have important implications for the incentives created by the Plan.

Excluding the emissions and electricity generation at new sources from the calculation of a state's emissions rate for compliance purposes will distort investment decisions and undermine progress toward cost-effectiveness goals. One of the desired benefits of building (or repowering) efficient gas generation is to lower the average emissions rate under a rate-based standard, particularly in states with little or no current excess gas generation capacity. Excluding new generation from this calculation would therefore reduce the incentive for new investment, as it would provide at best indirect progress toward compliance. We discuss the investment incentives arising under a mass-based approach in the next section.

c. Energy-efficiency adjustments under a rate-based standard

Another concern with the rate-based standard outlined in the proposed Plan relates to the inclusion of programs for demand-side energy efficiency improvements (such as programs designed to increase the adoption of more-efficient appliances). While these programs can offer a cost-effective way for states to cut emissions by reducing electricity consumption, the problem is that accurately measuring how efficiency investments affect electricity demand is notoriously difficult, and recent studies indicate that the savings are frequently overestimated by a wide margin.[3]

This is important because overestimation of the gains from energy efficiency will reduce the stringency of rate-based standards. To understand why this is the case, recall that the denominator for the rate-based standard includes an adjustment for avoided generation due to energy-efficiency improvements. In particular, avoided generation increases the denominator, helping to bring a state into compliance. With enough avoided generation from energy-efficiency, any state can be brought into compliance, even a state which otherwise has taken few steps to reduce carbon dioxide emissions. This becomes a problem when estimates of avoided generation are overstated. An overestimated measure of avoided generation can make a state appear to be in compliance, when in reality it is not. This problem arises with energy-efficiency because unlike the other components of the compliance formula, avoided generation is not directly observed and must be estimated using engineering and econometric techniques.

Indeed, accounting for energy efficiency in rate-based standards creates a potential "loophole" that is quantitatively important because the proposed Plan relies heavily on energy-efficiency to generate the targeted 30 percent reduction in emissions from the power sector below 2005 levels, with energy efficiency accounting for approximately 20 percent of the targeted emissions reduction.[4] Moreover, depending on how states choose to comply, national annual spending on utility energy efficiency programs could triple.[5]

There are several reasons why actual energy savings often end up smaller than predicted. Understanding what drives these measurement errors is important for determining which estimates the EPA should rely on. First, evidence suggests that many people counted as participants in energy-efficiency programs would have undertaken the energy saving behavior even in the absence of the program.[6] Second, an

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[3] "Bridging the Energy Efficiency Gap: Policy Insights from Economic Theory and Empirical Evidence." Kenneth Gillingham and Karen Palmer. 2014. *Review of Environmental and Economics and Policy*, 8(1): 18-38.
[4] EPA Technical Support Document State Goal Data Computation Appendix 1.
[5] ICF International. "EPA's 111(d) Clean Power Plan Could Increase Energy Efficiency Impacts, Net Benefits, and Total Value." White Paper and Webinar: October 28, 2014.
[6] See, for example: Judson Boomhower and Lucas Davis, 2014 "A Credible Approach for Measuring Inframarginal Participation in Energy-Efficiency Programs," *Journal of Public Economics*, 113: 67-79; Anna Alberini, Will Gans,

energy efficiency improvement essentially reduces the cost of an energy end use. For example, an hour of lighting becomes cheaper once a household switches from an incandescent bulb to an LED. In response to this efficiency-induced reduction in cost, firms and households may increase demand for energy services. This "rebound effect" has been widely understood for decades, and although 100 percent rebound is rare, it is not uncommon for as much as 30 to 40 percent of the predicted gains from energy-efficiency to be offset.[7] Third, many energy efficiency programs explicitly require *ex ante* estimates to be of a certain size in order for participants to receive subsidies. Hence contractors and energy-efficiency auditors may make conscious or unconscious choices in performing audits that bias the estimated savings upward. Similarly, the compensation received by investor-owned utilities for administering energy-efficiency programs usually depends, in part, on the magnitude of the estimated savings, which also creates a potential incentive for overstatement.

d. Suggested modifications to the Plan

To summarize, we have three concerns about the use of rate-based standards under the proposed Plan. First, a rate-based approach distorts production incentives by subsidizing production at existing units with emissions intensities below the standard. Second, if new electricity generating units are not regulated under the Plan, incentives to invest in new gas generation are diluted under a rate-based standard. Third, the proposed adjustment for generation avoided due to energy-efficiency programs has the potential to weaken the stringency of the standard and undermine cost effectiveness by over-incentivizing investments in energy efficiency.

There is some ambiguity surrounding the potential inclusion of new gas generation for achieving compliance under the Plan. To promote cost-effective reductions in emissions, the EPA should encourage states to integrate existing and new polluting sources in their implementation plans.

To mitigate concerns about the crediting of energy efficiency measures, the EPA should establish detailed protocols and guidance for evaluation, monitoring, and verification of efficiency programs. Moreover, in quantifying the savings from these interventions, the EPA should strongly favor field-based savings estimates over engineering estimates and should encourage evaluators to take advantage of state-of-the-art approaches to program evaluation. We believe that randomized controlled trials (RCTs), and quasi-experimental methods are likely to be more reliable than other empirical approaches to estimating realized savings. In general, we believe that field-based, *ex post* empirical estimates are likely to be more reliable than engineering studies. Execution and internal validity must be considered, as well, to determine which evaluation approaches would most accurately capture real-world savings.

3. The mass-based approach

As discussed previously, the rate-based standard depends both on the level of emissions (in the numerator) and the level of electricity generation (in the denominator). In contrast, a mass-based standard depends on the level of emissions only. This seemingly small difference in the structure of the standard begets potentially significant differences in operating and investment incentives. Economists for decades have advocated mass-based standards for addressing externalities like CO_2 emissions. In particular, by fixing the total level of emissions and allowing emitters to trade permits, cap-and-trade programs reduce

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and Charles Towe, 2013, "Free Riding, Upsizing, and Energy Efficiency Incentives in Maryland Homes," Fondazione Eni Enrico Mattei Working Papers. Paper 835.

[7] See, for example: Ken Gillingham, David Rapson, and Gernot Wagner. 2014. "The Rebound Effect and Energy Efficiency Policy," Resources for the Future, Discussion Paper RFF DP 14-39; Severin Borenstein, forthcoming, "A Microeconomic Framework for Evaluating Energy Efficiency Rebound and Some Implications," *Energy Journal*.

emissions at least cost. The price of the permit leads emitters to internalize the externality, and the trading ensures that emissions reductions are efficiently allocated across all emitters in the market.

Under the proposed Plan, states have the ability to convert their rate-based standards to a mass-based cap on total GHG emissions. A recently released technical support document provides guidance on this conversion, and outlines some alternative approaches that states could take to translate a rate-based standard to a mass-based approach. Having completed this conversion, states could pursue a variety of alternative policy approaches, including implementing a cap-and-trade program under which the rights to emit would be tradable.

Notably, the mass-based approach avoids some of the aforementioned pitfalls of a rate-based approach. Mass-based standards do not implicitly subsidize output. The cap on total emissions under a mass-based approach implies a "shadow" price on emissions, but doesn't offer a reward for increased electricity output. In addition, a mass-based approach avoids the need for estimating the reduction in electricity output associated with energy-efficiency improvements. The mass-based approach directly rewards energy-efficiency improvements that lead to emissions reductions, since such improvements help the state to keep emissions within the cap.

These advantages notwithstanding, mass-based standards do raise two concerns with respect to efficiency and cost-effectiveness in this context. In what follows, we discuss these concerns and suggest ways to address them within the proposed Plan.

a. Investment incentives under a mass-based standard

Under a mass-based approach, the incentives with respect to investment in new natural gas generation work in the opposite direction from that for a rate-based standard. If states are adopting a mass-based approach and thereby capping their emissions, excluding new natural gas generation would create a strong bias toward premature closure of existing capped facilities and their replacement by new, uncapped power plants. In contrast, recall that under a rate-based compliance approach, excluding new natural gas generation decreases the incentive for new investment.

In other words, if new natural gas generation is not regulated under the Plan, investment incentives are distorted one way or another under both the mass-based and rate-based emissions standards. We urge the EPA to encourage states to integrate existing and new sources of generation in their implementation plans. Including new and existing sources under the same mass-based standard would eliminate the incentive to over-invest in new generation.

b. On the relative inflexibility of mass-based standards

One concern unique to the mass-based standard is its inflexibility over time. If economic growth is robust, the constraint will be more binding (with higher costs) than if economic growth is slow. If natural gas prices are high relative to coal, it will be more costly to reach a given mass-based standard than if gas prices are low. If there are breakthroughs in energy efficiency technology, the standard will be easier to reach than if energy efficiency delivers lower levels of cost-effective savings.

It is possible to design a mass-based system so that it has flexibility, addressing these concerns and making it more comparable to a rate-based standard with respect to its stringency. The EPA should allow for a mass-based standard in which the numerical cap may be adjusted over time in a well-defined way that does not detract from the emissions control objectives of the 111(d) rule. By making the cap a function of factors that are clearly exogenous to the state program, flexibility and costs savings can be obtained without diminishing the overall objectives of the program. For instance, factors such as Gross State Product, the relative price of natural gas versus coal, and the national average level of GHG emissions efficiency (CO_2/GDP) for all other states can be used to stipulate how the state's overall cap will adjust over time. If GSP increases over time, then the cap can increase, which is exactly how the rate-based standard works. If gas prices increase significantly, the cost of reprioritizing dispatch increases and it would be appropriate to increase the cap in that case. If, on the other hand, gas prices stay low or become lower, it may be appropriate to tighten the cap further. Any set of predefined adjustments in the cap that meets the same mass-based standard *in expectation* could be permitted, so long as any adjustment variables are outside the control of the state (to avoid the state gaming the system).

Like the simpler inflexible mass-based standard, a dynamically flexible mass-based standard in which the target level is only a function of exogenous variables creates efficient incentives for emissions reduction. At the same time, the flexible mass-based standard is less likely to cause price volatility and economic disruption. A dynamically flexible mass-based standard can also be more attractive to states in dealing with uncertainties related to economic growth and technological change.

A mass-based standard could also be expanded to handle increased electricity use that results from substitution towards electric vehicles (EVs) and away from vehicles fueled by refined oil products. EVs are a very young technology with almost no installed base. If the market penetration of EVs expands over the policy time horizon, the cap could be designed in a way that reflects this increase in electricity demand.

In sum, we believe that a dynamically flexible mass-based cap should be permitted by the EPA. The EPA should provide guidance to states on how to implement a dynamically flexible mass-based standard, and it should be open to alternative formulae for flexibility. This will result in lower costs of the program, while preserving the intent.

4. The importance of cross-state coordination

The proposed Plan allows for the submission of multi-state implementation plans. This is important because it allows groups of states to propose methods of joint implementation (such as multi-state cap-and-trade systems) that can be more cost-effective than what would be possible without such coordination. Even absent multi-state implementation plans, it will be important for states to be able to link their compliance efforts in some way. An example would be the trading of emissions allowances across states that have adopted market-based approaches to meeting state-specific mass-based standards. This form of linkage can reduce overall costs, lower price volatility, and reduce market power of individual permit market participants.

The need for cross-state coordination—through joint implementation plans or linked compliance obligations—is especially great in view of the fact that states are connected through regional electricity networks. Whereas the Plan's emission targets are delineated by state lines, the power sector's grid and markets are not. Regionally integrated electricity markets are organized as multi-state wholesale markets or power pooling arrangements. Actions taken in one state thus affect electricity flows—and associated emissions—in neighboring states.

Absent regional coordination, compliance with the Plan has the potential to interfere with the efficient allocation of production and investment in these regionally integrated systems. To illustrate this important point, we extend our discussion of rate-based and mass-based standards to a regional context in which the dispatch of electricity production across a multi-state region is centrally coordinated. While our earlier discussion of rate-based and mass-based standards was framed in general terms, the discussion in this section introduces more detailed examples to illustrate some important points.[8]

a. Production incentives in a regional electricity market

In any electricity system, plants are dispatched (or operated) in the approximate order of their variable operating costs.[9] Low cost plants operate almost all the time, while high cost plants operate only during the high demand conditions in which their capacity is needed. This "merit-ordering" of power plants is designed to ensure that electricity demand is met at least cost, given available capacity.

The introduction of an emissions regulation alters a fossil-fueled power plant's variable operating costs and can thereby affect the merit-order of dispatch. Recent analysis by Bushnell *et al*.[8] demonstrates the implications of alternative policy designs on system dispatch and associated power sector outcomes. Here we summarize some of their findings, based on policy alternatives that are roughly similar to those specified in the proposed Plan. Although the analysis is calibrated using data from a specific region and year (the western interconnect in 2007), the main results apply with generality.

The following analysis assumes that all states use a market-based approach to meet their compliance obligation. Under a mass-based system, this means that producers within the state must purchase allowances to offset their emissions. Under a rate-based system, it means that plants with emissions rates below the standard can sell compliance credits to the plants with emissions rates that exceed the standard.[10] The analysis focuses on how these alternative policy designs affect re-dispatch (i.e., Building Block 2 of the proposed Plan).[11]

i. Production incentives under a regionally harmonized standard

We begin with a discussion of how the simulated power system dispatch is affected under a regionally coordinated rate-based or mass-based standard. Under the mass-based regime, "regionally harmonized"

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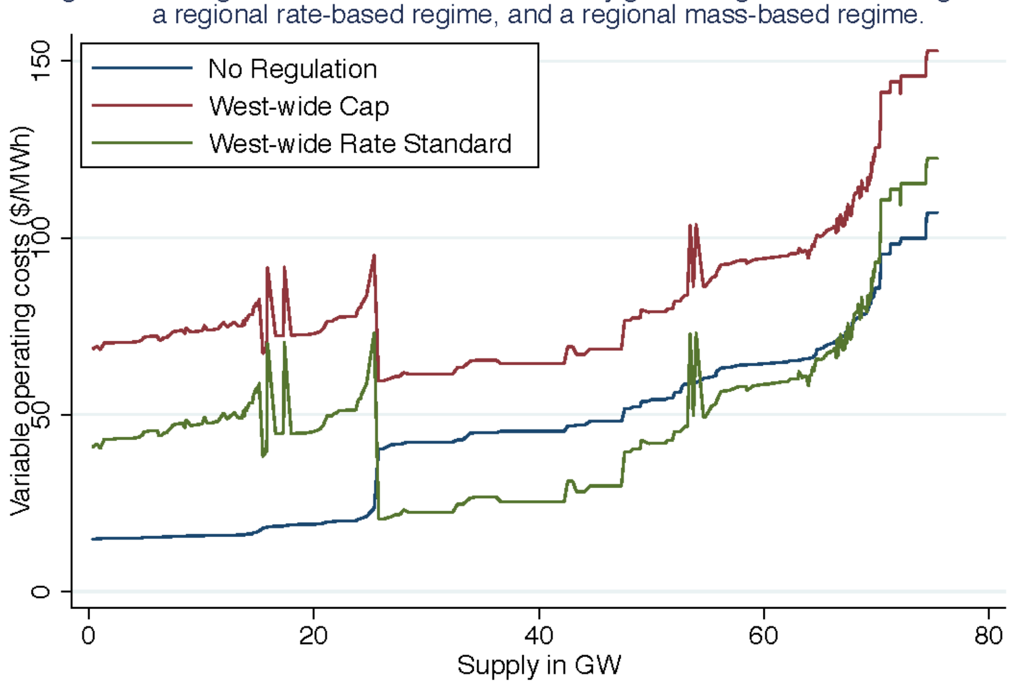
[8] The simulations reported here are described in detail in a forthcoming working paper: James B. Bushnell, Stephen P. Holland, Jonathan E. Hughes, and Christopher R. Knittel. 2014. "Strategic Policy Choice in State-Level Regulation:The EPA's Clean Power Plan", EI at Haas WP 255 and MIT CEEPR WP-2014-09.
[9] System congestion, inter-temporal operating constraints, and other factors can result in "out-of-merit" dispatch. This analysis abstracts away from these considerations.
[10] We recognize that some states may choose not to adopt market-based approaches to compliance. Even in the absence of formal allowance or emissions-rate trading systems, many of the incentives described here will apply to plant owners and affect the operation of their plants. In the absence of trading, the inefficiencies that we discuss would tend to be exacerbated.
[11] Specifically, Bushnell *et al*. model how a given policy design would affect the operating costs of each unit and thereby the dispatch order. As a first step, emissions and generation in the year 2007 are simulated in the absence of regulation. Then corresponding state-specific emissions rates are calculated. To define state-specific, rate-based emissions standards, the base (unregulated) rates are multiplied by the reductions assumed under Building Block 2 (in percentage terms) of the proposed plans. Additionally, to convert these rate-based targets to mass-based limits, they take the product of the rate-based target and the quantity of electricity generated at the baseline.

means that the regional target is simply the sum of the individual states' emissions targets. An alternative interpretation is that emissions trading is allowed across all states in the region. In either case, the analysis assumes that permits are allocated via an auction, grandfathering, or some combination of these two approaches. Importantly, auctioning and grandfathering have identical impacts on marginal production incentives.[12] Under the rate-based regime, a "harmonized" regional target is defined by summing the mass-based targets across states (to define the numerator of the target) and dividing by the sum of baseline generation across all states. Then, in each case, the dispatch model is used to identify the permit price that clears the market and therefore brings the region into compliance.

Figure 1 illustrates how these policies affect plants' operating costs. The solid blue line traces out the variable cost curve (or merit order) absent any emissions regulation. For this base case, the graph orders plants along the horizontal axis in increasing order of their variable operating costs. The units to the left of the jump at 23 GW are primarily coal-fired, while units to the right are primarily gas-fired.

The red line traces out the variable operating costs at these units (including the cost of holding permits for compliance purposes) under the regional mass-based cap. Note that the graph preserves the baseline merit ordering; the red line does not represent the new merit order under the policy. Intuitively, the mass-based regulation increases the variable operating costs of the coal-fired plants much more than it increases the variable operating costs of natural gas-fired plants. This reflects the fact that coal plants emit more CO_2 per unit of electricity generated.

Figure 1: Changes in the merit order of electricity generating units with no regulation, a regional rate-based regime, and a regional mass-based regime.



[12] Note that policy impacts on variable operating costs – and system dispatch- would manifest differently if permits were allocated dynamically according to production on a going-forward basis (versus auctioned or grandfathered).

The green line traces out variable operating costs (including compliance costs) under the harmonized rate-based standard (again preserving the baseline merit order). The coal generation units have emissions rates above the standard and must purchase credits to remain in compliance. Thus their variable costs increase. Most natural gas plants have emissions rates below the standard. These plants can sell compliance credits, so their operating costs decrease.

The impacts of the rate-based or mass-based policy on operating costs and merit order will be sensitive to our assumptions about the stringency of the standard. But the figure serves to illustrate two general results that we highlight here.

First, variable operating costs (as perceived by the firms) are higher under the mass-based standard as compared to the rate-based standard. It follows that electricity prices will be lower under the rate-based approach. Importantly, one should not infer from this that *social* costs are higher under the mass-based standard. The private variable costs indicated in the graph are comprised of variable input costs (e.g. fuel) and compliance costs, whereas social variable costs are comprised of variable input costs and the external damages from emissions.

Lower electricity prices under the rate-based standard reflect the fact that a rate-based standard confers an implicit subsidy to plants with emissions rates below the standard (recall the discussion of the implicit production subsidy in Section 2(a) of this comment). Hence, to the extent that demand for electricity is price-responsive, there will be a higher level of electricity consumption under the rate-based approach compared to the mass-based approach. If consumer prices under the rate-based standard fail to reflect the full social cost of electricity production, the level of electricity production—and the overall costs of achieving any mandated level of reductions—would be higher under the rate-based standard. This means that while producer variable costs are lower under a rate-based standard, a mass-based approach will provide a more cost-effective approach for achieving emissions reductions.

The second general result to highlight is that, whereas the introduction of an emissions regulation changes the merit order significantly relative to the unregulated baseline, under the mass-based and rate-based regional scheme the merit-order of plants is approximately the same. Under both approaches, some coal plants are replaced with low-cost gas plants at the bottom of the merit order. Thus, the main difference between the regionally coordinated mass-based target and regionally coordinated rate-based target lies in the level (versus dispatch order) of production.

ii. Production incentives when standard stringency varies across states

We now consider a scenario where the stringency of the standard varies across states in a regional power system. We continue to assume that the form of the standard does not vary, and in particular, we consider a case where all states convert to a mass-based standard. Whereas the mass-based scenario in Figure 1 is based on the assumption that a single mass-based standard applies to all plants in the western U.S., in the present scenario individual states have their own targets and there is no possibility of trading compliance obligations across state boundaries. In this case, it is important to keep in mind that *electricity will nevertheless be traded* among states within a regional power system.

Figure 2 illustrates how variation in stringency across states affects the merit-order in this case. As a reference case, the black markers in the figure trace out the merit order (inclusive of emissions-related compliance costs) under a region-wide cap with interstate trading of emissions obligations. This black line is based on the redline from Figure 1, now sorted in the order of increasing variable operating costs. This is the merit-order that will meet the mandated emissions reductions at least cost. The red and green markers (relating to coal and natural gas, respectively) indicate the variable costs under "autarkic" compliance—that is, without trading of compliance obligations between states. Any difference between the black markers and the others reflects an inefficient deviation from the efficient merit order (given the standard).

Figure 2: Changes in the merit order of electricity generating units with a regional mass-based regime and individual state-level mass-based regimes.

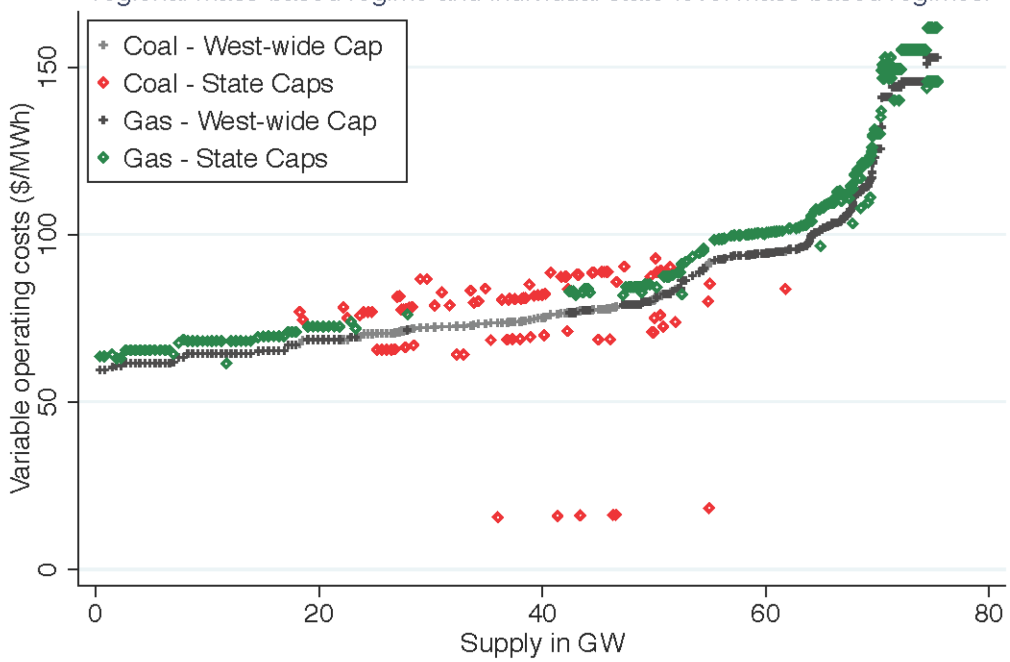


Figure 2 illustrates how a lack of coordination or linkage between states with different mass-based standards significantly alters the order of dispatch. For example, note that technically identical coal plants that sit side-by-side in the reference merit order (the black line) are impacted very differently under the uncoordinated policy if they are located in states with very different emissions standards. Plants in states with relatively aggressive standards see operating costs increase relative to the reference case, whereas coal plants in states with much less stringent standards move to the front of the dispatch order!

Importantly, any re-ordering of the dispatch order that is due to inter-state differences in the stringency of emissions standards—versus real differences in the emissions intensity of production—will *undermine* the efficiency of power-system operations. This underscores the importance of allowing for trades in emissions across states in the same electricity market.

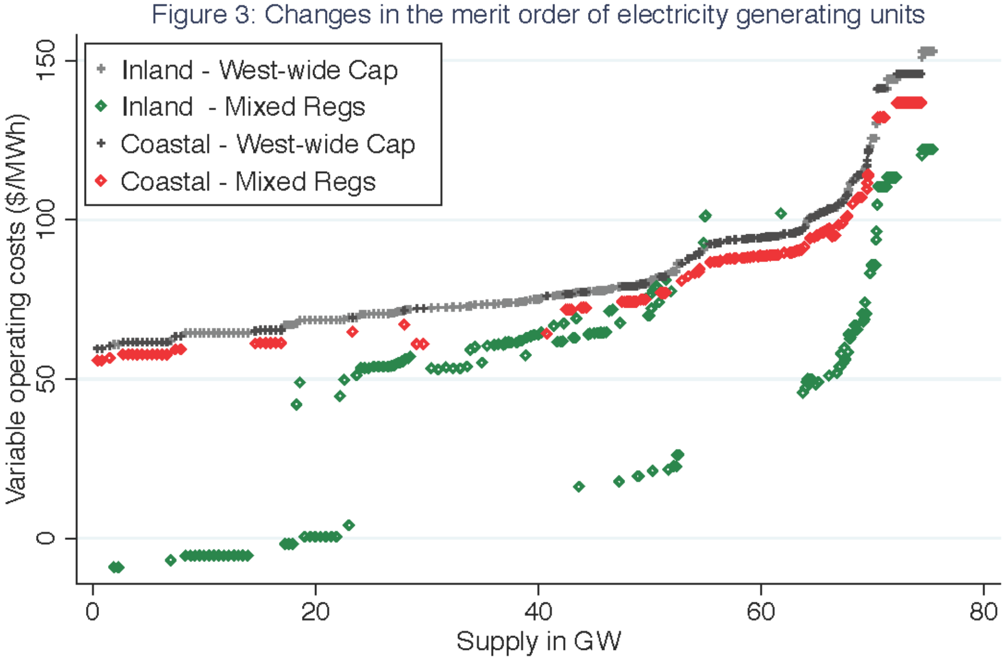
iii. Hybrid scenario: rate- and mass-based regulations

The previous section showed how cross-state variation in the stringency of the standard distorts dispatch in a regional power system, even if the type of standard (i.e. rate- or mass-based) is harmonized across the region. We now consider a scenario in which some states in a region adopt rate-based standards while other states elect to convert to a mass-based standard. We refer to this as a “hybrid” regime.

Figure 3 illustrates one such hypothetical outcome, where the three WEST Coast states adopt a shared mass-based system, while all inland western states adopt a shared rate-based target. As in Figure 2, the black markers trace out the merit order (inclusive of emissions-related compliance costs) under a region-wide cap with interstate trading of emissions obligations. The green markers correspond to plants regulated under the (inland) rate-based regime in the hybrid scenario. The red markers denote operating costs under the (coastal) mass-based regime in the hybrid scenario.

Two results from this figure are worth highlighting. The first pertains to costs. The average effect of the policy on plant-level variable operating costs (as perceived by firms) is lower under the hybrid scenario as compared to the scenario that features a regional emissions cap. This is true in *both* the mass-based and rate-based states. Intuitively, this is because some compliance is achieved in the capped states by increasing imports of electricity from the rate-based states. Under a hybrid scenario, we should expect to see a re-allocation of production towards the rate-based states because the rate-based regulation subsidizes gas production. This hybrid design effectively makes imports of gas from the rate-based states to the mass-based states even more attractive than they would otherwise be. Under such conditions, increasing imports from rate-based states becomes a low-cost option for complying with the mass-based standard imposed by the coastal region.

Figure 3: Changes in the merit order of electricity generating units



Gray markers illustrate a regional mass-based regime while red and green markers illustrate a hybrid approach involving sub-regional mass- and rate-based regimes

A second, related implication is that states may face strong incentives to choose different compliance approaches (i.e., rate- versus mass-based). In other words, setting aside concerns about the administrative and process costs of coordinating compliance across states, regional coordination is not the most likely outcome given incompatibilities in economic incentives. Notably, it can be in a state’s interest to choose the *opposite* regulatory mechanism as their neighbors. This is true regardless of whether carbon allowances are traded between the states. Figure 3 illustrates this point quite clearly. Note that, conditional on the coastal region adopting a mass-based standard, the inland states will want to adopt a rate-based standard in order to enhance their opportunity to increase exports to the mass-based states. Moreover, the coastal states will benefit from increasing imports from the inland states because this reduces the cost of complying with the mass-based standard. In other words, by choosing to implement the policy in a way that differs from the coastal states in the region, inland states can take advantage of new opportunities to import or export power that could lower their own individual compliance costs.

b. Treatment of new natural-gas generation

As we note above, the effect of the proposed Plan on incentives to build new gas generation depends significantly on a state's choice between a mass-based versus a rate-based standard. These considerations become more complex when states with different regulatory approaches share a common power market.

Consider the case where state A adopts a mass-based approach and state B adopts a rate-based one. Also assume that both states have emissions rate targets above that of an efficient new combined cycle gas turbine (CCGT). State A, the capped state, will want to reduce its utilization (and emissions) from its existing sources. If new sources are also covered, then state A could increase its imported power from state B, while state B builds new CCGT capacity and lowers its average emissions rate in the process. Because, as described above, the implied production cost for "cleaner" generation is lower in the rate-based states, it will be more attractive for all parties involved to allow the new investment in the rate-based state, B, and transfer the power to the capped state A.

If new plants are excluded from the regulation, this bias toward investment in rate-based states is diluted. State A, the capped state, still has an incentive to shift production from existing sources, but is largely indifferent as to where those new sources are located. It could be just as economic to build new capacity within state A as outside it. Similarly, state B's incentive to create more low carbon generation is largely muted by the fact that this extra production would not aid its progress toward lowering the average emissions rate from existing sources.

To summarize, just as a mix of mass and rate-based regulations would increase inefficiencies in the short-run operations of regional power markets, a hybrid-approach to compliance would also distort investment decisions, likely in favor of building new plants in rate-based states instead of mass-based ones.

c. Suggested modifications to the Clean Power Plan as proposed

The EPA has requested comments on the role for regional coordination for achieving reductions under Building Block 2 (re-dispatch), and whether specific targets for increased utilization of natural gas plants (existing or new) should be established. We argue here that a regional system is the only way to completely eliminate potentially serious inconsistencies in the operations of power plants in different states. In this case, the ideal would be a regional, market-based system that is harmonized across all states sharing a regional power market.

Coordination across states is most easily achieved if states convert to a mass-based standard and implement a flexible, market-based approach to compliance. Under an emissions trading program, emissions reductions could be traded freely across states. Alternatively, if states chose to achieve compliance via the introduction of a carbon tax or fee (see more on this below), a uniform regional emissions tax or fee would result in cost-effective dispatch.

Whereas overall, system-wide efficiency will almost certainly be maximized under a harmonized regional approach, the distribution of any benefits from coordination is quite uneven among individual states (and among actors within a state). In light of the incentives that are working against regional coordination, we believe that merely allowing the possibility of this kind of regional cooperation will be insufficient. We believe that the EPA should take active steps to lower the barriers to regional cooperation on mass-based compliance for both new and existing sources, steps that would increase the likelihood that states will engage in regional cooperation. The goal of all of these suggestions is to lower the costs, measured either in terms of legal uncertainty or administrative complexity, of states and ideally regions for adopting a mass-based, regional approach to compliance.

In particular, we recommend that the EPA take the following steps:

1. The EPA has provided a detailed guidance in a technical support document discussing alternative approaches to converting emissions-rate based goals to mass-based equivalents. The complexity of the process could bias states in favor of adopting the rate-based default. The EPA should make it as easy for a state to convert to a mass-based target by including a set of mass-based targets for existing sources within each state. These mass-based targets would be those regarded as equivalent to the rate-base standard currently in the proposed Plan. Doing so will both simplify the adoption of mass-based targets by states—they will no longer have to go through the process of quantifying a mass-based target using energy modeling resources that they may or may not have—and create greater legal certainty for states that the mass-based target they adopt will be acceptable to the EPA. At the same time, allowing states to submit dynamically flexible mass-based standards will help to alleviate concerns they might otherwise have about volatility in the cost of meeting a mass-based standard.

2. The EPA should also provide an alternative mass-based target that incorporates emissions from new sources. States could then choose to submit plans that include new sources, also subject to regulation under the NSPS for EGUs, if that approach is appropriate to their circumstances. Again, providing states with these targets rather than asking them to develop them will significantly lower the burden and perceived legal risk of states opting for a mass-based approach.

3. The EPA should provide a model Federal Implementation Plan for states to adopt if they so choose that takes the mass-based target supplied in (2) above and sets rules for a tradable allowance program. Further, the EPA should facilitate adoption of the Federal Implementation Plan by developing an EPA administered allowance registry, allowance tracking system, and compliance systems. By establishing a ready-made Federal Implementation Plan that states could opt into if they so choose, the EPA will significantly lower the regulatory and legal burden for states that choose a compliance strategy that avoids many of the pitfalls we describe above. Also, doing so will significantly increase the odds of regional collaboration within regional electricity markets.

4. The EPA should leave to states that opt into the Federal Implementation Plan the decision about how to allocate allowances and/or allowance revenue under their mass-based compliance

program. The allocation of allowances is best left to state governments and any limitations on state power to allocate allowances might serve to deter participation in a Federal Implementation Plan as described above at (3).

5. The Plan provides flexibility by enabling states to choose how to meet their rate-based or mass-based standard. However, in contrast to cap-and-trade, it currently is unclear whether states have the legal authority to propose a state-level carbon tax as a means of compliance in their state implementation plans. We believe that the EPA should act to resolve this legal uncertainty; otherwise, states interested in exploring the carbon tax option will be reluctant to do so.

Longstanding legal precedent indicates that the EPA cannot compel states to adopt any particular compliance strategy under the Plan. However, the EPA has almost always offered model Federal Implementation Plans for past Section 111 rules and for rules applying the Good Neighbor Provision of Section 110, which cover the sources at issue in the Plan. The EPA should not deviate from this precedent. This approach has resulted in widespread adoption of the EPA proposed compliance strategies. This has occurred because states face high administrative burdens in developing their own compliance strategies and are happy to adopt EPA-approved approaches that help them avoid those costs. We believe that in order to minimize disruption of economic dispatch in wholesale electricity markets, the EPA should take similar action, as described above, for the Plan.

6. Conclusions

We believe that the Clean Power Plan is an important initiative in U.S. climate-change policy, one that has the potential to yield meaningful reductions in CO_2 emissions in a relatively cost-effective manner. Our comments are intended to indicate ways that the Plan can be improved so as to help assure that it achieves its intended emissions reductions at low cost. Toward this end, we point out ways that the design of the rate-based and mass-based compliance options offered by the Plan can be improved. We find that the mass-based approach has several advantages relative to the rate-based approach and believe that the Plan will perform best to the extent that states adopt this approach. We also find that cross-state coordination is critical for keeping costs of compliance to a minimum. This is especially important in light of the fact that electricity is traded in multi-state, regional markets. Absent coordination across states within a common regional electricity market, compliance with the Plan has the potential to interfere with the efficient allocation of production and investment in the power sector. Finally, to help avoid potential distortions in investment decisions, the EPA should encourage states to design implementation plans in which existing and new plants are treated in an integrated fashion.